

RESEARCH AND ANALYSIS

An investigation of the comparability of scores between optional questions in GCSE English literature, GCSE history and A level sociology

Qingping He and Beth Black

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Summary

Optionality, the use of optional questions in examinations where different candidates can answer different sets of questions to gain access to the same maximum mark or grade set, is widespread in GCSE and A level qualifications. There are two broad types of optionality – use of optional questions within an examination paper (within-paper optionality) and use of optional papers within an assessment component (between-paper optionality).

The use of optional papers usually indicates that a teacher or school has chosen a particular curriculum option (for example the Elizabethans rather than the Norman Conquest). The use of optional questions within a paper in some cases reflects that teachers have a curriculum choice (for example in English literature, Macbeth rather than As You Like It) or in the optionality allows students to make a decision on the day depending upon which question they think they are likely to fare better (for example a choice of 2 Macbeth questions: extract-based or discursive).

The parity or comparability of options (questions or routes) has always been a concern for relevant stakeholders. This research focuses on the extent to which there is parity of standards across different routes to certification within a qualification. As part of this research, the comparability of marks between optional questions and grades between optional routes at both component and the overall qualification levels for 7 specifications from GCSE English literature, GCSE history and A level sociology was assessed using a number of statistical methods. Two years of assessment data (2018 and 2019) were used to establish whether the findings were likely to be true in more than just one year's assessment.

This research also looked at whether there was any relationship between question/route choice and candidate characteristics.

This research finds there is variability in relative difficulty between optional questions/sections within examination papers. Where optional papers are used within an assessment component (such as the components in the 3 GCSE history specifications), the variability in difficulty between optional questions from different optional papers is considerably larger than that between optional questions within the same paper. The variability in difficulty between optional questions results in variability in relative difficulty between different routes at both component and the overall qualification levels.

For the 2 GCSE English literature specifications, difference in average mark from similar candidates between the most difficult and the easiest question options was as high as 13% of the maximum available mark in 2018 and 10% in 2019.

For the 3 GCSE history specifications, this was over 23% in 2018 and 35% in 2019 for optional questions from different optional papers in the same component. For the two A level sociology specifications, this was about 6% in 2018 and 8% in 2019.

There is considerable variability in relative grade difficulty between different routes to the same grades at component level and the overall qualification level.

At component level: for the 4 papers from the two GCSE English literature specifications, difference in relative grade difficulty between the most difficult and the easiest routes was about three-quarters of a grade at grade 7 and one grade at grade 4. The 3 GCSE history specifications show the largest variability in relative grade

difficulty at both grades 7 and 4, with a maximum difference of about one-and-three-fifths of a grade at grade 7 and as much as two-and-two-fifths of a grade at grade 4 between the most difficult and the easiest routes. For the 3 A level sociology papers, this was about two-fifths of a grade at A and three-quarters of a grade at C.

At the overall qualification level: for the 2 GCSE English literature specifications, the difference in grade difficulty between the most difficult and the easiest certification routes was about two-fifths of a grade at grade 7 and a half-grade at grade 4.

For the 3 GCSE history specifications, this was about one grade at grade 7 and three-quarters of a grade at grade 4. For the 2 A level sociology specifications, the most difficult route is about a sixth of a grade harder at A than the easiest route and nearly a quarter of a grade harder at C.

The magnitude of relative difficulty between optional questions/sections was similar in both 2018 and 2019 for the specifications studied. For a small proportion of the optional questions, the relative difficulties were consistent between the 2 years.

For the majority of the optional questions/sections and certification routes from the 5 GCSE specifications analysed, there seems to be a trend that more able students (and students with low levels of deprivation) were more likely to choose easier questions or certification routes (in terms of facility) than less able students (or students with high levels of deprivation). However, there are also situations where the trend was not entirely clear or even reversed.

There appears no clear pattern in the relationship between certification routes and candidates' characteristics with respect to grade difficulty at individual grades. There was also generally no clear pattern in the relationship between question difficulty and the other variables such as gender and ethnicity for the majority of the optional questions/sections and routes examined.

Introduction

Optionality refers to the use of optional questions in examinations where different candidates can answer different (sets of) questions to achieve the same total scores (marks) or grades. The effect of optionality in examinations has been studied from a range of perspectives, including reliability, validity, comparability, teaching and learning, and others (see, for example, Meyer, 1939; Stalnaker, 1951; Devadson, 1963; MacNamara and Madaus, 1969; Mackay, 1970; Ducette and Wolk, 1972; Wang, Wainer and Thissen, 1995; Walstad, 2006; Mundia, 2010; Wainer, 2011; Adepoju, 2012; Harrison, 2018; Bramley and Crisp, 2019).

In the context of secondary school qualifications such as GCSEs and A levels in England, optionality is widely used in subjects like history, English literature, sociology, religious studies and others. Two types of optionality are generally involved – use of optional questions within an exam paper (within-paper optionality) or use of optional papers within an assessment component or unit (between-paper optionality).

Bramley and Crisp (2019) discussed some of the arguments for and against the use of optionality in examinations (see also Mackay, 1970; Weber, Frary, and Cross, 1995). Some of the arguments for the use of optional questions in examinations are outlined below:

- Optionality can increase the coverage of the domain of content to be assessed because different students will answer a different set of questions and the total number of questions used in the exam can be considerably larger than in an exam where all questions are compulsory.
- Optionality can give the teacher greater freedom to teach a smaller number of sections of the broad subject area and individual students greater freedom to pursue their specific interests.
- Optionality allows students to select contexts or topics that appear to be attractive to them during an examination. This would, in turn, provide an individualised testing experience for the learners. Choice of questions could also give them a sense of control and therefore increase their motivation.
- Use of optional questions could allow students to demonstrate their best work because they will select questions which they believe will allow them to give their best performance.

Some of the arguments against the use of optional questions include:

- Use of optional questions could reduce content validity and the interpretability of scores from the exam. The questions taken by different students would constitute samples from different topic areas of the domain representing different goals, abilities and objectives. This would affect the interpretation and comparability of scores from different students in terms of the type of skills and abilities measured by different questions.
- Optionality could provide a limited (and even distorted) sample of students' achievement due to particular sets of questions which they are best prepared to answer.
- Optionality could reduce the comparability of scores from optional questions in terms of difficulty and fairness of the exam. It is extremely difficult for question setters to produce optional questions with a similar level of difficulty. Furthermore, because students selecting different questions can be of different abilities, it is not at all straightforward to estimate the difficulty of different optional questions. Students could potentially be graded on different scales, with some of them harder or easier than others. The selection of questions by students may also be affected by their ability.
- Optionality in exams requiring extended responses could add variability to marking quality. There could be interactions between marker expertise and question option, resulting in different marking standards for different questions and reduced overall marking reliability.
- Use of optional questions could produce undesirable study habits. Students could be encouraged to prepare several answers in advance, commitment to memory and select the questions where the answers are most appropriate.
- There could also be practical disadvantages with optionality in examinations. These would include reduced efficiency due to the need to develop more questions and mark schemes, increased reading demand on students, ineffective selection of questions by students, and required mark allocation resulting to reduced quality of question.

The parity or comparability of options (questions or routes) has always been a concern for relevant stakeholders. This research focuses on the extent to which there is parity of

standards across different routes to certification within a qualification. As part of this research, the comparability of marks between optional questions and grades between optional routes at both component and the overall qualification levels for 7 specifications from GCSE English literature, GCSE history and A level sociology was assessed using a number of statistical methods. Two years of assessment data (2018 and 2019) were used to establish whether the findings were likely to be true in more than just one year's assessment.

This research also looked at whether there was any relationship between question/route choice and candidate characteristics.

The overall aim of the study is to generate statistical evidence to assess, for the selected subjects, the extent to which:

- marks from different optional questions/sections in an assessment component are comparable
- grade standards set for different routes in a component are comparable
- grade standards set for different certification routes at the overall qualification level are comparable

The relationship between choice of question and candidate's characteristics is also examined.

Data Collection and Analysis

This section provides a brief explanation of the procedures used for data collection and analysis.

Data collection

The subjects investigated in this report are reformed GCSE English literature, GCSE history and A level sociology, which use optional questions (and optional papers in the case of the GCSE history specifications) in their examinations. The data used was requested from the relevant awarding organisations (AOs) specifically for this study. The data contains candidates' item level data as well as overall subject level marks and grades.

In addition, data extracted from the national pupil database (NPD) was also used. This data contains candidates' demographic information as well as attainment at GCSE (represented by the normalised average GCSE point score) and other information. The normalised GCSE point scores have a mean of 100 and a standard deviation of 33.3 and are based on all GCSE candidates.

Methods of analysis

Bramley and Crisp (2019) and Harrison (2018) discussed some of the most widely used statistical methods for studying optionality in tests and examinations. In general, the comparability of raw/scaled scores (marks) between optional questions/sections can be investigated through the examination of the relationships between scores on different optional questions/sections and some common ability measures. Differences in such relationships would suggest incomparability.

In the present study, attainment measures of candidates at GCSE (GCSE specifications) and scores on common papers (A level specifications) will be used as

common ability measures. In view of the nature of the data to be analysed, 4 approaches are used to examine such relationships. These are described briefly below.

Regression analysis

Linear regression will be used to model the relationship between scores on optional questions/sections (y) in a paper and common ability measure (continuous variable x), question/section option (dummy variable o which takes the value of 0 or 1) and the interaction between ability and option (xo):

$$y = \alpha + \beta x + \gamma o + \delta(xo) \quad (1)$$

where α , β , γ and δ are the regression coefficients. Variation of regression coefficients between different options would suggest inconsistency in difficulty between the options. It is possible to define a difficulty measure for each option from the various coefficients. If $\delta = 0$, γ could be used as a measure of overall difficulty. The regression model represented by Equation (1) can also be applied to component level and subject level raw/scaled scores with respect to different routes to the same score.

Optional question characteristic curves (OQCCs) approach

In order to derive a measure of overall facility (or difficulty) for an optional question/section in an exam paper, candidates are divided into 10 groups (or bands) based on their normalised mean GCSE scores (or scores on common papers), with the number of candidates in each band similar. The highest band contains candidates with the highest level of attainment at GCSE (or performance on the common compulsory papers), while the lowest band candidates with the lowest level of attainment (or performance).

For a specific optional question/section in a paper, the mean score in each band can be calculated, and graphic representation of the relationship between mean score on the question/section option and ability band will be referred to as optional question characteristic curve (OQCC). Difference between these OQCCs could be an indication of difference in facility (difficulty).

Given the characteristic curve of a question/section, its facility can be defined as the average percentage score on the option by all candidates should they all take that question/section, which can be estimated as the all-candidates weighted OQCC. That is, it can be calculated as the multiplication of the OQCC of the question/section and the proportions of all-candidates in the score bands.

Questions with high facility values are easier than questions with low values. The facility defined based on OQCC is independent of the ability distribution of the candidates taking the question. The facility for an optional route at component level or the overall qualification level can be estimated in a similar fashion. For optional routes, facility is a measure of difficulty before awarding.

Chained equipercentile equating (CEPE)

If 2 tests are taken by the same group of students (or 2 groups with the same underlying ability distribution), the equivalency of scores on the 2 tests can be established using a range of classical test equating methods (see Livingston, 2004). One of the methods is equipercentile equating (EPE): scores on the 2 tests represent the same level of performance if they represent the same percentile on their respective score distributions.

If the 2 groups cannot be assumed to be equivalent but a common test taken by both groups is available, the equivalency of scores on the 2 tests can be established through the chained equipercentile equating (CEPE) method (see Livingston, 2004): scores on the 2 tests are equivalent if they correspond to the same score on the common (anchor) test obtained through their respective EPE.

Operationally, this can be achieved like this: for a given score on the first test, find the score on its anchor score distribution using EPE; for this anchor score, find the percentile in the anchor score distribution of the second test, the score on the score distribution of the second test that produces the same percentile will be equivalent to the score on the first test. This process forms a chain.

In this study, scores on common papers and measures of attainment at GCSE are used as anchor tests. The R package “equate” which implements CEPE will be used for equating scores from optional questions or routes.

Rasch modelling

The Rasch family of models, including the partial credit model (PCM, see Masters, 1982; Wright and Masters, 1982), have been developed for analysing data from tests composed of individual items that measure a single ability in common to establish measurement scales.

The PCM, which is to be used in the present study, states that, for a polytomous item with a maximum available score of m (the number of score categories minus 1), the probability $P(\theta, x)$ of an examinee with ability (latent trait) θ scoring x on the item can be expressed as:

$$P(\theta, x) = \frac{\exp \sum_{k=0}^x (\theta - \delta_k)}{\sum_{l=0}^m \exp [\sum_{k=0}^l (\theta - \delta_k)]} \quad (2)$$

where δ_k is the location of the k^{th} score category on the latent trait continuum (also termed category threshold or difficulty, see Andrich, 2015). The Rasch model is used to analyse data from all questions (compulsory and optional) from all components in a specification together.

Common compulsory questions (papers) are used to link candidates taking different optional questions/sections. This places all candidates and questions/sections (compulsory or optional) on the same ability/difficulty scale. Different optional questions/sections can be directly compared for relative difficulty using the item/question characteristic curves (the Rasch optional question characteristic curves – ROQCCs).

The ROQCC shows the relationship between expected score on a question option and ability. This relationship is assumed to apply to the observed raw score and raw scores from different optional questions can then be compared or equated (Rasch true score equating – TE).

To avoid the need to estimate the thresholds for score categories which are not observed (for example, the lowest and highest score categories in some high tariff questions), the Rasch unidimensional measurement model software RUMM2030 will be used. RUMM2030 re-parameterises category thresholds of an item into a form of principal components (up to 4) with the coefficients readily constructed (see Andrich, Sheridan & Luo, 2009; RUMM2030).

With the estimation of the principal component parameters and the constructed coefficients, the thresholds for all score categories (whether observed or not) in the item can be calculated. The Rasch model will be used when an external common ability measure is not available.

These methods examine the comparability of scores between optional questions/sections from different perspectives and involve different assumptions about the data analysed. They complement each other in many cases. These methods can also be used to investigate the comparability of scores between different routes at component level and the overall qualification level.

Comparability of grading standards

The comparability of grade standards at individual grades between optional routes at component level and the overall qualification level can be investigated by comparing the equivalent grade boundary marks obtained through equating and the original grade boundary marks established during awarding.

For GCSEs, focus will be on comparability at two key grades¹, grades 4 and 7. For A levels, focus will be on the key grade A and also grade C². Further, the difference between the equivalent grade boundary mark and the original grade boundary mark at a specific grade is compared with the gradewidth (GW) to indicate the difference in grade difficulty between optional routes in terms of grade unit.

For GCSEs, gradewidth is calculated as the difference between the boundary marks at grades 7 and 4 divided by 3 (and rounded up to the nearest integer). For A levels, this is calculated as the difference between boundary marks at A and C divided by 2 (and rounded up to the nearest integer).

Question choice and candidate's characteristics

The relationship between choice of question option and candidate's characteristics will be examined empirically.

Results

This section presents the main findings from the analyses of the 3 subjects based on the 2018 data. Results from the 2019 data will be discussed briefly where needed. We will first look at the comparability of scores between optional questions/sections in individual papers, and then explore its impact on the comparability of scores and grades between optional routes at component level and the overall qualification level. Finally, we will look at the relationship between choice of question option and candidate's characteristics.

Specifications investigated

A total of 7 specifications were studied: 2 from GCSE English literature (Spec A and Spec B), 3 from GCSE history (Spec A, Spec B and Spec C), and 2 from A level

¹ A key grade is a grade which is determined judgementally within the awarding process with a combination of human judgement and use of statistics. Grades which are not key grades are usually determined arithmetically – ie using as far as possible equal mark intervals between the key grades.

² Grades A and E are key grades for A level. This research focuses on A level grade C rather than grade E because the relatively high percentages of candidates receiving a grade E or above mean these kinds of analyses would be less useful or meaningful.

sociology (Spec A and Spec B). Table 1 below illustrates the assessment structure of the specifications.

Table 1 Assessment structure of the specifications studied.

Spec	Component				Optional questions	
	Code	Max mark	Opt. papers	Opt. Ss/Qs	Min mark	Max mark
GCSE English Lit Spec A	P1	64	-	Y	30	34
	P2	96	-	Y	30	34
GCSE English Lit Spec B	P1	80	-	Y	40	40
	P2	80	-	Y	20	40
GCSE History Spec A	P1	52	C10...C12	Y	20	20
	P2*	64	C20...P29	Y	32	32
	P3	52	C30...C33	N	-	-
GCSE History Spec B	P1	80	C11...C19	Y	18	20
	P2	50	C21	Y	25	25
	P3	80	C31...C39	Y	18	18
GCSE History Spec C	P1	84	-	Y	40	44
	P2	84	-	Y	40	44
A level Sociology Spec A	P1	80	-	N	-	-
	P2	80	-	Y	40	40
	P3	80	-	N	-	-
A level Sociology Spec B	P1	90	-	Y	52	52
	P2	105	-	N	-	-
	P3	90	-	Y	70	70

*Paper 2 was further split into two papers from 2019.

Both GCSE English literature specifications have two components, Paper 1 and Paper 2 both of which have optional questions. For Specification A, Paper 1 has two sections (Sections A and B). Section A is worth 34 marks and candidates are required to answer one from six questions, and Section B is worth 30 marks and candidates are asked to answer one from seven questions.

Paper 2 is worth a total of 96 marks and has three sections (Sections A, B and C). Students are required to answer one from 24 questions in Section A (worth 34 marks), one from two questions in Section B (worth 30 marks) and Question 27 (which has two items) in Section C (worth a total of 30 marks).

For Specification B, both papers are worth 80 marks. Paper 1 has two sections (Sections A and B, each of which is worth 40 marks in total), and students need to answer one from six questions in Section A and one from 16 questions in Section B. Paper 2 also has two sections (Sections A and B each of which is worth 40 marks), and students answer one from seven questions in Section A and one from three questions in Part A of Section B and Question 11 in Part B.

GCSE history Specs A and B have three components (Paper 1, Paper 2 and Paper 3). For Specification A, Paper 1 is worth 52 marks, and there are three optional papers (labelled C10, C11, and C12). Each of the optional papers has three sections (all questions in Sections A and B are compulsory and answer one of two questions in Section C). Paper 2 is worth 64 marks and there are 10 optional papers (labelled C20, C21 ..., and C29). Each of these optional papers has two sections (all questions in Section A are compulsory and answer one of two questions in Section B). Paper 3 is worth 52 marks and there are four optional papers (C30, C31, C32 and C33). Each

optional paper has two sections and all questions in the two sections are compulsory. This specification was amended in 2019 where Paper 2 is further split into two papers (Paper B and Paper P each of which has a number of optional papers).

For Specification B, Paper 1 is worth 80 marks and has 10 optional papers (C10, C11 ..., and C19). Each of these optional papers has two sections (Sections A and B), and both sections have a number of compulsory questions and two optional questions. Paper 2 is worth 50 marks and only has one paper (labelled C21). Candidates answer any two of the three questions in the paper. Paper 3 is worth 80 marks, and there are nine optional papers in this component (C31, C32, ..., and C39). Each of the optional papers has two sections (Sections A and B), and both sections have a number of compulsory questions and two optional questions.

GCSE history Spec C has two components (Paper 1 and Paper 2), and each of the two papers has two sections (Section A and Section B). The maximum available marks are 40 and 44 for Section A and Section B respectively in Paper 1 and 44 and 40 for Section A and Section B in Paper 2. Each section has a number of options, which makes it effectively a four-paper specification. All questions in an optional section are compulsory.

Both A level sociology specifications have three components (Papers 1, 2 and 3). For Specification A, every paper is worth 80 marks. All questions in Papers 1 and 3 are compulsory. There are two sections (Sections A and B) in Paper 2 each of which is worth 40 mark. There are four optional questions (topics) in each section and candidates are asked to answer one of them.

For Specification B, Paper 1 is worth 90 marks, Paper 2 105 marks, and Paper 3 105 marks. All questions in Paper 2 are mandatory. Both Papers 1 and 3 have two sections (Sections A and B), with all questions in Section A compulsory. For Section B, candidates are required to answer one from three questions.

The popularity of individual optional questions/sections from the specifications and percentage of female candidates taking each question/section option are shown in Tables A1-A3 in Appendix A.

Comparability of scores between optional questions

For the 5 GCSE English and GCSE history specifications, candidates' attainment at GCSE is used as a common ability measure for comparing marks from different optional questions/sections. For the 2 A level sociology specifications, performance on compulsory papers (Papers 1 and 3 for Spec A and Paper 2 for Spec B) is used as common ability measure for comparing marks on optional sections. It is to be emphasized that, in situations where optional sections are used, comparison is carried out at section level.

For optional questions in the two GCSE English literature specifications, correlations between question marks and common ability measures (GCSE point scores) are relatively high, varying from 0.73 for Section B in Paper 2 from Spec B to 0.79 for Section B in Paper 2 from Spec A. For the three GCSE history specifications, correlations vary from 0.70 for optional questions in Paper 3 from Spec B to 0.81 for optional questions in Paper 2 from Spec A. For the two A level sociology specifications, correlations between question marks and marks on compulsory papers are moderately strong, varying from 0.59 for questions in Section A of Paper 2 (Spec A) to 0.65 for questions in Section B of Paper 3 (Spec B).

Regression analysis

Values of coefficient of determination and model parameters from regressing marks on optional questions against common ability measures (GCSE point scores or marks on compulsory papers) from the assessment components are listed in Tables A4-A6 in Appendix A.

As an example of using regression analysis to study comparability of marks between optional questions/sections, Figure 1 shows the relationship between candidates' marks on a selection of optional questions/sections from one of the assessment components in each of the 7 specifications and their average GCSE point scores (GCSE specifications) or marks on compulsory papers (A level specifications), with the regression lines superimposed.

Similar graphs for all the other optional questions/sections are included in Appendix B (Figures B1, B2, B7-B9, B16, B17, B22 and B23). If marks from different optional questions/sections are comparable based on candidates' common ability measures, the regression lines will be close to each other. Any spread of the lines (as represented by the variation in intercept γ and the interaction between common ability measures and question option δ) would suggest variability in difficulty.

At a specific point or region on the common ability measures, options with regression lines at the top can be viewed as easier than those below, because for candidates with similar marks on the compulsory papers or level of GCSE attainment their marks on the question/section option at the top will be higher than the marks on the options below. If δ varies between optional questions (heterogeneity of regression slopes), the regression lines will not be parallel. The existence of interactions between question option and the common ability measures would suggest that there is a degree of differentiated difference in difficulty between the question options.

For GCSE English literature Spec A, values of regression coefficients for optional questions from the two sections in Paper 1 vary less than those for the questions in Section A of Paper 2 which has 4 times as many optional questions as Paper 1 (see Table A4 in Appendix A and also Figure B1 in Appendix B). The effect of interaction between question option and attainment at GCSE relative to the reference question option is small but significant for some of the options, indicating a degree of differentiated difficulty between the options. For optional questions in Section B of Paper 1 from Spec B which has the largest number of optional questions, variation of regression coefficients is larger than that for the optional questions in the other sections (see Table A4 and Figure B2).

For GCSE history Spec A, variation in regression coefficients for optional questions in the optional papers from Paper 2 is larger than that for the questions in the optional papers from Paper 1, indicating larger variability in difficulty between questions in Paper 2 (see Table A5 and also Figures B7 and B16). As Paper 2 has more optional papers than Paper 1, this suggests large between-paper variability in question difficulty.

For optional questions in the papers from Paper 1 in Spec B (see Table A5 and Figures B8 and B17), variability in difficulty between the questions in Section B is larger than those in Section A. There is less variability in difficulty between the questions from the optional papers in Paper 3. For Spec C (see Table A5 and Figure B9), options in Section B of Paper 2 exhibits least variability in difficulty, while those in Section B of Paper 1 most variability. For Section A in both papers, the regression lines are reasonably parallel.

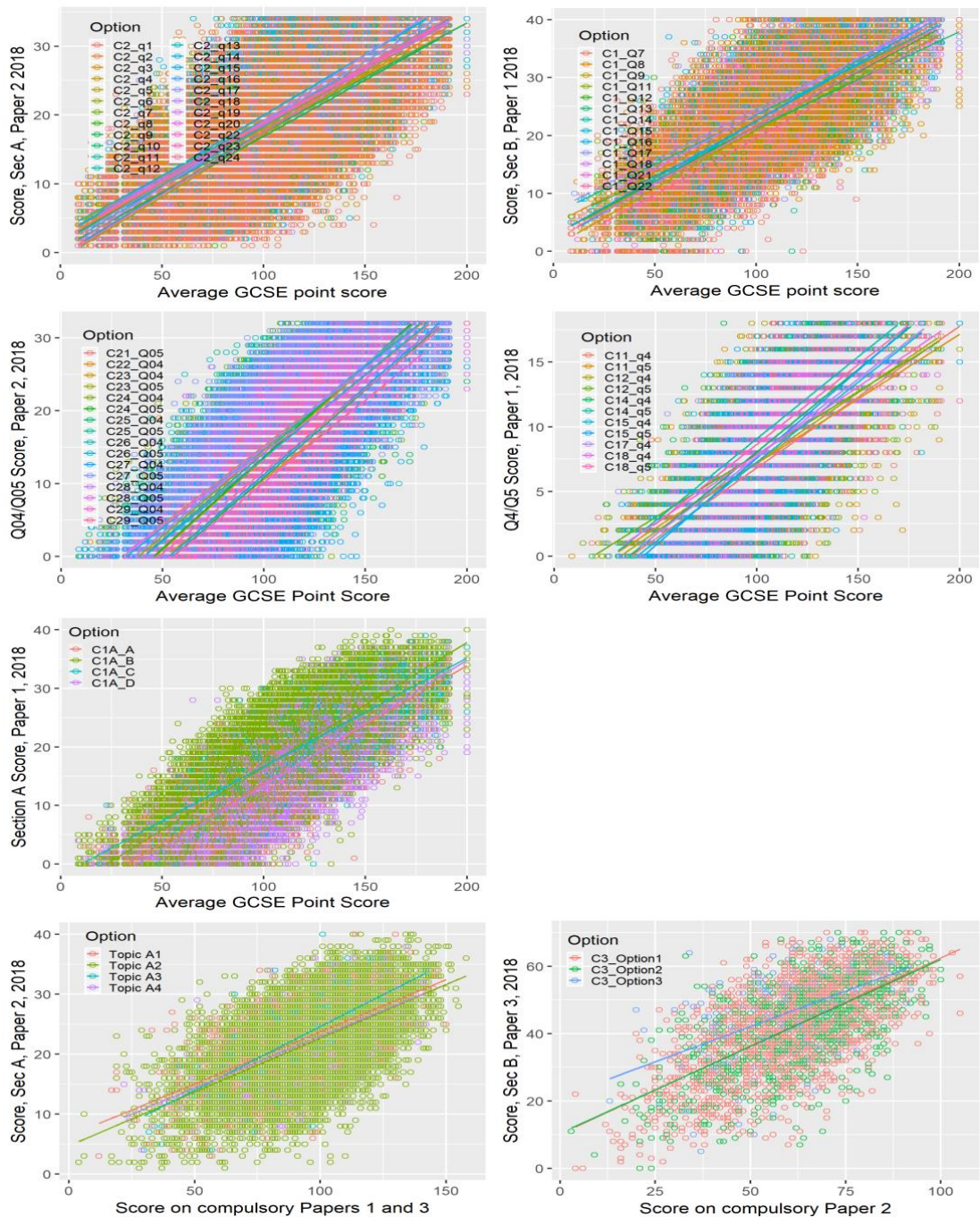


Figure 1 Relationship between marks on selected optional questions and GCSE point scores/marks on compulsory papers from the assessment components studied in 2018: top graphs are for the two GCSE English literature specifications, middle graphs the 3 GCSE history specifications, and bottom graphs the 2 A level specifications. The regression lines are also plotted in the graphs.

For Paper 2 in A level sociology Spec A (see Table A6 and Figure B22), variability in regression coefficients for optional questions in Section A is slightly smaller than that for the questions in Section B. For Spec B (see Table A6 and Figure B23), variation for questions from Section B of Paper 3 are larger than that for questions in Section B of

Paper 1. For Paper 2 in Spec A, the spread of the regression lines for Section A is slightly smaller than that for Section B. For Spec B, the spread of the regression lines for Section B of Paper 3 is the largest while that for Section B of Paper 1 the smallest. The effect of interaction between performance on the compulsory paper and question options is small but significant for all sections except Section B in Paper 1 from Spec B.

Optional Question Characteristic Curves (OQCCs)

If the regression lines such as those shown in Figure 1 were parallel, the overall relative difficulty of an optional question/section could be defined as the value of its intercept. In view of the differentiated difficulty of optional questions across the range of common ability measures, a measure of overall difficulty was derived here using the optional question characteristic curve (OQCC) approach.

The graphs in Figure 2 show the distributions of mean marks expressed as percentages of the maximum available mark for the selected question/section options (shown in Figure 1) against bands of average GCSE point scores (GCSE Specifications) or marks on compulsory papers (A level specifications) (for all the other options, see Figures B3, B4, B10-B12, B18, B19, B24 and B25 in Appendix B).

Some of the curves are not smooth due primarily to small sample size and the distribution of marks. Similar to the regression lines, at a specific score band of the common ability measure, curves in the top would represent easier options whereas those in the bottom more difficult options. Tables A7-A9 in Appendix A shows values of facility estimated based on OQCCs for all the optional questions from the assessment components studied in 2018.

For Paper 1 in GCSE English literature Spec A, values of average marks for the optional questions vary from 17.0 (or 50.1% of maximum mark) to 18.1 (53.1% of max mark), a difference of 1.1 (3.0% of max mark) between the most difficult and the easiest options (see Table A7). For Section B, these vary from 14.6 (48.7% of max mark) to 16.2 (53.9% of max mark), with a difference of 1.6 marks (5.2% of max mark) between the most difficult option and the easiest option.

For Paper 2, the estimated average marks vary from 17.1 (50.2% of max mark) to 20.6 (60.7% of max mark) for Section A, with a maximum difference of 3.5 marks (10.5% of max mark). For Section B, the average mark is similar for both questions.

For Spec B, values of average marks of the questions in Section A of Paper 1 vary from 20.0 marks (50.1% of max mark) to 21.9 marks (54.8% of max mark), with a difference of 1.9 marks (4.7% of max mark) between the most difficult and the easiest options.

For Section B, these vary from 20.4 (51.1% of max mark) to 25.7 marks (64.3% of max mark), with a difference of 5.3 marks (13.2% of max mark) between the most difficult and the easiest options. For Paper 2, the facility varies from 21.2 marks (53.1% of max mark) to 22.9 marks (57.3% of max mark) for Section A, with a maximum difference of 1.7 marks (4.2% of max mark). For Section B, the facility is similar for the three questions.

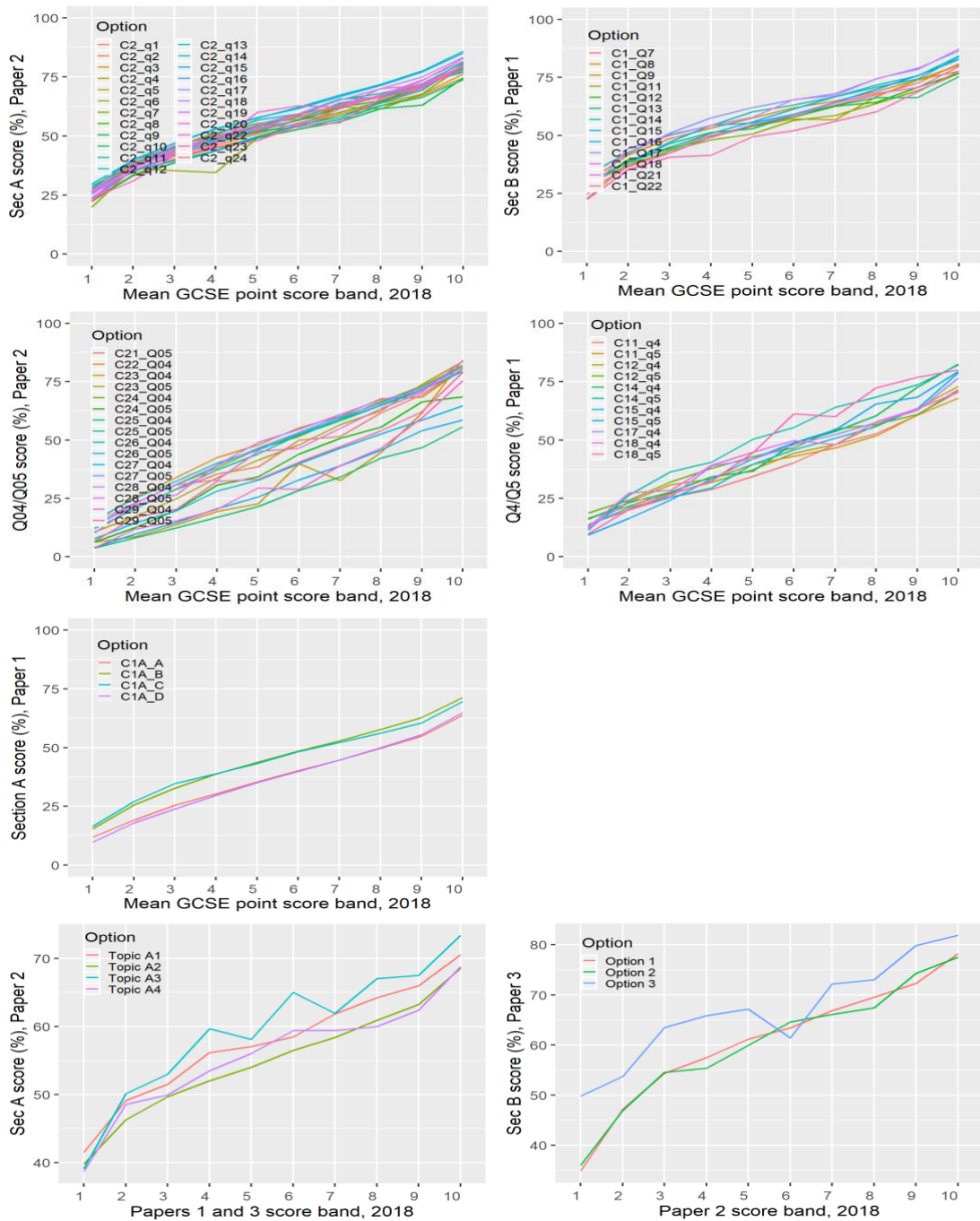


Figure 2 Relationship between percentage marks by students choosing different question options shown in Figure 1 and bands of GCSE point scores/marks on compulsory papers in 2018: top graphs are for the two GCSE English literature specifications, middle graphs for the three GCSE history specifications, and bottom graphs for the two A level specifications.

For questions from optional papers in Paper 1 of GCSE history Spec A, the mean mark on the easiest question is 0.7 marks (3.4% of max mark) higher than that on the most difficult question (see Table A8). There is substantial variability in facility between the optional questions from optional papers in Paper 2. The estimated mean marks vary from 8.6 (26.9% of max mark) to 15.9 (49.6% of max mark), with a difference of 7.3

marks (22.7% of max mark) between the most difficult question and the easiest question.

For questions in Section A from the papers in Paper 1 of Spec B, mean marks vary from 7.1 (39.5% of max mark) to 9.1 (50.8% of max mark), with a maximum difference of 2 marks (11% of max mark). For Section B, these vary from 6.5 (32.4% of max mark) to 10.6 (53.1% of max mark), with a maximum difference of 4.1 (20.5% of max mark) between the questions. For optional questions from the papers in Paper 3, variability in facility is smaller, with values of facility ranging from 6.7 (37.3% of max mark) to 8.3 (46.1% of max mark).

For Spec C, mean marks vary from 14.7 (36.9% of max mark) to 17.9 (44.7% of max mark) for options in Section A of Paper 1 and from 13.7 (31.0% of max mark) to 20.0 (45.5% of max mark) for options in Section B. For Paper 2, these vary from 14.6 (33.2% of max mark) to 19.1 (43.4% of max mark) for options in Section A and from 15.1 (37.7% of max mark) to 17.0 (42.3% of max mark) for options in Section B.

For the two sections in Paper 2 from A level sociology Spec A, Section A is slightly easier than Section B. The facility varies from 54.7% to 59.2% for options in Section A and from 51.2% to 54.6% for options in Section B (see Table A9). The difference between the most difficult option and the easiest option is 1.8 marks (4.5% of max mark) for Section A and 1.3 marks (3.2% of max mark) for Section B.

For Section B in Paper 1 and Paper 3 from Spec B, questions in Section B of Paper 1 are easier than those in Paper 3. The facility varies from 65.3% (the most difficult option) to 68.3 (the easiest option) for options in Section B of Paper 1 and from 60.0% (the most difficult option) to 66.8% (the easiest option) for options in Section B of Paper 3. The difference between the most difficult and the easiest options is 1.5 marks (2.9% of max mark) for Paper 1 and 4.7 marks (6.7% of max mark) for Paper 3.

To get an overall view of the level of variability in relative difficulty (facility) between optional questions from different specifications, the box plots in Figure 3 show the distributions of differences in facility between optional questions and the most difficult option (in the same group of questions/section options) in the same year (2018 or 2019).

For the 2 GCSE English literature specifications, these are as high as 13% in 2018 and about 10% in 2019. For the 3 GCSE history specifications, these are about 23% in 2018 and over 35% in 2019. For the 2 A level sociology specifications, these are over 6% in 2018 and about 8% in 2019. Variability in difficulty between optional questions from GCSE history specifications is substantially higher than that between optional questions from the other specifications.

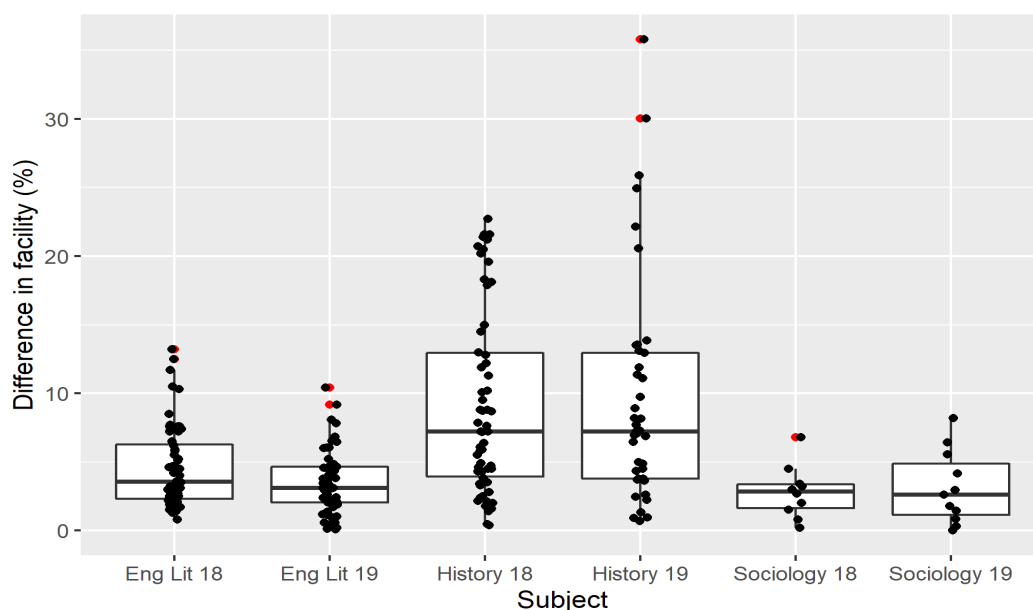


Figure 3 Distribution of differences in facility between optional questions and the most difficult option (in the same group of optional questions/sections) from the 7 GCSE and A level specifications in 2018 and 2019.

Chained equipercentile equating (CEPE) of optional questions

In this section, average GCSE point scores were used as an anchor test for equating marks on optional questions using CEPE for the 5 GCSE specifications. For the 2 A level sociology specifications, marks on compulsory papers were used as anchor tests. When using CEPE, one of the optional questions was used as a reference and marks on all the other questions were equated to the marks on the reference question. For each raw mark on an optional question, there will be an equated mark (equated to the reference option).

When the difference between the equated mark and the original mark for an option is positive at a specific raw mark point, the option is more difficult than the reference option at that point. When the difference is negative, the option is easier than the reference option.

The relationship between equated marks and raw marks for the selected optional questions/section shown in Figures 1 and 2 is depicted in Figure 4 (see Figures B5, B6, B13-B15, B20, B21, B26 and B26 for all the other optional questions/sections from the specifications studied).

In Figure 4, the identity line represents the relationship for the reference option. Options with curves above the identity line are more difficult than the reference option, whereas those with curves below the identity line are easier than the reference option. If the lines cross the identity line, there is differentiated relative difficulty between the options.

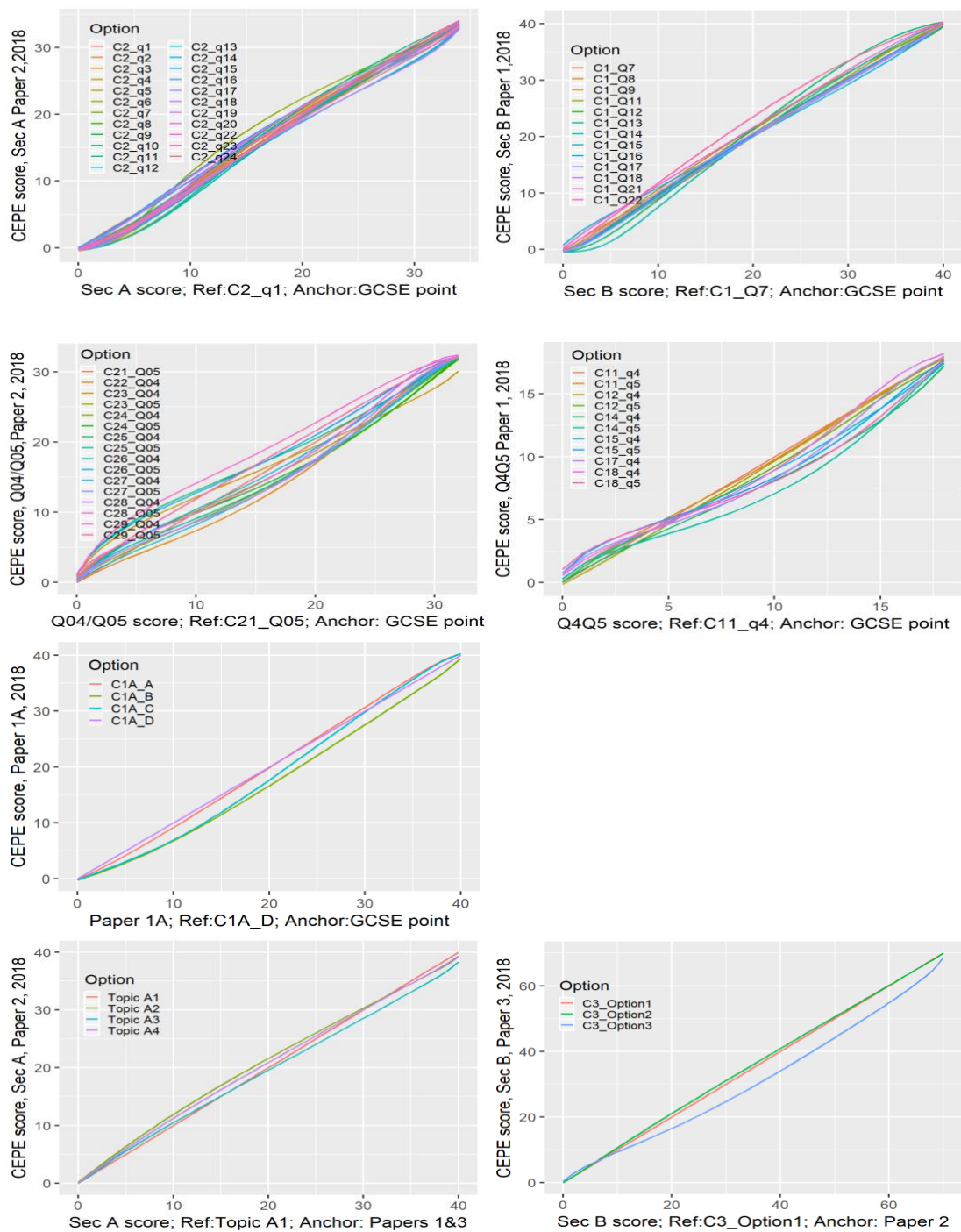


Figure 4 Distributions of equated marks against the original raw marks for the selected optional questions shown in Figure 1 based on CEPE using GCSE attainment/performance on compulsory papers as anchor tests: top graphs are for the 2 GCSE English literature specifications, middle graphs the 3 GCSE history specifications, and bottom graphs the 2 A level specifications.

For Section A in Paper 1 from GCSE English literature Specification A, at a raw mark of 20, the difference in equated mark between the most difficult and the easiest options is about 1 mark (3% of max mark). For Section B, at a raw mark of 20, this difference is about 2 marks (6% of the max mark). For Section A in Paper 2, at a raw mark of 20, the

difference between the most difficult and the easiest options is about 3 marks (9% of the max mark).

For Section B, the equated marks for the 2 options in the middle of the mark range are close, with a maximum difference in the lower part of about 3 marks (10% of max mark). For Section A in Paper 1 from Specification B, at a raw mark of 20, the difference in equated mark between the most difficult and the easiest options is over 2 marks (5% of the max mark). For Section B, this difference is slightly less than 3 marks (7.5% of max mark) at a raw mark of 20.

For Section A in Paper 2, at a raw mark of 20, the difference between the most difficult option and the easiest option is nearly 4 marks (10% of max mark). For Section B, the maximum difference between the most difficult option and the easiest option is slightly over 2 marks (10% of max mark).

For optional papers from Paper 1 of GCSE history Specification A, the difference between the most difficult and the easiest question options is about 1.5 marks (7.5% of max mark) across the mark range. For questions from the papers in Paper 2, the difference in equated mark between the most difficult and the easiest options at a raw mark of 15 is over 6.7 marks (20.9% of max mark).

For questions from optional papers in Paper 1 of Specification B, the variability in difficulty between the optional questions in Section B is larger than that in Section A. At a raw mark of 10, the maximum difference in equated mark is about 2.9 marks (16.1% of max mark) for Section A and 4.2 marks (21.0% of max mark) for Section B. For questions in Paper 3, at a raw mark of 10, the differences in equated mark between the most difficult and the easiest options are less than 1 mark for Section A and slightly over 1 mark (5.5% of max mark) for Section B.

For Spec C, the equated mark varies from 17 marks (35.0% of max mark) to 23 marks (57.5% of max mark) at a raw mark of 20 for Section A in Paper 1. Options in Section B of Paper 1 show the largest variability in equated marks, with a maximum difference of 9 marks (20.5% of max mark) between the options. In contrast, options in Section B of Paper 2 show the least variability, with a maximum difference of just 1 mark (2.5% of max mark) between the options.

For Section A in Paper 2 from A level sociology Spec A, the difference between the most difficult and the easiest options near the mark of 20 is slightly less than 2 marks (or about 5% of the maximum mark). For Section B, maximum difference in equated marks between the options is nearly 3 marks (about 7.5% of the maximum question mark) at raw marks of 5 and 35.

For Spec B, there is less variability in difficulty between the options in Section B of Paper 1 than that in Paper 3. For Section B in Paper 1, the difference in equated marks in the middle mark range is generally less than 2 marks (4% of the max mark). For Section B in Paper 3, over the majority of the mark range, the difference in equated mark between the most difficult option and the easiest option is over 6 marks (about 8.5% of the max mark).

To provide an overall view of the level of variability in relative difficulties of optional questions/sections derived based on CEPE, the box plots in Figure 5 shows the distribution of the difference in equated marks expressed as a percentage of the maximum question mark between the options and the most difficult option (in the same

group of options) at a raw mark that is half of the maximum question mark from the 7 specifications.

GCSE history again shows the largest variability in relative difficulty, with differences between the questions as high as 45% of the maximum question mark. For GCSE English literature and A level sociology, these differences varied from 0 to about 10% of the maximum question mark. The values of relative difficulty derived based on CEPE are broadly similar to those shown in Figure 3 which is based on the OQCC approach except for GCSE history in 2019.

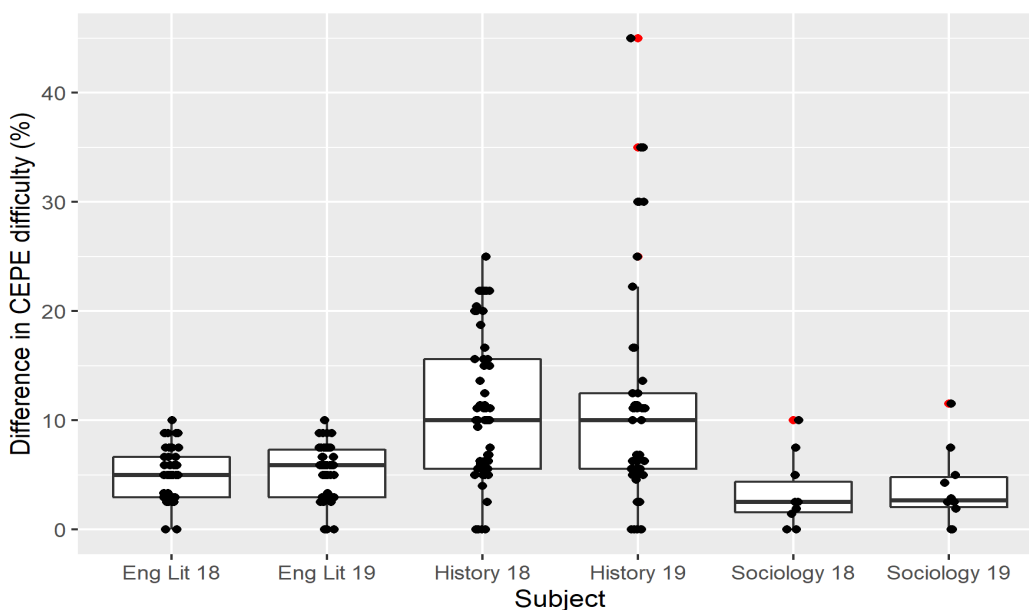


Figure 5 Distribution of differences in relative difficulty based on CEPE between optional questions and the most difficult option (in the same group of optional questions/sections) from the seven GCSE an A level specifications in 2018 and 2019.

Impact on comparability of grades at component level

This section explores how comparability of scores between optional questions in question papers affect the comparability of grades between optional routes at component level using CEPE. Mean GCSE point scores were used as an anchor test for 5 GCSE specifications and marks on compulsory papers as anchor tests for the 2 A level specifications.

Similar to the equating of marks from optional questions, for each raw mark in an optional route, there is an equated mark (equated to a reference route). The relationships between equated marks and raw marks for a selection of routes from all assessment components that use optional questions in the specifications are shown in Figure 6.

As in Figure 4, the identity line represents the relationship for the reference route. Routes with curves above the identity line are more difficult than the reference route, whereas those with curves below the identity line are easier than the reference route. If

the lines cross the identity line, there is differentiated relative difficulty between the optional routes. For the components depicted in Figure 6, the 3 GCSE history specifications show the largest variability in difficulty between the selected routes.

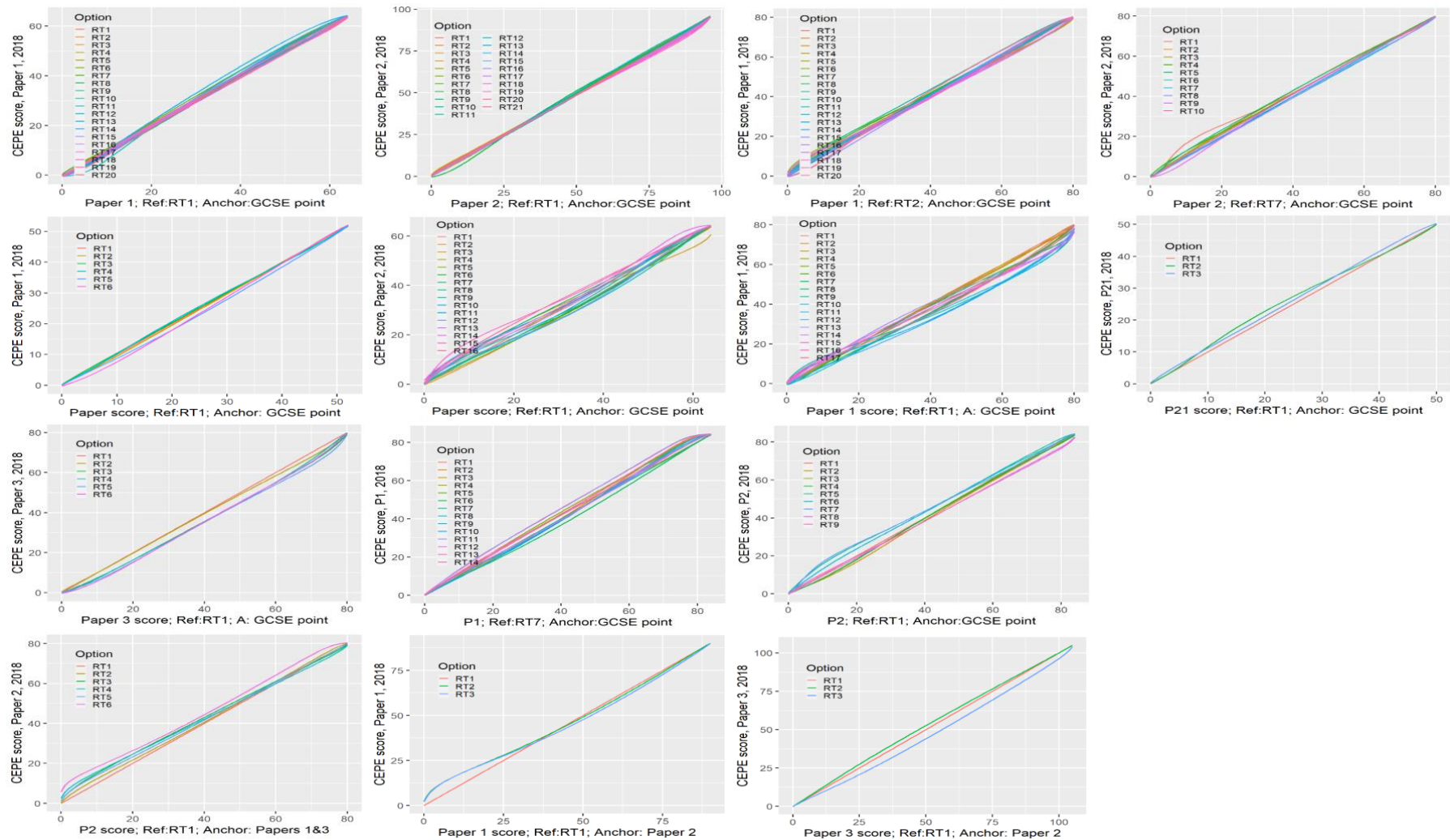


Figure 6 Distributions of equated marks against the original raw marks for selected routes in assessment components that use optional questions from the 7 specifications based on CEPE in 2018: top graphs are for the two GCSE English literature specifications, middle graphs the 3 GCSE history specifications, and bottom graphs the 2 A level specifications.

For the 2 GCSE English literature specifications, only routes with entries higher than 1,000 for the papers from Spec A and 500 for the papers from Spec B were analysed in this report. There were a total of 20 routes selected for Paper 1 and 21 routes for Paper 2 for Spec A, and 20 from Paper 1 and 10 for Paper 2 from Spec B.

For Paper 1 from Spec A, at a raw mark of 25, the difference in equated mark between the most difficult route and the easiest route is about 3.4 marks (5.3% of max mark). At a raw mark of 45, this is about 5 marks (7.8% of max paper mark).

For Paper 2, at a raw mark of 35, the difference between the most difficult route and the easiest route is about 1.7 marks (1.8% of the max mark). At a raw mark of 65, this is about 3.8 marks (4.0% of max mark).

For Paper 1 from Spec B, at a raw mark of 35, maximum difference in equated mark between the selected routes is about 4.4 marks (5.5% of max mark). At a raw mark of 60, this is about 5.2 marks (6.5% of max mark).

For Paper 2, at a raw mark of 30, maximum difference in equated mark between the selected routes is about 3.8 marks (4.8% of the max paper mark). At a raw mark of 50, this is about 3.7 marks (4.6% of max mark).

For the 3 GCSE history specifications, only routes with entries greater than 400 for papers from Specs A and B and 1,000 for papers from Spec C were analysed.

For routes in Paper 1 from Spec A, at raw marks of 20 and 35, differences in equated marks between the most difficult route and the easiest route are 2.9 marks (5.6% of max paper mark) and 1.9 marks (3.7% max paper mark) respectively.

For optional papers in Paper 2, the variability in difficulty between the selected routes is larger than that for the optional routes in Paper 1. At raw marks of 22 and 42, the maximum differences in equated marks between the selected routes are 7.8 marks (12.1% of max paper mark) and 7.1 marks (11.4% max paper mark) respectively.

For the selected routes in Paper 1 from Spec B, at raw marks of 30 and 50, the maximum differences in equated marks between the routes are 8.6 marks (10.8% of max paper mark) and 9.6 marks (12% of max mark) respectively.

For the 3 routes in Paper 2, at raw marks of 20 and 35, the differences between the most difficult routes and the easiest route are 2.8 marks (5.6 of max paper mark) and 1.5 marks (3% of max mark) respectively. For the selected routes in Paper 3, at raw marks of 30 and 50, these differences are 4.7 marks (5.9% of max paper mark) and 5.2 mark (6.5% of max mark) respectively.

For Spec C, these are 8 marks (9.5% of max mark) and 9 mark (10.7% of max mark) respectively at raw marks of 30 and 50 for Paper 1. For Paper 2, the differences are 9 marks (10.7% of max mark) and 5 marks (6.0% of max mark) respectively at raw marks of 25 and 45.

For the 2 A level sociology specifications, only routes with entries greater than 400 were analysed.

Of the selected routes for Paper 2 in Spec A, at a raw mark of 37, the difference in equated mark between the most difficult route and the easiest route is about 4.5 marks (5.6% of the max mark of the paper). At a raw mark of 52, this is about 4.1 marks (5.1% of max mark).

For Paper 1 from Spec B, at raw marks of 51 and 73, the maximum differences in

equated marks between the selected routes are 2.4 marks (2.7% of max mark). For Paper 3, these are 8.7 marks (about 8.3% of max mark) and 6.8 marks (6.5% of max mark) respectively at the raw marks of 57 and 80.

Figure 7 shows differences in boundary marks at grades 7 and 4 (for GCSEs) and grades A and C (for A levels) for the selected routes from the components displayed in Figure 6. In the figure, 2 lines corresponding to the value of a quarter of the gradewidth are also drawn. Tables A10-A12 in Appendix A list the original grade boundary marks and the differences between the equated grade boundary marks and the original boundary marks for the selected routes.

For the selected routes from the 2 papers in GCSE English literature Spec A, at grade 7, the difference in equivalent boundary mark between the most difficult route (in terms of grade difficulty) and the easiest route is 5 marks (slightly over four-fifths of a grade) for Paper 1.

At grade 4, this is about 3 marks (half of a grade) (see Table A10). For Paper 2, the maximum difference in equivalent boundary mark between routes is 4 mark (over two-fifths of a grade) at grade 7 and 1 mark (slightly over a tenth of a grade) at grade 4. For Paper 1 from Spec B, this is about 6 marks (nearly four-fifths of a grade) at grade 7 and 5 marks (near two-thirds of a grade) at grade 4. For Paper 2, the most difficult route is about 4 marks (nearly two-thirds of a grade) more difficulty than the easiest route at both grades 7 and 4.

For Paper 1 in GCSE history Spec A, the grade boundaries were set separately for each optional paper in a component to take account of differences in difficulty between the optional papers. The maximum difference in equivalent boundary marks at both grade 7 and 4 between the selected routes within an optional paper is about 1 mark (see Table A11).

Variability in equivalent boundary marks is larger between optional papers, with a maximum difference of 3 marks at grade 7 and 2 marks at grade 4. The most difficult route is about three-quarters of a grade harder at grade 7 and half of a grade harder at grade 4 than the easiest routes.

For the selected routes in Paper 2, variability in difficulty between the routes from different optional papers is also substantially larger than that between the routes within the same paper in terms of raw marks. Maximum differences in equivalent boundary marks between the routes are 11 marks at grade 7 and 16 marks at grade 4, representing a difference of more than one-and-three-quarters of a grade at 7 and two-and-two-fifths of a grade at 4. For routes within an optional paper, these are nearly half of a grade at grade 7 and one grade at grade 4.

For GCSE history Spec B, all optional papers in a component have the same grade boundary marks (this only happened in 2018. In 2019, different grade boundary marks were set for different optional papers).

For optional papers in Paper 1, maximum differences in equivalent boundary marks between the selected routes are 9 marks at grade 7 and 10 marks at grade 4 (see Table A11).

Taking into account again the grade boundaries originally set for the papers, at grade 7, the most difficult routes are about one-and-a-third of a grade harder than the easiest route. At grade 4, this is about one and two fifths of a grade. For routes within the same paper, some routes can be over two-fifths of a grade harder than others.

For Paper 2 (C21), at grade 7, the most difficult route is about a fifth of a grade harder than the easiest route. At grade 4, this is over three-fifths of a grade.

For Paper 3, for routes within the same optional paper, the difference in equivalent boundary marks is generally within 1 mark. For routes from different optional papers, the difference between the most difficult route and the easiest route is about four-fifths of a grade at 7 and two thirds of a grade at 4.

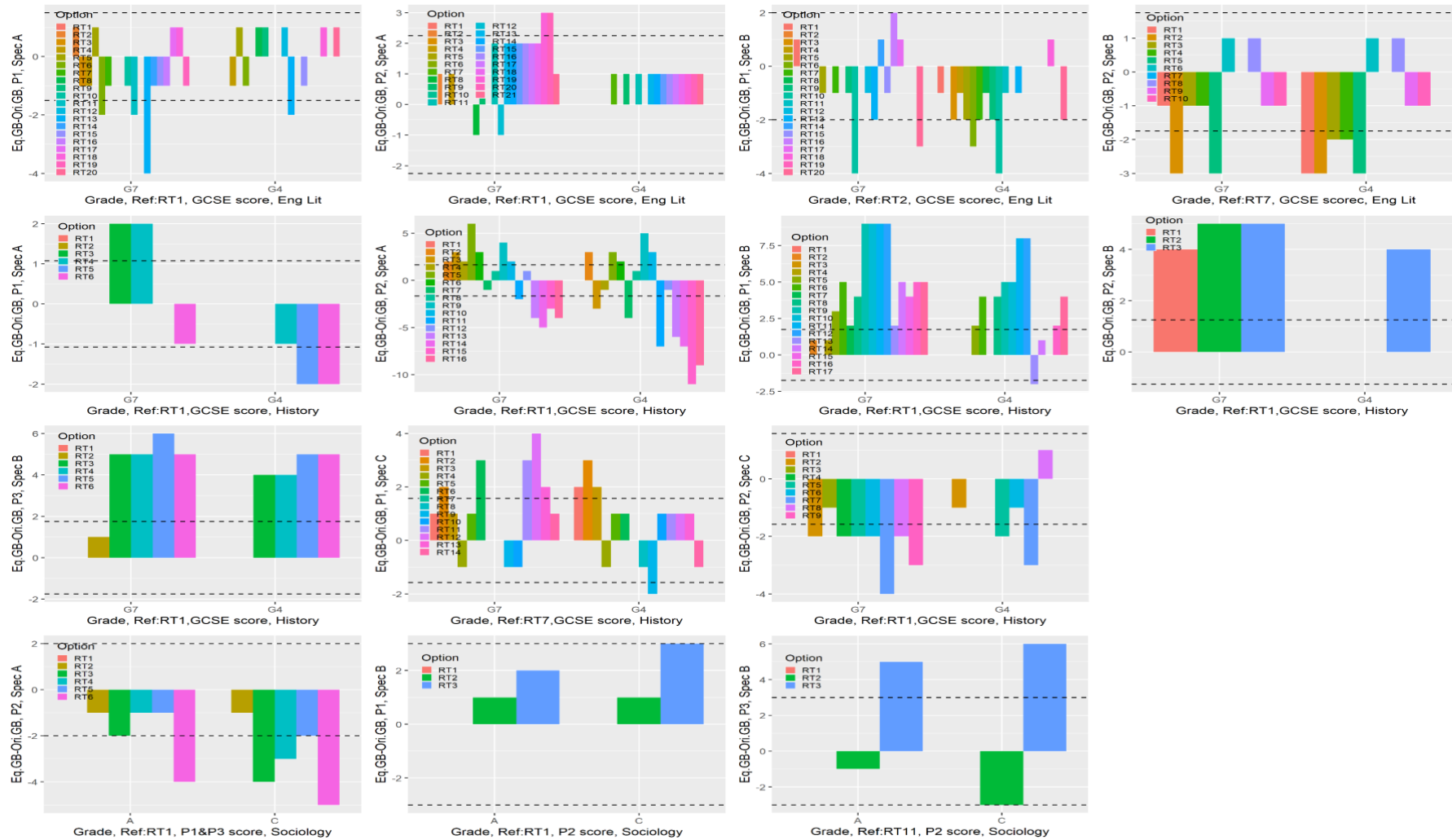


Figure 7 Differences between equivalent and original grade boundary marks at 7/A and 4/C for the selected routes from the assessment components shown in Figure 6: top graphs are for the 2 GCSE English literature specifications, middle graphs the 3

GCSE history specifications, and bottom graphs the 2 A level specifications. The dashed lines correspond to the value of a quarter of gradewidth in the individual component.

For Paper 1 from GCSE history Spec C, the difference in equated grade boundary marks between the most difficult route and the easiest routes is 5 marks (over four-fifths of a grade) at both grades 4 and 7 (see Table A11). For the selected routes in Paper 2, this is 4 marks (slightly over half a grade) at both grades 4 and 7.

For Paper 2 from A level sociology Spec A, the difference between the most difficult route and the easiest route is 4 marks (half a grade) at grade A and 5 marks (three-fifths of a grade) at grade C. For Paper 1 from Spec B, this is 2 marks (slightly less than a fifth of a grade) at grade A and 3 marks (a quarter of a grade) at grade C (see Table A12). For Paper 3, the difference is 6 marks (half a grade) at grade A and 9 marks (three quarters of a grade) at grade C.

Similar to Figures 3 and 5, the box plots in Figure 8 show the distributions of differences in relative grade difficulty in gradewidth (GW) unit between the selected optional routes and the most difficult route for the components from the 7 specifications in 2018 and 2019.

For the 2 GCSE English literature specifications, these vary from a fifth of a grade to about three-quarters of a grade at both grade 4 and grade 7 in 2018. In 2019, these are about one grade at grade 4 and three-fifths of a grade at 7.

For the 3 GCSE history specifications, at grade 7, the difference in grade difficulty between the easiest and the most difficult route is about one-and-three-fifths of a grade in both 2018 and 2019. At grade 4, this is nearly two-and-a-half grades in 2018 but it decreased to about one-and-a-half grade in 2019.

For the 2 A level sociology specifications, the easiest route is about half a grade easier than the most difficult route in 2018 at grade A, which decreases to about two-fifths of a grade in 2019. At grade C, the maximum difference in difficulty between the selected routes is about three-quarters of a grade in 2018, which decreases to about a third of a grade in 2019.

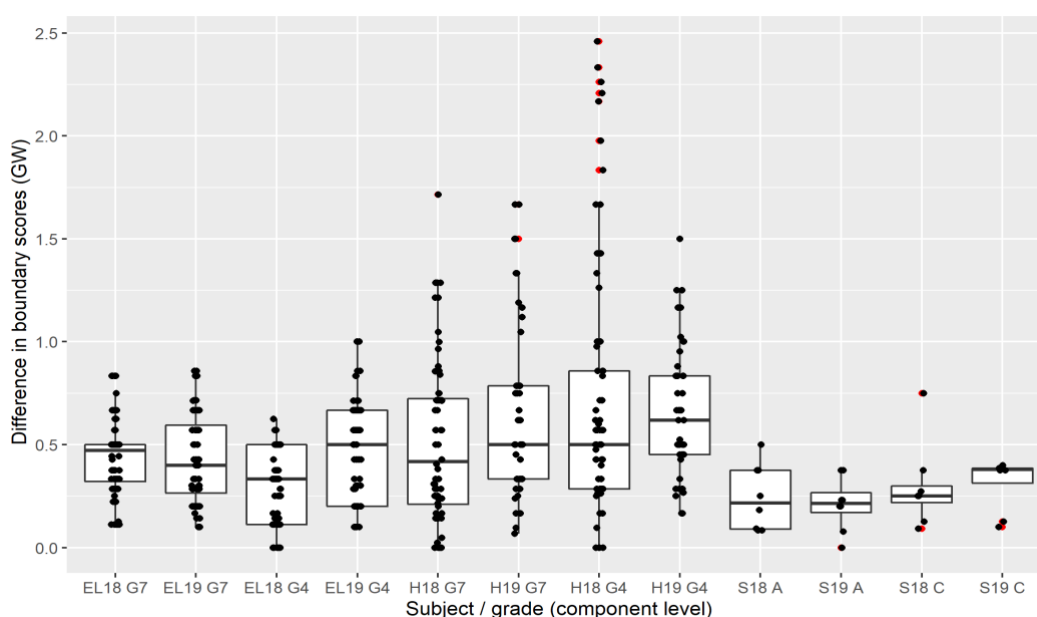


Figure 8 Distribution of differences in relative grade difficulty at grades 7/A and 4/C between selected optional routes and the most difficult route for the assessment components from the 7 specification in 2018 and 2019.

Impact on comparability of grades at certification level

This section looks at how comparability of grades between optional routes at the overall qualification level is affected by optionality. It is possible to produce equivalent qualification grade boundary marks using component level equivalent grade boundary marks and compare them with the original grade boundaries set during awarding to examine the comparability of performance standards between different certification routes indirectly. Here, however, marks on different certification routes are equated directly using CEPE for the 2 GCSE subjects (using mean GCSE point scores as an anchor test) and Rasch TE for the A level subject.

For the 2 GCSE English literature specifications, only routes with entries larger than 3,800 for Spec A and 500 for Spec B were included in the analysis. A total of 19 certification routes from Spec A and 18 routes from Spec B were examined. The top graphs in Figure 9 show distributions of equated marks against the original marks for the selected certification routes.

For routes in Spec A, the differences in equated marks between the most difficult route and the easiest route are 2.1 marks (1.3% of the max qualification mark) at a raw mark of 61 and 3.4 marks (2.1% of max mark) at a raw mark of 106. For Spec B, the differences are 3.3 marks (2.1% of the max qualification mark) at a raw mark of 67 and 3.1 marks (1.9% of max mark) at a raw mark of 113.

The graphs in the middle of Figure 9 show distributions of equated marks against the original marks for the selected certification routes for the 3 GCSE history specifications. Routes with entries larger than 400 for Spec A and 1,000 for Specs B and C were analysed.

For Spec A, the maximum differences in equated mark between the selected routes are 11 marks (6.5% of max available mark) and 9 marks (5.5% of max available mark) respectively at raw marks of 70 and 115. For Spec B, these are 6 marks (2.9% of max available mark) and 8 marks (3.8% of max available mark) at raw marks of 80 and 135 respectively. For Spec C, the differences are 10 marks (6.0% of max mark) at raw marks of 60 and 90.

For the 2 A level sociology specifications, only routes with entries larger than 400 were included in the analysis. The relationship between expected mark and Rasch ability for all possible routes to certification for the 2 specifications is shown in the bottom graphs in Figure 9. For Spec A, the differences in equated marks between the most difficult route and the easiest routes are about 3.2 marks (1.3% of max qualification mark) at the expected marks of 120 and 165. For Spec B, these are about 7.7 marks (2.6% of max mark) and 6.3 (2.1% of max mark) respectively at the expected marks of 160 and 228.

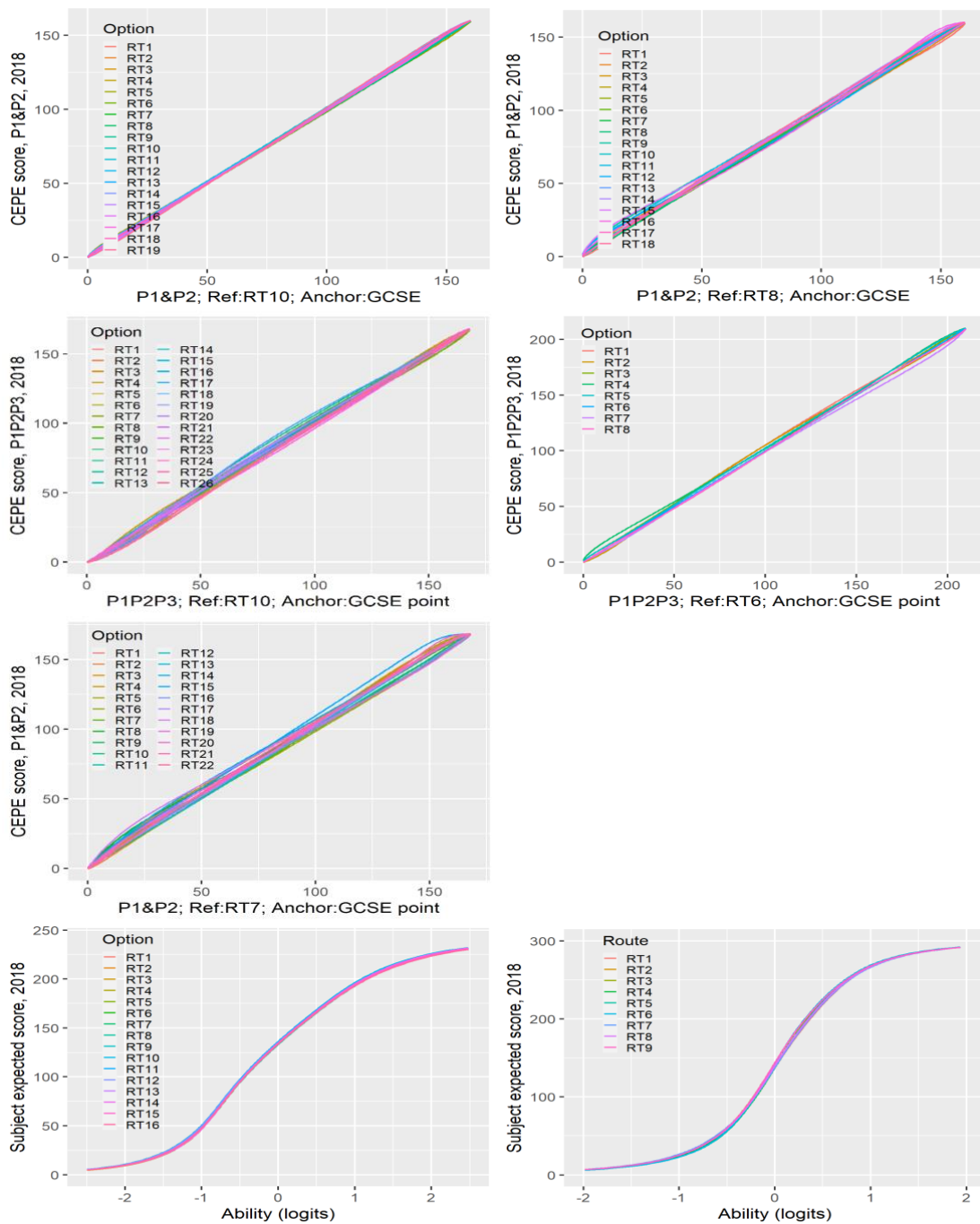


Figure 9 Distributions of equated/expected marks against the original raw marks/Rasch ability for the selected certification routes from the 7 specifications in 2018: top graphs are for the two GCSE English literature specifications, middle graphs the 3 GCSE history specifications, and bottom graphs the 2 A level specifications.

Figure 10 shows differences in boundary marks at grades 4 and 7 (for GCSEs) and grades C and A (for A levels) for the selected routes displayed in Figure 9. Again, the two lines corresponding to the value of a quarter of qualification gradewidth are also drawn in the figure. Tables A13-A15 in Appendix A list the original grade boundary

marks and the differences between the equated grade boundary marks and the original grade boundaries for the selected routes shown in Figure 9.

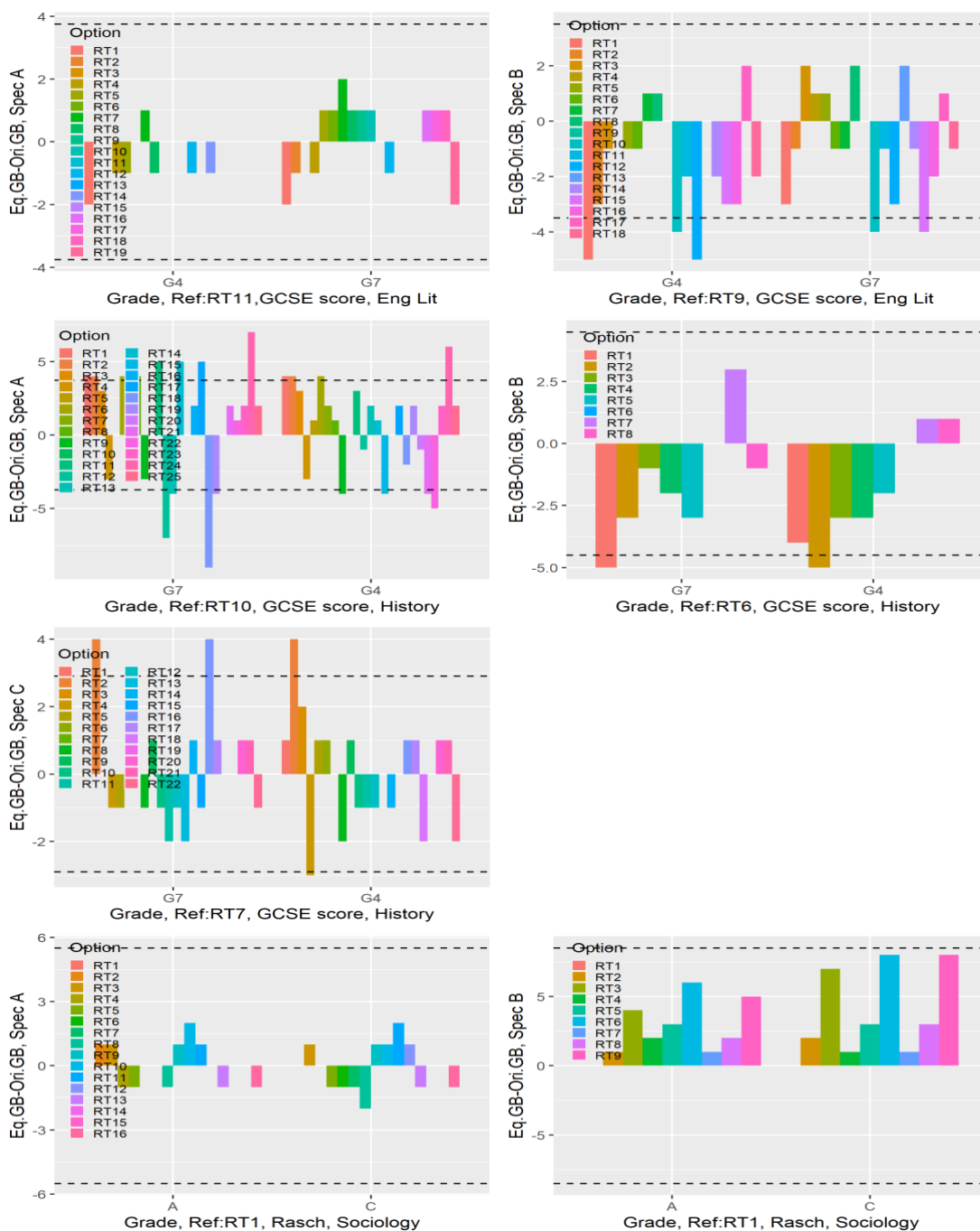


Figure 10 Differences between equated grade boundary marks and the original grade boundary marks at 7/A and 4/C for the selected certification routes shown in Figure 9: top graphs are for the two GCSE English literature specifications, middle graphs the 3 GCSE history specifications, and bottom graphs the 2 A level specifications. The dashed lines correspond to the value of a quarter of the gradewidth of the individual qualifications.

Of the routes from GCSE English literature Spec A examined, at grade 7, the difference in equivalent boundary marks between the most difficult and the easiest certification routes (in terms of grade difficulty) is about 4 marks (a quarter of a grade) (see Table A13). At grade 4, this is 3 marks (a fifth of a grade). For the selected certification routes from Spec B, at grade 7, the difference is 6 marks (two-fifths of a grade). At grade 4, this is 7 mark (half a grade).

For the selected routes from GCSE history Spec A, the maximum difference in equivalent boundary marks between the selected certification routes is about 16 marks (slightly over one grade) at grade 7 (see Table A14). At grade 4, these are 11 marks (about two-thirds of a grade). For the selected certification routes from Spec B, at grade 7, the maximum difference is 8 marks (two-fifths of a grade). At grade 4, this is 6 marks (a third of a grade). For the selected routes from Spec C, the maximum differences in equated marks are about 6 marks (half a grade) at grade 7 and 7 marks (three-fifths of a grade) at grade 4.

For the certification routes from A level sociology Spec A, at grade A, the difference in boundary mark between the most difficult route and the easiest route is 3 marks (slightly over a tenth of a grade, see Table A15). At grade C, this is about 4 marks (nearly a fifth of grade). For the selected certification routes from Spec B, the maximum differences in equivalent marks are 6 marks (slightly over a sixth of grade) at grade A and 8 marks (nearly a quarter of grade) at grade C respectively.

Figure 11 show the distributions of differences in relative grade difficulty in qualification gradewidth unit between different certification routes and the most difficult route in a specification in the same year (2018 or 2019). For the 2 GCSE English literature specifications, at grade 7, the easiest route is about two-fifths of a grade easier than the most difficult route in both 2018 and 2019.

At grade 4, this is about half a grade in 2018 and a third of a grade in 2019. For the 3 GCSE history specifications, at grade 7, the difference in difficulty between the easiest and the most difficult certification route is about one grade in 2018 and four-fifths of a grade in 2019. At grade 4, this is slightly over three-quarters of a grade in 2018 and half a grade in 2019.

For the 2 A level sociology specifications, the easiest route is about a sixth of a grade easier than the most difficult route in both 2018 and 2019 at grade A. At grade C, this is nearly a quarter of a grade.

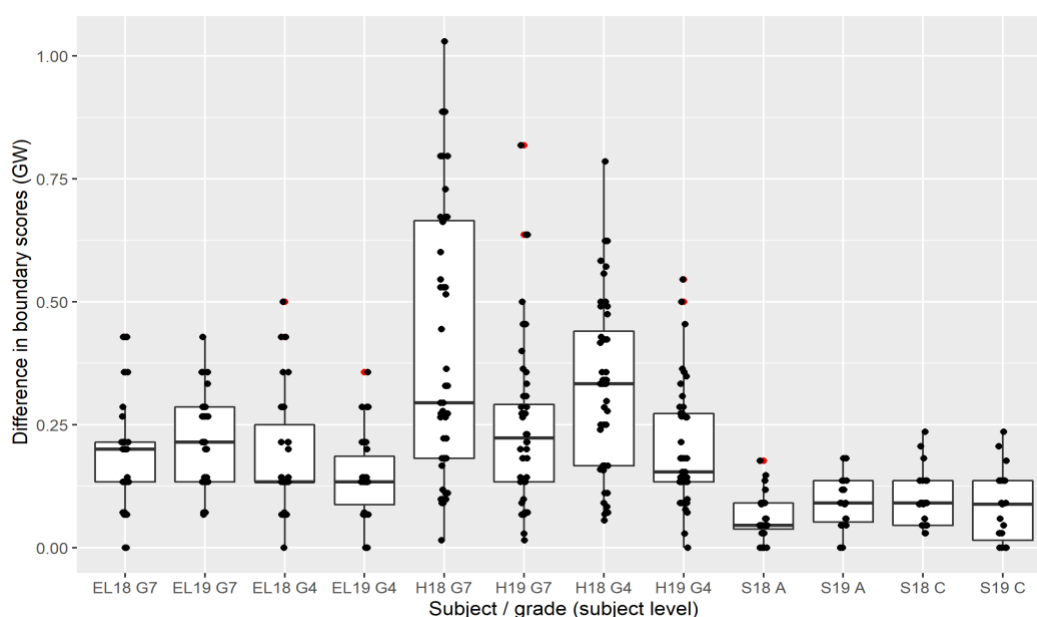


Figure 11 Distribution of differences in relative grade difficulty at grades 7/A and 4/C between different certification routes and the most difficult route for the selected routes from the seven specifications shown in Figures 9 and 10 in 2018 and 2019.

Variation of question difficulty between 2018 and 2019

Since the structure of all the question papers in terms of question format and content topics covered from the 7 GCSE and A level specifications are the same in both 2018 and 2019 except for Paper 2 in GCSE history Specification A which was split into two components (Paper P and Paper B) in 2019, a direct comparison of facility estimated using the OQCC approach for the same optional questions/sections between 2018 and 2019 is made possible. This is shown in Figure 12. It appears that the magnitude of relative difficulties between optional questions/sections is similar in both 2018 and 2019 for the specifications studied.

For the 2 GCSE English literature specifications, the order of relative difficulty of the questions from the 2 sections in Paper 1 appears to be relatively consistent between 2018 and 2019, but that of the questions in Paper 2 shows greater variability. For the 3 GCSE history specifications, for the majority of the questions, the order of relative difficulty changed between the 2 years.

For the 2 A level sociology specifications, the relative difficulties of the topics in both Sections A and B in Paper 2 from Spec A appear to be consistent between 2018 and 2019. For questions in Section B of the 2 papers from Spec B, the difficulty distributions seem not consistent between the two years.

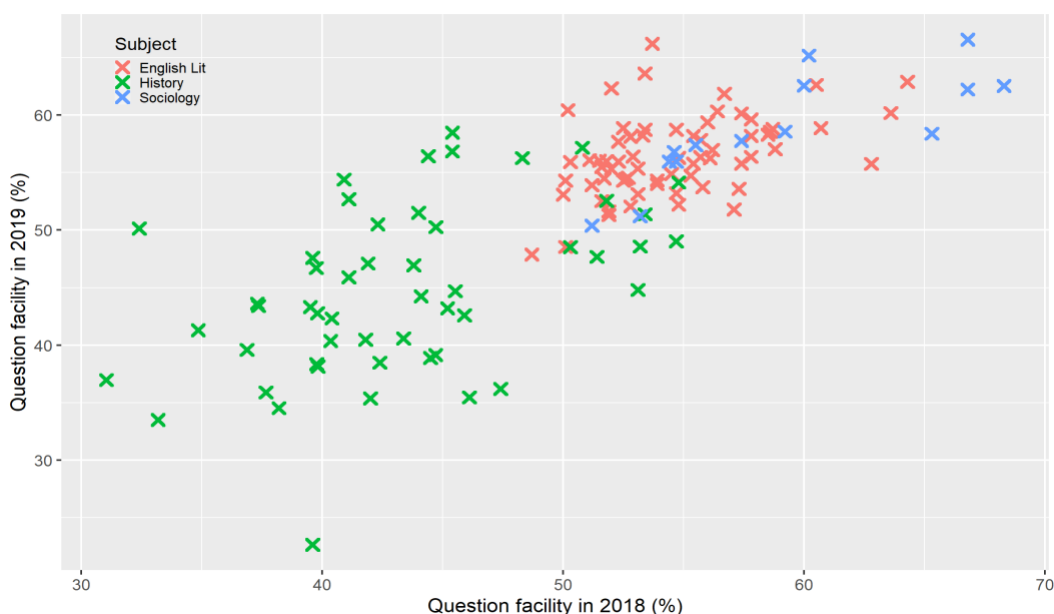


Figure 12 Comparison of facilities of optional questions/sections from the 7 specifications between 2018 and 2019.

Relationship between choice of questions and candidate's characteristics

Research into how choice of questions by examinees in examinations where optionality is used is affected by their characteristics and whether fairness is achieved has been limited. An attempt has been made here to examine the relationship between difficulty of optional questions selected and candidates' characteristics in GCSE English literature and history. A level sociology was excluded due to small sample size.

Figure 13 compares the relative facilities of a selection of optional questions from the 5 GCSE specifications and average mean GCSE point score and IDACI score of candidates taking these questions (scaled). The facilities were estimated using the OQCCs approach described previously. The questions depicted in Figure 13 are the same questions as those shown in Figure 1.

The proportions of candidates taking different questions, receiving FSM, with SEN and EAL, and being male and non-white are also shown in the figure. The questions are arranged in the order of facility from left to right (i.e. questions on the right are more difficult than those on the left). Because the questions are arranged in order of facility, the graphs provide some visual indications of possible relationships between question facility (difficulty) and candidates' average profile.

Figure 14 shows the relationships for the selected certification routes from the 5 specifications which are shown in Figure 9. Again, the facilities of the certification routes were derived using the OQCCs method and the routes are arranged in the order of facility from left to right. For the majority of the optional questions and routes analysed, there seems to be a trend that more able students (and students with low levels of deprivation) are more likely to choose easier questions or routes (in terms of facility) than less able students (or students with higher levels of deprivation).

However, there are also situations where the trend is not entirely clear or even reversed. These findings are generally consistent with findings reported by other researchers (Willmott and Hall, Wang et al, 1995; Wainer and Thissen, 1994, Bramley and Crisp, 2019). There is generally no clear pattern in the relationship between question/route difficulty (in terms of facility) and the other variables such as gender and ethnicity for the majority of the optional questions and routes analysed.

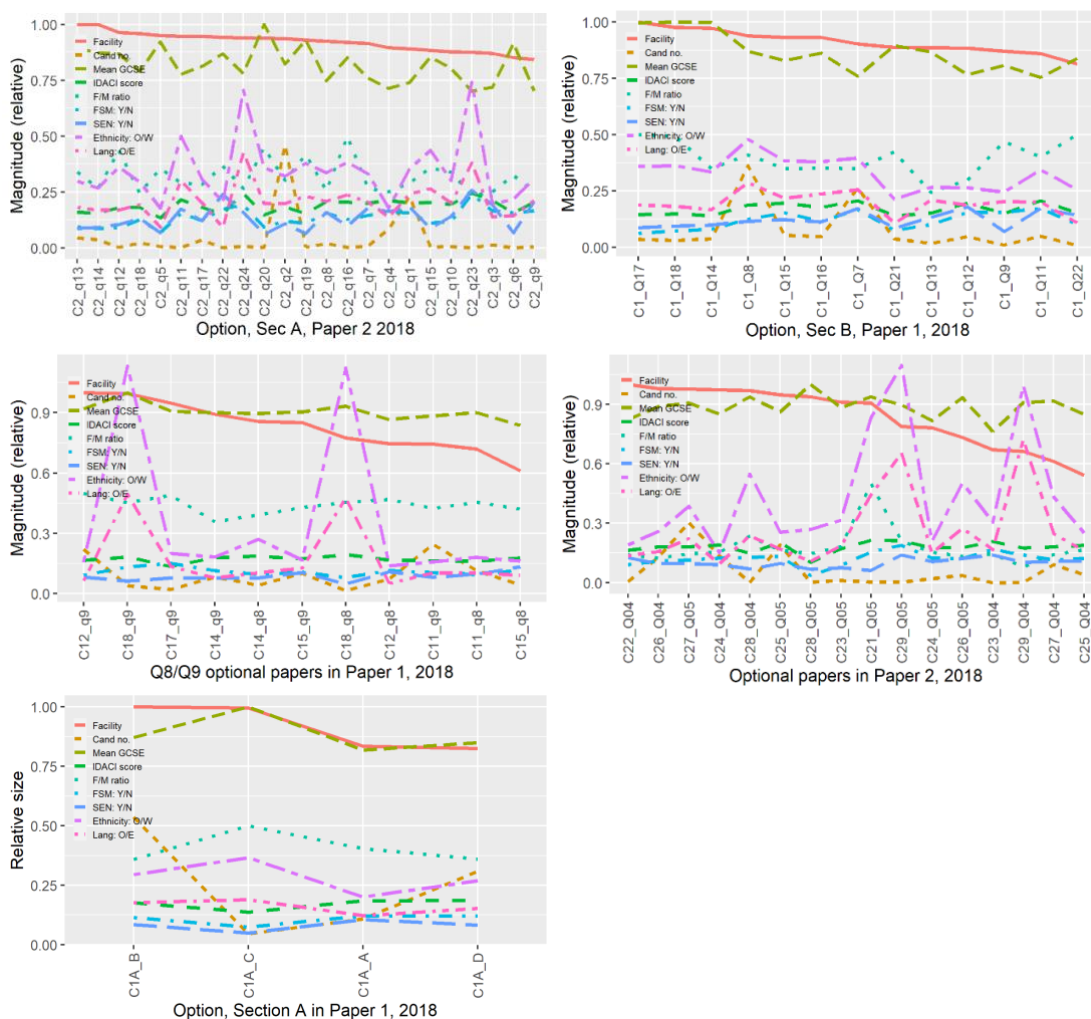


Figure 13 Comparison of facilities (based on OQCCs) of the selected optional questions shown in Figure 1 and average profiles of candidates: top 2 graphs are from the 2 GCSE English literature specifications and the bottom 3 graphs are from the 3 GCSE history specifications.

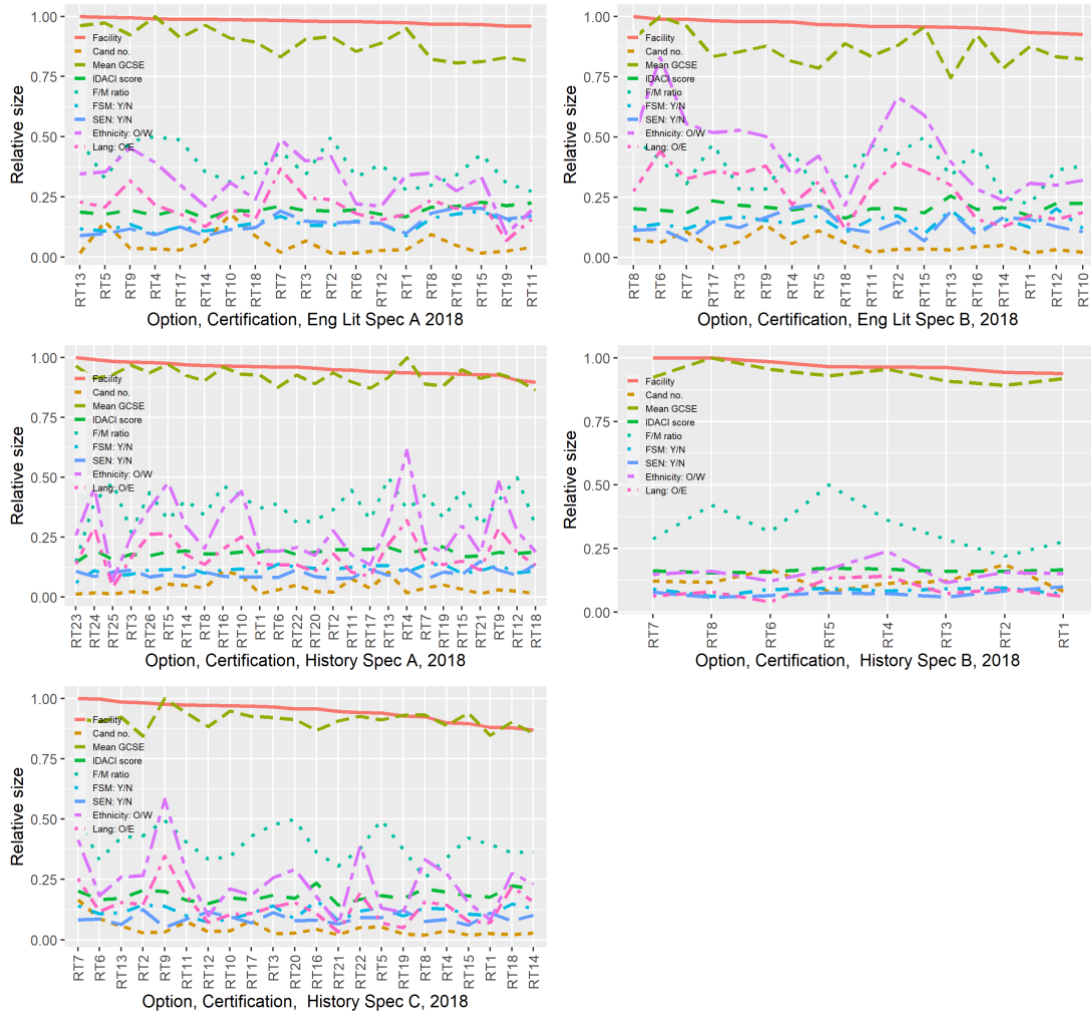


Figure 14 Comparison of facilities (based on OQCCs) and average profiles of candidates for the selected optional certification routes from the 5 GCSE specifications in 2018.

To look at the relationship between routes to certification and candidates' profiles with respect to grade difficulty, Figure 15 depicts the relationships for the selected certification routes shown in Figure 14 at grades 4 and 7, with routes arranged in order of grade difficulty derived using CEPE (that is, routes on the left are easier than those on the right in terms of grade difficulty). Unlike the patterns seen in Figure 14, there appears no clear pattern in the relationship between grade difficulty and candidates' characteristics, including attainment at GCSE.

It is to be noted that the facility of a certification route based on OQCC was estimated as an overall measure of difficulty for the whole route before awarding, whereas grade boundaries were set at specific marks on the qualification mark distribution during awarding.

For qualifications where the same grade boundary marks are set for different routes (such as GCSE English literature), the relationship between grade difficulty and candidates' characteristics at a specific grade may not be as clear and obvious as the relationship between facility and candidates' characteristics due to factors such as

differentiated difficulty of optional questions or routes. For qualifications where optional papers are used and grade boundary marks are set separately for individual papers (such as GCSE history), the situation is further complicated by the need to combine different papers at qualification level.

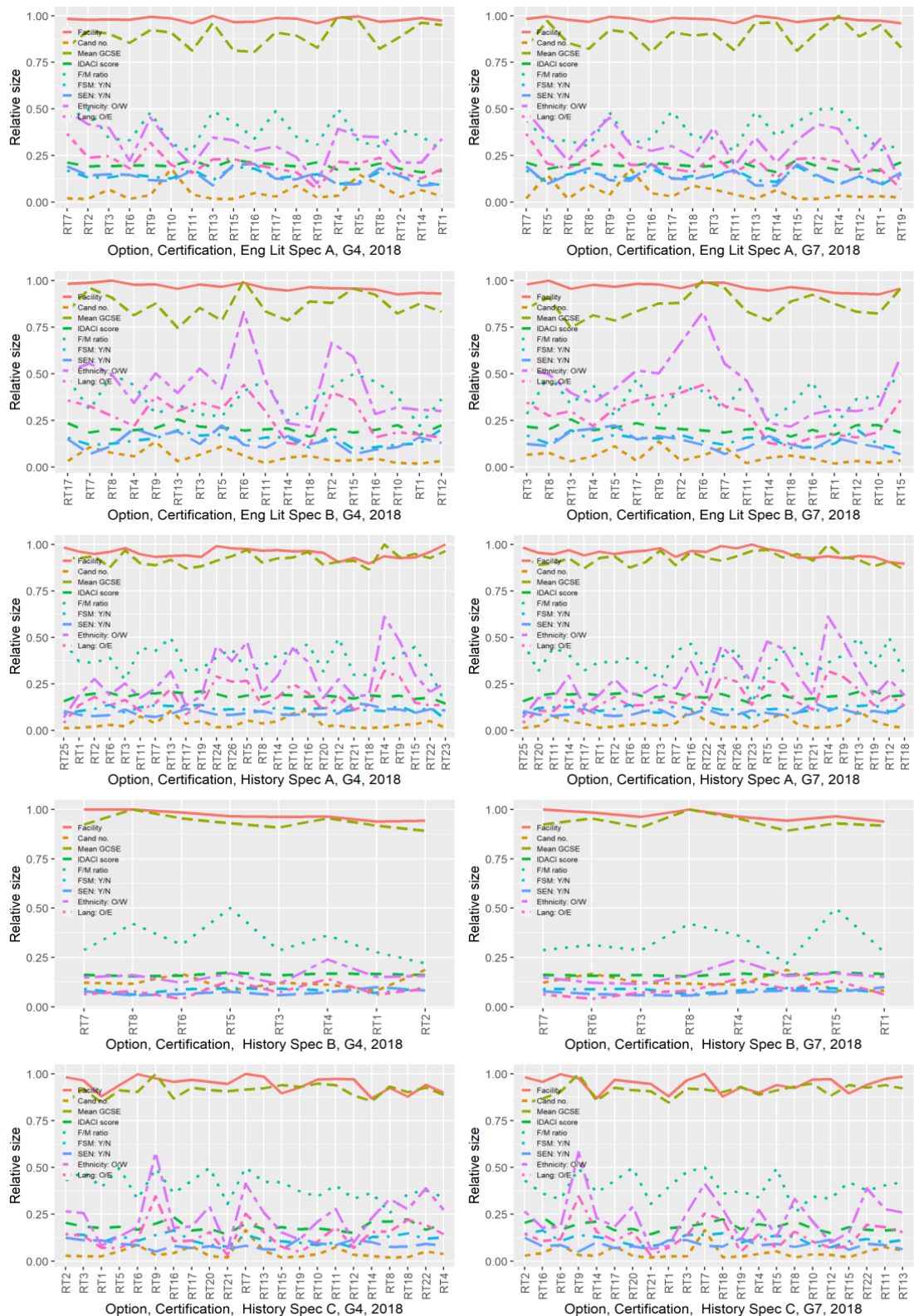


Figure 15 Comparison of facilities (based on OQCs) and candidates' average profiles for the selected certification routes for the 5 GCSE specifications in 2018, with routes arranged in the order of grade difficulty derived using CEPE at grades 4 and 7.

Discussion and concluding remarks

The comparability of marks between optional questions and grades between optional routes at component level and the overall qualification level for 7 GCSE and A level specifications from 2018 and 2019 was investigated using a number of statistical methods.

Results from this study indicated that:

- There is variability in relative difficulty between optional questions/sections within examination papers. Where optional papers are used within a component (such as the components in the 3 GCSE history specifications), the variability in difficulty between optional questions from different optional papers is considerably larger than that between optional questions within the same paper. The variability in difficulty between optional questions results in variability in relative difficulty between different optional routes at both component level and the overall qualification level.

For the 2 GCSE English literature specifications, difference in average mark from similar candidates between the most difficult and the easiest question options was as high as 13% of the maximum question mark in 2018 and 10% in 2019.

For the 3 GCSE history specifications, this was over 23% of the maximum question mark in 2018 and 35% in 2019 for optional questions from different optional papers.

For the 2 A level sociology specifications, maximum difference in average marks between the question options was over 6% of the maximum question mark in 2018 and nearly 8% in 2019.

- There is also variability in relative grade difficulty between different routes to the same grades at component level and the overall qualification level.
 - At component level, for the 4 papers from the 2 GCSE English literature specifications, difference in relative grade difficulty between the most difficult and the easiest routes was about three-quarters of a grade at grade 7 and one grade at grade 4.

The 3 GCSE history specifications show the largest variability in relative grade difficulty at both grades 7 and 4, with a difference in relative grade difficulty of about one-and-three-fifths of a grade at grade 7 and as high as two-and-two-fifths of a grade at grade 4 between the most difficult and the easiest routes.

For the 3 A level sociology papers, maximum difference in grade difficulty between the selected routes was about two-fifths of a grade at A and three-quarters of a grade at C.

- At the overall qualification level, for the 2 GCSE English literature specifications, difference in grade difficulty between the most difficult and the easiest certification routes was about two-fifths of a grade at 7 and half a grade at 4.

For the 3 GCSE history specifications, this was about one grade at 7 and three-quarters of a grade at 4.

For the 2 A level sociology specifications, the most difficult route was about a sixth of a grade harder at A than the easiest route and nearly a quarter of a grade harder at C.

- The magnitude of relative difficulties between optional questions/sections was similar in both 2018 and 2019 for the specifications. For a small proportion of the optional questions in the different specifications, the relative difficulties were consistent between the 2 years.
- This research suggests that the awarding process fails fully to take account of differences in difficulty between optional routes when setting component grade boundaries.
- For the majority of the optional questions/sections and certification routes from the 5 GCSE specifications analysed, there seems to be a trend that more able students (and students with lower levels of deprivation) were more likely to choose easier questions or certification routes (in terms of facility as calculated in this research) than less able students (or students with high levels of deprivation). However, there are also situations where the trend was not entirely clear or even reversed.

There appears no clear pattern in the relationship between certification routes and candidates' characteristics with respect to grade difficulty at individual grades. There is also generally no clear pattern in the relationship between question difficulty and the other candidate variables such as gender and ethnicity for the majority of the optional questions and routes analysed.

It is also worth noting that for some of the specifications only routes with relatively large entries were included in the analysis at component and the overall qualification levels.

The use of optional questions in examination papers (and in some cases optional papers in assessment components) in GCSEs and A levels to a large extent reflects the nature and structure of subject content and how it is delivered in schools. One of the perceived advantages with optionality is that it can potentially give individual teachers (or even schools) greater freedom to teach a smaller number of sections of the broad subject area and individual students greater freedom to pursue their specific interests.

It is also frequently argued that use of optional questions could allow students to demonstrate their best work because they will select questions which they believe they can give their best performance. However, because optional questions are assumed to assess the same skills and constitute part of the same qualification, they should place similar level of demand on students. Differences in difficulty between optional routes need to be taken into account when setting qualification grade boundaries.

Notwithstanding the limitations of the methods used and the specific subjects investigated, findings from the present study do suggest that setting comparable grade standards for different routes to certification in qualifications where optionality is used can present a very challenging task. This should be taken into consideration when designing future assessments employing optionality. If optional questions are to be used, appropriate and valid procedures should be in place to take account of

differences in difficulty in optional questions when setting thresholds for performance standards to ensure that results are reliable, valid and comparable and fairness is achieved.

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Appendix A Additional Tables

Table A1 Number of candidates and percentage of females taking individual optional questions in the papers from the two GCSE English literature Specifications in 2018.

Spec/Component		Section	Optional Question		N (% of total)	Female (%)
Code	Max Mark		ID	Max Mark		
Spec A Paper 1	64	A	C1_q1	34	255,086 (62.0)	49.2
			C1_q2		133,540 (32.5)	51.9
			C1_q3		2,998 (0.7)	50.1
			C1_q4		8,570 (2.1)	54.9
			C1_q5		8,174 (2)	60.4
			C1_q6		1,462 (0.4)	49.3
		B	C1_q7	30	139,457 (33.9)	50.8
			C1_q8		193,166 (47.0)	48.7
			C1_q9		9,177 (2.2)	53.2
			C1_q10		6,216 (1.5)	81.7
			C1_q11		20,648 (5)	51.5
			C1_q12		5,687 (1.4)	85.5
			C1_q13		32309 (7.9)	47.9
Spec A Paper 2	94	A	C2_q1	34	95,781 (23.2)	50.4
			C2_q2		187,100 (45.4)	51.3
			C2_q3		5,170 (1.3)	46.7
			C2_q4		34,533 (8.4)	46.7
			C2_q5		2,505 (0.6)	55.0
			C2_q6		237 (0.1)	52.7
			C2_q7		3,098 (0.8)	49.0
			C2_q8		8,199 (2.0)	47.4
			C2_q9		1,604 (0.4)	45.7
			C2_q10		2,257 (0.5)	53.6
			C2_q11		549 (0.1)	50.3
			C2_q12		1,142 (0.3)	60.2
			C2_q13		17,833 (4.3)	54.0
			C2_q14		14,751 (3.6)	48.1
			C2_q15		1,924 (0.5)	55.7
			C2_q16		1,267 (0.3)	63.1
			C2_q17		14,310 (3.5)	50.0
			C2_q18		8,905 (2.2)	46.3
			C2_q19		1,362 (0.3)	59.4
			C2_q20		1,063 (0.3)	61.1
			C2_q21		221 (0.1)	56.1
			C2_q22		500 (0.1)	44.2
			C2_q23		2,580 (0.6)	48.3
			C2_q24		95,781 (23.2)	50.4
		B	C2_q25	30	85,572 (20.7)	58.8
			C2_q26		310,332 (75.2)	49.0
		C	(C2_q27)	32	411,779 (99.8)	50.2
Spec B Paper 1	80	A	C1_Q1	40	29,780 (57.3)	47.9
			C1_Q2		592 (1.1)	47.1
			C1_Q3		17,816 (34.3)	49.1
			C1_Q4		1,136 (2.2)	62.9
			C1_Q5		360 (0.7)	50.3
			C1_Q6		2,297 (4.4)	50.1
		B	C1_Q7	40	13,279 (25.5)	47.0
			C1_Q8		18,324 (35.3)	50.9
			C1_Q9		474 (0.9)	53.8
			C1_Q10		2,652 (5.1)	50.8
			C1_Q11		2,652 (5.1)	50.8

			C1_Q12		2,541 (4.9)	44.0	
			C1_Q13		822 (1.6)	38.7	
			C1_Q14		1,747 (3.4)	47.2	
			C1_Q15		2,545 (4.9)	47.1	
			C1_Q16		2,281 (4.4)	47.5	
			C1_Q17		1,838 (3.5)	54.8	
			C1_Q18		1,625 (3.1)	53.0	
			C1_Q21		1,750 (3.4)	51.7	
			C1_Q22		418 (0.8)	56.0	
Spec B Paper 2	80	A	C2_Q1	40	1,229 (2.3)	67.0	
			C2_Q2		1,274 (2.4)	45.4	
			C2_Q3		20,978 (40.0)	48.0	
			C2_Q4		23,564 (45.0)	47.8	
			C2_Q5		685 (1.3)	81.5	
			C2_Q6		541 (1.0)	55.3	
			C2_Q7		3,189 (6.1)	45.8	
		B	Pt A	C2_Q8	20	3,204 (6.1)	46.5
				C2_Q9		16,554 (31.6)	56.4
			Pt B	C2_Q10	20	30,138 (57.5)	45.8
				C2_Q11		52,004 (99.3)	48.4

Table A2 Number of candidates and percentages of females taking individual optional questions/sections from the three GCSE history specifications in 2018.

Spec Code	Component		Paper ID	Optional Question		N (% of total)	Female (%)
	Code	Max Mark		ID	Max Mark		
A	Paper 1	52	C10	C10_Q05	20	16817 (13)	50.8
				C10_Q06		29459 (22.8)	55.7
			C11	C11_Q05		46973 (36.3)	59.1
				C11_Q06		22341 (17.3)	49.9
			C12	C12_Q05		4588 (3.5)	36.9
				C12_Q06		2351 (1.8)	27.2
	Paper 2	64	C21	C21_Q05	32	573 (0.4)	79.2
				C22		C22_Q04	983 (0.8)
			C23	C23_Q04		220 (0.2)	53.6
				C23_Q05		1514 (1.2)	59.2
			C24	C24_Q04		17795 (13.8)	54.9
				C24_Q05		2108 (1.6)	55.6
			C25	C25_Q04		5509 (4.3)	56.7
				C25_Q05		23418 (18.2)	56.1
			C26	C26_Q04		16683 (12.9)	49.6
				C26_Q05		3426 (2.7)	51.5
			C27	C27_Q04		12231 (9.5)	53.2
				C27_Q05		36701 (28.4)	53.3
			C28	C28_Q04		370 (0.3)	64.3
				C28_Q05		709 (0.5)	53.7
C29	C29_Q04	408 (0.3)	38.7				
	C29_Q05	681 (0.5)	63.1				
B	Paper 1	80	C11	C11_q4	18	3651 (21.7)	48.3
				C11_q5		2217 (13.2)	60.4
			C12	C12_q4		2893 (17.2)	51.7
				C12_q5		1731 (10.3)	62.3
			C14	C14_q4		801 (4.8)	49.8
				C14_q5		1112 (6.6)	49.2
			C15	C15_q4		1050 (6.2)	51.7
				C15_q5		1187 (7)	53.4
			C17	C17_q4		279 (1.7)	57.0

			C18	C18_q4	20	488 (2.9)	51.8
				C18_q5		313 (1.9)	60.1
			C11	C11_q8		1695 (10.1)	55.2
				C11_q9		3568 (21.2)	53.5
			C12	C12_q8		1069 (6.3)	55.8
				C12_q9		3218 (19.1)	57.6
			C14	C14_q8		623 (3.7)	51.5
				C14_q9		1154 (6.9)	48.7
			C15	C15_q8		633 (3.8)	53.1
				C15_q9		1456 (8.6)	53.7
			C17	C17_q9		295 (1.8)	57.3
			C18	C18_q8		222 (1.3)	55.0
	C18_q9	569 (3.4)		55.5			
	Paper 3	80	C33	C33_q4	18	657 (3.9)	52.7
				C33_q5		563 (3.3)	49.0
			C39	C39_q4		8332 (49.5)	51.2
				C39_q5		5735 (34.1)	56.6
			C33	C33_q8		941 (5.6)	52.6
C33_q9				238 (1.4)		50.8	
C39	C39_q8	10951 (65.1)	54.9				
	C39_q9	2417 (14.4)	53.1				
C	Paper 1	84	Sec A	C1A_A	40	8867 (10.8)	55.9
				C1A_B		43917 (53.7)	52.9
				C1A_C		3857 (4.7)	60.8
				C1A_D		25160 (30.8)	53.1
			Sec B	C1B_A	44	13600 (16.6)	53.6
				C1B_B		33984 (41.48)	55.0
				C1B_C		19127 (23.3)	53.5
				C1B_D		14574 (17.8)	50.1
	Paper 2	84	Sec A	C2A_A	44	60522 (73.5)	54.8
				C2A_B		13716 (16.7)	52.1
				C2A_C		8122 (9.9)	46.7
			Sec B	C2B_A	40	29786 (36.1)	49.7
				C2B_B		3002 (3.6)	45.5
				C2B_C		45752 (55.4)	56.3
C2B_D	3973 (4.8)	57.4					

Table A3 Number of candidates and percentage of females taking different optional sections in the papers from the two A level sociology specifications in 2018.

Spec Code	Component		Section	Optional Question		N (% of total)	Female (%)
	Code	Max Mark		ID	M Mark		
A	Paper 1	80				28,490	77.1
	Paper 2	80	A	Topic A1	40	1657 (5.9)	76.7
				Topic A2		25,310 (90.6)	77.4
				Topic A3		310 (1.1)	67.1
				Topic A4		673 (2.4)	72.1
			B	Topic B1	40	19,493 (70.0)	77.2
				Topic B2		1,799 (6.5)	78.0
				Topic B3		6,150 (21.9)	76.6
				Topic B4		466 (1.7)	76.8
	Paper 3	80				28,342	77.1
B	Paper 1	90	A				
			B	Option 1	52	1762 (50.7)	76.6
				Option 2		1396 (40.1)	75.1
Option 3	319 (9.2)	67.7					

Paper 2	105					
Paper 3	105	A				75.2
		B	Option 1	70	2171 (62.8)	78.5
			Option 2		1066 (30.8)	71.4
			Option 3		220 (6.4)	71.4

Table A4 Regression coefficient of determination and model parameters for optional questions against average GCSE point scores in the four papers from the two GCSE English literature specifications in 2018.

Spec code	Paper	Optional Question	R ²	α	β	γ	δ	
A	Paper 1	C1_q1	0.61	0.85	0.17	Reference		
		C1_q2				1.34	-0.01	
		C1_q3				-0.23	0.00	
		C1_q4				0.52	0.00	
		C1_q5				1.88	-0.01	
		C1_q6				0.49	0.00	
		C1_q7	0.62	0.07	0.15	-0.83	0.01	
		C1_q8				-0.51	0.00	
		C1_q9				0.24	0.00	
		C1_q10				Reference		
		C1_q11				-0.06	0.01	
		C1_q12				0.00	0.00	
		C1_q13				-0.95	0.00	
	Paper 2	C2_q1	0.62	-0.35	0.18	Reference		
		C2_q2				2.04	-0.01	
		C2_q3				0.70	-0.01	
		C2_q4				2.82	-0.03	
		C2_q5				3.31	-0.02	
		C2_q6				-0.59	0.00	
		C2_q7				1.75	-0.01	
		C2_q8				1.87	-0.01	
		C2_q9				0.88	-0.02	
		C2_q10				2.85	-0.02	
		C2_q11				3.52	-0.02	
		C2_q12				2.70	-0.02	
		C2_q13				2.79	0.00	
		C2_q14				-0.05	-0.01	
		C2_q15				1.15	0.00	
		C2_q16				1.47	0.00	
		C2_q17				0.30	0.00	
C2_q18	2.85	0.01						
C2_q19	2.85	-0.02						
C2_q20	3.15	-0.02						
C2_q22	2.47	-0.02						
C2_q23	-0.31	0.00						
C2_q24	2.28	-0.01						
C2_q25	0.63	-2.43				0.17	Reference	
C2_q26							0.21	0.00
B	Paper 1	C1_Q1				0.58	1.10	0.20
		C1_Q2	-1.29	0.00				
		C1_Q3	0.86	-0.01				
		C1_Q4	1.24	-0.02				
		C1_Q5	-2.44	0.01				
		C1_Q6	-0.13	-0.01				
		C1_Q7	0.57	2.65	0.18	-0.81	0.02	
		C1_Q8				2.02	0.00	

		C1_Q9				-1.91	0.02
		C1_Q11				Reference	
		C1_Q12				0.10	0.01
		C1_Q13				2.05	-0.02
		C1_Q14				3.79	-0.01
		C1_Q15				-1.15	0.03
		C1_Q16				0.05	0.02
		C1_Q17				4.38	-0.01
		C1_Q18				2.09	0.01
		C1_Q21				-0.61	0.01
		C1_Q22				-2.59	0.01
	Paper 2	C2_Q1				Reference	
		C2_Q2				2.60	-0.03
		C2_Q3				0.20	-0.01
		C2_Q4	0.55	1.64	0.20	1.60	-0.02
		C2_Q5				5.33	-0.05
		C2_Q6				4.18	-0.05
		C2_Q7				0.71	-0.01
		C2_Q8				Reference	
		C2_Q9	0.53	-0.87	0.11	0.53	0.00
		C2_Q10				0.70	0.00

Table A5 Regression coefficient of determination and model parameters for optional questions/sections against average GCSE point scores in the papers from the three GCSE history Specifications in 2018.

Spec Code	Paper	Optional Question	R ²	α	β	γ	δ
A	Paper 1	C10_Q05	0.55	-2.64	0.12	Reference	
		C10_Q06				1.24	-0.01
		C11_Q05				1.19	-0.01
		C11_Q06				-0.17	0.00
		C12_Q05				1.05	0.00
		C12_Q06				0.68	-0.01
	Paper 2	C21_Q05	0.65	-8.84	0.22	Reference	
		C22_Q04				2.40	-0.01
		C23_Q04				-2.36	-0.01
		C23_Q05				-2.75	0.03
		C24_Q04				-0.10	0.01
		C24_Q05				-2.65	0.03
		C25_Q04				-4.37	0.02
		C25_Q05				-0.85	0.01
		C26_Q04				1.74	0.00
		C26_Q05				-0.51	0.00
		C27_Q04				-3.96	0.02
		C27_Q05				0.53	0.01
		C28_Q04				2.21	-0.01
		C28_Q05				3.03	-0.02
C29_Q04	-3.70	0.00					
C29_Q05	-2.04	0.00					
B	Paper 1	C11_q4	0.53	-4.13	0.11	Reference	
		C11_q5				1.31	-0.01
		C12_q4				0.61	0.00
		C12_q5				2.28	-0.01
		C14_q4				-0.59	0.02
		C14_q5				0.53	0.02
		C15_q4				-0.93	0.01
		C15_q5				-1.81	0.03

		C17_q4				-0.24	0.01	
		C18_q4				1.45	0.00	
		C18_q5				0.48	0.01	
		C11_q8				Reference		
		C11_q9				-3.06	0.03	
		C12_q8				-1.89	0.02	
		C12_q9				0.53	0.02	
		C14_q8				-2.47	0.04	
		C14_q9	0.55	-4.76	0.12	-2.09	0.04	
		C15_q8				-2.61	0.01	
		C15_q9				-2.23	0.03	
		C17_q9				1.90	0.00	
		C18_q8				-2.90	0.03	
		C18_q9				2.09	0.01	
	Paper 3	C33_q4				Reference		
		C33_q5	0.52	-4.89	0.11	-0.30	0.01	
		C39_q4				0.83	0.00	
		C39_q5				2.08	-0.01	
		C33_q8				Reference		
		C33_q9	0.49	-4.33	0.11	-0.73	0.01	
		C39_q8				-0.15	0.01	
	C39_q9				-0.49	0.01		
	C	Paper 1	C1A_A				Reference	
			C1A_B	0.71	-6.57	0.20	1.75	0.01
			C1A_C				4.68	-0.02
			C1A_D				-1.51	0.01
			C1B_A				Reference	
			C1B_B	0.71	-9.84	0.24	2.32	0.02
C1B_C						0.53	0.02	
C1B_D					2.68	0.00		
C1B_E					2.59	-0.04		
Paper 2		C2A_A				Reference		
		C2A_B	0.70	-6.57	0.23	-4.93	0.02	
		C2A_C				-1.94	0.03	
		C2B_A				Reference		
		C2B_B	0.69	-9.50	0.23	4.64	-0.03	
	C2B_C				2.93	-0.02		
	C2B_D				2.54	-0.02		

Table A6 Regression coefficient of determination and model parameters for optional sections in the papers from the two A level sociology specifications in 2018.

Spec Code	Component	Optional Question	R ²	α	β	γ	δ
A	Paper 2	Topic A1	0.35	6.38	0.17	Reference	
		Topic A2				-1.65	0.01
		Topic A3				-3.00	0.04
		Topic A4				-0.66	0.00
		Topic B1	0.40	0.74	0.21	Reference	
		Topic B2				-0.87	0.01
		Topic B3				1.63	-0.01
		Topic B4				-1.24	0.00
B	Paper 1	Option 1	0.39	14.88	0.31	Reference	
		Option 2				-2.01	0.06
		Option 3				-1.04	0.03
	Paper 3	Option 1	0.42	10.19	0.52	Reference	

		Option 2			0.23	-0.01
		Option 3			10.95	-0.10

Table A7 Estimated average and percentage marks for optional questions in the four papers from the two GCSE English literature specifications in 2018.

Spec code	Component	Optional Question	Max Mark	Facility (GCSE)	
				Mark	% of Mark
A	Paper 1	C1_q1	34	17.5	51.5
		C1_q2		17.5	51.6
		C1_q3		17.0	50.1
		C1_q4		18.0	52.9
		C1_q5		18.0	52.8
		C1_q6		18.1	53.1
		C1_q7	30	15.4	51.2
		C1_q8		15.0	50.0
		C1_q9		15.6	51.9
		C1_q10		15.7	52.3
		C1_q11		16.2	53.9
		C1_q12		15.5	51.6
		C1_q13		14.6	48.7
	Paper 2	C2_q1	34	18.1	53.4
		C2_q2		19.2	56.4
		C2_q3		18.1	53.3
		C2_q4		19.6	57.8
		C2_q5		17.8	52.5
		C2_q6		18.6	54.7
		C2_q7		18.9	55.4
		C2_q8		17.1	50.2
		C2_q9		17.8	52.3
		C2_q10		19.1	56.1
		C2_q11		19.9	58.7
		C2_q12		20.6	60.7
		C2_q13		20.6	60.5
		C2_q14		18.3	53.7
		C2_q15		18.9	55.7
		C2_q16		19.5	57.4
		C2_q17		19.7	57.8
		C2_q18		19.3	56.7
		C2_q19		19.6	57.8
		C2_q20		19.0	56.0
		C2_q22		18.1	53.4
C2_q23	19.5	57.4			
C2_q24	17.7	52.0			
C2_q25	30	15.1		50.3	
C2_q26		15.5	51.8		
B	Paper 1	C1_Q1	40	21.9	54.8
		C1_Q2		20.7	51.9
		C1_Q3		21.9	54.7
		C1_Q4		21.1	52.8
		C1_Q5		20.0	50.1
		C1_Q6		21.1	52.7
		C1_Q7	40	22.3	55.7
		C1_Q8		23.5	58.8
		C1_Q9		21.0	52.6
		C1_Q11		21.0	52.5
		C1_Q12		21.8	54.5

		C1_Q13		22.5	56.2	
		C1_Q14		25.1	62.8	
		C1_Q15		23.4	58.5	
		C1_Q16		23.5	58.6	
		C1_Q17		25.7	64.3	
		C1_Q18		25.5	63.6	
		C1_Q21		22.3	55.8	
		C1_Q22		20.4	51.1	
	Paper 2	40	C2_Q1		22.9	57.3
			C2_Q2		21.9	54.8
			C2_Q3		21.5	53.9
			C2_Q4		22.2	55.4
			C2_Q5		22.8	57.1
			C2_Q6		21.2	53.1
			C2_Q7		22.1	55.3
		20	C2_Q8		10.5	52.6
			C2_Q9		10.3	51.7
			C2_Q10		10.4	52.0

Table A8 Estimated average and percentage marks for optional questions/sections from the three GCSE history specifications in 2018.

Spec Code	Component	Optional Question	Max Mark	Mean Mark	% of Max Mark
A	Paper 1	C10_Q05	20	10.4	51.8
		C10_Q06		10.6	53.2
		C11_Q05		11.0	54.8
		C11_Q06		10.7	53.4
		C12_Q05		10.9	54.7
		C12_Q06		10.3	51.4
	Paper 2	32	C21_Q05	14.4	45.0
			C22_Q04	15.9	49.6
			C23_Q04	10.6	33.3
			C23_Q05	14.5	45.2
			C24_Q04	15.5	48.3
			C24_Q05	12.4	38.8
			C25_Q04	8.6	26.9
			C25_Q05	15.1	47.1
			C26_Q04	15.5	48.5
			C26_Q05	11.7	36.4
			C27_Q04	9.7	30.4
			C27_Q05	15.5	48.5
			C28_Q04	15.4	48.1
			C28_Q05	14.9	46.5
C29_Q04	10.5	33.0			
C29_Q05	12.5	39.1			
B	Paper 1	C11_q4	18	7.1	39.5
		C11_q5		7.4	40.9
		C12_q4		7.5	41.9
		C12_q5		8.0	44.4
		C14_q4		8.2	45.4
		C14_q5		9.1	50.8
		C15_q4		7.6	42.3
		C15_q5		7.9	44.0
		C17_q4		7.9	43.8
		C18_q4		7.9	44.1
		C18_q5	8.7	48.3	
C11_q8	20	7.6	38.2		

		C11_q9		7.9	39.6
		C12_q8		7.9	39.6
		C12_q9		10.6	53.1
		C14_q8		9.1	45.4
		C14_q9		9.5	47.4
		C15_q8		6.5	32.4
		C15_q9		9.0	45.2
		C17_q9		10.1	50.3
		C18_q8		8.2	41.1
		C18_q9		10.6	52.9
	Paper 3	C33_q4	18	6.7	37.3
		C33_q5		7.2	39.8
		C39_q4		7.5	41.8
		C39_q5		8.3	46.1
		C33_q8	18	7.3	40.4
		C33_q9		7.6	42.0
		C39_q8		8.3	45.9
		C39_q9		8.0	44.7
C	Paper 1	C1A_A	40	14.9	37.4
		C1A_B		17.9	44.7
		C1A_C		17.8	44.5
		C1A_D		14.7	36.9
		C1B_A	44	15.3	34.8
		C1B_B		20.0	45.5
		C1B_C		18.1	41.1
		C1B_D		17.5	39.8
	C1B_E		13.7	31.0	
	Paper 2	C2A_A	44	17.8	40.3
		C2A_B		14.6	33.2
		C2A_C		19.1	43.4
		C2B_A	40	15.1	37.7
		C2B_B		17.0	42.4
C2B_C		15.9		39.8	
C2B_D		15.9	39.8		

Table A9 Estimated average and percentage marks for optional sections in the papers from the two A level sociology specifications in 2018.

Spec Code	Component	Optional Question	Max Mark	Facility (Compulsory)	
				Max Mark	% of Mark
A	Paper 2	Topic A1	40	23.0	57.4
		Topic A2		21.9	54.7
		Topic A3		23.7	59.2
		Topic A4		22.2	55.5
		Topic B1	40	21.3	53.2
		Topic B2		21.8	54.6
		Topic B3		21.8	54.4
		Topic B4		20.5	51.2
B	Paper 1	Option 1	52	34.0	65.3
		Option 2		35.5	68.3
		Option 3		34.7	66.8
	Paper 3	Option 1	70	42.1	60.2
		Option 2		42.0	60.0
		Option 3		46.7	66.8

Table A10 The original boundary marks for a selection of optional routes from the four papers in the two GCSE English literature specifications in 2018 established during awarding and the differences between the equivalent boundary marks derived using CEPE and the original grade boundary marks.

Spec code	Component	Route	Original boundary		GW	Diff btw equiv GB and ori GB	
			G4	G7		G4	G7
A	Paper 1	RT1	25	43	6	Reference	
		RT2				0	1
		RT3				0	-1
		RT4				-1	-1
		RT5				1	1
		RT6				-1	-2
		RT7				0	-1
		RT8				1	0
		RT9				1	0
		RT10				0	-1
		RT11				0	-2
		RT12				1	0
		RT13				-2	-4
		RT14				0	-1
		RT15				-1	-1
		RT16				0	-1
		RT17				0	1
		RT18				1	1
		RT19				0	-1
		RT20				1	0
	Paper 2	RT1	36	63	9	Reference	
		RT2				0	1
		RT3				0	0
		RT4				0	1
		RT5				0	0
		RT6				0	0
		RT7				1	0
		RT8				0	-1
		RT9				1	1
		RT10				0	0
		RT11				1	2
		RT12				0	-1
		RT13				1	2
		RT14				1	2
		RT15				1	2
		RT16				1	2
		RT17				1	2
		RT18				1	2
		RT19				1	3
		RT20				1	3
		RT21				1	1
B	Paper 1	RT1	35	58	8	-1	1
		RT2				Reference	
		RT3				-2	0
		RT4				-1	0
		RT5				-2	-1
		RT6				-3	0
		RT7				-2	-1
		RT8				-1	0
		RT9				-2	-1

		RT10				-4	-4
		RT11				-1	0
		RT12				0	-1
		RT13				-1	-2
		RT14				0	1
		RT15				0	-1
		RT16				0	2
		RT17				0	1
		RT18				1	0
		RT19				0	0
		RT20				-2	-3
	Paper 2	RT1	32	51	7	-3	-1
		RT2				-3	-3
		RT3				-2	-1
		RT4				-2	-1
		RT5				-3	-3
		RT6				1	1
		RT7				Reference	
		RT8				1	1
		RT9				-1	-1
		RT10				-1	-1

Table A11 The original boundary marks for the selected optional routes in the papers from seven components in the three GCSE history specifications in 2018 and the differences between the equivalent boundary marks derived using CEPE and the original grade boundary marks.

Spec code	Code	Route	Original boundary		GW	Diff btw equiv GB and ori GB		
			G4	G7		G4	G7	
A	Paper 1	RT1	23	36	5	Reference		
		RT2				0	0	
		RT3				0	2	
		RT4				-1	2	
		RT5				-2	0	
		RT6				-2	-1	
	Paper 2	RT1	22	42	7	Reference		
		RT2	22	42	7	3	2	
		RT3	22	40	6	-3	3	
		RT4	22	40	6	-1	2	
		RT5	22	39	6	3	6	
		RT6	22	39	6	2	3	
		RT7	23	42	7	-4	-1	
		RT8	23	42	7	1	1	
		RT9	20	42	8	5	4	
		RT10	20	42	8	3	2	
		RT11	26	44	6	-7	-2	
		RT12	26	44	6	-1	1	
		RT13	27	46	7	-6	-4	
		RT14	27	46	7	-7	-5	
		RT15	26	43	6	-11	-3	
		RT16	26	43	6	-9	-4	
	B	Paper 1	RT1	31	51	7	Reference	
			RT2				0	1
			RT3				0	0
			RT4				0	1
RT5			2				3	
RT6			4				5	
RT7			0				2	

C		RT8				4	4
		RT9				5	9
		RT10				5	9
		RT11				8	9
		RT12				8	9
		RT13				-2	2
		RT14				1	5
		RT15				0	4
		RT16				2	5
		RT17				4	5
	Paper 2	RT1	21	34	5	Reference	
		RT2				-3	-1
		RT3				-1	-1
	Paper 3	RT1	30	49	7	Reference	
		RT2				0	1
		RT3				4	5
		RT4				4	5
		RT5				5	6
	RT6	5	5				
	Paper 1	RT1	23	42	7	2	1
		RT2	28	46	6	3	2
		RT3	26	46	7	2	1
		RT4	28	46	6	-1	-1
		RT5	27	45	6	1	1
		RT6	32	49	6	1	3
		RT7	30	49	7	Reference	
		RT8	32	49	6	-1	0
RT9		33	50	6	-2	-1	
RT10		31	50	7	1	-1	
RT11		24	41	6	1	3	
RT12		29	45	6	1	4	
RT13		27	45	6	1	2	
RT14		29	45	6	-1	1	
Paper 2	RT1	27	43	6	Reference		
	RT2	30	46	6	-1	-2	
	RT3	28	44	6	0	-1	
	RT4	28	45	6	0	-2	
	RT5	23	41	6	-2	-2	
	RT6	24	42	6	-1	-2	
	RT7	24	43	7	-3	-4	
	RT8	27	47	7	1	-2	
RT9	28	48	7	0	-3		

Table 12 Original component level grade boundary marks for the three papers from the two A level specifications in 2018 established during awarding and differences between equivalent boundary marks derived using CEPE and the original grade boundary marks.

Spec code	Code	Route	Original boundary		GW	Diff btw equiv. GB and ori. GB	
			C	A		C	A
A	Paper 2	RT1	37	52	8	Reference	
		RT2				-1	-1
		RT3				-4	-2
		RT4				-3	-1
		RT5				-2	-1
		RT6				-5	-4
B	Paper 1	RT1	51	73	11	Reference	

		RT2				1	1
		RT3				3	2
	Paper 3	RT1	57	80	12	Reference	
		RT2				-3	-1
		RT3				6	5

Table A13 The original boundary marks for different certification routes from the two GCSE English literature specifications in 2018 established during awarding and the differences between the equivalent boundary marks derived using CEPE and the original grade boundary marks.

Spec code	Route	Original boundary		GW	Diff btw equiv. GB and ori. GB	
		G4	G7		G4	G7
A	RT1	61	106	15	-2	-2
	RT2				0	-1
	RT3				0	0
	RT4				-1	-1
	RT5				-1	1
	RT6				0	1
	RT7				1	2
	RT8				-1	1
	RT9				0	1
	RT10				0	1
	RT11				Reference	
	RT12				-1	-1
	RT13				0	0
	RT14				-1	0
	RT15				0	0
	RT16				0	1
	RT17				0	1
	RT18				0	1
	RT19				0	-2
B	RT1	67	109	14	-5	-3
	RT2				-3	-1
	RT3				-1	2
	RT4				0	1
	RT5				-1	1
	RT6				-1	-1
	RT7				1	-1
	RT8				1	2
	RT9				Reference	
	RT10				-4	-4
	RT11				-2	-1
	RT12				-5	-3
	RT13				0	2
	RT14				-2	-1
	RT15				-3	-4
	RT16				-3	-2
	RT17				2	1
	RT18				-2	-1

Table A14 The original boundary marks for different certification routes from the three GCSE history specification in 2018 established during awarding and the differences between the equivalent boundary marks derived using CEPE and the original grade boundary marks.

Spec code	Route	Original boundary		GW	Diff btw equiv. GB and ori. GB	
		G4	G7		G4	G7
A	RT1	68	112	15	4	4
	RT2	67	110	15	4	4
	RT3	71	114	15	3	3
	RT4	72	116	15	-3	-3
	RT5	72	116	15	1	0
	RT6	68	112	15	4	4
	RT7	67	110	15	2	3
	RT8	71	114	15	1	4
	RT9	72	116	15	-4	-3
	RT10	72	116	15	Reference	
	RT11	68	110	14	3	5
	RT12	67	118	17	-1	-7
	RT13	67	118	17	2	-4
	RT14	71	112	14	1	5
	RT15	72	114	14	-4	0
	RT16	72	114	14	0	2
	RT17	68	110	14	2	5
	RT18	67	118	17	-2	-9
	RT19	67	118	17	2	-4
	RT20	72	114	14	-1	0
	RT21	72	114	14	-4	2
	RT22	76	118	14	-5	1
	RT23	72	116	15	2	2
	RT24	68	110	14	6	7
	RT25	72	114	14	2	2
B	RT1	82	134	18	-4	-5
	RT2	82	134	18	-5	-3
	RT3	82	134	18	-3	-1
	RT4	82	134	18	-3	-2
	RT5	82	134	18	-2	-3
	RT6	82	134	18	Reference	
	RT7	82	134	18	1	3
	RT8	82	134	18	1	-1
C	RT1	50	85	12	1	0
	RT2	55	89	12	4	4
	RT3	56	90	12	2	0
	RT4	54	88	12	-3	-1
	RT5	55	89	12	1	-1
	RT6	59	92	11	1	2
	RT7	60	93	11	Reference	
	RT8	55	90	12	-2	-1
	RT9	56	91	12	1	1
	RT10	57	92	12	-1	-1
	RT11	58	93	12	-1	-2

RT12	59	92	11	-1	-1
RT13	60	93	11	0	-2
RT14	51	84	11	-1	1
RT15	52	85	11	0	-1
RT16	56	88	11	1	4
RT17	57	89	11	1	1
RT18	52	86	12	-2	0
RT19	54	88	12	0	0
RT20	55	89	12	1	1
RT21	56	88	11	1	1
RT22	57	89	11	-2	-1

Table A15 The original boundary marks for certification routes from the two A level sociology specifications in 2018 established during awarding and the differences between the equivalent boundary marks based on Rasch modelling and the original grade boundary marks.

Spec code	Max mark	Route	Original boundary		GW	Diff btw equiv GB and ori GB	
			C	A		C	A
A	240	RT1	121	164	22	Reference	
		RT2				0	1
		RT3				1	1
		RT4				0	-1
		RT5				-1	-1
		RT6				-1	0
		RT7				-1	0
		RT8				-2	-1
		RT9				1	1
		RT10				1	2
		RT11				2	1
		RT12				1	0
		RT13				-1	-1
		RT14				0	0
		RT15				0	0
		RT16				-1	-1
B	300	RT1	160	228	34	Reference	
		RT2				2	1
		RT3				7	4
		RT4				1	2
		RT5				3	3
		RT6				8	6
		RT7				1	1
		RT8				3	2
		RT9				8	5

Appendix B Additional Figures

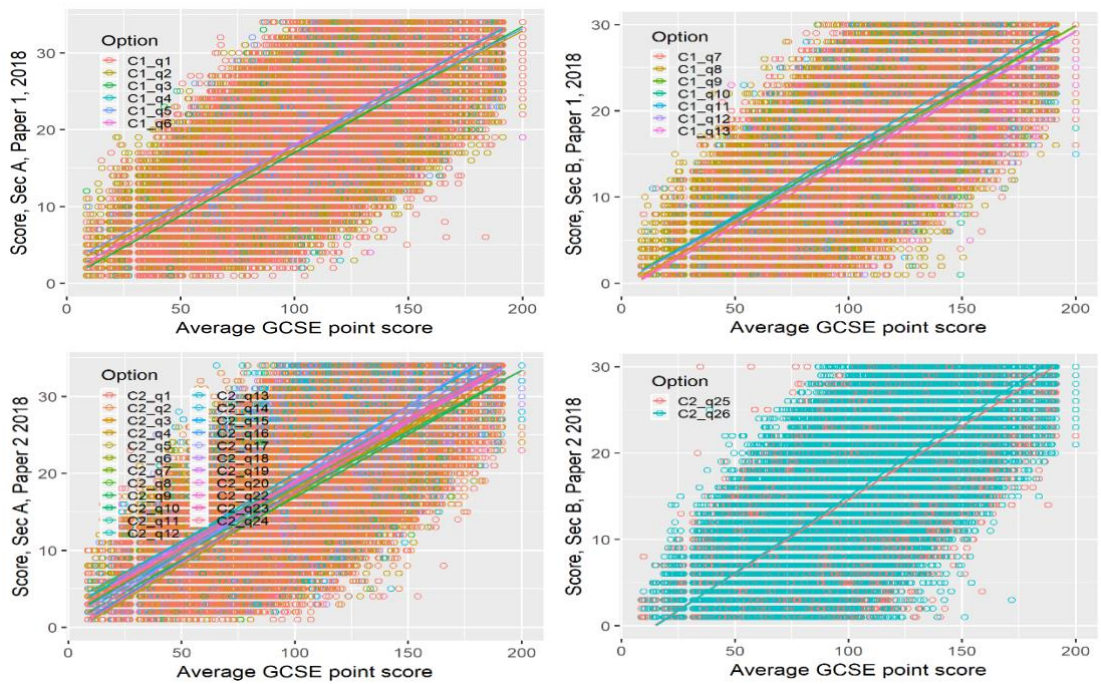


Figure B1 Relationship between marks on optional questions and average GCSE point scores for optional questions in Papers 1 and 2 from GCSE English literature Specification A in 2018, with regression lines superimposed.

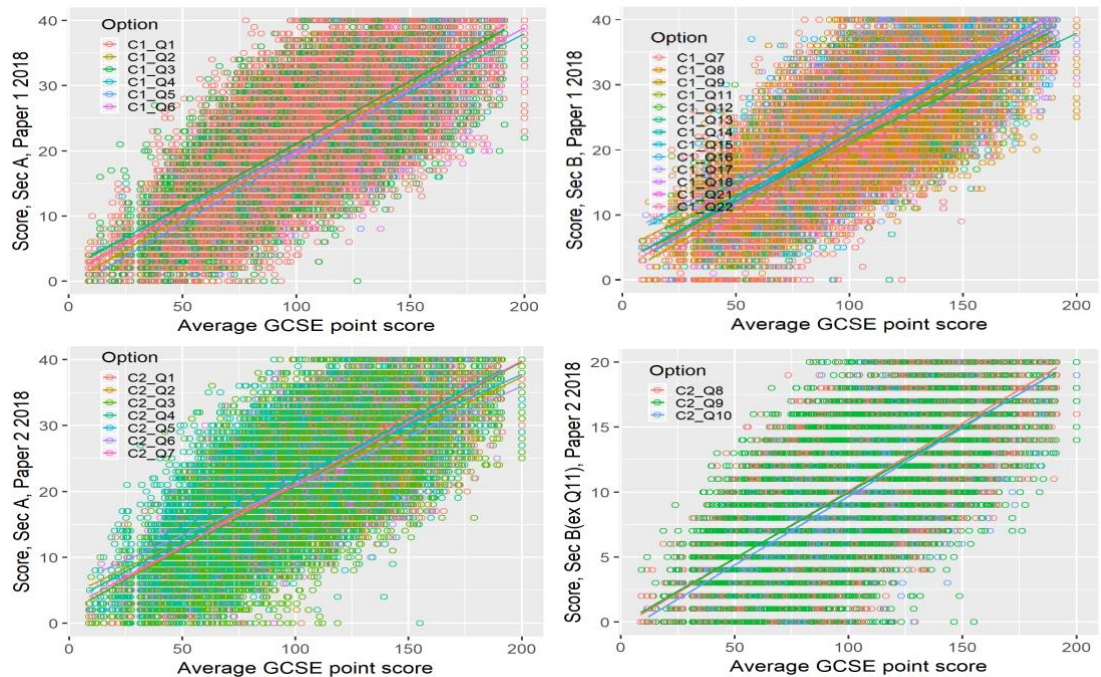


Figure B2 Relationship between marks on optional questions and average GCSE point scores for optional questions in Papers 1 and 2 from GCSE English literature Specification B in 2018, with regression lines superimposed.

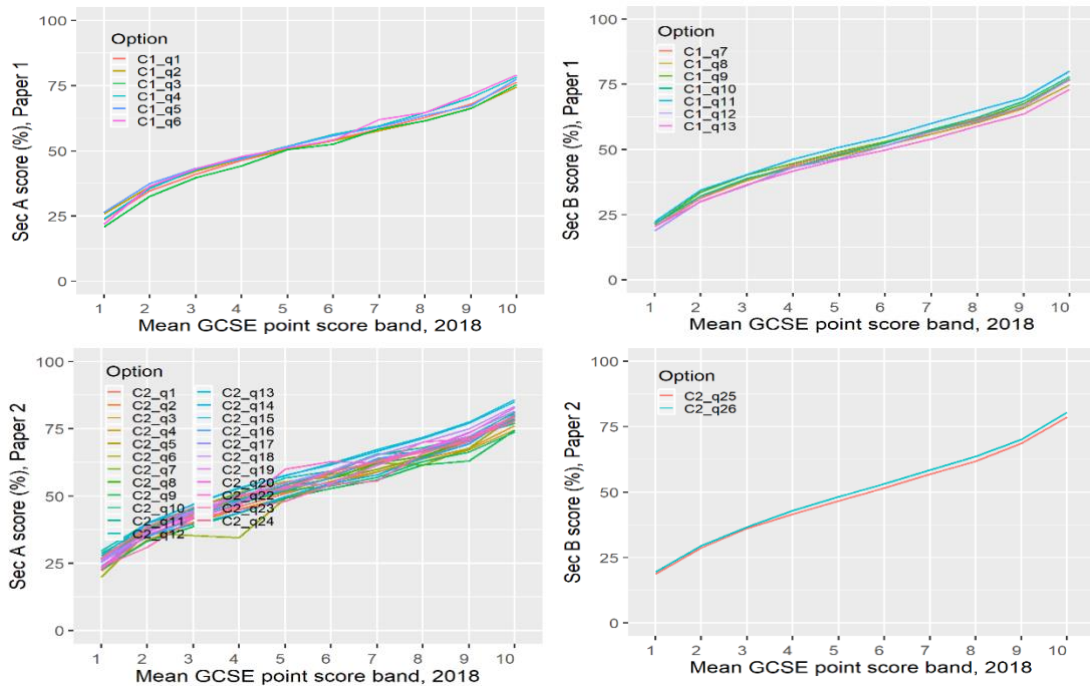


Figure B3 Relationship between percentage marks on optional questions and bands of GCSE point scores for optional questions in Papers 1 and 2 from GCSE English literature Specification A in 2018.

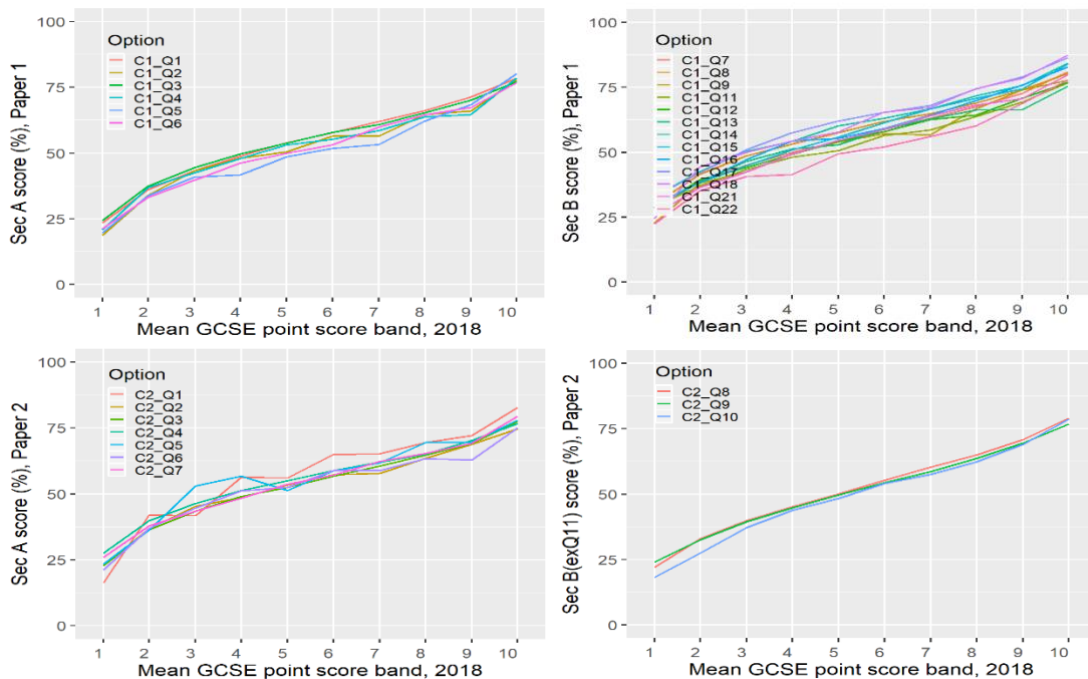


Figure B4 Relationship between percentage marks on optional questions and bands of GCSE point scores for optional questions in Papers 1 and 2 from GCSE English literature Specification B in 2018

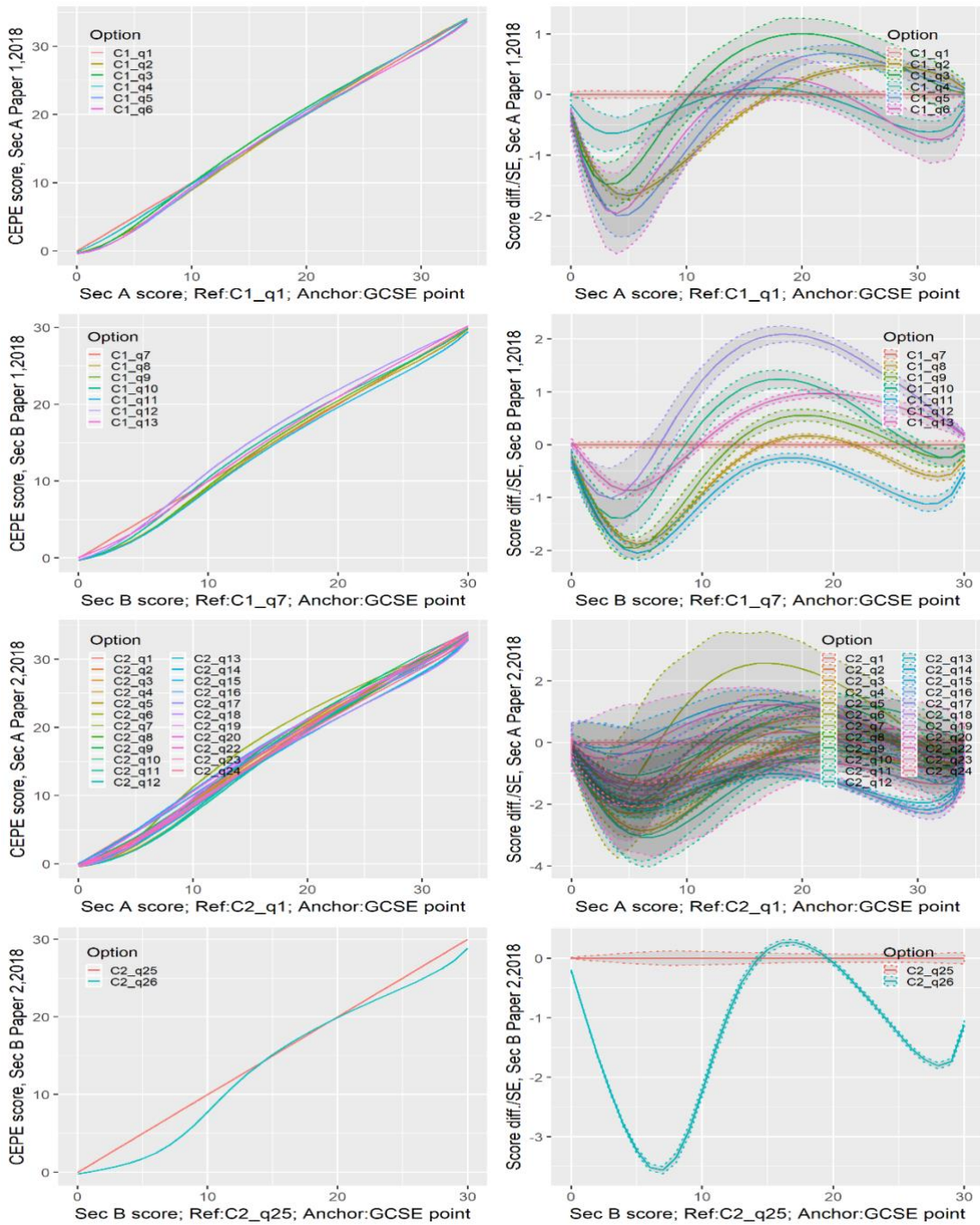


Figure B5 Distributions of equated marks against the original raw marks and the differences between equated marks and raw marks for optional questions in Sections A and B of Papers 1 and 2 from GCSE English literature Specification A in 2018 based on the chained equipercentile equating (CEPE) method using GCSE attainment as an anchor test. The standard error of equating estimated using a bootstrap method represented by the shaded area around the difference marks is also shown.

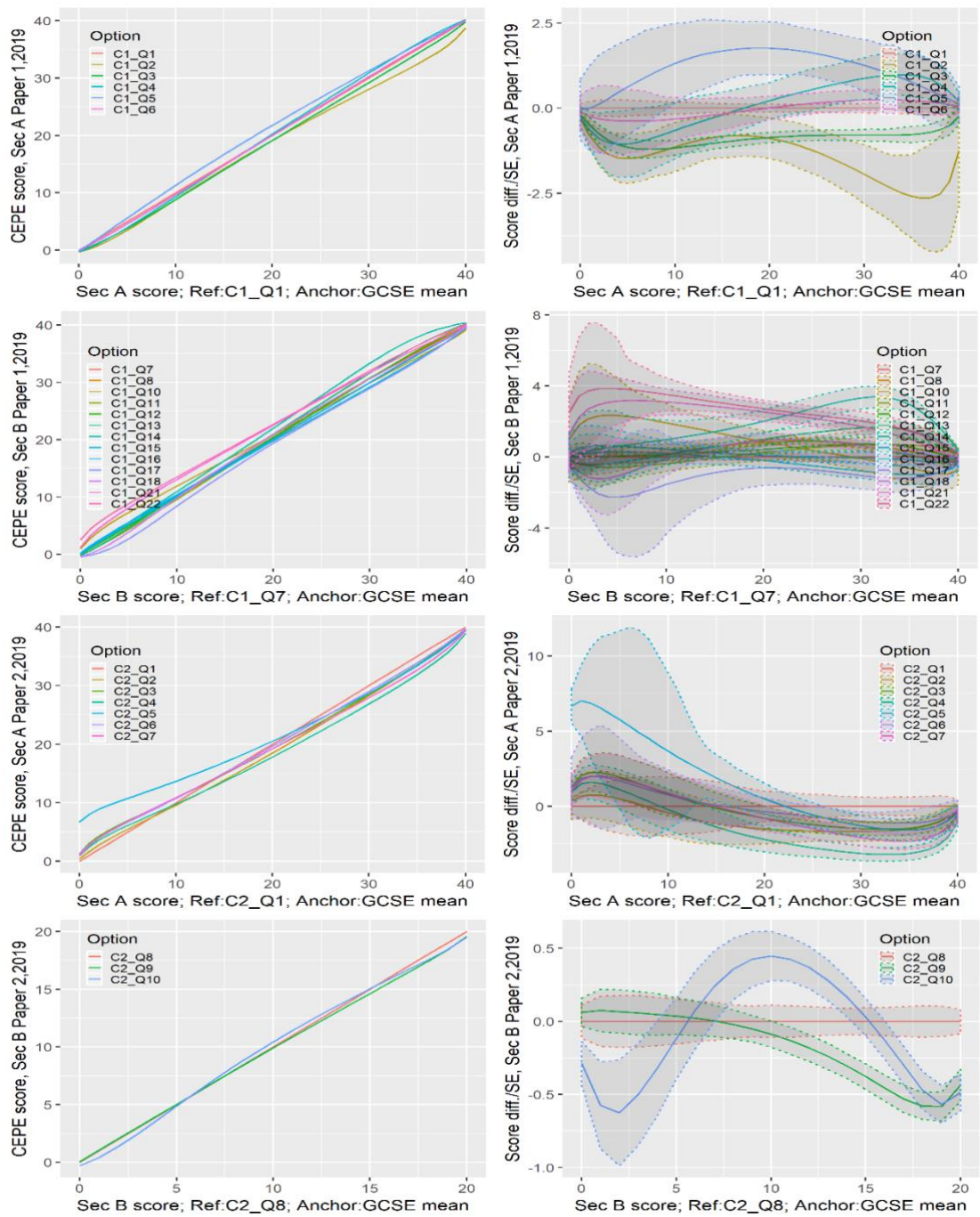


Figure B6 Distributions of equated marks against the original raw marks and the differences between equated marks and raw marks for optional questions in Sections A and B of Papers 1 and 2 from GCSE English literature Specification B in 2018 based on CEPE using GCSE attainment as an anchor test.

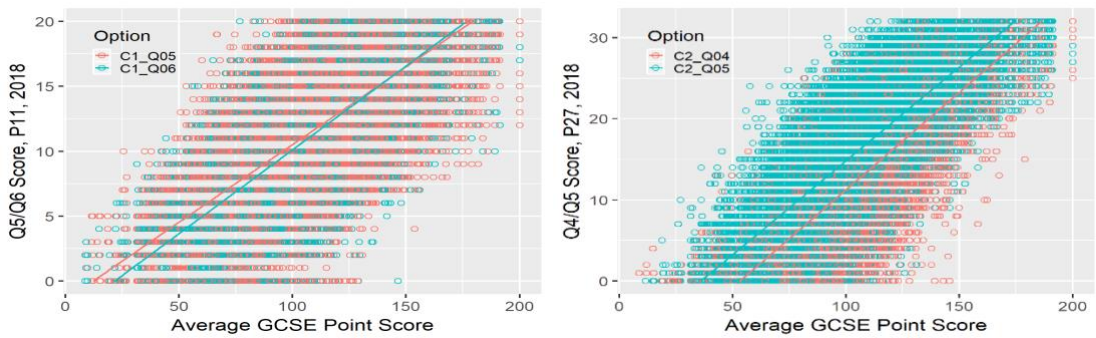


Figure B7 Relationship between marks on optional questions in two of the optional papers (P11 and P27) and average GCSE point scores from GCSE history Specification A in 2018, with regression lines superimposed.

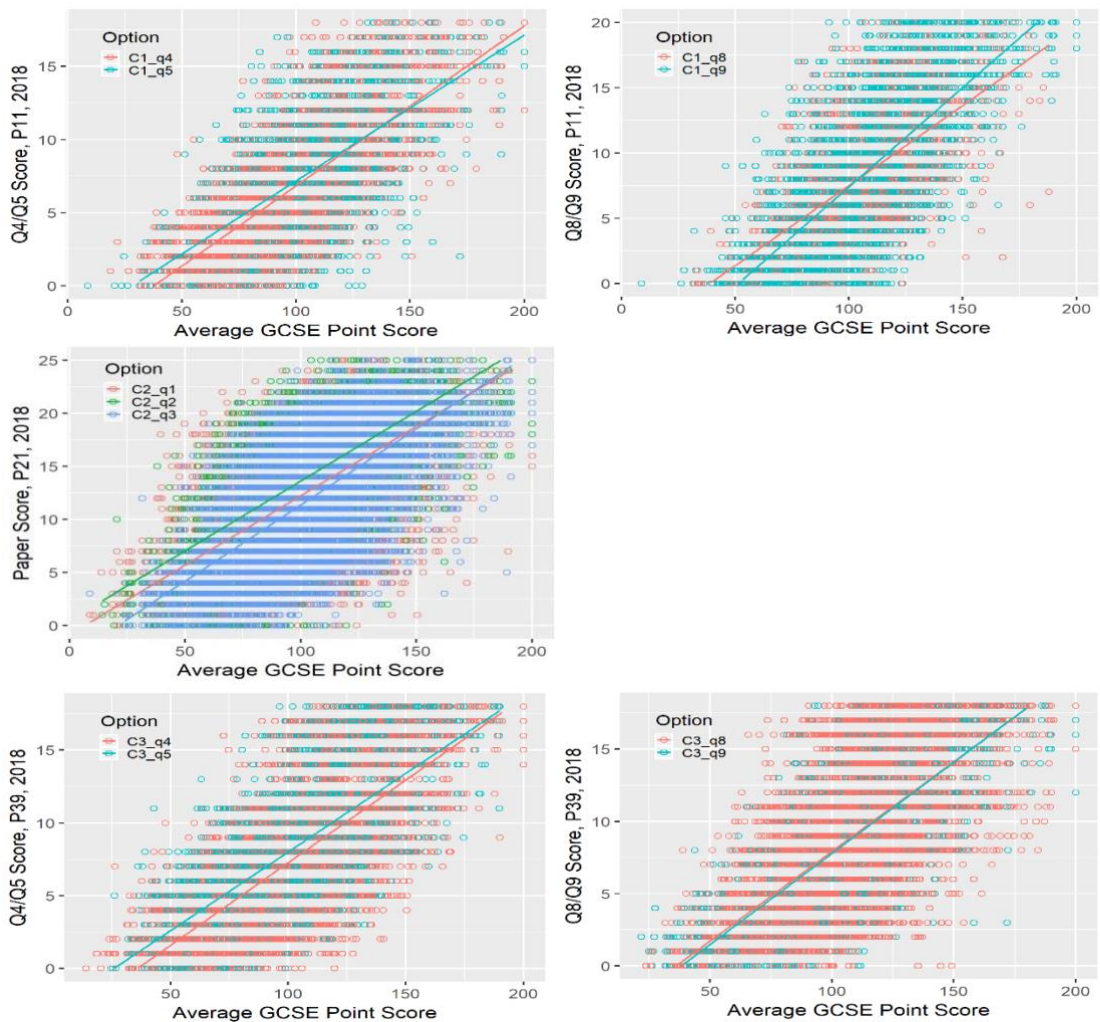


Figure B8 Relationship between marks on optional questions in three optional papers (C11, P21 and P39) and average GCSE point scores from GCSE history Specification B in 2018, with regression lines superimposed.

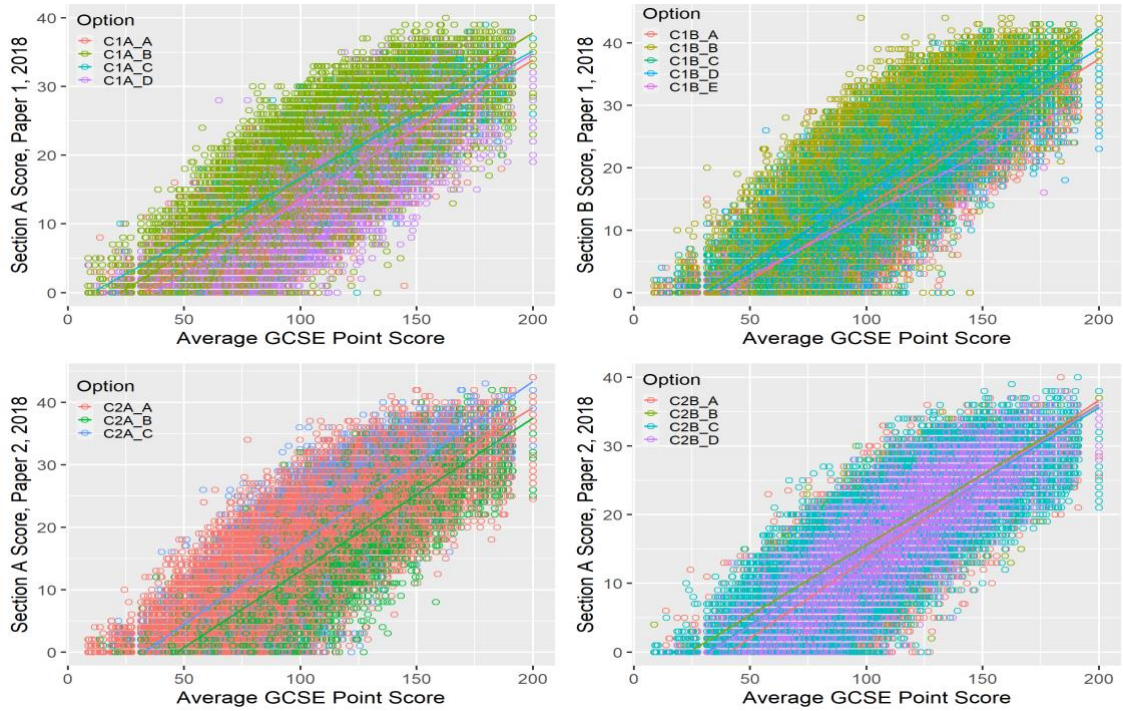


Figure B9 Relationship between marks on optional sections and average GCSE point scores for the two papers from GCSE history Specification C in 2018, with regression lines superimposed.

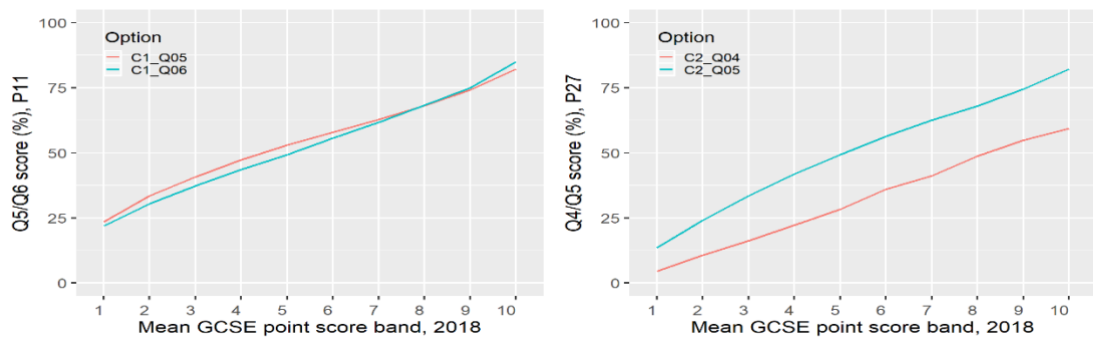


Figure B10 Distribution of percentage marks for optional questions against GCSE attainment bands for two of the optional papers from GCSE history Specification A in 2018.

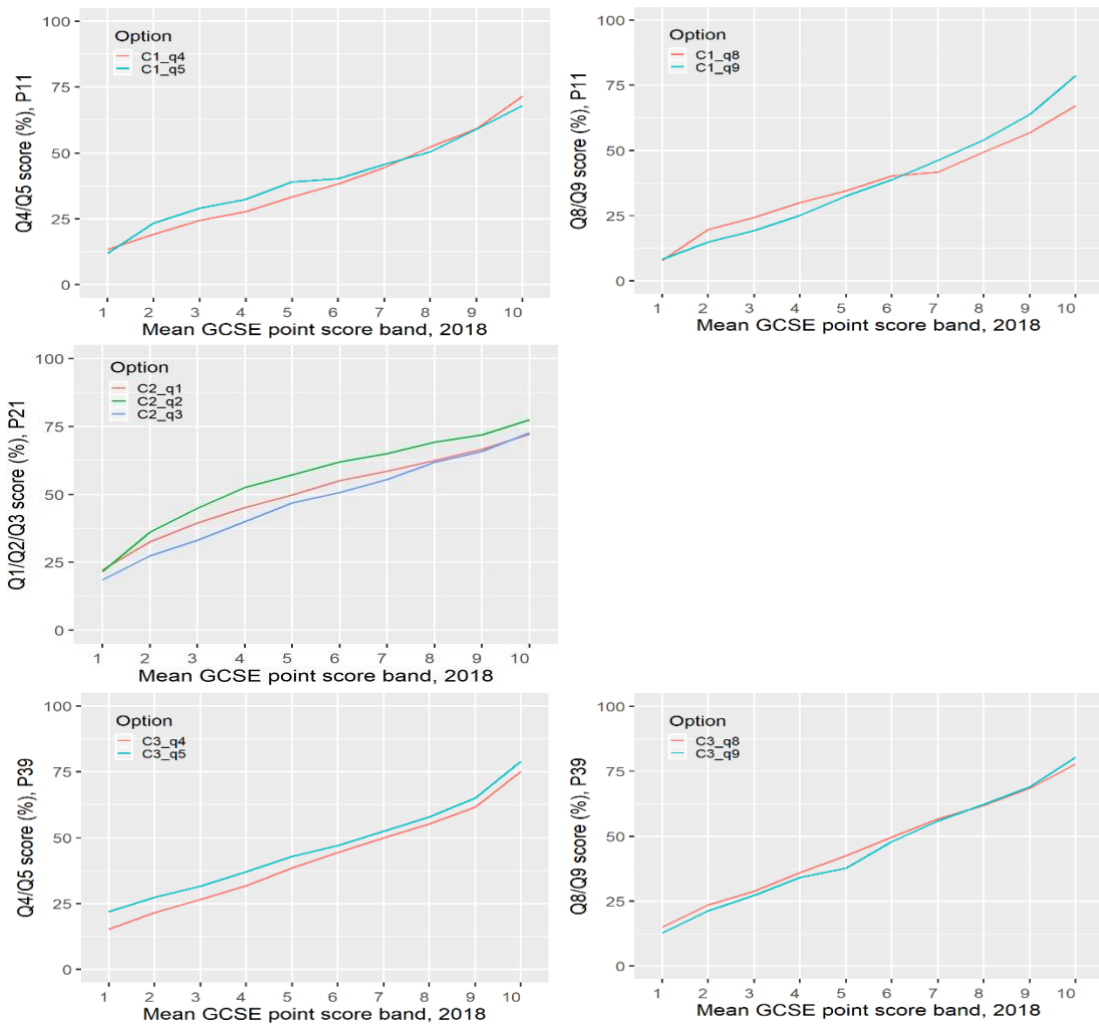


Figure B11 Distribution of percentage marks for optional questions against GCSE attainment bands for three of the optional papers from GCSE history Specification B in 2018.

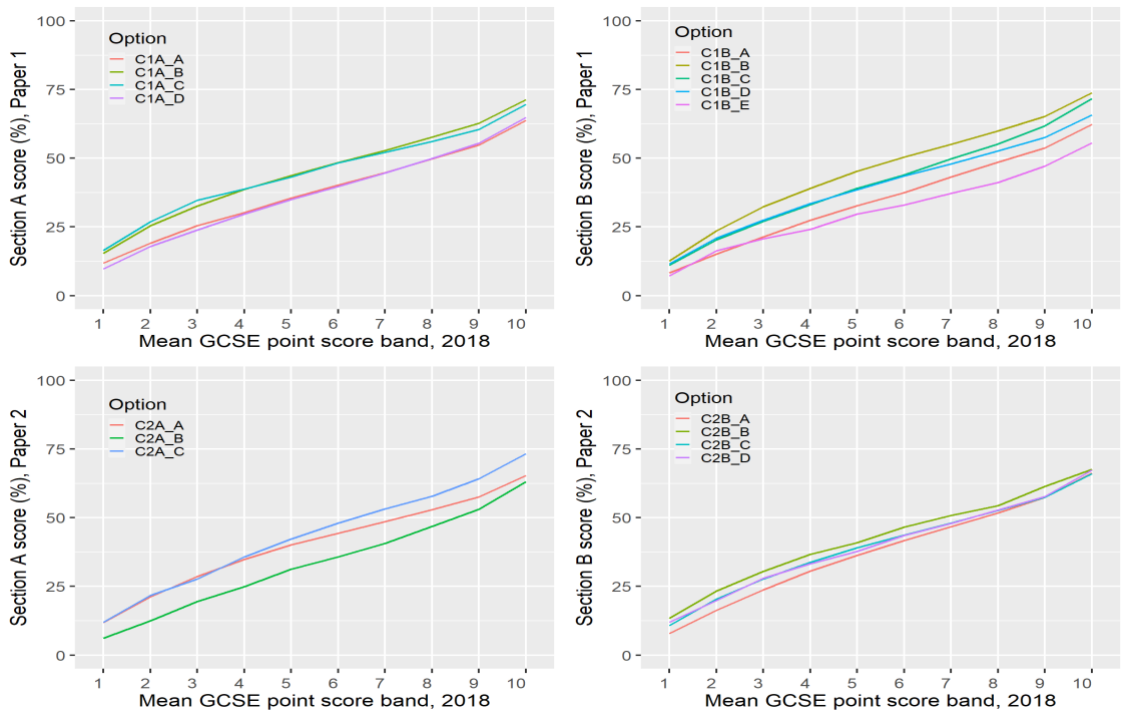


Figure B12 Distribution of percentage marks for optional sections against GCSE attainment bands in the two papers from GCSE history Specification C in 2018.

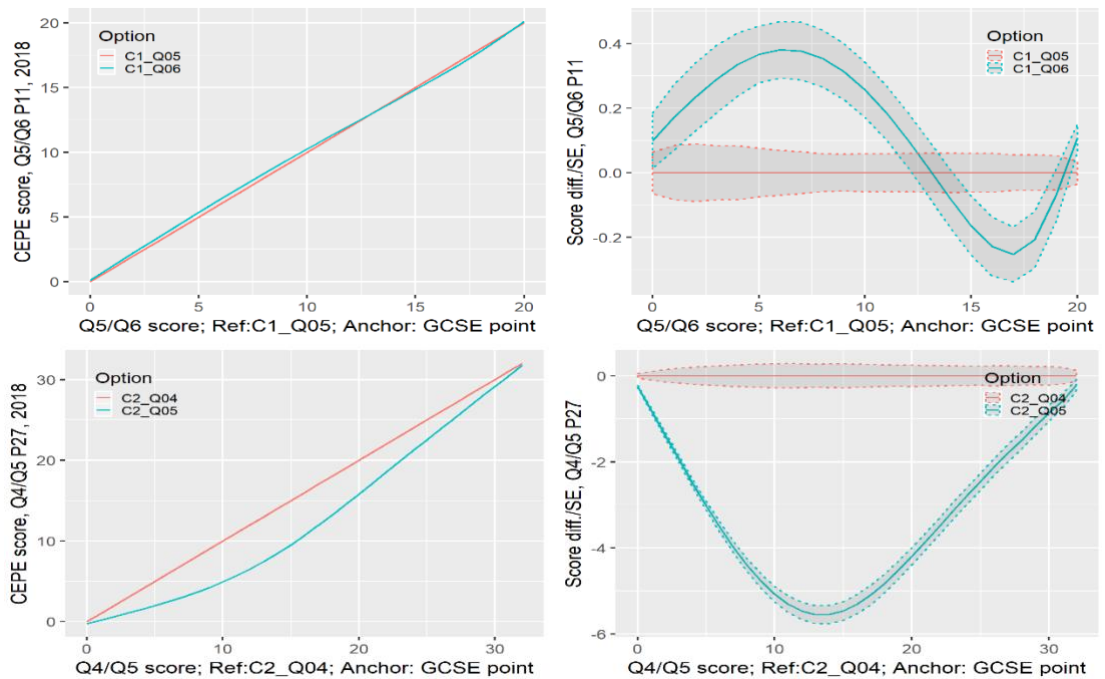


Figure B13 Distributions of equated marks against the original raw marks and the differences between equated marks and raw marks for question options in two of the optional papers from GCSE history Specification A in 2018, based on CEPE using GCSE attainment as an anchor test.

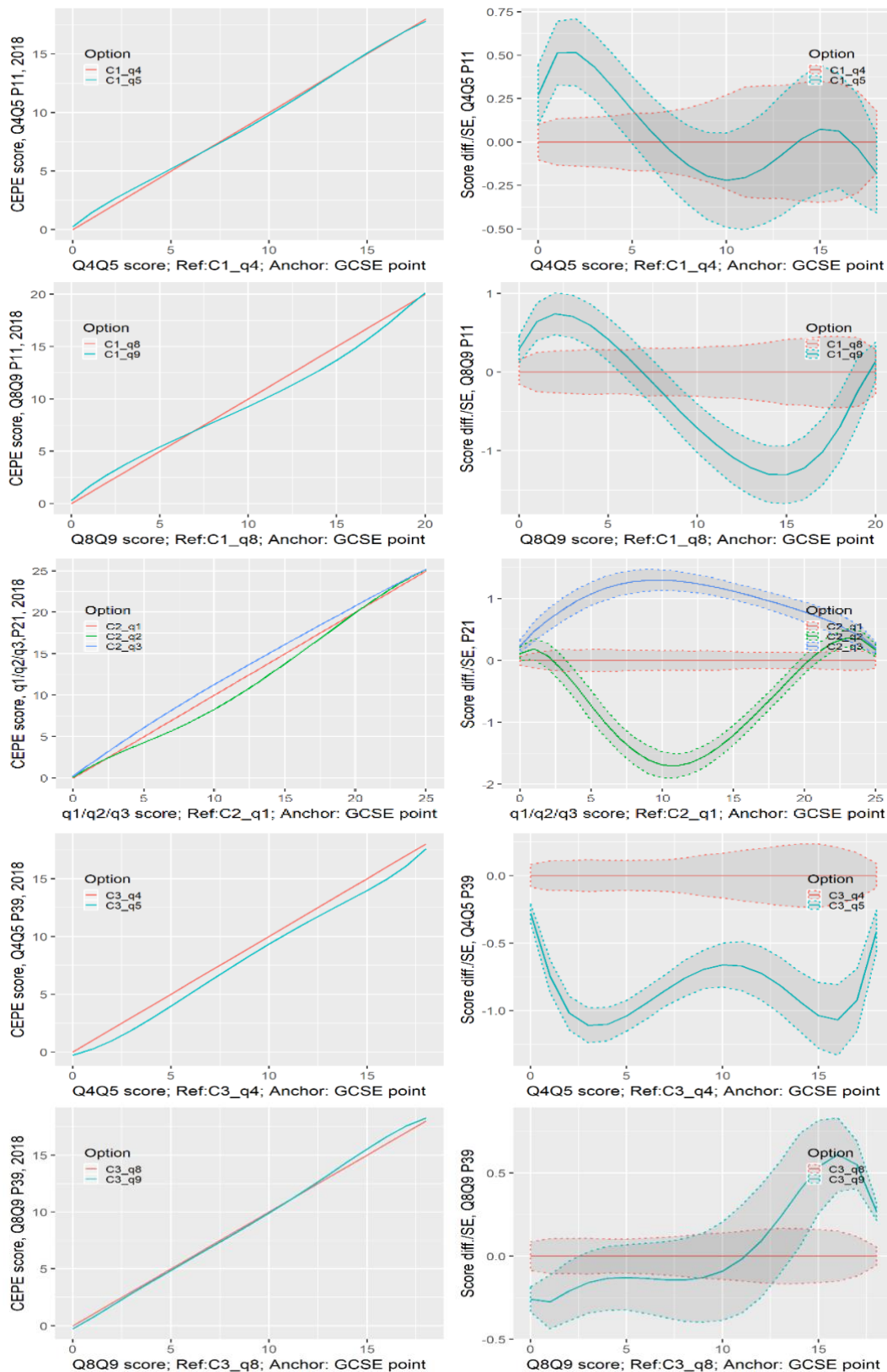


Figure B14 Distributions of equated marks against the original raw marks and the differences between equated marks and raw marks for question options in three of the papers from GCSE history Specification B in 2018, based on CEPE using GCSE attainment as an anchor test.

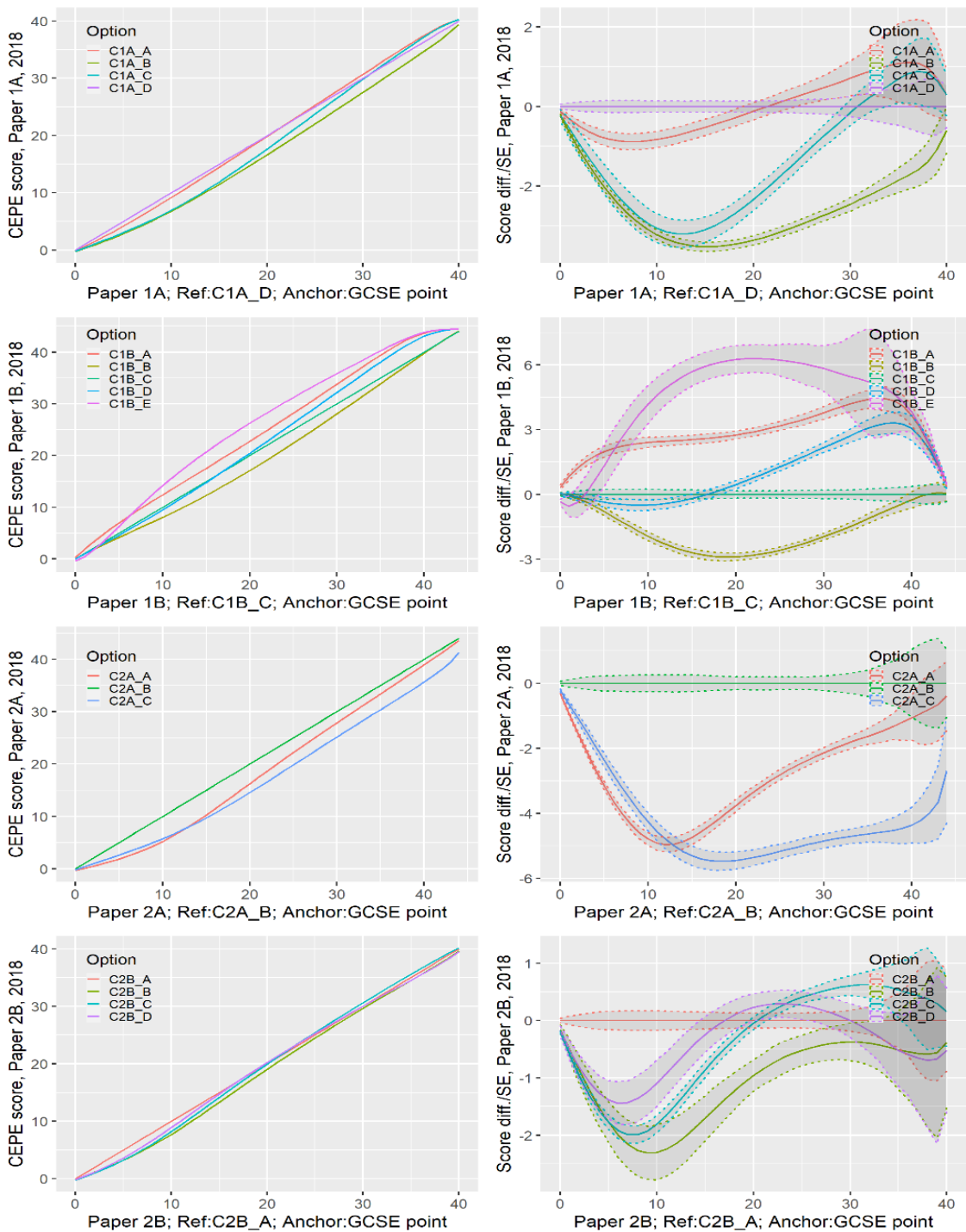


Figure B15 Distributions of equated marks against the original raw marks and the differences between equated marks and raw marks for section options in the two papers from GCSE history Specification C in 2018, based on CEPE using GCSE attainment as an anchor test.

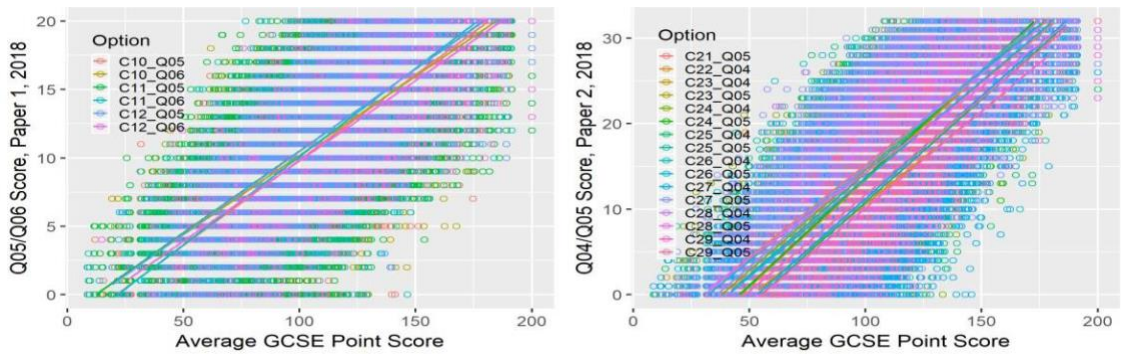


Figure B16 Relationship between marks on optional questions from different optional papers in Paper 1 and Paper 2 from GCSE history Specification A in 2018 and average GCSE point scores, with regression lines superimposed.

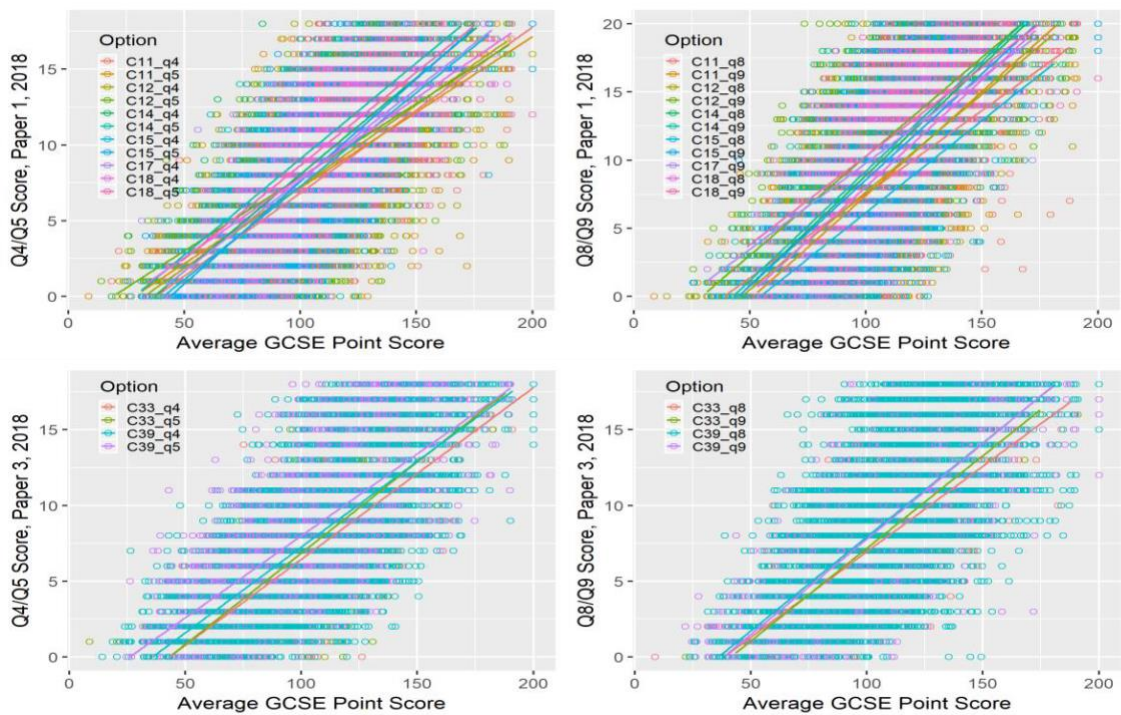


Figure B17 Relationship between marks on optional questions from different optional papers in Paper 1 and Paper 3 from GCSE history Specification B in 2018 and average GCSE point scores, with regression lines superimposed.

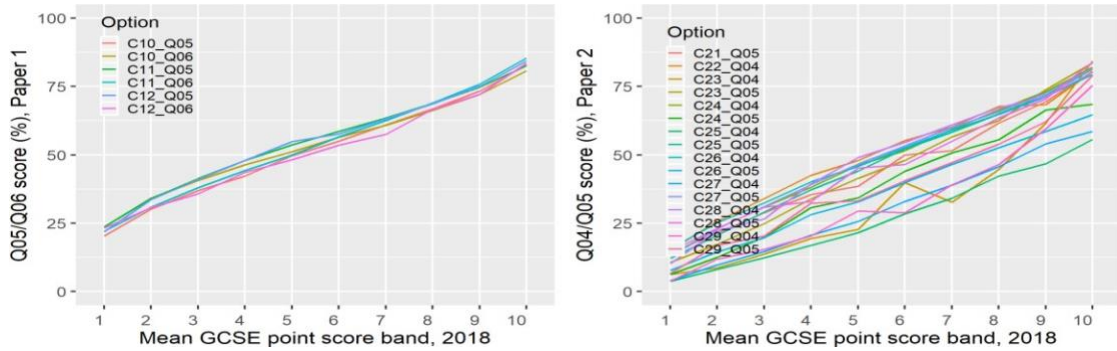


Figure B18 Percentage marks in each GCSE attainment band for candidates taking different optional questions from different optional papers in Paper 1 and Paper 2 from GCSE history Specification A in 2018.

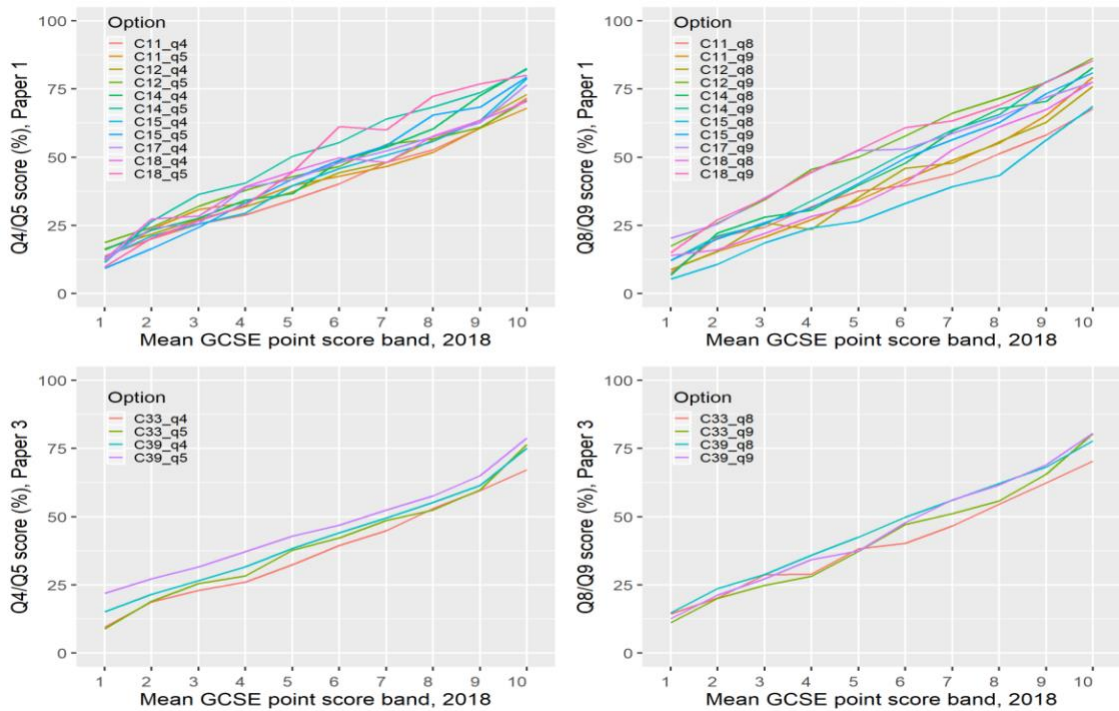


Figure B19 Percentage marks in each GCSE band for candidates taking different optional questions in different optional papers in Paper 1 and Paper 3 from GCSE history Specification B in 2018.

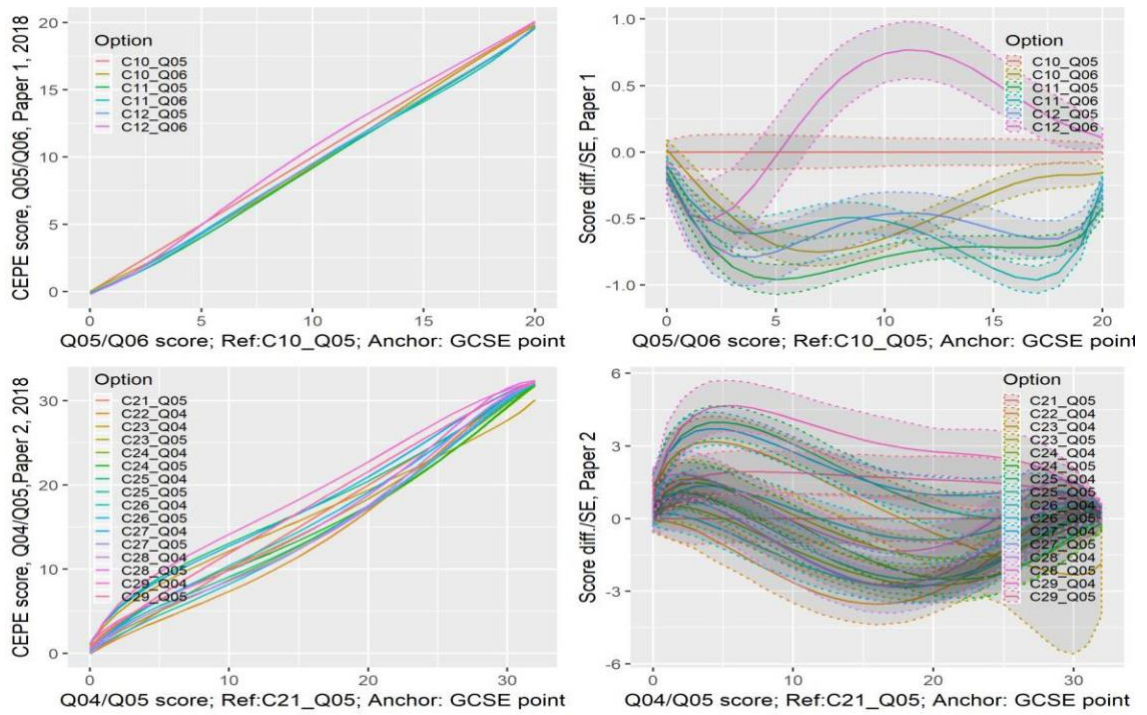


Figure B20 Distributions of equated marks and differences between equated marks and raw marks for question options in different optional papers of Paper 1 and Paper 2 from GCSE history Specification A in 2018, based on CEPE using GCSE attainment as an anchor test.

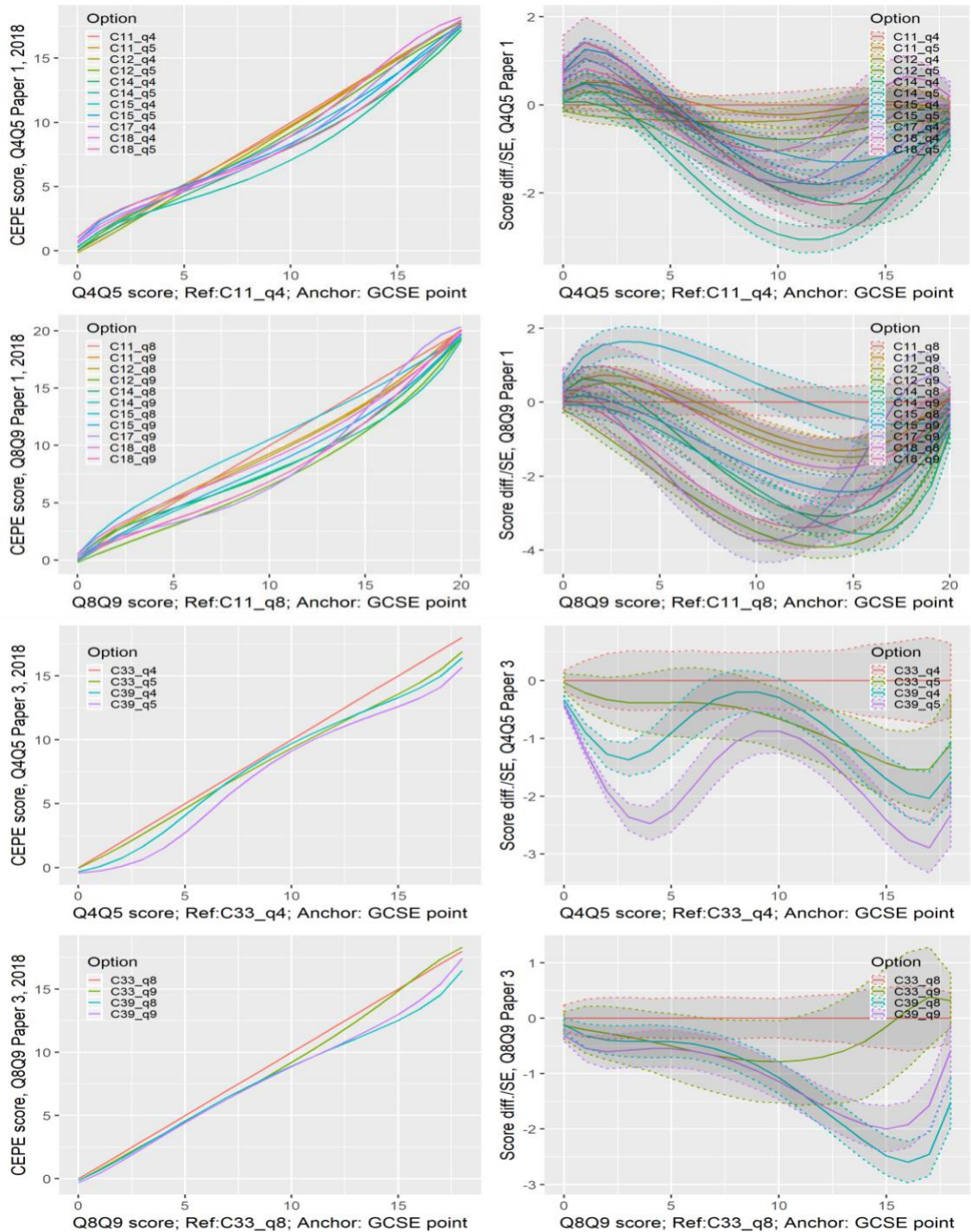


Figure B21 Distributions of equated marks and differences between equated marks and raw marks for question options in different optional papers of Paper 1 and Paper 3 from GCSE history Specification B in 2018, based on CEPE using GCSE attainment as an anchor test.

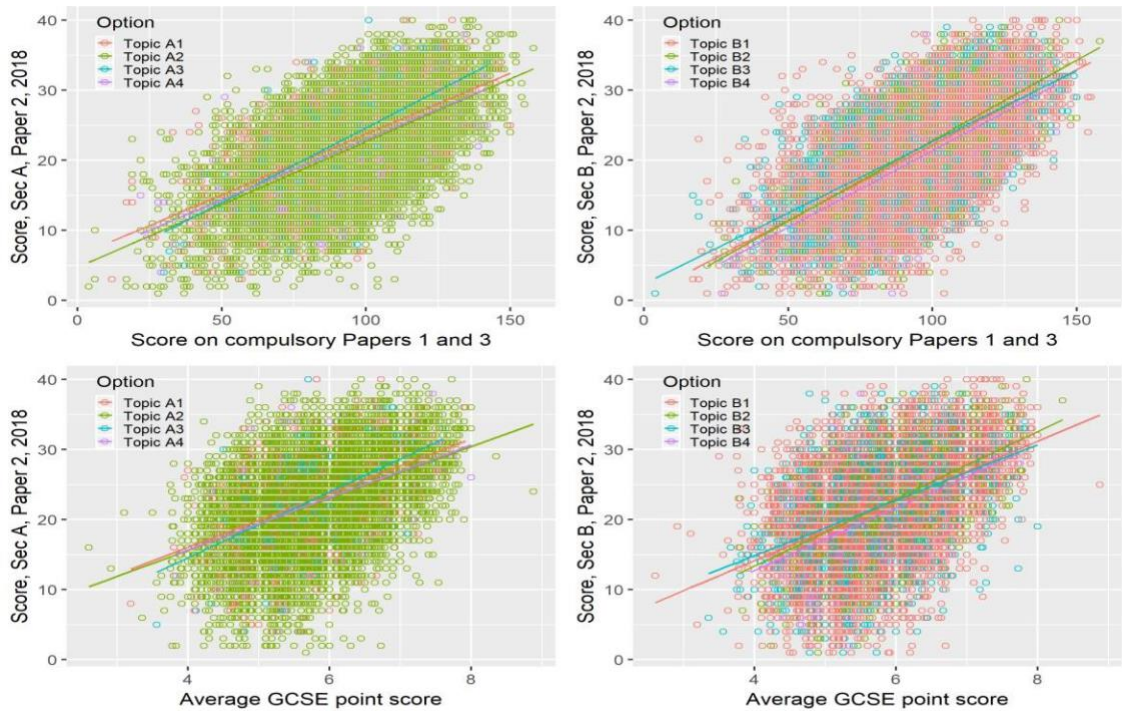


Figure B22 Relationship between marks on optional questions and marks on compulsory Papers 1 and 3 for Sections A and B in Paper 2 from A level sociology Specification A in 2018, with regression lines superimposed.

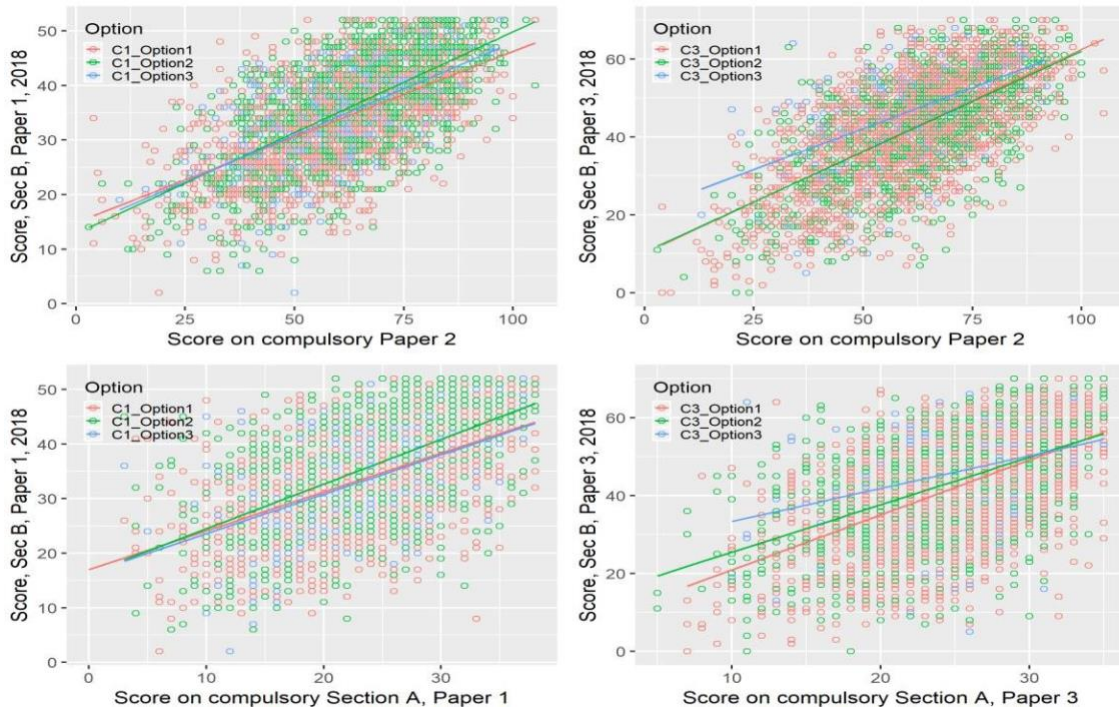


Figure B23 Relationship between marks on optional questions and compulsory Paper 2 for Section B in Papers 1 and 3 from A level sociology Specification B in 2018, with regression lines superimposed.

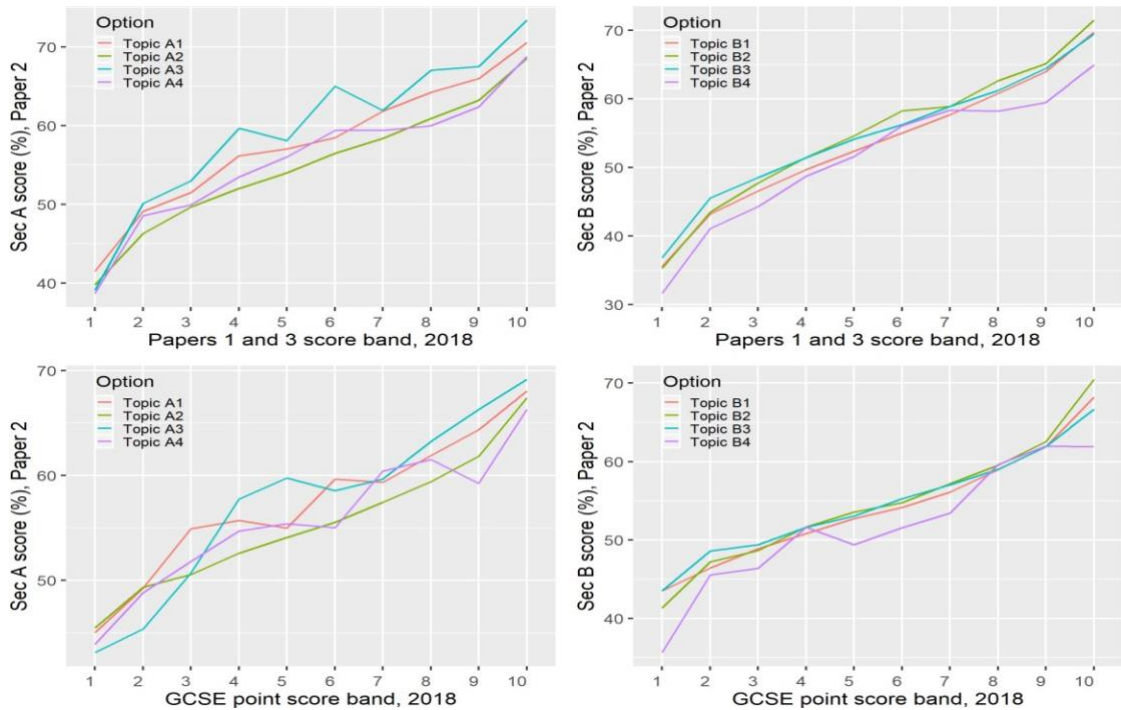


Figure B24 Relationship between percentage marks by students choosing different question options and bands of marks on compulsory Papers 1 and 3 for Sections A and B in Paper 2 from A level sociology Specification A in 2018.

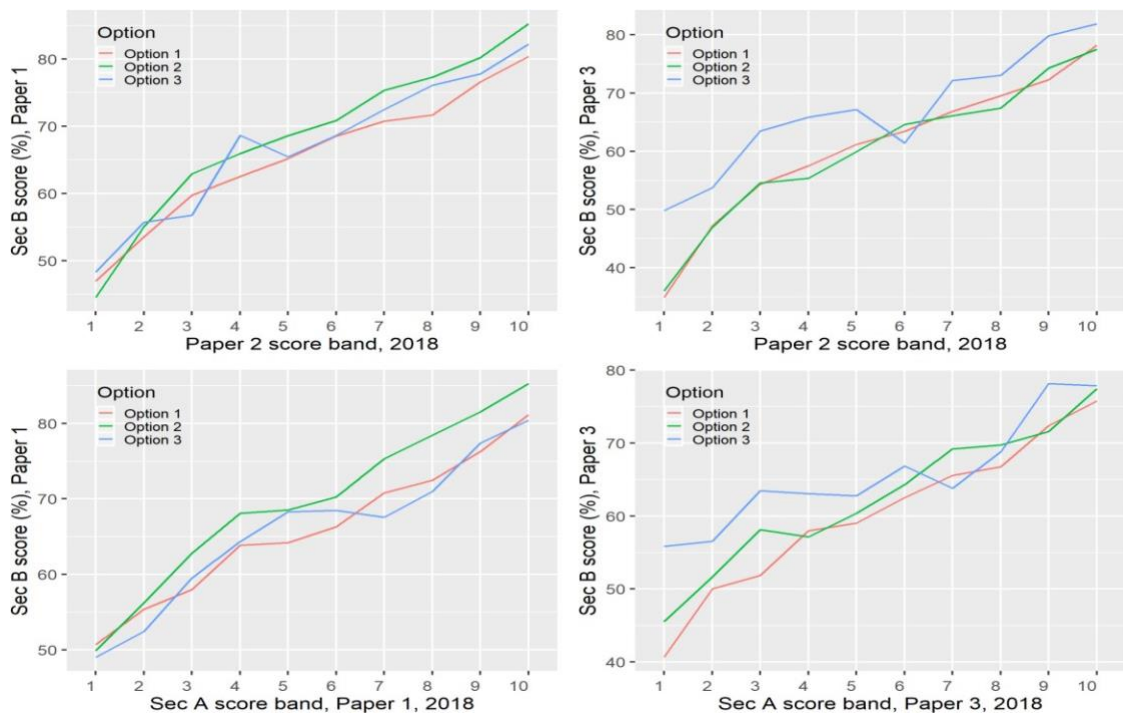


Figure B25 Relationship between percentage marks by students choosing different question options and bands of marks on compulsory Paper 2 for Section B in Paper 1 and Paper 3 from A level sociology Specification B in 2018.

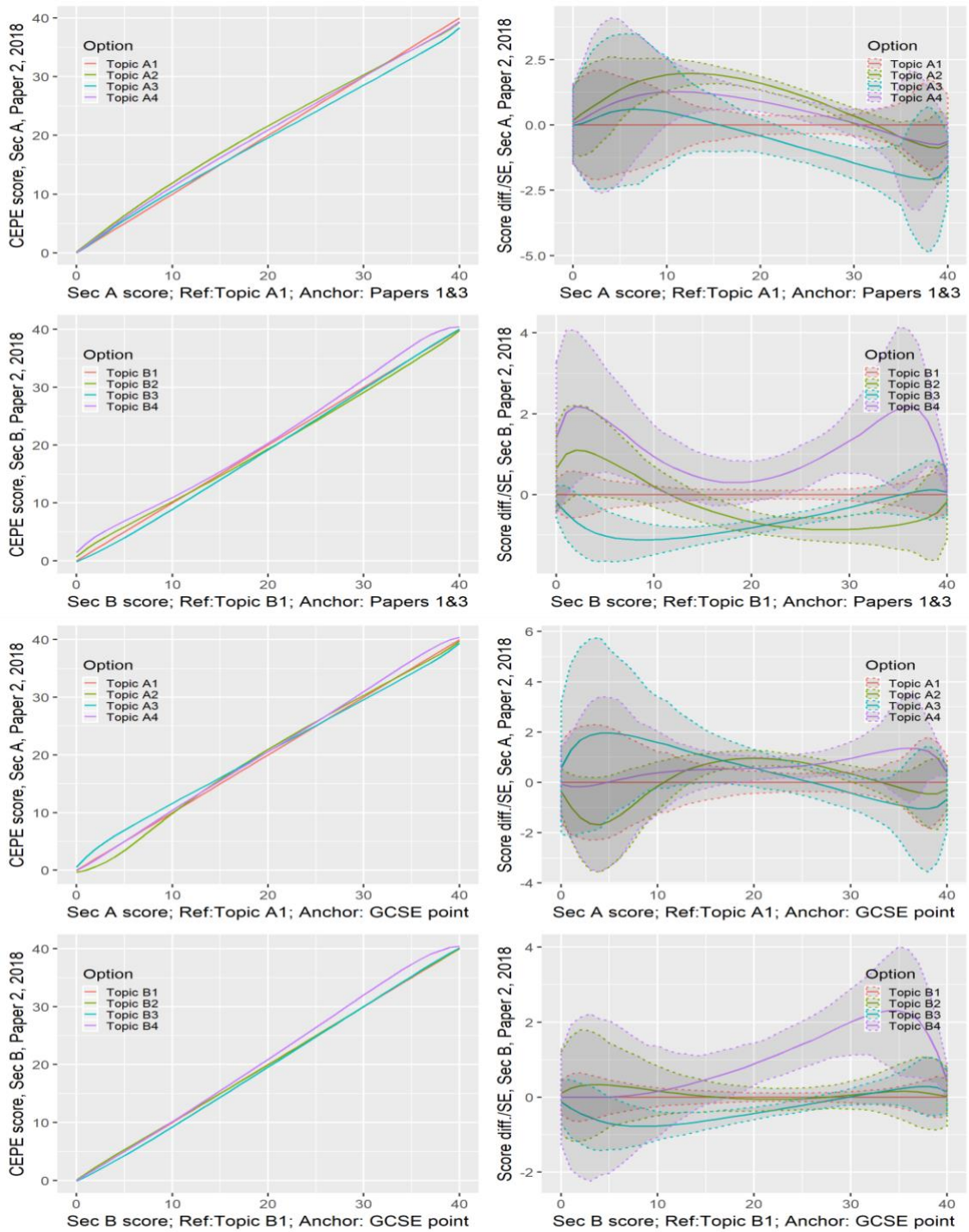


Figure B26 Distributions of equated marks and differences between equated marks and raw marks for optional topics in Sections A and B of Paper 2 from A level sociology Specification A in 2018, based on CEPE using Papers 1 and 3 as an anchor test.

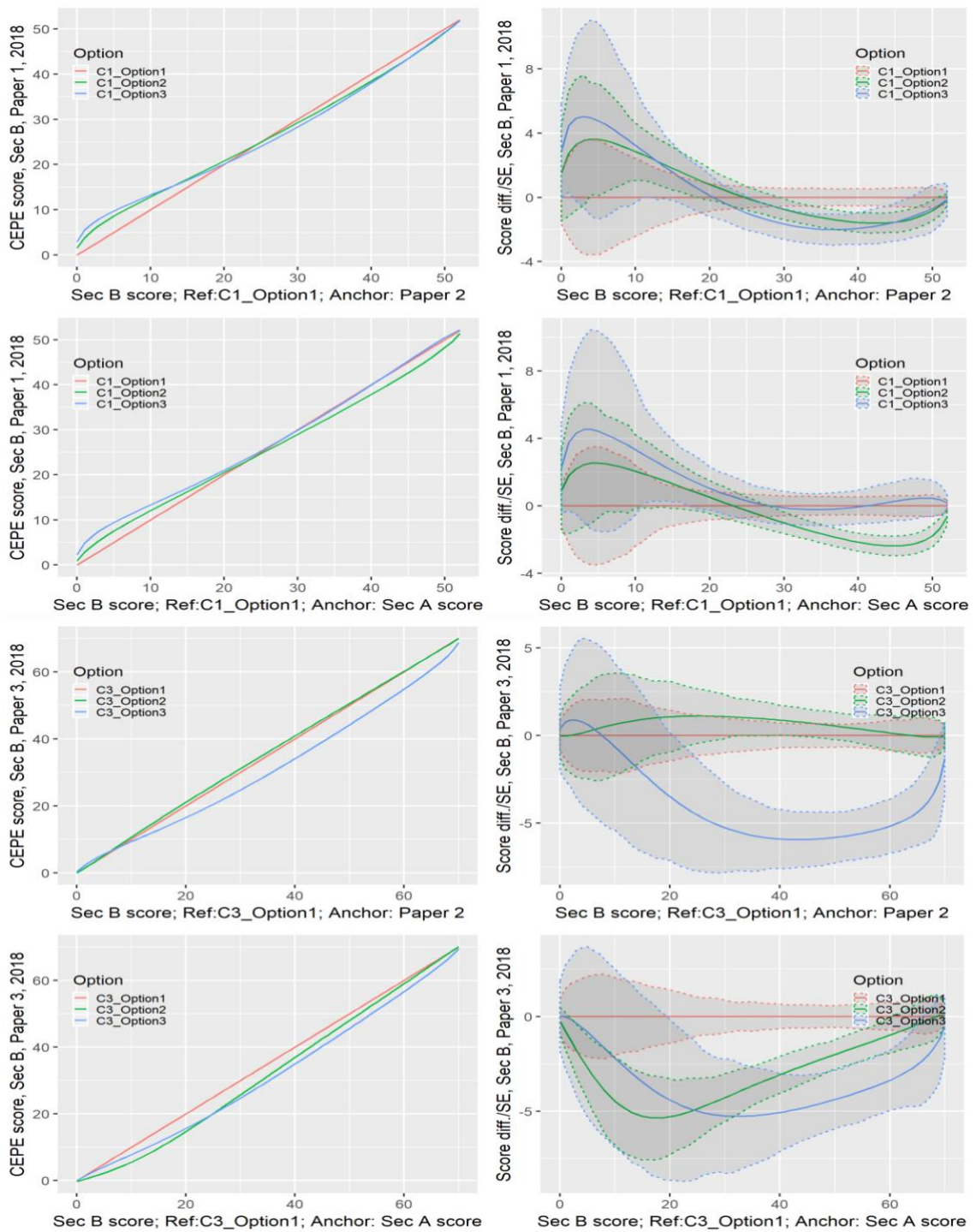


Figure B27 Distributions of equated marks and differences between equated marks and raw marks for optional questions in Sections B of Paper 1 and Paper 3 from A level sociology Specification B in 2018, based on CEPE using Paper 2 and Section A as anchor tests.



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Earlsdon Park
53-55 Butts Road
Coventry
CV1 3BH

0300 303 3344
public.enquiries@ofqual.gov.uk
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