Course report 2022

Subject	Applications of Mathematics
Level	Higher

This report provides information on candidates' performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any appeals.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022	870

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

A	Percentage	23.5	Cumulative percentage	23.5	Number of candidates	205	Minimum mark required	64
B	Percentage	20.3	Cumulative percentage	43.8	Number of candidates	175	Minimum mark required	52
C	Percentage	25.2	Cumulative percentage	69.0	Number of candidates	220	Minimum mark required	41
D	Percentage	19.1	Cumulative percentage	88.1	Number of candidates	165	Minimum mark required	29
No award	Percentage	11.9	Cumulative percentage	N/A	Number of candidates	105	Minimum mark required	N/A

You can read the general commentary on grade boundaries in appendix 1 of this report.

In this report:

♦ 'most' means greater than 70%
♦ 'many' means 50% to 69%
♦ 'some' means 25% to 49%
♦ 'a few' means less than 25%

You can find more statistical reports on the statistics page of SQA's website.

Section 1: comments on the assessment

The course assessment was accessible to most candidates. Feedback suggests that it gave candidates a good opportunity to demonstrate the breadth and depth of their knowledge of the subject at this level.

The course assessment did not perform as expected. The overall level of demand was higher than intended. The grade boundaries were adjusted to take account of this.

Question paper

The question paper did not perform as expected. Candidates found questions 1, 3(b), 3(c), 6(a), 7(c), 7(d), 8(b), 9(b) 10(a), and 10(b) more demanding than expected. Most candidates attempted all questions apart from questions 5(c)(i), 7(b)(ii), 7(c), 8(d), and 9(b).

Project

The project performed as expected. Feedback from the marking team indicates it was positively received by centres and was fair and accessible for candidates.

Section 2: comments on candidate performance

Question paper

Question 1: calculating a loan schedule

Many candidates were unable to calculate the monthly interest rate given the annual interest rate. Many candidates simply divided the number of months by 12. Some candidates were unsure how to calculate the capital content of repayment. They added the repayment and interest content of repayment, rather than subtracting the interest content of repayment from the repayment amount.

Question 2(a): completing a PERT chart

Most candidates achieved full marks, although some candidates missed out on marks on the backward scan by stating the incorrect completion time.

Question 2(b): determining the critical path

Many candidates achieved full marks; however, a significant number of candidates made basic numerical errors, which led to them missing out on the available mark.

Question 2(c): constructing a Gantt chart

Many candidates achieved full marks, although some candidates missed out on marks because they drew bars inaccurately.

Question 3(a): stating the type of data

Many candidates achieved full marks by correctly stating that the data was discrete numerical.

Question 3(b): explaining why a claim is not valid

Most candidates were unable to give a valid or complete explanation.
Many candidates failed to use appropriate statistical language.

Question 3(c): stating a statistical test

Most candidates were unable to state the appropriate statistical test. Many candidates answered 't-test', which was incorrect.

Question 3(d): stating a valid assumption

Most candidates were unable to state a valid assumption, with many candidates stating that the sample size had to be the same.

Question 3(e): explaining the effect

Many candidates achieved full marks for this question. Some candidates did not attempt this question or did not state a valid conclusion.

Question 4(a): calculating a balance with varying interest rates

Many candidates achieved full marks. Most candidates who achieved full marks used the following method.

$$500 \times 1.033 + 500 = 1016.50$$

$$1016.50 \times 1.024 + 500 = 1540.90$$

$$1540.90 \times 1.01 = 1556.30$$

The most common error candidates made was writing the percentage as an incorrect multiplier, for example 101% as 1.1.

Question 4(b): calculating AER

Many candidates knew how to approach this question. Some candidates, despite showing appropriate working (2100 ÷ 2056.30 = 1.02125…) did not communicate their answer as 2.125…%.

Question 5(a)(i): determining the school roll

Most candidates knew how to attempt this question. However, many candidates did not complete the highlighted cells in the spreadsheet. These cells were included to assist candidates and provide a structure for their answer. Candidates who did not complete these cells made more errors and regularly left the answer as a decimal instead of as a whole number.

Question 5(a)(ii): commenting on precision

Many candidates did not write an appropriate comment about the prediction.

Some candidates did not attempt this part of the question after completing part (a)(i), or they commented on the relationship between time and the predicted school roll rather than the precision of the prediction.

Question 5(b): commenting on the relationship

Some candidates did not attempt this question.

Question 5(c)(i): extending the spreadsheet and constructing a graph

Many candidates successfully extended the table but did not produce the graph.
Some candidates did not provide a printout of the extended table or the graph as detailed in the 'Information and instructions for candidates' page.

Question 5(c)(ii): using the graph

Following on from question 5(c)(i), many candidates did not create a graph so were unable to use this to make a valid statement.

Question 6(a): calculating overall percentage increase

Many candidates were unsure of the process required for this question and simply added the percentages together.

Question 6(b): calculating cost

Many candidates were able to demonstrate the strategy for this question. Some candidates made calculation errors or used inconsistent units in their working.

Question 7(a)(i): constructing a scatter plot

Many candidates plotted back squat weight versus vertical jump height. Although this is an acceptable scatter plot, it made finding the regression line further on in the question difficult. Vertical jump height should have been on the y-axis and back squat weight on the x-axis.

Question 7(a)(ii): making an appropriate comment

Many candidates made an appropriate comment, with most commenting on the relationship between the back squat weight and the vertical jump height.

Question 7(b)(i): finding the correlation coefficient

Some of the candidates who attempted this question calculated the coefficient of determination value $\left(R^2\right)$ instead of the required correlation coefficient $\left(R\right)$.

Question 7(b)(ii): finding the equation of the regression line

As many candidates plotted back squat weight versus vertical jump height in part a(i), they were unable to obtain the appropriate equation for the regression line.

Question 7(c): using an equation to estimate a value

Most candidates did not use statistical software to estimate the vertical jump height and did not state an appropriate comment.

Question 7(d): explaining why a statistical test does not support advice

Most candidates did not explain why the statistical analysis did not support the advice. Instead, they used their general knowledge.

Question 8(a): calculating the net pay

Most candidates used the data booklet to obtain the tax bands required for this question. Most candidates gained marks for this question, although few gained full marks. Common errors included:
♦ not calculating the correct taxable income
♦ using incorrect values when calculating the tax bands
♦ making mistakes when calculating the tax in each band

Successful candidates set out the working in a clear logical manner or within a table, for example:

Taxable income (£)	Tax band	Tax payable (£)
12570	0%	0
2097	19%	398.43
10629	20%	2125.80
18366	21%	3856.86
3138	41%	1286.58
	Total	7667.67

Question 8(b): calculating the expected value

Most candidates were unaware of the process for answering this question.

Question 8(c): stating an appropriate reason

Many candidates achieved full marks. Candidates stated a wide variety of appropriate reasons.

Question 9(a): completing a payment schedule

Some candidates failed to print out the solutions for this question.

Question 9(b): finding AER using appropriate software

Many candidates did not attempt this question, despite it being similar to question 9(a). Most candidates who attempted this question did not use the Goal Seek function to find the annual effective rate of interest.

Question 10(a): determining if a statement is correct

Most candidates did not attempt any calculation for this question and simply made a statement based on their general knowledge.

Question 10(b): estimating an amount

Many candidates did not work out the average age of an adult gorilla. Most candidates stated that it was 35 years. The information required was in the data booklet.
The data booklet also gave the information that mountain gorillas survive on a mainly vegetarian diet. Therefore, an appropriate assumption is that 49% is the maximum percentage of the diet that consists of termites and ants.

Project

Introduction

Most candidates performed well in this section. However, many candidates failed to explain the background and context to gain the first mark. Some candidates did not state their research questions clearly. This left some candidates unsure about what they were using their data for and caused issues in subsequent areas of their projects.

Many candidates, including those who had gathered their own data, provided information on the background of the data source. Most candidates considered the validity of the source. However, few made a suitable reference about the credibility of the method used to gather the data to ensure that it was unbiased and uninfluenced.

Subjective impression

Many candidates gained marks for this section. However, some candidates did not generate appropriate graphical displays for their data or research question. Within the research question, if a candidate mentions a 'difference', then the data type should be numerical and appropriate graphical displays are histograms and box plots. The descriptive statistics used for this type of data should be mean and standard deviation or median and interquartile range.

Within the research question, if a candidate mentions a 'relationship', then the data type should be numerical and appropriate graphical displays are scatter plot and one other. The descriptive statistics used for this type of data should be mean and standard deviation or median and interquartile range.

Within the research question, if a candidate mentions an 'association' (relationship between categorical data), then the data type should be categorical and appropriate graphical displays are bar chart and pie chart. The descriptive statistics used for this type of data should be percentage or proportion and sample size.

Analysis and interpretation

Some candidates did not use an appropriate test for the research question stated or for the type of data stated.

Within the research question, if a candidate mentions a 'difference' and states that the data type is numerical, then the appropriate test is either a 2-sample t-test or a paired t-test.

Within the research question, if a candidate mentions a 'relationship' and states that the data type is numerical, then a regression line is appropriate.

Within the research question, if a candidate mentions 'association' (relationship between categorical data) and states that the data type is numerical, then the appropriate test is a z-test for two proportions.

Conclusion

Many candidates did not make a connection or provide a summary between their graphical displays, descriptive statistics, or additional statistics to their conclusion.

The last mark in this section was only available to candidates who answered the research question by referring to all of the statistics in context: graphical displays, descriptive statistics, and additional statistics.

Presentation

Many candidates gained marks for this section.

Candidates who gained the most marks for presentation:

♦ introduced graphical displays, descriptive statistics, and additional statistics using appropriate text in the appropriate sections of the report

♦ included appropriate headers in each section of the report

♦ maintained a flow in the report by linking sections in context

Section 3: preparing candidates for future assessment

Some candidates were well prepared and attempted most questions.

The majority of candidates used appropriate statistical software. However, too many candidates did not provide printouts in both numerical and formulae view, despite being instructed to do so.

Teachers, lecturers, and candidates can consult the detailed marking instructions for the 2022 question paper and project on SQA's website.

Question paper

The following advice may help prepare future candidates for the Higher Applications of Mathematics question paper. Teachers and lecturers should:

♦ encourage candidates to use the formula $(1+i)^{\frac{1}{12}} - 1$ to calculate a monthly interest rate, given an annual effective rate of interest

♦ remind candidates that they should print spreadsheets in both numerical and formulae view

♦ encourage candidates to use the checklist on the inside of the front page of the question paper to ensure that they have printed all relevant documents

♦ encourage candidates to use appropriate statistical language when asked to make statistical comments

♦ ensure candidates know that they should state data types as 'discrete numerical' or 'nominal categorical'

♦ consider what types of questions may be asked in the question paper after the release of the data booklet

♦ encourage candidates to copy appropriate statistical diagrams into the assessment template provided

♦ encourage candidates to use shading on the bars of their Gantt charts

♦ consider the best way to allow candidates to practise skills for questions that require them to use software packages

♦ encourage candidates to set out clear, concise, and appropriate working for questions about calculating income tax, or to set out the working in a table

Project

The following advice may help prepare future candidates for the Higher Applications of Mathematics project. Teachers and lecturers should:

♦ ensure that candidates use appropriate data sets

♦ ensure that candidates have a suitable research question based on their data

♦ encourage candidates to view example projects on the Understanding Standards website

♦ encourage candidates to use the correct statistical language, for example some candidates stated 'accept the null hypothesis' instead of 'fail to reject the null hypothesis'

Appendix 1: general commentary on grade boundaries

SQA's main aim when setting grade boundaries is to be fair to candidates across all subjects and levels and maintain comparable standards across the years, even as arrangements evolve and change.

For most National Courses, SQA aims to set examinations and other external assessments and create marking instructions that allow:

♦ a competent candidate to score a minimum of 50% of the available marks (the notional grade C boundary)
♦ a well-prepared, very competent candidate to score at least 70% of the available marks (the notional grade A boundary)

It is very challenging to get the standard on target every year, in every subject at every level. Therefore, SQA holds a grade boundary meeting for each course to bring together all the information available (statistical and qualitative) and to make final decisions on grade boundaries based on this information. Members of SQA's Executive Management Team normally chair these meetings.

Principal assessors utilise their subject expertise to evaluate the performance of the assessment and propose suitable grade boundaries based on the full range of evidence. SQA can adjust the grade boundaries as a result of the discussion at these meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper or other assessment has been more, or less, difficult than usual.

♦ The grade boundaries can be adjusted downwards if there is evidence that the question paper or other assessment has been more difficult than usual.
♦ The grade boundaries can be adjusted upwards if there is evidence that the question paper or other assessment has been less difficult than usual.
♦ Where levels of difficulty are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year on year. This is because the specific questions, and the mix of questions, are different and this has an impact on candidate performance.

This year, a package of support measures including assessment modifications and revision support, was introduced to support candidates as they returned to formal national exams and other forms of external assessment. This was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic. In addition, SQA adopted a more generous approach to grading for National 5, Higher and Advanced Higher courses than it would do in a normal exam year, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams have done so in very different circumstances from those who sat exams in 2019.

The key difference this year is that decisions about where the grade boundaries have been set have also been influenced, where necessary and where appropriate, by the unique circumstances in 2022. On a course-by-course basis, SQA has determined grade boundaries in a way that is fair to candidates, taking into account how the assessment (exams and coursework) has functioned and the impact of assessment modifications and revision support.

The grade boundaries used in 2022 relate to the specific experience of this year's cohort and should not be used by centres if these assessments are used in the future for exam preparation.

For full details of the approach please refer to the National Qualifications 2022 Awarding — Methodology Report.