An Roinn Oideachais
agus Scileanna
Department of
Education and Skills

Calculated Grades for Leaving Certificate 2020

Report from the National Standardisation Group to the Independent Steering Committee and the Programme Board

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Contents

1. Introduction

The primary purpose of this report is to set out clearly to the Independent Steering Committee and the Programme Board for the Leaving Certificate Calculated Grades process the actions taken by the National Standardisation Group to ensure that the national standardisation process was carried out properly in accordance with its stated purposes. This includes making explicit all of the decisions taken throughout the process, explaining the rationale for them, and providing sufficient detail to assure the Committee and the Board that they can confidently stand over the outcomes of the process.

Notwithstanding that this purpose requires a considerable level of depth and technical detail, the National Standardisation Group is conscious that this report will also be made available to education stakeholders and the public at large, who have a legitimate interest in understanding the process and how it was carried out and who also need to be confident that it was designed and carried out in such a way as to be as fair as it could be in responding to these unprecedented circumstances.

For this reason, we have chosen to make the main body of the report as concise and accessible to the general reader as possible. The result is that much of the detail with which the Independent Steering Committee and the Programme Board need to be fully satisfied is presented in the appendices to the report rather than the main body. We trust that the Committee and the Board will understand our decision in this regard.

The National Standardisation Group wishes to thank the Director and staff of the Calculated Grades Executive Office for providing the information, analyses, and support it needed to allow it to carry out its functions. The Group also wishes to commend the teachers, principals, deputy principals and other education professionals for the integrity, professionalism and commitment shown towards making this unprecedented process work as fairly as possible in the interests of the Leaving Certificate students of 2020.

It should be noted that data presented in the body of this report was correct at the time the National Standardisation Group was concluding its work and agreeing this report. The tables of results presented in Appendix H were subsequently updated as the process of grading and issuing results was nearing completion. Accordingly, there may be some discrepancies between the information in the body of the report and this appendix.

2. Background

Owing to the COVID-19 crisis, it was not possible to operate the Leaving Certificate examinations safely in July/August 2020 as planned. Existing and anticipated physical and practical requirements to protect the health of all citizens meant that the holding of the examinations was not feasible. The then Minister for Education and Skills recognised the need to facilitate students in the Leaving Certificate class of 2020 in their progression to further or higher education or the world of work. To achieve this in the current circumstances, a system of calculated grades was offered. In addition, the option of sitting the Leaving Certificate examinations when it becomes feasible to hold them remains open to all students. It is planned to hold these postponed examinations in November and December 2020, subject to prevailing public health advice at the time.

A calculated grade is a grade that can be provided to students following the combination of information provided by the school about a student's expected performance in an examination and national data available in relation to the performance of students in examinations over a period of time.

Calculated grades result from combining school estimates of the overall percentage marks and rankings of students in a particular subject at a particular level with data available from the Department of Education and Skills about past examinations, and using what we know about how such data can be linked and analysed to help align judgmental standards across schools.

The process of arriving at a calculated grade was applied to:

- Established Leaving Certificate – subjects
- Leaving Certificate Applied – subjects, tasks and vocational specialisms
- Leaving Certificate Vocational Programme – Link Modules.

There are two main phases in the process of arriving at a calculated grade:

- a school-based phase
- a national standardisation phase

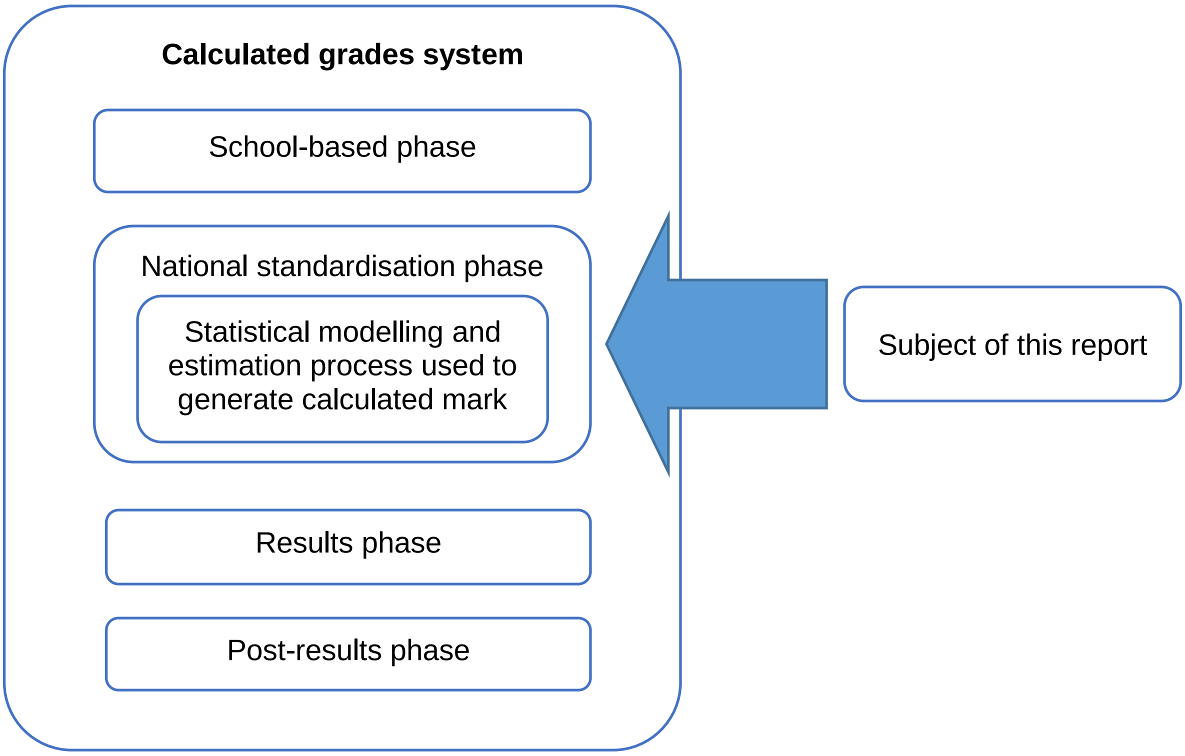
The school-based phase is not the focus of this report and it is sufficient to note here that the role of the school was to provide:

- an estimate of the percentage mark in each subject that each candidate is likely to have achieved if they had sat the Leaving Certificate examination in 2020 under normal conditions
- a class ranking for each student in each subject – i.e., a list of all the students in each individual class group for a particular subject at a particular level in order of their estimated level of achievement.

In providing the above estimated marks and rankings, there were four main school-based steps:

- the teacher's estimation of student marks and rankings
- school alignment of marks for a subject through a subject alignment group comprising teachers who taught the subject to Leaving Certificate students this year
- oversight of the alignment process by the school principal
- transmission by the school of the marks and rankings for national standardisation.

The subject of this report is the national standardisation phase, which took up where the school-based phase left off.



3. Why standardisation makes results fairer

Standardisation is a process that seeks to ensure that information coming from one source can be legitimately and fairly compared with information coming from another source. In the context of the Leaving Certificate, it is about making sure that, as far as possible, the grades students receive are fair and comparable representations of their levels of achievement in the subject concerned. The result of properly achieved standardisation is that anybody using the certificate to make decisions about those holding the certificate can legitimately place equal value on the same grade in the same subject at the same level on the certificates of two different students, without regard to where they went to school or the year in which the certificate was obtained. Other terms with a similar meaning to *standardisation* are *moderation*, *calibration*, and *alignment*.

Many people will point out that teachers and schools are best placed to observe and evaluate the level of achievement of their students and are therefore best placed to give accurate estimates as to their likely performance in an examination. This raises the question as to why any standardisation process – statistical or otherwise – should 'overrule' those judgments. This perspective is accurate in some respects and less so in others.

Research makes clear that because teacher judgments are made in the context of each school, they need to be examined and adjusted to ensure comparability across different schools. A summary of the relevant research on teacher estimation of student performance is available in the *Discussion paper for SEC-DES Technical Working Group on Calculated Results* (Department of Education and Skills, 2020). In short, teachers are extremely good at assessing their students within their own local and familiar frame of reference. They are especially good at placing students in the correct *order* of likely performance, (*A* is better than *B*, who is in turn better than *C*) and also quite good at considering the *degree* to which the achievement levels of their students differ from each other, (*A* is only a little better than *B*, who is much better than *C*). These two kinds of information are referred to by measurement experts as 'ordinal level' information and 'interval level' information respectively. Research also shows that the accuracy with which teachers can do both of these things increases the more familiar they are with the test on which that they are trying to estimate student performance.

However, research also shows that it is more difficult for teachers to align their estimates accurately with the judgments of other teachers in other schools and with an external national standard. Because of this, if there was no process of standardisation to align those judgmental standards with each other, scores from different teachers and schools would not be comparable to each other, and this would not be fair to students. It is important to ensure that, as far as possible, all students are being judged according to the same standards, just as they are in the externally set and marked state examinations in a normal year. This does **not** mean that we would expect the same distribution of results to come from every school.

Two strategies were used in the calculated grades process to improve comparability of standards across teachers and schools. First, an in-school alignment process was carried out in each school. The main purpose of this alignment process was to ensure that all teachers who are providing estimated percentage marks in respect of the same subject in the school are applying standards that are appropriate and are consistent with each other when doing so. This does not mean that the distribution of marks was or should necessarily have been the same for each class. The alignment procedures that were followed at school level were important, because the Department does not have the kind of data or evidence that would allow the reliable realignment of standards between different teachers within the same school, so the alignment procedures within the school were the only means through which fairness across different class groups taking the same subject within the school could be achieved.

Once the alignment process was complete, including the appropriate oversight steps carried out by the principal, the estimated percentage marks and the class rank orders were considered to represent the collective professional judgment of all those involved, rather than solely the professional judgment of an individual teacher. There was a strong commitment to respecting this collective professional judgement of schools in the process, and later sections of this report make clear how this was done.

The second strategy used to improve comparability across teachers and schools was the national standardisation process. Having aligned the standards applied by different teachers in the same school through the in-school alignment process, the national standardisation process used statistical techniques to help align standards across schools.

Depending on how they are done and what data they use, statistical standardisation processes can serve two purposes:

- to align the standards applied in different schools with each other
- to align those standards also with an established national standard.

Aligning standards across different schools is about striving for comparability of grades among all of the current year’s students, while aligning standards with a national standard is about striving also for comparability of grades between the current year’s students and students taking examinations in other years. The first can be done without doing the second, but the second cannot be done without doing the first.

The extent to which one or both of these purposes can be achieved depends on many constraints, including the data that are available for the national standardisation process, the uses to which it is acceptable to put that data, and any potential unintended consequences of using data in particular ways. This is especially so if it involves negative consequences for groups of students who are already disadvantaged in some way by other features of the education system.

There are often competing objectives to be reconciled when designing and implementing a standardisation process, and the end result will inevitably represent a compromise among these. It is inevitable that not everyone will agree with all of the decisions made in reconciling these competing objectives. It will be argued that decisions made to make the process fairer in one respect will have resulted in it being less fair in some other respect. Sections 5 describes the national standardisation process as it was originally planned and ultimately implemented, as important changes were made along the way to both the purpose of the standardisation process and the uses that were to be made of certain data sets in light of the experience of standardisation processes used in a similar context in other countries.

4. The role and the work of the National Standardisation Group

The National Standardisation Group is the decision-making group responsible for the implementation of the iterative design and development cycles required to produce and refine the standardisation process and the application, review, and adjustment of the data in line with the commitments, principles, parameters and constraints associated with the calculated grades process to arrive at fair and just representations of student performance.

The purpose, role and membership of the Group, along with information on the duration of its work and the decision making, governance and oversight arrangements that would apply, were set out in the paper *Establishment of a National Standardisation Group for Calculated Grades*, which is at Appendix A. This document, in effect, constituted the original terms of reference of the Group.

The aim of the National Standardisation Group was to deliver a set of calculated grades that met the objectives of being fair and accurate at the point in the iterative process at which a safe, satisfactory and defensible set of outcomes has been achieved.

In carrying out its work, the Group was required to have regard to the utility of the set of outcomes for the class of 2020 in aiding their progression to employment, further education and training, and higher education, which includes the timeliness of the availability of the results.

Included in the Terms of Reference for the National Standardisation Group is that the Group will consider the statistical outcomes within a decision-making framework which takes account of the commitments, principles, values and constraints which apply to calculated grades and to arrange for the implementation of adaptations in order to tune the model through various iterations. In line with this requirement, the Group set out a decision-making framework to govern its work. This is at Appendix B.

After the release of the results arising from calculated grades processes that had been used for cancelled examinations in other jurisdictions, and in light of public disquiet in those jurisdictions and consequent public discourse in Ireland in relation to aspects of what had occurred in those cases, changes were made to the terms of reference of the National Standardisation Group. These changes were set out in a memorandum of 24 August to the Independent Steering Committee for Calculated Grades, the External Reviewer for Calculated Grades, the National Standardisation Group for Calculated Grades, and the Programme Board for Calculated Grades. This memorandum is at Appendix C.

The substance of the change to the terms of reference was twofold. First, the Group was asked to exclude the 'school historical data' from the process of generating calculated grades. Second, while the need to align standards across schools to the greatest degree that is feasible and defensible remained, the need to also align those standards to the examining standards that have applied in preceding years and will apply in subsequent years was to be accorded a greatly diminished importance. The context for this latter decision was that, as will be seen in Section 5 below, aligning standards with historical national standards would have required adjusting downwards a very large proportion of the grades implied by the estimated percentage marks supplied by schools.

4.1. Role

The role of the group, as set out in *Establishment of a National Standardisation Group for Calculated Grades*, was as follows.

> The role of the Group is to
>
> a. Initially to determine the school and demographic characteristics that will be used to validate the model, (e.g., sector, gender, socio-economic status, programme length, medium of instruction, etc.)
> b. Consider the statistical outcomes within a decision-making framework which takes account of the commitments, principles, values and constraints which apply to calculated grades and to arrange for the implementation of adaptations in order to tune the model through various iterations. This will require the Group to:
>   i. Compare outcomes at national level to with those of recent years of each grade distribution for each subject and each level (78 LCE curricular distributions, 1 LCVP distribution, 18 NCL distributions, and 20 LCA subject, specialism, and task distributions).
>   ii. Consider effects and impacts at school level – through overall summary analysis of the information categorising and summarising the extent to which school distributions within each of these subject and level combinations are aligned with the sets of estimated results from those schools and the school-level conditioning distributions.
>   iii. Ensure that the appropriate balance is struck between optimising statistical accuracy and maintaining 'face validity' – the degree certain forms of interactivity in the data have credibility and can maintain stake-holder support.
>   iv. Check the degree to which commitments made in respect of the model have been realised, such as fair treatment of unusually high-achieving individual students (or groups) in traditionally modestly scoring settings.
>   v. Interrogate such issues as, for example, ensuring that students taking additional subjects out of school, and students taking all subjects outside of a school setting, are treated equitably compared to students taking their subjects within a school setting.
>   vi. Review the outcomes of model-validation analyses to check for potential undesirable differential effects on subgroups of interest, including differential gender effects and differential effects by school characteristics.
> c. Seek onward referral of any policy matter for which direction has not already been given to the Group.

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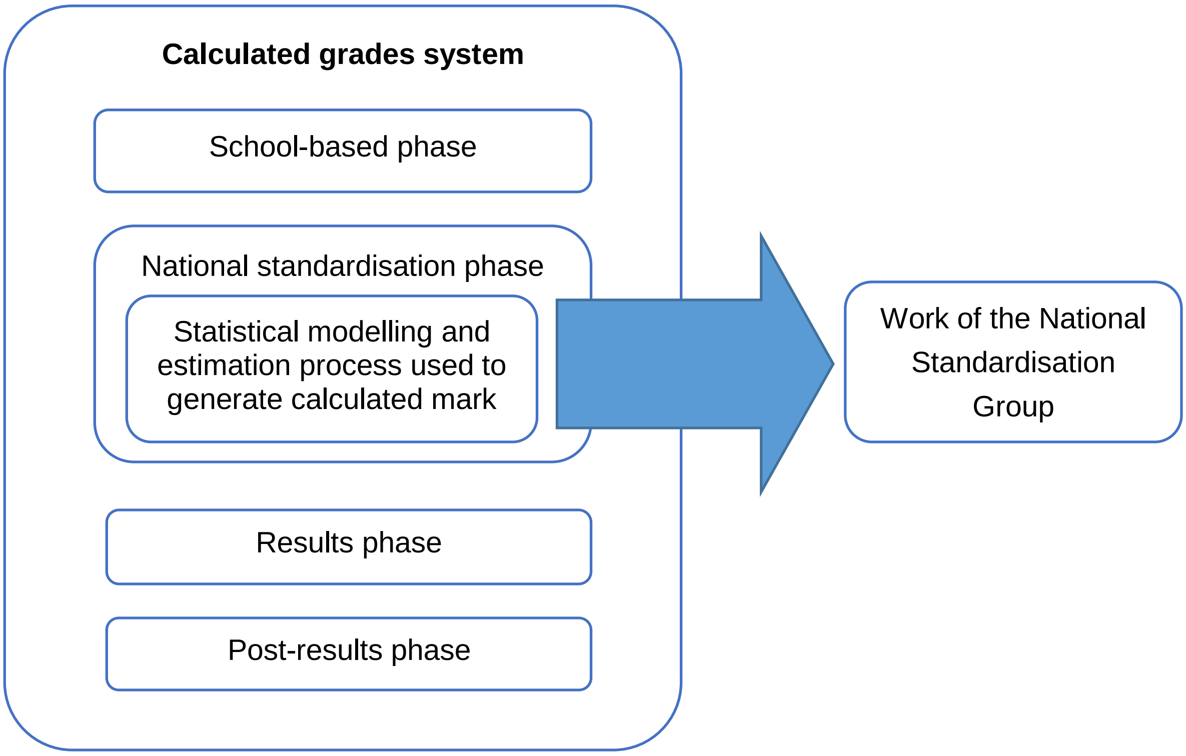
4.2. Scope and boundaries of the work of the National Standardisation Group

The national standardisation process is but one aspect of the calculated grades system.



The work of the National Standardisation Group was situated within the National Standardisation Phase of the overall system. It was therefore primarily concerned with making decisions related to the functioning of the statistical modelling and estimation process, so as to maximise the extent to which the objectives described earlier were met. Nonetheless, the group paid full regard to the functioning of the Calculated Grades system as a whole.

In relation to the model validation aspect of its role, the Group was conscious that there is a difference between validation of the standardisation process (the statistical modelling process that is used to generate the calculated marks) and validation of the calculated grades system as a whole, and that its role encompassed the former and not the latter. However, many of the mechanisms used to carry out validation are such that they may provide information about the combined functioning of the school-based phase and the national standardisation phase, rather than about the standardisation phase alone. Since it was not possible to revisit the school-based phase, the Group could only make decisions about the standardisation phase. While certain difficulties evident in the data emerging from the school-based phase were amenable to mitigation through the standardisation phase, others were not, and this limited what Group could do about them. All that could be done in these circumstances was to recognise and note where this had occurred. Validation is dealt with in Section 11.

4.3. The work of the Group

The National Standardisation Group held eight meetings over the course of the standardisation phase of the process. It had originally been intended that the Group would meet twice weekly, but it became clear that work could be carried out more efficiently and effectively with less frequent meetings, allowing more time for analysis of the model variants by the Calculated Grades Executive Office. At each meeting, decisions were made in accordance with the decision-making framework and were recorded in the minutes. Outcomes of the latest iterations of the model were reviewed, features discussed, and a direction of travel for the next set of iterations agreed. This work was supported by the staff of the Calculated Grades Executive Office and Polymetrika International Incorporated, the external partner carrying out the implementation of the models. Detailed interrogation of the outcomes of each iteration was facilitated by members of the Group having access to a secure web application that provided a variety of forms of tabular and graphical data analysis at multiples levels of detail. The Calculated Grades Executive Office also provided notes and analyses on issues that required consideration and decision.

Over the course of this work, over 40 variants of the model were tested, although some of these were developmental variants used by Polymetrika to probe the effects of using certain information in different ways in order to refine the main variants for consideration by the National Standardisation Group. An overview of the evolution through the various families of models is given in Appendix D.

Seven of the eight meetings of the Group were held before the change to the terms of reference was notified to the Group on 24 August, and the final meeting was held after that date. Additional work after the final meeting was carried out remotely.

The minutes of all meetings of the National Standardisation Group are being made available on the Department's website. The substance of, rationale for, and implications of the decisions made by the Group are dealt with in the various sections of this report and its appendices.

5. The standardisation model

The goal of the statistical modelling process is to use available data to determine the result that each student is most likely to have achieved if the students had sat for actual examinations under normal circumstances.

The design of the calculated grades model was informed by advice from a Technical Working Group comprising experts drawn from the State Examinations Commission, the Inspectorate of the Department of Education and Skills, the Educational Research Centre and international external expertise.

In carrying out its work the Group had regard to the data sources that were available and might have been potentially relevant to the estimation of student examination performance. With the recent decision to remove the school historical data from consideration and to have a greatly diminished role for the national standards, the information sources remaining available for use are the school estimates and rank orders, and the prior attainment and related variables of the 2020 Leaving Certificate students from when they sat their Junior Cycle.

5.1. The use being made of Junior Cycle data

In its consideration of Junior Cycle data the Group noted that:

- while Junior Cycle examination results are strong predictors of Leaving Certificate performance they are inadequate by themselves to estimate individual student performance;
- Junior Certificate results are not credible measures of the outcomes of learning that took place in senior-cycle;
- data might be missing for some students.

There is relevant research about the predictive power of the Junior Certificate performance on attainment at Leaving Certificate, but it was not cited in the Technical Working Group's discussion paper. See, for example, *From Junior to Leaving Certificate: A longitudinal study of 1994 Junior Certificate Candidates who took the Leaving Certificate Examination in 1997; final report.* NCCA/ERC.

While recognising some of the concerns that might arise from using the Junior Cycle data at an individual level, the Technical Working Group concluded that because of the near-universal coverage of the Junior Certificate, the results provide a useful means of determining the objective performance distributions of classes and schools. On that basis, the group proposed the use of prior attainment data at student level in aggregate form only to inform conditioning distributions, and not to affect the individual student's calculated result. That is to say, the advice was that a student's Leaving Certificate calculated grades should not be determined by their individual performance at Junior Cycle. Nevertheless, the linkage between Junior Cycle and Leaving Certificate examination results in previous years facilitates the creation of a statistical model that allows Junior Certificate results to provide 'conditioning information' for the current cohort of 2020 candidates.

Notwithstanding the proposals of the Technical Working Group, it has been suggested that a student's prior attainment at Junior Cycle *should* be used at an individual level to help determine their calculated grade at Leaving Certificate. This certainly would have been feasible from a statistical modelling perspective. However, the main difficulty with this is that there is questionable acceptability attached to the notion that one's Leaving Certificate performance might be constrained in some way by one's performance on another examination in the past. This is because there are many factors at an individual level that could affect the reliability of any such estimation process, including individual circumstances at the time of the previous examinations, and significant individual differences in how students can progress in the intervening period. Such factors will have a tendency to 'even out' when aggregated across a group, which makes the use of such prior attainment information much more tenable at a group level than at an individual level. In addition to this question of fairness to the individual, it is also likely that there would be negative consequences for certain categories of student who may have a greater propensity to improve in the period between Junior Cycle and Leaving Certificate examinations.

The Junior Cycle data sets

Two distinct sets of Junior Cycle data are being used in the model

1) The Junior Cycle data for the Leaving Certificate students of 2020.
2) The Junior Cycle data linked to the Leaving Certificate national cohorts of 2019, 2018 and 2017.

The approach to the entire process is described in in 5.2 below, but in summary the use of Junior Cycle data is as follows:

1) Use the Junior Certificate data linked to students who graduated in previous years to build a statistical model that describes how a student with any particular profile of Junior Certificate results is likely to perform in any given Leaving Certificate examination in a particular subject at a particular level.
2) Use Junior Certificate performance data linked to the 2020 students to estimate the 'conditional likelihood' of Leaving Certificate performance for each 2020 student with valid data – that is, how likely it is that a student with such a Junior Certificate results profile would perform at any particular level in that examination.
3) Aggregate these conditional likelihood functions across the group of students in the school who are taking the subject concerned at the level concerned to estimate the conditioning distributions for Leaving Certificate examination results at the school level for the 2020 students.

This procedure only uses student-level data for the purpose of estimating information at the school level (i.e., the group of all students in the school taking that subject at that level).

Making best use of Junior Cycle examination data

There are a number of different ways in which Junior Cycle data can be collated and combined in order to feed into a statistical model that helps to estimate Leaving Certificate examination results. Different approaches were explored at different stages in the development of the model. The approach ultimately adopted and the rationale for it is outlined in a note from the Calculated Grades Executive Office to the National Standardisation Group at Appendix E.

5.2. Statistical Estimation Overview

In its simplest representation, the Leaving Certificate 2020 estimation is a variation on equipercentile linking used in a variety of educational tests, using school estimates instead of direct examination scores. In general, teacher estimates are the best estimate of the rank ordering of students' performance, but they do not exhibit the same interval-level properties as actual examination scores. Teacher estimates are systematically higher than examination scores, and the relative differences between students do not have the same consistency as examination scores. To remediate these distributional differences, the rank orders of students based on the school estimates of Leaving Certificate 2020 performance were mapped to the expected distribution of Leaving Certificate 2020 scores such that the scores calculated by the mapping procedure produce a distribution that reflects, as closely as possible, the expected distribution of Leaving Certificate results.

This basic procedure is complicated by two main factors that limit the degree to which the expected distribution of Leaving Certificate results can map to an expected historical distribution:

1) lack of explicit between-school alignment of teacher estimates, and
2) not using historical performance of previous students at school and national levels to moderate the teacher estimates.

The first factor is a consequence of the operational feasibility of data collection. Any teacher alignment process has an exponential order of complexity in the number of teachers participating in the alignment, as it requires collaboration between all participants. At a national level, such an exercise is impossible even in normal circumstances. Therefore, alignment of teacher estimates was performed at the school level, and the rank-based score estimation process must be replicated separately within each school.

The estimation procedure used variables that describe the prior educational attainment and schooling experiences of Leaving Certificate 2020 students to develop a linear regression model that predicts the Leaving Certificate 2020 performance of each student in each subject. The regression model produces a "best estimate" for each student, and the residual error of prediction for each model indicates the degree to which using the "best estimate" at an individual level would be incorrect. These results are indicative rather than prescriptive, because the regression-based estimate is not a credible replacement for actual examination results. At most, the point estimate and the residual error of prediction describe, for each student, the expected distribution of performance of all students with similar predictor characteristics.

Although insufficient by themselves to estimate Leaving Certificate scores, the predicted distributions from the regression model can be used to constrain the bias in the school estimates. Systematic errors in the prediction model are unlikely to be the same as bias in the school estimates, which is typically more reflective of student behaviours and student-teacher relationships that do not influence prior examination attainment. Therefore, combining information from both sources will increase the chances that the errors in both will cancel out and the result will be a more accurate estimator of examination performance. Using the regression-based distributions in aggregate at a school level will also increase the likelihood that the random error in generalising a regression model to a specific student will cancel out at a school level when the results from multiple students are combined.

In the absence of examination scores, the best estimate of the expected distribution of Leaving Certificate performance in each school is the distribution of the school estimates. However, these estimates do not have the same precision and equal interval properties as actual examination scores. In addition to macro-level distributional differences, teacher estimates tend to cluster around multiples of 5, are influenced by the locations of grade boundaries, and gravitate to extremes more than actual scores. To reduce the effects of these micro-level estimation errors, the school estimates were combined and smoothed to produce a broadly supported discrete distribution for the entire school. To respect explicit and implied commitments to use the interval-level information in teacher estimates as much as possible, the smoothing process replaced each teacher estimate with a continuous kernel function that preserves the location of each estimate while converting it into a continuous distribution that is defined over the full score range of 0-100. The aggregation of these student-level kernels at the school level describes an expected score-frequency distribution for each school that is likewise defined across the full possible range of examination scores.

Combining the predicted distributions from the regression model with the kernel distributions from the school estimates relies on four basic principles related to the priority, credibility and relevance of evidence. First, the school estimates represent the most accurate information available describing Leaving Certificate performance. Corollary to this assumption, in the absence of contrary evidence or as the quality of alternate evidence decreases, score estimates should converge on the initial school estimates. Second, where multiple sources of evidence exist, the procedure should assign greater influence to evidence that is less influenced by random error (or variation that is unrelated to Leaving Certificate performance). Third, where multiple sources of evidence are available and of equal credibility, the calculated results should be equally supported by all sources of evidence. Finally, where teachers have provided evidence to suggest that certain students should be considered separately from the other students in a school, these ‘outlier students’ should not be included in distributional mapping procedures that assume a continuity of scores.

Implementing these priorities produced the following multistep estimation procedure:

1) Using student level predictors of Leaving Certificate performance, estimate a predictive model using data from 2017-2019 Leaving Certificate students.
2) Apply the regression modelling outcomes (i.e., regression coefficients and residual variance) to the predictor variables of the 2020 students to calculate individual predicted performance distributions for each student.
3) Aggregate the individual distributions to the school level and standardise them to produce a probability density function describing the plausible distribution of Leaving Certificate 2020 outcomes in the school based on the predictor variables. Each distribution is defined discretely on each unit percent score in the range 0-100 for each school.
4) Identify outliers in the distributions of teacher estimates for each school. Based on the guidance provided to schools, teachers may have assigned extreme-valued scores to students that they believed did not fall within the same distribution as other students. Teachers may have identified high or low performance students as outliers, and many schools had no outliers. Students identified as outliers are set aside from the distributional mapping procedures in steps 5 to 10.
5) Using the students who are not identified as outliers, replace the 2020 teacher estimates with continuously defined beta-distribution kernel functions defined over 0-100 and aggregate to the school level to create a school-level discrete distribution describing the teacher estimates. Again, each distribution is defined discretely on each unit percent score in the range 0-100 for each school.
6) Assign weights to the two distributions based on a combination of the school size and the predictive power of the regression model; as the school size approaches 1 or the proportion of Leaving Certificate examination variance explained by the regression model approaches 0, the weight allocated to the regression distribution also approaches 0. The weight allocated to the teacher distribution is 1 minus the weight allocated to the regression distribution.
7) Calculate the weighted geometric mean of the two discrete distributions at each unit score value using the allocated weights.
8) Calculate the cumulative distribution function for each school as the discrete integral of the mean distribution.
9) Based on the rank order of students, assign calculated scores based on the equivalent percentile rank in the calculated cumulative distribution function for each school, adjusting each estimate so that, as the weight of the regression distribution approaches 0, the range of the estimated scores approaches the range of the teacher estimates.
10) Calculate the ratio of the variance between the original school estimates and the calculated scores.
11) Adjust the variance of school estimates within each outlier group by applying the calculated ratio between school estimates and the calculated scores so that the ratio of school estimates to calculated scores in the outlier groups is the same as for the non-outlier group and the width of the gap between the highest/lowest member of

each outlier group and the closest member of the non-outlier group is preserved. Calculated scores are constrained to fall in the 0-100 range.

12) Concatenate the variance-adjusted outlier scores to the main set of calculated scores for each school.
13) Assign the calculated scores to individual student records.

The product of this procedure is a set of scores that is primarily based on teacher estimates, where bias in the teacher estimates has been corrected based on evidence of prior attainment, to the degree that such evidence exists and is a credible predictor of Leaving Certificate performance. The rank order of students in each school is consistent with the rank order inherent in the school's score estimates, and the rank order of students between schools reflects the convergence of evidence between the school estimates and the prior attainment and academic progress of the students in each school.

To satisfy these priorities, constraints on the national level distribution are relaxed so that the overall performance at a national level may systematically diverge from previous years' performance.

5.3. Format of mark outputs

It may be noted that, although schools were permitted to use decimal numbers when providing estimated percentage marks, the output from the calculated grades process is a whole number on the percentage scale (that is, a whole number from 1 to 100). The National Standardisation Group noted the rationale for arranging to have outputs in this form, the rationale for which was set out by the Calculated Grades Executive Office in the note at Appendix F.

6. Delivering on commitments made

6.1. Ensuring that the results of school groups in 2020 were not unduly constrained by the historical performance of the school

This matter required explicit consideration in the earlier stages of the work of the National Standardisation Group, because at that time, it was intended that the conditioning distributions for each school would be informed by how that school had previously performed in that subject at that level. This meant that the standardisation process would have to be designed in such a way that it could accommodate changes to the distribution of results from a school where there was evidence that the group of students within the school was stronger (or weaker) than usual. It was the use of the prior attainment data (Junior Cycle results) of the group of students taking the subject in the school in combination with the historical results of the school that served this purpose.

After the decision to remove ‘school historical information’ from consideration in the standardisation process, the question of allowing it to unduly constrain the results of the current group no longer arose.

6.2. Ensuring that the results of individual students in 2020 were not unduly constrained by the historical performance of the school

This matter also required explicit consideration in the earlier stages of the work of the National Standardisation Group for the same reason as in 6.1 above, and again became moot after the school historical information was removed from consideration. However, in this case, a corresponding commitment might reasonably be inferred that the results of individual students were not to be unduly constrained by the group-level prior attainment information used to condition the distribution of results from the school. The mechanisms used to meet this commitment remained the same after the historical information was removed. These are the two strategies mentioned in Section 5 – the use of the ‘interval level’ information in the school estimates, which had general applicability across the group, and the specific ‘outlier treatment’ used to handle individual scores or small clusters of scores that were distant from others in the group.

6.3. Placing a high value on the estimates from schools

This is fully reflected in the model as described above. The commitment to place a high degree of confidence in the estimates supplied by the schools was reflected in the following ways:

- The relative placement of students by schools was preserved in a number of respects:

  - No two students who were placed in a particular order by the school were placed in the reverse order following standardisation. That is, standardisation preserved not only the rank order of students within each class, but also preserved the order of the estimated marks within the subject and level across the school, thereby respecting the collective professional judgments brought to bear in the in-school alignment process.
  - The ‘interval level’ information in the school estimates (the relative sizes of the gaps between the estimated marks) has been used in the calculated results
  - In cases where schools identified exceptional students by placing them well ahead of their peers, a specific ‘outlier’ treatment was put in place to ensure that these gaps were not reduced by the standardisation process.
  - Any cases where the calculated mark differed from the school estimated mark by a large amount were reviewed by assessment staff from the Calculated Grades Executive Office to check whether the standardisation model had made a reasonable and appropriate adjustment.[1]
- The standardisation process has been built on the premise that the estimated marks should only be adjusted to the extent that there is credible statistical evidence to justify changing them. The manner in which the different sources of information vary in their degree of influence in accordance with their degree of credibility in each specific circumstance and at each specific point in the distribution brings a high level of refinement to meeting this commitment.

[1] In addition, it was observed that the model behaved inconsistently in a small number of cases where schools had provided estimated marks at or close to 0, resulting in inappropriate large increases in some of these cases. In order to counteract this, a *post hoc* adjustment was introduced to ensure that no calculated mark could be more than double the estimated mark provided by the school.

7. Overview of the school estimate data

7.1. Cohort shift across levels

When interpreting the grade distributions that might be expected in any given year, we need to bear in mind whether the proportion of candidates at each level (higher, ordinary, foundation) has changed. Since the introduction of the new grading system for Leaving Certificate in 2017 there has been a shift each year in the cohort from ordinary to higher level across all subjects. This shift has continued in the 2020 cohort and is more pronounced in 2020 than it was in 2019 or 2018, with 69% of the total number of entries being for higher level compared with 64%, 65%, and 66%, respectively in 2017, 2018, and 2019. The shift is more significant in some subjects than others – for example, Biology (+5.7%), Business (+5.4%) and French (5.0%).

In the case of mathematics and Irish, the cohort shift has resulted in a substantially reduced cohort taking foundation level (2.1% in 2019 and 1.0% in 2020) which might ordinarily be expected to have implications on outcomes for these subjects at this level and this was considered by the National Standardisation Group when evaluating the outcomes at this level.

7.2. Prevalence of high grades

As a first step, the school-based estimates were passed through the statistical model with no adjustments being made in order that they be available as individual distributions for each subject for review purposes. This showed strong evidence that there was overestimation of outcomes at all points in the achievement spectrum and that it was more pronounced at the upper end. Aggregated across all subjects, the percentage of grade 1s at higher level in 2019 was 5.8% while in the 2020 school estimates 13.4% of students were awarded a grade 1. The percentage at grade 1 in the school estimates was more than double that of 2019 in many subjects and in the case of some subjects it was over three times higher.

Figure 1 illustrates the percentage of cases at each grade as awarded in each of the years 2017, 2018 and 2019, and as estimated by schools for 2020. Table 1 gives the same information in cumulative form – the percentage at or above each grade.

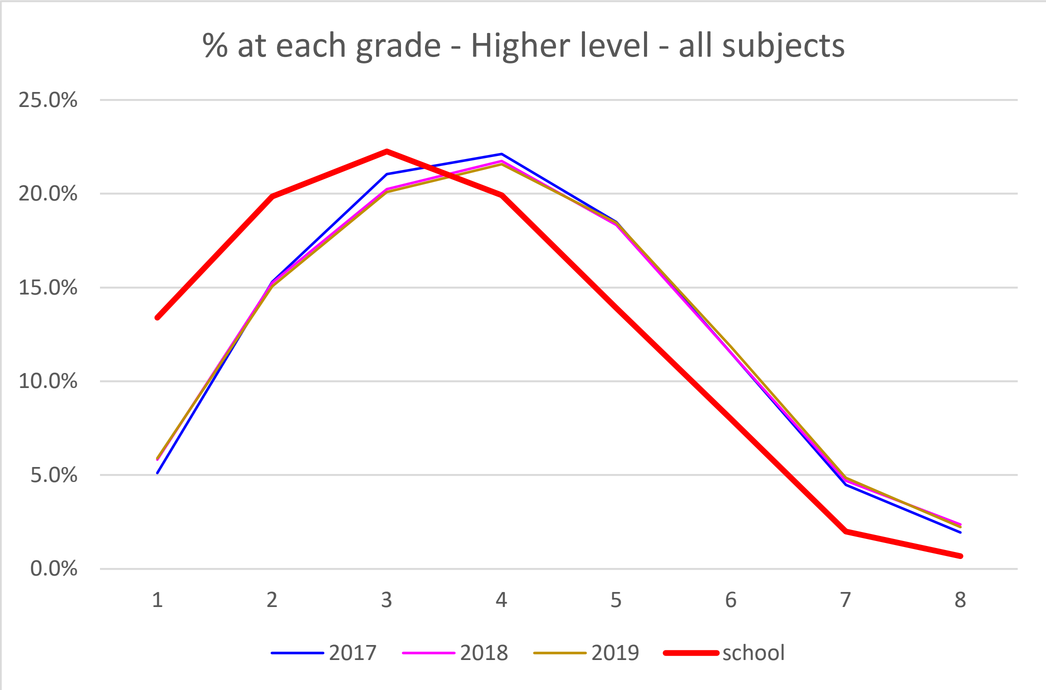


Figure 1: number of higher-level grades awarded at each grade across all subjects as a percentage of all higher-level grades awarded, for 2017, 2018 and 2019, and in the estimates from schools for 2020.

	1	1..2	1..3	1..4	1..5	1..6	1..7	1..8
2017	5.1%	20.4%	41.5%	63.6%	82.1%	93.6%	98.1%	100.0%
2018	5.8%	21.1%	41.3%	63.1%	81.4%	92.9%	97.6%	100.0%
2019	5.9%	20.9%	41.0%	62.6%	81.1%	92.9%	97.8%	100.0%
2020 (sch. est.)	13.4%	33.2%	55.5%	75.4%	89.3%	97.3%	99.3%	100.0%

Table 1: cumulative number of higher-level grades awarded at each grade across all subjects as a percentage of all higher-level grades awarded, for 2017, 2018 and 2019, and in the estimates from schools for 2020.

These figures show that, even if the grading standards across all schools were in perfect alignment with each other, so that the only change required was to bring the distribution nationally into line with the averages of the preceding three years, (and taking no account of the shift from ordinary to higher level in the cohort,) just over 60% of higher-level grades would need to be reduced by one grade. Since cross-school realignment can increase but not decrease the number of grade changes, this may be regarded as a conservative estimate of the proportion of higher-level grades that would need to have changed in the standardisation process if the grade distribution had been brought fully into alignment with the norms of recent years.

There is also evidence of overestimation at all points in the distribution at ordinary level, with 1.5% of the cohort receiving a grade 1 in 2019 while 3.9% of the 2020 cohort would receive a grade 1 based on the school estimates. At a subject level, there are slight variations with some subjects in line with previous grade 1 outcomes and others slightly lower at this level.

Figure 2 illustrates the percentage at each grade as awarded in each of the years 2017, 2018 and 2019, and as estimated by schools for 2020. Table 2 gives the same information in cumulative form – the percentage at or above each grade.

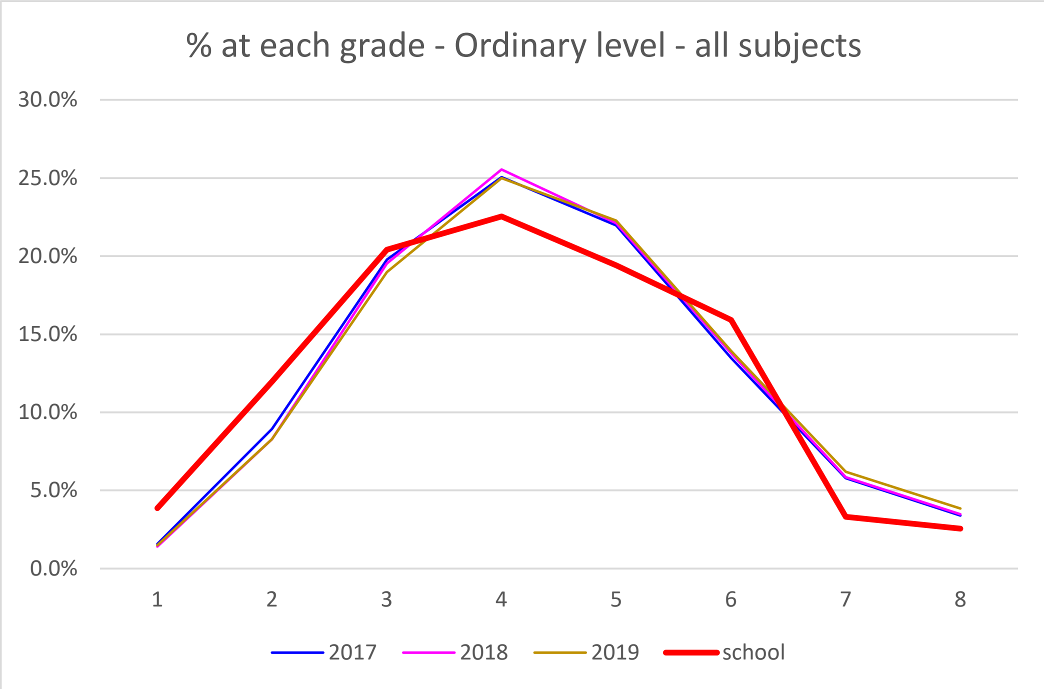


Figure 2: number of ordinary level grades awarded at each grade across all subjects as a percentage of all ordinary level grades awarded, for 2017, 2018 and 2019, and in the estimates from schools for 2020.

	1	1..2	1..3	1..4	1..5	1..6	1..7	1..8
2017	1.6%	10.5%	30.3%	55.4%	77.3%	90.8%	96.6%	100.0%
2018	1.4%	9.7%	29.2%	54.8%	76.9%	90.7%	96.5%	100.0%
2019	1.5%	9.8%	28.8%	53.8%	76.0%	90.0%	96.2%	100.0%
2020 (sch. est.)	3.9%	15.8%	36.3%	58.8%	78.2%	94.1%	97.4%	100.0%

Table 2: cumulative number of ordinary level grades awarded at each grade across all subjects as a percentage of all ordinary level grades awarded, for 2017, 2018 and 2019, and in the estimates from schools for 2020.

Corresponding to the situation at higher level, these figures show that, even if the grading standards across all schools were in perfect alignment with each other, so that the only change required was to bring the distribution nationally into line with the averages of the preceding three years, (and taking no account of the shift from ordinary to higher level or foundation to ordinary level in the cohort,) just over 25% of ordinary level grades would need to have been reduced by one grade. This may therefore be regarded as a conservative estimate for the proportion of ordinary level grades that would need to have changed in the standardisation process if the grade distribution had been brought into alignment with the norms of recent years.

Comparable levels of overestimation were observed in the foundation level data for mathematics and Irish, the LCVP link modules, and the examinations and tasks in Leaving Certificate Applied.

7.3. Gender differences

Females tend to do better on average than males in the examinations and gender differences are likewise evident in the school estimates. However, the differential between females and males is wider in the school estimates than in previous examination outcomes, with the exception of a few subjects.

In the case of higher-level mathematics, males tend to do better on average than females. For example, in 2019 males scored on average 2-3 percentage points better than females. However, the school-based estimates reverse this trend with females on average scoring approximately 1 percentage point higher than males. The overestimation at the upper end is evident for both males and females in grades 1 and 2 with both receiving a significantly higher percentage of these grades, but the percentage increase evident in the school estimates is much higher for females than males.

Gender differences in the school estimates and the calculated grade outcomes are dealt with in more detail in Section 11.

7.4. Clustering, tied marks, and ranks

Clustering

One difficulty that can emerge with teacher estimation of student performance is that, in addition to the fact that people tend to gravitate towards multiples of 5 and particularly 10 when estimating anything on a numerical scale, there is also a tendency among teachers to cluster their estimates in response to the known locations of grade boundaries.

While the guidance for schools drew attention to this tendency and advised teachers to try to avoid it, it was nonetheless evident in the data, as one might expect. The histograms in Figure 3, Figure 4, and Figure 5 below show the distributions of the estimated marks from schools, aggregated across all Leaving Certificate Established subjects at each level. Some clustering of the type described is evident and the distributions show a clear reluctance on the part of schools to provide estimates that are close to grade boundaries – especially just below them. Similar patterns were observed in the LCVP link modules estimates, as is evident in Figure 6, and noting that the grade boundaries are at 50%, 65%, and 80%. Clustering was less evident in estimates for Leaving Certificate Applied students. It is likely that this is due to the fact that there are different numbers of credits associated with different examinations and tasks, with the result that the threshold marks for the award of the different levels of credit are less familiar to teachers and located in less intuitive places on the percentage scale. Illustrating this by aggregating the estimates across all examinations and tasks would not be helpful for the same reason, so it is more clearly indicated by showing the estimates for one subject. Figure 7 shows the estimates for the social education examination, which is one of the core subjects taken by all students and is marked out of ten credits and where the threshold marks are at multiples of 9 (i.e., 9, 18, 27, 36, 45, 54, 63, 72, 81, and 90).

Clustering of this kind causes some difficulties for the standardisation process, as when mark distributions are moved up or down, expanded or compressed, or adjusted in other ways, the peaks in the distributions can interact with the grade boundaries in unpredictable ways. This partly explains aspects of the apparent differences in the outcome distributions across subjects, as the level of clustering in the school estimates was not the same across all subjects.

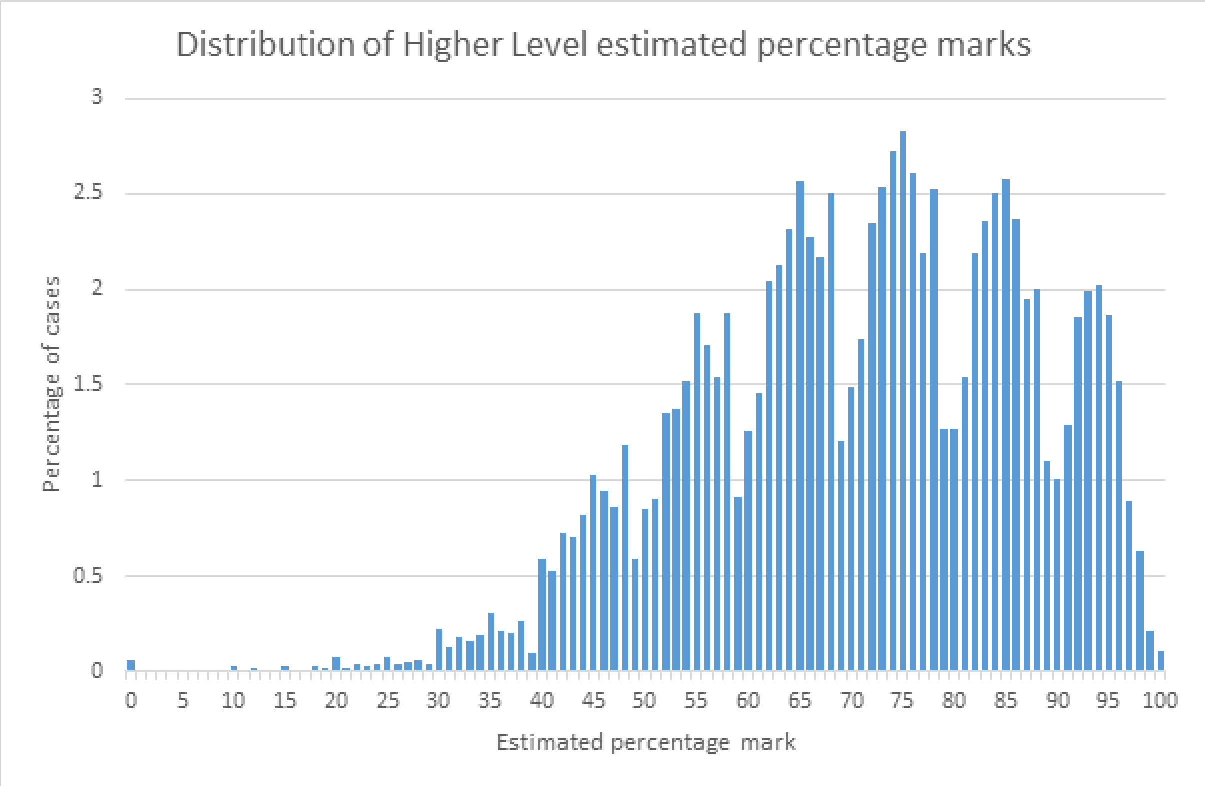


Figure 3: distribution of estimated percentage marks from schools aggregated across all higher level subjects.

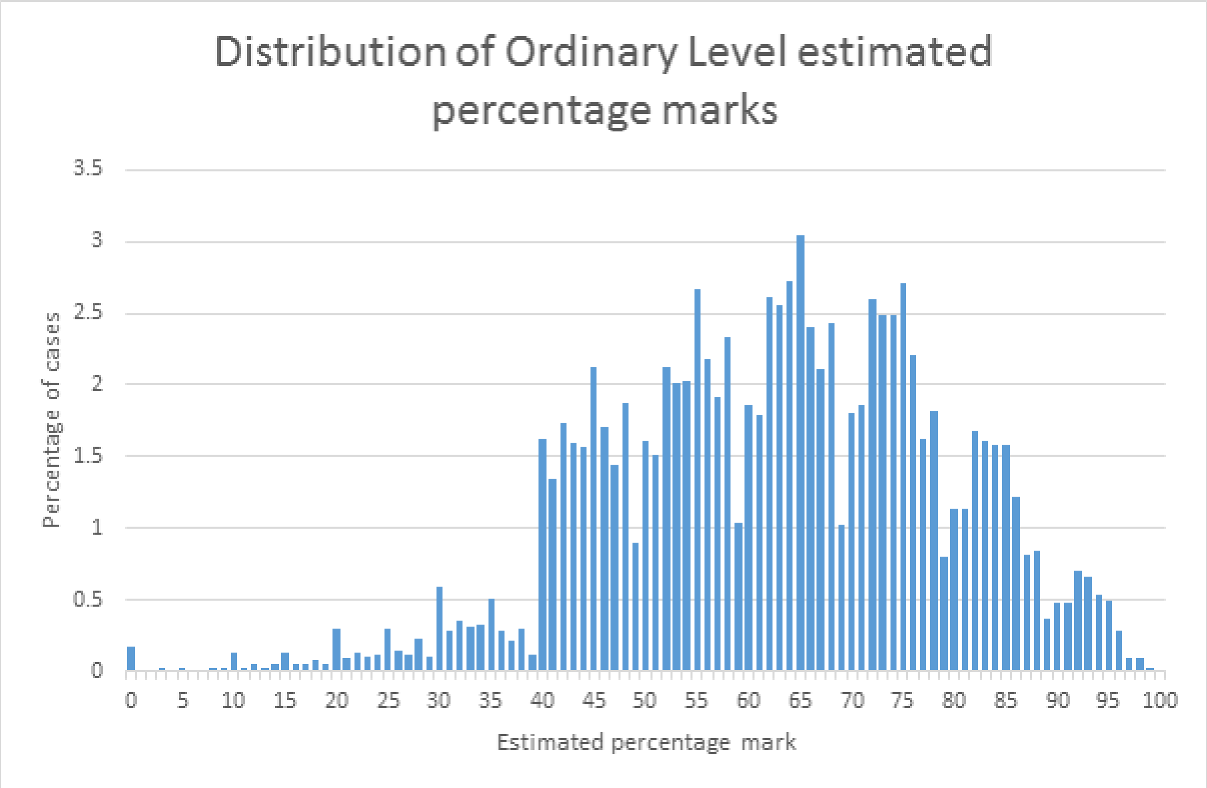


Figure 4: distribution of estimated percentage marks from schools aggregated across all ordinary level subjects.

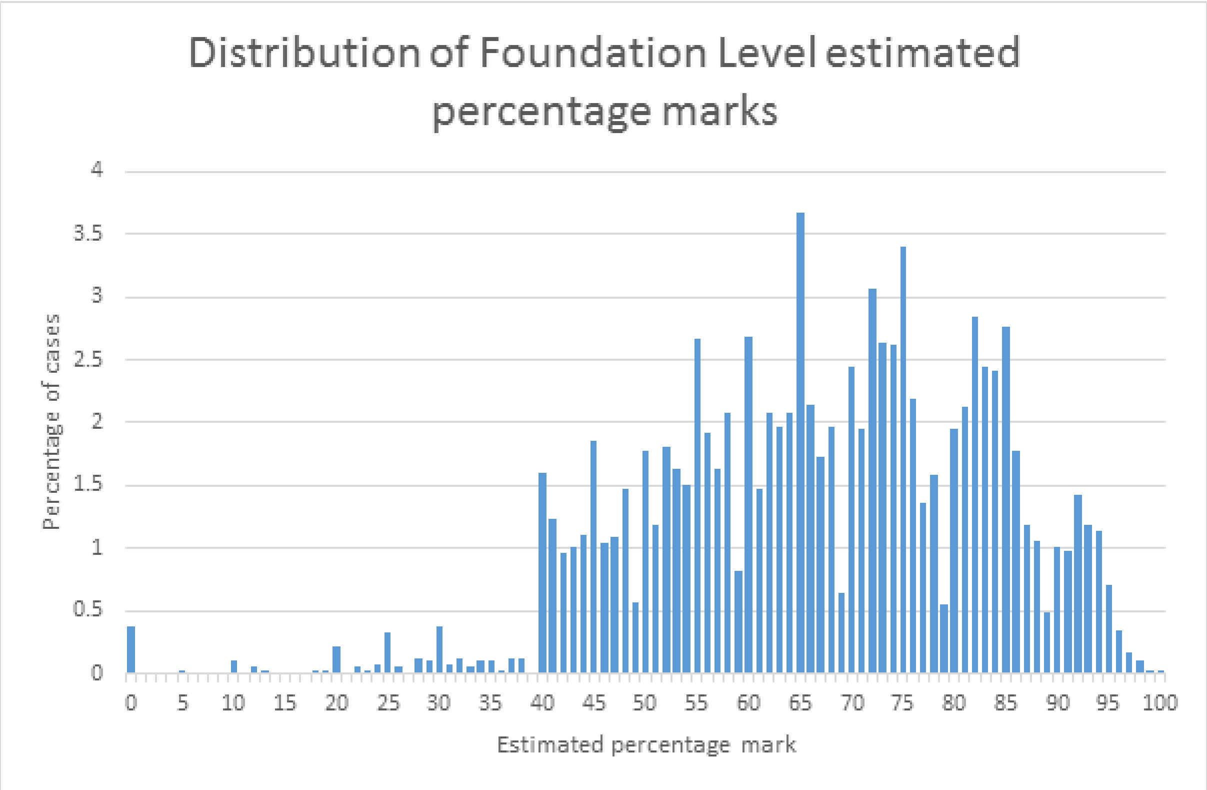


Figure 5: distribution of estimated percentage marks from schools aggregated across all foundation level subjects (Irish and mathematics).

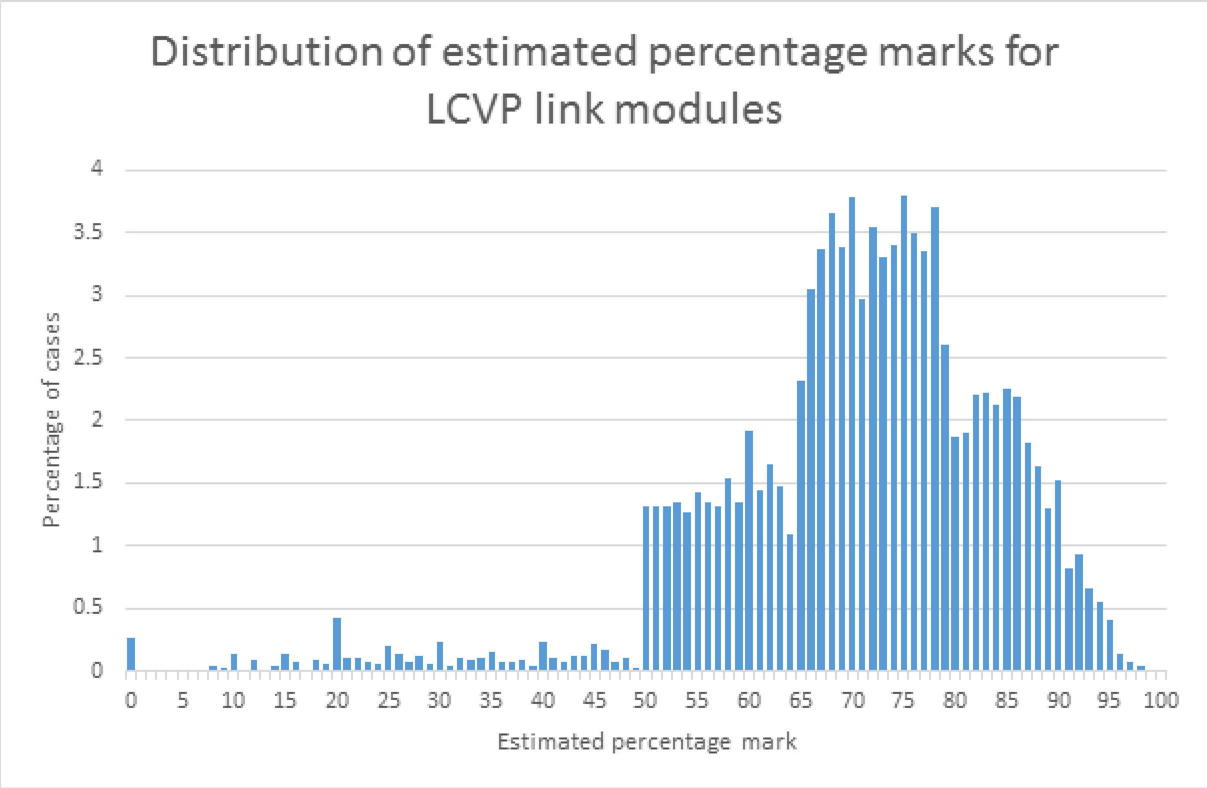


Figure 6: distribution of estimated percentage marks from schools for LCVP link modules.

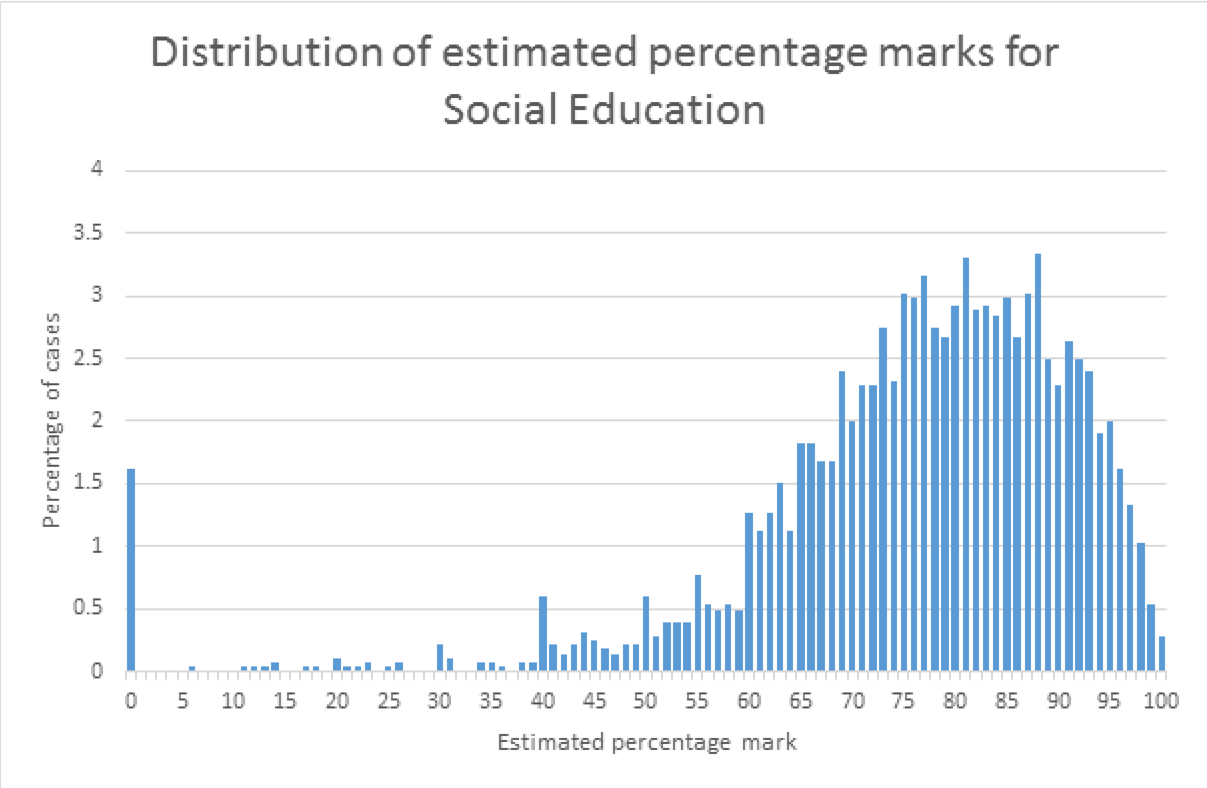


Figure 7: distribution of estimated percentage marks from schools for Leaving Certificate Applied, Social Education.

Tied marks and rank ordering

Another potential difficulty that might have emerged in the data was the possibility that schools might cluster large numbers of candidates on the same mark. As this can cause significant difficulties in a standardisation process, teachers were asked to strictly rank order all the students in the class group, including those that were placed on the same mark. This would have allowed for the possibility that the standardisation process could separate out students that had been given the same estimated mark if that proved necessary. The use of decimals was also allowed, which meant that if teachers were reluctant to explicitly order two or more students that they had placed on the same mark, they could use decimals to place them close together without giving them the same mark.

As it happened, and probably due to the availability of these options and the guidance for schools on avoiding clustering, the clustering of estimates on the same mark within a school was not as extensive as it might have been. Because of this, the explicit rank ordering of students on the same mark did not have to be used to separate students in the standardisation process. That is, in all cases where two in-school students were awarded the same estimated percentage mark by the school, they received the same calculated mark.

7.5. High quality in the school estimate data

It is important to note that the levels of overestimation in the data, the existence of score clustering, and the presence of gender effects should not in any way be taken to indicate that teachers, (including principals and deputy principals involved in overseeing the alignment process,) engaged with the process with anything other than the utmost integrity and professionalism. Rather, these are features that are known to exist almost universally in a variety of estimation processes of this type. Furthermore, it is only natural that teachers who are working closely with their students over a long period of time will see the best in them and will both want and expect them to do well. This causes a natural tendency towards optimism in estimating performance. While the guidance issued to schools drew attention to tendencies towards overestimation, sources of unconscious bias, and so on, it is impossible to completely eliminate these even when actively trying to guard against them. It is clear from the raw data that teachers and schools engaged with the estimation and in-school alignment processes with a great deal of care and dedication. The profession is to be commended for the extraordinary level of commitment shown towards making this unprecedented process work as fairly as possible in the interests of the Leaving Certificate students of 2020.

8. Overview of final calculated grades data

8.1. Outcomes

Tables and graphs of the results for each subject and level, including the LCVP link modules and the Leaving Certificate Applied final examinations and Personal Reflection Task, are provided at Appendix H. They show the percentage of candidates achieving each grade in the Leaving Certificate results from 2017, 2018 and 2019, the averages across those three years, the percentage that would have achieved each grade in 2020 if the school estimates had been left unadjusted, and the actual outcomes from the calculated grades process. In keeping with the established practice of the State Examinations Commission, only results from cohorts of at least ten students are given.

The aggregated results across all subjects at each level are given in the tables below, and are illustrated in the figures below. In the case of each level, the first table shows the percentage *at* each grade, while the second shows the percentage *at or above* each grade. Aggregated results are not shown for the Leaving Certificate Applied, as there are differing numbers of credits available for different subjects, vocational specialisms, and tasks.

These aggregated results show that, on average across all subjects, the calculated grades are a considerably stronger set of results than would arise in any normal year, while also being somewhat weaker than the results that would have emerged if the school estimates had been left unadjusted. It must be borne in mind, however, that the effect of standardisation is not primarily to be found in the overall grade distributions at national level, but rather in the detailed adjustments both upwards and downwards in the results from individual schools in order to address the varying levels of generosity or severity in their estimates. That is, even if the distributions of calculated grades nationally were identical to those arising from the school estimates, it would not be true to say that standardisation had had no effect.

Higher level

	percentage at each grade							
	1	2	3	4	5	6	7	8
2017	5.1	15.3	21.0	22.1	18.5	11.5	4.5	1.9
2018	5.8	15.3	20.2	21.8	18.3	11.5	4.7	2.4
2019	5.9	15.1	20.1	21.6	18.5	11.8	4.9	2.2
mean '17–'19	5.6	15.2	20.5	21.8	18.4	11.6	4.7	2.2
School est.	13.4	19.9	22.3	19.9	13.9	8.0	2.0	0.7
Calc. grades	8.9	17.0	23.7	23.3	16.2	8.1	2.1	0.6

Table 3: percentage at each grade, aggregated across all higher level subjects

	percentage at or above each grade							
	1	1..2	1..3	1..4	1..5	1..6	1..7	1..8
2017	5.1	20.4	41.5	63.6	82.1	93.6	98.1	100.0
2018	5.8	21.1	41.3	63.1	81.4	92.9	97.6	100.0
2019	5.9	20.9	41.0	62.6	81.1	92.9	97.8	100.0
mean '17–'19	5.6	20.8	41.3	63.1	81.5	93.1	97.8	100.0
School est.	13.4	33.2	55.5	75.4	89.3	97.3	99.3	100.0
Calc. grades	8.9	25.9	49.6	72.9	89.1	97.2	99.3	100.0

Table 4: percentage at or above each grade, aggregated across all higher level subjects

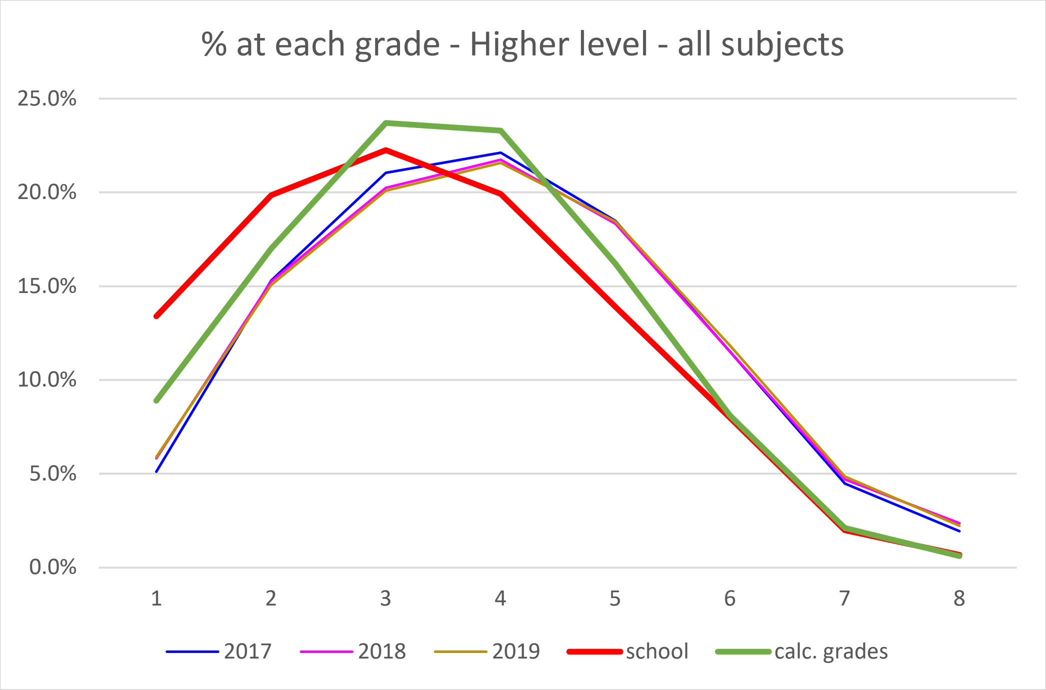


Figure 8: distribution of grades at higher level, aggregated across all subjects

Ordinary level

	percentage at each grade							
	1	2	3	4	5	6	7	8
2017	1.6	8.9	19.8	25.1	22.0	13.5	5.8	3.4
2018	1.4	8.3	19.5	25.6	22.1	13.8	5.8	3.5
2019	1.5	8.3	19.0	25.0	22.3	13.9	6.2	3.8
mean ‘17–‘19	1.5	8.5	19.4	25.2	22.1	13.7	5.9	3.6
School est.	3.9	12.0	20.4	22.6	19.4	15.9	3.3	2.6
Calc. grades	3.2	10.3	19.7	24.6	21.7	14.7	3.8	2.0

Table 5: percentage at each grade, aggregated across all ordinary level subjects

	percentage at or above each grade							
	1	1..2	1..3	1..4	1..5	1..6	1..7	1..8
2017	1.6	10.5	30.3	55.4	77.3	90.8	96.6	100.0
2018	1.4	9.7	29.2	54.8	76.9	90.7	96.5	100.0
2019	1.5	9.8	28.8	53.8	76.0	90.0	96.2	100.0
mean ‘17–‘19	1.5	10.0	29.4	54.6	76.8	90.5	96.4	100.0
School est.	3.9	15.8	36.3	58.8	78.2	94.1	97.4	100.0
Calc. grades	3.2	13.5	33.2	57.8	79.5	94.2	98	100.0

Table 6: percentage at or above each grade, aggregated across all ordinary level subjects

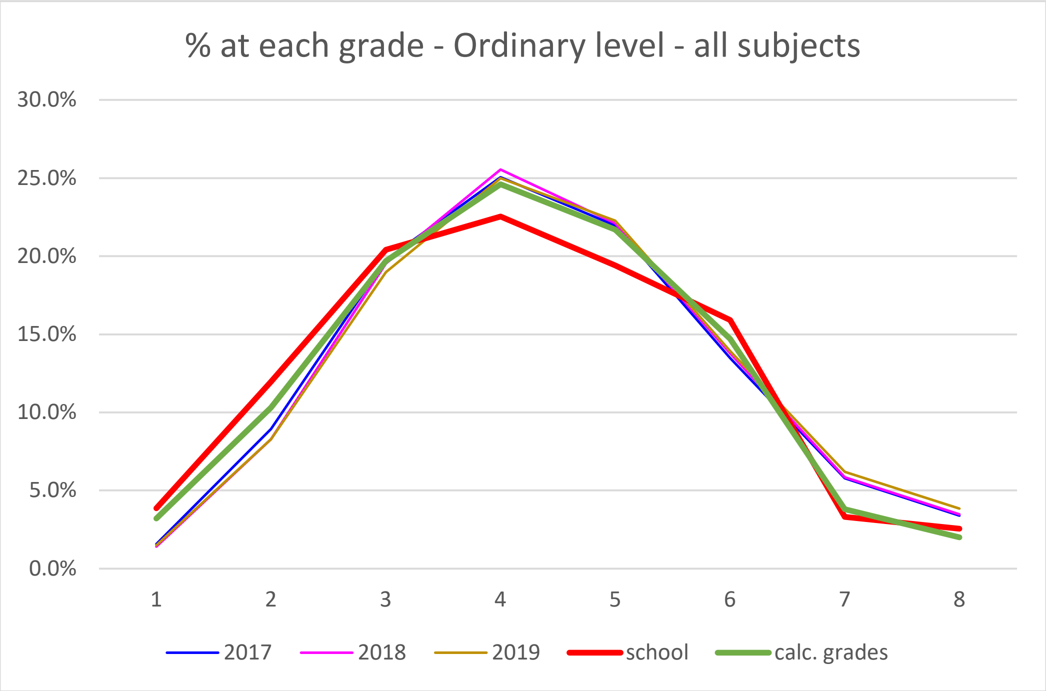


Figure 9: distribution of grades at ordinary level, aggregated across all subjects

Foundation level

	percentage at each grade							
	1	2	3	4	5	6	7	8
2017	3.1	12.0	20.3	25.5	20.7	11.9	4.6	1.9
2018	2.4	10.5	19.7	24.2	20.8	13.5	5.6	3.3
2019	3.5	12.9	19.6	22.7	20.4	12.5	5.8	2.7
mean '17–'19	3.0	11.8	19.9	24.2	20.6	12.6	5.3	2.6
School est.	7.1	19.1	21.8	20.4	17.0	11.9	1.0	1.6
Calc. grades	6.7	18.6	22.1	21.5	17.6	10.9	1.3	1.4

Table 7: percentage at each grade, aggregated across all foundation level subjects (Irish and mathematics)

	percentage at or above each grade							
	1	1..2	1..3	1..4	1..5	1..6	1..7	1..8
2017	3.1	15.1	35.4	60.9	81.6	93.5	98.1	100.0
2018	2.4	12.9	32.6	56.8	77.6	91.1	96.8	100.1
2019	3.5	16.3	35.9	58.6	79.0	91.5	97.3	100.0
mean '17–'19	3.0	14.8	34.7	58.8	79.5	92.1	97.4	100.0
School est.	7.0	26.0	47.7	68.0	84.9	96.7	97.8	100.0
Calc. grades	6.7	25.2	47.3	68.8	86.4	97.4	98.6	100.0

Table 8: percentage at or above each grade, aggregated across all foundation level subjects (Irish and mathematics)

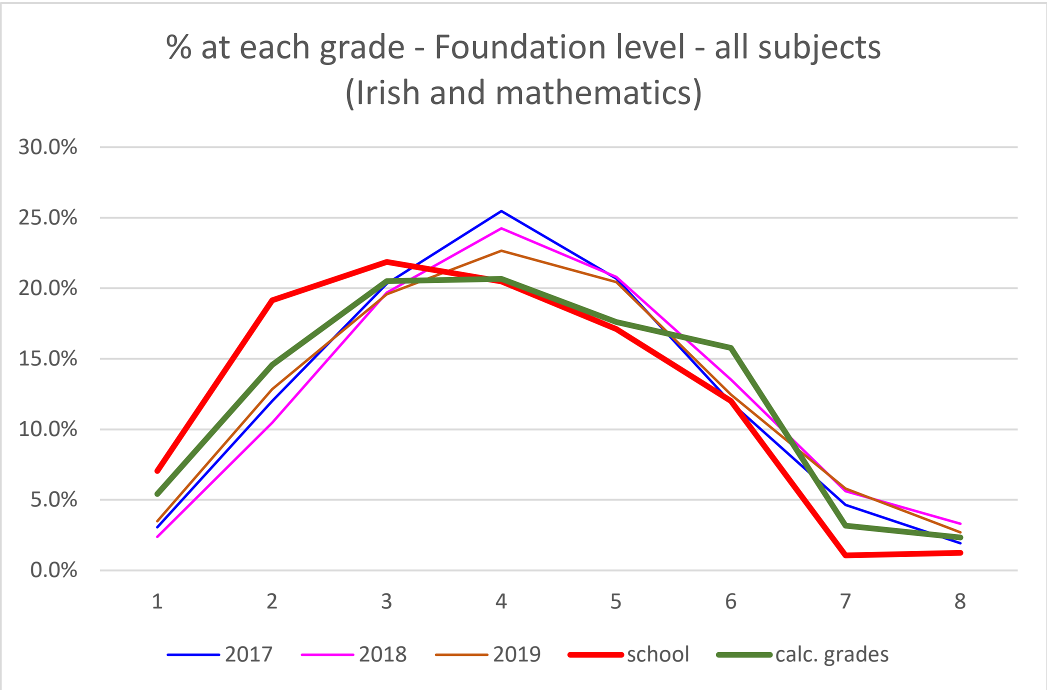


Figure 10: distribution of grades at foundation level, aggregated across all subjects (Irish and mathematics)

8.2. Degree of change between school estimates and calculated grades

The distribution of the signed differences between the school estimated marks and the final calculated marks is summarised in the tables and figures below. In each case, the difference referred to is the calculated mark minus the school estimated mark, so a negative number means that the school's estimated mark for the student has been brought down and a positive number means that it has been brought up. As school estimates are in some cases decimal numbers, the differences below are rounded to the nearest whole number for the purposes of the summaries below.

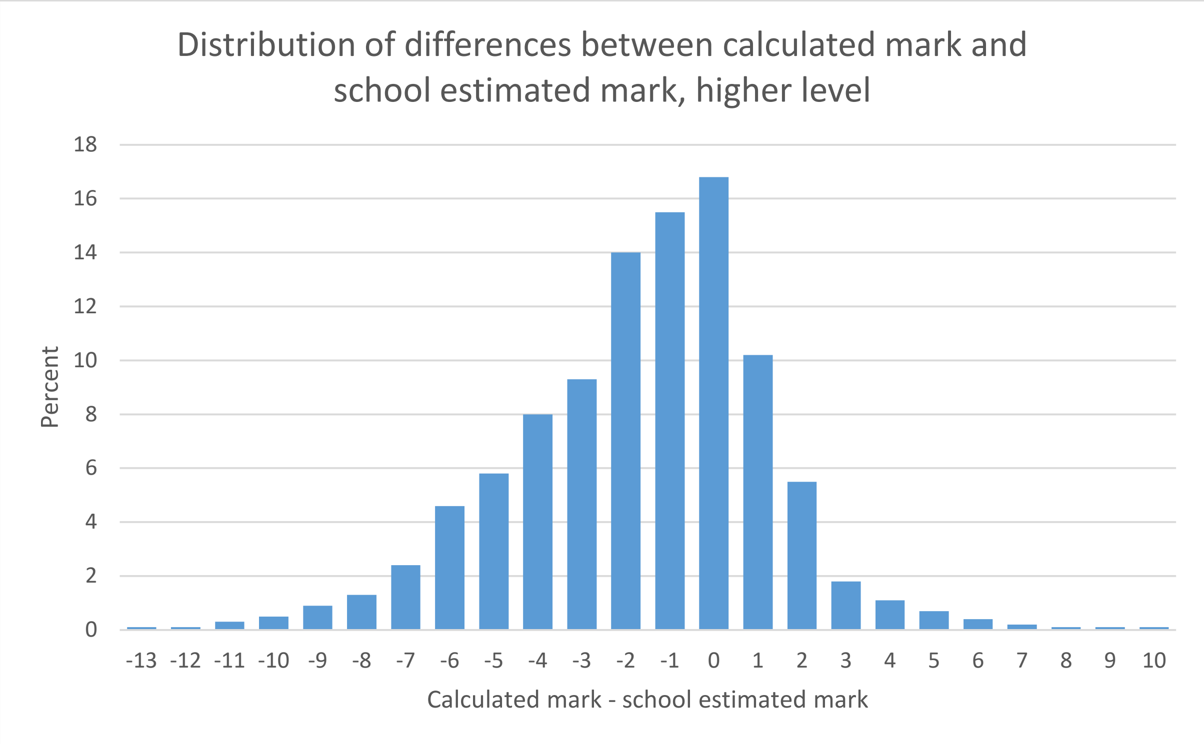


Figure 11: distribution of d = calculated mark – school estimated mark, higher level, all subjects

Change	number	percentage
reduced by more than 10 marks	1761	0.5
reduced by 6 to 10 marks	27239	9.7
reduced by 1 to 5 marks	147896	52.6
unchanged	47324	16.8
increased by 1 to 5 marks	54155	19.3
increased by 6 to 10 marks	2301	0.9
increased by more than 10 marks	430	0.0

Table 9: changes from school estimated mark to final calculated mark, higher level, all subjects

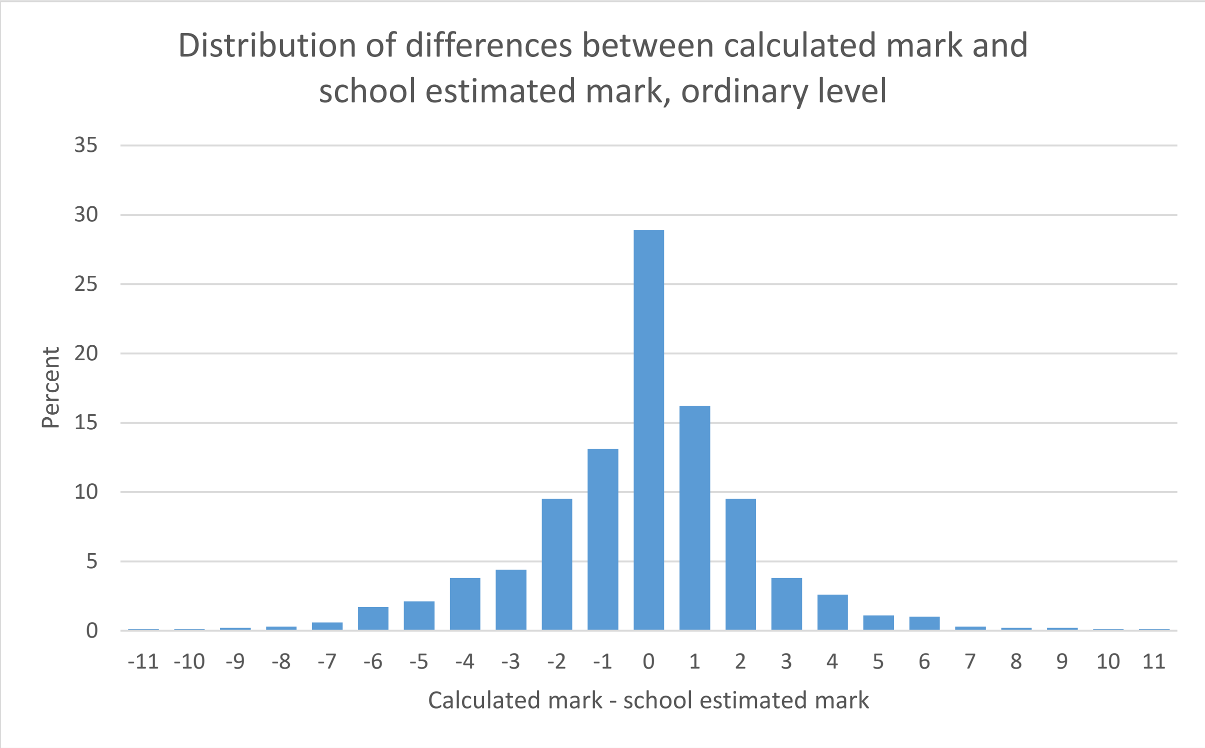


Figure 12: distribution of d = calculated mark – school estimated mark, ordinary level, all subjects

Change	number	percentage
reduced by more than 10 marks	166	0.1
reduced by 6 to 10 marks	3191	2.9
reduced by 1 to 5 marks	36041	32.9
unchanged	31691	28.9
increased by 1 to 5 marks	36494	33.2
increased by 6 to 10 marks	1941	1.8
increased by more than 10 marks	282	0.1

Table 10: changes from school estimated mark to final calculated mark, ordinary level, all subjects

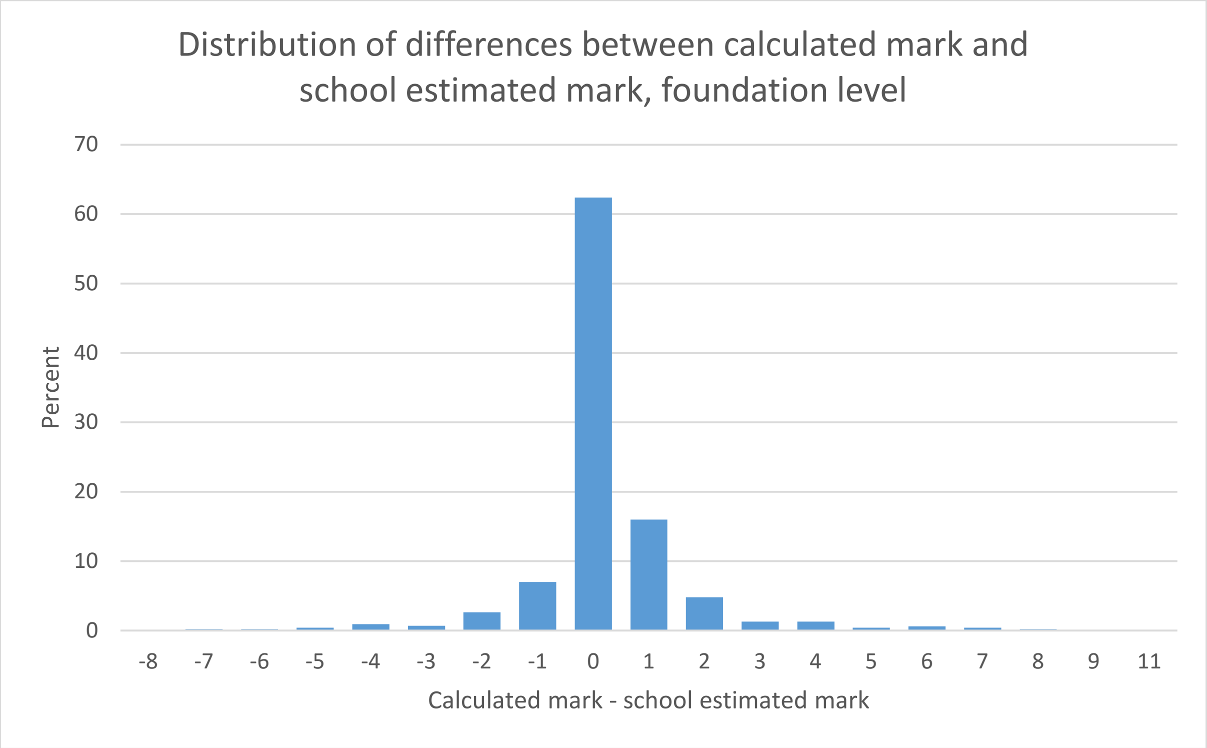


Figure 13: distribution of d = calculated mark – school estimated mark, foundation level, all subjects (Irish and mathematics)

Change	number	percentage
reduced by more than 10 marks	2	0.0
reduced by 6 to 10 marks	23	0.5
reduced by 1 to 5 marks	474	11.6
unchanged	2528	62.4
increased by 1 to 5 marks	962	23.8
increased by 6 to 10 marks	54	1.3
increased by more than 10 marks	8	0.1

Table 11: changes from school estimated mark to final calculated mark, foundation level, all subjects (Irish and mathematics)

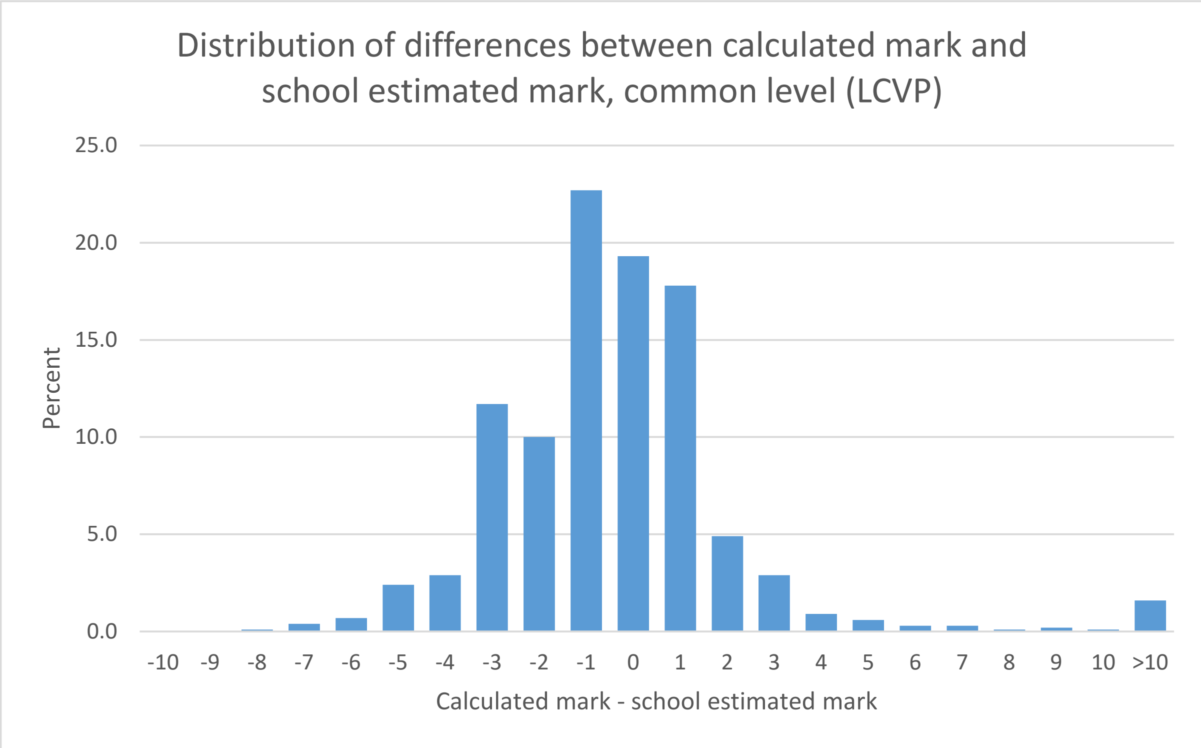


Figure 14: distribution of d = calculated mark – school estimated mark, common level, LCVP link modules

Change	number	percentage
reduced by more than 10 marks	0	0.0
reduced by 6 to 10 marks	157	1.2
reduced by 1 to 5 marks	6697	49.7
unchanged	2597	19.3
increased by 1 to 5 marks	3662	27.1
increased by 6 to 10 marks	139	1.0
increased by more than 10 marks	442	1.6

Table 12: changes from school estimated mark to final calculated mark, common level, LCVP link modules

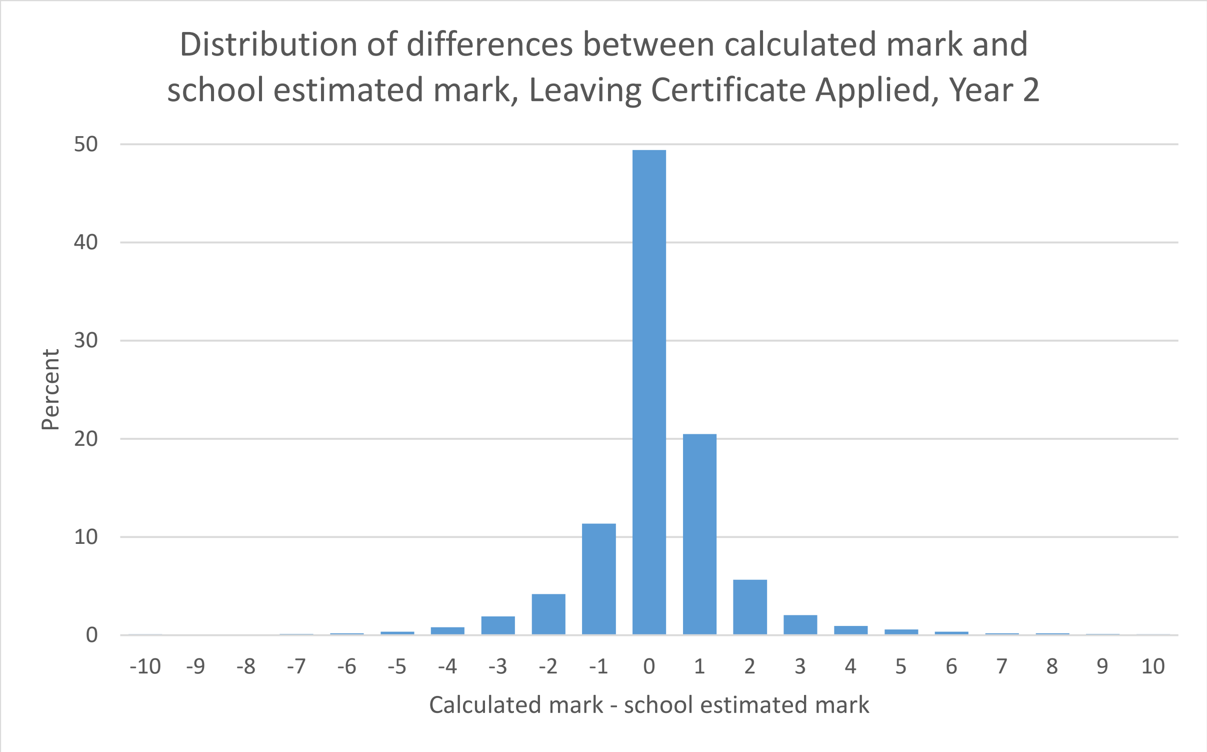


Figure 15: distribution of d = calculated mark – school estimated mark, Leaving Certificate Applied final examinations and the Personal Reflection Task.

Change	number	percentage
reduced by more than 10 marks	0	0.0
reduced by 6 to 10 marks	114	0.6
reduced by 1 to 5 marks	3720	18.7
unchanged	9828	49.4
increased by 1 to 5 marks	5913	29.7
increased by 6 to 10 marks	209	1.1
increased by more than 10 marks	104	0.5

Table 13: changes from school estimated mark to final calculated mark, Leaving Certificate Applied final examinations and the Personal Reflection Task

Most of the mark adjustments did not lead to changes of grade. The distribution of grade changes from those implied by the school estimated marks to the final calculated grades is summarised in the figures below.

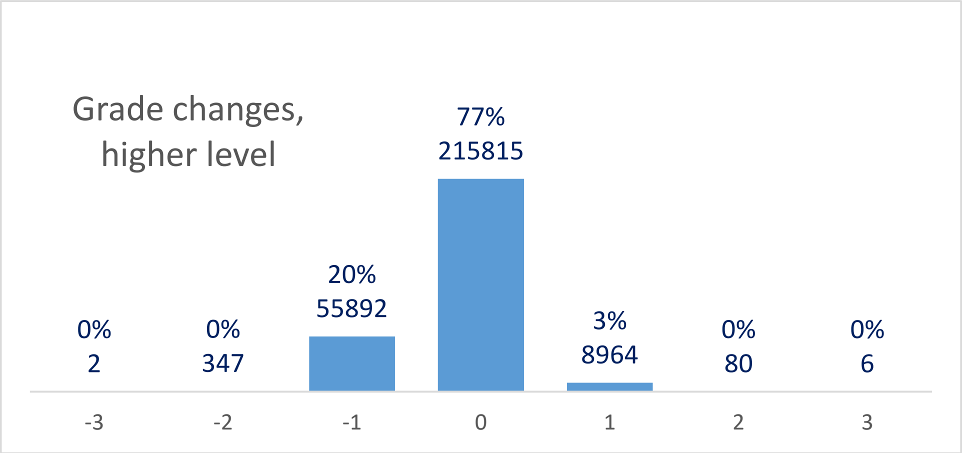


Figure 16: distribution of d = improvement from school estimated grade to calculated grade, higher level, all subjects (negative number = reduced grade)

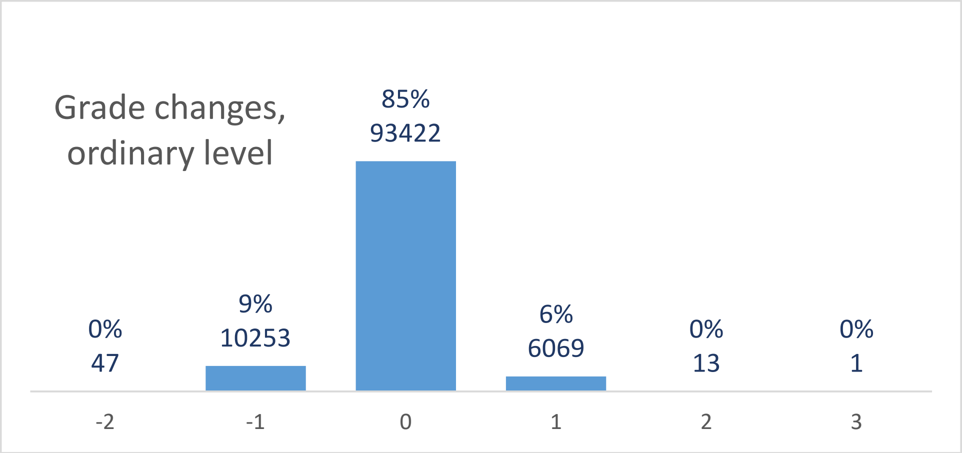


Figure 17: distribution of d = improvement from school estimated grade to calculated grade, ordinary level, all subjects (negative number = reduced grade)

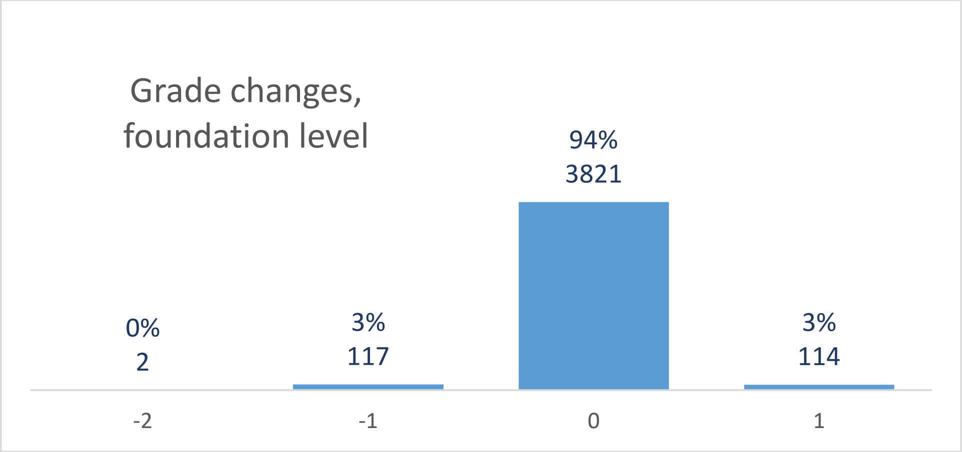


Figure 18: distribution of d = improvement from school estimated grade to calculated grade, foundation level, all subjects (Irish and mathematics; negative number = reduced grade)

9. Application of the model to the Leaving Certificate Applied

Fundamentally, the application of the model in the case of the Leaving Certificate Applied followed the same principles as for the Leaving Certificate Established and the Link Modules for the Leaving Certificate Vocational Programme. However, because of the modular nature of the Leaving Certificate Applied, a more extensive amount of prior attainment data was available for use in the modelling process. That is, Leaving Certificate Applied Year 2 students have already 'banked' results from satisfactory completion of modules, from tasks completed in earlier sessions, and in some cases from examinations completed at the end of Year 1. Likewise, Year 1 students have some prior attainment data arising from module completion and one task already completed at the end of Session 1. This form of prior attainment information for both groups is highly relevant, especially because it relates to achievement within the same programme as is currently being followed and is more recent than Junior Cycle data. Taking advantage of this data was regarded as particularly appropriate in light of the fact that the Leaving Certificate Applied cohort includes many students who have been less well served than their peers by the nature of the curricular programmes they have previously been involved in. As Junior Cycle performance might therefore be considered to be a less reliable indicator of success in their current programme than is the case for students following the Leaving Certificate Established programme, the fairness of the model is enhanced by supplementing the Junior Cycle data with this more recent in-programme prior attainment data.

This means that a more extensive set of prior attainment information was used for the group-level conditioning of Leaving Certificate Applied students. Other than in this respect, the standardisation process for Leaving Certificate Applied students was the same as for all others. It may also be noted that the integrated and school-based nature of the programme meant that calculated marks did not need to be generated for out-of-school learners or subjects taken outside of the school. As for all other in-school students, prior attainment information was only used for group-level conditioning and not for individual-level score estimation.

The calculated grades process was applied to the final examinations at the end of Session 4 (Year 2 students) and Session 2 (Year 1 students), along with the tasks due for completion by the end of those sessions. A small number of students required a calculated mark for 'deferred tasks'. These are tasks normally completed at the end of Year 1 or Session 3 but for which assessment can be deferred if the student is unavailable for assessment for certain specified reasons. As the numbers involved are very small (no more than a handful from any one school,) the statistical standardisation model could not fruitfully have been applied, so these cases were dealt with manually by the Calculated Grades Executive Office. Unless the estimates received from schools were judged to be clearly out of line with the candidate's performance across the remainder of the programme, the school estimates were left unchanged.

With regard to the general impact of the calculated grades process on Leaving Certificate Applied students, it is also noted that the modular nature of the programme means that their overall results are in large measure based on credits that they had already accumulated before the school closures caused by COVID-19, so the process affected a much smaller proportion of their overall qualification assessment activity than was the case for students of the other Leaving Certificate programmes.

Year 1 students do not generally receive their results from Session 2 until later in the year, and the processing of Year 1 results remains underway. Accordingly, Leaving Certificate Applied outcomes reported on here are for Year 2 students only.

Given the complexity of the Leaving Certificate Applied programme, the standardisation model was developed, tested and refined primarily on the Leaving Certificate Established subjects. When applied to the more complex data sets involved in Leaving Certificate Applied, with more flexible pathways through the programme, a wide array of elements of different kinds being used as predictor variables, and comparatively small classes and standardisation groups, the model behaved inconsistently in a number of cases. In order to avoid delaying the issue of results, and to provide a ‘safety net’ against erratic changes as a result of these occurrences, an additional constraint beyond the one mentioned in the footnote in Section 6.3 above was put in place to apply to the LCA datasets alone: no mark was allowed to fall more than 10 marks below the school estimated mark. This had the effect of controlling this occasional erratic behaviour of the model under certain conditions.

10. How various special cases were dealt with

The general principle followed by the National Standardisation Group was that the same principles and procedures should apply as far as possible to all students and all student groups. Nonetheless, there are certain special cases that required special consideration, and this section identifies these and summarises how they were dealt with. More detailed information about the deliberations of the National Standardisation group in considering these special cases is given in various appendices as referred to below and which contain notes prepared by the staff of the Calculated Grades Executive Office for consideration by the National Standardisation Group.

10.1. Subjects being offered for the first time in a school

This special case required explicit consideration in the earlier stages of the work of the group, because at that time, it was intended that the conditioning distributions for each school would be informed by how that school had previously performed in that subject at that level. This meant that a decision would need to have been made as to what if any information would replace that 'school historical information' in a case where a school was offering a subject for the first time or had students taking it at a particular level for the first time.

After the decision to remove school historical information from consideration in the standardisation process, the circumstance of a school offering a subject for the first time no longer required special consideration, as the absence of information that was not ultimately needed clearly did not present a problem.

10.2. New schools

As in the case described in 10.1 above, this issue became irrelevant with the decision not to use school historical information in the standardisation model. Accordingly, new schools were treated in exactly the same way as all other schools.

10.3. New subjects – Physical Education and Computer Science

This scenario presented a number of potential difficulties for the standardisation process. First, since there is no 'national historical information' about the distribution of marks or grades, a method was required to establish what might constitute a credible set of results at the national level that would reflect the results that one might have expected to see had these examinations proceeded as normal.

The National standardisation Group sought the assistance of the State Examinations Commission in this matter. The Commission has experience and expertise in the area of setting and maintaining examining standards, including experience of standard setting in the context of newly introduced subjects. The Commission followed a procedure that involved analysing the grade distributions of a range of other subjects that it considered to be relevant comparators. The Commission then combined the outcomes of this analysis with expert judgment about the subjects concerned and their examination structure in order to produce a 'synthetic' distribution for each of these subjects at each level, to be used as a replacement for a national historical distribution. The response from the State Examinations Commission to the Calculated Grades Executive Office presenting these distributions and the basis for them is given in 0.

Following the Minister's decision that aligning the grade distributions of 2020 with the historical norms was to be accorded greatly diminished importance, these synthetic national distributions became less relevant. Nevertheless, they still served a purpose, as they provided a benchmark against which to judge the degree to which overestimation of student performance by schools in these subjects may have differed from its degree in other subjects, and also against which to judge the degree to which the final outcomes from the calculated grades process in these subjects were stronger than would be expected in an ordinary examination year.

The second difficulty presented by the absence of any previous examination information about these new subjects is that such information is one of the basic building blocks of the 'regression model' that allows us to generate the conditioning distributions at school level that in turn allow us to align standards across schools. To overcome this barrier to building an appropriate regression model, a suitable measure that could serve as a 'proxy' for likely performance in these subjects was required. The National Standardisation Group considered three options outlined in a note prepared for the group by the staff of the Calculated Grades Executive Office (see Appendix J). The option chosen was to build the regression model using the same predictor variable set as was used for all other subjects, and to use, as the predicted variable, average performance at the relevant level across the same range of subjects that the State Examinations Commission had used to generate the synthetic national distributions. That is, the models were based on the premise that performance in these new subjects would have a similar relationship to Junior Certificate performance as is evident in the corresponding blend of comparator subjects.

10.4. Small classes and small standardisation groups

In this context, a 'class' is taken to mean all of the students at a particular level within a class, and 'group' or 'standardisation group' is the group of all students within a school who are taking a subject at a particular level.

Small standardisation groups present a particular difficulty in the standardisation process. A small class does not present a problem if it ends up being part of a standardisation group that is sufficiently large. For example, if there are only 2 students taking a particular subject at Ordinary level in one class but there are 20 students taking the same subject at Ordinary level in another class in the same school, then these 22 students form a single standardisation group, which is not a 'small group' and therefore does not require any special treatment, so in this case the class of size 2 has not presented a problem. However, in some cases, even after pooling together all of the students of a particular subject at a particular level in the school, we may still be left with a small group.

The problem presented by small standardisation groups is that there is not enough statistical information to credibly make any substantial adjustments to the school estimates.

Many avenues towards overcoming this difficulty were investigated during the development and refinement of the standardisation model. These options explored statistically credible ways of ensuring that weighting the distributional information according to its 'stability' (which is related to the sample size but is also affected by other features) might satisfactorily resolve the issue. However, under all of the options explored, it was clear that the prior attainment regression model was overly influential in adjusting teacher estimates in cases where group sizes were small. This was particularly so after the decision to remove the additional potentially supporting statistical information from the school historical distributions from consideration. The National Standardisation Group considered that it was not credible for teacher estimates that have been through a school alignment process to be moved by a large number of marks based solely on a regression model applied to only a handful of students.

It was therefore agreed that the difficulty should be dealt with through the explicit application of a weighting function to the regression estimates, to diminish their effect towards negligibility as the size of the standardisation group reduces towards 1. This weighting function has the following properties:

1. As the predictive value of the regression model approaches 0, the contribution of the regression distribution approaches 0 and the student calculated marks converge on the teacher estimates.

2. Likewise, as the school size approaches and drops below 6, the influence of the regression distribution approaches 0 and the student calculated marks converge on the teacher estimates.

3. As school size increases, the estimated distribution converges on the unweighted geometric mean of the two components distributions.

For details, see the technical details of the standardisation model at Appendix G.

The National Standardisation Group recognises that this means that the marks of students in small standardisation groups are less likely to be adjusted in the standardisation process, but there is no viable alternative given the commitment to place a high level of credibility on the estimated marks supplied by schools and to adjust them only where there is a statistically credible basis for doing so.

10.5. Subjects studied outside of the school

This category refers to cases where a student is taking most of their subjects in regular classes in the school, but is also taking one or more additional subjects outside of the school. This is a distinct category from 'out-of-school learners', who are dealt with in section 10.6 below.

In the case of subjects studied outside of the school, two distinct cases arise. If the subject being taken outside of school is also a subject that is offered within the school, then the estimated mark submitted by the school to the Calculated Grades Executive Office is considered to have been aligned already with the standards applied in that subject by the school and is therefore pooled for the purpose with the other estimates from the school at the same subject and level. This is because, in those cases, the school has confirmed in the course of submitting the estimate that it has resulted from the application of the same standards as those applied by the school.

On the other hand, if the subject being studied outside of the school is *not* also offered within the school, then the estimate concerned has not been encompassed by the in-school alignment procedures and this estimate is therefore treated in the same way as estimates for out-of-school learners, as described in section 10.6 below.

For further detail relevant to the deliberations of the National Standardisation Group with regard to this topic, see the note from the Calculated Grades Executive Office to the National Standardisation Group on *Treatment of Students in Small Classes and of Subjects Studied Outside of School (including Out-of-School Learners) in the National Standardisation Process* in Appendix K.

10.6. Out-of-school learners

This category consists of learners who are not registered as students in a school at all for any of their subjects. The process described here also applies in the case of an individual subject taken outside of school by a learner who is registered in a school and where the subject concerned is not offered in the school. In both of these cases, the estimate received has not been subject to school-level alignment oversight. While the principal has signed off on the credibility and integrity of the *source* of the estimate in the latter case, (s)he has not made any assertions regarding the alignment of standards with those applied within the school (as this could not credibly be done in respect of a subject not offered in the school).

It may be noted that the great majority of non-curricular language estimates fall into this category, but that there are many more cases across a broad range of other subjects.

This group presents a challenge to the maintenance of fairness, equity, and integrity in the process. Given the observed tendency towards positive bias in the teacher/tutor estimates, any procedure that systematically leaves these estimates unaffected by the standardisation process would not be considered fair if it can be avoided, as it would result in such students receiving, on average, more favourable treatment than regular in-school learners.

While these students, for any given subject and level, could procedurally be regarded as a single group, it is not a group whose estimates have been aligned relative to each other or any other group. The only available relevant source of distributional information within the scope of the normal application of the model is the prior attainment information aggregated across the group. Confining the procedure to the use of this form of information would leave the rank order of this pooled group intact, but this is unjustified, as constraining the rank order to remain intact is only appropriate when the set of marks has already been subjected to an internal alignment process. Furthermore, it is difficult to argue that it is fair, as it advantages students whose tutors have given generous estimates relative to those who have not. Given these circumstances, fairness is better achieved by relaxing some constraints that apply to the model in the generality of cases so as to allow statistical information to mitigate the absence of the usual in-school alignment and cross-school standardisation methods. In these circumstances, all available relevant data (excluding the demographic data of gender and those arising from school-level indicators) were permitted to be included in the estimation process at the individual level.

That is, the estimation model for subjects studied outside of a school (including out-of-school learners) and which have not been through an in-school alignment process involved the use of individual prior attainment data. This means that an individual student's calculated mark will be directly informed to some degree by his or her own prior attainment at Junior Certificate. Prior attainment in the Leaving Certificate examinations of repeat Leaving Certificate students was not used, as it was considered that the cohort of repeat students is likely to disproportionately contain students whose performance on the first occasion underrepresented their expected overall performance standards.

As noted earlier, some further detail relevant to the deliberations of the National Standardisation Group with regard to subjects studied outside of school and out-of-school leaners is in *Treatment of Students in Small Classes and of Subjects Studied Outside of School (including Out-of-School Learners) in the National Standardisation Process* at Appendix K.

10.7. Non-curricular language examinations

Scope of the calculated grades process

Being 'non-curricular', the nature and purpose of the non-curricular language examinations are not aligned with the basic premises of the calculated grades process, as they are not intended to relate to any programme of learning in school. While this suggests that they ought not to fall within the scope of the calculated grades process at all, the Government and the then Minister for Education and Skills, when introducing the scheme, were keenly committed to putting in place a process that could provide calculated grades to as many students as possible in as many subjects as possible in order to ensure equity and fairness for all students in the manner in which progression to further studies or the world of work is facilitated. The Department received requests to consider providing alternatives to the calculated grades process that could apply to the non-curricular language examinations only, so as to allow those who had entered for these examinations to demonstrate the relevant skills by some other means. However, the provision of an alternative arrangement for these students could not be made in a manner that could be considered equitable and fair to these students and all other students and so would have undermined the principles of fairness and equity underpinning the calculated grades process. Accordingly, these examinations were brought within the scope of the calculated grades process despite the misalignment between their respective core assumptions. The process therefore sought to deliver as fair as possible a grade in these less-than-ideal circumstances to as many students as could conceivably and credibly be brought within its scope.

Standardisation issues

These examinations pose three particular difficulties in the standardisation process, as follows:

1. Since the examinations are non-curricular by design, all prospective examinees are by definition 'studying the subject outside of the school'. While all those for whom estimates have been possible are in receipt of some form of tuition, in almost all cases this is unconnected with the schools they are enrolled in. (Operationally, they are almost all students in classes of size 1 and there is no in-school group to whom they can be linked.)
2. In the majority of cases, the individual language cohorts are too small to be modelled adequately for standardisation.
3. The amount and type of 'missingness' in the data is such that the assumption of distributional equivalence between the current cohort and previous cohorts is less tenable. While this initially posed an additional difficulty for the National Standardisation Group with respect to aligning standards with historical standards, this difficulty became moot following the Minister's decision that aligning 2020 outcomes with historical standards was to be accorded a greatly diminished importance.

Pooling

The non-curricular language examinations are designed to function as a single suite of examinations with a shared purpose, target audience, and structure. They are all intended to measure the same target skills in the respective languages to the same standard and in the same way. The examinations share a common structure and annually share a common question (worth 40% of the marks) to be answered in the respective languages. The preparation and marking of all of the examinations are overseen by the same Deputy Chief Examiner, who conducts the process in a manner that seeks to ensure comparability across the suite.

For these reasons, it was considered appropriate to pool all of the non-curricular language examinations for the purposes of standardisation. It may be noted that, although the rationale for pooling them is based primarily on the principle of their equivalence by design, pooling them has the added benefit of giving greater distributional stability and reliability to the full suite, leading to more reliable treatment of the smaller cohorts without adversely affecting the treatment of the larger ones.

Consequences of absence of in-school instruction

It should also be noted that, other than the small number that may involve an in-school class, all estimates for the non-curricular language examinations are necessarily dealt with in the same way as out-of-school learners and subjects studied outside of the school that are not offered within the school – that is, in the manner described in section 10.6 above. As a consequence, in the great majority of cases, prior attainment data was used as part of the direct estimation process, which was not the case for in-school candidates in other subjects.

Further information

Some further detail relevant to the deliberations of the National Standardisation Group with regard to non-curricular language examinations is in Appendix L, which is a note from the Calculated Grades Executive Office to the National Standardisation Group on this topic.

10.8. Subjects with very small national cohorts

There are some subject and level combinations that have such small national cohorts that it would be difficult to sustain a statistically based standardisation process at a national level, not to mind at a school level. While it remained technically feasible to implement the standardisation process on these data sets, the level of statistical instability was such that the model was unlikely to cause any substantive change to the teacher estimates in most circumstances. In the case of all subject and level combinations that had a national cohort size of less than 100, staff of the Calculated Grades Executive Office with assessment expertise reviewed these outcome sets in detail to confirm that the outcomes were not unreasonable in the current context.

10.9. Home Economics – journal already marked

Home Economics (Scientific and Social) was the only subject with more than one examination component where schools were required to provide an estimated percentage mark for the written examination paper only (or for the written paper and textile elective combined, where relevant). The Journal had already been marked by the State Examinations Commission earlier in the year. This mark was not adjusted as part of the statistical standardisation process. Instead, the mark for the Journal was combined with the calculated mark (derived from standardisation of the estimated mark provided by the school) to arrive at the final mark for grading.

11. Validation

11.1. What is ‘validation’?

In the field of educational assessment, validation of a test or examination is generally regarded as a process of assembling and evaluating the evidence that supports or refutes the intended interpretations and uses of the scores or grades produced by the test or examination. In the current context, since we do not have an actual examination but a process that replaced an examination, validation involves assembling and evaluating the evidence that supports or refutes the intended interpretations and uses of the outcomes of the calculated grades process. Since the purpose of the process was to determine, as far as possible within the limits of the various constraints imposed, the grade that each student would be most likely to have achieved if the examinations had taken place under normal circumstances, the validity of the calculated grades outcomes is related to the validity of the Leaving Certificate examinations themselves: that is, can stakeholders confidently use the outcomes of the calculated grades process in the same ways for the same purposes that they would have used the results of the examinations.

This is broad in scope. There are some aspects that are amenable to systematic quantitative and qualitative analysis, while other aspects are based on evaluating the credibility of the process itself and the accuracy with which it was carried out.

A working paper on aspects that are amenable to analysis was considered by the National Standardisation Group over the course of its first three meetings and refined by the Calculated Grades Executive Office in response to these considerations. The paper was adopted by the National Standardisation Group at its third meeting and is at Appendix M.

11.2. Credibility of the process and its assumptions

The earlier sections of this report have laid out details of the standardisation process, including how it operated in both the general case and in special cases. The Group considers that the key role played by the estimates from schools, who know their students best, is a central pillar in the argument in support of the credibility of the calculated grades process as a whole. This is complemented by the judicious application of a sophisticated statistical methodology to the standardisation process. The assumptions made about what is accurate about teacher assessments of student performance and what aspects require alignment and standardisation are soundly based in relevant research, as outlined in the discussion paper prepared by the joint technical working group in April. Likewise, the statistical assumptions on which the standardisation process was based, as made clear in Section 5 and Appendix G are well supported and reasonable.

From a statistically purist perspective, standardisation could certainly have been rendered more accurate at an overall level if the ‘school historical information’ had remained available for use in the conditioning distributions, as this was the vehicle through which school effectiveness factors were to be incorporated into the standardisation process. But it is also true to say that it could have been made more accurate by including other individual or school-level predictor variables, such as gender, school DEIS[2] status, school sector, and so on. Just as it is reasonable to decide on policy grounds that students' grades should not be explicitly influenced by the inclusion of such demographic or school categorisation variables as part of the process of estimating individual grades or conditioning distributions, so too can it be argued that there are policy reasons – beyond the statistical – not to include the school historical information. There is little to be gained by increasing the accuracy of the standardisation process if, by doing so, one runs a real risk of losing public support in the process.

Likewise, a clear tension emerged late in the day regarding the degree to which there would be stakeholder or public support for the substantial levels of adjustment to school estimates that would have been required to bring the calculated grades back into line with national historical norms. The National Standardisation Group noted the Minister's concerns in this regard and the corresponding decision to focus efforts on the alignment of standards as accurately as possible across the 2020 cohort. Notwithstanding that the inevitable consequence is a considerably stronger set of results than those of the recent past, it is to be hoped that end-users of the certification and other stakeholders will nonetheless accept the systemic benefits of according these grades the same value as those obtained in any other year, especially since the State has placed its weight so firmly behind this position, and given the undoubted challenges and difficulties faced by the graduating cohort of 2020.

11.3. Accuracy with which the process was followed

Confirmation that all stages of a process were engaged with fully, properly, and accurately is also an aspect of validation. As noted earlier in the present report, the evidence in the raw data from schools suggests that those involved in the school-based phase engaged in the work diligently and with integrity. While the Group had no role in designing or overseeing that phase, we can see no reason in the raw data to question the validity of the overall process on the basis of any deficiency with which the school-based phase was carried out. Operational aspects of the implementation of the national standardisation phase of calculated grades process were the responsibility of the Calculated Grades Executive Office and incidental to the main focus of the work of the National Standardisation Group. These aspects are the subject of a separate report from the Calculated Grades Executive Office. That report, along with reports on independent external checks carried out by the Educational Research Centre, should satisfy stakeholders that there are no threats to the validity of the interpretation of outcomes on the basis of any administrative failures.

As noted in Section 4, detailed interrogation by members of the National Standardisation Group of the outcomes of each iteration of the standardisation model was facilitated by

[2] The DEIS programme (Delivering Equality of Opportunity in Schools) is aimed at providing supports to schools with high concentrations of students from socio-economically disadvantaged backgrounds who are correspondingly at risk of educational disadvantage.   DEIS status indicates that a school meets a certain threshold on a composite indicator designed to identify schools serving areas of 'concentrated disadvantage'

having access to a secure web application that provided a variety of forms of tabular and graphical data analysis at multiples levels of detail. This level of access allowed the Group to be confident that at all stages the model was doing what it was intended to do at that stage, subject to any anomalies that were being identified and addressed as the work proceeded. The details of the model as implemented have been described at both an overview and a detailed level in earlier sections. The detailed descriptions have allowed the Group to satisfy itself that the decisions made by the Group have been faithfully transacted by the Calculated Grades Executive Office and Polymetrika International Incorporated.

11.4. Comparing the model with other potential models

Validity arguments in general also encompass interrogation of how the process being validated compares and relates to other processes that are or might have been used to serve the same purpose. The National Standardisation Group considers that the detailed exploration of many different variants of the model over the course of its refinement, which involved exploring its actual effects on the live data, as well as detailed discussions of the appropriateness and reasonableness from a theoretical perspective of what was being done at each stage, has served to produce a model that stands up to scrutiny from the perspective of doing the fairest job possible given the constraints that applied in its terms of reference in its terms of reference as amended.

11.5. Quantitative analysis of aspects of validation

This section deals with the aspects of validation that were identified in the working paper referred to in Section 11.1 above and which is at Appendix M.

The purpose of this form of validation is to check the extent to which the outcomes of the calculated grades process behave in a way that is similar to the outcomes of the regular Leaving Certificate examination process. There are known associations between certain individual demographic and school-level characteristics and examination results. Looking at whether these associations are replicated in the calculated grades process is a form of checking as to whether the statistical model and the process as a whole are behaving as expected. That is, since the intention of the process is to predict the grade that each student would have achieved if the examinations had taken place as normal, then it is reasonable to check whether the interactions between these characteristics and calculated results are similar to the interactions observable in historical data between these characteristics and examination results. For example, and taking student gender to be a characteristic of interest, if the performance of female students relative to male students in the various subjects turns out to be similar under the calculated grades model as is normally the case in any other examination year, then this can be taken to be an indicator that the calculated grades model is not ‘misbehaving’ in respect of its primary function.

It should be noted that at no time was gender, school DEIS-status, or any other individual demographic or school-category indicator used in the statistical model, for

either estimation or conditioning, in the calculated results process. These characteristics were only used for descriptive validation checks of the kind described here.

The working paper on aspects of validation set out a number of checks of this type that could be carried out as part of the broader programme of model validation. In an ideal world and with no time constraints, this form of validation could look at every factor that is known to (or thought to) correlate with examination results and for which data are available or could be sourced. However, it was recognised that this may not be feasible in the time available. As it transpired, there has only been time to carry out the 'Priority 1' aspects as identified by the Group. These are: student gender, including interaction between gender and gender mix of school, and socioeconomic disadvantage (at school level, as indicated by DEIS status).

As proposed in the working paper, these aspects were looked at both at a subject-specific and at an aggregate level. The subject-specific analyses were carried out on Irish, English, and mathematics, at each level separately. The aggregate-level analysis used a measure that placed scores in examinations at all levels on a single scale and then averaged them across all subjects taken by the student to give a single overall composite score for each student. After a brief description of the overall population outcomes using the composite score, the validation analysis based on aggregate scores is presented for each of the factors considered. Subject-specific tables for English, Irish, and mathematics at each level, disaggregated by the indicator of interest are in Appendix N.

The composite scale and the overall composite score distribution

Note that the composite score is on a scale that runs from 0 to 140. It is described in full in Appendix M. Broadly speaking, a score on the composite scale corresponds to getting that percentage score on an ordinary-level examination, or getting that percentage score minus 40 on a higher-level examination, or getting that percentage score plus 40 on a foundation-level examination.

The distribution of these composite scores for the full population of all grades issued for each of the past three years and in the school estimated marks and the final calculated marks is presented in Table 14 and Table 15 below. This gives a composite picture across all levels of the same patterns as were evident in the tables and charts in Section 8.1 above.

Year	*N*	Minimum	Maximum	mean	std. dev.
2017	55,752	0	136	87.2	22.4
2018	54,414	0	137	87.6	22.6
2019	56,040	0	137	87.9	22.4
2020 sch. est.	57,598	0	138	95.3	22.5
2020 calc. mark.	57,598	0	139	94.1	21.6

Table 14: population summary statistics for composite score (which is the score for each subject on the composite scale averaged over all subjects taken by the student)

percent at or above	2017	2018	2019	2020 sch. est.	2020 calc. mark
10	100.0	100.0	100.0	99.9	99.9
20	99.8	99.8	99.7	99.8	99.9
30	99.1	99.1	99.1	99.5	99.6
40	97.3	97.3	97.4	98.6	98.8
50	93.0	93.2	93.5	96.2	96.4
60	86.3	86.3	87.0	91.7	91.9
70	76.9	77.1	77.7	85.1	85.0
80	64.3	64.8	65.5	75.6	75.0
90	48.8	49.5	50.1	62.4	60.7
100	31.4	32.4	32.4	46.3	43.3
110	14.9	16.2	16.0	28.5	24.8
120	4.4	4.9	4.8	12.4	9.5
130	0.3	0.3	0.4	2.3	1.5
140	0.0	0.0	0.0	0.0	0.0

Table 15: percentage of the population with composite scores at or above thresholds at 10-point intervals

The distribution of the 2020 scores is stronger all round, in that there are more students reaching each threshold score in 2020 than in the previous years. Up to the threshold of 60 points on the scale, the 2020 calculated marks distribution is stronger than that of the school estimates, while at all thresholds above this, the school estimates are stronger.

Gender

On the composite score

	N		mean		std. dev.	
Year	female	male	female	male	female	male
2017	27,890	27,862	90.0	84.3	21.8	22.7
2018	27,580	26,834	90.5	84.6	22.0	22.8
2019	28,358	27,682	91.1	84.6	21.5	22.7
2020 sch. est.	29,205	28,393	99.2	91.3	21.3	22.9
2020 calc. mark.	29,205	28,393	97.9	90.3	20.6	21.9

Table 16: average scores on the composite scale of female and male students over the last three years and in the school estimates and the calculated marks

Across a large portion of the composite scale, one unit corresponds to one percentage point on the examination scale at higher and ordinary level, so this allows one to get a sense of the scale of the differences observed in Table 16. Female students outperform male students on average in a typical year (by 5.7, 5.9 and 6.5 points respectively in 2017, 2018 and 2019). The school estimates displayed a wider gap than this, at 7.9 points. While the gap had widened in successive years over the period 2017 to 2019, the increase to 7.9 points is too great to be considered a continuation of a trend. The application of the standardisation process had the effect of marginally narrowing the gap in the school estimates, to 7.6 points.

It may also be noted from Table 16 that the spread of scores on this composite scale is wider for male students than female students, as indicated by the higher standard deviation. The combination of a lower mean and higher standard deviation for males means that effects may differ in different parts of the distribution. This can be seen in Table 17 below.

	2017		2018		2019		2020 sch. est.		2020 calc. mark	
percent at or above	F	M	F	M	F	M	F	M	F	M
10	100.0	99.9	100.0	99.9	100.0	99.9	100.0	99.9	100.0	99.9
20	99.9	99.7	99.9	99.7	99.9	99.7	99.9	99.8	99.9	99.8
30	99.5	98.9	99.5	98.9	99.5	98.9	99.7	99.4	99.8	99.5
40	98.2	96.8	98.2	96.9	98.3	96.9	99.2	98.2	99.3	98.4
50	94.9	92.2	95.2	92.2	95.5	92.4	97.6	95.4	97.8	95.7
60	89.5	84.7	89.3	84.8	90.4	85.0	94.6	89.8	94.7	90.1
70	81.6	74.4	81.7	74.8	83.0	74.5	89.7	82.1	89.6	82.0
80	70.6	60.8	71.3	61.2	72.6	61.0	82.3	71.0	81.7	70.3
90	56.3	44.7	57.0	45.0	58.4	45.1	71.0	56.5	69.6	54.7
100	38.3	28.0	39.2	28.8	39.9	28.2	55.9	40.0	52.9	37.2
110	19.4	13.4	21.0	14.0	20.9	13.9	36.6	23.8	32.5	20.6
120	6.2	4.2	6.9	4.6	6.7	4.6	17.2	10.3	13.8	7.8
130	0.5	0.5	0.6	0.4	0.6	0.5	3.8	2.0	2.7	1.3
140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 17: percentage of male and female students with composite scores at or above thresholds at 10-point intervals

More female than male students reach every threshold on the scale, and the gap is greatest in the region 80 to 110 on the composite scale in all years. From 90 upwards, the gap is wider in 2020 in both the school estimates and the calculated marks, although to a lesser extent in the latter than the former.

See Appendix N for grade distributions by gender for English, Irish and mathematics.

Gender and gender mix of school

On the composite score

By gender, single-sex schools

	N		mean		std. dev.	
Year	female	male	female	male	female	male
2017	11,029	8,788	92.6	87.5	21.2	22.9
2018	10,820	8,461	93.0	88.2	21.5	22.7
2019	10,988	8,749	93.5	87.8	21.0	23.0
2020 sch. est.	10,938	8,713	100.8	95.4	21.0	23.0
2020 calc. mark.	10,938	8,713	99.5	94.0	20.4	21.9

Table 18: average scores on the composite scale of female and male students in single-sex schools

By gender, mixed-sex schools

	N		mean		std. dev.	
Year	female	male	female	male	female	male
2017	16,850	19,069	88.3	82.9	21.9	22.4
2018	16,757	18,363	88.9	83.0	22.1	22.7
2019	17,368	18,926	89.5	83.1	21.7	22.4
2020 sch. est.	18,265	19,670	98.3	89.5	21.4	22.6
2020 calc. mark.	18,265	19,670	97.0	88.6	20.7	21.7

Table 19: average scores on the composite scale of female and male students in mixed-sex schools

Based on mean scores on the composite measure, the gender gap in examination achievement is wider among students in mixed-sex schools than among students in single-sex schools. This remains the case in the school estimates and in the calculated results.

In all five data sets, the four categories of student in decreasing order of mean score are: females in all-female schools, females in mixed-sex schools, males in all-male schools, males in mixed-sex schools. When ordered according to the size of the increase in the mean from 2019 to 2020 (estimates or calculated) the order is: females in mixed-sex schools (greatest increase); males in all-male schools; females in all-female schools; males in mixed-sex schools.

Observations on gender differences

Gender differences similar to those described above were evident from the start and in the outputs from all variants of the model. This was not unexpected, given that research suggests that unconscious estimation bias in similar contexts to this are generally in the direction of favouring female students. The question might be asked as to why a correction for such bias might not have been built into the modelling process. There are a number of difficulties with doing this. Firstly, although we can detect a certain level of bias in the very large data set that exists nationally, we cannot detect how evenly such bias might be spread. In particular the size of the effect is too small to be reliably detectable at the individual school level, and it would be questionable to make a gender-bias correction in a particular school without being able to demonstrate that gender bias had occurred in that school and the size of its effect. Secondly, making any such correction would violate two of the strong commitments made about the process – that demographic characteristics would *not* be used as part of estimating scores, and that the rank order of students as indicated by the school estimates would be respected. (In mixed-sex schools, where the increase in the gender gap was the greatest, a correction for gender bias would inevitably cause rank order violations.)

Knowing that such unconscious bias might come into play and that it would not be possible to address it during standardisation without violating other commitments, the Department made strong efforts to mitigate the problem through the guidance offered to schools. The National Standardisation Group considered gender issues in detail at a number of meetings and affirmed the position that student gender should not be brought into play as a predictor variable, for the reasons outlined. The Group is satisfied that recognising the potential for gender bias and offering clear guidance to schools at the time of the school-based phase was the only viable means available to the Department to mitigate this difficulty.

DEIS status

At the school level, all recognised second-level schools can be categorised as either ‘DEIS’ or ‘non-DEIS’. The DEIS programme (Delivering Equality of Opportunity in Schools) is aimed at providing supports to schools with high concentrations of students from socio-economically disadvantaged backgrounds who are correspondingly at risk of educational disadvantage. DEIS status indicates that a school meets a certain threshold on a composite indicator designed to identify schools serving areas of ‘concentrated disadvantage’. The tables below categories schools into DEIS, non-DEIS, and ‘other’. The ‘other’ category includes all non-recognised schools. The majority of the students in the category are in private schools (‘grind schools’), but the category also includes other settings such as Youthreach centres, prisons, and other settings approved for the holding of state examinations.

On the composite score

	N			mean			std. dev.		
Year	DEIS	non-DEIS	other	DEIS	non-DEIS	other	DEIS	non-DEIS	other
2017	9,501	43,048	3,195	74.7	89.9	87.0	22.0	21.2	26.6
2018	9,776	41,631	3,007	75.3	90.3	90.3	22.2	21.4	25.8
2019	10,060	42,832	3,148	75.2	90.6	91.3	22.1	21.2	25.0
2020 sch. est.	10,526	44,078	2,994	84.2	97.6	100.8	23.3	21.2	25.2
2020 calc. mark.	10,526	44,078	2,994	83.5	96.4	98.8	22.4	20.5	23.9

Table 20: average scores on the composite scale of students in schools classified by DEIS status

Students in non-DEIS schools outperform students in DEIS schools on average in a typical year (by 15.2, 15.0 and 15.4 points respectively in 2017, 2018 and 2019). The school estimates displayed a somewhat narrower gap than this, 13.4 points. The application of the standardisation process had the effect of narrowing the gap in the school estimates further, to 12.9 points.

It may also be noted from Table 20 that the spread of scores is wider for students in DEIS schools than students in non-DEIS schools, as indicated by the higher standard deviation. The combination of a lower mean and higher standard deviation means that effects may differ in different parts of the distribution. This can be seen in Table 21.

	2017			2018			2019			2020 sch. est.			2020 calc. mark		
percent at or above	DEIS	non-DEIS	other	DEIS	non-DEIS	other	DEIS	non-DEIS	other	DEIS	non-DEIS	other	DEIS	non-DEIS	other
10	99.9	100.0	99.9	99.9	100.0	99.9	99.9	100.0	100.0	100.0	100.0	99.4	100.0	100.0	99.7
20	99.6	99.9	98.8	99.6	99.9	99.5	99.4	99.9	99.7	99.7	99.9	99.2	99.8	99.9	99.5
30	98.4	99.6	97.3	98.3	99.5	97.9	98.1	99.5	98.2	99.1	99.8	98.7	99.2	99.8	99.1
40	94.6	98.4	93.6	94.6	98.4	95.3	94.4	98.5	95.7	97.0	99.2	97.8	97.4	99.3	97.8
50	86.1	95.6	88.2	86.5	95.7	90.8	86.5	95.9	92.1	92.0	97.7	94.6	92.7	97.9	94.6
60	73.8	90.4	81.9	74.5	90.3	84.0	75.0	90.8	86.3	83.6	94.4	91.1	84.0	94.5	90.8
70	58.7	82.5	75.0	60.0	82.5	79.0	60.1	83.2	79.4	72.7	89.0	86.6	72.8	88.9	86.7
80	43.1	70.7	66.3	43.9	71.2	71.3	44.2	71.8	71.9	59.4	80.5	81.6	58.7	79.9	81.2
90	27.1	55.3	55.3	27.8	55.9	60.6	28.4	56.5	62.1	44.0	67.8	75.1	42.1	66.3	73.8
100	14.4	36.8	40.0	15.1	37.7	45.2	14.5	37.9	46.0	28.1	51.7	65.0	25.7	48.8	59.8
110	5.4	18.4	21.4	5.9	19.7	25.7	5.3	19.6	26.2	14.9	32.8	47.2	12.7	29.1	39.1
120	1.0	6.0	7.2	1.5	6.5	8.4	1.1	6.6	8.1	5.6	15.2	22.6	4.4	12.0	17.0
130	0.1	0.6	0.4	0.1	0.6	0.8	0.1	0.6	0.8	1.0	3.2	4.9	0.6	2.2	3.0
140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 21: percentage of students with composite scores at or above thresholds at 10-point intervals according to DEIS status of school

Students on average in non-DEIS schools outperform students in DEIS schools at all points in the distribution, though the effect is at its most pronounced in the area of 80–90 scale points. The ‘DEIS gap’ at almost all points of the distribution has narrowed in the school estimates in comparison to the last three years. The calculated grades behave similarly in this regard, narrowing the gap slightly more than the school estimates at some points in the distribution and slightly less at others.

See Appendix N for grade distributions by DEIS status of school for English, Irish and mathematics.

Observations on outcomes by school DEIS status

The model is behaving very similarly in DEIS schools and non-DEIS schools. Where differences exist, they tend to favour DEIS schools, in that they are tending to show a narrowing of the DEIS gap rather than a widening of it.

Degree of movement from school estimates to calculated results by DEIS status

Validations of the kind described here would normally be concerned with investigating differential effects in the final outcomes of a process rather than differential effects occurring in some internal element of it. Nevertheless, the question of whether school estimates were being adjusted downwards in schools serving socioeconomically disadvantaged areas more often than in other schools drew a great deal of attention in other jurisdictions and consequent speculation in Ireland. For this reason, information in this regard is provided.

Mark change by level and DEIS status

DEIS status	N	Minimum	Maximum	Mean	Std. Deviation
DEIS	76,106	-28	70	-0.8	3.1
Non-DEIS	315,927	-28	51	-1.3	2.9
other	16,403	-18	38	-2.8	3.6

Table 22: summary statistics on difference in mark between school estimate and calculated mark

This indicates that marks were adjusted downwards on average more in non-DEIS schools than DEIS schools, on average. The greater standard deviation in DEIS schools, indicates that more are moving by somewhat larger amounts (in both directions).

Grade change by level and DEIS status

Higher %	All	DEIS	Non-DEIS	Other
2 or more grades below	0.1	0.2	0.1	0.5
1 Grade below	19.9	17.7	19.3	36.8
No change	76.8	77.9	77.4	61.9
Higher	3.2	4.2	3.2	0.8

Table 23: grade changes by DEIS status of school, higher level

Ordinary %	All	DEIS	Non-DEIS	Other
2 or more grades below	0.0	0.1	0.0	5.9
1 Grade below	9.3	8.5	9.8	88.3
No change	85.1	85.2	84.9	5.8
Higher	5.5	6.2	5.3	0.0

Table 24: grade changes by DEIS status of school, ordinary level

Foundation %	All	DEIS	Non-DEIS	Other
2 or more grades below	<0.1	-	0.1	-
1 Grade below	2.9	3.2	2.7	2.2
No change	94.3	92.8	95.5	91.1
Higher	2.8	4.0	1.7	6.7

Table 25: grade changes by DEIS status of school, higher level

All grades %	All	DEIS	Non-DEIS	Other
2 or more grades below	0.1	0.1	0.1	0.4
1 Grade below	16.8	13.6	16.8	30.2
No change	79.3	81.2	79.4	67.6
Higher	3.9	5.0	3.7	1.9

Table 26: grade changes by DEIS status of school, aggregated across all levels

Observations on grade movement by school DEIS status

The model is behaving very similarly in DEIS schools and non-DEIS schools. Where differences exist, they tend to favour the DEIS schools, in the sense that a higher proportion of grades in DEIS schools were left unchanged than was the case in non-DEIS schools, a higher proportion were moved up, and a lower proportion were moved down.

12. Conclusion

Having carried out its role in accordance with its terms of reference, as originally set out in the document *Establishment of a National Standardisation Group for Calculated Grades* (Appendix A), and subsequently as amended in the *Memorandum of 24 August to the Independent Steering Committee for Calculated Grades, the External Reviewer for Calculated Grades, the National Standardisation Group for Calculated Grades, and the Programme Board for Calculated Grades* (Appendix C), and acting also in accordance with its *Decision-Making Framework* (Appendix B), the National Standardisation Group is satisfied that it is now in a position to:

> *"…deliver a set of calculated grades that meets the objectives of being fair and accurate at the point in the iterative process at which a safe, satisfactory and defensible set of outcomes has been achieved."*

The group is satisfied that the statistical model that the the Calculated Grades Executive Office and Polymetrika International Incorporated have used to produce the final set of calculated grades is fair and defensible in the context of the constraints that apply. Notwithstanding that the process has produced a considerably stronger set of results than those of the recent past, it is to be hoped that end-users of the certification and other stakeholders will nonetheless accept the systemic benefits of according these grades the same value as those obtained in any other year, especially since the State has placed its weight so firmly behind this position, and given the undoubted challenges and difficulties faced by the graduating cohort of 2020.

The Group recommends to the Independent Steering Group and the Programme Board that the results be submitted to the Minister for approval of their issue to students.

Appendix A. Establishment of a National Standardisation Group for Calculated Grades

Calculated Grades Executive Office

V6. 06072020

Establishment of a National Standardisation Group for Calculated Grades

A. Background

1. The Government decided on 8 May 2020 to establish a system to be *operated by the Minister on an administrative basis pursuant to* executive powers of Government under Article 28.2 of the Constitution whereby Leaving Certificate candidates could opt to have calculated grades issued to them by the Minister in order to facilitate their progress to third-level education or the world of work in Autumn 2020.

2. The Calculated Grades Executive Office has been established within the Department of Education to deliver the system of calculated grades. The scope of the Executive Office includes planning and delivery of the system, all necessary stakeholder engagement, delivery of the results, management of the appeals process and engagement with the State Examinations Commission on issues relating to students who wish to avail of the option to take a written Leaving Certificate examination. In its work, the Office will ensure that the implementation of the calculated grades system adheres to the principles and values which underpin a high-quality assessment process in the particular context of not being able to run "business as usual" Leaving Certificate examinations.
3. A Department of Education Programme Board will provide governance and decision making for the overall programme associated with the calculated grades model and will oversee the calculated grades system from the perspective of project delivery and policy coherence. A smaller management group will act as the decision-making group for matters which do not require Programme Board sign-off.

4. An Independent Steering Committee has been established by the Minister for Education and Skills to seek to provide assurance to the Minister of the quality and integrity of the outcomes of the calculated grades system including by satisfying itself as to the fairness and accuracy of the outcomes following the national standardisation process.

5. The calculated grades model adopted by Government was on foot of advice from a Technical Working Group which included representatives with relevant expertise from the DES, the SEC, the Educational Research Centre (ERC), and independent statistical and psychometric expertise. The outline of the approach developed by the Technical Working Group included a process of national standardisation of scores to ensure fairness amongst all students.

6. The national standardisation process is an iterative process involving the application of a statistical model to the data, detailed review of outcomes to identify desirable and undesirable features and artefacts in the output data. It will also include adjustment of the parameters, constraints and similar details of the model to be applied in the next iteration, leading through a number of such iterations to a final version of the model that yields fair and just representations of student performance.

B. Establishment of a National Standardisation Group

7. While the details of the decision-making structures and processes were not explicitly described by the Technical Working Group, implicit within the modelling approach proposed is the requirement for a decision-making forum to undertake the national standardisation process to balance the competing objectives that will inevitably arise as the model is developed and refined in the context of the constraints of the agreed approach to providing calculated grades.

8. It is now proposed to the Calculated Grades Programme Board to establish this decision-making forum, in the form of a National Standardisation Group, comprised of representatives from the Calculated Grades Executive Office, the Department of Education Inspectorate, the Educational Research Centre and the State Examinations Commission.

C. Purpose of the National Standardisation Group

9. The National Standardisation Group will be the decision-making group responsible for the implementation of the iterative standardisation process and the application, review, and adjustment of the data in line with the principles, parameters and constraints associated with the model to arrive at fair and just representations of student performance.

10. The objective of the National Standardisation Group will be to deliver a set of calculated grades that meets the objectives of being fair and accurate at the point in the iterative process at which a safe, satisfactory and defensible set of outcomes has been achieved.

11. In carrying out its work the Group will have regard to the utility of the set of outcomes for the class of 2020 in aiding their progression to employment, further education and training, and higher education, which includes the timeliness of the availability of the results.

D. Role of the National Standardisation Group

12. To achieve its purpose, the National Standardisation Group will:

a) Initially determine and prioritise the school and/or demographic characteristics to be used to validate the statistical model (which might include, for example, gender, socio-economic status, sector, programme length, medium of instruction, etc) having regard to the constraints associated with the model including the time overhead of validating the model against each selected characteristic,

b) Consider the statistical outcomes within a decision-making framework which takes account of the commitments, principles, values and constraints which apply to calculated grades and to arrange for the implementation of adaptations in order to tune the model through various iterations. This will require the Group to:

i. interrogate the data-sets emerging from the model at each iteration from a range of perspectives at national level, at various disaggregated levels, and, on a selective and targeted basis when necessary to check a particular type of validation issue, at school level.

ii. Compare outcomes at national level to with those of recent years of each grade distribution for each subject and each level (78 LCE curricular distributions, 1 LCVP distribution, 18 NCL distributions, and 20 LCA subject, specialism, and task distributions).

iii. Consider effects and impacts at school level – through overall summary analysis of the information categorising and summarising the extent to which school distributions within each of these subject and level combinations are aligned with the sets of estimated results from those schools and the school-level conditioning distributions.

iv. Ensure that the appropriate balance is struck between optimising statistical accuracy and maintaining 'face validity' – the degree certain forms of interactivity in the data have credibility and can maintain stake-holder support.

v. Check the degree to which commitments made in respect of the model have been realised, such as fair treatment of unusually high-achieving individual students (or groups) in traditionally modestly scoring settings.

vi. Interrogate such issues as, for example, ensuring that students taking additional subjects out of school, and students taking all subjects outside of a school setting, are treated equitably compared to students taking their subjects within a school setting.

vii. Review the outcomes of model-validation analyses to check for potential undesirable differential effects on subgroups of interest, including differential gender effects and differential effects by school characteristics.

c) Seek onward referral of any policy matter for which direction has not already been given to the Group.

E. Frequency of Meetings and Timeline for the Work

13. This will be an intense process requiring significant time commitment by the Group members. Each meeting will follow analysis which will identify features for consideration of appropriate action. Different courses of action will have different implications for other aspects of the outcomes. Decisions are fed in to the adaptations of the model for the next iteration on the data set, and the cycle repeats. Following the first run of the model, it is anticipated that the Group will be required to meet twice per week, with these meetings taking place on Monday afternoons and Thursday afternoons and with the initial meeting planned for Thursday 2nd July, followed by the first substantive meeting on Thursday 9th July.

14. On some occasions, multiple variants of the model will be run for comparative consideration. While it is conceivable that fewer cycles than expected will be required for a satisfactory outcome, the external consultant's experience of projects of this type, given the kinds of complex constraints that are already emerging, suggests that at least 6 to 8 weeks is required from first consideration of analysis of a comparatively complete (85%+) dataset to safely achieve a satisfactory and defensible set of outcomes, exclusive of contingency time. Other external experts consulted in the context of contingency planning have advised that this an ambitious timeline for this kind of work in a high-stakes context.

15. It may be noted that each iterative cycle can draw from a fresh feed of the input datasets, and small amounts of missing data outstanding will not significantly affect the patterns in the data, so this timeline already capitalises on the fact that analysis can begin before the dataset is fully complete.

F. Decision Making, Governance and Oversight

16. As noted, the objective of the National Standardisation Group will be to deliver a set of calculated grades that meets the objectives of being fair and accurate and to determine the point at which a safe, satisfactory and defensible set of outcomes has been achieved.

17. The Group will be required to provide the Independent Steering Committee with a preliminary report following initial work and with a final report in advance of the results issue. The preliminary report will be provided to the Steering Committee within a fortnight of the Group's first substantive meeting. Outside of these reporting arrangements, the Independent Steering Committee will receive updates from time to time from the CGEO on the work of the standardisation group.

18. The National Standardisation Group will make its recommendation to the Programme Board that its objective has been achieved and final sign off of the set of Calculated Grades will be at Programme Board. The Programme Board will be kept informed of progress by the Director of the Executive Office.

19. It is intended that the system of calculated grades will be subject to a process of external validation. Any documentation, reports, etc, generated by the Group can be provided to the validator.

G. Membership of the National Standardisation Group

20. The expertise of the National Standardisation Group is in the field of high states examinations and assessment, educational evaluation, and second level education and the organisations represented on the Group were central to the development of the system of calculated grades. The proposed members of the Group are:
    - Andrea Feeney, Chairperson, Director, Calculated Grades Executive Office
    - Hugh McManus, Assistant Director, Calculated Grades Executive Office
    - Elaine Sheridan, Assistant Director, Calculated Grades Executive Office
    - David Millar, Assessment Manager, Calculated Grades Executive Office
    - Orlaith O'Connor, Assistant Chief Inspector, Department of Education and Skills
    - Dr Jude Cosgrove, CEO, Educational Research Centre
    - Aidan Farrell, Chief Executive Officer, State Examinations Commission

    In light of the time demands for this critical and challenging work, the Inspectorate, ERC and SEC were asked to nominate a primary representative and an alternate in the event that the primary representative is unable to attend. For reasons of continuity, the primary representative will be asked to attend all meetings where possible. The alternates for each organisation are:

    Dr Harold Hislop, Chief Inspector, Department of Education.

    Gerry Sheil, Senior Research Fellow, Educational Research Centre.

    Dr Tim Desmond, Head of Examinations and Assessment, State Examinations Commission.

    Fernando Cartwright, PII, will attend all meetings. In addition, a person (or representative of an agency) whose role includes the provision of contingency cover for PII's involvement in the project may be present at meetings in an observer capacity, in order to help streamline any contingency takeover of work that may be required. Other staff members from CGEO will attend meetings to contribute expertise as well as administrative and secretarial support. Only group members will have a decision-making role.

[Later amendment] Dr Kentaro Yamamoto was appointed in an expert role which includes a level of contingency cover for Polymetrika; as technical advisor on the standardisation process and to provide expert advice and oversight regarding data integrity. In fulfilling the role, Dr Yamamoto attends some meetings of the NSG in an observer capacity.

H. Duration

21. The Group's work concludes following the issue of the results and completion of all associated reporting. It is not intended that there will be any role for the group in the appeals process unless such a requirement were to emerge.

Appendix B. National Standardisation Group – Decision Making Framework

Calculated Grades Executive Office

Confidential Working Paper

STATUS: Approved. Meeting 5 27/07/2020

National Standardisation Group – Decision Making Framework

1. Introduction and Background

The National Standardisation Group is the decision-making group responsible for the implementation of the iterative standardisation process and the application, review, and adjustment of the data in line with the principles, parameters and constraints associated with the model to arrive at fair and just representations of student performance.

The role of the group, as set out in the paper *Establishment of a National Standardisation Group for Calculated Grades* is at **Appendix A**.

The objective of the National Standardisation Group is to deliver a set of calculated grades that meets the objectives of being fair and accurate at the point in the iterative process at which a safe, satisfactory and defensible set of outcomes has been achieved.

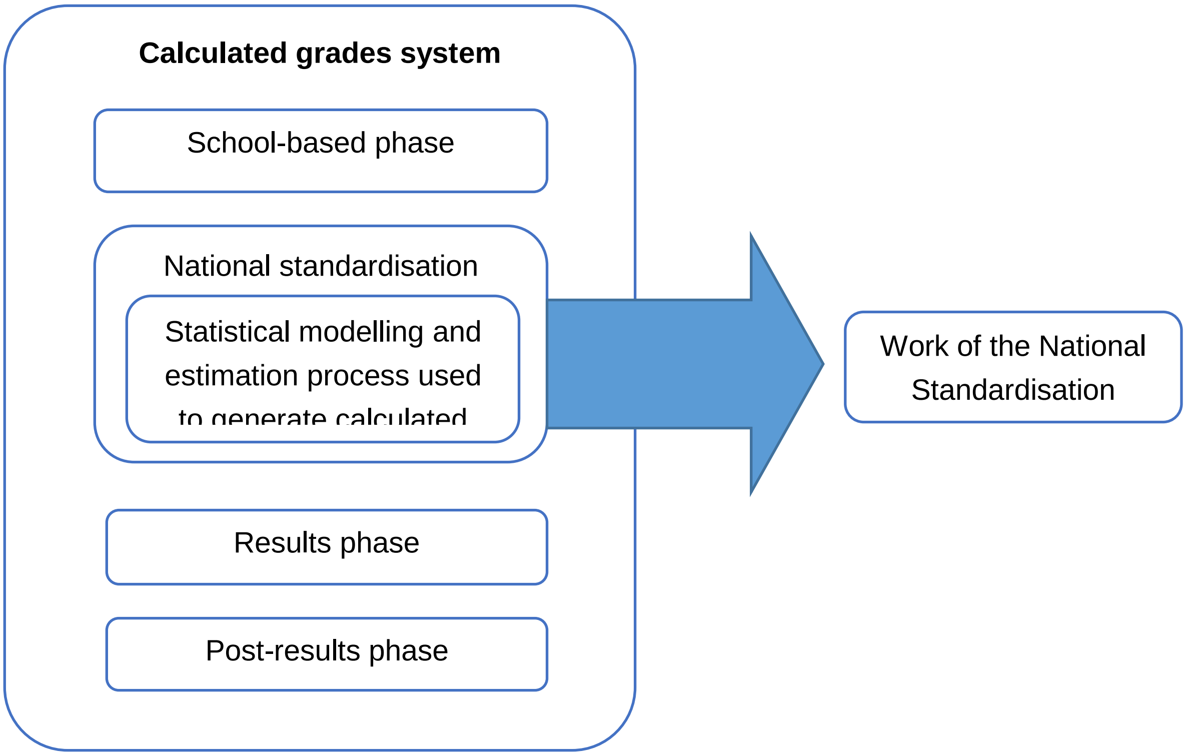
In carrying out its work the Group will have regard to the utility of the set of outcomes for the class of 2020 in aiding their progression to employment, further education and training, and higher education, which includes the timeliness of the availability of the results.

Included in the Terms of Reference for the National Standardisation Group is that the Group will consider the statistical outcomes within a decision-making framework which takes account of the commitments, principles, values and constraints which apply to calculated grades and to arrange for the implementation of adaptations in order to tune the model through various iterations.

The purpose of this paper is to propose a decision-making framework which will set the parameters for the work of the National Standardisation Group. The paper draws together issues surfaced in the technical documents relating to the statistical model and the principles and commitments made in already published documents about the system of calculated grades. It also suggests an overarching set of principles and a series of questions designed to guide the Group in its consideration of the issues that will arise over the course of the iterative process.

2. Scope and boundaries of the work of the National Standardisation Group

The national standardisation process is but one aspect of the calculated grades system.



The work of the National Standardisation Group is situated within the National Standardisation Phase of the overall system. It is therefore primarily concerned with making decisions related to the functioning of the statistical modelling and estimation process, so as to maximise the extent to which the objectives described earlier are met. Nonetheless, the group will have full regard to the functioning of the Calculated Grades system as a whole.

The primary provider of the standardisation model, is Polymetrika International Inc. (PII). Within the system the role of the Educational Research Centre (ERC) is to provide data quality assurance and verification service on the data processing and standardisation processes. ERC will be operating the standardisation process, including all data integrity checks, asynchronously in parallel to the processing by PII. This primary and secondary processing approach is designed to provide reassurance to the National Standardisation Group and to other stakeholders about the integrity of the process.

In particular, in relation to *validation*, a distinction needs to be drawn between validation of the standardisation process (the statistical modelling process that is used to generate the calculated marks) and validation of the Calculated Grades system as a whole. The means through which the validation will be carried out is such that, in general, it provides information about the combined functioning of the school-based phase and the national standardisation phase. It is to be noted that, as it will not be possible to revisit the school-based phase, the group will only be able to make decisions that can optimise the effectiveness of the standardisation phase. While certain difficulties evident in the data emerging from the school-based phase may be amenable to mitigation through the standardisation phase, others will not, and this constrains the scope of the work of the group. That is, the group will only be able to recognise and note where this has occurred.

A high-level description of the national standardisation process is at **Appendix B**.

3. Principles underpinning the work of the National Standardisation Group

The following principles will underpin the work of the group.

- The results will be fair and accurate representations of likely student performance in the Leaving Certificate examinations.
- The approach will preserve the integrity and interpretation of the Leaving Certificate examinations. The method should provide results that are, to the greatest extent possible, unbiased and of comparable statistical dependability to the Leaving Certificate examinations that would have been conducted in a business-as-usual academic year.
- The approach will ensure that factors and objectives beyond pure statistical optimisation of data-based estimates must also be taken account of.
- The Group will have full regard to the published commitments about the system of calculated grades. (See section 5 below)
- The Group will need to balance any competing tensions that emerge in the model, recognising that conflicts may emerge in particular circumstances between different commitments given or between any commitment given and what the model is capable of delivering. The decisions made by the Group will be such as to ensure adherence in as broad a range of circumstances as is possible to commitments made. However, it is recognised that the overriding imperatives of fairness and accuracy may require the relaxation or adjustment of some of these commitments in particular circumstances. In considering the fairest course of action in such circumstances, the Group will have regard to the impact of such decisions on other aspects of the model, including whether a decision made to address a difficulty in respect of one aspect of the model or its application leads to unfairness, advantage or disadvantage in any other aspect of the application of the model. All such decisions must be documented and accompanied by a clear rationale, which set out the consequences of the particular decision on both the aspect of concern and the other aspects of the model.
- Decisions taken at any meeting may be considered provisional until the outcome/effect of the decision is fully realised, which may lead to the decision being revisited at a later meeting.

4. Questions and issues for consideration

The questions and issues that that the National Standardisation Group will need to consider include but are not necessarily limited to the following.

1. On what basis will the National Standardisation Group conclude that the results are fair and accurate? In particular, how will the group determine that a point has been reached in the iterative process at which a safe, satisfactory and defensible set of outcomes has been achieved?
2. Given commitments already made, determine whether conditioning distributions will apply at class or school level.
3. In the context of public examinations systems like the Leaving Certificate, what if any action will the group take if differential effects, beyond those that already exist in the examinations system, are found in the course of validation? In particular, where these effects are a consequence of:
    a. the functioning of the statistical model

   b. the functioning of the school-based phase
   c. the impact of the commitments made about the calculated grades system
4. How will the statistical standardisation process provide for:
   a. small schools/centres
   b. small groups taking a subject in a school (including groups of size 1)
   c. students who studied outside school and were not in a class group
   d. new schools/centres with only some or limited historical school data
   e. new subjects without any school or national historical data
5. The need to be assured that a group whose performance is stronger or weaker than typically seen in a school is properly dealt with
6. The need to be assured that an individual whose performance is stronger or weaker than typically seen in a school is properly dealt with
7. The need to be assured that no advantage accrues to students in schools that overestimated performance relative to schools that provided estimates that were more accurate or similarly that no disadvantage accrues to students in schools that underestimated performance.
8. Is the proximity (from below) of calculated marks to grade boundaries similar to that of previous years, and is it dealt with appropriately?
9. How will measurement error be reported on?

This list is not exhaustive, and any member of the group may raise a concern or question for the group to consider, provided that the group is satisfied that its consideration is within the remit of the group in order to fulfil its functions.

5. Commitments, Constraints, Limitations, and 'Signposts'

The following section sets out the commitments made and the constraints and limitations that have been articulated in the published documentation or that otherwise apply. It also sets out 'signposts' that have appeared in documents produced to date – these are indications as to how certain aspects of the system will work that fall short of being commitments.

5.1 Relevant Publications

These are the key documents to which the Group should have regard. A full communications inventory is at **Appendix C**

1. Methodological Considerations for 2020 Leaving Certificate Estimation V4
2. Discussion paper for SEC-DES Technical Working Group on Calculated Results
3. Guide to calculated Grades for Leaving Certificate 2020:
4. Guide for Schools on Providing Estimated Percentage Marks and Class Rank Orderings.
5. Supplement to Guide for Schools on Providing Estimated Percentage Marks and Class Rank Orderings
6. Further information in relation to the Calculated Grades process
7. Calculated Grades Data Collection Guide for Data Entry Users and Approvers
8. A Guide to Calculated Grades for Out-of-School Learners

Regarding 1 above, it is noted that the Methodological Considerations document is an evolving document which will be developed over the course of the standardisation process.

Regarding 2 above, it is noted that this sets out the perspective of the Technical Working Group in advance of the final decision to establish the system of Calculated Grades. While due regard is to be paid to this document in light of its role in the government decision, the Group is not rigidly circumscribed by its proposals or descriptions as to how aspects of the system might operate.

Definitive statements made in the remaining documents should be regarded as commitments. Accordingly, any deviation from them requires a clear rationale based on the fundamental objectives.

5.2 Commitments, Constraints and Limitations

The numbers in brackets after each item in the list below indicate the document above in which they appear.

- School-sourced data will be combined with historical examination data available to the Department through a process called national standardisation in order to generate the calculated grade for the students in the subject. This national standardisation process will bring the two data sets into alignment with each other and will be used to ensure the calculated grades reflect standards that are properly aligned across schools and with a common national standard. [3, 4]
- The statistical process will take account of the fact that the particular group of students in the school in 2020 may be stronger or weaker than in previous years, and will also allow for the fact that particular individuals within those groups might have levels of achievement that vary considerably from what has previously been seen in the school.[4]
- The national standardisation process being used will not impose any predetermined score on any individual in a class or a school. [4]
- The rank order within the class group will be preserved in the statistical process. [1, 4]
- If the group of students in a school in the current year is particularly “strong”, the expected level of achievement of the group will reflect that fact. [4]
- If one or more individuals stand out as particularly strong, that will be reflected in the school’s estimated marks and thereby be taken fully into account.[4]
- The teachers’ estimated marks from each school will be adjusted to bring them into line with the expected distribution for the school.[4]
- We expect that many estimated marks may change, to at least some degree. Although some will change more than others depending on the quality of the data we receive from schools. [4]
- The calculated marks will be converted into calculated grades, and these grades will be issued to candidates. The calculated grades will be expressed in the same manner as currently applies to Leaving Certificate grades – H1 etc. [4]
- The Department does not have the kind of data or evidence that would allow the reliable realignment of standards between different teachers within the same school. [4]
- Full and careful participation [by schools] in the alignment procedures within the school are the only means through which fairness across different class groups taking the same subject within a school can be achieved. [4]

- The date for issue of results has been announced as 7 September. The work of the NSG will need to conclude in the week ending 21 August in order to meet this, so as to allow time for subsequent results processing, including quality assurance and data integrity checks.
- Individual historical data shall not be used deterministically at an individual level to constrain estimates of student performance.[1]
- Historically poor performance of a school should not impose an upper limit on the calculated mark of an individual student.[1]
- The calculated scores will respect the rank ordering of students at the class level that have been specified by teachers.[1]
- The calculated scores will have the same consequence as historical Leaving Certificate results, including for use in certifying secondary completion and determining third-level entrance.[1]

5.3 'Signposts'

Guide for Schools on Providing Estimated Percentage Marks and Class Rank Orderings suggests very strongly that conditioning distributions will be applied at school level rather than class level. The reason for this arises from the fact that there is no domain-specific concurrent data that could allow teacher effects on quality of learning within the subject domain to be disaggregated reliably from teacher estimation biases. To adhere to the overriding intention to provide outcomes that match as closely as possible the results of the examination process, it is important to recognise and accommodate the existence of differential teacher effects on learning. Since the in-school alignment process provides a vehicle (albeit perhaps an imperfect one) for accommodating such effects, and in the absence of domain-specific concurrent data, it is considered that insufficient credibility would attach to using other forms of predictor variables to override the in-school alignment process. It is for this reason that the guide stated:

> The Department does not have the kind of data or evidence that would allow the reliable realignment of standards between different teachers within the same school.

and

> Full and careful participation [by schools] in the alignment procedures within the school are the only means through which fairness across different class groups taking the same subject within a school can be achieved.

In addition to assertions made in published documentation, the process as implemented should also give due regard to the description of the proposed process in the *Discussion paper for SEC-DES Technical Working Group on Calculated Results*, since this document was a significant part of the basis used to make the final decision to introduce the scheme of calculated grades in the first place. That is, it informed the decision that the proposal represented a credible and valid means of certifying achievement in the current circumstances.

The various elements of the envisaged process as described in that paper are not all laid out here, but some aspects of the overall approach envisaged should be noted. Sections 6 and 7 of that document are particularly germane, in the sense that they set out, for example, what particular data sets will be used for estimation, conditioning and validation (and why), and also set out potential methodological variations of the model. In addition, Section 8 lays out a set of five premises that were proposed to underpin the approach, given the context:

Premise 1: when balanced against practicability and operational risk, maximum utility in this context is achieved by collecting an estimated percentage mark for each student in each class, along with a strict rank ordering of the students in the class.

Premise 2: prior attainment data at student level should be used only in aggregate form to inform conditioning distributions, and not to affect the individual student's calculated result.

Premise 3: teacher-estimate data for one subject should not be allowed to influence student likelihood functions or conditioning distributions for another subject.

Premise 4: the model must adequately accommodate intra-school teacher effects on likely attainment.

Premise 5: adequate records should be generated to facilitate reasonable oversight by school authorities and to facilitate the implementation of a suitable appeals process

6. Decision-making process

All decisions made by the group will have due regard to this framework.

Where possible, any aspect of the functioning of the model that requires a decision will be flagged in advance of the meeting at which it is to be discussed. This will, in general, happen either through the agreement of the group at a preceding meeting, or by a request from the CGEO arising from its considerations of the most recent iteration of the model. Such a request from the CGEO may (but will not necessarily) arise from observations from Polymetrika International Inc regarding some aspect of the functioning of the model. These arrangements do not preclude any member of the group from raising a question for consideration.

The CGEO will arrange, through its agreements with Polymetrika International Inc., for the group to have access to model outcome data in a suitable format and in sufficient time to provide an informed basis on which each decision can be made.

All decisions will be recorded in the minutes of the meeting at which they were made. The rationale for the decision will be recorded to an appropriate level of detail.

Decisions taken at any meeting may be considered provisional until the outcome/effect of the decision is fully realised, which may lead to the decision being revisited at a later meeting.

Where a decision impinges on a policy matter on which the group has not already been given guidance or a policy directive, such a decision will be considered provisional pending the approval of the Programme Board. The Director of the CGEO will arrange for the provisional decision, including its rationale and implications, to be brought to the attention of the Programme Board.

While the CEO of Polymetrika International Inc will attend meetings of the group, and may offer observations, decisions are exclusively the preserve of the members of the group.

7. Role of the Analysis Support Team

In recognition of the large number of model output data sets that need to be examined in detail at each iteration of the model and the extremely tight timeframe available between iterations, the CGEO has engaged an analysis support team.

The purpose of this is to assist the CGEO in keeping the National Standardisation Group fully informed about the outcomes of each iteration of the model, recognising that is not feasible for all members of the Group to examine all model output distributions in detail on each occasion.

The Analysis Support Team will review, across all distributions, the features of the model outcomes that are due to be discussed by the National Standardisation Group at forthcoming meetings and provide the CGEO with relevant qualitative summary information about what is observed, including identifying subjects or subject-level combinations that are atypical or otherwise warrant specific attention.

The CGEO will in turn use this information to keep the Group fully informed. This will allow members of the Group to have confidence regarding the extent to which the features they observe in the distributions that they are in a position to examine in detail themselves are replicated across other subjects and levels.

The Analysis Support Team has no decision-making role.

APPENDIX A *[to the decision-making framework]*. Role of the National Standardisation Group

The role of the Group is to

a. Initially to determine the school and demographic characteristics that will be used to validate the model, e.g. (sector, gender, socio-economic status, programme length, medium of instruction, etc.
b. Consider the statistical outcomes within a decision-making framework which takes account of the commitments, principles, values and constraints which apply to calculated grades and to arrange for the implementation of adaptations in order to tune the model through various iterations. This will require the Group to:
    i. Compare outcomes at national level to with those of recent years of each grade distribution for each subject and each level (78 LCE curricular distributions, 1 LCVP distribution, 18 NCL distributions, and 20 LCA subject, specialism, and task distributions).
    ii. Consider effects and impacts at school level – through overall summary analysis of the information categorising and summarising the extent to which school distributions within each of these subject and level combinations are aligned with the sets of estimated results from those schools and the school-level conditioning distributions.
    iii. Ensure that the appropriate balance is struck between optimising statistical accuracy and maintaining 'face validity' – the degree certain forms of interactivity in the data have credibility and can maintain stake-holder support.
    iv. Check the degree to which commitments made in respect of the model have been realised, such as fair treatment of unusually high-achieving individual students (or groups) in traditionally modestly scoring settings.
    v. Interrogate such issues as, for example, ensuring that students taking additional subjects out of school, and students taking all subjects outside of a school setting, are treated equitably compared to students taking their subjects within a school setting.
    vi. Review the outcomes of model-validation analyses to check for potential undesirable differential effects on subgroups of interest, including differential gender effects and differential effects by school characteristics.
c. Seek onward referral of any policy matter for which direction has not already been given to the Group.

APPENDIX B *[to the decision-making framework]*. High Level Description of the National Standardisation Process

Conditioning data

Includes variables that uniquely identify classes, teachers or schools, or nest students in groups larger than classes. The existing examinations data that has been used to generate the conditioning distributions:

1. national distributions
2. school level distributions based on the historical distributions of Leaving Certificate results,
3. school level distributions based on the relationship between performance at LC and JC
4. class level distributions based on the prior Junior Certificate examination results of the current 2020 candidate

The relevant Department data sets that support the process include mark data at:-

- national level for both Leaving Certificate and Junior Certificate examinations for 2019 previous years;
- school level for both Leaving Certificate and Junior Certificate examinations for 2019 and previous years;
- candidate level for both Leaving Certificate and Junior Certificate examinations for 2019 and previous years;
- candidate level for the Junior Certificate results of the 2020 Leaving Certificate cohort of candidates

In the national standardisation phase school-sourced data will be combined with historical data order to generate the calculated grade for the students in their subject. This standardisation process will be used to ensure that the calculated grades reflect standards that are properly aligned across schools and with a common national standard. The key principles of objectivity, equity and fairness will be further underpinned within the national standardisation process and the process has been designed to arrive at fair representations of student performance which does not favour any type of student or school.

Estimate – estimated percentage mark and rank order

Scale – subject, class and school membership; JC examination results; Number of years since JC. Previous years' LC results. (Conditioning)

Validate – Historical and known relationship to the distribution of test scores; national means and standard deviations (Validating)

1. CGEO uses statistical methods to align school standards to national standards
2. The statistical methods are primarily based on established patterns of achievement within schools, taking account of any changes in school-cohort characteristics
3. School's predictions, followed by CGEO/NSG standardisation, yield CGEO's calculated results

The model uses conditioning information to estimate and correct for the systematic under and over representation in the teacher-sourced information.

The validating information will be used to evaluate the credibility of the estimated results   Credible results will produce macro-level distributions of performance that are within the ranges typically observed in previous years.

APPENDIX C *[to the decision-making framework]*: Communications Inventory

The main **Guides for students, schools, and parents** were developed in consultation with unions and management bodies through the National Advisory Group for Contingency Planning. The range of guidance documents comprised:
1. A Guide to Calculated grades for Leaving Certificate Students 2020 (20 May)
2. Guide for Schools on Providing Estimated Percentage Marks and Class Rank Orderings (21 May)
3. Calculated Grades – A Guide for parents and guardians (26 May)
4. Calculated Grades – A Guide for Leaving Certificate Students (26 May)
5. Supplement to Guide for Schools (28 May)
6. Further Information in relation to the Calculated grades process (w/b 1 June)
7. Calculated Grades Data Collection Guide for Data Entry Users and Approvers (8 June)
8. Guide on application for out of school learners (to issue week beginning 22 June)
9. Your Questions Answered – This is the Questions and Answers Section of gov.ie/leavingcertificate. It has been an evolving information resource.

All documents available on gov.ie/leavingcertificate.

Other
Calculated Grades Student Portal – (Phase 1 Opening) 26 – 29 May - Registration and Confirmation of Levels – Before You Start Guide.

Departmental press releases were published throughout the process:
1. Minister announces postponement of 2020 Leaving Certificate examinations (8 May)
2. Minister for Education and Skills Joe McHugh TD announces publication of guidance for schools on Calculated Grades (21 May)
3. Statement from the Department of Education and Skills on clarifications provided to the ASTI and TUI regarding indemnity for teachers (22 May)
4. Minister McHugh announces online registration for Leaving Certificate Calculated Grades opens on Tuesday 26 May (25 May)
5. 58,821 Students register so far on Leaving Certificate Student Calculated Grades Portal (28 May)
6. Leaving Certificate Student Calculated Grades Portal Deadline extended as 59,859 register (28 May)
7. 60,035 Students register on Leaving Certificate Student Calculated Grades Portal (29 May)
8. Minister McHugh announces opening of Calculated Grades Data Collection App for Schools (8 June)

Radio/advertising campaign: This accompanied the opening of the Calculated Grades Student Portal in the week beginning 25th May. It involved radio and newspaper ads and social media campaign on Twitter and Snapchat.

Circulars on Calculated Grades include:
1. Circular 0037/2020 on Implementation of Calculated Grades Model was published on 21 May, along with the Guide for Schools.
2. Circular 0039/2020 on assistance for schools during the Calculated Grades Model was disseminated on 5 June.

Instructional videos were uploaded to the Department's YouTube, including a Guide for Schools and Supplementary Advice.

Appendix C. Memorandum of 24 August setting out changes to the terms of reference of oversight groups for calculated grades

MEMORANDUM

To: Independent Steering Committee for Calculated Grades

External Reviewer for Calculated Grades

National Standardisation Group for Calculated Grades

Programme Board for Calculated Grades

From Dalton Tattan, Assistant Secretary General

Date: 24 August 2020

The Programme Board, the National Standardisation Group, the Independent Steering Committee and the External Reviewer will be aware of the iterative developmental work that the Calculated Grades Executive Office and its contractors, Polymetrika and ERC, have been carrying out to implement a standardisation process for calculated grades. The Minister for Education has been briefed regularly on the progress of this work and is deeply appreciative of the work of the Office and the groups above for the work that has been completed to date.

From the outset it was accepted that different sources of data would have to be used in a flexible way to process students' estimated marks through the standardisation process. Government, students, teachers, schools and others were informed that it was intended that the following sets of data could be used in the standardisation process to ensure equitable treatment of candidates in each subject and at each level (Higher Level, Ordinary Level and Foundation level):

1. the estimated marks and ranking of students supplied by schools to the Calculated Grades Executive Office.
2. Junior Cycle examinations performance of the class of 2020 in each school based on their collective performance
3. The historical school distribution – based on historical Leaving Certificate examination performance at the school level across three prior years and related Junior Certificate/Cycle examinations performance for each of these years.
4. the historical national distribution of student results on a subject by subject basis– based on historical Leaving Certificate examination performance.

The Minister is aware that these data sets, for many subjects and levels, have been processed several times through mathematical algorithms which seek to achieve the outcomes that would statistically be the most likely outcome of Leaving Certificate results if the students had undertaken the traditional examinations. She is also aware of the mechanisms that have been included in the processing to fulfil the published requirement to identify and treat fairly outlier candidates and small classes. As planned, following each run of the data, the mathematical algorithms have been adjusted so that they strive to move closer at each iteration towards working consistently and fairly across all subjects and all levels, and that the extent to which this might be achievable is dependent on the availability of data within each subject and level.

The Minister is conscious, however, that the use of school-by-school historic data on the performance of students in past cohorts in each subject (category 3 above) has been criticised in the public discourse about calculated grades and has led in the UK context to accusations that students attending disadvantaged schools were at risk of being unfairly treated or subjected to "a post-code lottery". The Minister is aware of the loss of public confidence in the moderation process and in the results issued by the authorities that occurred in the UK as a result.

In view of these expressed concerns, the Calculated Grades Executive Office was asked to process data for standardisation without the use of school-by-school historical data on the performance of students in past cohorts in each subject (category 3 above) and this was carried out on a considerable portion of the data. Having considered the high-level outcomes of removing the historical school data it has been determined that, in light of the concerns expressed above, on balance, the standardisation process should operate without the use of this category of data. The Minister has approved this approach.

The Minister is also conscious that there has been criticism in the public discourse of the application of the more general principle that the judgments of schools be adjusted so as to rigidly maintain year-to-year comparability in the 'national standards' of the examinations. Accordingly, while the need to align standards *across schools* to the greatest degree that is feasible and defensible remains, the Minister considers that the need to also align those standards to the examining standards that have applied in preceding years and will apply in subsequent years should be accorded a greatly diminished importance. This will necessarily affect the degree to which the historic national standards (category 4 above) are relied upon within the standardisation process.

This note is to inform the Programme Board, the National Standardisation Group, the Independent Steering Committee and the External Reviewer of these changes in approach and to ask them to complete their work in line with these decisions. The Minister is making arrangements to inform her Government colleagues of these decisions in advance of results day.

Appendix D. Evolution of the standardisation model

Note: much of this document was written in advance of the decision to remove historical school data from consideration and to accord the historical national distributions a greatly diminished importance.

Description of Progress in Modeling LC2020 Data to Calculate Student Scores

Background

There are several practical constraints on the modeling procedures, implied by public commitments and validation processes and implicit in the nature of the data. These constraints are:

1. The first four central moments (mean, standard deviation, skewness, kurtosis) of the calculated results for all subjects must approximate the historical central moments
2. The mean (and, specifically, proportions of students in higher grades) of calculated grades must not be lower than historical norms.
3. The calculated marks are bounded by 0 and 100.
4. The procedure must incorporate all available data: historical school data, student prior attainment, teacher estimated scores, teacher-assigned rankings (recalculated from estimated scores).
5. School averages must be consistent with historical school averages.
6. Within-school variation must be consistent with historical within-school variation.
7. Student performance should not be constrained by historical school performance if data from teachers suggest a student may be exceptional.
8. Rank order of calculated scores within schools must agree with rank order of teacher estimates.
9. Individual student scores cannot be constrained by predictions of performance based on personal academic history (i.e., JC results)

Although some of these constraints are contradictory, such as simultaneously maintaining the consistency with historical school distributions (5 and 6) and allowing students to deviate from historical schools distributions if indicated by the teacher estimates (7), they collectively represent aspirational objectives that the modeling process should make all reasonable attempts to satisfy. On review, the NSG may relax the constraints implied by specific commitments.

Description of Data

There are five distinct sources of data:

1. historical performance data describing the same leaving exams (LC, LCA) to be calculated in 2020 but measured in prior years,
2. teacher estimates of student performance on 2020 leaving exams,
3. prior attainment data describing performance on Junior Cycle exams in previous years,
4. personal characteristics of individual students, and
5. characteristics of schools.

All source data are at the student level. The leaving exam data are associated with schools. Leaving exam data from previous years is not associated with leaving exam data from 2020. Leaving exam data in all years are associated with Junior Cycle data in previous years at the student level.

These structures allow modeling of:

- school level performance (i.e., school distributions of student performance) on comparable measures across years,
- national level performance on comparable measures across years,
- relationships at the student level between comparable measures of Junior Cycle and leaving examinations across years,
- relationships at the student level between examination performance and student characteristics, and
- relationships at the school level between school level performance and school characteristics.

Description of the Modeling Process

The goal of the modeling process is to use the available data to determine what the distribution of performance in a school would be if the students had sat for actual examinations. Applying the teacher-assigned, school-level rank orders of students to each of these distributions will produce usable student scores.

For each school, the data allow the production of the following distributions that approximate, to varying degrees, this target distribution:

1. The historical national distribution – based on historical leaving exam performance, the national distribution describes, in the absence of more detailed information about a school, the broadest possible distribution of student performance. This distribution has some properties with respect to individual schools. If a school were composed of students randomly drawn from the population, its distribution would be proportionally equivalent to the national distributions. For all other schools, if the variance of the school distribution will be smaller than that of the national distribution. Therefore, this distribution is useful in the degree to which the school is randomly equivalent to the population.
2. The historical school distribution – based on historical leaving exam performance at the school level across three prior years, the school distribution describes how students in the school would perform if they were randomly equivalent to the historical population of students who previously attended the school. An important distinction is that this distribution does not represent a previous year or the expectation of how performance is distribution in any single year. The distribution describes the range of performance across all available years of data. This distribution is useful in the degree to which the current students are like previous students in each school. Examination of school performance across multiple years suggest school distributions tend to be relatively stable.
3. The residual distribution of leaving performance regressed on prior attainment – this distribution is based on prior examination performance of the current students in a school and the predictive relationship between prior attainment and leaving exam performance evident in previous years' leaving examinations. It is calculated by constructing a residual distribution for each student in a school, using a parametric distribution with a mean equal to the regression-based prediction and a variance equal to the residual variance of the regression model, and summing these distributions across all students in a school. In the absence of any predictive value of prior attainment, this distribution will approximate the national distribution. Independent of the predictive value of prior attainment, as the sample of students approaches a random sample of students from the national population, this distribution will approximate the national distribution. This distribution assumes a linear

relationship between prior attainment and leaving exam results, which is supported by observed data. This distribution is useful in the degree to which the predictive power of relationships and the distinctiveness of the students in a school.

4. The distribution of teacher estimates for 2020 leaving exam scores – this distribution is based on the teachers' estimates of the numeric scores for each student. Teacher estimates are assumed to be accurate and are the basis of all procedures and models. If teachers' estimates are unbiased, this distribution will be identical to the target distribution, up to the random measurement error in both examinations and teacher judgment. If the teachers' estimates are biased in average performance and/or variability between students, the distribution will be approximate the target up to a linear transformation. If teachers' estimates have a monotonic relationship with actual performance, the distribution will approximate the target distribution with a nonlinear transformation. However, estimating a nonlinear transformation of these data at the school level requires stable estimates of both the expected distribution and the teacher estimates, which becomes tautological, since if the expected distribution were known, the estimation would not be necessary. Therefore, this distribution is useful in the degree to which the bias is nonexistent, the bias in estimates is linear, or the bias is consistent across all schools.

Combining the information from these distributions requires assumptions about the relationship between the information they provide. Broadly, combining them at all requires the assumption that they are influenced by different sources of error. If they all were subject to the same influences, we should only use the source with the smallest error; however, if they have different sources of error, there is a greater chance that the combination will allow the errors to cancel out, producing a more accurate estimate.

If the relationship between two data sources is redundant, in the sense that they ought to be measuring the same information but are subject to different random errors, the information should be combined using a compensatory mechanism. The arithmetic mean, for example, allows overestimations in one source to balance against underestimations in another. The arithmetic mean can also be weighted when the variability (random inaccuracy) of each source is estimated to produce a composite with a minimum level of variability.

If the two data sources are complementary, in the sense that, despite describing the same construct, their variance is sensitive to different underlying factors, their information should be combined using a similarly non-compensatory mechanism. The geometric mean, for example, allows one information source to constrain another such that the resulting combination represents what can be agreed upon using both sources. The geometric mean may also be weighted so that the degree of constraint each source imposes is commensurate with its stability.

In general, unbiased information can be treated as redundant and biased information can be treated as complementary. Unfortunately, in the absence of the target distributions, it is not possible to know in advance which of the source distributions for the 2020 modeling are biased and which are unbiased. Given the multiple data sources, a key indicator used in this process is the degree to which each distribution matches the consensus of the remaining distributions. While generally useful, this approach breaks down when there is no clear consensus between the different sources, and a treatment with specific assumptions must be evaluated by examining the credibility (i.e., lack of artefactual bias) of the results it ultimately produces.

The modeling procedure follows an iterative exploratory-confirmatory cycle of first estimating results of several approaches that make a variety of assumptions and evaluating the degree to which the results are biased with respect to the consensus of all approaches and the expected results. Where an algorithm for estimating a distribution component may be tuned, this tuning is performed iteratively to reduce bias in the component prior to combining it with other distributions.

Where components are aggregated with weights, different weighting strategies optimize against different criteria. A common practice, weighting by degrees of freedom (or sample size), assigns greater influence to information that is less likely to be overfitted. With the current data, which is likely influenced by clustering but where the effective degrees of freedom are unknown, an analogous approach is to weight each distribution by the inverse of its estimated variance. This procedure is reasonable if the variance estimates themselves are reasonably accurate. However, it is worth recognizing that the variance estimates are typically an order of magnitude less stable than the estimates themselves, so there is some inherent imprecision in this approach. While more accurate (in the sense of reduced total variance) than unweighted estimates, it is still worth comparing results from weighted calculations to those from unweighted (equally weighted) calculations to determine if biases in weight estimates produce biases in results. Specific approaches are evaluated against the consensus of alternatives and the plausibility of the end results.

One of the potential issues with inverse-variance weighting is the possibility of overweighting generic information, assigning too much influence to stable-but-irrelevant information over unstable-but-specific information. For example, the national distribution tends to be very stable, but allowing it to influence schools more than school-specific data will introduce unacceptable bias in calculated school distributions. As an alternative to strict inverse-variance weighting, weighting by negative log-variance provides a compromise to describe the relative stability of different sources without introducing too much bias. As with all modeling procedures, the weighting strategies for each summation and aggregations are evaluated against alternatives and plausibility of results.

Due to practical time constraints, most of these investigative directions are pursued simultaneously, alongside other developments in computational efficiency and data integrity in micro-iterations, with periodic consolidations to produce landmark models. The landmark models may not represent plausible solutions, but they capture stable points in the modeling evolution. Each stage in modeling typically progresses by using comparison of relative change and relative difference to determine the magnitude of error in the results of a model, introduce arbitrary constants to determine the size of adjustments to weights that would provide the proper correction, and then identifying the aggregation procedure and weighting method that match the required values.

The main guiding philosophy rationalizing the modeling process is that the derivation of calculated results should be guided by statistical criteria: minimizing random error and encouraging biases to cancel. Although the desired characteristics of the results in terms of distribution, comparative group performance, and variance decomposition are known based on historical patterns, explicitly targeting these characteristics should be minimized in general and avoided in early modeling steps because they tend to remove natural patterns in the data.

The evaluation of landmark models by the NSG is typically informed by a larger set of considerations, including credibility of results and overall acceptability in terms of the balance between statistical and practical factors.

Description of Models

The following are some descriptions of the characteristics of key landmark models. Models are referred to by the version name in the LC2020 Platform. Although sequential models generally reflect a linear progression, the parallel nature of the investigations necessitated some out-of-sequence results. Where sets of models were used to explore specific conditions and test tuning values but do not represent any landmark progress, the sets are summarized by the conditions that were explored. Some versions are not referred to explicitly because they dealt primarily with operational issues related computational testing and data validation.

Version4, Version5 – To remediate the non-linear bias in teacher estimates, which tend to overestimate scores more for higher-performing students than lower performing students, these models explored the use and weighting of regression and historical distributions to mitigate the teacher bias. The results suggest the models overemphasised the national distribution for all schools; while generally recovering the national variability, the results underestimate between-school variability.

Version7 – To remediate the lack of between school covariance, this model modified with variability-based weight assigned to the regression component for each school with the global predictive power of the regression model (1 - R-squared) to reduce the impact of the regression relative to historical data. The results improved the variance decomposition of results, but not the covariance between school results across years. Results suggest that a compensatory approach to the historical, regression and teacher estimates may be adequate in removing the teacher bias and recovering the target national distribution. Between-school covariation across years does not reflect historical expectations.

Version8, Version9, Version10, Version11a-b – To improve the specificity of the model to smaller schools, this model increased sensitivity to distribution component variance by experimenting with -log variance weighting and evaluating the aggregation of the regression-based distribution and teacher estimated distribution in the absence of the historical school distribution. The purpose of this series of models was to develop an understanding of the behaviour of the regression distribution and how it interacts with the teacher estimates. These two distributions are based on the current students in a school but with different bias and student-specificity. The results of this series suggest that using symmetric posteriors for students for building the regression distributions produces more useful results than using asymmetric posteriors derived from the beta-distribution using the predicted mean and residual variation for each student.

Version 12, Version12b, Version13, Version13a, Version13b, Version13c, Version13d – This set of models explored the role and estimation of the historical school distributions. The algorithm for mixture modeling of school distributions was modified to allow estimation of distributions for smaller schools. The models considered various thresholds of school sizes for allowing estimation of mixture distributions and the separate interactions between the historical distribution and the other three distributions with different weighting strategies. The results collectively indicate that the historical distribution should be considered as complementary to the teacher distribution and that the strategy for combining the historical distribution with the national distribution should use weights that allow the weight of the national distribution to approach 0 as the stability of a school's historical distribution approaches the stability of the national distribution.

Version14 – This model explored modifications to computational algorithms to improve runtime and validate data handling. It was not used as the basis of any subsequent models.

Version15 - This model is derived from 13d. Its main feature is the consistent use of negative log variance weighting for model components. Regression and teacher estimate components are treated as parallel direct estimates (combined using a weighted average), and the national and school historical distributions are treated as a conditioning distribution. The mixing weight of the school historical weight in deriving the conditioning distribution is the ratio of the naive school weight to the naive national weight, and the final national weight is 1 minus the final school weight.

Version13e, Version13f, Version13g, Version13h –Explored permutations of differential aggregation patterns strategies for components, consistently using negative log variance weighting for all components for all aggregation methods.

Version16 - Derived from version 15, this version references a different data query that consolidated Junior Cycle data into a reduced number of indicators. This version produces slightly higher predictive strength of JC results for most subjects. This model represents the limit of what is possible with the statistical model under the limitation that no explicit nonlinear modifications or adjustments are made to distributions beyond weighted aggregation strategies. This model recovers the national distribution and historical school level correlation, but the proportion of between school variation is less than historical patterns. This reduced variance is a consequence of modeling the school distributions to incorporate the uncertainty inherent in the combined historical, regression, and teacher estimated distributions. While maintaining the total variance approximately constant, greater within-school variance will always reduce the between school variance, and vice versa. Examination of the results suggests the articulation of a new corollary constraint: unless there is compelling evidence from the regression and teacher data, it is impossible to defend results that assign a lower-than-historical-average to typically high performing schools. Given that the regression distributions tend to be the broadest of the 3 sub-national distributions and that teacher estimates generally overestimate historical performance, this constraint requires that the school means of the calculated grades must be greater than or equal to the historical means. To maintain the historical national distribution, this constraint also implies that historically lower performing schools must also have a mean that is consistent with historical norms, which, to maintain consistent total variance, implies that within-school variance must, on average, be consistent with historical norms for each school.

Version13i, Version13j, Version 13k – Recognising that unavoidable reductions in variance are associated with the use of non-compensatory aggregation applied to the teacher distributions, these models explore alternate handling of the teacher estimates. The revised models use compensatory aggregation to combine the regression and national distribution and use non-compensatory aggregation to combine the result with the historical school distribution; teacher estimates are not explicitly included in the models aside from informing student rank ordering. These models introduce the use of explicit school-level standardization to anchor each school's post-conditioning distribution to historical school level norms.

Version 13l –Modification of minimum component variance constraints on the mixture model estimation for this version allows the estimation to correctly produce historical distributions for schools with abnormally low within-school variance (e.g., students in Irish schools on Irish exams).

Version13m – To respect the commitment that teacher estimates for individual students should allow teachers to assign scores to individual students that would allow exceptional students to receive scores that are not bound by historical school norms, the within-school estimation in this model explicitly adjusts the gaps in calculated scores between adjacently-ranked students in each school to be greater than or equal to the gap in the original teacher estimates, adjusted for the difference in variation between the teacher estimates and conditioned school distribution. These adjustments are expected to produce within-school skewnesses and kurtoses that are more consistent with teacher judgment than historical distributions. Post-adjustment, school means, and variances are anchored to historical distributions (and, when unavailable for a school due to small sample sizes, the conditioning distribution based on regression and national distributions). The resulting moments of school distributions conform to expectations, but the total variation is less than the historic national distribution. The assigned score is the maximum of the conditioned estimate and the gap-adjusted estimate, which introduces some breaking of the rank order of students at the bottoms of the school distributions. Calculated student scores also reflect the score clustering bias in original teacher estimates.

Version13n - Explicit national level standardization of the scores in this model uses non-linear equipercentile mapping to ensure that the total distribution conforms to historical national norms while respecting the global rank-ordering of students defined by the estimation process that is informed by the historical school distributions, regression distributions and teacher estimates.

Version17 – Applies the version13n model to all subjects, which also includes the features of verson13m. The modification to the mixture model estimation algorithm from version 13l results in some Heywood cases that prevent estimation for some schools in a small number of subjects.

Version18a-f – Responding to a trend in public discourse around the role that teacher estimates play in the estimation of calculated marks, this family of models explores the consequences of explicitly allowing the teacher estimates to provide the basis of estimation, following the assumption that, in the absence of other evidence, the uncorrected teacher estimates should be assigned to students. All other distributions are considered complementary to the distribution of teacher estimates.

Version18g-h – Using the same underlying model as Versions18a-f, these models exclude both distributional mapping at the school level to historical school distributions and at the national level. As a result, the score distributions differ substantially from historical norms and school and national levels, but the differences between teacher estimates and calculated marks are greatly reduced compared to previous models. Version18g is tentatively accepted as a possible solution, pending NSG approval of treatments for small schools, out-of-school students, and new subjects. Estimates in small schools tend to have estimates that are shrunken towards the national distribution compared to those in large schools. Despite the absence of historical information, the use of only the regression distributions does provide an appropriately nonlinear correction to the teacher estimates.

Version20a-b – Based on the Version18 family of models, these models implement treatments of small schools, out-of-school students and new subjects that are approved by the NSG. These treatments impose additional constraints on the regression distributions so that their influence becomes negligible as school size approaches 1 but are still applied to out-of-school students whose teachers did not participate in an in-school alignment process. To prevent the shrinkage of estimates towards the national distribution when the regression model has poor predictive power, the regression distribution devolves to a uniform distribution (rather than normal distribution) as the R-squared statistic of the regression model approaches 0. The estimation procedure is applied to Non-curricular languages and Leaving Certificate Applied subjects. Complete sets of predictor variables are used for all subjects, which include Junior Cycle results, program length and repeat status for all subjects and module completion status for LCA subjects. The calculated marks are more similar to the uncorrected teacher estimates than can be justified given the observed macro level bias in teacher estimates, which suggests that the estimation model may be underutilising the available information about student prior attainment.

Version20c-d – Review of the historical Junior Cycle and Leaving Certificate exams suggests that the multiple correlation coefficient (R-squared) used to limit the maximum contribution of the regression models may underestimate the true correlation due to the attenuating effect of measurement error on observed correlations because the input data are considered free from error. Referring to published values of measurement error for comparable examinations, conservative estimates of measurement error are applied to the estimation model to correct for the attenuation of observed correlation. The outcome is that the information from prior student attainment has a greater moderating effect on the teacher estimates than previous versions. Version20d, using an estimated average test reliability of 0.9 to correct for attenuation, has an acceptable level of correction while minimizing divergence from teacher estimates.

Appendix E. Junior Certificate/Cycle composite input measure

To: National Standardisation Group,

From: Calculated Grades Executive Office

Purpose: Matter for Noting

Status:. CONFIDENTIAL. FINAL. This version noted by NSG 27/08/2020.

(This version contains a minor amendment to reflect that the JC Composite will be mathematics, Irish, English and student's two other best subjects.)

Issue to be addressed

The initial versions of the standardisation model are running into some difficulty in building the regression model used to create likelihood functions for Leaving Certificate performance in a particular subject at a particular level based on a vector of student characteristics that mostly consists of marks from individual subjects at a particular level in Junior Certificate. The large number of available subject and level combinations at JC level, and the fact that each student does comparatively few of them, results in a sparsely populated vectors and a correspondingly sparsely populated student × predictor matrix. Furthermore, the clustering of subjects and subject-level combinations at school level exacerbate the 'missing data' problem associated with this sparseness. The degree and nature of the sparseness makes the assumptions underlying the normal methods for dealing with such missing data questionable.

One solution would be to collapse all of the Junior Certificate attainment information for a student down to a single composite score, but another credible and potentially valuable approach to dealing with this is to collapse the large number of predictor variables down to a few (but not one). The best solution is likely to arise through removing as much of the sparseness as possible, while retaining the predictive power that arises from using multiple indicators rather than one.

In order to combine predictor variables associated with examinations at different levels, a scaling procedure is required in order to reflect the distinct levels of achievement represented by examinations at different levels within each subject. (Indeed, such a scaling is required in any case in order to sensibly apply certain other approaches to dealing with missing data in a regression matrix.)

Level scaling and composite measures

We need to take account of the fact that the marks for subjects need to be weighted in some way, to account for the fact that they are derived from examinations taken at different levels (Higher, Ordinary, Foundation or Common). Accordingly, any form of aggregation – whether it collapses outcomes across all subjects to a single composite score or just reduces the number of indicators – needs to incorporate a composite scale in the first instance to allow aggregation across levels. To be well behaved from a measurement perspective and to serve the intended purpose, the CGEO considers that the composite measure (or collection of measures) should have the following properties:

- capture maximal information about subjects and the subject combinations selected by candidates by being based on as full a range of subjects taken by each candidate (at all levels) as feasible
- entail a suitable means of mapping outcomes at all levels (Higher, Ordinary, and Foundation) to a common scale to facilitate appropriate aggregation across different level combinations
- capture maximal information about the estimation outcomes by being based on calculated marks rather than calculated grades
- offset the need to maintain a reasonable number of data fields with the need to minimise the amount of missing data in those fields
- show stability in its compensatory behaviour.

To meet these objectives, it is proposed to map marks at the various levels to a common scale in a manner that reflects the alignment across levels in the Junior Certificate Overall Performance Scale (OPS), developed and used by the Educational Research Centre (ERC) (Kellaghan & Millar, 2003; Martin & Hickey, 1993; Sofroniou, Cosgrove & Shiel, 2002; Weir & Kavanagh, 2018). These alignments imply a mark equivalence at the corresponding grade threshold scores, and also imply that the alignment in these areas of overlap is a constant offset. This alignment is realised by applying a constant offset of 45 marks between Higher-level and Ordinary-level marks, and a further offset of 45 marks between Ordinary-level and Foundation-level marks.

A question remains as to whether it is appropriate to continue this offset to the bottom of the scale in each case. It would be unreasonable to interpret, for example, a score of 0 marks at Higher level (or even a score marginally above 0) to be equivalent to a score of 45 marks (or indeed any substantive mark) at Ordinary level. The most obvious choices, then, are to continue the offset equivalence only down to some lower limit beyond which the case is omitted from consideration, or to map the lower end of the scale (the range represented by grade NG and potentially also that represented by grade F) in a linear or other manner so as to make the scores of 0 on all scales coincide. The latter approach retains information about all outcomes for all candidates, but cannot be achieved without distorting interval aspects of at least two of the three scales. If the Foundation level scale were to be left intact, the degree of stretching required to map, in particular, scores of below 25 at Higher level to the range 0 to 115 would cause very low scores at this level to have an extreme effect on the mean and variance of the scaled scores. Likewise, leaving the interval nature of the Higher level score intact would make it difficult to avoid overly compressing the Ordinary and, in particular, the Foundation-level scale. Accordingly, it is proposed to leave the intervals on the Ordinary level scale intact, and map the other two scales to correspond to it. It is recognised that this entails compressing a substantial portion of the Foundation-level scale, but this is reasonable in the current context and given the difficulties that any alternative would entail. The impact of any compression is minimal on students, as its effect is only that very low performance on a Foundation-level paper will not 'drag down' their composite attainment score quite as much as it would if the scale were not compressed in this way. The result is that, even if one were to consider that interval aspects of these scales in these regions carries meaning that is comparable across scale regions and scales, which is questionable, there is at worst a marginal overestimation of the attainment of very low-scoring students relative to others.

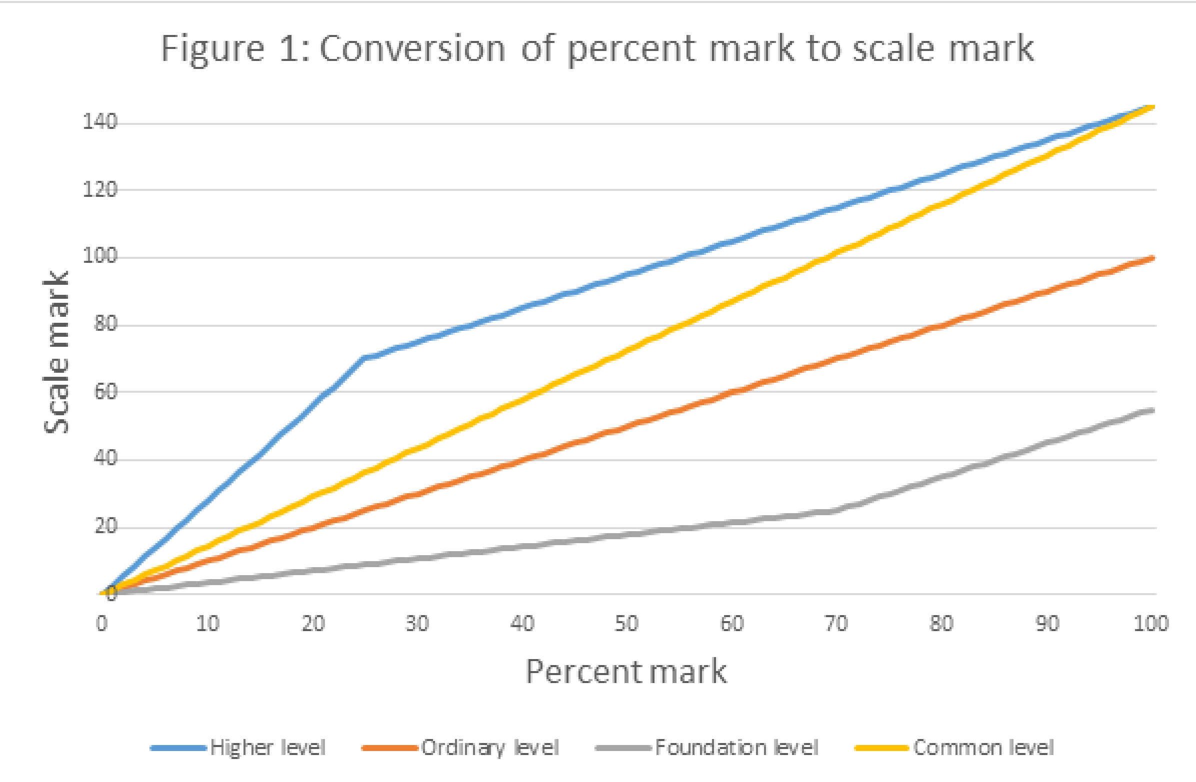
As regards where exactly towards the lower end of the scales the stretching or compression should begin, it is suggested that, notwithstanding the JOPS alignment of Higher-level F with Ordinary-level C, the threshold value of 10% is very low and therefore likely to lie beyond the range where accurate measurement of achievement is occurring. Furthermore, there is a gap immediately below this on the Higher-level scale, in that the category below it (NG) is considered lower than several further grades on the Ordinary-level scale. This could be construed as implying no more than that the threshold between F and NG lies somewhere in the DEF range on the Ordinary scale. That is, and taking account of how low the F threshold is, we may consider that the alignment of the Higher level E/F boundary with the B/C boundary at Ordinary level is the last fully intact one, having an aligned grade both above and below it. On this basis, the E/F boundary seems the most reasonable point to begin the stretching of the Higher-level scale. Accordingly, the following is proposed:

- If Ordinary level, then scaled score = calculated score
- If Higher level, and calculated score is at least 25, then scaled score = calculated score + 45
- If Higher level, and calculated score is less than 25, then scaled score = calculated score × 14/5
- If Foundation level, and calculated score is at least 70, then scaled score = calculated score – 45
- If Foundation level, and calculated score is less than 70, then scaled score = calculated score × 5/14.

The above adjustments to put performance at different levels of the same subject on the same scale can be extended to the new grades in the Junior Cycle English examinations from 2017 onwards, since the model is dealing with percentage marks rather than grades. However, the introduction of Common level Junior Cycle examinations in Business Studies and Science in 2019 that is intended to encompass the full range of achievement previously covered by the two separate scales requires the inclusion of a conversion which covers the entire range of the older Higher and Ordinary levels (ranging from 0-145 above). This gives:

- If Junior Cycle Common level, then scale score = calculated score x 145/100.

Figure 1 shows how marks from each level map to the common scale



Once performance at different levels of the same subject are mapped to the same scale there are a number of options for how they can be used in the model. The could be averaged in a composite score, aggregated (as in the ERC OPS, where a candidate's best seven results were summed), or a mixed approach adopted where results in the Core subjects (Irish, English and mathematics[3]) are used separately, on the common scale, along with the two best other subjects (again measured on the common scale). The latter approach is considered likely to be most effective. It is proposed not to include CSPE in any such 'best of' calculation, as it is a common-level paper that does not carry the same design intent or mark spread as that of the new Junior Cycle common level and is likely to have substantially less discriminatory power in any such selection-based aggregate measure, (being less likely to be as representative of the overall level of achievement than selections that exclude it).

The purpose of creating a common scale and subsequent composite measure is to improve the predictive power of prior performance. As noted in the opening paragraph, since comparatively few candidates sit a particular subject at a particular level, and sit 10 or 11 of the 50-plus subject/level options available, much of the data matrix is empty or sparsely populated. A composite approach will solve this problem, improve the accuracy of the model and hence the accuracy of the calculated marks and, ultimately, calculated grades.

Additionally, and subject to checking that it has sufficient statistical value in the model, the incorporation of a 'best of' aspect to the composite collection of measures is justifiable in the context of predicting LC performance on the grounds that, when moving on to Leaving Certificate studies, students proceed with fewer subjects than at Junior Cycle level and will show a propensity to continue with the areas of study that most interest them and in which they tend to perform better.

In summary, allowing separate levels within a subject to be fed into the model on a common scale reduces missing elements in the data matrix and is superior to replacing the missing elements with the mean of the non-missing data (either at a candidate or subject level). However, this still does not adequately reduce the degree of missingness that arises if all subjects continue to be fed separately into the model. To address this, prior performance could be combined into a single composite score. However, the advice of the psychometricians is that the greatest gain would be achieved by using a subset of the JC subjects in the model. These would be Irish, English and mathematics (taken by the very great majority of candidates) and the best two of each candidate's other subjects. The advice is that a single composite will be less valuable than a relatively small number of predictors, such as the set suggested. Taking more subjects would only add very slightly to the predictive power of candidates' prior performance and would begin to reintroduce the problem of missing data as more (less often taken) subjects were added.

Kellaghan, T. & Millar, D. (2003). *Grading in the Leaving Certificate Examination: A Discussion Paper*. Dublin: Educational Research Centre.

Martin, M.O., & Hickey, B.L. (1993). *The 1992 Junior Certificate Examination: a Review of Results.* Dublin: National Council for Curriculum and Assessment.

Sofroniou, N., Cosgrove, J., & Shiel, G. (2002). Using PISA variables to explain performance on Junior Certificate examinations in mathematics and science. *Irish Journal of Education*, 33, 99-124.

Weir, S., & Kavanagh, L. (2018). *The evaluation of DEIS at post-primary level: Closing the achievement and attainment gaps*. Dublin: Educational Research Centre.

[3] In JC 2018, 99.3% of candidates sat at least one of the core subjects (86.9% Irish, 98.9% English, 99.0% mathematics).

Appendix F. Treatment of the Calculated Grades Mark Outputs – Grading

Adopted Meeting 3 16/07/2020

Treatment of the Calculated Grades Mark Outputs – Grading

To: National Standardisation Group, DES Programme Board

From: Calculated Grades Executive Office

Purpose: Matter for Noting

Background

Despite that grade bands are expressed as percentage ranges, such as 90% – 100% for grade 1, etc., the SEC does not, in a normal examination year, convert students' raw marks to percentage scores for the purpose of grading, but grades on the basis of the marks themselves. For example, in a subject for which the total of the available marks across all components of the examination is 600, then the threshold mark for the award of a grade 1 is 540 marks (i.e., 90% of 600). A student who scores 539 marks has not reached that threshold and is therefore awarded a grade 2. It is not considered relevant that if 539 were expressed as a percentage of 600 (which gives 89.833…%) and subsequently rounded to the nearest integer, it would round to 90%. The fact remains that, just as 539 falls short of the raw mark threshold of 540, so too does 89.833…% fall short of 90%. For this reason, grade bands below grade 1 are expressed in terms that makes this lack of rounding clear. That is, for example, grade 2 is not referred to as going up to 89%, but as going up to, but not including, 90%. Irrespective of the total number of marks available for the examination, marks are always awarded in whole number increments, so the final mark is always an integer.

Students see their marks when they view their scripts, and since last year on the student portal after the initial issue of the Leaving Certificate grades. The perceived lack of rounding is a common source of complaint by students but one which is absolutely defensible in circumstances in which marks form the basis of the grades and not percentages.

The SEC does present its grading system in the form of percentages, including on provisional statements of results and on certificates. However, it is made clear that the he use of percentages on these documents is used to facilitate understanding of the Grading system. The documents provided to students about the examinations and the results make clear that that in the examination marking and resulting processes, grades are derived from marks not percentages and that rounding up to the next grade band does not arise.

Mark outputs in the 2020 calculated grades process

In submitting their estimates, teachers and schools were facilitated in using decimal percentage marks (with up to 1 decimal place) if they wished to do so. This was regarded as helpful in cases where they might otherwise have been inclined to award the same estimated mark to two or more students, and where they might have been reluctant to identify explicitly a rank order among students to whom they had awarded the same mark. The use of the decimal was, therefore, primarily made available to break ties and at no time was it considered that the estimates were being given to the level of precision implied by the use of the decimal place. Notwithstanding the facility to use decimals, the great majority of estimates submitted are integers, and only about a fifth of all estimates used decimals.

While the estimated marks inputted to the calculated grades process are integers or restricted to one decimal place, the outputs (calculated marks) from the standardisation process will be integers throughout the standardisation process and be imported back into the marks database for grading as integers. The calculated mark will be graded on the basis of a mark out of 100 as is the case for any subject marked out of 100 marks in a normal examination year.

No rounding of the calculated marks will take place, as they are created as integers in the first instance (i.e., as one of the 101 whole numbers from 0 to 100). It might be noted that consideration was given to arranging instead for the creation marks on a 1001-point scale which could have been represented as a number to one decimal place from 0.0 to 100.0. This would then have resulted in importing calculated "marks" to one decimal place into the marks database for grading, and in providing these calculated "marks" to one decimal place to students. However, this would have then raised the question as to how decimal marks – which are a concept that has never previously existed in the SEC's examining practices – would be treated for grading purposes when they fell close to a grade boundary. Accordingly, consideration was also given to how one would, in this hypothetical scenario, deal with marks that fell within 0.5 marks of a grade boundary, as these would be a likely source of significant pressure from students to round up, by adjusting the grading tables to take account of these unprecedented decimal marks (e.g. 89.5 would be graded as a grade 1). Given these difficulties and the lack of any particular value in the creation of unnecessary decimal values on the scale, the National Standardisation Group concluded that there was no good reason to arbitrarily create calculated marks on such a 1001-point scale rather than the intuitive and sufficient 101-point integer scale from 0 to 100.

The outputting of the calculated mark as an integer is important given the circumstances of the 2020 Leaving Cert examinations, in order to allow it to be considered to be a discrete 'mark' in the traditional sense rather than a different form of measure on a continuous scale. Students will be provided with an opportunity to sit the examinations at a later date and it is possible that their final results may include a combination of grades from the calculated grades system and the later examinations. Students will receive their results from both the calculated grades system and the later examinations as grades and will also be provided with access to the final mark awarded in each subject shortly after receiving their results. Treating the calculated mark as a discrete mark out of 100 marks, means that students will receive a mark for subjects resulted through the calculated grades system and a mark for the subjects for which they sit the later examination. This ensure comparability between the calculated grades system and the later examinations.

Furthermore, previous and future Leaving Certificate results have been and will be graded on the basis of marks. The consideration of the calculated mark as a mark out of 100 ensures that the calculated grades and the normal Leaving Certificate grades are comparable and of equal status in 2020 and in the future.

Appendix G. Technical details of the standardisation model

The standardisation model for Leaving Certificate 2020 is a statistical procedure rather than a purely statistical algorithm. This distinction is important, because it governs the type of evidence that is considered as well as how the evidence is used in the calculations. The weakness inherent in automated algorithms is their dependence on the notion of prediction, which seeks to detect the patterns between predictors and outcomes in a training data set and then replicate those patterns in a new data set that only contains a partial subset of variables or records.

Statistical prediction models are inherently biased. Since the utility of a prediction model is based on the degree to which the phenomena in the new data set replicate the phenomena in the training data set, if the two data sets differ in any way, the estimated outcomes produced by the prediction model will be biased towards the training data, with the bias increasing as the differences between the data sets increase. If the two data sets were identical in all respects except for the missing outcomes in the new data, the results would still be biased, because the application of the prediction model assumes that the relationships between predictors in outcomes in the cases described by the new data are the same as they are in the training data. This assumption is tenable in when comparing randomly equivalent samples but becomes decreasingly so as the samples represent qualitatively different populations.

Unfortunately, some bias is necessary to the usefulness of prediction models. Recognizing that there are unavoidable random differences between data sets, useful prediction models focus on predictions that avoid or smooth-over features of training data that are likely to be the result of random variability. For example, instead of assuming the proportion of students with a score of 45% will be exactly the same in all data sets, a useful model might estimate more stable statistics, such as the mean and standard deviation, which, when applied to an estimating function such as the normal distribution, can predict the expected proportions at each possible score across a large number of comparable data sets. Transferring the focus of estimation from describing a specific sample to describing expected behaviour over a large number of samples also shifts the nature of bias in the prediction of outcomes; whereas the former approach biases estimates to a variability of a specific sample, the latter approach biases estimates to the characteristics of the long-run average.

In their extremes, two approaches define a continuum between extreme sample bias, where the estimates over-represent the idiosyncrasies of a single sample, and estimation bias, where the estimates over-represent the assumptions underlying the mathematical models used for calculation. Statistical approaches to estimation usually favour bias towards the long run average implied by estimation. There is often no evidence available at the time of estimation to determine if the specific variability in the training data will be similar to the variability of the new data, and it is more reasonable to assume that the long run averages of both data sets will be more similar to each other than the specific instance of the training distribution will be to the specific instance of the application data.

In general, if the estimation is biased towards the long run average, the estimates are only useful if they are accompanied by a measure of variation (e.g., standard error) that describes how generalizable they are likely to be for a single data set. These estimates of variation are essential to the correct interpretation. Naïve use of the estimates without consideration of variation may seem harmless but often lead to disastrous consequences in social or educational applications due to the compounding of historical disadvantage or misleading stereotypes. In the calculation of Leaving Certificate 2020 results, such an approach is unacceptable because the scores estimated for individuals would essentially be an aggregate of the performance of other students with similar characteristics and in similar a context and would ignore the skills, effort and achievement unique to each person.

To minimize the influence of sample and estimation bias, the Leaving Certificate 2020 procedure takes a different approach: rather than assume that the results are missing and using a prediction model to estimate them, the score estimates provided by students' teachers are treated as actual test scores. In principle, because the teacher estimates are direct estimates of student performance, they could replace test scores in the same manner that other direct measures, such as alternate test forms, are used interchangeably. However, it is evident from comparison of the distributional properties of the teacher estimates to previous Leaving Certificate examination results in *Figure 1* that the teacher estimates are not directly interchangeable in practice. The score distributions are so stable across the previous three years that the lines are indistinguishable, but the distribution of 2020 teacher estimates is distinct. Given the stability across the previous three years, it is extremely unlikely that the student population in 2020 is so dramatically higher performing than all previous years, coinciding with the absence of formal examinations. More likely, the difference is the result of measurement bias in the Leaving Certificate 2020 teacher estimates.

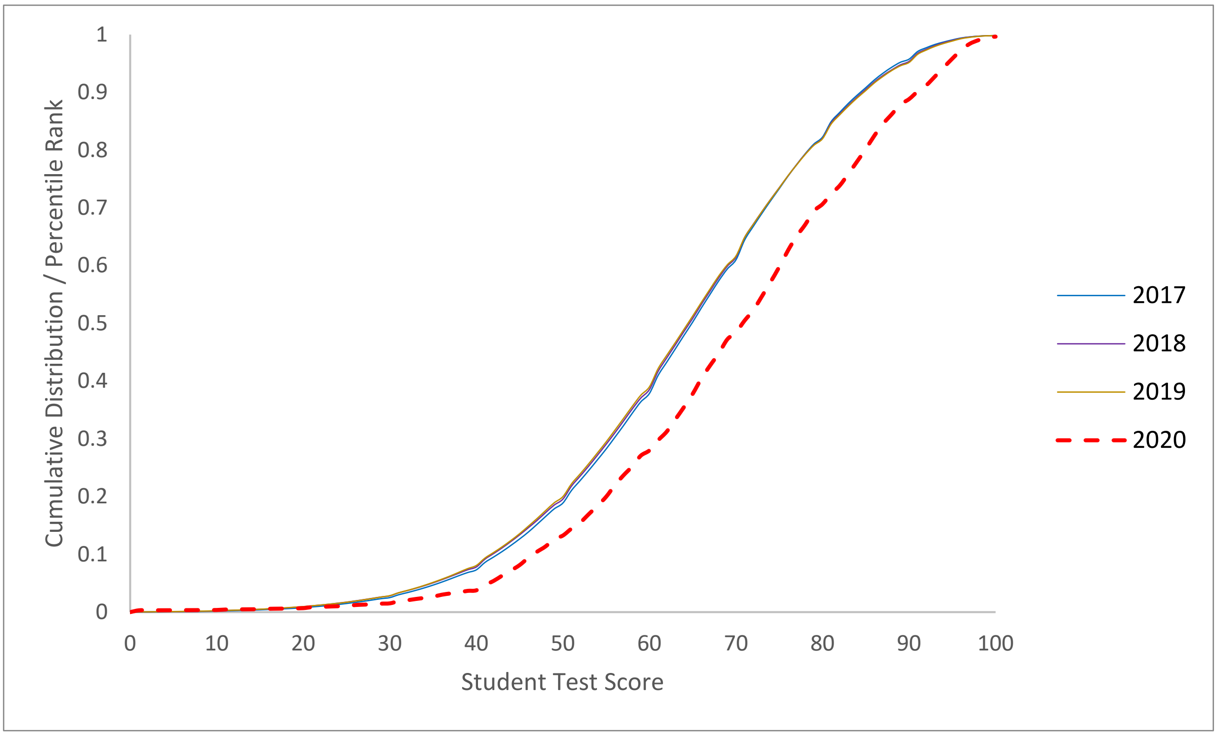


Figure 1 Aggregate bias in teacher estimates

Distinction should be made between measurement bias and other statistical bias. Sample and estimation bias, described in the preceding paragraphs, is a consequence of the lack of equivalence between different samples of data or between the assumptions of the statistical methods and a particular data set. In contrast, measurement bias is a consequence of measuring a construct that is slightly different than the expected construct, either because of a different operational definition is used during measurement or because a measurement technology introduces a systematic difference from what the measurement should be. A biased measurement may be used in place of a true measurement, but the bias must be corrected to prevent misinterpretation.

Correcting estimation bias is typically a straightforward procedure, and much simpler than most statistical algorithms. Assuming a monotonic relationship between the biased an unbiased estimates, where the rank order of estimates is consistent between the biased and unbiased estimates even if the intervals between adjacent scores are not, the bias correction simply requires adjusting the distribution of biased estimates so that it resembles the distribution of unbiased estimates. This type of adjustment is frequently performed in the context of equipercentile test equating, where two test forms are assumed to be measuring the same phenomenon, but the directly observed score distributions have different interval-level properties.

In the test equating context, in a population with a known distribution on a given test, each student will have a percentile rank, and if a new, equivalent test of the same construct is administered, each students' percentile rank based on the new test will, in theory, be the same. By extension, given the known distributions of either test, a single percentile rank can be used to estimate equivalent scores on both tests. In the example of *Figure 2*, the cumulative distribution functions of two test forms, A and B, for a given group clearly have different test score distributions, but the equivalence of percentile ranks implies that, for example, a score of 0.4 on Test A is equivalent to a score of 0.78 on Test B[1] because both scores have the same percentile rank on their respective test score distributions.

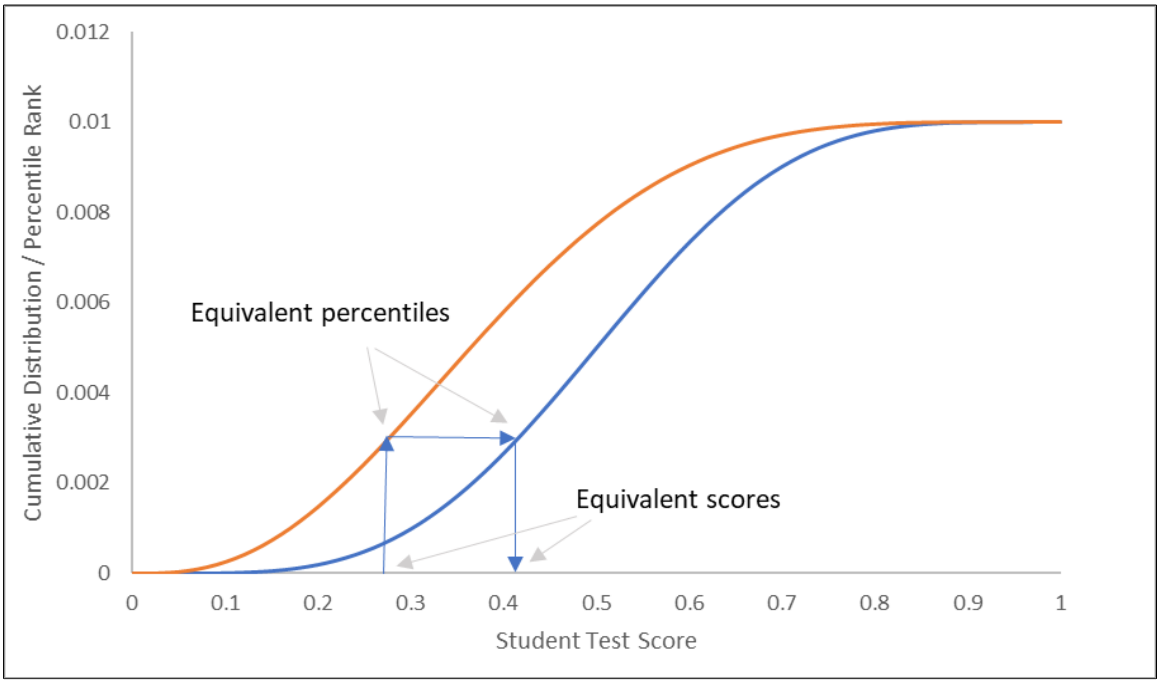


Figure 2 Equivalent-percentile test scores for a given group of students and a single test common construct

This principle provides a framework for calculating scores in the Leaving Certificate 2020 context that can adequately reproduce historical known distributions. Previous research provides evidence that teacher-assigned rank-ordering of students based on estimated test scores is reliable. Therefore, the

[1] The disparity between these distributions is for illustration; it is unlikely that two equivalent tests would have such different distributions.

logic of calculating Leaving Certificate 2020 results in the absence of individual test scores simplifies (conceptually) to a two-step process:

1. estimate the expected distribution for Leaving Certificate 2020 test scores, and
2. use the teacher-assigned rank orders of students to estimate individual Leaving Certificate 2020 results for each student.

Clearly, this procedure requires some expectation of what the distribution of scores would be, had they been directly observed. At a national level, the stability across years suggests that the historical distribution would be an appropriate target. From *Figure 1*, it is clear that, relative to historical performance, the teacher Leaving Certificate 2020 estimates have a positive bias, and the magnitude tends to increase as the value of the estimates increases. In other words, scores tend to be overestimated for everybody, but the overestimation is even greater for higher performing students.

If the teacher estimates were directly comparable across schools, the bias correction could simply map the teacher estimates onto the historically stable national distribution. However, because the estimated marks were only subject to within-school alignment, there is no assurance that the teacher estimates are comparable across schools. The scatter plots of school average performance in each pair of years indicates that the 2020 school average teacher estimates appear to be universal biased, but because the rank order of schools is not exactly the same across years (note the changing relative position of the largest marker, corresponding to a same large school over time, indicated by the red arrows).

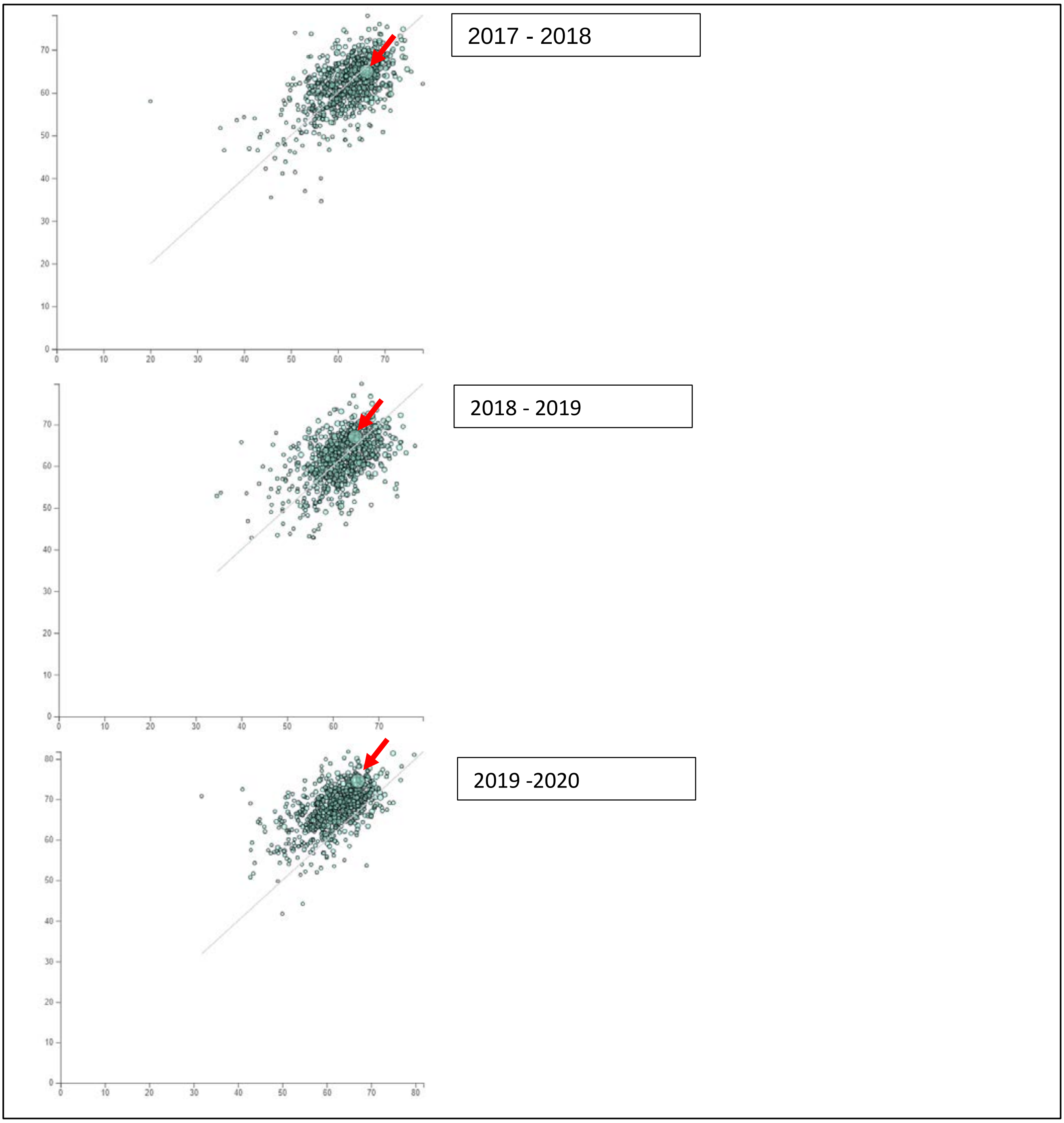


Figure 3 Inconsistency of average school performance across years

Correcting for distributional bias is slightly more problematic at the school level than at the national level. Due to constraints imposed on the standardisation process, the only sources of information available for this purpose are the students' prior attainment in Junior Cycle examinations and descriptions of their academic programmes since then (collectively referred to henceforth as 'prior attainment').

The general logic of combining information about prior attainment with information from the teacher estimates follows the assumption the two sources of information are not redundant. Although both types of information have some relationship to actual examination performance, prior attainment should not be considered a parallel measure or even a proxy for examination performance. Rather, examination of the relationship between prior attainment and examination in previous years may be used to generate credible distributions of the expected distribution of examination performance for students with specific patterns of prior attainment in the Leaving Certificate 2020 cohort. Given these limitations, it is important that any prior attainment be incorporated as a probabilistic rather than deterministic information to reflect the uncertainty inherent in generalizing broad descriptions of cognitive performance prior to upper second level education to performance in specific subjects after its completion.

To incorporate this treatment into the standardisation model, the teacher estimates must also be converted to a probabilistic description. Within a likelihood framework, the product of the probability density function for school k derived from the prior attainments of students in the school, $P\left(\theta_{kR}|x_j\right)$, and the probability density function derived from teacher estimates, $P(\theta_{kT})$), produces a joint likelihood function (or conditioned posterior distribution, depending on one's statistical perspective) that incorporates the information from both sources, via .

$$P^*\left(\theta_{ijk}\right) = P\left(\theta_{ijkR}|x_k\right)^{w_R} * P\left(\theta_{ijkT}\right)^{1-w_R} \text{, where } 0 < w_R < 1 \tag{1}$$

or for computational stability,

$$P^*\left(\theta_{ijk}\right) = e^{\,Log\left(P(\theta_{kR}|x_k)\right)*w_R + \,Log\left(P(\theta_{kT})\right)*(1-w_R)}\ , \tag{2}$$

where w_R and $(1 - w_R)$ are the aggregation weights representing the relative contribution of each component to the estimation of a specific score, θ_i, in school *k*.

Equation 1 is illustrated in *Figure 4* for a theoretical school with 4 students. The three panels in *Figure 4* describe the relationships in the standardisation model between the distributions describing i) teacher estimated performance based on kernel estimators, (see below), ii) prior attainment based on the aggregation of regression-based predicted distributions, and iii) the combined distribution calculated as the weighted geometric mean of both. In Panel 1, the School distribution is the simple aggregate or sum of the smaller distributions (kernels) representing the teacher estimates. In Panel 2, the Teacher-based school distribution is illustrated alongside the regression-based distribution and the joint distribution calculated by taking the geometric mean of the two distributions[2]. The resulting joint distribution represents a compromise between the two sources of information; however, because the regression-based distribution is much wider, is has a weaker contribution to the result. Nonetheless, it has a significant effect in the moderating the probability of scores at the lower end, relative to the unconditioned distribution, as shown in Panel 3. In practical terms, the effect of conditioning is negligible when the two sources of information agree, and the effects are more significant as the disagreement increases.

[2] All distributions have been standardized to have an integrated area of 1.

Figure 4 Conditioning of the teacher estimates using information about prior attainment

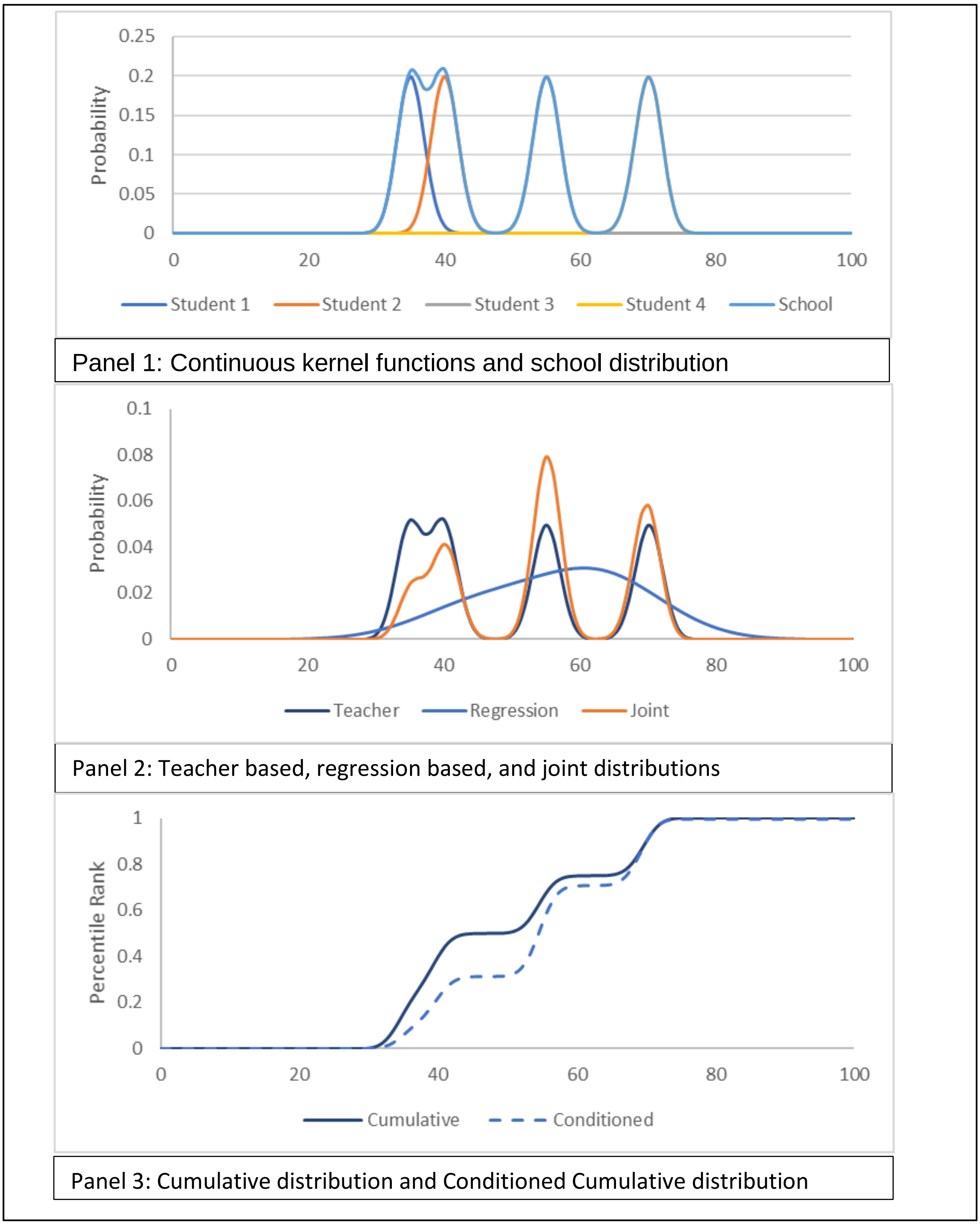


Figure 5 Conditioning of the teacher estimates using information about prior attainment

The following subsections describe the methods used to produce the regression-based distributions based on prior attainment, teacher estimate distributions, and their respective weights.

Processing of Prior Attainment Data

Comparable prior attainment data is available for Leaving Certificate 2020 students as well as students in the preceding 3 years (2017-2019). Using these data, the following procedure generates the prior attainment distributions for each school.

For all available years with relevant performance data (2017, 2018, 2019, 2020), construct a data matrix, X, containing performance predictor variables, including Junior Cycle examination performance, the number of years between Junior Cycle and Leaving Certificate sittings, Leaving Certificate repeat status, and, in the case of Leaving Certificate Applied subjects, module completion status. The Junior Cycle performance includes performance in the core subjects of Irish, English, and mathematics, as well as the top two scores in non-core for each student. The top two scores are treated as equivalent given the elective nature of Junior Cycle examinations and the interpretation of these results as indicative of general cognitive skill rather than domain-specific skills. Under this interpretation, the non-core scores represent peak cognitive performance of each student, which may be more comparable than performance in arbitrarily selected subjects with substantially non-random patterns of missing data. The interaction between the number of years between Junior Certificate and Leaving Certificate sittings and repeat status defines an additional variable describing whether a student has taken Transition year (if a student's exam interval is 3 years and they are not a repeat student or if their exam interval is 4 years, then they are assumed to have taken Transition year). Additional variables describing the binary completion status of Leaving Certificate Applied modules are available for Leaving Certificate Applied students. The number of modules varies by subject.

In the predictor matrix, replace missing values with column means and create dummy indicator variables to model potential non-random missingness. At this stage, the modified matrix of predictor variables, X^* has dimensions *m* x *n*, where *m* is the number of students with prior attainment data across all 4 years, and *n* is twice the number of predictor variables in X less the number of original and dummy coded variables with 0 variance, because any variables with 0 variance should be removed before proceeding.

Standardize the resulting matrix and perform a reduced singular value decomposition (SVD) to produce a matrix of uncorrelated variables that retain at least 90% of the variance in the original standardized matrix. This procedure first performs a routine SVD to decompose the $\boldsymbol{X}$ matrix into three factors, of which two are relevant: the matrix of singular values, **S**, and the matrix **V** containing the left singular vectors of the standardised $\boldsymbol{X}^*$. The number of singular vectors to retain from **V** is determined by the minimum number of elements, n_v, of the main diagonal of **S** required to produce a sum greater than or equal to 90% of the trace of **S**. Retaining the first n_v columns of **V**, a varimax rotation is performed on the reduced **V*** matrix to distribute the variance more evenly across the columns of **V***. The matrix product **X* V*** produces an *m* x n_v matrix of orthogonal predictor variables, $\widehat{\boldsymbol{X}}$, that provide greater computational stability for estimating regression models than the original unadjusted set of predictor variables.

Separate the 2017-2019 records from the 2020 records from, $\widehat{\boldsymbol{X}}$, and match the 2017-2019 records with their respective Leaving Certification examination scores in column vector $\boldsymbol{\Theta}$**.** Using the matched data, estimate the regression coefficients, **B**, that fits $\widehat{\boldsymbol{X}}$ to $\boldsymbol{\Theta}$.

Using the **B** coefficients, calculate:

1. the proportion of variance in $\boldsymbol{\Theta}$ accounted for by $\widehat{\boldsymbol{X}}$, R-squared,
2. the residual variance $\boldsymbol{\Theta}$ net of $\widehat{\boldsymbol{X}}$, $\sigma_{\mathbf{r\Theta}}$, and
3. the expected values of $\boldsymbol{\Theta}$, $\widehat{\boldsymbol{\Theta}_r}$**,** for each Leaving Certificate 2020 student by calculating the matrix product of the submatrix of $\widehat{\boldsymbol{X}}$ corresponding to the Leaving Certificate 2020 students and the regression coefficients, **B**.

Using the values of $\widehat{\boldsymbol{\Theta}_r}$ and the residual variance of the regression model, $\sigma_{\mathbf{r\Theta}}$, define a predicted distribution of performance for each Leaving Certificate 2020 student using a normal distribution,

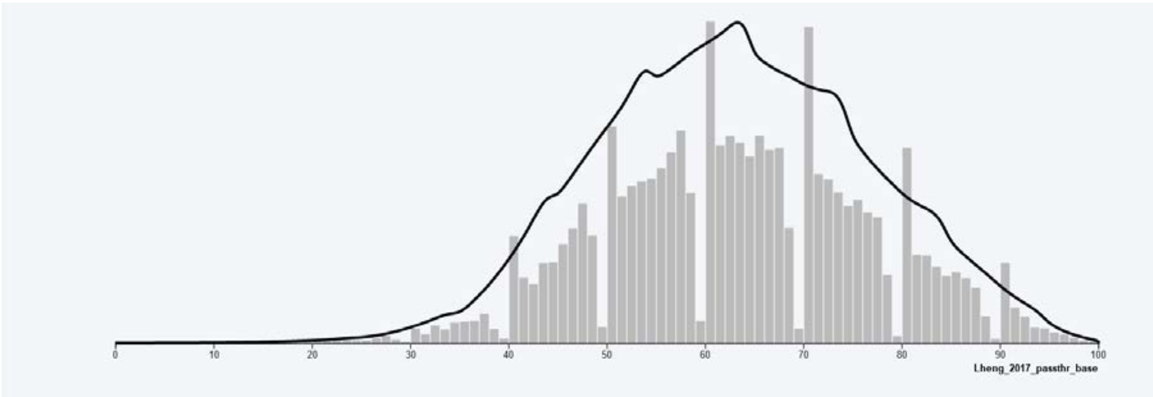
$P(\theta|x_{ij}) \sim N(\widehat{\Theta_r}, \sigma_{r\Theta})$, and evaluate the distribution function at each unit score value, *i*, to define a discrete distribution describing the probability that a student would have a Leaving Certificate 2020 score of θ_i given their pattern of prior attainment.

Using a set of 10 jackknife samples, replicate the estimation of **B** to generate a jackknife variance distribution for each student score, θ_{ij}, that describes the variability of the prediction model , $\sigma_{\Theta ij}$, at each score value for each student.

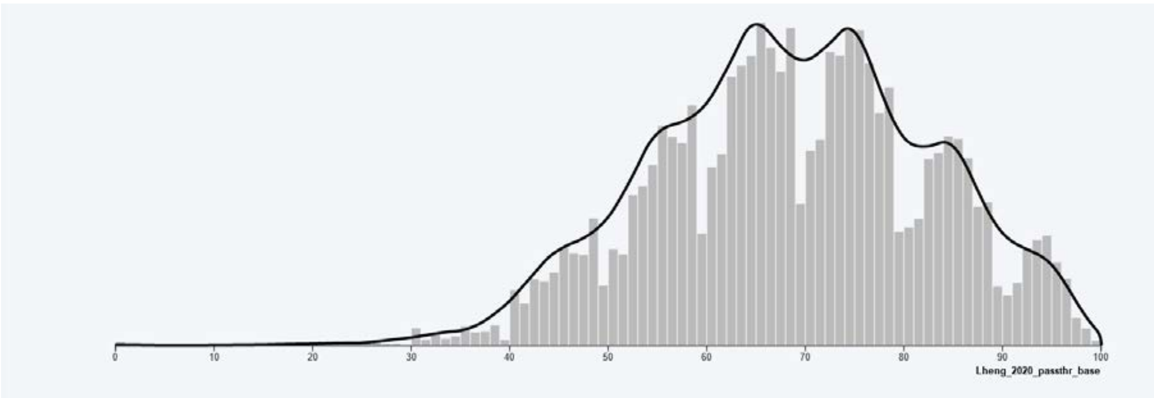
The collection of student level vectors of $P(\theta_i|x_j)$, *i* ϵ {0, 1, 2, …, 100}, is retained for use in subsequent steps of the procedure.

Processing Teacher Estimates

Unlike the distributions predicted by the regression model, teacher estimates are not subject to sampling error (because they describe the complete set of students for whom estimates are required). However, the distribution of the estimates suggests that they are subject to measurement error. Unlike typical directly estimated examination scores, the teacher estimates exhibit multi-modal behaviour, clustering around multiples of 5 and within grade boundaries. *Figure 6* illustrates these characteristics, comparing the distribution of 2017 Higher level English scores with the 2020 teacher estimates. Whereas the 2017 distribution is largely normal (with the exception of the movement of scores away from values immediately below grade boundaries), the distribution of 2020 teacher estimates is more clearly multimodal, clustered within grade boundaries with peaks and troughs corresponding to increments of 5 percentage points.



Panel 1. Distribution of examination scores, 2017 Higher level English



Panel 1. Distribution of teacher estimates, 2020 Higher level English

Figure 6 Measurement error in teacher estimates

This clustering pattern in teacher estimates suggests a consistent degree of imprecision across the entire range of scores. Based on the 10 point width of the trough-to-trough bands in teacher distributions, it may be reasonable to interpret the pattern of teacher estimates as having an expected measurement error of approximately 2 percentage points, implies that the 99% confidence interval for most scores would correspond to the teacher's estimate +/- 5 percentage score points, which is consistent with the tendency of scores to be normally distributed around the mid-point of each grade band.

Using this estimate of measurement, the discrete distributions describing the probability of teacher estimates at each score value for each student may be estimated using the following procedure.

Replace the point values of the teacher estimates with kernel functions with means equal to the teacher estimate and variance equal to the squared estimate of measurement error. Reflecting the nature of the underlying score distribution (bounded by 0 and 100), the kernel used by this process is a beta distribution with shape parameters alpha and beta[3],

$$K(\theta) \sim \mathbf{Beta}(alpha, beta)$$
$$= \frac{1}{\mathbf{B}(alpha, beta)} x^{alpha-1} (1-x)^{beta-1} \tag{3}$$

Where **B**(*alpha,beta*) evaluates the Beta function to provide a normalization constant that constrains the integrated area to equal 1, *alpha* and *beta* are functions of the mean and variance of the measurement distribution, estimated using the teacher estimate, θ_T^*, and the fixed value of 0.0004 (the square of 0.02), respectively, as follows:

when 0.0004 < θ_T^* (1 - θ_T^*),

$$alpha = \theta_T^* ((\theta_T^* (1 - \theta_T^*)) / 0.0004 - 1)$$
$$beta = (1 - \theta_T^*) ((\theta_T^* * (1 - \theta_T^*)) / 0.0004 - 1)$$

otherwise

$$beta = \theta_T^* ((\theta_T^* (1 - \theta_T^*)) / 0.0004 - 1)$$
$$alpha = (1 - \theta_T^*) ((\theta_T^* * (1 - \theta_T^*)) / 0.0004 - 1). \tag{4}$$

Using this kernel function, the probability of each student's score is estimated for all scores in the range 0 to 100 (scores of 0 and 100 were adjusted to the evaluation values of 0.1 and 99.9, respectively, because the beta distribution is asymptotically undefined at the limits of 0 and 100).

The resulting distribution of probabilities describes the probability that the teacher's estimate for each student might have taken each possible score value.

Combining the Regression and Teacher Estimate Distributions

The regression distribution and the teacher distribution are combined in the standardisation model by the weighted geometric mean, expressed in Equation 5. Both the regression and teacher estimated distributions are calculated as the sum of student-level probability densities, $\mathrm{P}(\theta_{ij}|x_j)$, in the cases of the regression outputs and $K(\theta_{ij})$ in the case of the teacher estimates aggregated

[3] Notation in this section omits the indices for individual scores and students because all parameters are indexed by the i^{th} score and the j^{th} student.

across students in each school for each score value, *I*, to produce the estimating distribution that describes the probability of each student-score, θ_{ij}, for school *k*,

$$P^{*}(\theta_{ijk}) = P(\theta_{ijkR}|x_k)^{w_R} * P(\theta_{ijkT})^{1-w_R}$$
$$= w_r Log\left[\sum \mathrm{P}(\theta_i|x_j)\right] + (1-w_r)Log[\sum K(\theta_i)].$$

5

The solution to the inverse function $\hat{\theta}_{jk} = P^{*-1}(p_{\theta jk})$, where $p_{\theta jk}$ is the percentile rank of student *j* in school *k* is the estimate for the calculated score for student *j* in school *k*.

Since the weight assigned to the teacher estimate distribution is the unit complement of the weight of the regression distribution, both estimates are derived from the same base function:

$$w_r = \frac{r^{*}_{X^{*}\theta}}{(1+e^{6-s})}$$

6

when the student is in school or has a Leaving Certificate 2020 score estimated by a teacher who participated in an in-school alignment, and simply

$$w_r = r^{*}_{X^{*}\theta}$$

7

if the teacher estimate is not informed by an in-school alignment process, where:

$r^{*}_{X^{*}\theta}$ is the attenuation-corrected multiple correlation of the regression model following the correction formula

$$r^{*}_{X^{*}\theta} = \frac{r_{X^{*}\theta}}{geom(r_{XX})},$$

8

$geom(r_{XX})$ is the geometric mean of the estimated measurement reliabilities of the predictor variables used in the regression equation, and

s is the school size.

This weighting function has the following properties:

1. As the predictive value of the regression model approaches 0, the contribution of the regression distribution approaches 0 and the student calculated marks converge on the teacher estimates.
2. Likewise, as the school size approaches and drops below 6, the influence of the regression distribution approaches 0 and the student calculated marks converge on the teacher estimates.
3. As school size increases, the estimated distribution converges on the unweighted geometric mean of the two components distributions.

One of the unfortunate consequences of converging on a uniform distribution rather than a curved distribution is that, for some small schools, the estimating distribution also appears to be flat, punctuated with the narrow spikes corresponding to the locations of teacher estimates. In these cases, the rank-based estimation process may behave unpredictably, depending the exact locations of the teacher estimates, and may assign extreme scores to students that greatly differ from the teacher estimates with no obvious rationale.

To remedy this phenomenon, the range of the calculated scores is corrected to converge on the range of the teacher estimates and the individual estimates will converge on the teacher according to the function

$$\widehat{\boldsymbol{\theta}}_{\boldsymbol{Final}} = (1 - w_r)\theta_T^* + w_r P^{*-1}(\theta_{ijk}),$$

The resulting $\widehat{\boldsymbol{\theta}}_{\boldsymbol{Final}}$ values are the final estimates used for reporting calculated student marks.

Treatment of Outlier Students

In the guidance provided to schools, teachers were instructed to assign scores that adequately reflected the degree of difference in the performance of the students. In particular they were instructed to ensure that exceptional students were not merely placed ahead of others but given scores that fully reflected the degree to which they excelled. Such exceptional students cannot be assumed to share the general distributional properties of the other students. Given that the estimation described in the preceding section is implicitly distribution based, adequately modeling the teacher estimates requires removing students designed as outliers prior to conducting the distributional mapping.

Outlier detection uses a customized EM algorithm that is optimized for detecting and classifying outliers at the extremes of a distribution. The algorithm assumes that each collection of scores is generated by 3 potential groups, each with a separate Gaussian distribution. A score may be assigned to a maximum of one group at a time. The starting conditions of the model assign all scores, in rank order, to the middle group and calculates the likelihood that the data are generated by the Gaussian distribution with mean equal to the mean of component scores and variance equal to the variance of component scores. The following steps are repeated until convergence or one of the stopping conditions is met:

1. Beginning with the lowest end of the distribution, assign all scores equal to the lowest score value in the middle group (initially containing all scores) to the lowest score group.
2. Estimate the complete data likelihood by calculating the product of probabilities that all scores belong to the distributions to which they are allocated, and compare it to the previously estimated data likelihood.
3. If the gap between the score value most recently moved to the low group and the new lowest value of the middle group is greater than 20, leave the most recently moved score in the low distribution and repeat the classification for the next lowest score in the middle distribution. [4]
4. If the likelihood does not increase, stop iterating, return the last-moved record(s) to the middle group, and proceed with the reclassification of scores at the higher end of the distribution.
5. If the gap between the score is less than the gap between closest the non-identical pairs in both the lower and middle groups, return the last-moved record(s) to the middle group, and proceed with the classification of scores at the higher end of the distribution.
6. Repeat the same classification steps for scores at the high end, sequentially evaluating the highest scores in the middle group for reclassification instead of the lowest scores.

[4] Note that this step is a 'failsafe' mechanism to deal with certain exceptional cases. It does not mean that a gap of 20 is required in general in order that values distant from the main set be considered outliers.

When outliers are identified, they are not included in the distributional mapping exercise. Instead, the scores classified as outliers are adjusted so that the ratio of the standard deviation between teacher estimates to standard deviation between calculated scores is the same for all groups and the gap between the set of outliers and the closest non-outlier score remains at the value set by the teacher:

$$a = \frac{\sigma_{\theta Final}}{\sigma_{\theta Teacher}}$$

$$\widehat{\boldsymbol{\theta}}_{\boldsymbol{Outlier}\,(j)} = (\boldsymbol{\theta}_{\boldsymbol{Outlier}\,(j)} - \boldsymbol{\theta}_{\boldsymbol{Outlier}\,(\boldsymbol{j-1})}) * a + \widehat{\boldsymbol{\theta}}_{\boldsymbol{Outlier}\,(\boldsymbol{j-1})},$$

where *j*=2, … , *n* and $\widehat{\boldsymbol{\theta}}_{\boldsymbol{Outlier}\,(\boldsymbol{1})} = \boldsymbol{\theta}_{\boldsymbol{Outlier}\,(\boldsymbol{1})}$ for low outlier group,

j = *n*, *n*-1, …1 and $\widehat{\boldsymbol{\theta}}_{\boldsymbol{Outlier}\,(\boldsymbol{n})} = \boldsymbol{\theta}_{\boldsymbol{Outlier}\,(\boldsymbol{n})}$ for the high outlier group.

9

The adjusted outlier scores $\widehat{\boldsymbol{\theta}}_{\boldsymbol{Outlier}}$ are concatenated with the other adjusted $\widehat{\boldsymbol{\theta}}_{\boldsymbol{Final}}$ results and matched to the source student data records for storage and subsequent reporting.

Appendix H. Tables and graphs of results for each subject and level

Tables and graphs of the results for each subject and level, including the LCVP link modules and the various Leaving Certificate Applied subjects and tasks, are provided below. They show the percentage of candidates achieving each grade in the Leaving Certificate results from 2017, 2018 and 2019, the averages across those three years, the percentage that would have achieved each grade in 2020 if the school estimates had been left unadjusted, and the actual outcomes from the calculated grades process. In keeping with the established practice of the State Examinations Commission, only results from cohorts of at least ten students are given.

Data are presented first for Irish, English, and mathematics, and then the remaining Leaving Certificate Established curricular examinations in alphabetical order, followed by the non-curricular languages, the Leaving Certificate Vocational Programme link modules, the Leaving Certificate Applied final examinations for Year 2 students in a selection of subjects, and the Personal Reflection Task.

In the case of Home Economics, the tables presented relate to the written paper only. This was the only subject in which coursework had been collected and marked by the State Examinations Commission (SEC). See note at 10.9 of the main report. The standardisation process was applied to the estimated mark provided by schools which related to the written examination only. The calculated mark for the written examinations and the journal mark provided by the State Examinations Commission were combined to arrive at the final results in this subject.

It should be noted that, the data presented below were updated after the National Standardisation Group had concluded its work and there may therefore be some discrepancies between the information presented below and that in the body of the report. Furthermore, there may be some other small discrepancies between the information in the tables below and the data ultimately published on the Department's website. These are due to the timing of the extraction and collation of the data below while some final quality assurance checks and resolution of queries was not yet finished.

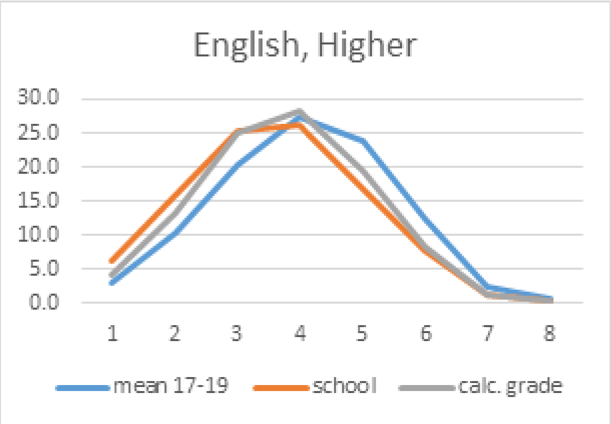
English

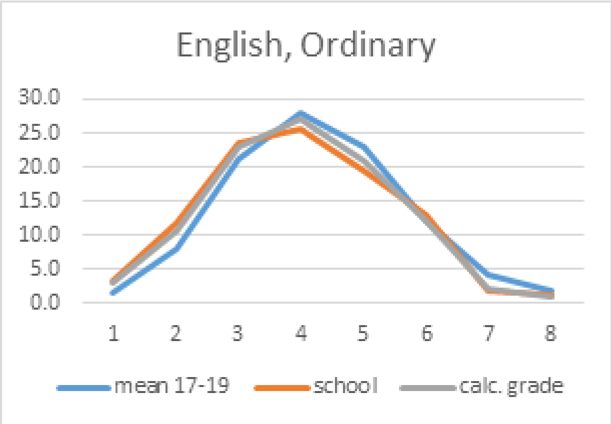
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	38,749	2.9	10.7	20.6	26.8	23.3	12.7	2.4	0.6
2018	38,283	2.9	10.0	20.0	27.9	24.2	12.2	2.3	0.5
2019	40,217	2.9	10.0	20.4	27.6	23.8	12.0	2.6	0.6
2017–2019	117,249	2.9	10.2	20.3	27.4	23.8	12.3	2.4	0.6
school est. 2020	41,934	6.3	15.9	25.4	26.1	16.9	7.8	1.2	0.3
calc. grade 2020	41,934	4.3	13.2	24.9	28.3	19.3	8.3	1.4	0.3

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	15,389	1.6	8.7	22.6	27.4	22.6	11.7	3.6	1.7
2018	14,753	1.5	8.1	20.9	28.2	22.6	12.3	4.5	2.0
2019	14,477	1.5	7.2	20.3	28.1	23.5	12.7	4.5	2.0
2017–2019	44,619	1.5	8.0	21.3	27.9	22.9	12.2	4.2	1.9
school est. 2020	14,636	3.4	11.7	23.5	25.7	19.4	13.0	2.0	1.4
calc. grade 2020	14,636	3.0	10.6	22.9	27.0	21.0	12.1	2.2	1.2





Irish

Higher level

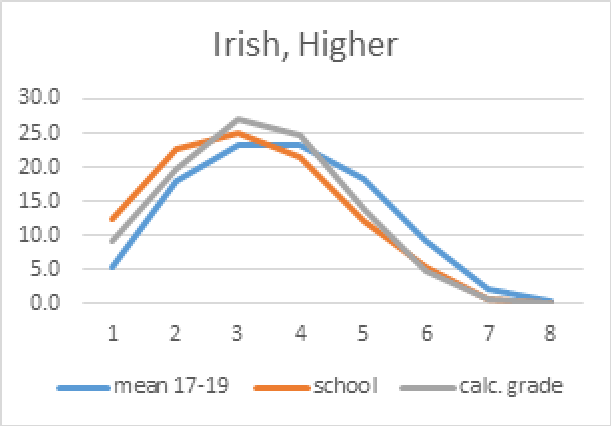
		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	22,122	5.3	18.5	24.0	23.5	18.2	8.4	1.9	0.3
2018	22,400	4.9	18.1	23.2	23.6	18.4	9.5	2.1	0.3
2019	23,176	5.7	17.7	22.4	23.0	18.3	9.6	2.8	0.4
2017–2019	67,698	5.3	18.1	23.2	23.4	18.3	9.2	2.3	0.3
school est. 2020	24,704	12.5	22.7	25.0	21.5	12.2	5.3	0.7	0.2
calc. grade 2020	24,704	9.1	19.7	27.1	24.6	13.8	4.8	0.7	0.2

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	22,521	0.3	5.8	18.3	26.5	25.5	15.8	5.8	2.1
2018	21,439	0.3	5.2	19.0	28.1	24.6	14.7	5.6	2.5
2019	22,324	0.3	5.2	18.5	26.2	25.0	15.7	6.3	2.8
2017–2019	66,284	0.3	5.4	18.6	26.9	25.0	15.4	5.9	2.5
school est. 2020	23,550	2.5	10.9	20.8	23.6	20.3	16.6	3.2	2.2
calc. grade 2020	23,550	1.9	8.7	19.4	26.3	23.3	15.4	3.6	1.5

Foundation level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	3,190	1.3	8.7	19.1	24.7	22.5	14.1	6.6	3.1
2018	2,912	1.3	9.9	19.3	25.2	21.9	12.7	6.4	3.3
2019	2,834	1.9	11.8	19.9	24.5	20.9	12.0	6.2	2.9
2017–2019	8,936	1.5	10.1	19.4	24.8	21.8	13.0	6.4	3.1
school est. 2020	1,461	6.0	18.6	25.3	22.3	15.5	10.7	0.5	1.1
calc. grade 2020	1,461	5.8	17.7	25.5	23.1	16.0	10.3	0.5	1.1


Irish, Higher
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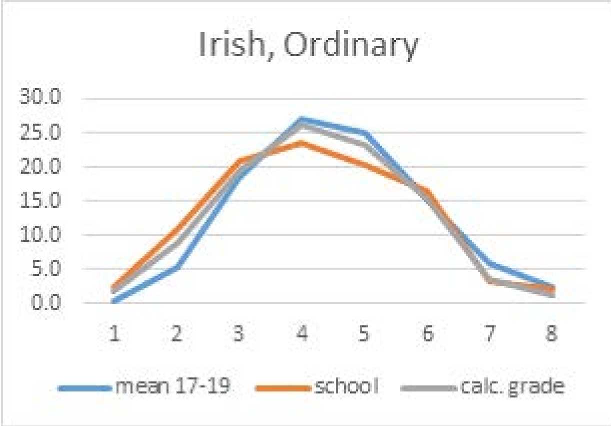
calc. grade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school
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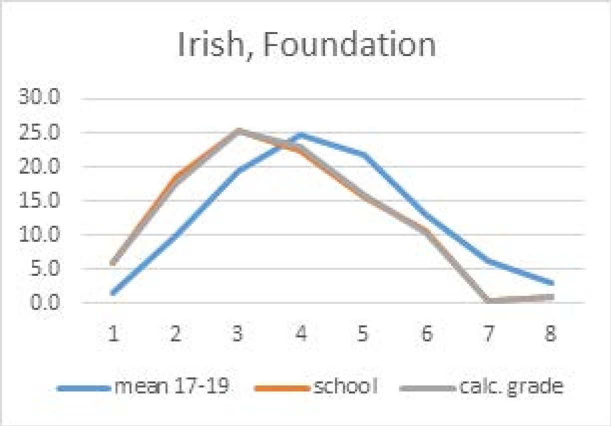
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mean 17-19
school
calc. grade

Mathematics

Higher level

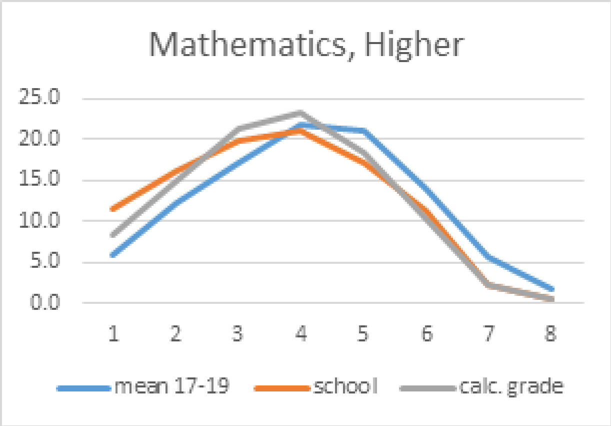
		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	16,394	6.0	12.2	16.2	21.3	21.5	14.7	6.2	2.0
2018	16,837	5.5	13.5	18.7	21.6	20.1	13.0	5.8	1.7
2019	18,153	6.0	11.1	17.0	22.6	21.7	14.3	5.4	1.8
2017–2019	51,384	5.8	12.2	17.3	21.9	21.1	14.0	5.8	1.8
school est. 2020	20,522	11.6	16.3	19.9	21.0	17.2	11.3	2.3	0.5
calc. grade 2020	20,522	8.4	15.1	21.4	23.2	18.6	10.4	2.4	0.5

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	32,335	2.2	12.5	20.9	23.2	19.4	11.9	6.0	3.9
2018	31,336	1.5	10.8	20.7	24.1	20.2	13.1	5.9	3.7
2019	31,474	1.7	11.2	20.1	23.1	20.2	12.9	6.6	4.3
2017–2019	95,145	1.8	11.5	20.6	23.5	19.9	12.6	6.2	4.0
school est. 2020	33,826	5.4	14.4	20.3	20.6	17.7	16.0	3.3	2.4
calc. grade 2020	33,826	4.4	12.4	20.3	23.1	19.9	14.0	4.1	1.8

Foundation level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	5,936	4.0	13.8	21.0	25.9	19.7	10.7	3.6	1.3
2018	5,218	3.0	10.8	19.9	23.7	20.2	14.0	5.2	3.3
2019	5,467	4.3	13.4	19.4	21.7	20.2	12.7	5.6	2.6
2017–2019	16,621	3.8	12.7	20.1	23.8	20.0	12.4	4.8	2.4
school est. 2020	2,593	7.7	19.4	19.8	19.4	17.9	12.6	1.3	1.9
calc. grade 2020	2,593	7.1	18.7	20.6	20.6	18.6	11.3	1.7	1.4


Mathematics, Higher
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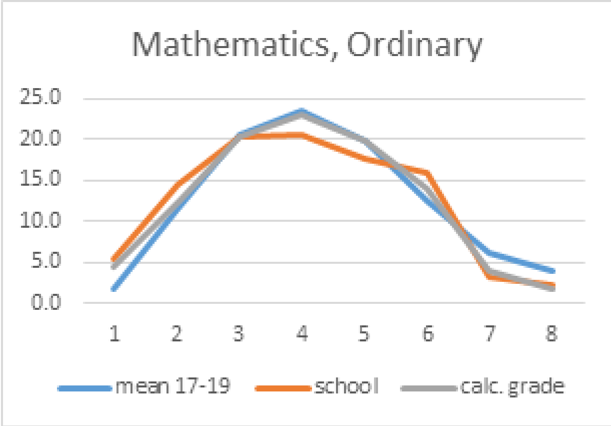
mean 17-19
school
calc. grade


Mathematics, Ordinary
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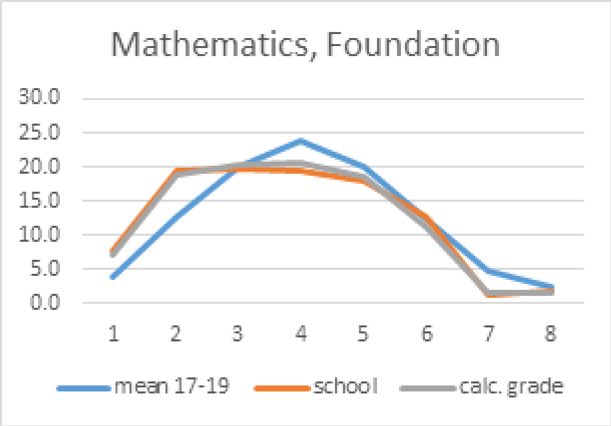
mean 17-19
school
calc. grade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8
mean 17-19
school
calc. grade

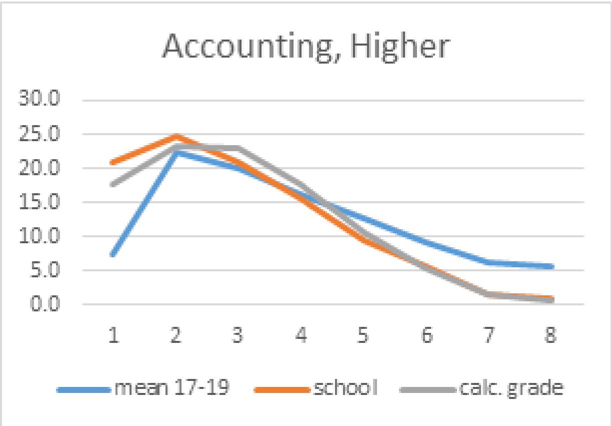
Accounting

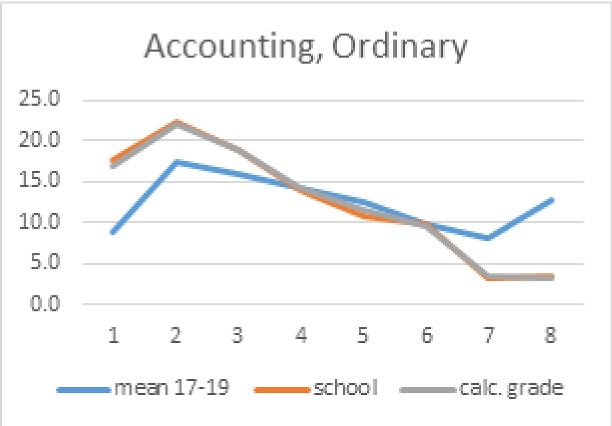
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	5,379	7.1	26.4	22.3	15.5	11.5	8.2	4.9	4.1
2018	5,551	9.1	19.1	18.4	16.8	13.7	9.3	7.0	6.6
2019	6,095	6.6	21.5	19.6	16.3	12.6	10.1	6.9	6.5
2017–2019	17,025	7.6	22.3	20.1	16.2	12.6	9.2	6.3	5.8
school est. 2020	6,314	21.0	24.7	20.8	15.7	9.5	5.7	1.7	0.9
calc. grade 2020	6,314	17.4	23.2	23.0	17.8	10.6	5.4	1.7	0.8

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,525	7.9	16.8	15.3	14.6	13.2	10.4	9.0	12.9
2018	1,597	9.7	16.8	16.7	13.3	12.5	10.6	8.3	12.0
2019	1,812	8.9	18.4	15.8	15.1	12.3	8.6	7.5	13.4
2017–2019	4,934	8.8	17.4	15.9	14.4	12.6	9.8	8.2	12.8
school est. 2020	1,792	17.6	22.2	18.8	14.1	10.8	9.8	3.3	3.5
calc. grade 2020	1,792	16.8	22.1	18.8	14.7	11.4	9.3	3.6	3.2

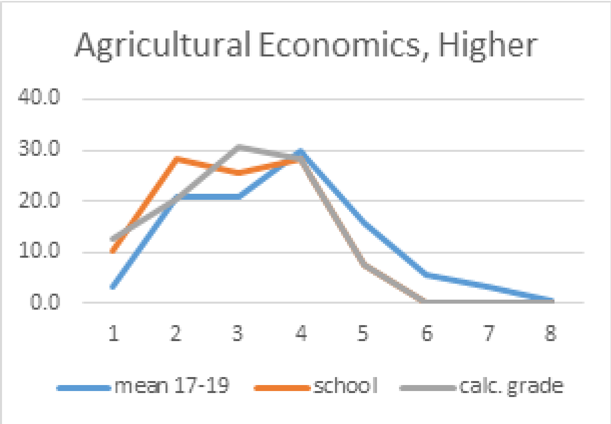




Agricultural Economics

Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	77	5.2	16.9	22.1	28.6	15.6	6.5	3.9	1.3
2018	37	2.7	24.3	18.9	35.1	8.1	5.4	5.4	0.0
2019	31	0.0	25.8	19.4	25.8	25.8	3.2	0.0	0.0
2017–2019	145	3.5	20.7	20.7	29.7	15.9	5.5	3.4	0.7
school est. 2020	39	10.3	28.2	25.6	28.2	7.7	0.0	0.0	0.0
calc. grade 2020	39	10.3	25.6	25.6	30.8	7.7	0.0	0.0	0.0



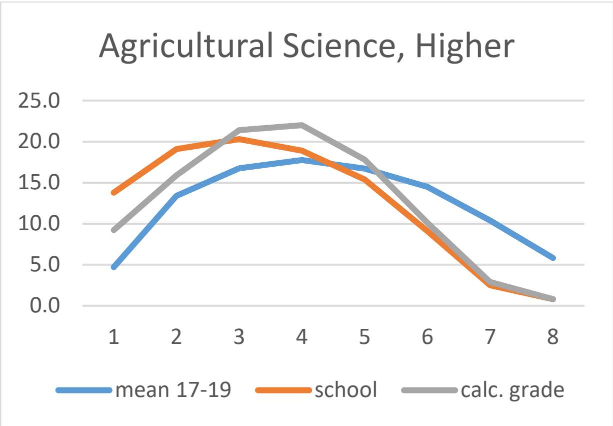
Agricultural Science

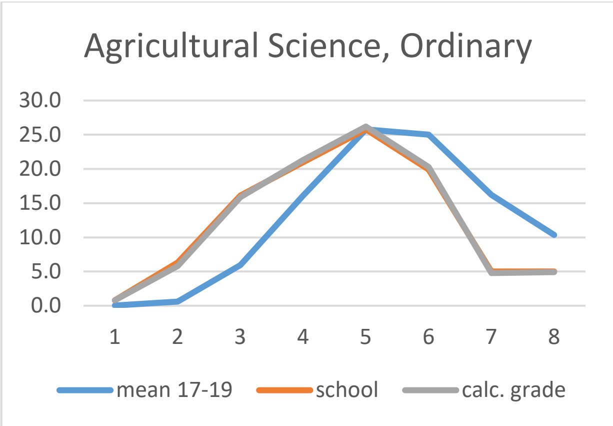
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	6,376	4.5	14.5	17.0	18.9	17.0	14.2	8.7	5.2
2018	6,543	4.8	13.8	18.4	17.7	16.6	14.0	9.7	4.9
2019	6,605	4.8	11.9	14.9	16.7	16.5	15.2	12.7	7.3
2017–2019	19,524	4.7	13.4	16.8	17.8	16.7	14.5	10.4	5.8
school est. 2020	7,371	13.8	19.1	20.3	18.9	15.4	9.1	2.5	0.8
calc. grade 2020	7,371	9.1	15.9	21.3	22.0	17.9	10.1	2.9	0.8

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,284	0.1	0.4	5.5	16.2	26.9	25.5	15.7	9.7
2018	1,235	0.0	0.6	5.5	15.0	24.5	27.7	16.7	10.1
2019	1,140	0.0	0.8	6.9	17.3	25.9	21.6	16.2	11.3
2017–2019	3,659	0.0	0.6	5.9	16.1	25.8	25.0	16.2	10.3
school est. 2020	1,129	0.8	6.3	16.1	21.0	25.8	19.9	5.0	5.0
calc. grade 2020	1,129	0.8	5.9	15.7	21.4	26.1	20.2	5.0	4.9

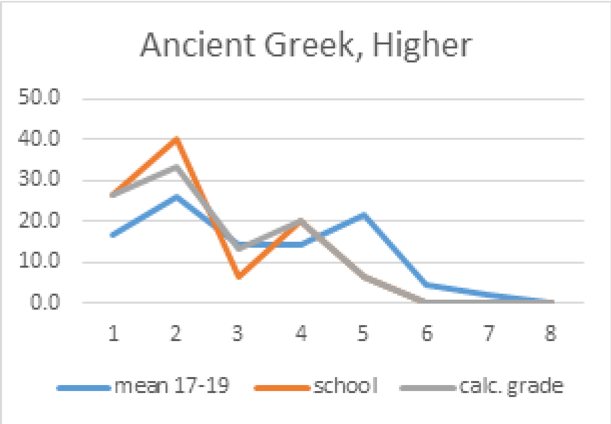




Ancient Greek

Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	13	0.0	46.2	7.7	23.1	23.1	0.0	0.0	0.0
2018	12	25.0	8.3	25.0	8.3	16.7	16.7	0.0	0.0
2019	17	23.5	23.5	11.8	11.8	23.5	0.0	5.9	0.0
2017–2019	42	16.7	26.2	14.3	14.3	21.4	4.8	2.4	0.0
school est. 2020	15	26.7	40.0	6.7	20.0	6.7	0.0	0.0	0.0
calc. grade 2020	15	26.7	33.3	13.3	20.0	6.7	0.0	0.0	0.0



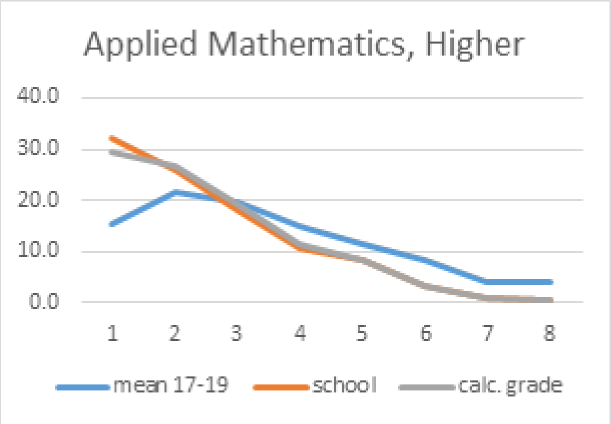
Applied Mathematics

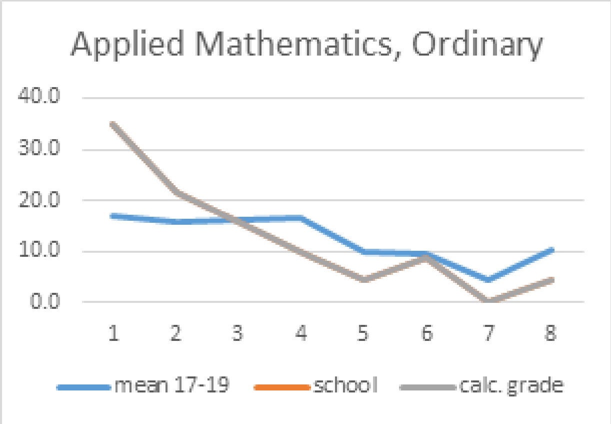
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,869	14.4	23.1	20.6	15.3	11.5	7.6	4.3	3.2
2018	1,826	15.2	22.2	20.2	14.9	11.8	8.3	3.6	3.7
2019	1,988	16.2	20.0	18.7	14.8	11.4	9.4	4.8	4.9
2017–2019	5,683	15.3	21.7	19.8	15.0	11.6	8.5	4.2	4.0
school est. 2020	2,115	32.3	25.9	18.3	10.7	8.2	3.2	0.9	0.5
calc. grade 2020	2,115	29.6	26.7	19.3	11.6	8.2	3.4	0.8	0.5

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	100	15.0	13.0	24.0	16.0	8.0	9.0	3.0	12.0
2018	128	20.3	22.7	14.1	19.5	8.6	7.8	2.3	4.7
2019	116	15.5	10.3	12.1	13.8	12.9	12.1	7.8	15.5
2017–2019	344	17.1	15.7	16.3	16.6	9.9	9.6	4.4	10.5
school est. 2020	69	34.8	21.7	15.9	10.1	4.3	8.7	0.0	4.3
calc. grade 2020	69	34.8	21.7	15.9	10.1	4.3	8.7	0.0	4.3





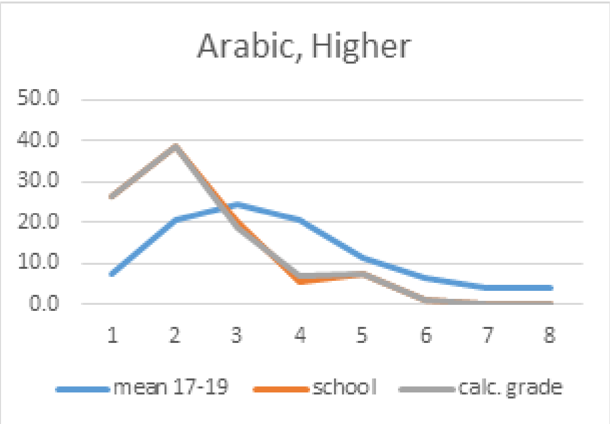
Arabic

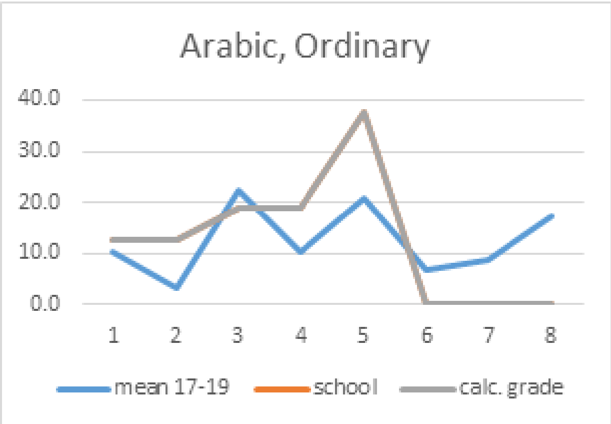
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	99	8.1	28.3	26.3	16.2	14.1	2.0	1.0	4.0
2018	133	8.3	15.8	23.3	22.6	13.5	7.5	4.5	4.5
2019	168	6.5	19.6	25.0	22.0	8.3	8.9	5.4	4.2
2017–2019	400	7.5	20.5	24.8	20.8	11.5	6.7	4.0	4.3
school est. 2020	155	26.5	38.7	20.0	5.8	7.7	1.3	0.0	0.0
calc. grade 2020	155	26.5	38.7	18.7	7.1	7.7	1.3	0.0	0.0

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	19	5.3	10.5	31.6	10.5	15.8	5.3	0.0	21.1
2018	15	13.3	0.0	13.3	6.7	26.7	6.7	13.3	20.0
2019	24	12.5	0.0	20.8	12.5	20.8	8.3	12.5	12.5
2017–2019	58	10.3	3.4	22.4	10.3	20.7	6.9	8.6	17.3
school est. 2020	16	12.5	12.5	18.8	18.8	37.5	0.0	0.0	0.0
calc. grade 2020	16	12.5	12.5	18.8	18.8	37.5	0.0	0.0	0.0





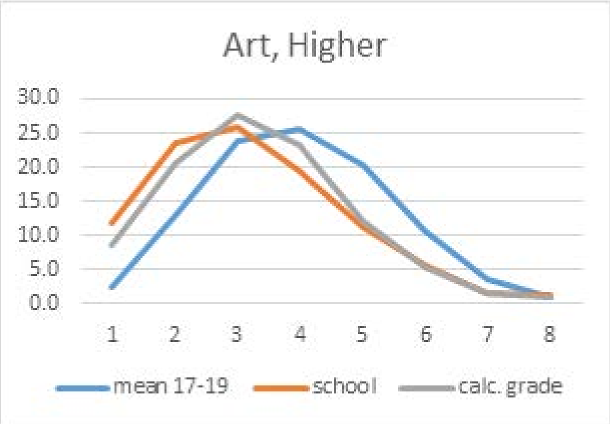
Art

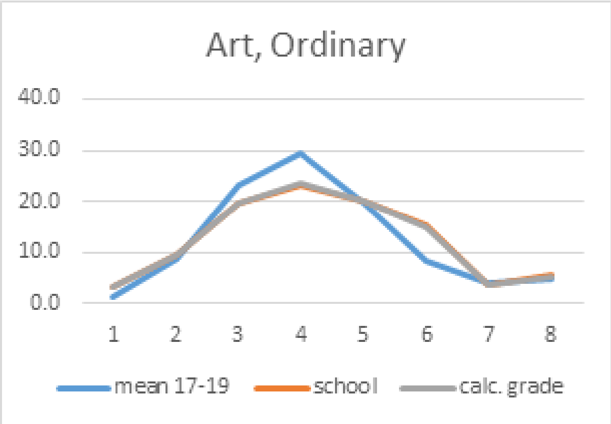
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	7,737	1.2	11.4	26.8	27.9	21.3	8.8	2.1	0.4
2018	7,293	3.0	13.5	21.8	24.5	20.3	11.6	4.2	1.0
2019	7,622	3.0	13.9	22.5	24.2	19.1	11.5	4.3	1.4
2017–2019	22,652	2.4	12.9	23.7	25.6	20.2	10.6	3.5	0.9
school est. 2020	8,112	11.9	23.4	25.9	19.3	11.1	5.6	1.7	1.2
calc. grade 2020	8,112	8.5	20.4	27.7	23.4	12.3	5.3	1.6	0.9

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,671	0.4	5.6	17.7	32.4	25.5	11.5	3.9	3.0
2018	1,753	1.4	11.5	26.5	28.6	16.6	6.3	3.7	5.4
2019	1,563	2.2	9.5	25.1	27.8	16.8	7.9	4.5	6.1
2017–2019	4,987	1.3	8.9	23.1	29.6	19.6	8.5	4.0	4.8
school est. 2020	1,504	3.3	9.4	19.7	23.1	20.1	15.2	3.5	5.5
calc. grade 2020	1,504	3.4	9.4	19.7	23.5	20.1	15.0	3.7	5.2





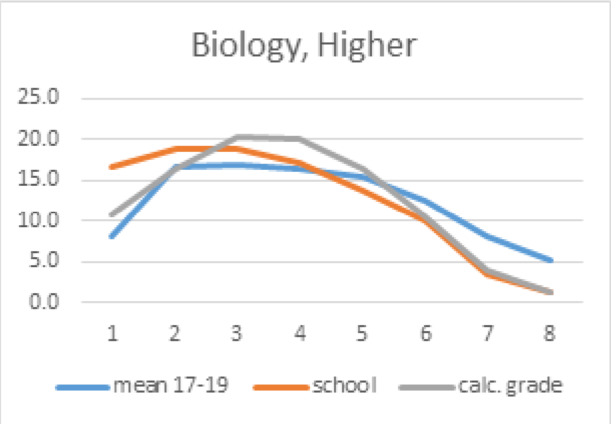
Biology

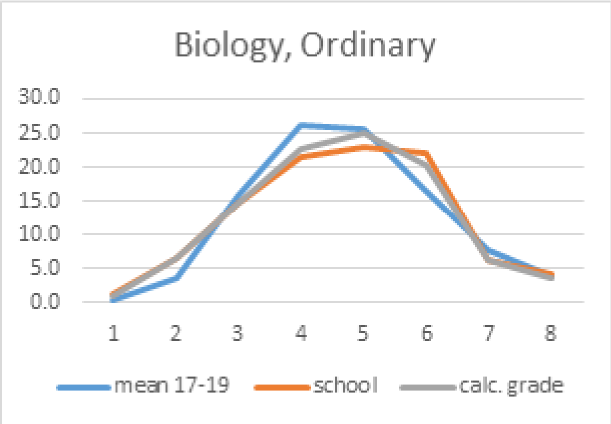
Higher level

year	number	percentage awarded each grade							
		1	2	3	4	5	6	7	8
2017	26,684	5.1	16.4	18.1	18.3	16.6	13.4	8.0	4.2
2018	26,543	11.6	18.1	16.1	14.8	13.7	10.8	7.9	7.0
2019	27,063	7.7	15.8	16.6	16.5	16.3	13.7	8.6	4.8
2017–2019	80,290	8.1	16.8	16.9	16.5	15.5	12.6	8.2	5.3
school est. 2020	29,575	16.6	18.8	18.8	17.2	13.8	10.0	3.4	1.3
calc. grade 2020	29,575	10.8	16.4	20.3	20.3	16.4	10.6	4.0	1.3

Ordinary level

year	number	percentage awarded each grade							
		1	2	3	4	5	6	7	8
2017	7,608	0.4	4.4	17.3	26.9	24.9	15.5	6.7	3.9
2018	7,006	0.5	3.2	15.7	25.6	26.7	17.2	7.7	3.4
2019	7,046	0.2	3.2	14.7	26.1	25.6	17.0	8.5	4.7
2017–2019	21,660	0.4	3.6	15.9	26.2	25.7	16.5	7.6	4.0
school est. 2020	5,264	1.4	6.7	14.7	21.4	23.0	22.2	6.2	4.3
calc. grade 2020	5,264	0.9	6.6	14.7	22.9	24.9	20.3	6.3	3.5





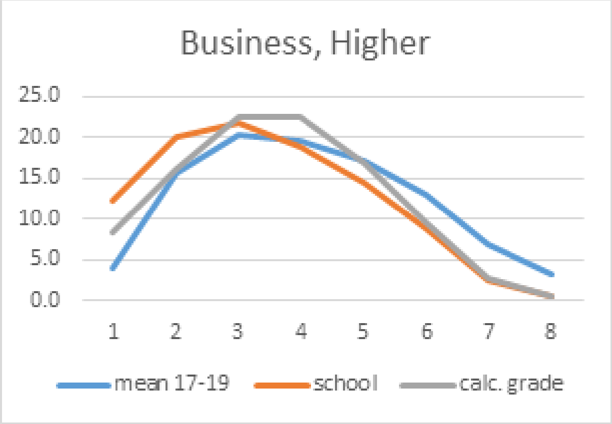
Business

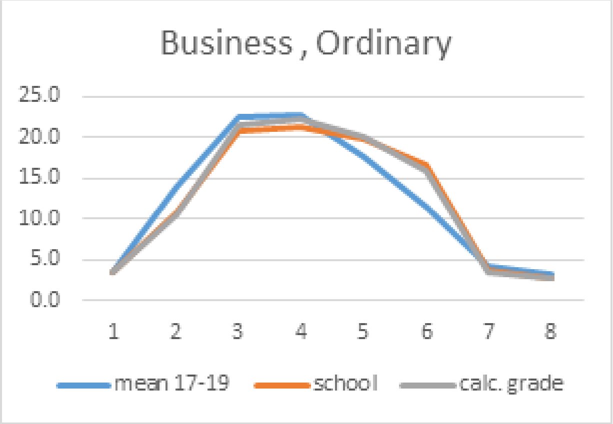
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	13,219	3.8	15.0	20.8	20.2	17.3	12.9	7.0	2.9
2018	13,329	4.1	16.1	20.4	20.1	16.7	12.7	6.6	3.3
2019	13,805	4.0	16.2	19.8	18.6	17.5	13.2	7.2	3.5
2017–2019	40,353	4.0	15.8	20.3	19.6	17.2	12.9	6.9	3.2
school est. 2020	15,206	12.4	20.0	21.9	19.0	14.5	9.0	2.6	0.7
calc. grade 2020	15,206	8.5	16.3	22.6	22.6	17.1	9.6	2.8	0.6

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,354	3.3	13.9	22.6	21.7	17.5	12.1	5.0	3.9
2018	3,638	3.7	14.3	23.2	22.3	18.3	11.2	3.6	3.3
2019	3,521	3.7	14.0	22.2	24.7	17.6	11.3	3.7	2.8
2017–2019	11,513	3.5	14.1	22.7	22.8	17.8	11.6	4.2	3.4
school est. 2020	2,676	3.6	10.8	20.9	21.3	19.8	16.8	3.8	2.9
calc. grade 2020	2,676	3.4	10.6	21.5	22.2	20.3	15.6	3.6	2.6





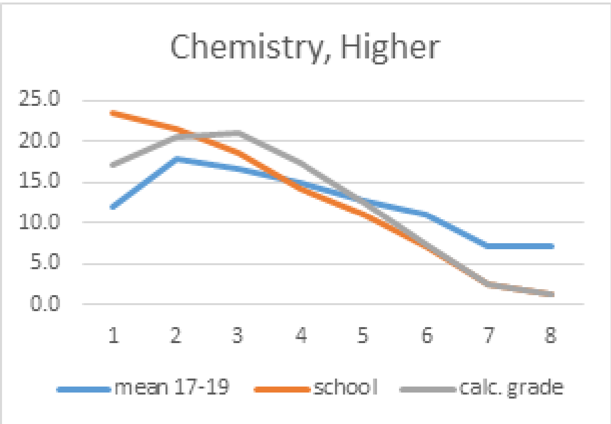
Chemistry

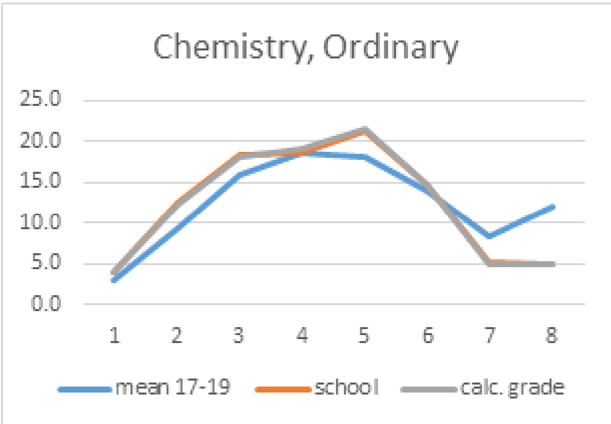
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	8,162	11.3	17.7	17.3	14.9	13.0	11.1	7.7	6.9
2018	7,943	11.7	18.5	16.1	15.2	12.4	11.2	7.6	7.3
2019	8,244	13.2	17.9	16.7	14.7	12.6	10.9	6.5	7.5
2017–2019	24,349	12.1	18.0	16.7	14.9	12.7	11.1	7.3	7.2
school est. 2020	8,689	23.6	21.6	18.6	14.2	11.1	7.1	2.5	1.2
calc. grade 2020	8,689	17.1	20.5	21.3	17.4	12.5	7.4	2.6	1.2

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,306	2.3	8.3	18.1	21.1	19.8	13.4	7.4	9.6
2018	1,224	3.2	10.0	15.8	17.6	16.7	14.7	8.3	13.6
2019	1,262	3.9	10.0	13.6	17.4	18.2	14.2	9.8	12.8
2017–2019	3,792	3.1	9.4	15.9	18.7	18.3	14.1	8.5	12.0
school est. 2020	967	3.9	12.6	18.4	18.6	21.4	14.8	5.3	5.0
calc. grade 2020	967	4.0	12.6	18.1	19.0	21.6	14.6	5.1	5.0





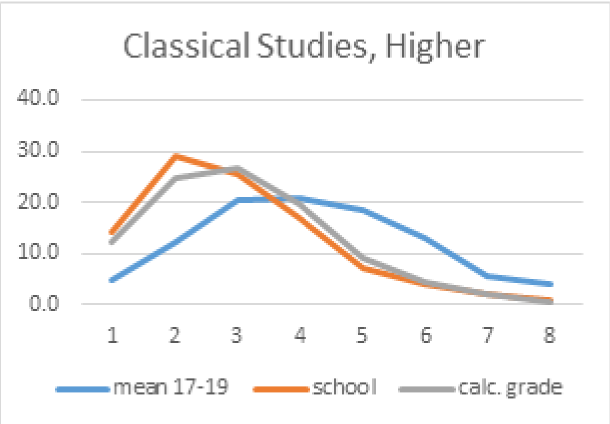
Classical Studies

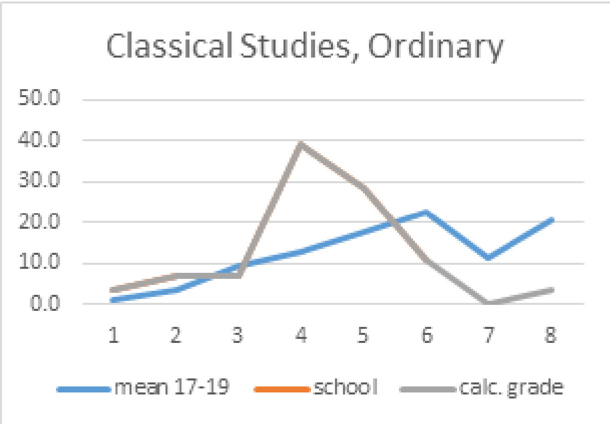
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	563	3.7	11.0	18.3	24.9	18.7	13.0	6.6	3.9
2018	527	4.9	10.1	19.9	18.8	20.3	15.0	5.9	5.1
2019	440	6.4	17.0	23.9	18.2	16.6	10.5	4.3	3.2
2017–2019	1,530	4.9	12.4	20.5	20.9	18.6	13.0	5.7	4.1
school est. 2020	489	14.3	29.0	25.6	16.8	7.4	4.1	2.0	0.8
calc. grade 2020	489	12.3	24.3	27.2	19.6	9.2	4.5	2.2	0.6

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	49	0.0	2.0	12.2	20.4	20.4	18.4	8.2	18.4
2018	45	2.2	4.4	4.4	6.7	20.0	24.4	13.3	24.4
2019	52	1.9	3.8	11.5	11.5	13.5	25.0	13.5	19.2
2017–2019	146	1.4	3.4	9.5	13.0	17.8	22.6	11.7	20.5
school est. 2020	28	3.6	7.1	7.1	39.3	28.6	10.7		3.6
calc. grade 2020	28	3.6	7.1	7.1	39.3	28.6	10.7	0.0	3.6





Computer Science

Higher level

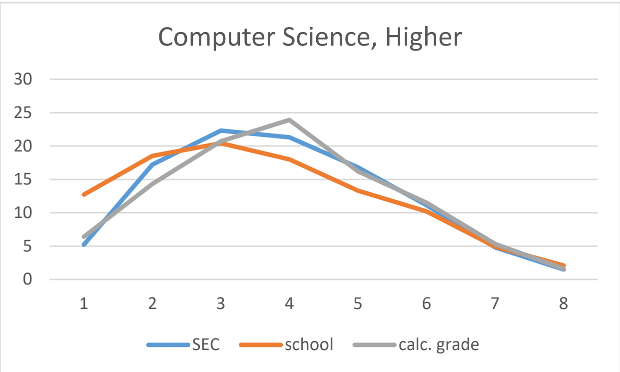
		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
*SEC**	-	5.2	17.2	22.3	21.3	16.8	11.1	4.8	1.5
school est. 2020	677	12.7	18.5	20.4	18	13.3	10.2	4.9	2.1
calc. grade 2020	677	6.4	14.0	20.7	24.2	16.2	11.5	5.3	1.6

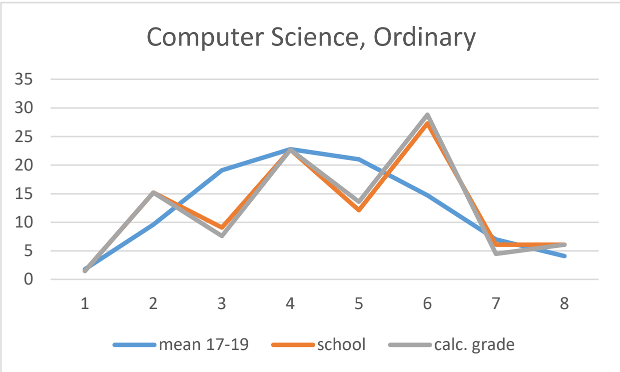
*See section 10.3: New subjects – Physical Education and Computer Science

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
*SEC**	-	1.8	9.6	19.1	22.8	21	14.7	7	4.1
school est. 2020	66	1.5	15.2	9.1	22.7	12.1	27.3	6.1	6.1
calc. grade 2020	66	1.5	15.2	7.6	22.7	13.6	28.8	4.5	6.1

*See section 10.3: New subjects – Physical Education and Computer Science





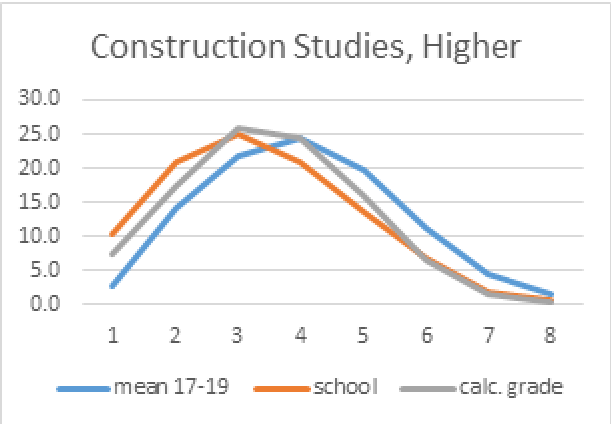
Construction Studies

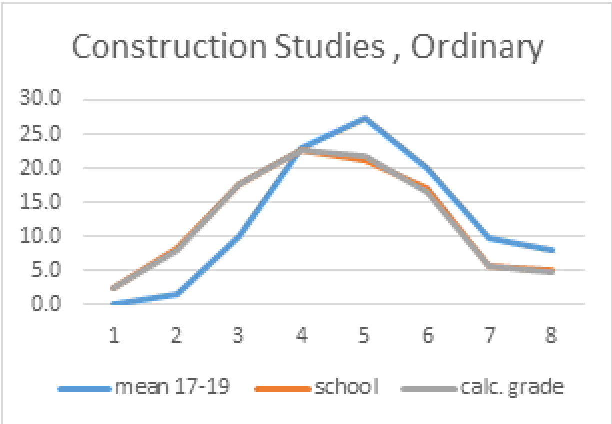
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	7,451	2.9	14.8	22.4	23.8	19.3	11.1	4.2	1.5
2018	7,104	2.1	13.0	22.1	26.2	20.4	10.9	4.1	1.2
2019	7,896	2.9	14.9	20.7	23.5	19.3	11.8	5.2	1.7
2017–2019	22,451	2.6	14.3	21.7	24.5	19.6	11.3	4.5	1.5
school est. 2020	8,568	10.5	20.8	25.1	20.9	13.6	6.8	1.8	0.6
calc. grade 2020	8,568	7.4	17.3	26.0	24.5	16.0	6.6	1.6	0.5

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,299	0.0	1.6	8.7	24.9	28.6	20.5	8.8	6.9
2018	1,144	0.2	1.3	11.8	21.8	26.0	19.1	10.7	9.1
2019	1,114	0.2	2.2	9.5	21.7	27.5	20.6	10.2	8.1
2017–2019	3,557	0.1	1.7	9.9	22.9	27.4	20.1	9.8	8.0
school est. 2020	1,145	2.4	8.2	17.6	22.8	21.3	17.0	5.6	5.1
calc. grade 2020	1,145	2.4	8.1	17.7	22.8	21.7	16.8	5.6	4.9





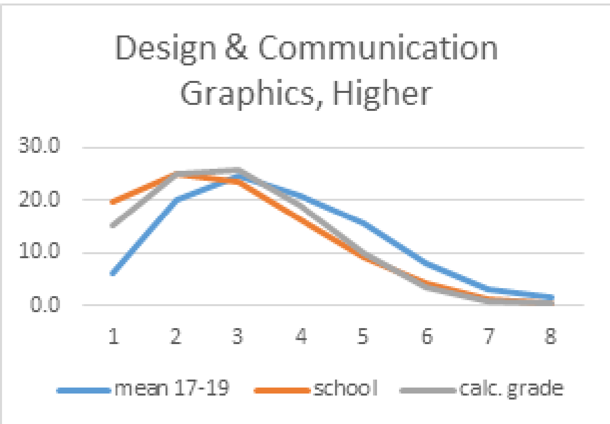
Design & Communication Graphics

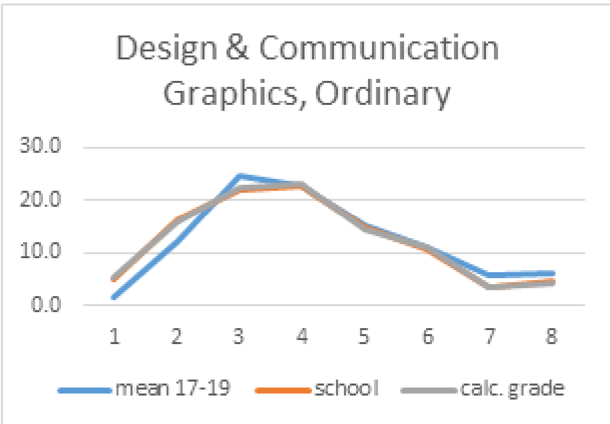
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,445	6.6	20.7	25.8	21.1	14.6	7.9	2.2	1.1
2018	4,480	5.8	20.1	24.0	20.2	15.9	8.7	3.5	1.9
2019	4,566	6.5	19.9	23.7	21.3	15.7	7.9	3.3	1.7
2017–2019	13,491	6.3	20.2	24.5	20.9	15.4	8.2	3.0	1.6
school est. 2020	4,721	19.7	25.1	23.6	16.2	9.2	4.4	1.1	0.6
calc. grade 2020	4,721	15.0	24.6	26.2	19.1	9.9	3.7	0.9	0.6

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,130	2.1	14.5	27.2	22.3	12.8	10.3	5.0	5.8
2018	913	0.8	9.3	23.3	24.0	16.9	12.5	6.4	6.9
2019	1,025	2.1	12.4	23.2	22.3	15.9	11.1	6.3	6.5
2017–2019	3,068	1.7	12.3	24.7	22.8	15.1	11.2	5.9	6.4
school est. 2020	927	5.2	16.3	22.1	22.9	14.7	10.8	3.6	4.5
calc. grade 2020	927	5.3	15.9	22.4	23.1	14.5	10.9	3.7	4.3





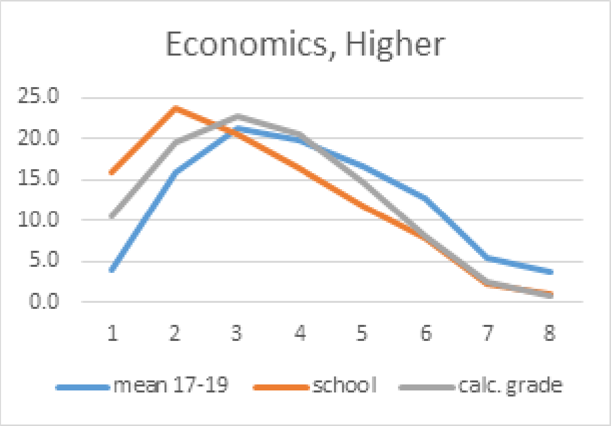
Economics

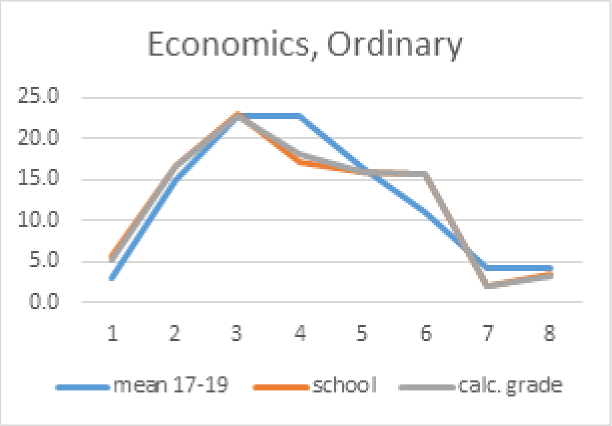
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,976	3.8	15.8	21.6	20.7	17.0	12.5	5.3	3.2
2018	4,947	4.1	15.6	22.2	20.1	17.6	12.9	4.6	3.0
2019	4,990	4.2	16.5	20.2	18.9	15.8	13.1	6.6	4.9
2017–2019	14,913	4.0	16.0	21.3	19.9	16.8	12.8	5.5	3.7
school est. 2020	5,078	16.0	23.8	20.7	16.5	11.9	7.9	2.2	1.0
calc. grade 2020	5,078	10.4	19.4	23.0	20.8	14.8	8.2	2.5	0.9

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	880	3.2	15.1	23.3	22.6	15.8	9.7	5.6	4.8
2018	818	3.1	16.6	23.2	23.5	16.6	10.3	3.3	3.4
2019	873	3.1	13.3	22.1	22.6	17.3	13.1	4.1	4.5
2017–2019	2,571	3.1	15.0	22.9	22.9	16.6	11.0	4.4	4.3
school est. 2020	666	5.6	16.8	23.1	17.3	15.9	15.8	2.1	3.5
calc. grade 2020	666	5.3	16.8	22.8	18.2	16.2	15.3	2.3	3.2





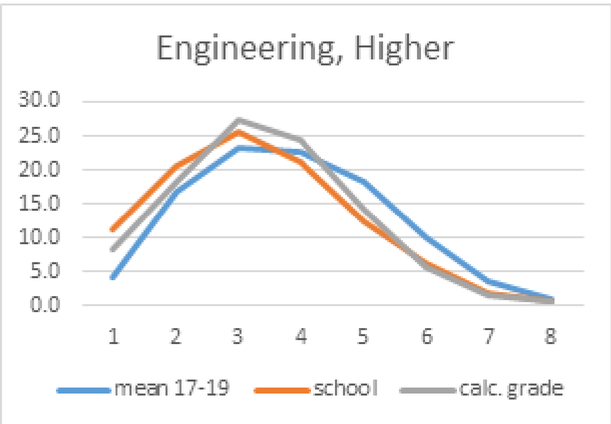
Engineering

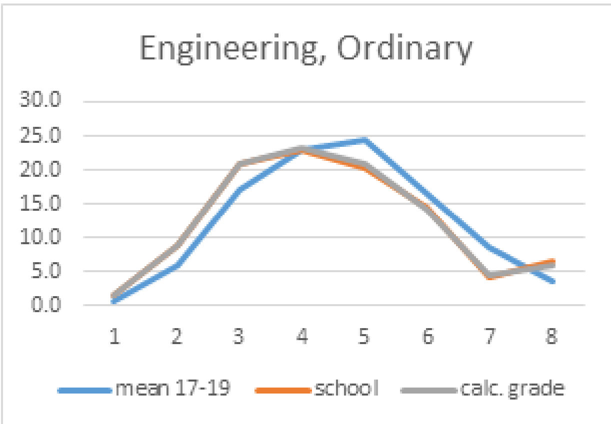
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,586	4.6	17.0	23.4	22.1	19.9	9.5	2.9	0.6
2018	4,668	4.3	17.8	24.0	23.7	16.9	9.3	3.3	0.8
2019	4,765	3.6	16.0	22.5	22.4	17.9	11.7	4.3	1.7
2017–2019	14,019	4.2	16.9	23.3	22.7	18.2	10.2	3.5	1.0
school est. 2020	5,327	11.3	20.6	25.6	21.1	12.4	6.3	2.0	0.8
calc. grade 2020	5,327	8.3	18.2	27.3	24.4	14.1	5.7	1.5	0.6

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	689	0.6	5.7	16.1	26.6	24.2	16.5	7.5	2.8
2018	586	0.3	6.8	18.3	22.4	23.5	15.4	8.5	4.8
2019	650	0.9	5.2	17.2	19.5	25.8	17.5	10.0	3.7
2017–2019	1,925	0.6	5.9	17.1	22.9	24.5	16.5	8.6	3.7
school est. 2020	780	1.7	9.0	20.8	22.9	20.3	14.6	4.2	6.5
calc. grade 2020	780	1.7	8.8	20.9	23.1	21.2	14.0	4.4	6.0





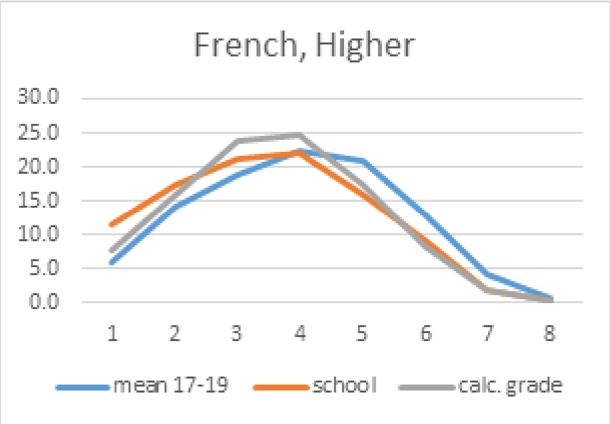
French

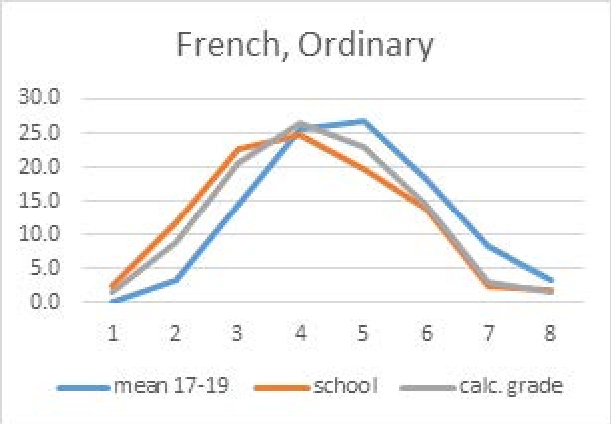
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	15,934	6.0	14.6	19.6	23.3	20.3	11.6	4.0	0.7
2018	15,485	5.9	14.0	18.0	21.2	20.7	14.3	5.0	0.8
2019	15,654	6.2	13.9	18.7	22.6	21.3	13.0	3.7	0.6
2017–2019	47,073	6.0	14.2	18.8	22.4	20.8	13.0	4.2	0.7
school est. 2020	16,507	11.6	17.5	21.2	22.2	16.0	9.2	1.8	0.5
calc. grade 2020	16,507	7.7	15.9	23.8	24.7	17.4	8.3	1.9	0.4

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	9,449	0.1	3.6	14.9	24.4	26.0	18.3	8.9	3.8
2018	8,225	0.1	3.2	13.7	25.5	26.7	18.9	8.4	3.4
2019	7,707	0.1	2.8	14.7	27.0	27.7	17.6	7.1	3.0
2017–2019	25,381	0.1	3.2	14.5	25.5	26.7	18.3	8.2	3.4
school est. 2020	6,356	2.6	11.7	22.8	24.7	19.8	14.0	2.4	2.0
calc. grade 2020	6,356	1.6	8.7	20.5	26.8	23.3	14.5	3.0	1.7





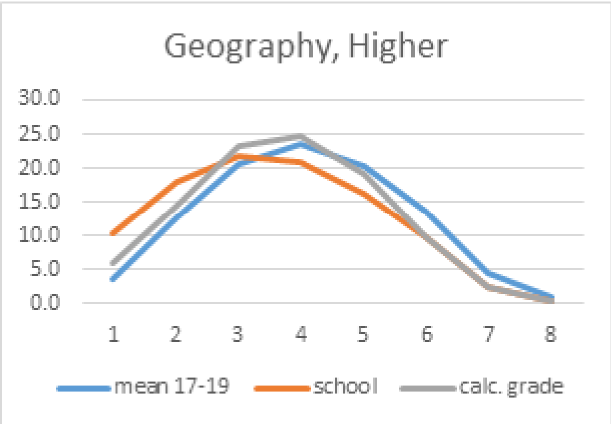
Geography

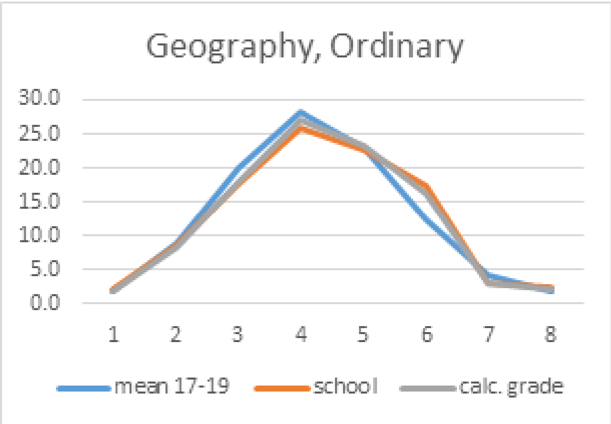
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	19,293	3.4	12.7	21.8	24.0	20.1	12.9	4.2	0.9
2018	19,106	3.5	12.5	19.7	23.3	20.8	14.1	4.9	1.1
2019	19,982	3.7	13.1	20.7	23.1	20.2	13.7	4.6	1.0
2017–2019	58,381	3.5	12.8	20.7	23.5	20.4	13.6	4.6	1.0
school est. 2020	20,503	10.5	18.0	21.7	20.8	16.2	9.9	2.4	0.5
calc. grade 2020	20,503	6.0	14.3	23.2	24.6	19.1	9.9	2.3	0.5

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,658	1.7	8.5	20.7	28.3	23.0	12.4	3.9	1.5
2018	4,220	2.0	9.5	20.0	27.7	21.3	13.1	4.3	2.2
2019	4,139	1.9	8.3	19.0	28.5	24.4	12.0	4.3	1.7
2017–2019	13,017	1.9	8.8	19.9	28.2	22.9	12.5	4.2	1.8
school est. 2020	3,642	2.1	8.5	17.8	25.8	22.8	17.5	3.0	2.5
calc. grade 2020	3,642	1.8	8.4	17.8	27.1	23.5	16.1	3.0	2.1





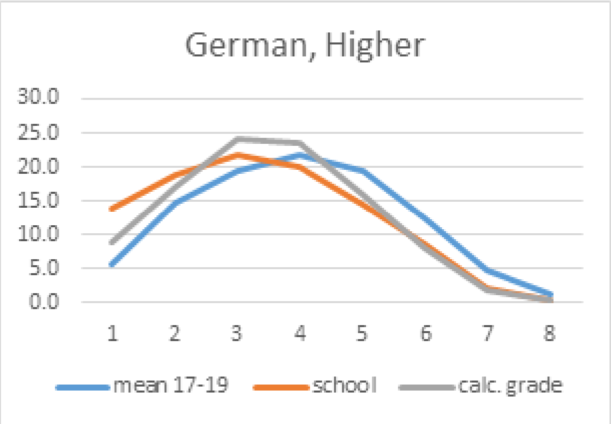
German

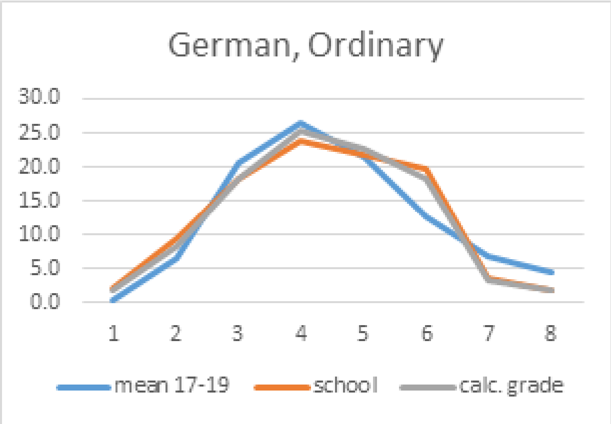
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	5,618	5.6	15.1	19.4	23.2	20.1	11.6	4.0	0.9
2018	6,194	5.4	15.3	20.5	21.6	18.8	12.5	4.9	1.0
2019	6,247	6.1	14.1	18.5	21.0	19.6	13.2	5.5	2.0
2017–2019	18,059	5.7	14.8	19.5	21.9	19.5	12.5	4.8	1.3
school est. 2020	6,772	13.9	18.8	21.8	20.0	14.5	8.5	2.1	0.5
calc. grade 2020	6,772	9.0	17.1	24.1	23.6	16.1	8.0	1.8	0.4

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	2,319	0.5	6.3	22.1	27.7	20.4	11.6	6.6	4.7
2018	2,309	0.3	6.2	20.6	27.5	23.3	13.2	6.0	2.8
2019	2,297	0.7	7.1	18.9	24.6	21.2	13.6	8.2	5.8
2017–2019	6,925	0.5	6.5	20.5	26.6	21.6	12.8	6.9	4.4
school est. 2020	1,926	2.1	9.4	18.2	23.7	21.7	19.6	3.5	1.9
calc. grade 2020	1,926	1.9	8.4	18.2	25.4	22.7	18.2	3.4	1.8





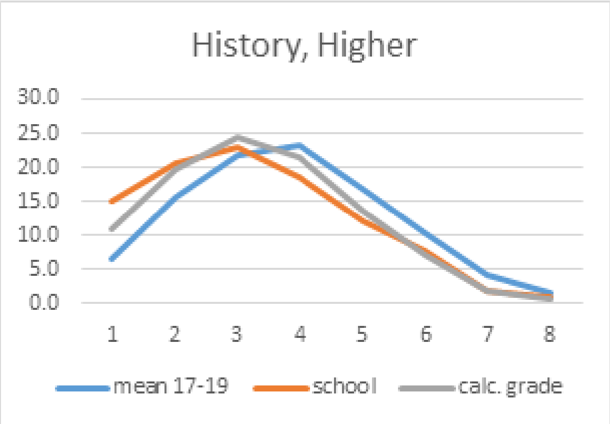
History

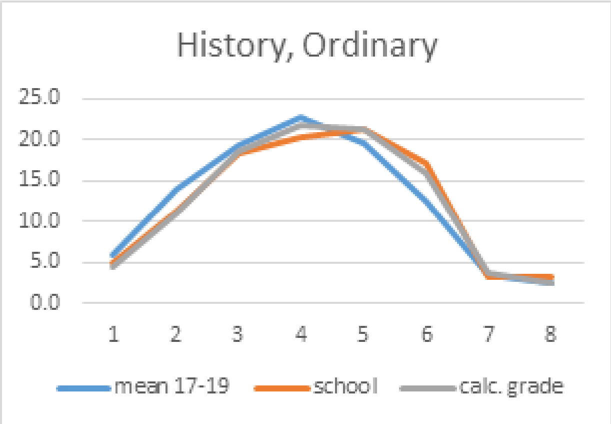
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	8,994	6.2	15.6	22.5	23.5	16.7	10.1	4.0	1.3
2018	8,509	6.5	14.9	21.2	22.9	17.5	10.9	4.7	1.3
2019	8,824	6.7	16.1	21.9	23.1	16.1	10.3	4.0	1.8
2017–2019	26,327	6.5	15.5	21.9	23.2	16.8	10.4	4.2	1.5
school est. 2020	9,441	15.0	20.7	23.0	18.5	12.2	7.7	2.0	0.9
calc. grade 2020	9,441	10.9	19.7	24.5	21.6	13.6	7.0	2.0	0.8

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	3,200	7.1	15.8	21.4	22.4	17.7	10.5	2.9	2.2
2018	2,966	5.1	11.0	17.7	24.3	21.6	13.6	3.9	2.6
2019	2,919	5.2	14.8	18.5	21.9	19.4	13.9	3.7	2.7
2017–2019	9,085	5.8	13.9	19.3	22.9	19.5	12.6	3.5	2.5
school est. 2020	2,809	4.9	11.4	18.5	20.3	21.4	17.1	3.3	3.2
calc. grade 2020	2,809	4.6	11.2	18.7	21.8	21.4	15.9	3.7	2.6





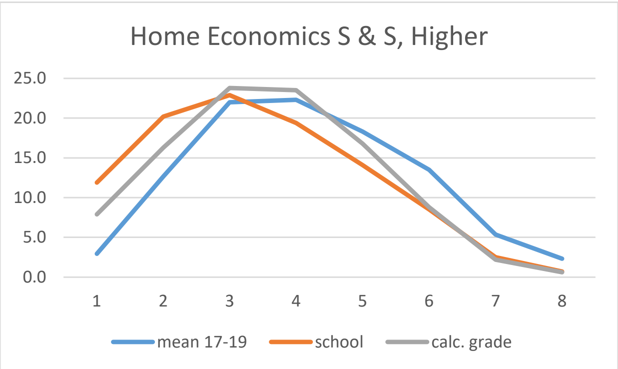
Home Economics (Scientific and Social) Written Paper Only

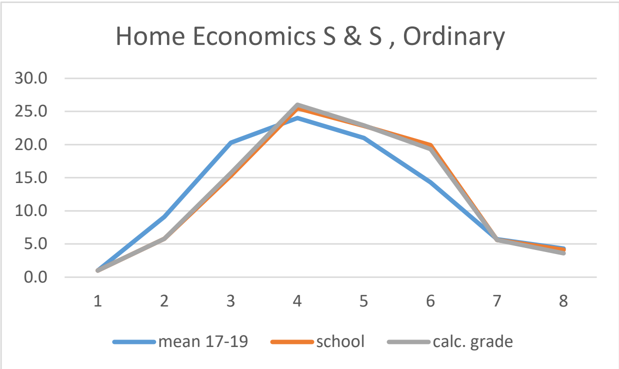
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	9,414	2.9	12.7	22.0	21.6	18.8	14.1	5.4	2.4
2018	9,190	3.0	12.7	22.1	21.6	18.8	13.7	5.4	2.7
2019	9,730	2.9	12.6	21.9	23.8	18.9	12.8	5.3	1.9
2017–2019	28,334	2.9	12.7	22.0	22.3	18.3	13.5	5.4	2.3
school est. 2020	10,245	11.9	20.2	22.9	19.4	14.1	8.5	2.5	0.7
calc. grade 2020	10,245	7.9	16.3	23.8	23.5	16.8	8.8	2.2	0.6

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	2,400	0.9	8.4	20.5	23.7	21.9	14.9	5.7	4.0
2018	2,368	1.1	9.7	20.6	24.0	20.4	13.9	5.6	4.6
2019	2,272	1.1	9.2	19.8	24.5	20.9	14.1	5.7	4.7
2017–2019	7,040	1.0	9.1	20.3	24.0	21.0	14.3	5.7	4.3
school est. 2020	1,739	1.0	5.8	15.3	25.5	22.8	19.9	5.6	4.1
calc. grade 2020	1,739	1.0	5.8	15.7	26.0	22.9	19.3	5.6	3.6





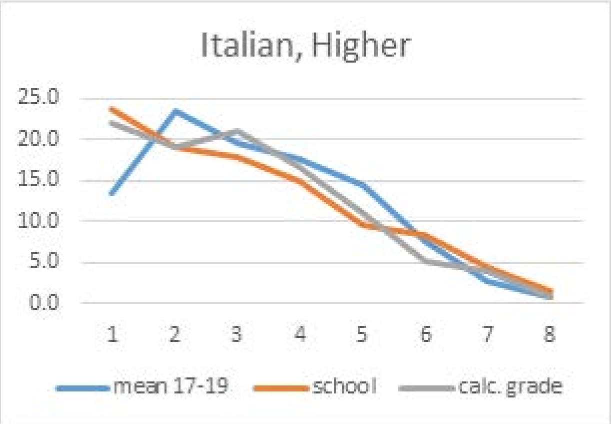
Italian

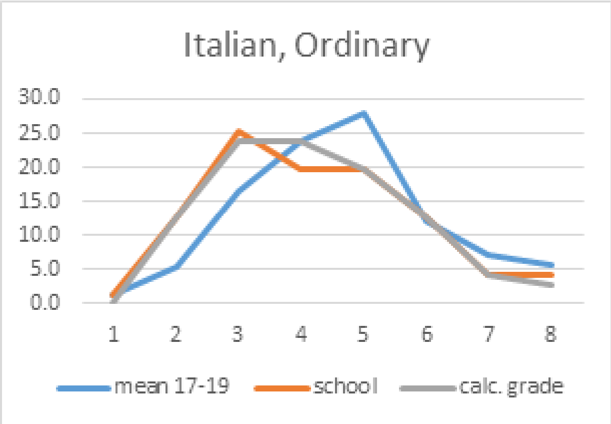
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	387	12.9	22.0	19.6	19.9	16.5	6.2	2.1	0.8
2018	363	10.2	23.7	19.6	19.3	13.8	9.9	2.8	0.8
2019	361	17.5	24.7	19.7	13.6	13.0	7.2	3.6	0.8
2017–2019	1,111	13.5	23.4	19.6	17.7	14.5	7.7	2.8	0.8
school est. 2020	326	23.8	19.2	18.0	14.9	9.5	8.5	4.6	1.5
calc. grade 2020	326	21.8	19.9	21.9	16.9	11.0	5.2	4.0	0.3

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	110	1.8	4.5	18.2	22.7	26.4	14.5	3.6	8.2
2018	99	0.0	5.1	11.1	23.2	37.4	14.1	7.1	2.0
2019	112	1.8	6.3	19.6	25.9	21.4	8.0	10.7	6.3
2017–2019	321	1.2	5.3	16.5	24.0	28.0	12.1	7.2	5.6
school est. 2020	70	1.4	12.7	25.4	19.7	19.7	12.7	4.2	4.2
calc. grade 2020	70	0.0	12.9	22.9	22.9	21.4	12.9	4.3	2.9





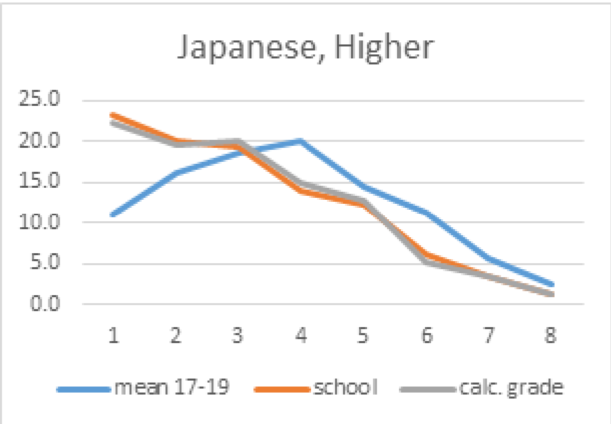
Japanese

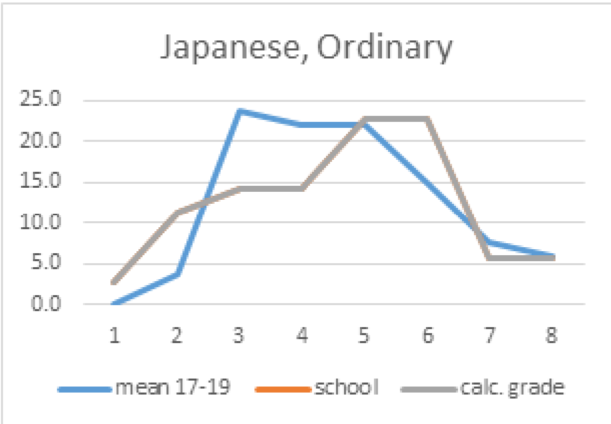
Higher level

year	number	percentage awarded each grade							
		1	2	3	4	5	6	7	8
2017	236	10.2	14.4	19.5	18.2	11.4	15.7	6.8	3.8
2018	236	14.4	15.7	17.4	19.5	12.3	11.9	6.4	2.5
2019	208	8.7	19.2	19.2	22.6	20.2	5.8	3.4	1.0
2017–2019	680	11.2	16.3	18.7	20.0	14.4	11.4	5.6	2.5
school est. 2020	225	23.2	20.2	19.3	14.0	12.3	6.1	3.5	1.3
calc. grade 2020	225	22.7	20.9	19.1	15.1	12.9	5.3	3.1	0.9

Ordinary level

year	number	percentage awarded each grade							
		1	2	3	4	5	6	7	8
2017	60	0.0	3.3	23.3	23.3	25.0	16.7	6.7	1.7
2018	60	0.0	5.0	26.7	16.7	23.3	11.7	10.0	6.7
2019	66	0.0	3.0	21.2	25.8	18.2	16.7	6.1	9.1
2017–2019	186	0.0	3.7	23.7	22.1	22.0	15.1	7.6	5.9
school est. 2020	35	2.9	11.4	14.3	14.3	22.9	22.9	5.7	5.7
calc. grade 2020	35	2.9	11.4	14.3	14.3	22.9	22.9	5.7	5.7

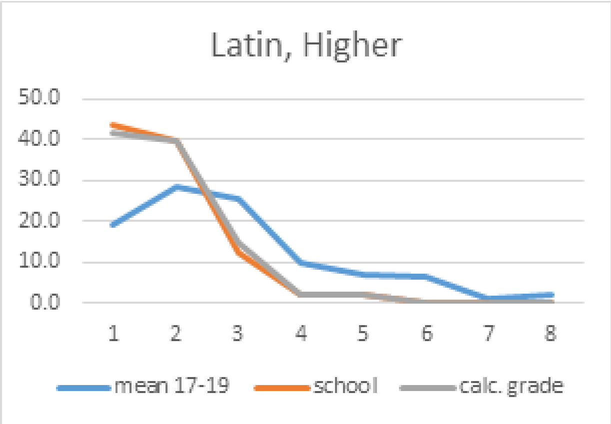




Latin

Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	74	21.6	23.0	23.0	9.5	5.4	12.2	2.7	2.7
2018	59	16.9	27.1	32.2	10.2	10.2	1.7	0.0	1.7
2019	54	18.5	37.0	22.2	11.1	5.6	3.7	0.0	1.9
2017–2019	187	19.2	28.3	25.7	10.2	7.0	6.4	1.1	2.2
school est. 2020	48	43.8	39.6	12.5	2.1	2.1	0.0	0.0	0.0
calc. grade 2020	48	41.7	39.6	14.6	2.1	2.1	0.0	0.0	0.0



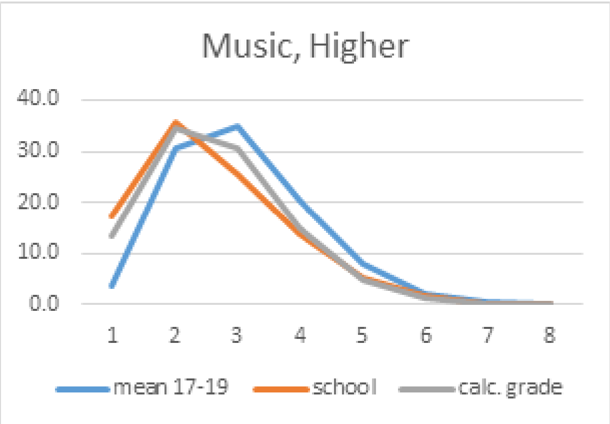
Music

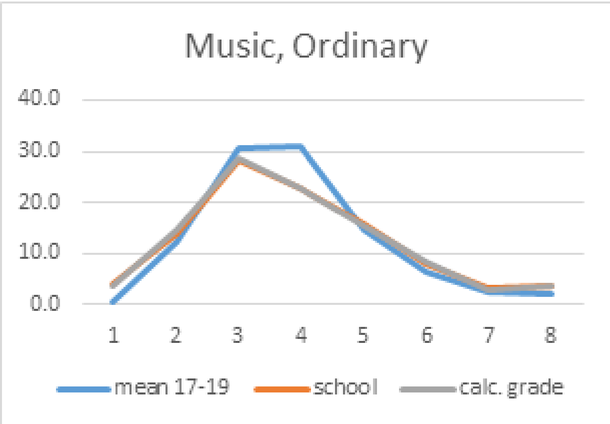
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	6,060	3.4	30.7	34.9	20.7	7.6	2.2	0.4	0.1
2018	5,921	3.4	28.8	34.1	22.1	8.5	2.5	0.5	0.1
2019	6,234	3.9	32.1	35.8	18.7	7.3	1.8	0.4	0.1
2017–2019	18,215	3.6	30.6	34.9	20.5	7.8	2.2	0.4	0.1
school est. 2020	6,504	17.5	35.7	25.5	13.7	5.2	1.8	0.3	0.2
calc. grade 2020	6,504	13.0	34.3	31.0	15.2	4.8	1.3	0.2	0.2

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	459	0.2	8.7	29.2	32.2	16.1	6.8	2.6	4.1
2018	462	0.9	13.4	32.9	31.6	11.9	5.4	2.4	1.5
2019	425	0.5	14.4	29.6	28.5	16.5	7.3	2.6	0.7
2017–2019	1,346	0.5	12.1	30.6	30.8	14.8	6.5	2.5	2.1
school est. 2020	427	4.2	14.0	28.3	22.7	15.9	7.9	3.3	3.7
calc. grade 2020	427	3.7	14.5	28.6	23.0	15.5	8.7	2.6	3.5





Physical Education

Higher level

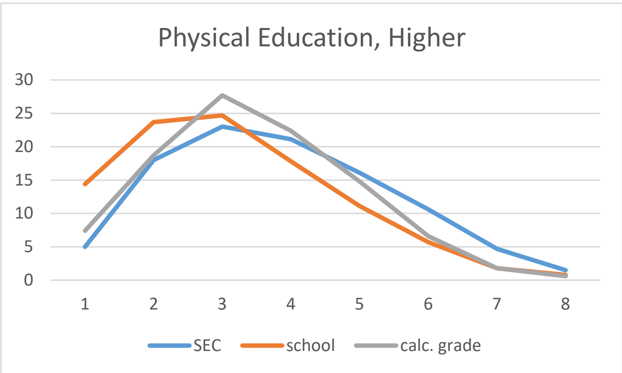
		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
*SEC**	-	5.0	18.0	23.0	21.1	16.1	10.6	4.7	1.5
school est. 2020	1374	14.4	23.7	24.7	17.8	11.1	5.7	1.8	0.8
calc. grade 2020	1374	7.4	18.6	27.7	22.6	14.8	6.6	1.8	0.6

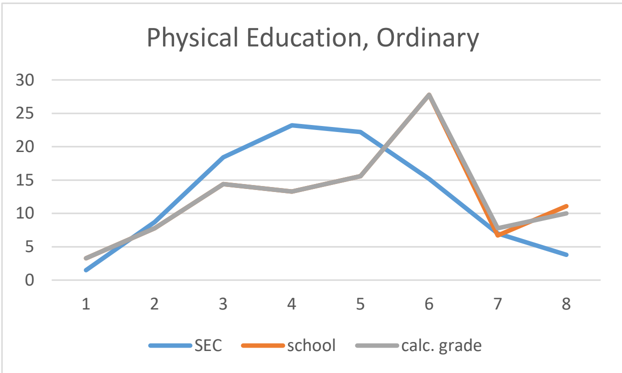
*See section 10.3: New subjects – Physical Education and Computer Science

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
*SEC**		1.5	8.7	18.4	23.2	22.2	15.2	7.0	3.8
school est. 2020	90	3.3	7.8	14.4	13.3	15.6	27.8	6.7	11.1
calc. grade 2020	90	3.3	7.8	14.4	13.3	15.6	27.8	7.8	10

*See section 10.3: New subjects – Physical Education and Computer Science





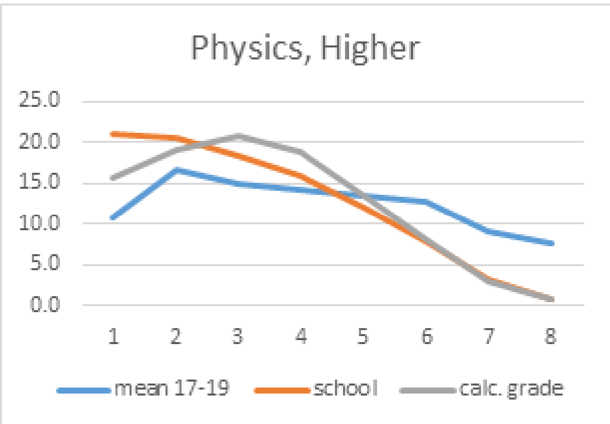
Physics

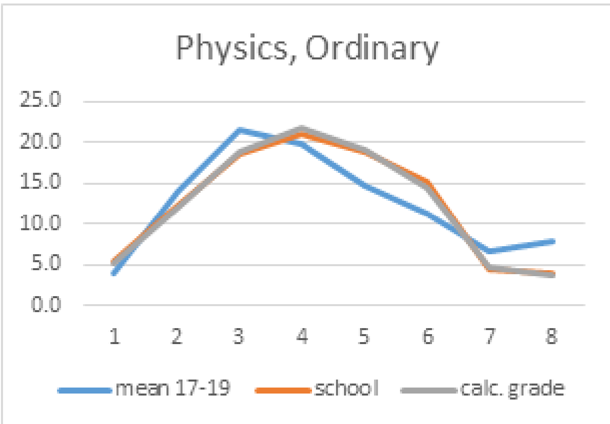
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	6,271	10.8	16.5	14.4	13.7	12.8	14.1	9.5	8.2
2018	6,258	10.9	17.1	15.8	14.9	13.2	11.6	8.8	7.7
2019	6,583	10.8	16.3	15.0	14.2	14.6	12.6	9.1	7.4
2017–2019	19,112	10.8	16.6	15.1	14.3	13.6	12.8	9.1	7.8
school est. 2020	7,032	21.0	20.6	18.4	16.0	12.0	7.9	3.2	0.9
calc. grade 2020	7,032	15.6	18.9	20.8	18.9	13.6	8.2	3.1	0.9

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,314	3.9	13.9	21.3	21.5	13.9	11.6	7.2	6.7
2018	1,277	4.3	14.3	20.6	18.0	16.3	10.7	7.1	8.6
2019	1,359	3.7	13.9	23.0	19.9	14.1	11.6	5.7	8.1
2017–2019	3,950	4.0	14.0	21.7	19.8	14.7	11.3	6.7	7.8
school est. 2020	1,055	5.4	12.2	18.7	21.1	19.0	15.3	4.5	3.9
calc. grade 2020	1,055	5.4	12.0	19.0	21.5	19.1	14.3	4.8	3.8





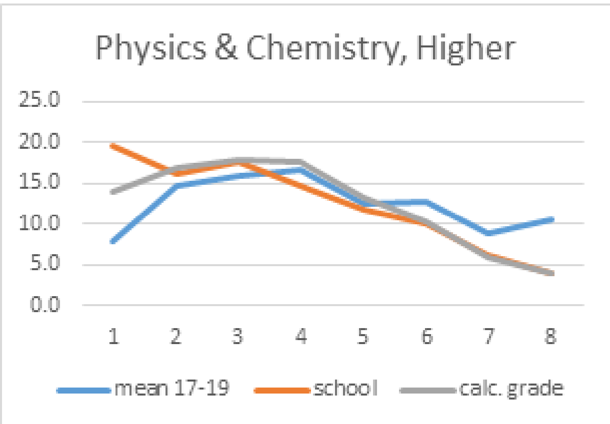
Physics & Chemistry

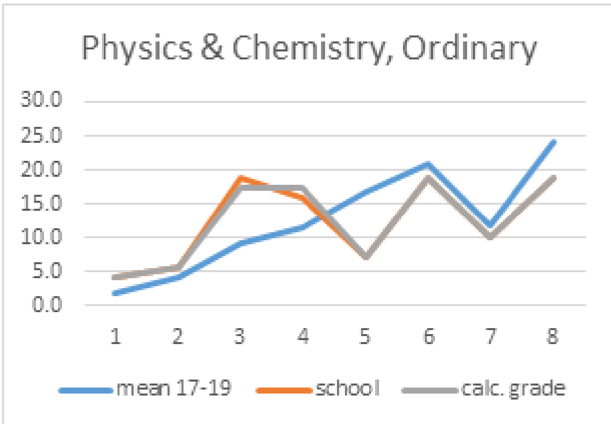
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	481	9.8	13.9	16.2	17.7	11.0	11.4	10.0	10.0
2018	415	5.8	14.5	14.9	18.1	14.5	14.7	7.5	10.1
2019	464	7.8	15.7	17.0	14.2	12.1	12.7	9.1	11.4
2017–2019	1,360	7.9	14.7	16.1	16.6	12.4	12.9	8.9	10.5
school est. 2020	461	19.5	16.3	17.6	14.8	11.7	10.0	6.3	3.9
calc. grade 2020	461	14.8	16.9	17.8	17.4	13.2	10.4	5.6	3.9

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	110	0.0	2.7	10.0	13.6	15.5	19.1	10.9	28.2
2018	103	1.9	2.9	7.8	9.7	18.4	26.2	13.6	19.4
2019	74	4.1	8.1	9.5	10.8	16.2	16.2	10.8	24.3
2017–2019	287	1.7	4.2	9.1	11.5	16.7	20.9	11.8	24.0
school est. 2020	69	4.3	5.8	18.8	15.9	7.2	18.8	10.1	18.8
calc. grade 2020	69	4.3	5.8	17.4	17.4	7.2	18.8	10.1	18.8





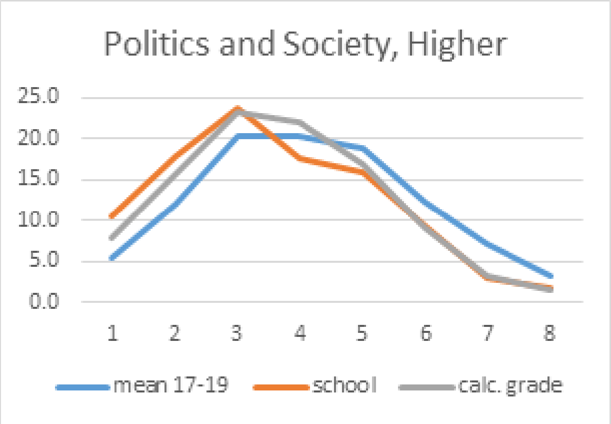
Politics and Society

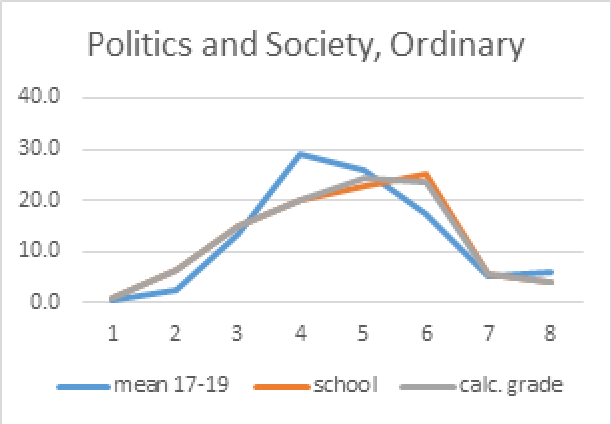
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	-	-	-	-	-	-	-	-	-
2018	774	6.1	13.2	20.4	19.4	19.1	12.1	6.8	774
2019	676	4.6	10.9	20.4	21.3	18.9	12.4	7.8	676
2017–2019	1,450	5.4	12.1	20.4	20.3	19.0	12.2	7.3	1,450
school est. 2020	1,437	10.5	18.0	23.7	17.7	15.9	9.3	3.1	1,437
calc. grade 2020	1,437	7.9	15.3	23.6	22.1	17.3	9.1	3.2	1,437

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	-	-	-	-	-	-	-	-	-
2018	93	1.1	3.2	14.0	28.0	28.0	12.9	7.5	5.4
2019	103	0.0	1.9	12.6	30.1	24.3	21.4	2.9	6.8
2017–2019	196	0.5	2.5	13.3	29.1	26.1	17.4	5.1	6.1
school est. 2020	214	0.9	6.5	14.9	20.0	22.8	25.1	5.6	4.2
calc. grade 2020	214	0.9	6.5	14.5	20.6	24.3	23.8	5.6	3.7





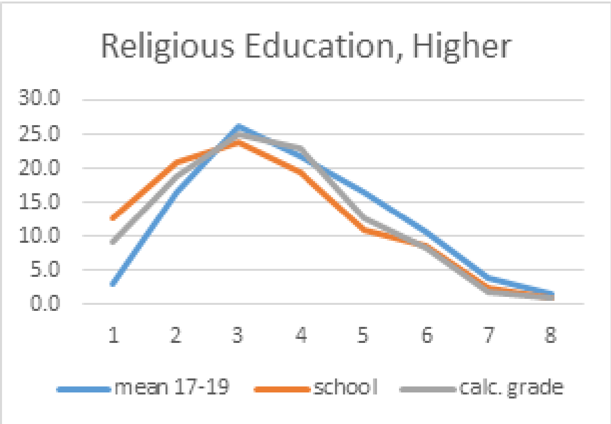
Religious Education

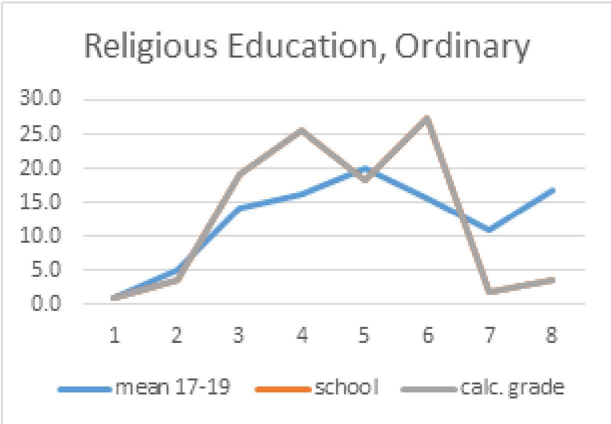
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,202	3.1	14.7	25.9	21.5	17.3	11.4	4.2	1.9
2018	1,081	3.0	16.6	27.8	22.8	15.5	9.2	3.8	1.4
2019	1,164	3.1	18.0	24.7	21.3	16.3	11.2	3.7	1.7
2017–2019	3,447	3.1	16.4	26.1	21.8	16.4	10.6	3.9	1.7
school est. 2020	1,199	12.8	20.9	23.9	19.3	10.9	8.6	2.5	1.1
calc. grade 2020	1,199	8.8	18.6	25.4	22.9	13.0	8.1	2.0	1.1

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	107	1.9	8.4	12.1	15.0	24.3	17.8	4.7	15.9
2018	108	0.9	2.8	16.7	16.7	17.6	19.4	13.9	12.0
2019	129	0.0	3.9	14.0	17.1	18.6	10.9	14.0	21.7
2017–2019	344	0.9	5.0	14.3	16.3	20.1	15.7	11.1	16.9
school est. 2020	110	0.9	3.6	19.1	25.5	18.2	27.3	1.8	3.6
calc. grade 2020	110	0.9	3.6	19.1	25.5	18.2	27.3	1.8	3.6





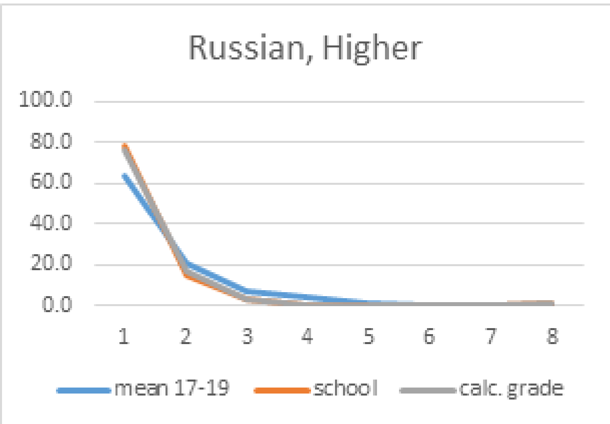
Russian

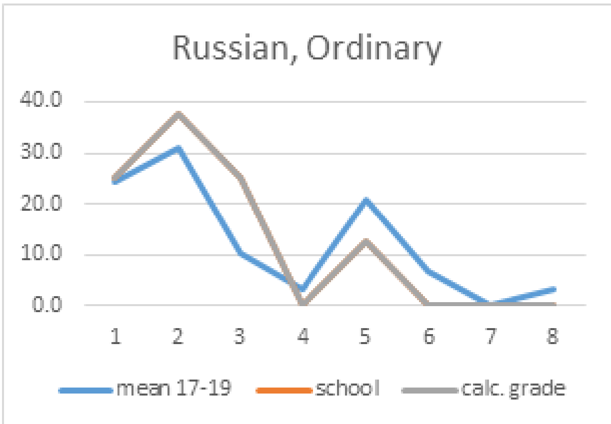
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	310	71.6	18.7	3.2	4.2	1.9	0.3	0.0	0.0
2018	350	63.7	20.6	8.0	4.3	1.4	1.1	0.9	0.0
2019	458	58.1	22.9	10.5	4.6	1.3	1.1	1.1	0.4
2017–2019	1,118	63.6	21.0	7.7	4.4	1.5	0.9	0.7	0.2
school est. 2020	367	78.3	15.2	3.7	0.5	0.3	0.3	0.0	1.6
calc. grade 2020	367	79.6	15.5	3.8	0.5	0.5	0.0	0.0	0.0

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	-	-	-	-	-	-	-	-	-
2018	17	11.8	41.2	11.8	5.9	17.6	11.8	0.0	0.0
2019	12	41.7	16.7	8.3	0.0	25.0	0.0	0.0	8.3
2017–2019	29	24.2	31.1	10.4	3.5	20.7	6.9	0.0	3.4
school est. 2020	8	25.0	37.5	25.0	0.0	12.5	0.0	0.0	0.0
calc. grade 2020	8	25.0	37.5	25.0	0.0	12.5	0.0	0.0	0.0





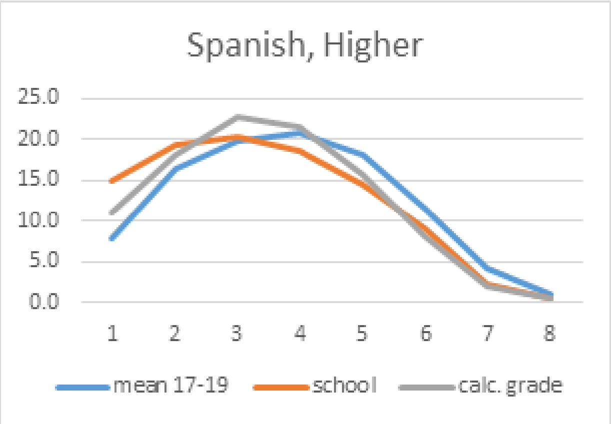
Spanish

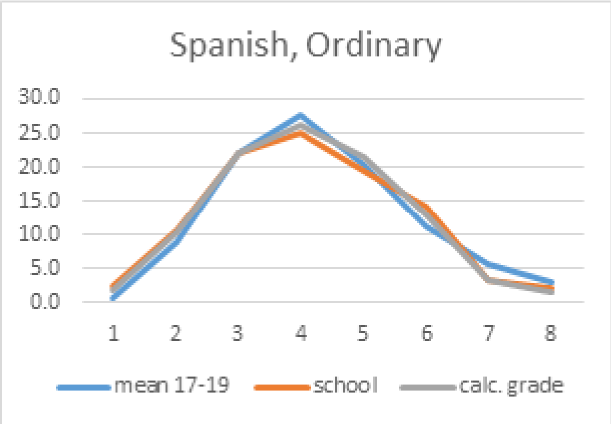
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	4,916	8.6	16.5	20.9	21.6	18.4	10.4	3.0	0.5
2018	4,967	7.6	16.5	21.1	21.4	17.9	10.9	3.7	0.8
2019	5,646	7.7	16.2	17.9	19.9	18.1	12.9	5.8	1.5
2017–2019	15,529	8.0	16.4	19.9	20.9	18.1	11.5	4.2	1.0
school est. 2020	6,301	14.9	19.3	20.3	18.7	14.4	9.2	2.4	0.7
calc. grade 2020	6,301	11.1	18.2	22.7	21.5	15.6	8.3	2.0	0.7

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	2,170	0.7	8.5	20.8	28.5	20.3	12.0	5.8	3.3
2018	2,060	0.5	9.7	24.4	26.8	20.3	10.3	4.9	3.1
2019	2,065	0.9	8.3	21.4	28.0	20.6	11.6	6.1	3.1
2017–2019	6,295	0.7	8.8	22.2	27.8	20.4	11.3	5.6	3.2
school est. 2020	2,029	2.4	10.8	22.2	25.1	19.5	14.3	3.3	2.3
calc. grade 2020	2,029	1.9	10.4	22.1	26.2	21.7	12.9	3.3	1.6





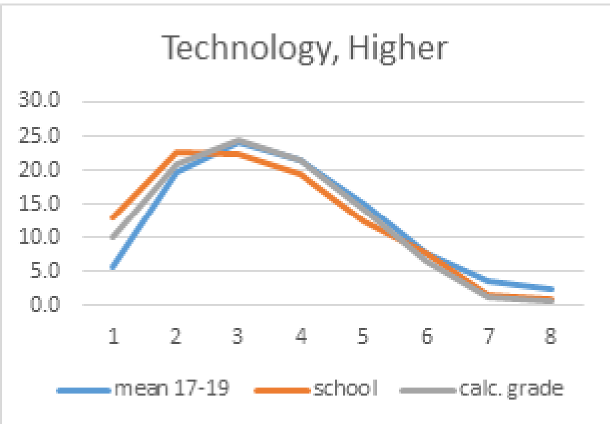
Technology

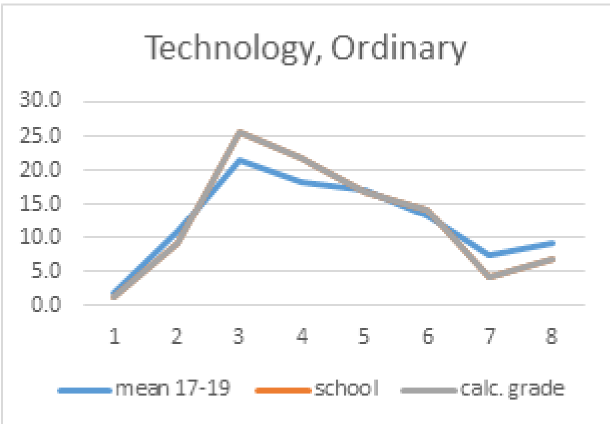
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,367	7.0	21.5	24.2	21.4	15.1	6.4	2.7	1.5
2018	1,430	5.4	20.0	24.5	22.3	14.1	7.7	3.7	2.4
2019	1,695	5.0	18.2	23.4	20.9	16.0	9.1	4.4	3.0
2017–2019	4,492	5.7	19.8	24.0	21.5	15.1	7.8	3.7	2.4
school est. 2020	1,696	13.0	22.6	22.5	19.3	12.3	7.7	1.5	0.9
calc. grade 2020	1,696	10.0	20.8	24.5	21.7	14.3	6.6	1.4	0.8

Ordinary level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	160	1.9	9.4	23.8	20.6	16.3	10.6	8.8	8.8
2018	104	1.9	9.6	21.2	19.2	21.2	15.4	5.8	5.8
2019	176	1.7	13.1	19.9	15.9	15.3	14.8	7.4	11.9
2017–2019	440	1.8	10.9	21.6	18.4	17.1	13.4	7.5	9.3
school est. 2020	161	1.2	9.3	25.5	21.7	16.8	14.3	4.3	6.8
calc. grade 2020	161	1.2	9.3	25.5	21.7	16.8	14.3	4.3	6.8

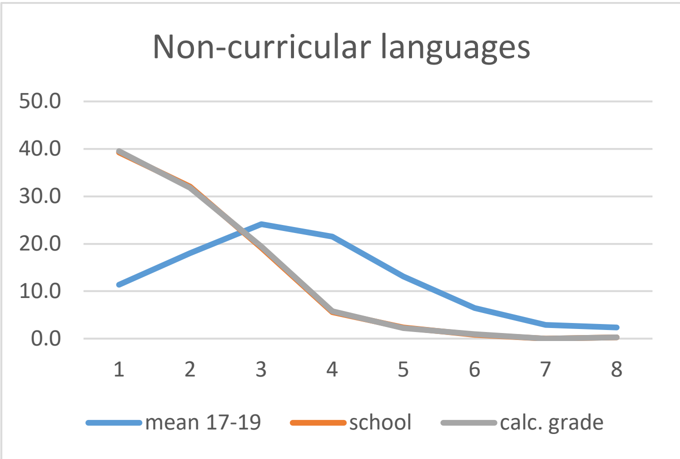




Non-curricular languages

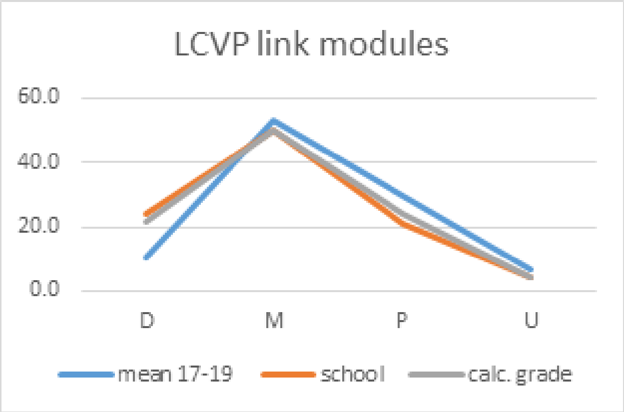
Higher level

		percentage awarded each grade							
year	number	1	2	3	4	5	6	7	8
2017	1,430	10.2	19.2	23.7	20.1	11.9	7.6	4.4	2.9
2018	1,462	10.6	16.6	23.9	22.9	15.9	6.0	2.1	2.0
2019	1,681	13.5	18.3	24.7	21.5	11.5	5.8	2.3	2.3
2017–2019	4,573	11.4	18.0	24.1	21.5	13.1	6.5	2.9	2.4
school est. 2020	969	39.3	32.1	19.2	5.62	2.39	0.83	0.0	0.3
calc. grade 2020	969	39.5	31.8	19.4	5.8	2.3	0.9	0.0	0.3



LCVP link modules

		percentage at each grade			
year	number	distinction	merit	pass	ungraded
2017	14,038	11.1	55.5	28.1	5.3
2018	13,369	11.8	51.8	29.6	6.8
2019	13,130	8.9	52.5	30.9	7.6
2017–2019	40,537	10.6	53.3	29.5	6.6
school est. 2020	13,470	24.2	50	21.2	4.6
calc. grade 2020	13,470	21.4	50.3	23.8	4.5

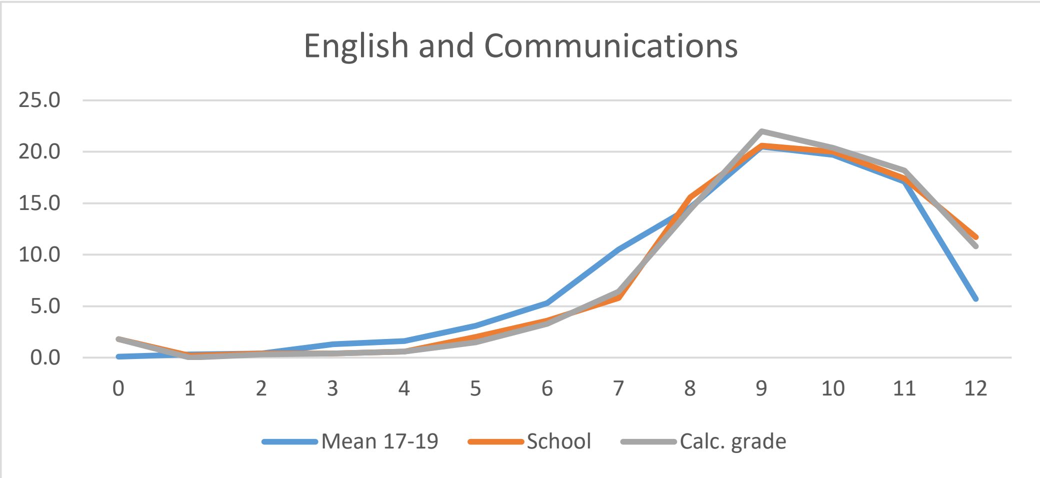


Leaving Certificate Applied

Note that, while in the Leaving Certificate Established the labelling of the grades is such that the grade with the lower number is the higher level of achievement, Leaving Certificate Applied grading is based on accumulation of credits, so a higher number of credits is a higher level of achievement.

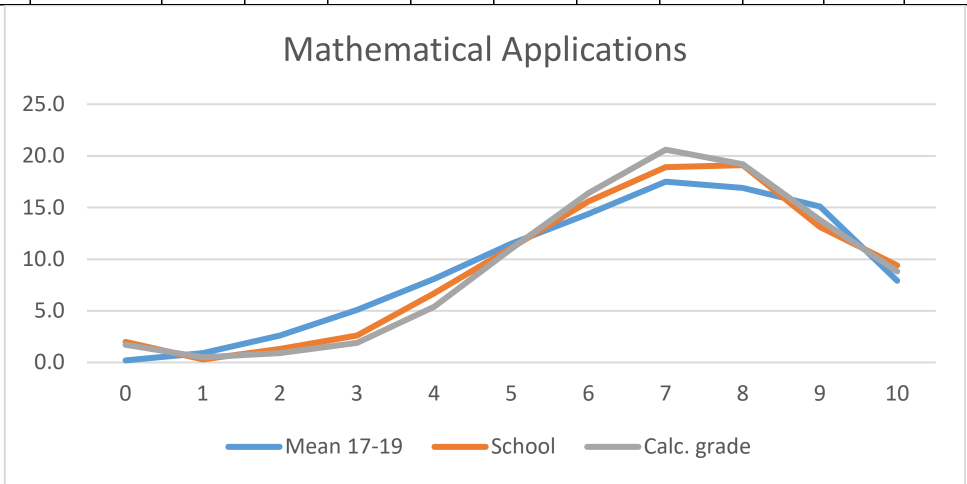
English and Communication

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	2586	0.1	0.5	0.3	1.5	1.5	3.2	5.1	10.8	15.4	19.8	20.2	16.0	5.5
2018	2560	0.1	0.2	0.5	1.1	1.7	3.8	5.9	11.5	14.6	21.2	18.4	16.5	4.7
2019	2583	0.0	0.3	0.4	1.2	1.7	2.2	4.8	9.1	13.7	20.4	20.4	18.8	6.9
2017–2019	7729	0.1	0.3	0.4	1.3	1.6	3.1	5.3	10.5	14.6	20.5	19.7	17.1	5.7
School est.	2850	1.8	0.2	0.4	0.4	0.6	2.0	3.6	5.8	15.6	20.6	20.0	17.4	11.7
Calc. grades	2850	1.8	0	0.3	0.4	0.6	1.5	3.4	6.3	14.5	21.9	20.2	18.6	10.6



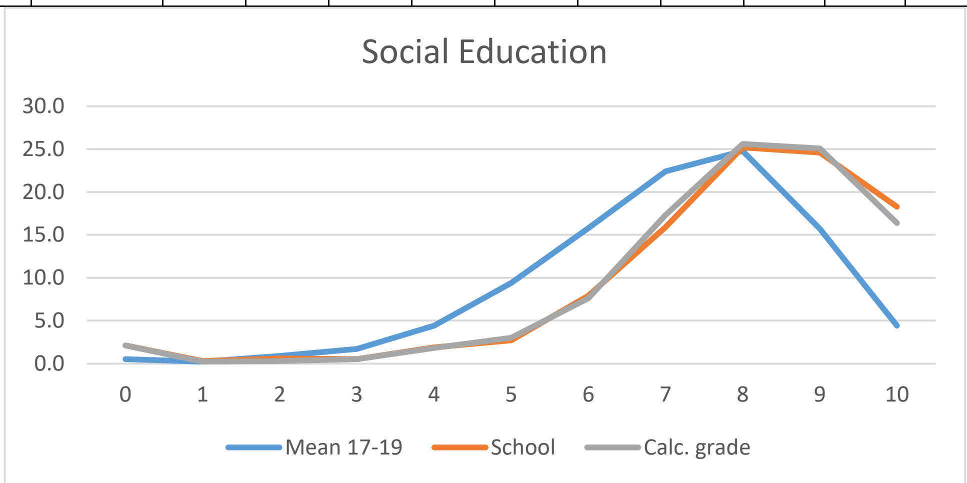
Mathematical Applications

	number of students	percentage at each number of credits										
		0	1	2	3	4	5	6	7	8	9	10
2017	2552	0.2	0.8	2.4	4.5	7.1	10.3	13.7	17.3	17.7	16.9	9.2
2018	2525	0.0	1.1	3.0	5.7	8.2	12.5	14.3	18.0	16.2	14.1	6.8
2019	2540	0.2	0.8	2.3	5.1	9.0	11.6	15.2	17.3	16.7	14.2	7.6
2017–2019	7617	0.2	0.9	2.6	5.1	8.1	11.5	14.4	17.5	16.9	15.1	7.9
School est.	2850	2.0	0.3	1.3	2.6	6.7	11.1	15.6	18.9	19.1	13.1	9.4
Calc. grades	2850	2	0.2	0.9	1.8	5.4	11	16.4	20.6	19.2	13.8	8.8



Social Education

	number of students	percentage at each number of credits										
		0	1	2	3	4	5	6	7	8	9	10
2017	2567	0.0	0.2	0.8	1.7	3.9	8.3	15.7	24.2	26.1	14.8	4.4
2018	2541	0.0	0.2	1.2	2.1	4.6	10.4	15.4	21.6	24.4	15.9	4.2
2019	2567	0.1	0.3	0.7	1.8	4.8	9.5	16.4	21.5	23.9	16.5	4.6
2017–2019	7675	0.5	0.2	0.9	1.7	4.4	9.4	15.8	22.4	24.8	15.7	4.4
School est.	2850	2.1	0.3	0.6	0.5	1.9	2.7	7.9	15.9	25.2	24.6	18.3
Calc. grades	2850	2.1	0.2	0.3	0.5	1.8	3.1	7.6	17.8	25.2	25.2	16.2



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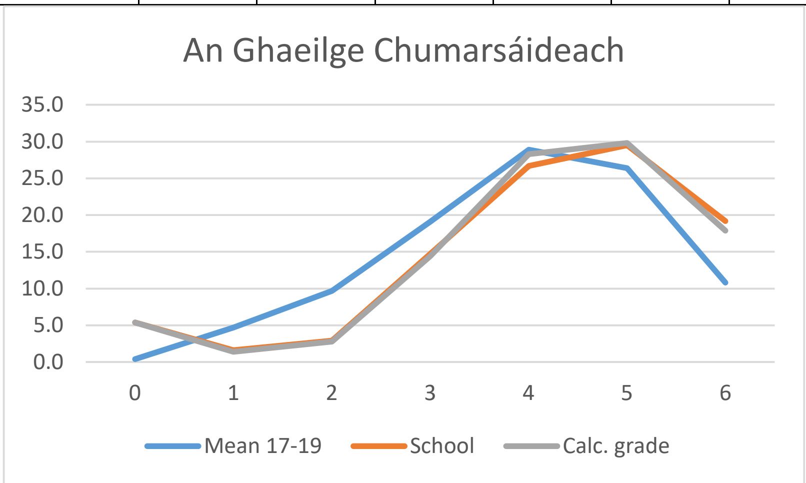
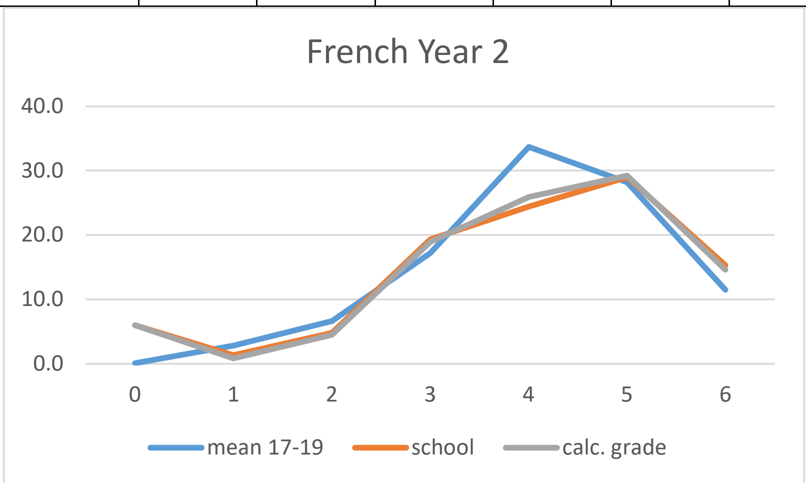
	number of students	percentage at each number of credits						
		0	1	2	3	4	5	6
2017	1696	0.4	3.7	8.1	18.2	30.6	27.9	11.1
2018	1622	0.3	4.9	10.0	17.4	29.0	27.7	10.5
2019	1545	0.6	5.5	11.1	21.6	27.2	23.4	10.6
2017–2019	4863	0.4	4.7	9.7	19.1	28.9	26.4	10.8
School est.	887	5.4	1.6	2.9	14.7	26.7	29.5	19.2
Calc. grades	887	5.4	1.2	2.9	14.4	28.4	30.1	17.5



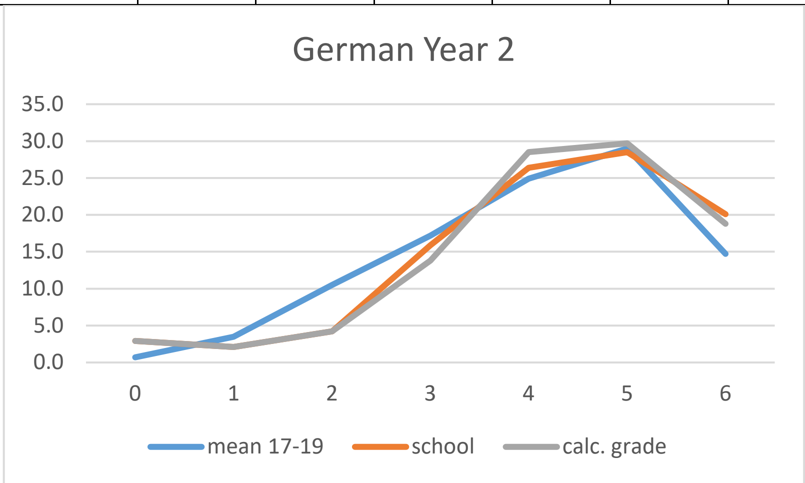
French – Year 2

	number of students	percentage at each number of credits						
		0	1	2	3	4	5	6
2017	1100	0.0	3.3	6.0	16.1	34.2	30.5	10.0
2018	1087	0.4	3.1	7.3	20.2	33.7	24.7	10.7
2019	991	0.0	1.9	6.6	15.2	33.1	29.3	13.9
2017–2019	3178	0.1	2.8	6.6	17.2	33.7	28.2	11.5
School est.	903	6.0	1.3	4.8	19.3	24.4	29.0	15.3
Calc. grades	903	0.8	4.3	19.2	25.8	29.8	14.2	903



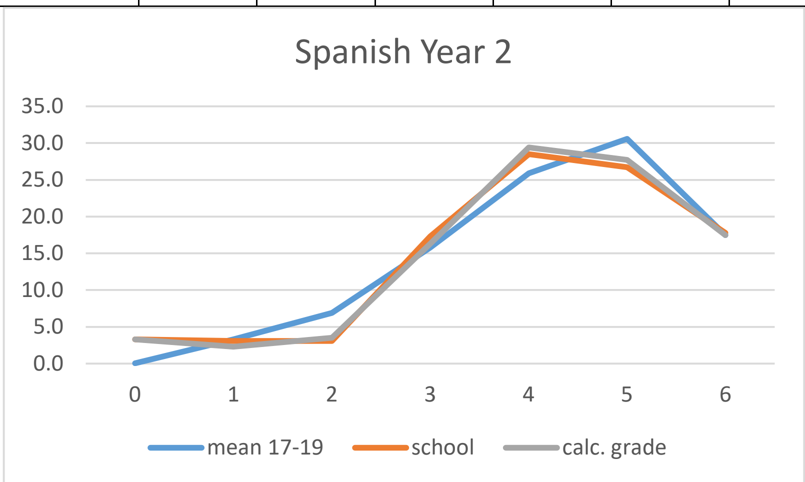
German – Year 2

	number of students	percentage at each number of credits						
		0	1	2	3	4	5	6
2017	417	0.2	2.6	12.2	18.7	24.5	27.3	14.4
2018	335	0.3	3.3	11.3	17.6	24.8	27.2	15.5
2019	374	0.3	4.5	8.0	15.2	25.4	32.4	14.2
2017–2019	1126	0.7	3.5	10.5	17.2	24.9	29.0	14.7
School est.	239	2.9	2.1	4.2	15.9	26.4	28.5	20.1
Calc. grades	239	2.9	2.1	4.2	13.8	28.5	29.7	18.8



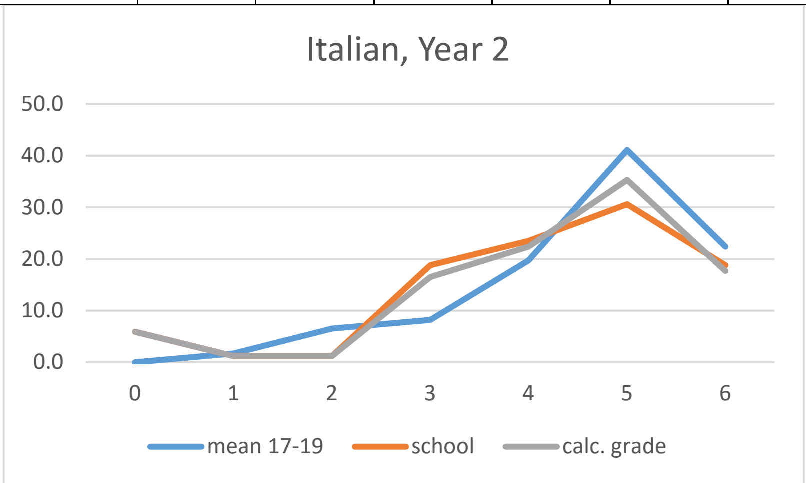
Spanish – Year 2

	number of students	percentage at each number of credits						
		0	1	2	3	4	5	6
2017	417	725	0.0	4.4	7.9	16.3	24.8	27.4
2018	335	689	0.1	2.3	5.2	13.4	26.6	34.7
2019	374	779	0.1	3.2	7.6	17.6	26.3	29.7
2017–2019	1126	2193	0.1	3.3	6.9	15.8	25.9	30.6
School est.	606	3.3	3.1	3.1	17.3	28.5	26.7	17.8
Calc. grades	606	3.3	2.5	3.1	16.3	29.4	28.4	17.0



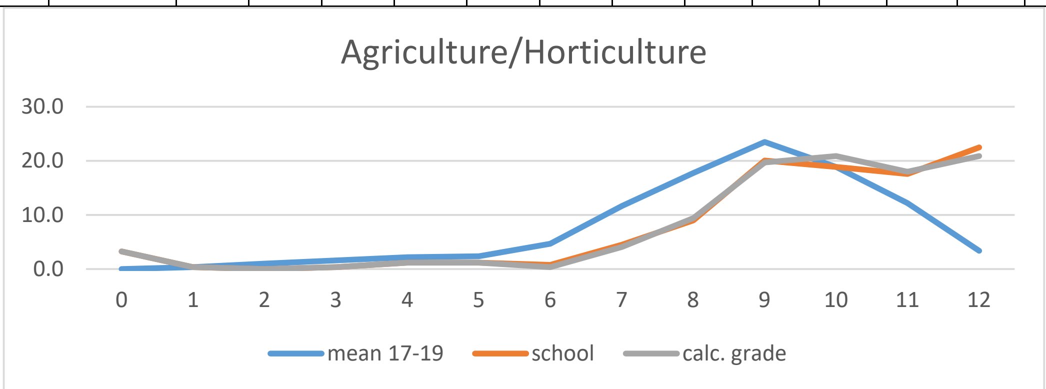
Italian – Year 2

	number of students	percentage at each number of credits						
		0	1	2	3	4	5	6
2017	417	96	0.0	1.0	6.3	9.4	22.9	39.6
2018	335	106	0.0	2.8	5.7	10.4	22.6	36.8
2019	374	81	1.2	1.2	7.4	4.9	13.6	46.9
2017–2019	1126	283	0.0	1.7	6.5	8.2	19.7	41.1
School est.	85	5.9	1.2	1.2	18.8	23.5	30.6	18.8
Calc. grades	85	5.9	1.2	1.2	16.5	22.4	35.3	17.6



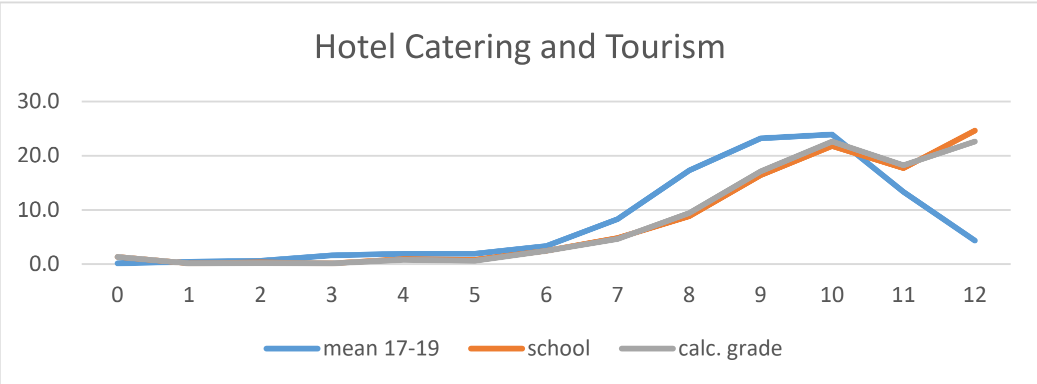
Agriculture/Horticulture

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	215	0.0	0.5	1.4	0.9	0.5	3.7	4.2	11.6	16.3	27.4	16.7	13.0	3.7
2018	219	0.0	0.5	0.9	2.3	3.7	2.7	4.6	12.8	16.9	20.5	19.6	13.7	1.8
2019	297	0.3	0.3	0.7	1.7	2.4	0.7	5.4	10.8	20.2	22.6	20.5	9.8	4.7
2017–2019	731	0.0	0.4	1.0	1.6	2.2	2.4	4.7	11.7	17.8	23.5	18.9	12.2	3.4
School est.	244	3.3	0.4	0.0	0.4	1.2	1.2	0.8	4.5	9.0	20.1	18.9	17.6	22.5
Calc. grades	244	3.3	0.4	0.4	1.2	1.2	0.4	4.1	9.8	19.7	20.5	18	20.9	244



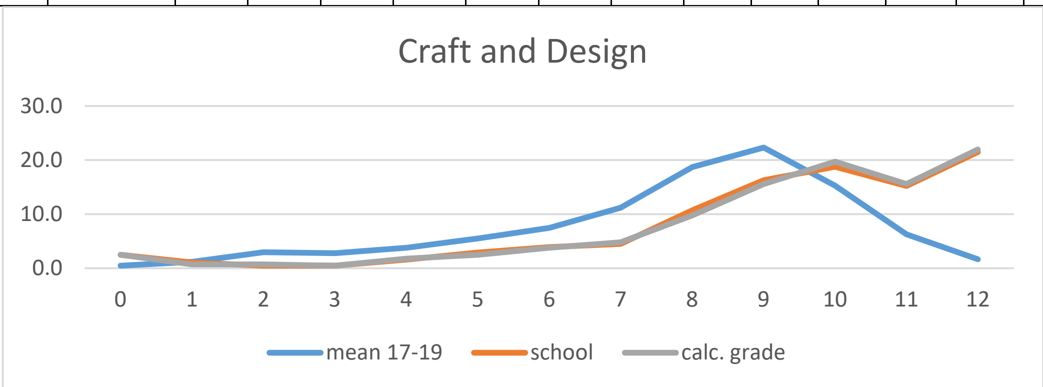
Hotel Catering and Tourism

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	1314	0.1	0.2	0.4	1.3	1.7	2.0	2.7	8.3	16.5	24.0	26.0	12.5	4.6
2018	1335	0.0	0.4	0.7	1.7	1.6	1.7	3.9	8.8	17.4	22.4	22.8	14.2	4.4
2019	1159	0.3	0.5	0.8	1.9	2.5	1.9	3.3	7.8	17.9	23.2	22.8	13.3	3.9
2017–2019	3808	0.1	0.4	0.6	1.6	1.9	1.9	3.3	8.3	17.3	23.2	23.9	13.3	4.3
School est.	1388	1.3	0.1	0.3	0.1	0.9	0.8	2.4	4.8	8.8	16.4	21.8	17.7	24.6
Calc. grades	1388	1388	1.3	0.1	0.2	0.8	0.7	2.3	4.7	9.5	17.6	22.1	18.4	22.3



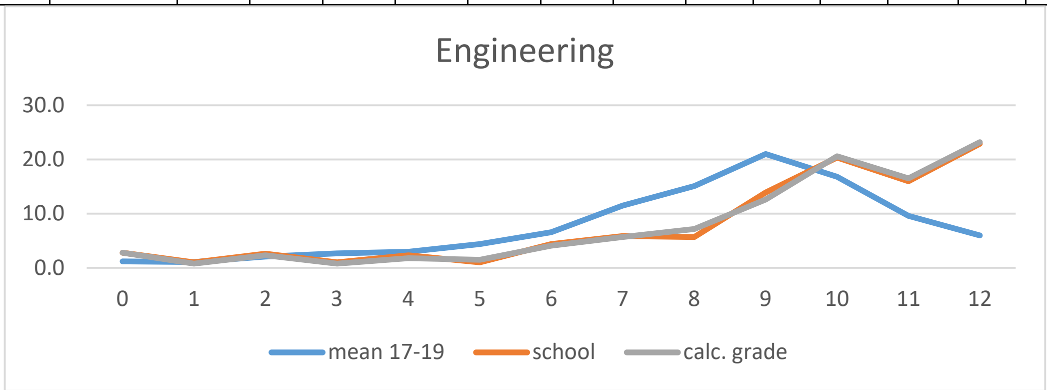
Craft and Design

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	468	0.2	1.1	2.4	3.0	5.6	6.2	9.4	13.0	19.2	19.2	14.5	4.1	2.1
2018	437	0.7	0.7	3.2	2.7	2.5	5.5	5.9	11.0	19.0	25.2	15.8	6.4	1.4
2019	469	0.6	1.9	3.4	2.8	3.4	4.9	7.2	9.6	17.9	22.6	15.6	8.5	1.5
2017–2019	1374	0.5	1.2	3.0	2.8	3.8	5.5	7.5	11.2	18.7	22.3	15.3	6.3	1.7
School est.	559	2.5	1.1	0.5	0.5	1.6	2.9	3.9	4.5	10.7	16.3	18.8	15.2	21.5
Calc. grades	559	2.5	0.7	0.7	0.5	1.6	2.5	4.1	4.7	9.7	15.9	18.8	16.6	21.6



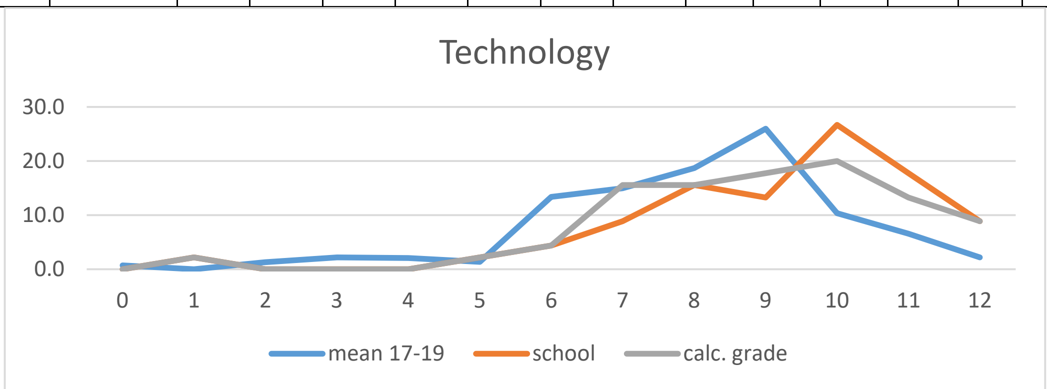
Engineering

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	422	0.5	0.7	2.6	3.8	4.0	3.8	7.6	12.6	18.7	19.7	13.3	8.3	4.5
2018	409	0.5	1.0	1.5	1.2	2.0	4.9	5.6	7.8	13.2	19.6	21.8	13.0	8.1
2019	434	0.2	1.4	2.1	3.0	3.0	4.6	6.7	14.1	13.4	23.7	15.2	7.4	5.3
2017–2019	1265	1.2	1.1	2.1	2.7	3.0	4.4	6.6	11.5	15.1	21.0	16.8	9.6	6.0
School est.	388	2.8	1.0	2.6	1.0	2.3	1.0	4.4	5.9	5.7	13.9	20.4	16.0	22.9
Calc. grades	388	2.8	0.8	2.1	1	2.1	1.3	4.1	5.7	7.2	13.4	20.4	15.7	23.5



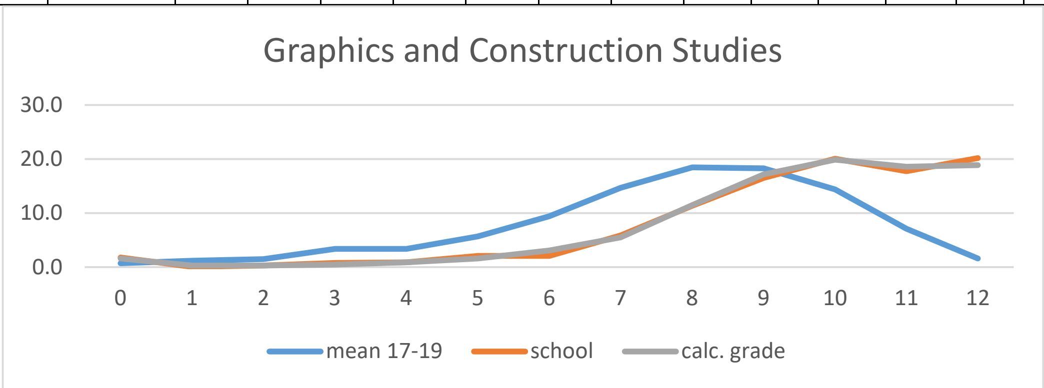
Technology

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	51	0.0	0.0	3.9	2.0	2.0	0.0	9.8	17.6	25.5	25.5	11.8	2.0	0.0
2018	22	0.0	0.0	0.0	4.5	0.0	0.0	13.6	4.5	18.2	31.8	9.1	13.6	4.5
2019	48	2.1	0.0	0.0	0.0	4.2	4.2	16.7	22.9	12.5	20.8	10.4	4.2	2.1
2017–2019	121	0.7	0.0	1.3	2.2	2.1	1.4	13.4	15.0	18.7	26.0	10.4	6.6	2.2
School est.	45	0.0	2.2	0.0	0.0	0.0	2.2	4.4	8.9	15.6	13.3	26.7	17.8	8.9
Calc. grades	45	2.2	0	0	0	2.2	4.4	15.6	17.8	20	20	8.9	8.9	45



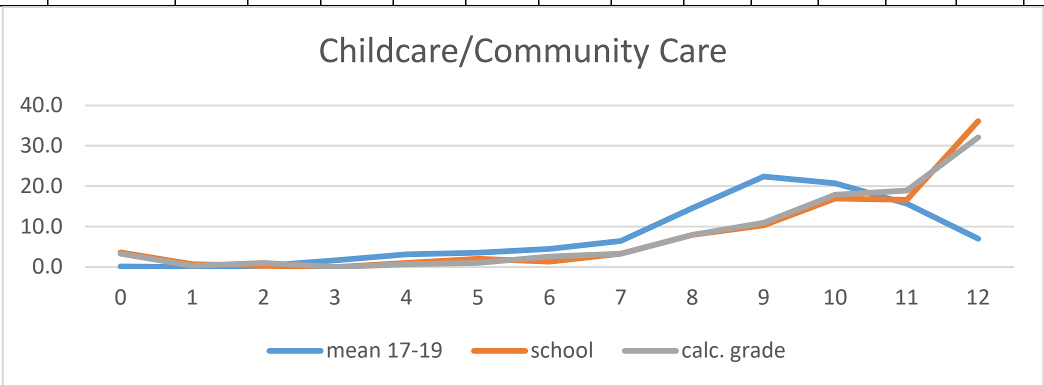
Graphics and Construction Studies

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	998	0.4	0.9	1.7	4.8	4.0	4.9	9.9	14.4	18.4	18.2	13.7	7.3	1.2
2018	1035	0.9	1.4	1.5	2.5	2.6	6.1	11.1	14.9	19.4	18.4	12.9	6.8	1.5
2019	1029	0.7	1.3	1.4	3.0	3.7	6.1	7.3	14.8	17.7	18.2	16.7	7.2	2.0
2017–2019	3062	0.7	1.2	1.5	3.4	3.4	5.7	9.4	14.7	18.5	18.3	14.4	7.1	1.6
School est.	1177	1.8	0.1	0.3	0.8	0.9	2.1	2.1	5.9	11.4	16.5	20.1	17.8	20.2
Calc. grades	1177	1.6	0.3	0.3	0.5	1	1.6	3.1	5.5	11.4	17.8	19.5	18.8	18.7



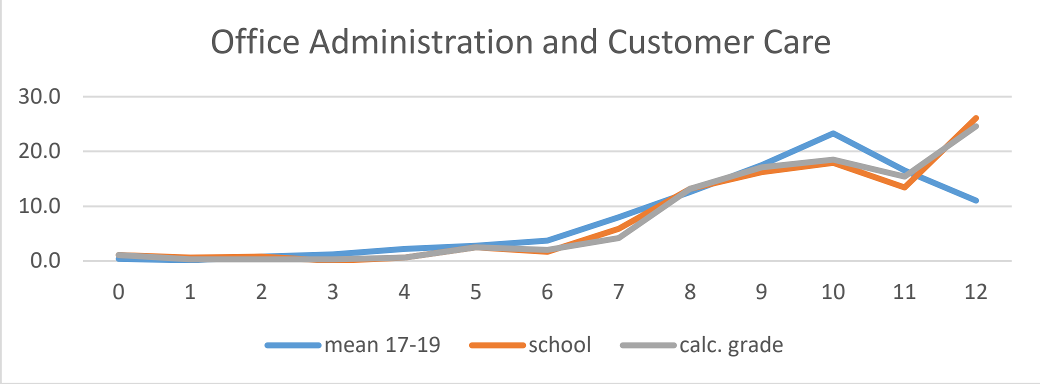
Childcare / Community Care

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	270	0.0	0.0	0.0	1.5	2.6	4.4	2.6	7.4	11.1	22.2	25.6	17.4	5.2
2018	225	0.4	0.0	0.9	1.8	4.4	4.4	6.7	4.4	14.7	20.9	20.9	12.9	7.6
2019	256	0.0	0.0	0.0	1.6	2.3	1.6	4.3	7.4	18.0	24.2	15.6	16.8	8.2
2017–2019	751	0.1	0.0	0.3	1.6	3.1	3.5	4.5	6.4	14.6	22.4	20.7	15.7	7.0
School est.	302	3.6	0.7	0.3	0.0	1.0	2.0	1.3	3.3	7.9	10.3	16.9	16.6	36.1
Calc. grades	302	3.3	0.3	1	0.7	1	2.6	3.6	7.9	10.9	17.5	19.2	31.8	302



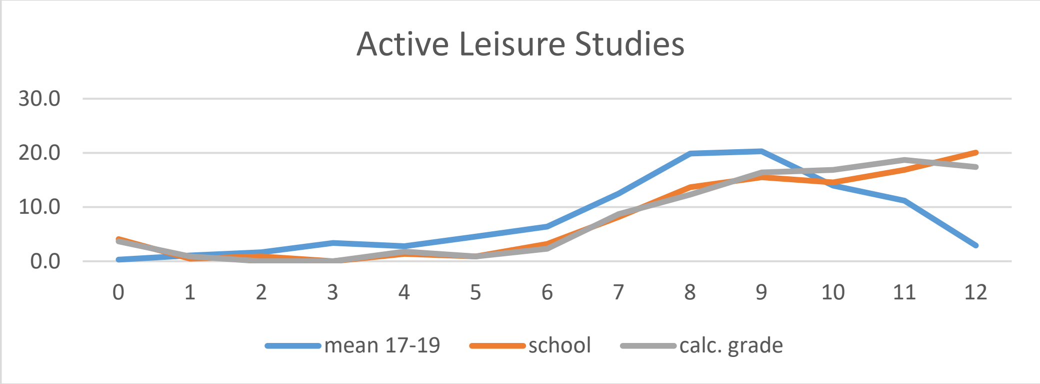
Office Administration & Customer Care

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	247	0.0	0.0	0.4	0.8	1.6	2.0	2.4	10.5	10.1	16.6	24.7	17.0	13.8
2018	326	0.0	0.3	0.6	0.6	2.8	2.1	4.3	7.1	15.0	19.3	23.6	16.0	8.3
2019	231	1.3	0.0	1.3	2.2	2.2	4.3	4.3	6.5	12.6	16.5	21.6	16.5	10.8
2017–2019	804	0.4	0.1	0.8	1.2	2.2	2.8	3.7	8.0	12.6	17.5	23.3	16.5	11.0
School est.	357	1.1	0.6	0.8	0.0	0.6	2.5	1.7	5.9	13.2	16.2	17.9	13.4	26.1
Calc. grades	357	1.1	0.3	0.3	0.3	0.6	2.5	2	4.2	13.2	17.1	18.5	15.4	24.6



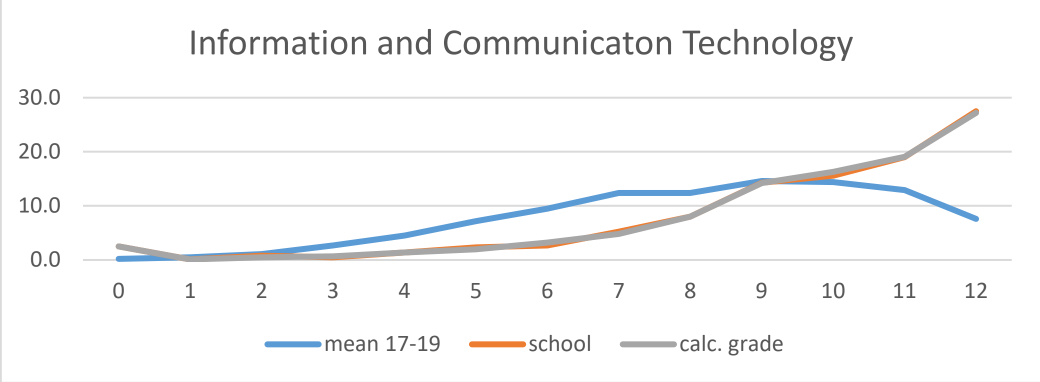
Active Leisure Studies

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	105	0.0	0.0	0.0	3.8	2.9	3.8	6.7	10.5	20.0	21.0	11.4	15.2	4.8
2018	116	0.9	0.9	2.6	1.7	2.6	1.7	6.9	13.8	15.5	20.7	18.1	12.9	1.7
2019	145	0.0	0.7	1.4	4.8	2.8	8.3	5.5	13.1	24.1	19.3	12.4	5.5	2.1
2017–2019	366	0.3	1.1	1.7	3.4	2.8	4.6	6.4	12.5	19.9	20.3	14.0	11.2	2.9
School est.	219	4.1	0.5	0.9	0.0	1.4	0.9	3.2	8.2	13.7	15.5	14.6	16.9	20.1
Calc. grades	219	3.7	0.9	0	0	1.4	1.4	1.8	9.1	12.3	16.4	16.9	18.7	17.4



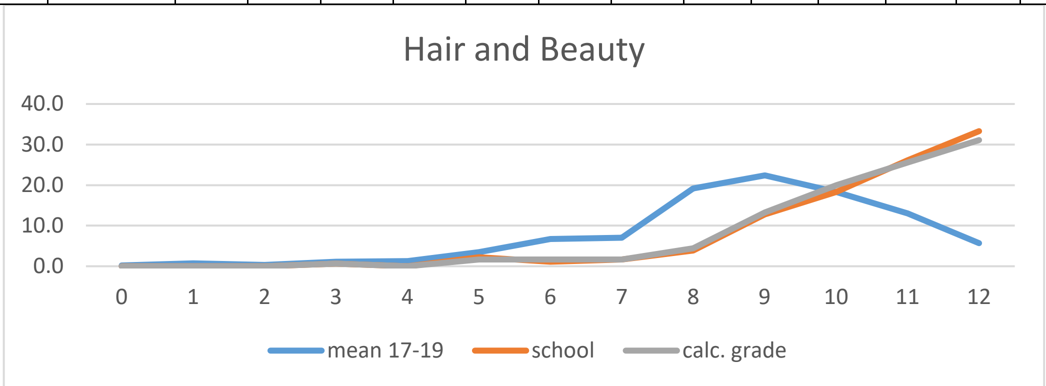
Information and Communication Technology

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	887	0.1	0.9	0.3	2.5	3.9	6.8	9.8	13.0	13.9	14.5	14.9	12.6	6.8
2018	796	0.1	0.3	1.0	1.8	4.1	8.2	8.8	11.9	13.3	14.9	15.3	12.4	7.8
2019	903	0.3	0.4	1.9	3.9	5.4	6.6	9.9	12.2	9.9	14.5	13.1	13.6	8.3
2017–2019	2586	0.2	0.5	1.1	2.7	4.5	7.2	9.5	12.4	12.4	14.6	14.4	12.9	7.6
School est.	839	2.5	0.1	0.8	0.5	1.4	2.3	2.7	5.2	8.0	14.3	15.6	19.0	27.5
Calc. grades	839	2.5	0.1	0.5	0.7	1.4	2	3.2	4.8	8	14.2	16.3	19.1	27.2



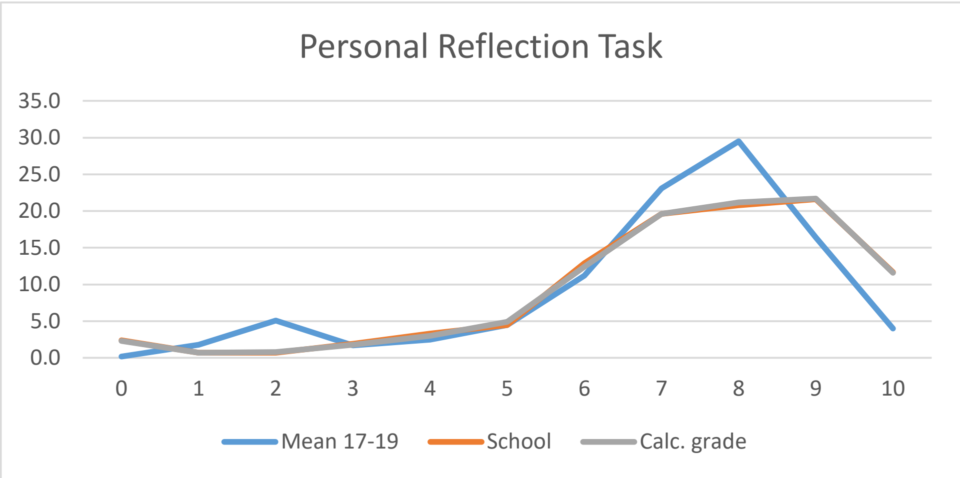
Hair and Beauty

	number of students	percentage at each number of credits												
		0	1	2	3	4	5	6	7	8	9	10	11	12
2017	156	0.6	1.3	0.6	1.9	1.3	3.8	5.8	10.9	19.9	22.4	16.0	9.6	5.8
2018	151	0.0	0.0	0.0	0.7	0.0	2.6	6.0	6.0	19.2	27.8	17.2	15.2	5.3
2019	147	0.0	0.7	2.0	0.7	2.7	4.1	8.2	4.1	18.4	17.0	21.8	14.3	6.1
2017–2019	454	0.2	0.7	0.3	1.1	1.3	3.5	6.7	7.0	19.2	22.4	18.3	13.0	5.7
School est.	180	0.0	0.0	0.0	0.6	0.0	2.2	1.1	1.7	3.9	12.8	18.3	26.1	33.3
Calc. grades	180	0	0	0	0.6	0	1.7	1.7	1.7	4.4	13.3	20	25.6	31.1



Personal Reflection Task

	number of students	percentage at each number of credits										
		0	1	2	3	4	5	6	7	8	9	10
2017	2668	0.1	1.9	5.2	2.4	2.8	4.7	11.2	21.7	26.9	17.5	5.5
2018	2632	0.3	2.2	5.2	1.4	2.8	5.0	12.2	24.0	30.4	13.3	3.2
2019	2640	0.3	1.3	5.0	1.4	1.9	3.8	10.1	23.6	31.1	18.4	3.2
2017–2019	7940	0.2	1.8	5.1	1.7	2.5	4.5	11.2	23.1	29.5	16.4	4.0
School est.	2852	2.4	0.7	0.7	1.9	3.3	4.5	12.9	19.6	20.8	21.6	11.7
Calc. grades	2852	2.3	0.6	0.8	1.8	3	4.9	12.4	19.6	21.3	21.7	11.6



Appendix I. Note from State Examinations Commission regarding anticipated national grade distributions for Physical Education and Computer Science

Grading profiles for examination subject not previously examined – Physical Education and Computer Science

1 Background

In the course of normal events the process of setting grade outcomes distribution for a newly introduced subject involves a number of considerations including

1. Nature of the subject
   a. Component structure & weightings as well as impact of multiple components
2. Nature of the cohort
   a. Composition and academic strength of the cohort
3. Professional and academic judgement
   a. Consideration of a combination of the requirements of the syllabus, the examination and, very importantly, the quality of student engagement as observed at the early stages of marking, by the college of professionals that form the senior examining team.
   b. Discussion with senior management experienced in assessment within the Examinations and Assessment Division of the SEC who advise on arriving at what constitutes an appropriate place for outcomes to fall.

The outcomes reflect what is seen as a fair and proper set of results considering the demands of subject, the demands of the test and a true reflection of actual candidate attainment.

2 Considerations for 2020 Leaving Certificate Physical Education and Computer Science

Due to Covid-19, in 2020 In 2020 the establishment of an appropriate set of outcomes for Leaving Certificate Physical Education and Leaving Certificate Computer Science will not benefit from the inputs derived from consideration of how the examination was received and engaged with by candidates (3 above) and therefore the actual evidence of student attainment of the curricular objectives is not available.

However, some of the SEC's historical data sets made available to the Calculated Grades Executive Office in the Department of Education and Skills for use in the determination of calculated grades can be analysed and used by the SEC to provide information that can advise on the possible outcomes of these candidates generally and so serves as strong support for the broader judgemental processes that have to be employed.

1. Nature of the subject
   a. Component structure & weightings as well as impact of numbers of components
2. Nature of the cohort
   a. Composition and strength of the cohort
   b. Analysis of the profile of the cohort for these subjects against the generality of candidates and some other subjects

Nature of the subject

Both PE and Comp Sc have essentially a 3 component assessment structures; PE has a Performance Assessment Project, a Performance Assessment and a written examination, while Comp Sc has a Project, a computer-based (programming) test and a written examination (though the latter two are taken as terminal tests as part of a single session). The impact of multiple components, particularly when each component has a significant weighting, tends to be the compression of the grade profile resulting in lower awards at the extremes of the grade spectrum.

Nature of the cohort

Physical Education would be expected to draw candidates with a 'sports' background and from across the academic ability range. The attainment profile of the group is likely to fall close to the mean of the generality of candidates.

Despite the intention that Computer Science would be seen as an attractive subject option to as wide a student audience as possible, it remains possible that it would not be seen as attractive to students of as wide arrange of general academic achievement as PE. At the very least it cannot be precluded that the two cohorts could have differing academic interests and a ranges of attainment levels. Computer Science could very well share a *niche* appeal somewhat like Music. This could give rise to the attainment profile of the two groups being different. If this were to turn out to be true, then it could also be likely that Computer Science is attracting students with a narrower range of academic achievement as well as a higher average expected attainment.

If these hypotheses about the nature of the student cohort were to contribute to deliberations in relation to the likely or projected outcomes distributions for these subjects the hypotheses should be tested through an analysis of historical prior candidate achievement data for these cohorts of candidates against national profiles at an overall level, and against a range of subject to establish what, if any, specific deviations from the norms exist. This would include consideration of overall mean attainment scores and scores relating to the 1^{st}, 2^{nd} and 3^{rd} quartiles of the cohorts to establish reasonable comparators.

The range of subjects to be considered would be English, History, Geography, Maths, Applied Maths, Physics, Chemistry, Biology, Music and the Technology suite of subjects. This would provide information covering a range of examination types, some with multiple components and a range of attainment profiles. This would provide a basis for assembling a range of subjects whose outcomes profiles could be used to advise a process of coming to a set of reasonable projected outcomes in these subjects for the 2020 calculated grades process.

Expected outcomes

Having tested the assumptions above in respect of the nature of the subjects and the nature of the cohorts for Physical Education and Computer Science estimates of outcomes for these subjects can be generated based on a range of subjects that approximate to the profile of candidates presenting for the subject.

This will result in a best estimate of outcomes for 2020 based of the available information on the cohorts presenting for examination and which will be a support to professional judgements made around the nature of the subject, candidature, and likely outcomes.

Future examinations

When the normal versions of examinations in these subjects are executed in the future, the examinations, marking schemes and candidate responses should be analysed against the prescribed learning outcomes as part of the 'college of professionals approach' and an appropriate attainment profile arrived at which is truly cognoscente of the actual levels of attainment demonstrated. For the future when more usual standard-setting approaches can apply in relation to these new subjects the outcomes of these deliberations should not be constrained by either the expected or final distributions that emerge from the calculated grades process of 2020.

3 Projected outcomes for LC 2020 LH & OL Physical Education and Computer Science

In arriving at projected outcomes in Tables 1 and 2 below for these examinations consideration was given to the following

1. Available Information Overall Performance Score (OPS) data
2. Information on the perceived relative difficulty of subjects
3. Professional Judgements In respect of the impact of multiple components and their weightings

A description of the analysis and considerations involved is provided in Section 4 below.

Table 1. **Higher level projected outcomes LC 2020**

Subject	Mean Grade	LC Outcomes for 2020 Cohort 1	2	3	4	5	6	7	8
Projected outcomes for PE	3.84	5.0	18.0	23.0	21.1	16.1	10.6	4.7	1.5
Projected outcomes for Computer Science	3.88	5.2	17.2	22.3	21.3	16.8	11.1	4.8	1.5

Table 2. **Ordinary level projected outcomes LC 2020**

Subject	Mean Grade	LC Outcomes for 2020 Cohort 1	2	3	4	5	6	7	8
Projected outcomes for PE	4.49	1.5	8.7	18.4	23.2	22.2	15.2	7.0	3.8
Projected outcomes for Computer Science	4.45	1.8	9.6	19.1	22.8	21.0	14.7	7.0	4.1

4. Analysis of available information

1. Available Information Overall Performance Score (OPS) data

Overall Performance Scores (OPS) have been used by Kellaghan *et al.* in various research projects examining the value of the Intermediate Certificate and Junior Certificate examinations outcomes as predictors of Leaving Certificate outcomes as far back as 1984[8]. The process uses an OPS calculated from the candidate best 7 subjects at Junior Cycle was shown to be a good overall predictor of overall outcomes at Leaving Certificate at that time[1].

Mean OPS scores and scores for each of the first three quartiles for the total 2020 LC cohort were compared with those for 2019. Mean OPS scores and scores for each of the first three quartiles for the 2020 LC PE and Comp Sc cohorts were compared with data across a range of subjects for the 2020 LC candidature, and their corresponding 2019 outcomes for a range of subjects. It was noted that, at Higher level, the profiles of the scores for the Comp Sc and PE cohorts were broadly similar, although the Comp Sc cohort had scores that had a marginally higher mean and were slightly more spread out than the PE cohort.

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[8] Greaney & Kellaghan (1984), *Equality of opportunity in Irish Schools: A longitudinal study of 500 students*, Dublin: Educational Company
Kellaghan & Dwan (1995), *The 1994 Leaving Certificate: Examinations: A summary of results*, Dublin: NCCA
Kellaghan & Dwan (1995), *Junior Certificate: Examinations: A summary of results*, Dublin: NCCA
Kellaghan, Millar & Farrell (1998), *From Junior to Leaving Certificate: A Longitudinal Study of 1994 Junior Certificate Candidates who took the Leaving Certificate Examinations in 1996*, Dublin: NCCA
Millar, Kellaghan, & Farrell (1999), *From Junior to Leaving Certificate: A Longitudinal Study of 1994 Junior Certificate Candidates who took the Leaving Certificate Examinations in 1997*, Dublin: NCCA

At Ordinary level, the Comp Sc cohort had substantially higher scores, although this is based on very small numbers (48 for PE and 35 for Comp Sc).

Data from a blend of subject who were identified as having OPS data spread either side of those of the new subjects and which included subjects with similar assessment components. These were combined to produce similar mean OPS and quartile data to the new subjects. From these the corresponding set of projected outcomes for the 2020 Leaving Certificate Comp Sc and PE candidature were generated.

Table 3 shows the suite of subjects that were considered for inclusion in the estimation for the HL PE and Computer Science grade distributions, as well as indications as to which were finally chosen.

For Higher level PE, the mean OPS for the suite of subjects included in estimating the grade distribution (69.54) is very close to the mean OPS for HL PE (69.64), and the values of the quartiles (Q1 Q2, and Q3) are relatively closely aligned.

The suite of subjects used to estimate the grade distribution for Higher level Comp Sc includes all of those used for HL PE, as well as Mathematics. This was done given the large cognate overlap between Mathematics and Comp Sc; given the relatively large overlap in candidates between HL Comp Sc and HL Maths – over 50% of HL Comp Sc candidates are also entered for HL Mathematics, as compared with 35% of HL PE candidates; and given the slightly higher mean OPS score for HL Comp Sc compared to HL PE. Again, there is relatively close alignment between the quartiles for HL Comp Sci and for the mean of the quartiles for the suite of subjects used to estimate its grades. While the mean OPS scores aren't quite as closely aligned as for PE, they are nonetheless relatively close, and the difference is accounted for by the inclusion of Mathematics, which it was felt was particularly important on cognate grounds.

Table 4 shows the suite of subjects that were considered for inclusion in the estimation for the OL PE and Computer Science grade distributions, as well as indications as to which were finally chosen. The number of candidates entered for OL PE and Comp Sc are very small (48 and 35, respectively), which should be borne in mind when interpreting these expected distributions.

For Ordinary level PE, the same suite of subjects was used as at Higher level. While this may represent a slightly high mean OPS (the mean of the suite is 55.64, as opposed to 54.88 for OL PE), the quartiles are very similar. Also, this difference in mean OPS may have been a result of the very small numbers involved in OL PE as much as a genuine feature of this cohort. As a result, it was decided to retain the same suite of subjects for OL as for HL for this subject.

For Ordinary level Comp Science, the difference in mean OPS was more pronounced when the same suite of subjects as HL was used (mean OPS for OL Comp Sc is 57.83, while it was 57.02 with the same suite of subjects as HL). As a result, OL Physics was added in to the suite. The choice of OL Physics was advised by a combination of its inclusion improving the OPS alignment of the group and a likely cognate overlap with Comp Sc. The inclusion of OL Physics increased the mean OPS to a value very close to that of OL Comp Sci.

2 Information on the perceived relative difficulty of subjects

Comparing the relative difficulty of different subjects has for many years been of interest to educational researchers. Such comparisons are extremely difficult and no ideal methodology has been identified to truly achieve absolute comparison data. The Longitudinal Studies carried out by the Educational Research Centre (ERC) on behalf of the NCCA[1] the further research carried out by the ERC on behalf of the

Department of Education and Science as part of the work of the Task Force on the Physical Sciences[9] used a process of *Subject-Pair Analysis* to compare the relative difficulty of subjects across a range of Leaving Certificate subjects. Though the fundamental assumptions underlying this form of analysis have been challenged it still represents a reasonable model for carrying out comparative studies[3]. The results of the studies carried out on Leaving Certificate subjects suggest that the range of subjects used in the analysis above in respect of OPS scores used for the projections of outcomes for LC PE and Comp Sc represent a broad spread of difficulty as determined by a *Subject-Pairs Analysis* approach and so should not provide any significant bias in the predicted outcomes in either a 'difficult' or 'easy' direction. Accordingly, no adjustment to the outcomes from the OPS treatment are recommended on the basis of the range of subjects chosen.

3 Professional Judgements In respect of the impact of multiple components and their weightings

Overall, in the absence of candidate-centred information from their engagement with an examination and their actual demonstrated levels of attainment against the syllabi requirements, the outcomes of the OPS analysis seem to provide a reasonable and justifiable set of outcomes for Leaving Certificate Physical Education and Computer Science at both Higher and Ordinary levels. However, it is noted that the award level for the bottom two grades is slightly higher that for many of the subjects that have multiple and highly weighted second and third components. In the context of the fact that multiple highly weighted components tends to narrow the profile of achieved attainment the OPS outcomes have been adjusted marginally at the lower end in recognition of this. The outcomes presented in Tables 1 and 2 above include this adjustment which is based on professional judgement.

The outcomes set out in Tables 1 and 2 are recommended as those to be applied in the calculated grades process of determining outcomes for LC Physical Education and Computer Science at Higher and Ordinary levels for 2020.

In due course when actual examinations occur for these subjects established outcomes should be developed that are fully advised by professional judgements including consideration of candidate attainment as demonstrated through their engagement with the assessment components in place, the extent to which these components assess the learning outcomes of the relevant syllabi, and the manner in which these components combine to impact the final aggregated outcome profile.

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[9] *Task Force on the Physical Sciences- Report and Recommendations to the Minister for Education and Science* available at *http://www.irlgov.ie/educ/pub.htm*

[3] Measuring Comparability of Standards between Subjects: why our statistical techniques do not make the grade, Newton P E, British Educational Research Journal available at https://bera-journals.onlinelibrary.wiley.com/doi/abs/10.1080/0141192970230404

Techniques for monitoring the comparability of examination standards, edited by: Paul Newton, Jo-Anne Baird, Harvey Goldstein, Helen Patrick and Peter Tymms; available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/487059/2007-comparability-exam-standards-i-chapter7.pdf

Table 3. Higher level 2020 prior attainment and 2019 outcomes

			Prior Attainment of 2020 Cohort (JOPS)						LC Outcomes for 2019 Cohort										
Subject	**Incl PE**	**Incl CompSci**	**N**	**Mean**	**SD**	**Q1**	**Q2**	**Q3**	**N**	**Mean Grade**	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Overall	N/A	N/A	55,624	69.98	8.72	65	71	76											
PE	N/A	N/A	1,413	69.64	7.38	66	71	75											
Computer Science	N/A	N/A	710	69.93	7.61	65	71	76											
Construction Studies	Y	Y	8,794	66.24	7.68	61	67	72	7,896	4.06	1.57	3.0	14.8	20.7	23.5	19.3	11.8	5.2	1.7
Engineering	Y	Y	5,390	67.12	7.73	62	68	73	4,765	3.96	1.58	3.7	15.9	22.4	22.4	17.9	11.7	4.3	1.7
Technology	Y	Y	1,689	67.86	7.99	63	69	74	1,695	3.84	1.67	5.1	18.3	23.5	20.6	16.0	9.3	4.2	3.0
Geography	Y	Y	21,052	69.56	7.42	65	70	75	19,983	4.06	1.55	3.9	13.2	20.7	23.0	20.1	13.6	4.6	1.0
History	Y	Y	9,765	71.41	7.55	67	72	77	8,825	3.81	1.63	6.9	16.2	21.7	23.2	16.1	10.3	4.0	1.7
Biology	Y	Y	30,555	72.05	7.04	68	73	77	27,063	4.16	1.94	8.2	15.7	16.5	16.5	16.1	13.7	8.6	4.8
Music	Y	Y	6,462	72.56	7.53	69	74	78	6,234	3.00	1.11	4.3	32.1	35.4	18.6	7.2	1.8	0.4	0.1
English			42,301	72.72	6.54	69	73	77	40,217	4.08	1.38	3.0	10.1	20.5	27.5	23.7	11.9	2.6	0.6
Physics			7,103	75.39	6.43	72	76	80	6,583	4.20	2.10	10.9	16.3	15.0	14.1	14.6	12.7	9.1	7.3
Mathematics		Y	21,632	76.07	5.43	73	77	79	18,153	4.14	1.65	6.4	11.2	17.1	22.5	21.6	14.2	5.3	1.7
Chemistry			8,690	76.35	6.06	73	77	81	8,243	3.90	2.10	13.5	18.1	16.5	14.6	12.5	10.9	6.4	7.4
Applied Maths			2,087	78.42	4.92	76	79	82	1,988	3.56	1.99	16.5	19.9	18.6	14.7	11.3	9.3	4.8	4.9
Mean projections based on subjects included for PE	N/A	N/A		69.54		65.0	70.4	75.1		3.84		5.0	18.0	23.0	21.1	16.1	10.3	4.5	2.0
Mean projections based on subjects included for Computer Science	N/A	N/A		70.36		66.0	71.3	75.6		3.88		5.2	17.2	22.3	21.3	16.8	10.8	4.6	2.0

Table 4. Ordinary level 2020 prior attainment and 2019 outcomes

Subject	Incl PE	Incl CompSci	Prior Attainment of 2020 Cohort (JOPS)						LC Outcomes for 2019 Cohort										
			N	Mean	SD	Q1	Q2	Q3	N	Mean Grade	SD	1	2	3	4	5	6	7	8
Overall	N/A	N/A	55,624	69.98	8.72	65	71	76											
PE	N/A	N/A	48	54.88	6.56	51	55	60											
Computer Science	N/A	N/A	35	57.83	6.92	52	59	64											
Technology	Y	Y	122	53.45	8.36	47	53	59	176	4.64	1.95	1.7	13.1	19.9	15.9	15.3	14.8	7.4	11.9
Construction Studies	Y	Y	773	54.10	7.47	49	54	59	1,114	5.17	1.46	0.2	2.2	9.5	21.7	27.5	20.6	10.2	8.1
Engineering	Y	Y	629	55.23	6.77	51	55	60	650	4.74	1.53	0.9	5.2	17.2	19.8	26.3	17.2	9.5	3.7
Geography	Y	Y	2,487	55.52	7.78	51	56	60	4,139	4.27	1.42	1.9	8.3	19.0	28.4	24.4	12.0	4.3	1.7
Music	Y	Y	332	55.54	8.84	50	56	61	425	3.82	1.30	0.5	14.4	29.6	28.5	16.5	7.3	2.6	0.7
History	Y	Y	2,087	56.91	8.41	52	57	63	2,919	4.05	1.66	5.2	14.8	18.6	21.9	19.4	13.9	3.6	2.7
Biology	Y	Y	3,410	58.75	7.56	54	59	64	7,046	4.82	1.44	0.2	3.2	14.7	26.1	25.7	17.0	8.5	4.7
English			12,731	60.93	8.77	55	61	66	14,477	4.31	1.42	1.5	7.3	20.3	28.1	23.5	12.7	4.5	2.0
Physics		Y	568	64.09	7.58	60	65	70	1,359	4.25	1.86	3.7	13.9	23.0	20.1	14.0	11.6	5.7	8.1
Chemistry			525	64.95	8.10	61	66	71	1,262	4.82	1.98	4.0	9.9	13.7	17.4	18.2	14.2	9.8	12.8
Mathematics		Y	32,341	66.64	7.62	62	68	72	31,474	4.35	1.63	1.7	11.2	20.1	23.2	20.1	13.0	6.5	4.3
Applied Maths			38	72.29	8.49	68	74	78	116	4.43	2.36	15.5	10.3	12.1	13.8	12.9	12.1	7.8	15.5
Mean projections based on subjects included for PE				55.64		50.6	55.7	60.9		4.50		1.5	8.7	18.4	23.2	22.2	14.7	6.6	4.8
Mean projections based on subjects included for Computer Science				57.80		52.9	58.1	63.1		4.46		1.8	9.6	19.1	22.8	21.0	14.2	6.5	5.1

Appendix J. Regression model for new subjects – Physical Education and Computer Science

To: National Standardisation Group,

From: Calculated Grades Executive Office

Purpose: Matter for Decision

Status:. CONFIDENTIAL. FINAL. Approved by NSG. Meeting 8 27/08/2020

Background

For the majority of subjects, a significant component of the conditioning distributions is based on a multivariate regression model that predicts – based on Junior Certificate results – how students are likely to perform in a given Leaving Certificate subject at a given level. This regression model is built from historical national data of all students who took that subject at that level in 2017, 2018, and 2019.

In the case of the two new subjects, there is no such historical data from which to build this model.

An alternative strategy is required in order to build an appropriate variant of this regression model that can take the place of the usual one for these two subjects.

Option 1: Use current-year concurrent data from other subjects instead of a model based on prior attainment

Under this option, the usual model would first be run to produce a set of calculated grades for all other subjects. Then, for each new subject at each level, an analysis would be undertaken to determine the relationship between the calculated grades for all other subjects and the marks for the new subject, using the school-estimated marks for the new subject as the basis for building the model, and using multi-level modelling to take account of the fact that these school-estimated marks are subject to in-school and cross-school factors.

This regression model can then be used in place of the usual regression model in the case of these subjects, noting that the calculated grades for all other subjects would have to be generated first, as running the model for the new subjects will be drawing on the outputs from all other subjects.

Option 2: Use a general overall Leaving Certificate composite score at the relevant level as a proxy for performance in the new subjects to build the prior-attainment based regression model

Under this option, the new subjects are assumed to have a relationship to JC prior attainment that resembles the 'average' one across all subjects at the same level. The same JC predictor set that is being used for all other regression models (core 3 + best 2 others) is taken as the predictor set for this model, and the predicted variable is the average score across all LC subjects taken (at the level concerned) by the student. This regression model is built from historical national data of all students in 2017, 2018, and 2019.

Option 3: Use a Leaving Certificate composite score at the relevant level, based on the same selection of subjects as the SEC used to determine the synthetic national distribution, as a proxy for performance in the new subjects to build the prior-attainment based regression model

Under this option, the new subjects are assumed to have a relationship to JC prior attainment that resembles the 'average' one across the selection of subjects that the SEC determined was a relevant indicator set for each new subject at the given level. The same JC predictor set that is being used for all other regression models (core 3 + best 2 others) is taken as the predictor set for this model, and the predicted variable is the average score across the set of LC subjects taken from the relevant selection at the relevant level by the student. This regression model is built from historical national data of all students in 2017, 2018, and 2019.

Relevant considerations

Polymetrika has advised that Option 1 is likely to be the model with the greatest predictive power, and that the predictive power is of the other two is likely to be similar.

Nevertheless, the use of the concurrent other-subject data for any part of the conditioning or estimation process for in-school learners is at odds with earlier decisions as to how the model would function for the generality of learners – primarily for face-validity reasons.

CGEO considers that either of options 2 or 3 is better for this reason.

Option 3 is perhaps more preferable than option 2, as it yields a certain consistency of approach by falling into line with the professional judgments made by the SEC as to what is a relevant set of indicator subjects in the context of standard setting for new subjects.

CGEO recommends to the National Standardisation Group that we proceed with Option 3 noting that some test modelling using this approach has been undertaken.

Appendix K. Treatment of Students in Small Classes and of Subjects Studied Outside of School (including Out-of-School Learners) in the National Standardisation Process

Status:. CONFIDENTIAL. APPROVED BY NSG Meeting 8 27/08/2020

To: National Standardisation Group,

From: Calculated Grades Executive Office

Purpose: Matters for Decision

NSG Decision Making Framework. Questions and Issues; Question 4. How will the statistical standardisation process provide for:

a) small schools/centres
b) small groups taking a subject in a school (including groups of size 1)
c) students who studied outside school and were not in a class group

Background

The statistical modelling process used for the national standardisation process uses distributional information about groups that students are in. The utility of group-level information is dependent on the group size (and other factors). The model automatically incorporates the reliability of different forms of group-level information in the manner in which it combines that information – giving greater weight to the more informative distributions in a given circumstance. Accordingly, as group-size decreases, the associated weakening of the reliability of distributional information arising from membership of that group is automatically taken account of through the reduced weighting of that information. This means that in the general case, specific intervention as group size decreases is not needed. At one stage in the development of the statistical model, it appeared that, in the extreme case where the group size is 1 or 2, the model would not have been capable of producing any measure of the bias of the variance estimate for the group, which would have prevented the accuracy of the distributional information from being calculated and appropriately weighted[10]. Further developments in the modelling process overcame this problem, but it is nonetheless appropriate to set out how these very small groups are handled. Details on the number of instances where groups of very small size arise is appended.

[10] Since at least two data points are required in order to calculate a variance estimate, based only on point-estimate samples from a distribution, the leave-one-out jack-knife method requires at least 3 values in order to produce a bias estimate.

Additional considerations arise with respect to subjects studied outside of the school. Since students taking a subject outside of the school (including all subjects in the case of out-of-school learners) are always allocated to a distinct class of size 1 for that subject, it is appropriate to deal with both of these matters in parallel. Decisions need to be made about what conditioning information should be used in these circumstances. In addition to dealing with the comparatively technical matter of how in-school small groups should be dealt with, this paper also addresses the more substantive issue of what conditioning information is appropriate to use for subjects studied outside of school to ensure equitable treatment of such students relative to in-school students. It proposes that certain information that is, in the generality of cases, used only for conditioning be used for direct estimation of marks for this category of students.

The groups concerned

Groups of size greater than 1 but which are still very small can arise for regular students taking the subject within the school. Standardisation groups of size greater than 1 cannot arise for students taking a subject outside of school or out-of-school learners, as the school-based procedures (in the Guide for Schools) required all such students to be allocated to a distinct class of size 1.

The CGEO proposes to the NSG that two categories of student be treated differently, based on whether the estimates have been through an in-school alignment process.

Category 1

This category consists of:

- regular students taking the subject within the school and
- students enrolled in the school but taking the subject outside of the school, and where the subject is also available in the school.

In both of these cases, the estimate received has been subject to school-level alignment oversight. In the first case, this was by means of a regular in-school alignment process, while in the second case, the principal, in accepting and signing Form C, has asserted that the estimate arises from the application of the same standards as those applied by the teachers of the subject within the school

In these circumstances, (that is, where the group of students in category 1 is small) the in-school alignment procedures of the school should still be respected, and the procedure should seek to mimic the one that applies to larger groups as closely as possible subject to the constraints of available relevant data. At the point in the model development process where it seemed as though the procedure would break down in the case of groups of size 1 or 2 and be unsatisfactory in the case of groups of size 3, the NSG gave consideration to a proposal to address this insufficiency of data by 'borrowing' data from the distribution in which one may find data that is most likely to be comparable to the theoretical distribution from which the observed small sample is drawn. Further developments in the model, and in particular the way in which distributional information as distinct from point-estimate information is being used in a particular step in the process, along with later a later development in relation to the reasonableness of adjusting marks on the basis of a statistical information derived from very small samples, have eliminated the problem and rendered these considerations moot.

It is noted, nonetheless, that because the procedure applying to all groups can be satisfactorily applied all the way down to groups of size 1, albeit with a suitably diminished weighting, the indications given in public descriptions of the model that the prior attainment information about individual candidates would only be used as part of group-level conditioning, might be perceived of having been breached in a case where the group concerned has only one student in it. The NSG gave consideration to this matter and noted the following:

- Notwithstanding that the group concerned is of size 1, the manner in which the information is being used is still by way of group-level conditioning information.
- Since the information is distributional information, (being a likelihood function built from modelling the relationships between prior attainment of students generally in the Junior Certificate examination and in a specific subject in the Leaving Certificate,) it is essentially information about the theoretical group of all students with prior attainment similar to this student, rather than being about this student *per se*.
- Since the sample is of size 1, information from it will inevitably be considered by the model to be comparatively unstable statistically, and will be either implicitly or explicitly 'down-weighted' to such an extent as to have little if any impact on the final score.
- This approach has the benefit of applying the same overall approach to these candidates as is applied to the generality of candidates, subject to the need to not allow information from small samples to have undue influence on scores.

On this basis the group agreed that no particular intervention should be made to treat small groups in this category, including groups of size 1, any differently from the approach used in the general methodology, subject to later decisions that may be required when the effects of the model on small groups have been more fully analysed.

An alternative treatment for the students in Category 1 who are studying the subject outside of the school would be to treat them in the same way as students in category 2 below. The argument for doing so would be that the alignment of standards that arises from the principal's consideration of the evidence made available to him/her when deciding whether to submit the estimate is a weaker form of alignment than that arising from the consideration of a school alignment group. Notwithstanding any consideration of whether or not that is true, the effect of moving such students into category 2 would be to set aside the affirmation made by the principal that the estimate was properly aligned with those of the school. It is also noted in this regard that the form used by the principal made explicit provision for the submitted estimate to be different from the one proffered by the tutor (although in most cases it was anticipated that a principal unconvinced as to the standard applied by the tutor would resolve the matter through discussion and submission of a revised estimate). In this context, The CGEO considers that the course of action that remains most faithful to the principles of the calculated grades process – and in particular the commitment to respect professional judgments made at school level as regards relative alignment of standards – is the one proposed here.

Category 2

This category consists of:

- out-of-school learners and
- students enrolled in a school and taking the subject outside of the school, where the subject is **not** offered by the school.

In both of these cases, the estimate received has not been subject to school-level alignment oversight. While the principal has signed off on the credibility and integrity of the *source* of the estimate in the former case, (s)he has not made any assertions regarding the alignment of standards with those applied within the school (as this could not credibly be done in respect of a subject not offered in the school).

It may also be noted that the great majority of non-curricular language estimates fall into this category, but that there are many more cases across a broad range of other subjects.

This group presents a challenge to the maintenance of fairness, equity, and integrity in the process. Given the observed positive bias in the teacher/tutor estimates, any procedure that systematically leaves these estimates unaffected or minimally affected by the standardisation process would not be considered fair by stakeholders, as it would result in such students receiving, on average, more favourable treatment than regular in-school learners.

It is proposed that the most reasonable course of action is to pool all of these students and treat them as though they were a single group. In most cases, this provides a sufficiently large data set on which to apply standardisation. However, it needs to be borne in mind that this pooled group is not like a regular single-school group in the following respects: it has not been subject to any form of internal procedural alignment process, and there is no requirement to leave its rank order intact.

As a group, the only available relevant sources of distributional information within the scope of the normal application of the model are the national distribution for the subject and the prior attainment information aggregated across the group. Confining the procedure to these forms of information would leave the rank order of this pooled group intact, but this is unjustified. Furthermore, it is difficult to argue that it is fair, as it advantages students whose tutors have given generous estimates relative to those who have not. Given these circumstances, fairness is better achieved by relaxing some constraints that apply to the model in the generality of cases so as to allow statistical information to mitigate the absence of the usual in-school alignment and cross-school standardisation methods. In these circumstances, all available relevant data (excluding the demographic data of gender and those arising from school-level indicators) should be permitted to be included in the estimation process at both the individual and group level.

That is, it is proposed that the estimation model for subjects studied outside of a school (including out-of-school learners) and which have not been through an in-school alignment process should allow the use of individual prior attainment data and, if it is found to be sufficiently informative and feasible to use, concurrent other-subject data – both of which are excluded from use in the generality of cases. This means that the estimation of an individual student's mark will be directly informed by his or her own prior attainment at Junior Certificate level and also conceivably by information coming from the estimation process in respect of his or her other subjects. Any information coming from the estimation process for other subjects will only be drawn in when it relates to subjects that have been through an in-school alignment process and if it process feasible and sufficiently statistically informative. That is, two or more out-of-school subject estimates will not be allowed to mutually influence each other. This means that calculated-mark estimation information for out-of-school learners in particular will not draw on any other Leaving Certificate subject estimates.

An alternative to what is proposed would be to decline to use this additional information for estimation. This would have the effect of treating the group as though all of these estimates had already been aligned relative to each other. For the reasons stated earlier, the CGEO considers that this would not be fair. Another possible alternative to the proposed approach would be to use not only the prior attainment and concurrent other-subject data, but the demographic data of gender (the only candidate-level demographic data available). However, while the inclusion of gender might improve the statistical accuracy of the estimates, the CGEO considers that it is not appropriate in light of the strong commitments made that demographic data would only be used for model validation and not for either group-level conditioning or candidate score estimation.

The proposed approach of allowing information to be used for estimation purposes that would otherwise only be used for conditioning will result in a more credible and fair treatment of out-of-school learners and students taking subjects outside of the school relative to the majority of regular in-school learners. If there had been little or no evidence of estimation bias in school estimates generally, these procedures might not be necessary, but given the substantial known estimation bias, it is necessary to apply all reasonable efforts to correct for it as equitably as possible in as many cases as possible. It is an appropriate response to the challenge of accommodating out-of-school studies within a calculated grades system that was designed to be a school-based model.

Out-of-school learners with no prior attainment information

Even after applying all of the above procedures, there remains a subset of out-of-school learners for whom no student-specific conditioning information is available: those without any linked Junior Certificate data, which indicates that they have not taken a Junior Certificate examination 2, 3, or 4 years previously. One option in response to this would be to leave these estimates unstandardised. However, in light of the positive bias known to be prevalent in the data, the CGEO does not consider this to be the fairest response. Instead, **the CGEO proposes that, subject to the operational feasibility of doing so, these estimates be adjusted by applying a correction equal to the average bias that has been observed across all other estimates in that subject at that level at that point in the distribution.** This leaves these students in a similar position to all others as regards the relative probability of having been subjected to an under-correction in comparison to an over-correction of school/tutor estimation bias. Again, another option would be to allow a further correction to be made for gender bias in the tutor estimates, but the CGEO considers this inappropriate for the same reason as noted above.

Summary of Matters for Noting

No particular intervention should be made to treat small groups of students taking subjects offered by the schools (either in school or out of school), including groups of size 1, any differently from the approach used in the general methodology, subject to later decisions that may be made when the effect of the model on small groups has been more fully analysed. The consequences of this approach where the group size is 1 are noted.

Summary of proposals for decision

1. The CGEO proposes that the estimation model for subjects studied outside of a school (including out-of-school learners) and which have not been through an in-school alignment process should allow the use of individual prior-attainment data and, if feasible and sufficiently statistically informative, concurrent other-subject data – both of which are excluded from use in the in the case of estimates that have been through an in-school alignment process.
2. The CGEO proposes that, subject to the operational feasibility of doing so, the estimates for out-of-school learners with no linked Junior Certificate prior attainment data be adjusted by applying a correction equal to the average bias that has been observed across all other estimates in that subject at that level at that point in the distribution.

SEE ADDENDUM

Addendum – 23 August 2020 – addressing large changes from teacher estimates arising in the model

Investigation of further iterations of the model after the above matters were agreed showed that the prior attainment regression model was overly influential in adjusting teacher estimates in cases where class sizes are small (in particular, of size 1, but also in other small cases). The CGEO considers that it is not credible for teacher estimates that have been through a school alignment process to be moved by a large number of marks based solely on a regression model applied to only a handful of students.

The CGEO accordingly proposes to deal with this through the explicit application of a weighting function to the regression estimates, to diminish their effect as the class size becomes small. The logistic function is proposed for this purpose, with point of inflection at a class size of 6 and exponential constant 1. That is: $(x) = \frac{1}{1+e^{6-x}}$. The impact of this will be that the regression model will have negligible for classes of size 1, and a smoothly increasing (S-shaped) effect as the class size rises, asymptotically approaching its full statistically optimal effect for larger class sizes (in effect, for classes of size 10 or more).

While not related to small class sizes, it may also be noted that large changes from the estimated mark to the calculated mark were also noted have also been identified in certain larger class sizes. This phenomenon under certain conditions related to effect of is a product of equipercentile mapping onto the tails of distributions which are skewed distributions to a higher degree than on average. This will be dealt with through an appropriate truncation of the tails in those circumstances.

Appendix L. National Standardisation and the Non-Curricular EU Languages

To: National Standardisation Group,

From: Calculated Grades Executive Office

Purpose: Matter for Decision

Status: CONFIDENTIAL. APPROVED by NSG 13/08/2020

1. Background – the Non-curricular EU Languages

The list of subjects for the Leaving Certificate examination includes the following language subjects: Irish, English, Ancient Greek, Arabic, French, German, Hebrew Studies, Italian, Japanese, Spanish and Russian.

The State Examinations Commission also provides examinations in a range of subjects in the language area referred to as the non-curricular EU languages (NCLs). These are languages which do not appear as part of the normal school curriculum but which students may opt to be examined in if they meet certain criteria. To be eligible to take an NCL examination, a student must:

- Be from a member state of the European Union
- Speak the language in which they opt to be examined in as a mother tongue,
- Have followed a programme of study leading to the Leaving Certificate
- Be taking Leaving Certificate English

Another condition is that candidates[11] may undertake examination in one non-curricular language subject only. These examinations are currently offered in: Latvian, Lithuanian, Romanian, Slovenian, Modern Greek, Finnish, Polish, Estonian, Slovakian, Swedish, Czech, Bulgarian, Hungarian, Portuguese, Danish, Dutch, Croatian, Maltese.

The development of the examinations in these languages has evolved over time. From time to time the SEC, and prior to 2003 the Department of Education and Skills, have received requests to provide examinations for native speakers in their mother tongue. The policy has been to accede to these requests in the case of the national languages of EU states, in order to reflect the spirit of the commitment made by member states under Article 149 of the Treaty of Nice. This states that "Community action shall be aimed at developing the European dimension in education, particularly through the teaching and dissemination of the languages of the Member States."

The model for the non-curricular language examination papers is based on the First Foreign Language final written paper of the European Baccalaureate.

[11] Most documentation from the Calculated Grades Executive Office refers to 'students' rather than 'candidates'. However, in the case of the NCL examinations, which are not intended to assess the outcomes of 'studying' the language concerned, they are 'candidates' or 'examinees' rather than 'students'

2. NCLs and the calculated grades process

The calculated grades process is, at its core, a school-based one. Its design relies fundamentally on the assumptions that

- the Leaving Certificate examinations are curricular examinations that are intended to measure the achievement of learning outcomes laid out in a subject syllabus/specification,
- the student is following the relevant programme of study under the guidance of a teacher,
- the teacher is continually monitoring the progress of the student through that programme of study,
- and the teacher is therefore well placed to provide an estimate, based on this work with the student and their experience of preparing students for examination in the past, of how well the student would have performed in the examination.

Being 'non-curricular', the nature and purpose of the NCL examinations are not aligned with the basic premises of the calculated grades process. While this suggests that the NCL examinations ought not to fall within the scope of the calculated grades process at all, the government and the then Minister for Education and Skills, when introducing the scheme, were keenly committed to putting in place a process that could provide calculated grades to as many students as possible in as many subjects as possible in order to ensure equity and fairness for all students in the manner in which progression to further studies or the world of work is facilitated. The Department received requests to consider providing alternatives to the calculated grades process that could apply to the NCL examinations only, so as to allow those who had entered for these examinations to demonstrate the relevant skills by some other means. However, the provision of an alternative arrangement for these students could not be made in a manner that could be considered equitable and fair to these students and all other students and so would have undermined the principles of fairness and equity underpinning the calculated grades process. Accordingly, the NCL examinations were brought within the scope of the calculated grades process despite the misalignment between their respective core assumptions. The process must therefore seek to deliver as fair as possible a grade in these less-than-ideal circumstances to as many students as can conceivably and credibly be brought within its scope.

3. Limitations

The calculated grades process cannot produce a grade for any student in the absence of an estimated mark from a credible source involved in the tuition of the student concerned. This severely limits the extent to which NCL examinees can be brought within its scope. Despite every effort being made by the Calculated Grades Executive Office to be as flexible as possible with regard to the sources of estimates, it has only proven possible to receive estimates for approximately half of all prospective candidates, as the remaining candidates were not receiving tuition from any source or were receiving it from a parent or other close relative from whom an estimate cannot be accepted for reasons of integrity and conflict of interest.

Estimates have been received in respect of candidates in 16 of the 18 available NCLs. Out of a total of 1944 subject entries for these subjects, to date estimates have been provided for 935. Subject by subject data is at Appendix 1.

4. Challenges for National Standardisation in the Non-Curricular EU Languages

The NCLs pose three particular difficulties in the standardisation process, as follows:

1. Since the examinations are non-curricular by design, all prospective examinees are by definition 'studying the subject outside of the school'. While all those for whom estimates have been possible are in receipt of some form of tuition, this is unconnected with the schools they are enrolled in. This means that there is no school-level historical distributional information that can be used for conditioning. (Operationally, they are all students in classes of size 1 and there is no in-school group to whom they can be linked.)
2. In the majority of cases, the individual language cohorts are too small to be modelled adequately for standardisation.
3. The amount and type of 'missingness' in the data is such that the assumption of distributional equivalence between the current cohort and previous cohorts is considerably less tenable. In particular, the experience of those involved in marking and overseeing these examinations in the past suggests that the examinees who have been receiving tuition typically perform better than those who have not. However, this informally observed phenomenon has not been researched and measured in the past, and so there is no purely quantitative evidence base that could be used to correct for any consequent sampling bias.

4. Proposals to deal with these challenges

4.1 Absence of school-level conditioning information

With respect to the first challenge above, the CGEO has prepared a separate note on dealing with small classes, including of size 1. If the proposals in that note are accepted, all NCL students will be in 'Category 2' as described in that note and will be pooled for conditioning on a national basis. This will also result in the relaxation of certain constraints on the normal application of the statistical model, including that rank order of tutor estimates will not necessarily be preserved within this pooled group, and all non-demographic forms of available predictive information will be allowed to feed into the statistical estimation process at an individual level. Further details are in that note.
The CGEO proposes to deal with all NCL cases (other than the small number that may involve an in-school class) in the manner described in its note on treatment of small classes. As a consequence, in the great majority of cases, prior attainment data and concurrent other-subject data will be used as part of the direct estimation process, which is not the case for in-school candidates.

4.2 Inadequate subject cohort size

The imperative to deal with this in the case of the NCLs is more acute in light of the first challenge above, as the national distribution needs to play a greater role in conditioning when school-level distributions are unstable, weakly modelled, or missing. It is therefore proposed to pool some or all of the individual language-specific NCL cohorts for conditioning purposes. This is justifiable on the following grounds:

Equivalence by design

The NCL examinations are designed to function as a single suite of examinations with a shared purpose, target audience, and structure. They are all intended to measure the target skills in the respective languages to the same standard and in the same way. The examinations share a common structure and annually share a common question (worth 40% of the marks) to be answered in the respective languages.[12] The preparation and marking of all of the examinations are overseen by the

[12] The question concerned is an essay question with two options. While one option may vary somewhat in its precise content across languages – being, for example, a response to a different quotation – the second option is a response to the same prompt across all languages.

same Deputy Chief Examiner, who conducts the process in a manner that seeks to ensure comparability across the suite.

In short, the NCLs should be considered to be parallel forms of the same test. It is therefore appropriate to treat them as such in the standardisation process.

Sampling equivalence

The under-sampling effect noted as challenge 3 above is – subject to the expected level of variation associated with small samples in the case of the smaller language – broadly equally prevalent across the full suite. (The number of entries and number of estimates across the languages is tabulated in Appendix 1.)

Observed similarities in the data

In the review of the 2020 data to date, and again subject to recognising the levels of variation to be expected in small samples, the level of positive bias in the teacher/tutor estimation is broadly similar across all of the languages. Furthermore, in the case of the language that have cohorts sufficiently large to run models on reliably (Polish, Romanian, Lithuanian and Portuguese, the only four with cohort sizes of over 100) the distributions are responding in broadly similar ways to the application of the models.

Conclusion

For these reasons, the CGEO considers that it appropriate to pool either some or all of the non-curricular language examinations for the purposes of standardisation. It should be noted that, in the absence of any pooling of these examinations, it will not be possible to model the national distributions of many of the smaller ones adequately for meaningful standardisation to occur. Pursuing the option of leaving them all separate would therefore leave all of these effectively unstandardised, which is unsatisfactory when a reasonable basis for standardisation exists. Operationally, another available option is to treat some of the larger cohorts in a stand-alone fashion and pool the smaller ones. However, once it is conceded that it is appropriate to pool at least some for this purpose, it is hard to justify not pooling them all, given the rationale above in support of pooling, as none of those arguments are based on cohort size. Pooling them all gives greater distributional stability and reliability to the full suite, leading to more reliable treatment of the smaller cohorts in particular without adversely affecting the treatment of the larger ones. **Accordingly, the CGEO proposes pooling all of the NCLs for the purposes of standardisation.**

4.3 Potentially biased sampling

The hypothesis that achievement levels in the NCL examinations are correlated with whether or not the candidate has engaged with regular tuition is certainly plausible. If true, the consequence is that the group of students who were in a position to have an estimated mark submitted on their behalf and therefore be included in the calculated grades process is a somewhat positively biased sample of the population of typical NCL examination candidates. Therefore, strictly conditioning them on the basis of previous national distributions would represent an over-correction of the positively biased tutor estimates. It is also unclear to what degree, if at all, the incorporation of prior attainment information in the estimation model might correct for this by detecting aspects of this potential sampling bias[13].

[13] While it is certainly possible to model how NCL examination performance in the past has related to prior attainment as measured by JC performance, and to include in such modelling the absence of JC matching that might be related to recent arrival in Ireland, there are no data available to check how any such effects interact with engagement with regular tuition. Furthermore, it can be argued that it is within the portion of variance that would *not* be explained by such a model that a significant part of the

Unfortunately, the hypothesis introduced above has not been quantitatively tested or otherwise investigated. There is therefore no reliable statistical basis to correct for it accurately. However, the perspective relayed by the SEC's Deputy Chief Examiner, based on feedback from examining teams over many years and his own long experience of these examinations, that this is a feature of observed response patterns and a natural consequence of the manner in which native speakers whose schooling is not carried out in their mother tongue typically perform in first-language examinations, should at least receive consideration.

The CGEO considers this hypothesis to be plausible, while conceding that the absence of research data means that its effect cannot be reliably dealt with through purely quantitative techniques and may be small. **Accordingly, the CGEO asks the NSG to consider whether a judgmentally based adjustment should be made to reflect an acceptance that some sampling bias of the kind described has occurred. The effect of such a decision by the NSG would be that, if considered necessary on review of the final distributions, a judgmentally based adjustment would be made to the conditioning distribution for the NCL examinations, so as to bring the final outcome distribution into line with one that the SEC's Deputy Chief Examiner considers would appropriately reflect the degree to which the identified form of sampling bias is likely to be present, and taking a conservative approach to any such adjustment (that is, to favour erring on the side of undercorrecting rather than overcorrecting).** The conservatism of approach is justified by the need to avoid overcorrection in circumstances where there is no quantitative information available to support the correction being made.

5. Summary of proposals for decision

The CGEO proposes the following with regard to the standardisation of the NCL examinations:

- that all NCL cases (other than the small number that may involve an in-school class) be dealt with in the manner described in its note on treatment of small classes. As a consequence, in the great majority of cases, prior attainment data and concurrent other-subject data will be used as part of the direct estimation process, which is not the case for in-school candidates.
- that all of the NCL data be pooled for the purposes of standardisation
- that, the NSG consider whether a judgmentally based adjustment should be made to reflect an acceptance that some sampling bias of the kind described in this note has occurred. The effect of such a decision by the NSG would be that, if considered necessary on review of the final distributions, a judgmentally based adjustment would be made to the conditioning distribution for the NCL examinations, so as to bring the final outcome distribution into line with one that the SEC's Deputy Chief Examiner considers would appropriately reflect the degree to which the identified form of sampling bias is likely to be present, and taking a conservative approach to any such adjustment.

intended construct lies. That is, it has always been considered part of the *de facto* purpose of the NCL examinations that they allow candidates to compensate to some degree for a likely underperformance resulting from having to engage with all of their other subjects and examinations through a language that is not their mother tongue. It is therefore plausible to suggest that at least this one aspect of the intended construct might be negatively correlated with English-medium alternative measures of overall academic achievement, even if this aspect might be masked by other aspects that correlate positively with such measures.

APPENDIX 1   DATA ON NCLs 2020

Note that the following data are subject to change as the CGEO continues to check the accuracy of the categorisation of any NCL estimates currently categorised as 'in-school'

Year	Sub. Code	Subject Name	Level	Entries	Estimates SOS	Estimates Other	TOTAL
2020	17	Dutch	A	23	15	2	17
2020	18	Portuguese	A	128	52	2	54
2020	19	Modern Greek	A	12	8	1	9
2020	38	Danish	A	4	3	0	3
2020	39	Swedish	A	10	7	1	8
2020	49	Finnish	A	2	1	0	1
2020	547	Czech	A	21	6	3	9
2020	548	Polish	A	893	415	12	427
2020	549	Latvian	A	64	17	2	19
2020	550	Lithuanian	A	167	78	4	82
2020	551	Hungarian	A	59	27	3	30
2020	552	Estonian	A	1	1	0	1
2020	553	Romanian	A	408	194	15	209
2020	554	Slovakian	A	38	15	1	16
2020	559	Bulgarian	A	30	8	4	12
2020	567	Croatian	A	84	35	3	38
				1944	882	53	935

Appendix M. Working paper on aspects for inclusion in the validation of the National Standardisation Model

STATUS: DRAFT, CONFIDENTIAL

The *Draft discussion paper for SEC-DES Technical Working Group on Calculated Results* proposed that demographic data would be used as part of the model validation process but not for conditioning distributions or estimation of individual student results.

It is important to note in this context that validation is *not* a process of showing that all aspects of the model or the process concerned are flawless – rather, it is the process of assembling and evaluating the evidence that supports or refutes the intended interpretations and uses of the outcomes of the score estimation process. Irrespective of whether any change to the statistical model or any other aspect of the calculated grades process turns out to be feasible or appropriate on foot of any undesirable features discovered during any aspect of the validation process, it is still necessary to carry out such checks so that the full implications of what the process has done are understood.

Certain demographic characteristics are known to correlate with examination outcomes. In theory, this means that the statistical accuracy of estimates could be improved by including such demographic information in the estimation model. However, in the course of the development, through the work of the Technical Working Group, of the proposed approach to calculated grades, it was been agreed that this would not be appropriate. That is, an individual student's calculated grade should not be directly influenced by, for example, whether the student was male or female, or fell into some particular socio-economic category. To put it another way, if two students in the same class were placed in a particular order of expected achievement on the basis of the professional judgment of the teacher and the school, it is unlikely to be considered credible or acceptable to stakeholders if, in the absence of any specific evidence of the relevant form of bias on the part of that teacher or alignment group, these two students were to have their positions reversed purely because of their gender or because of their household income (even if the information to reliably do this were available).

Notwithstanding this position, known associations between such demographic characteristics and examination results allows additional checking to take place of the statistical model and the process as a whole. That is, since the intention of the process is to predict the grade that each student would have achieved if the examinations had taken place as normal, then it is reasonable to check whether the interactions between these characteristics and calculated results are similar to the interactions observable in historical data between these characteristics and examination results. For example, and again taking student gender to be a characteristic of interest, if the performance of female students relative to male students in the various subjects turns out to be similar under the calculated grades model as is normally the case in any other examination year, then this can be taken to be an indicator that the calculated grades model is not 'misbehaving' in respect of its primary function. (Or, more properly, that this particular analysis does not provide evidence of misbehaviour.) There will be degrees to which different magnitudes or forms of deviation from the usual interactions will be regarded as tolerable. The National Standardisation Group will need to consider what, if any, levels or forms of deviation would justify revisiting aspects of the model or process.

This paper sets out a number of checks of this type that could be carried out as part of the broader programme of model validation. In an ideal world and with no time constraints, this form of validation could look at every factor that is known to (or thought to) correlate with examination results and for which data are available or could be sourced. However, this is not practicable in the time available, and so some forms of validation will need to be prioritised over others.

The following are proposed for analysis, with the indicated priorities:

Correlate	**Priority**
• student gender • gender mix of school, and interaction of this with student gender • socio-economic disadvantage	1
• language of instruction (English/Irish)	2
• participation in Transition Year • being a repeat student	3
• school sector (secondary, vocational, comprehensive, community, other)	4

The rationale for carrying out each of these is outlined below, and some details of the proposed approach are given where relevant. It may be noted that three forms of model validation are outlined in the 'methodological considerations' paper, two of which are most relevant to this discussion. The first form involves evaluating the credibility of the distributions produced by the calculated grades process from a number of perspectives – including distributions that are disaggregated in accordance with categorical correlating variables. The second involves comparing the outcomes of any actual proposed estimation model (which will necessarily exclude the validation variables as predictors) to the outcomes of the same model supplemented by including some or all of them. The effects proposed for consideration (as in the table above) are amenable for analysis using both of these approaches. Where appropriate and in line with the above prioritisation, interaction effects among the above correlating variables will also be included in the first form of validation analysis. (They are automatically incorporated into the second.)

Gender effects and school gender-mix effects

As note in the Technical Working Group's discussion paper, research points to the existence of student gender effects in teacher estimates of student performance in a range of contexts. Since the calculated grades model incorporates teacher estimation in a manner that does not usually arise in the generation of Leaving Certificate results, it is appropriate to examine whether the calculated grades model behaves differently from the usual examination process as regards differential effects by gender. The interaction of this with the gender mix of the school is valuable as it is primarily in mixed settings that systematic teacher estimation gender biases may be most readily detectable.

Socio-economic disadvantage

There has been considerable focus on the perceived possible detrimental effects of the calculated grades model on students in "disadvantaged schools" (schools whose students are drawn primarily from areas of socio-economic disadvantage). In the data available for use in the current context, there are two potential measures that could be used as a basis for exploring the differential effects of examinations and calculated grades on students of different levels of socio-economic disadvantage:

- At the individual student level, in any normal examination year, there would be the 'examination fee waiver', which can serve as a candidate-level proxy measure of socio-economic disadvantage. Some 39% of Leaving Certificate students are exempt from fees each year. While this indicator might be considered a desirable way to identify the interaction between the systems concerned and disadvantage, there is a difficulty in respect of the 2020 examinations: processing of fee applications was still underway when the announcement in relation to the implementation of the calculated grades model was made; this was accompanied by an announcement that examination fees would be waived for all candidates and reimbursed to those who had paid. The timing of this announcement meant that approximately half of the Leaving Certificate cohort had neither paid their fees nor applied for a fee exemption. Accordingly, fee-waiver status is only recorded for half of the cohort so the data set is incomplete and unreliable. Consideration was given to using fee exemption status of the student when they sat their Junior Certificate as a proxy for the missing 2020 information. The data, which are either 2 or 3 years old, must be considered unreliable as they:
    - Exclude students whose circumstances have changed and who are now reliant on a medical card but were not when they sat their Junior Cert examinations.
    - Exclude students who did not sit the Junior Certificate examinations such as students who have moved to Ireland in recent years.
    - Include students who are now reliant on a medical card although they were not when they sat their Junior Certificate.

- At the school level, all recognised second-level schools can be categorised as either 'DEIS' or 'non-DEIS'. The DEIS programme (Delivering Equality of Opportunity in Schools) is aimed at providing supports to schools with high concentrations of students from socio-economically disadvantaged backgrounds who are correspondingly at risk of educational disadvantage. DEIS status indicates that a school meets a certain threshold on a composite indicator designed to identify schools serving areas of 'concentrated disadvantage'.[14] As of the 2017 calculations, the methodology for assessing this is based on the Pobal HP index of the 'small areas' in which the home addresses of the schools' students are located. DEIS status can be considered a good binary indicator at the school level for identifying a subpopulation of schools that contains a high representation of students from socio-economically disadvantaged backgrounds.

- Also at the school, a further option is to use the underlying continuous measure on which the binary DEIS/non-DEIS categorisation is based. This would give a more nuanced indicator than the binary one, but is a less broadly used or cited indicator, necessitates a somewhat different form of analysis, and would result in outcomes of the analysis that are likely to be less easily explained to some of the relevant audiences, who might be more used to (and/or more easily understand) statements expressed in terms of differences between DEIS and non-DEIS schools.

Given the fact that the cross-school standardisation process has focussed attention on issues of fairness across school types at least as much as at the individual level, along with the absence of a complete dataset of the individual economic disadvantage indicators, the Calculated Grades Executive Office considers that model validation from the perspective of interaction with socio-

[14] see https://www.education.ie/en/Schools-Colleges/Services/DEIS-Delivering-Equality-of-Opportunity-in-Schools-/DEIS-Identification-Process.pdf

economic disadvantage should be based on school-level indicators. Given the time available, it is proposed to use the binary DEIS/non-DEIS indicator for the first form of validation referenced above (disaggregation of distributions). Nevertheless, in recognition the information loss associated with the use of a binary variable where an underlying continuous one exists, it is also proposed to source the underlying composite school score based on the HP index (2017 version) and, if time permits, to use this for model validation of the second form (model supplementation).

Language of Instruction

Language of instruction and/or the language through which an examination is taken are likely to be of interest of stakeholders, so an appropriate language indicator should be included in the validation model. The language through which each examination is ultimately taken is not recorded in the historical data. Furthermore, experience of the State Examinations Commission (SEC) is that language of entry (the record that a candidate intends to sit through Irish / English) is not reliable. For this reason, the Calculated Grades Executive Office considers that the school-level indicator on the Department's database of language of instruction is the most appropriate available indicator to use for the language-medium aspect of model validation.

Transition-Year participation

This is known to correlate with Leaving Certificate performance. While a direct indicator of participation is not available, the data do include the time interval between Leaving Certificate and Junior Certificate examination sit at the individual level. A three-year interval combined with non-repeat status can be taken to be a good indicator of participation in Transition Year. The time interval between Junior Certificate and Leaving Certificate is information that is available at individual level in the dataset and forms part of the conditioning information at group level. Nonetheless, it is also appropriate to consider it in the course of the validation checks if time permits.

Repeat candidate

This also is known to correlate with Leaving Certificate performance. This indicator is available at an individual level in the dataset and is available for use as conditioning information at group level. Nonetheless, it is also appropriate to consider it in the course of the validation checks if time permits.

School sector

School sector covaries with DEIS status and school gender mix, so a multivariate analysis would be required in order to extract any residual sector effects after DEIS and gender effects are factored out. Any effects by school sector will be largely attributable to these other two factors. Residual effects after accounting for these are likely to provide a less useful avenue for validation than the other correlates referred to above, so this is considered to be a low priority given the time available.

Proposed means of analysis

Gender, repeat status, and Transition Year participation (by proxy) are available as individual-level indicators in the examinations datasets already incorporated in the model. The Department's publically available list of recognised secondary schools yields the school-level indicators required for most of the remaining analyses. However, this is not a complete list of all learning settings from which examinees are drawn. Accordingly, for some analyses this list will be supplemented by the SEC's list of the remaining institutions (i.e., 'schools' recognised by the SEC for the holding of examinations that are not DES-recognised schools). These will be suitably categorised with respect to school type and according to other indicators where possible, although some may need to remain uncategorised for some indicators. For instance, the gender mix of these institutions will either be known or can be established from the gender mix of the current and/or historical examination entry cohorts, but it may not be feasible to reliable establish a categorisation that could serve as equivalent to the DEIS/non-DEIS status for recognised schools.

In addition to the publically available information, access will be sought to the DES information on the composite school score based on the HP index, as used for DEIS calculations from 2017 onwards. This will be added to the school-level indicator table in respect of all recognised schools. Other learning settings will necessarily be omitted from any analysis that uses this measure.

This school-level indicator table will be made available for the above forms of analysis in the statistical standardisation process as it is brought through the course of its refinement. This will facilitate the kinds of analysis described in detail in the *Methodological Considerations* paper, which include, as noted above, both the disaggregation of national distributions according to the characteristics of interest, and a model-based analysis that involves comparing outcomes from any proposed estimation model (which does not incorporate demographic characteristics directly within the estimation process) with alternative models that do.

Subject-based and Aggregate Approach

The question of whether these various forms of validation should be carried out on a subject-by-subject basis or by instead using a composite/aggregate outcome measure has also been considered. The use of an aggregate measure will improve the efficiency and manageability of the analysis, as it would not be feasible in the time available to carry out the analysis on all subjects individually. Also, an aggregate measure is a useful way to encapsulate the overall effect of a model. However, it does not provide the same level of detailed analysis as a subject-by-subject one, in the sense that discrepancies across subjects in opposite direction will tend to mask each other in an aggregate measure. Furthermore, caution needs to be exercised in using or interpreting an aggregate measure when analysing a system that is fundamentally a subject-specific certification process that in its design and construction carries no stated or implied cross-subject comparability of score meaning. It must be recognised, however, that such cross-subject comparability is routinely subsequently applied *de facto* by a range of end users.

In light of the above considerations, the National Standardisation Group has agreed that the optimal form of validation in the time available can be achieved through the use of an aggregate measure supplemented by a subject specific examination of English, Irish and mathematics. This gives a reasonable blend of the benefits of each approach in the time available.

The aggregate measure proposed by the CGEO for use in this work is described in the Appendix.

Appendix: composite outcome measure to be used in validation context

To be well behaved from a measurement perspective and to serve the intended purpose, the CGEO considers that the composite measure should have the following properties:

- capture maximal information about subjects and the subject combinations selected by candidates by being based on the full range of subjects taken by each candidate (at all levels)
- entail a suitable means of mapping outcomes at all levels (Higher, Ordinary, and Foundation) to a common scale to facilitate appropriate aggregation across different level combinations
- capture maximal information about the estimation outcomes by being based on calculated marks rather than calculated grades
- show stability in its compensatory behaviour.

To meet these objectives, it is proposed to map marks at the various levels to a common scale in a manner that reflects the policy on grade alignment across levels introduced in 2017 in tandem with the revised grading scheme, *viz*: H5 to O1, H6 to O2, H7 to O3, O5 to F1, O6 to F2, O7 to F3. These alignments imply a mark equivalence at the corresponding grade threshold scores, and also imply that the alignment in these areas of overlap is a constant offset. This alignment is realised by applying a constant offset of 40 marks between Higher-level and Ordinary-level marks, and a further offset of 40 marks between Ordinary-level and Foundation-level marks.

A question remains as to whether it is appropriate to continue this offset to the bottom of the scale in each case. It would be unreasonable to interpret, for example, a score of 0 marks at Higher level (or even a score marginally above 0) to be equivalent to a score of 40 marks (or indeed any substantive mark) at Ordinary level. The most obvious choices, then, are to continue the offset equivalence only down to some lower limit beyond which the case is omitted from consideration, or to map the lower end of the scale (the range represented by grade 8) in a linear or other manner so as to make the scores of 0 on all scales coincide. The latter approach retains information about all outcomes for all candidates, but cannot be achieved without distorting interval aspects of at least two of the three scales. If the Foundation level scale were to be left intact, the degree of stretching required to map, in particular, scores of below 30 at Higher level to the range 0 to 110 would cause very low scores at this level to have an extreme effect on the mean and variance of the scaled scores. Likewise, leaving the interval nature of the Higher level score intact would make it difficult to avoid overly compressing the Ordinary and, in particular, the Foundation-level scale. Accordingly, it is proposed to leave the intervals on the Ordinary level scale intact, and map the other two scales to correspond to it. It is recognised that this entails compressing a substantial portion of the Foundation-level scale, but this seems reasonable in the current context and given the difficulties that any alternative would entail. Accordingly, the following is proposed:

- If Ordinary level, then scaled score = calculated score
- If Higher level, and calculated score is at least 30, then scaled score = calculated score + 40
- If Higher level, and calculated score is less than 30, then scaled score = calculated score × 7/3
- If Foundation level, and calculated score is at least 70, then scaled score = calculated score – 40
- If Foundation level, and calculated score is less than 70, then scaled score = calculated score × 3/7.

The aggregate score for each candidate is then calculated as the mean scaled score across all subjects for which a calculated mark has been generated.

Consideration was also given to including LCVP link module scores on this scale, (aligning the distinction threshold score with the H4 threshold, the Merit threshold score with the H6 threshold, and the Pass threshold score with the O4 threshold). However, the ceiling effect that applies irrespective of how high the candidate level of achievement is such that interpretation of the aggregate measure would seem to be more reasonable with its omission.

Appendix N. Supplementary tables for Section 11

Gender

Higher level Irish, by grade and gender

year		N	percentage awarded each grade							
			1	2	3	4	5	6	7	8
2017	female	13,603	6.0	20.2	24.9	23.7	16.8	6.8	1.3	0.2
	male	8,519	4.2	15.7	22.4	23.2	20.4	11.0	2.7	0.4
2018	female	13,849	5.6	20.2	24.1	23.1	16.9	8.2	1.7	0.2
	male	8,551	3.7	14.7	21.7	24.3	20.8	11.5	2.9	0.5
2019	female	14,348	7	19.2	23	23.3	17.3	7.8	2.1	0.3
	male	8,828	4.5	15.3	21.3	22.6	19.6	12.2	3.9	0.6
2017–2019	female	41,800	6.2	19.9	24.0	23.4	17.0	7.6	1.7	0.2
	male	25,898	4.1	15.2	21.8	23.4	20.3	11.6	3.2	0.5
school est. 2020	female	15,433	14.1	24.3	25.6	21.0	10.1	4.3	0.5	0.1
	male	9,271	9.9	19.9	24.1	22.3	15.6	7.0	1.0	0.3
calc. grade 2020	female	15,433	10.3	21.5	28.1	23.7	11.8	3.9	0.5	0.1
	male	9,271	7.0	16.7	25.3	26.0	17.6	6.3	1.0	0.2

Ordinary level Irish, by grade and gender

year		N	percentage awarded each grade							
			1	2	3	4	5	6	7	8
2017	female	9,843	0.6	9.0	24.4	28.4	22.1	11.2	3.3	1.2
	male	12,678	0.1	3.3	13.5	25.1	28.1	19.4	7.7	2.8
2018	female	9,444	0.5	7.9	25.1	29.7	21.3	10.8	3.2	1.4
	male	11,995	0.1	3.1	14.3	26.8	27.1	17.7	7.5	3.4
2019	female	9,773	0.5	8.1	25.4	29.1	21.1	10.8	3.6	1.4
	male	12,550	0.1	2.9	13.2	24	28.1	19.5	8.4	3.8
2017–2019	female	29,060	0.5	8.3	25.0	29.1	21.5	10.9	3.4	1.3
	male	37,223	0.1	3.1	13.7	25.3	27.8	18.9	7.9	3.3
school est. 2020	female	10,004	4.1	15.6	25.2	24.2	17.0	10.8	2.0	1.1
	male	13,547	1.3	7.4	17.6	23.2	22.7	20.8	4.1	3.0
calc. grade 2020	female	10,004	3.1	12.4	23.7	27.5	20.1	10.4	2.2	0.8
	male	13,547	1.0	6.1	16.3	25.3	25.6	19.2	4.6	1.9

Foundation level Irish, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	1,038	3.0	14.5	24.2	22.6	17.2	11.2	5.0	2.3
	male	2,152	0.6	5.9	16.7	25.7	25.0	15.5	7.3	3.4
2018	female	1,022	2.2	15.9	23.1	26	16.7	8.7	5.3	2.2
	male	1,890	0.8	6.6	17.3	24.7	24.7	14.9	7	4
2019	female	926	3.7	16.7	22.8	24.6	15.2	10.4	4.8	1.8
	male	1,908	1.1	9.3	18.4	24.4	23.6	12.7	6.9	3.5
2017–2019	female	3.0	15.7	23.4	24.4	16.4	10.1	5.0	2.1	3.0
	male	0.8	7.3	17.5	24.9	24.4	14.4	7.1	3.6	0.8
school est. 2020	female	464	10.6	24.8	24.6	17.7	12.1	9.3	0.4	0.6
	male	997	3.9	15.7	25.6	24.5	17.1	11.3	0.6	1.3
calc. grade 2020	female	464	10.1	24.1	25.2	17.5	12.9	9.1	0.4	0.6
	male	997	3.9	14.8	25.5	25.6	17.5	10.9	0.5	1.3

Higher level English, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	20,986	3.3	11.7	22.0	27.3	22.5	11.1	1.8	0.4
	male	17,763	2.5	9.5	18.9	26.3	24.2	14.6	3.1	0.8
2018	female	21,026	3.2	11.4	21.2	28.7	23	10.5	1.8	0.3
	male	17,257	2.5	8.4	18.5	27.1	25.6	14.2	2.9	0.8
2019	female	22,097	3.4	11.3	22.1	28.2	22.6	10.3	1.9	0.3
	male	18,120	2.5	8.7	18.7	26.8	25.1	13.9	3.5	0.9
2017–2019	female	3.3	11.5	21.8	28.1	22.7	10.6	1.8	0.3	3.3
	male	2.5	8.9	18.7	26.7	25.0	14.2	3.2	0.8	2.5
school est. 2020	female	23,217	7.8	18.4	27.7	25.4	14.2	5.6	0.8	0.2
	male	18,717	4.6	12.9	22.7	26.9	20.2	10.6	1.7	0.4
calc. grade 2020	female	23,217	5.5	15.7	27.7	27.9	16.3	5.9	0.9	0.2
	male	18,717	2.8	10.2	21.5	28.8	23.1	11.2	2.0	0.4

Ordinary level English, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	6,005	2.2	11.6	26.3	28.5	19.6	8.9	2.1	0.8
	male	9,384	1.3	6.9	20.3	26.7	24.6	13.4	4.6	2.2
2018	female	5,824	2.1	10.9	24.1	29.3	20.5	9.3	2.9	0.9
	male	8,929	1	6.2	18.9	27.5	23.9	14.3	5.5	2.7
2019	female	5,514	2.1	9.6	24.4	29.3	21.9	9.4	2.6	0.8
	male	8,963	1.1	5.8	17.8	27.4	24.6	14.8	5.6	2.7
2017–2019	female	2.1	10.7	24.9	29.0	20.7	9.2	2.5	0.8	2.1
	male	1.1	6.3	19.0	27.2	24.4	14.2	5.2	2.5	1.1
school est. 2020	female	5,428	5.6	15.9	27.8	25.6	14.9	8.3	1.3	0.7
	male	9,208	2.1	9.2	21.0	25.7	22.1	15.8	2.4	1.8
calc. grade 2020	female	5,428	4.9	14.7	27.5	26.6	16.5	7.8	1.4	0.6
	male	9,208	1.8	8.2	20.1	27.2	23.6	14.7	2.8	1.4

Higher level mathematics, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	7,750	3.7	10.3	16.0	22.4	23.2	15.6	6.6	2.2
	male	8,644	8.0	13.9	16.4	20.2	20.0	13.9	5.8	1.9
2018	female	8,096	3.1	12.4	18.7	23	21.4	13.6	6	1.7
	male	8,741	7.6	14.5	18.7	20.3	18.9	12.5	5.7	1.8
2019	female	8,830	4	9.7	17.2	23.9	23.5	14.9	5.4	1.5
	male	9,323	8.7	12.6	16.9	21.2	19.8	13.6	5.3	1.9
2017–2019	female	24,676	3.6	10.8	17.3	23.1	22.7	14.7	6.0	1.8
	male	26,708	8.1	13.7	17.3	20.6	19.6	13.3	5.6	1.9
school est. 2020	female	10,265	10.4	17.2	20.9	21.6	17.4	10.3	1.8	0.5
	male	10,257	12.9	15.3	18.8	20.4	17.0	12.2	2.8	0.6
calc. grade 2020	female	10,265	7.9	16.1	22.3	23.9	18.1	9.3	1.9	0.4
	male	10,257	8.9	14.1	20.6	22.5	18.9	11.5	2.9	0.6

Ordinary level mathematics, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	16,675	2.4	13.6	21.7	23.0	18.8	11.7	5.4	3.4
	male	15,660	1.9	11.4	20.1	23.3	20.0	12.1	6.6	4.5
2018	female	16,310	1.9	12.1	21.6	24.4	19.9	12	5.2	2.7
	male	15,026	1.1	9.4	19.7	23.8	20.5	14.2	6.6	4.7
2019	female	16,358	1.9	12.2	21.3	23.3	19.2	12.6	6.2	3.2
	male	15,116	1.4	10.2	18.8	23	21.1	13.4	6.8	5.4
2017–2019	female	49,343	2.1	12.6	21.5	23.6	19.3	12.1	5.6	3.1
	male	45,802	1.5	10.3	19.5	23.4	20.5	13.2	6.7	4.9
school est. 2020	female	17,298	6.5	16.5	21.4	20.7	17.0	13.5	2.6	1.7
	male	16,528	4.1	12.2	19.1	20.4	18.6	18.6	3.9	3.1
calc. grade 2020	female	17,298	5.7	14.7	21.8	23.2	18.8	11.6	3.1	1.2
	male	16,528	3.2	9.9	18.7	23.0	21.0	16.5	5.3	2.4

Foundation level mathematics, by grade and gender

			percentage awarded each grade							
year		*N*	1	2	3	4	5	6	7	8
2017	female	2,800	3.1	11.4	21.4	25.9	21.5	11.6	3.7	1.3
	male	3,136	4.8	15.9	20.6	25.9	18.1	9.9	3.5	1.4
2018	female	2,556	2.3	8.3	18.6	24.2	21.5	15.3	6	3.7
	male	2,662	3.7	13.3	21.2	23.1	18.9	12.6	4.3	2.9
2019	female	2,595	3.7	12.3	18.5	22	21.2	13.5	6.1	2.6
	male	2,872	4.9	14.6	20.1	21.5	19.3	11.9	5.1	2.6
2017–2019	female	7,951	3.0	10.7	19.5	24.0	21.4	13.5	5.3	2.5
	male	8,670	4.5	14.6	20.6	23.5	18.8	11.5	4.3	2.3
school est. 2020	female	1,218	8.4	19.7	21.3	19.1	17.2	11.6	1.8	1.0
	male	1,375	7.1	19.1	18.5	19.6	18.5	13.6	0.9	2.7
calc. grade 2020	female	1,218	8.0	19.3	21.7	20.4	17.4	10.6	1.8	0.8
	male	1,375	6.3	18.8	18.9	20.9	19.5	12.0	1.6	2.0

School DEIS status

Higher level Irish, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	994	6.9	17.1	21.2	25.2	19.0	7.4	1.7	1.4
	Non-DEIS	18,766	5.5	19.7	24.9	23.4	17.2	7.5	1.5	0.2
	DEIS	2,362	3.0	8.8	17.9	23.3	25.2	16.3	4.7	0.9
2018	Other	979	5.8	20.5	26.3	24.7	13.8	6	2	0.8
	Non-DEIS	18,737	5.2	18.9	23.8	23.5	17.6	9	1.9	0.2
	DEIS	2,684	2.3	11.2	17.7	24.1	25.8	14	4.2	0.7
2019	Other	1,087	8.5	19.4	25.9	20.5	17.3	5.5	1.9	0.9
	Non-DEIS	19,315	6.4	18.9	23.1	23.4	17.3	8.5	2.2	0.3
	DEIS	2,774	2.5	8.8	15.7	21.4	25	18.2	7.3	1
2017–2019	Other	3,060	7.1	19.0	24.5	23.5	16.7	6.3	1.9	1.0
	Non-DEIS	56,818	5.7	19.2	23.9	23.4	17.4	8.3	1.9	0.2
	DEIS	7,820	2.6	9.6	17.1	22.9	25.3	16.2	5.4	0.9
school est. 2020	Other	1,045	17.7	29.0	28.3	19.9	3.5	1.5		
	Non-DEIS	20,519	12.9	23.3	25.5	21.1	11.7	4.8	0.6	0.2
	DEIS	3,140	8.3	16.6	21.0	24.3	17.9	10.1	1.6	0.3
calc. grade 2020	Other	1,045	13.6	23.7	29.6	22.0	8.8	2.2	0.1	
	Non-DEIS	20,519	9.4	20.3	27.5	24.4	13.4	4.3	0.5	0.2
	DEIS	3,140	5.3	14.1	23.4	26.8	19.6	8.9	1.7	0.2

Ordinary level Irish, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	484	0.4	9.1	23.8	28.1	20.7	12.6	2.9	2.5
	Non-DEIS	17,723	0.3	6.5	19.7	27.5	24.9	14.4	4.9	1.8
	DEIS	4,314	0.2	2.3	11.8	22.5	28.4	21.9	9.6	3.3
2018	Other	513	0.4	11.5	28.7	30.4	16.4	6.2	4.1	2.3
	Non-DEIS	16,535	0.4	5.8	20.6	29	24.1	13.3	4.8	2.0
	DEIS	4,391	0.0	2.4	11.8	24.3	27.2	21.0	8.9	4.4
2019	Other	571	1.4	10.3	23.5	28.2	21.0	10.3	3.0	2.3
	Non-DEIS	17,359	0.3	5.7	20.3	27.1	24.8	14.2	5.5	2.2
	DEIS	4,393	0.0	2.3	11.3	22.4	26.6	22.5	9.7	5.1
2017–2019	Other	1,568	0.7	10.3	25.3	28.9	19.4	9.7	3.3	2.4
	Non-DEIS	51,617	0.3	6.0	20.2	27.9	24.6	14.0	5.1	2.0
	DEIS	13,098	0.1	2.3	11.6	23.1	27.4	21.8	9.4	4.3
school est. 2020	Other	595	7.9	16.1	25.7	24.2	16.1	9.9	0.0	0.0
	Non-DEIS	17,889	2.6	11.8	22.1	24.1	19.7	15.2	2.8	1.8
	DEIS	5,067	1.4	7.0	15.8	22.0	22.9	22.1	5.1	3.7
calc. grade 2020	Other	595	5.9	17.3	27.4	26.1	16.1	7.2	0.0	0.0
	Non-DEIS	17,889	2.0	9.6	20.5	26.8	22.7	14.3	3.1	1.1
	DEIS	5,067	0.9	5.0	14.5	24.3	26.2	20.6	5.8	2.6

Foundation level Irish, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	42	7.1	11.9	23.8	21.4	11.9	11.9	7.1	4.8
	Non-DEIS	1,829	1.6	9.8	18.5	23.9	22.4	13.7	6.6	3.5
	DEIS	1,319	0.8	6.9	19.9	25.9	22.9	14.7	6.5	2.4
2018	Other	30	10	16.7	20	20	10	10	6.7	6.7
	Non-DEIS	1,620	1.3	12	18.6	26.4	20.6	11.9	6.4	2.9
	DEIS	1,262	1.1	6.9	20.3	23.8	23.9	13.9	6.3	3.8
2019	Other	28	10.7	21.4	17.9	21.4	21.4	3.6		3.6
	Non-DEIS	1,518	2.2	12.4	22.3	25.3	19.2	11	5.6	1.9
	DEIS	1,288	1.4	10.8	17	23.6	22.8	13.3	7	4.1
2017–2019	Other	100	9.3	16.7	20.6	20.9	14.4	8.5	6.9	5.0
	Non-DEIS	4,967	1.7	11.4	19.8	25.2	20.7	12.2	6.2	2.8
	DEIS	3,869	1.1	8.2	19.1	24.4	23.2	14.0	6.6	3.4
school est. 2020	Other	14	7.1	21.4	28.6	21.4	7.1	14.3		
	Non-DEIS	723	8.4	21.3	24.5	22.3	13.4	8.4	0.6	1.1
	DEIS	724	3.6	15.9	26.0	22.4	17.7	12.8	0.6	1.1
calc. grade 2020	Other	14	7.1	21.4	28.6	21.4	7.1	14.3		
	Non-DEIS	723	8.6	20.5	24.8	22.7	13.6	8.3	0.6	1.1
	DEIS	724	3.2	15.1	26.0	23.3	18.6	12.3	0.4	1.1

Higher level English, by grade and school DEIS status

year	DEIS status	*N*	percentage awarded each grade							
			1	2	3	4	5	6	7	8
2017	Other	1,302	4.1	13.9	22.4	28.3	19.4	9.3	2.1	0.5
	Non-DEIS	32,538	3.1	11.2	21.3	27.0	22.9	11.9	2.1	0.5
	DEIS	4,909	1.4	6.7	15.4	25.4	27.0	18.5	4.8	0.9
2018	Other	1,397	3.9	11.7	22	29	22.1	8.4	1.8	1.1
	Non-DEIS	31,674	3.1	10.7	20.8	28.4	23.3	11.3	2.1	0.4
	DEIS	5,212	1.2	5.8	14.3	25.2	29.8	18.7	4	0.9
2019	Other	1,463	3.9	15.1	26.1	26.5	17.7	8.1	1.9	0.6
	Non-DEIS	33,297	3.2	10.7	21.3	27.8	23.1	11.1	2.3	0.5
	DEIS	5,457	1.4	5.4	14.3	26.4	28.8	18.1	4.5	1.2
2017–2019	Other	4,162	4.0	13.6	23.5	27.9	19.7	8.6	1.9	0.7
	Non-DEIS	97,509	3.1	10.9	21.1	27.7	23.1	11.4	2.2	0.5
	DEIS	15,578	1.3	6.0	14.7	25.7	28.5	18.4	4.4	1.0
school est. 2020	Other	1,570	5.7	18.5	30.4	26.8	13.5	4.3	0.8	
	Non-DEIS	34,424	4.5	13.8	25.5	28.3	18.7	7.8	1.3	0.2
	DEIS	5,940	2.5	8.7	20.3	29.0	24.6	12.3	2.1	0.7
calc. grade 2020	Other	1,570	8.1	24.3	33.5	21.0	9.7	2.8	0.6	
	Non-DEIS	34,424	6.6	16.4	25.8	26.0	16.3	7.4	1.1	0.2
	DEIS	5,940	4.3	11.1	21.2	27.5	22.0	11.2	1.9	0.7

Ordinary level English, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	673	5.5	17.1	18.1	21.0	16.8	13.7	5.5	2.4
	Non-DEIS	10,238	1.7	9.4	25.2	28.1	21.2	10.0	3.0	1.3
	DEIS	4,478	0.8	5.8	17.5	27.0	26.7	15.1	4.8	2.5
2018	Other	594	7.1	16.5	21.4	17.5	14.8	13.8	5.6	3.4
	Non-DEIS	9,677	1.4	8.8	22.8	29	21.7	10.9	3.7	1.6
	DEIS	4,482	0.9	5.3	16.8	27.9	25.4	15.1	5.9	2.7
2019	Other	655	6.3	13.9	27.9	20	15.9	9.3	4.6	2.1
	Non-DEIS	9,278	1.6	8.1	21.9	28.8	23.1	11.2	3.9	1.4
	DEIS	4,544	0.7	4.7	16.1	27.8	25.6	16.4	5.6	3.1
2017–2019	Other	1,922	6.3	15.8	22.5	19.5	15.8	12.3	5.2	2.6
	Non-DEIS	29,193	1.6	8.8	23.3	28.6	22.0	10.7	3.5	1.4
	DEIS	13,504	0.8	5.3	16.8	27.6	25.9	15.5	5.4	2.8
school est. 2020	Other	584	8.7	14.0	23.3	20.7	17.0	11.6	1.9	2.7
	Non-DEIS	9,499	3.8	13.1	25.2	25.6	18.3	11.3	1.7	1.1
	DEIS	4,553	1.9	8.4	19.9	26.4	22.1	16.9	2.6	1.8
calc. grade 2020	Other	584	8.4	14.9	24.0	20.7	17.3	10.1	3.1	1.5
	Non-DEIS	9,499	3.4	11.9	24.6	27.2	19.7	10.6	1.9	0.9
	DEIS	4,553	1.5	7.5	19.2	27.5	24.1	15.6	3.1	1.5

Higher level mathematics, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	854	8.4	14.8	18.9	21.2	16.4	9.6	7.4	3.4
	Non-DEIS	14,152	6.1	12.6	16.4	21.5	21.5	14.4	5.8	1.7
	DEIS	1,388	3.1	6.9	12.1	19.0	24.9	20.2	9.6	4.3
2018	Other	967	6.8	17.5	19.9	18.1	17.2	11.5	6.2	2.9
	Non-DEIS	14,304	5.6	13.8	19.2	22	20	12.5	5.5	1.5
	DEIS	1,566	3.3	8	13.9	20.1	23.3	18.9	9	3.6
2019	Other	1,082	8.1	14.6	20.5	22.7	16.1	10.3	4.9	2.8
	Non-DEIS	15,365	6.7	11.4	17.3	23	21.6	13.7	4.9	1.4
	DEIS	1,706	2.9	7.2	12.4	18.2	24.9	22	9	3.4
2017–2019	Other	2,903	7.8	15.6	19.8	20.7	16.6	10.5	6.2	3.0
	Non-DEIS	43,821	6.1	12.6	17.6	22.2	21.0	13.5	5.4	1.5
	DEIS	4,660	3.1	7.4	12.8	19.1	24.4	20.4	9.2	3.8
school est. 2020	Other	1,251	19.0	20.5	19.7	17.7	12.4	8.2	2.0	0.5
	Non-DEIS	17,158	11.7	16.4	20.1	21.1	17.2	10.8	2.2	0.4
	DEIS	2,113	7.2	12.3	18.0	21.6	19.6	16.6	3.4	1.4
calc. grade 2020	Other	1,251	11.5	18.5	21.3	21.2	14.9	9.3	2.8	0.5
	Non-DEIS	17,158	8.6	15.4	21.7	23.3	18.4	9.9	2.2	0.4
	DEIS	2,113	5.2	11.3	18.9	22.8	21.8	15.1	3.5	1.3

Ordinary level mathematics, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	1,328	3.5	15.7	19.4	19.4	17.2	11.5	7.3	6.1
	Non-DEIS	25,014	2.3	13.4	22.2	23.7	19.1	11.1	5.1	3.0
	DEIS	5,993	1.3	8.5	15.9	21.7	21.2	15.1	9.1	7.2
2018	Other	1,164	2.1	13	22.4	21.4	18.6	12.5	6.6	3.4
	Non-DEIS	23,897	1.7	11.8	22.3	24.9	19.8	11.8	5	2.7
	DEIS	6,275	1	6.9	14.5	21.6	21.9	17.9	9.1	7.2
2019	Other	1,221	3.4	14.2	20.6	23.7	17.2	11	6.1	3.9
	Non-DEIS	23,975	1.8	12	21.2	24	20	12.1	5.6	3.3
	DEIS	6,278	1.1	7.7	15.6	19.7	21.1	16.9	9.8	8.1
2017–2019	Other	3,713	3.0	14.3	20.8	21.5	17.7	11.7	6.7	4.5
	Non-DEIS	72,886	1.9	12.4	21.9	24.2	19.6	11.7	5.2	3.0
	DEIS	18,546	1.1	7.7	15.3	21.0	21.4	16.6	9.3	7.5
school est. 2020	Other	1,057	9.0	20.0	20.5	21.4	15.9	12.7	0.2	0.4
	Non-DEIS	25,355	5.8	15.3	21.2	20.8	17.3	14.8	2.9	1.9
	DEIS	7,414	3.5	10.4	16.9	19.7	19.6	20.5	4.9	4.3
calc. grade 2020	Other	1,057	8.7	17.0	22.5	22.1	16.2	12.2	0.9	0.4
	Non-DEIS	25,355	4.9	13.3	21.3	23.4	19.3	12.8	3.6	1.4
	DEIS	7,414	2.6	8.6	16.5	22.2	22.2	18.2	6.5	3.3

Foundation level mathematics, by grade and school DEIS status

			percentage awarded each grade							
year	DEIS status	*N*	1	2	3	4	5	6	7	8
2017	Other	278	15.5	20.5	18.3	16.5	12.6	10.4	3.6	2.5
	Non-DEIS	3,640	4.3	14.8	22.1	27.2	18.3	9.2	3.0	1.2
	DEIS	2,018	1.9	11.0	19.3	25.0	23.2	13.4	4.7	1.5
2018	Other	197	13.7	11.7	19.3	18.8	13.2	11.7	2	9.6
	Non-DEIS	3,175	2.8	11.9	22	24.4	19.6	12.3	4.6	2.4
	DEIS	1,446	2.3	8.9	16.4	23	21.8	17	6.5	4.2
2019	Other	176	11.9	18.2	23.9	10.8	14.8	9.7	6.3	4.5
	Non-DEIS	3,275	4.9	15.2	20.8	22.5	18.9	11.6	4.5	1.7
	DEIS	2,016	2.8	10.3	16.7	21.5	22.8	14.6	7.4	3.8
2017–2019	Other	651	13.7	16.8	20.5	15.4	13.5	10.6	4.0	5.5
	Non-DEIS	10,090	4.0	14.0	21.6	24.7	18.9	11.0	4.0	1.8
	DEIS	5,480	2.3	10.1	17.5	23.2	22.6	15.0	6.2	3.2
school est. 2020	Other	121	5.8	12.4	16.5	17.4	19.8	19.0	1.7	7.4
	Non-DEIS	1,491	9.3	22.3	21.5	19.5	15.4	9.8	0.9	1.3
	DEIS	981	5.4	15.7	17.7	19.4	21.5	16.2	1.9	2.1
calc. grade 2020	Other	121	5.0	13.2	18.2	17.4	19.8	17.4	2.5	6.6
	Non-DEIS	1,491	8.7	21.9	21.9	20.1	16.2	9.1	1.1	1.0
	DEIS	981	5.0	15.4	17.8	21.9	21.8	14.1	2.4	1.5