Modelling GCSE grade 9 to 1 outcomes in 2017: A technical explanation

Introduction

This paper sets out the basis for modelling likely percentages of students at each of the 9 to 1 grades in GCSE mathematics and GCSE English language in 2017. The modelling is based on 2016 outcomes in the previous versions of the specifications. It is based on the underlying distributions of candidate marks (either uniform or raw marks). The paper outlines a number of assumptions involved in modelling. Some assumptions are more straightforward than others.

Data used in the modelling

All candidates in the following specifications were included in the analysis:

GCSE English/English language:

AQA English 4700
OCR English J350
Pearson English 2EH01
WJEC English 4190LA
AQA English language 4700
OCR English language J355
Pearson English language 2EN01
WJEC English language 4170LA
CIE First language English 0522

GCSE mathematics:

AQA mathematics 4360 (unitised)
OCR mathematics A J562 (unitised)
Pearson mathematics B 2MB01 (unitised)
WJEC mathematics 4350SA (unitised)
AQA mathematics B 4365 (linear)
OCR mathematics B J567 (linear)
Pearson mathematics A 1MA0 (linear)
WJEC mathematics 4370 (linear)

NB, modelling does not include specifications offered by CCEA; specifications which were part of the ‘Mathematics Linked Pair’ Pilots or specifications designed for Welsh speakers offered by WJEC or offered in Wales only (eg WJEC English language 4940 SA which includes Speaking and Listening as part of the final grade).

For GCSE English and English language, the modelling is based upon the uniform mark scales for all specifications.

For GCSE mathematics, this modelling is based upon the uniform mark scale (UMS) distributions for specifications, which were originally designed with a unitised structure of assessment; for specifications originally designed with a linear structure of assessment the modelling uses the raw mark distributions.

The data reflects candidate outcomes in these specifications at the point of results issue in August 2016.

Assumptions/rules applied in the modelling

For unitised specifications which use UMS the following rules were applied.

1. Grade 1, 4 and 7 should have boundaries at the same mark (UMS) thresholds as grades G, C and A respectively, giving the same cumulative percent outcomes.
2. Grade 9 is calculated according to the formula such that the percentage of those achieving at least grade 7 who should be awarded grade 9 = 7% + 0.5 × (percentage of candidates awarded grade 7 or above). For further information on the development of the formula see: http://www.cambridgeassessment.org.uk/Images/298710-a-possible-formula-to-determine-the-percentage-of-candidates-who-should-receive-the-new-gcse-grade-9-in-each-subject.pdf. The mark which gives the nearest outcome is chosen, whether higher or lower.
3. Grade 8 boundary is obtained by dividing the mark interval between grade 9 and grade 7. Where there is a remainder of one, the extra mark is added to the grade 8 interval.
4. On higher tier, the grades 5 and 6 boundaries are obtained by dividing the mark interval between grades 4 and 7. Where there is a remainder of one mark, the extra mark is added to the grade 6 interval. Where there is a remainder of two marks, one extra mark is added to each of the grade 6 and grade 5 intervals.
5. Similarly, on the foundation tier, grade 2 and grade 3 boundaries are obtained by dividing the mark interval between grade 4 and grade 1. Where there is a remainder of one mark, the extra mark is added to the grade 3 interval. Where there is a remainder of two marks, one extra mark is added to each of the grade 3 and grade 2 intervals.

Additional rules/assumptions for linear specifications in mathematics (and CIE First Language English)

For linear specifications where raw or scaled marks are retained, rather than UMS, the following rules and assumptions were modelled.

1. Grade 9 is calculated as above but it is worth noting it is based on the percentage of candidates achieving grade A/grade 7 of all candidates from both foundation and higher tiers; and not from the percentage of candidates who entered higher tier only.
2. Higher tier grade 3 boundary has been calculated as being in the same boundary location as that of the current 'allowed E' on higher tier. This means that grade 3 boundary is a greater interval below grade 4 as grade 5 is above it. This is appropriate for the modelling but will likely not reflect the practice in the live assessments. This is discussed below.
3. Foundation tier grade 5 boundary – this could be calculated in two ways for the purpose of this modelling and these are discussed below.
    a. Grade 5 boundary is the same distance above grade 4 as the grade 3 boundary is below it ('full fold-over');
    b. Grade 5 boundary is half the distance above grade 4 boundary as grade 3 boundary is below it ('half fold-over').

For raw mark distributions on linear specifications there are some complications in modelling grade 3 on the higher tier (the lowest available grade on the higher tier) and grade 5 on the foundation tier (the highest available grade on the foundation tier). This is because the current specifications are not designed for this grade set.

For grade 3 on higher tier, in 2017, the boundary is unlikely to be the same distance below grade 4 as grade 5 is above it, but rather equivalent of half the interval below 4 as 5 is above 4. Therefore, for the sake of this modelling, we are calculating the allowed grade 3 as being at the same boundary for the current allowed grade E.

For grade 5 on foundation tier in 2017, the boundary is likely to be set using statistical and technical evidence to align with the standard of grade 5 at the higher tier. Such evidence was not available for this modelling. So two approaches were modelled (1) the grade 5 boundary is the same distance above grade 4 as 3 is below it; and (2) the grade boundary is set half the distance above grade 4 as grade 3 is below it. The reason for this approach in the modelling is that the current specifications were not necessarily designed to reach to grade 5 equivalent. Additionally, in the way the current grade set maps to the new grade set, the distance between grade 4 and 3 is wider than that of C to D; and the distance between grade 4 and grade 5 is smaller than that of grade C to B. If we model a 'full fold-over' (as described in point 3a above) the outcomes at grade 5 would be 40.1% compared to 43% in mathematics for 'half fold-over' (as described in 8b). Thus, the combination of differences in tiering and differences in grade-widths means that some aspects of the modelling are based on particular assumptions. The outcomes in the tables below reflect the modelling of the half fold-over for grade 5 on the foundation tier.