ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Use of Mathematics 5351

Examiners' Report

2005 examination – June series

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Contents

Coursework Portfolio- Advanced

It was noticeable that again this year there was a considerable increase in the entry for the advanced courses. The candidate entry was usually good and there were many instances of cross-curricular work being done competently.

The portfolios moderated this year included many which were of a very high standard. Quite a number were written for their other studies and this cross-curricular work stimulated candidates to produce interesting portfolios of the best standard. In the unit entitled "Working with Algebraic and Graphical Techniques", many showed good quality work using exponential and logarithmic functions. These regularly achieved forty or more marks.

It was noticeable that a significant proportion of centres included portfolios which did not enable candidates to achieve a mark which accurately reflected their ability. This year there were in general three reasons why centres had their portfolio marks changed at moderation:

1. The portfolio did not satisfy all the requirements for that unit. For example, in the unit entitled "Working with Algebraic and Graphical Techniques", the requirements include: "A report of a piece of work where you have fitted a function to non linear data using logarithmic or other techniques to determine parameters by plotting a linear function." A number of centres ignored this requirement, whereas others assumed that it was adequate to use part of the raw data to produce a linear model, for instance a small section of a Boyle's law graph. This requirement relates either to plotting, for instance, y against x^2 in a function such as $y = ax^2 + b$ or, for the more able candidates, using log laws to obtain a linear graph representing $y = ax^b$.

2. The marking of the portfolio did not reflect the standard of all the work being assessed. For example although the better half of the portfolio is assessed as being representative of the candidate's standard of work by the end of the course, in the Advanced Statistics unit, the quality of the portfolio must be reflected by at least one of the two investigations and the critical analysis. All too regularly, the critical analysis was of a much lower standard than the investigations.

3. There was insufficient material which was of an AS standard. For example, for candidates to achieve a high mark of thirty or more marks in the Advanced Statistics unit, their portfolios must include topics which are clearly beyond the scope of the Intermediate Data unit. For example, Spearman's Rank Correlation coefficient, cumulative frequency and histograms are all appropriate for an AS module, but do not lend themselves to enable candidates to achieve a high grade AS assessment.

The majority of portfolios moderated were assessed correctly. The amount of annotation given varied widely between centres but in general the candidate record sheet contained enough information for the moderator to be able to confirm the centre's work.

A few centres gave their students tasks which were too structured and this prevented some candidates from being able to show their individual skills and initiative.

It was noticeable that candidates were attempting to show more explicit checking as was required in Theme 2, Using Appropriate Mathematics and Working Accurately. However candidates still find difficulty in showing clearly where checking had taken place.

With the considerable increase in the entry for AS Use of Mathematics, one problem was seen regularly. One centre declaration sheet confirming that the centre has carried out internal moderation is required for each level. All centres which entered their candidates for AS Use of Mathematics naturally entered their candidates for at least two units. Most of these centres supplied two or three centre declaration sheets, one for each unit. However, only one sheet was required, confirming that each unit at Advanced level had been assessed at the same standard.

Using and Applying Statistics 6990/2

General

On the whole, the candidates were well prepared for this paper and found the majority of the questions accessible. Most of the candidates attempted all of the questions in the order in which they appeared on the paper.

Question 1

This question was answered well on the whole, though a few of the candidates drew a histogram rather than a cumulative frequency diagram. A surprising number of those who did draw the correct type of diagram plotted points at the centres rather than at the ends of the intervals. Most of the candidates who produced a correct diagram in part (a) then went on to achieve full marks in part (b) by finding the median and interquartile range. Nearly half of the candidates who attempted part (c) found the percentage of men who beat the first woman rather than the percentage of men she beat.

Question 2

Most of the candidates were able to show calculations for part (a) and also explain the significance of the negative sign for part (b). However, not many of the candidates were able to adjust the percentage change correctly to take account of inflation in part (c). A few of the candidates omitted the whole question.

Question 3

The majority of the candidates used correct methods in parts (a) and (b)(i), though many did not give their answer to 2 significant figures as requested. Very few candidates were able to complete part (c) correctly. A significant number of candidates omitted part (c) and some omitted the whole question.

Question 4

This question was done well by the majority of candidates, especially those who used the statistical functions on their calculators in part (a) to find the mean values, the correlation coefficient and the line of best fit. It was disappointing to see candidates from some centres still struggle with time-consuming methods involving tables of squares and products. Some of these candidates obviously spent a long time on such calculations but often made errors which resulted in them failing to achieve any marks at all for their efforts.

Most of the candidates knew that the line of best fit should pass through the mean point and that the equation of the line of best fit also gives the intercept on the y axis. Using these facts they were able to draw the line of best fit accurately and efficiently and thereby gain the marks for part (b).

Many candidates were able to achieve some of the marks awarded for interpretation in parts (c) and (d), but only a few achieved full marks. Some candidates explained in general terms what information is given by a correlation coefficient, but did not interpret the values in this particular context.

Question 5

It was pleasing to see that a large proportion of candidates were able to achieve the majority of the marks in this question. Many candidates achieved full marks for part (a) and although part (b) proved more difficult, most of the candidates were able to standardise the values concerned and use the normal table correctly. About half of those who attempted part (b) completed it successfully, whilst the others generally made mistakes in the final steps to calculate the probability. A few of the candidates used the mean and standard deviation for the Japanese market, rather than the UK market.

Question 6

Most of the candidates who attempted this question had obviously spent time before the examination studying the diagram on the Data Sheet and making sense of it. Consequently the majority of these candidates achieved full marks for this question. There were only a few who attempted the question but failed to get full marks by either omitting one or more of the performance indicators or incorrectly interpreting the diagram.

Question 7

A significant number of candidates omitted this question. Of those who attempted it, very few used the correct method for part (a), the majority multiplying instead of dividing by 1.58. Most did gain a mark in part (b) for using the correct method, though there were few who actually got the correct answer. In part (c) most candidates missed the point that the sum is inverted so that larger values represent better performance.

Working with Algebraic and Graphical Techniques 6991/2

General

This paper was accessible to candidates with many showing that they were well prepared. The standard of presentation was usually good, but too many candidates tried to compress their answers onto one or two sides of paper and this made it more difficult to mark. The graphical questions were well answered in comparison with the algebraic questions, but too many candidates just plotted the points in questions 1 and 2 and then failed to join up the points. The descriptions of geometrical transformations were usually very poor.

Question 1

Most candidates had no problems with parts (a) and (b), with most drawing the graph accurately, but weaker candidates could go no further. Common answers were 45 for part (c), and 30 for q and 225 or 900 for p in part (d). In part(e) some said that it gave the coordinates of the maximum point without specifying which was p and which was q and so gaining no marks.

Question 2

Most scored well on this question but some lost marks by not plotting 9 sets of coordinates. Most scored the marks in parts (b) and (c), as follow through was allowed provided they had drawn a U shaped curve in part(a).

Question 3

This question was very poorly answered with many not even attempting it. Those who did often had their curves not symmetrical about the y axis or going through the origin. Some correctly reasoned which equation gave the best model without drawing any graphs. Some drew their sketch graphs on the grid for question 2 by putting in values for p and q which was allowed but is not encouraged as candidates should know that "sketch" does not mean spending time drawing an accurate graph.

Question 4

Many scored well on this question although part (a)(i) was poorly done with many attempting to work back from the answer. Most did well on parts (ii) and (iii), but some lost marks by not giving the values to 3 significant figures although they were still able to produce accurate graphs. Many got the values of A and k the wrong way round and $A = 4.5$ was a common answer as well as $k = -0.05$.

Most got part (b)(i) wrong by saying that it was the y intercept without relating it to the context of the question. Most got part (b)(ii) correct but some substituted T as 10. Part (b)(iii) was found to be harder with many knowing what to do but making mistakes when manipulating the logarithms, and some subtracting the 30 from 95. Very few gave a valid explanation for part (iv) as most commented that the cup of tea would cool down to room temperature and did not comment on the validity of the model.

Question 5

Most got part (a)(i) correct, but many only found the first value in part (a)(ii). Many attempted to do part (b)(i) without drawing a tangent and so got no marks, and part (ii) was poorly answered with most failing to mention "rate of change" and giving units such as "minutes per hour". In part (c) most knew what to do but many got the two readings and then failed to subtract them. Part (d) was well done but some divided by 10.4 and some used values of t rather than h. Part (e) was poorly done with many using "shift" instead of "translation" and so getting no marks, and some failed to use the words "scale factor" when describing the one-way stretch. Part (f) was done well with many getting the amplitude but the period was often given as 1 or 365, and in part (g) some attempted to substitute values for h and t to set up an equation for A.

Modelling with Calculus 6992/2

General

Although a number of candidates performed well, a significant proportion of candidates were ill-prepared for this paper. Question 1 was found to be a good introduction to the paper and most candidates gained the majority of their marks on the first two questions. Of the two questions which were found more challenging, question 4, on logarithmic and exponential functions, was answered better than question 3, on trigonometric functions.

It was disappointing to see that, although differentiation and integration were performed well by the majority of candidates, the solution of even linear equations caused considerable difficulty.

Question 1

Many candidates wrote down the function $\frac{df}{dx}$ correctly, but a large proportion then struggled to solve the equation $10x - 22 = 0$. Relatively few of those who did manage to solve the equation substituted the resulting $x = 2.2$ into the given equation of f to find the mean value. A number of candidates attempted to find the solution of part (a) by solving $f = 0$, and only found $\frac{df}{dx}$ when they were required to find $\frac{d^2f}{dx^2}$ in part (b). Most found $\frac{d^2f}{dx^2}$ correctly.
In part (c), many candidates forgot to give any indication of scale on the two axes.

Question 2

Many candidates found $\frac{d\theta}{dt}$ correctly but the solution of the quadratic equation $0.76t - 0.06t^2 = 0$ caused major problems. Virtually all candidates attempted to solve it by the quadratic formula, which involved using "c" = 0. Thus the $4ac$ term should have been 0, which most candidates did not obtain.
The method required for part (a)(ii) was often seen but the correct answer was rare.
The second differential required in part (a)(iii) was usually found correctly, but again a number of candidates only found $\frac{d\theta}{dt}$ in this part of the question. Many candidates realised that they had to show that $\frac{d^2\theta}{dt^2}$ was negative to justify that θ was a maximum in part (a)(iv), but frequently the value of θ was substituted rather than the value of t. The requirement in part (a)(v) to **state**, with only one mark to be awarded, should have reminded candidates that they were not expected to carry out any further working. Few candidates wrote down the answer, $t = 0$, the other value of t at the turning points found in part (a)(i).
In part (b)(i), a significant proportion of candidates did not attempt to use the trapezium rule to find an approximate value for the given integral. Those candidates who did attempt to use the trapezium rule, ignored the fact that $t = 0$ referred to the time when the thunderstorm finished. They then decided to read values from the graph given on the data sheet as the basis for the trapezium rule. A number of candidates used far more than the two strips required. By contrast, part (b)(ii) was very well done, with only a minority being unable to integrate the expression given, with the integral of 19 being the only common error.
In part (b) (iii), most candidates ignored the fact that a model rarely gives the exact value of the real situation, and simply explained that a trapezium with straight edges would not be accurate for an area bounded by a curve.

Question 3

This question was tackled badly. There were few convincing answers to part (a), the evaluation of $\cos\frac{\pi}{4}t$ with $t = 4$ to give $\cos \pi = 1$ was rarely seen. In part (b), the differentiation to obtain $\frac{dv}{dt}$ was rarely correct. A significant proportion of candidates forgot that the differential of the initial 60, a constant, is 0. A number of candidates differentiated $\cos\frac{\pi}{4}t$ to give $\frac{\pi}{4}\sin\frac{\pi}{4}$. In part (c), few candidates considered the trigonometric function $\sin\frac{\pi}{4}t$, which clearly had a maximum value of +1.

Many equated $\frac{dv}{dt}$ to 0, attempting to find the maximum value of v, rather than the maximum value of $\frac{dv}{dt}$.

Question 4

A few candidates simply integrated the given expression to obtain $S = \frac{1}{2}0.05t^2$. However, most candidates appreciated that they needed to transform the given equation into $\int \frac{dS}{S} = \int 0.05dt$. In the subsequent integration to obtain log $S = 0.05t + c$, the constant c was frequently omitted. The conversion from this to $S = Ae^{0.05t}$ was rarely convincing. In part (a)(ii), many candidates substituting $t = 0$ into $e^{0.05t}$ did not obtain 1, and again could not show the desired result. A significant proportion of candidates took 2000 to be the initial mass, rather than taking the initial mass to be S_0 in the year 2000. Of the remaining parts, only part (c) was reasonably well attempted, with $e^{0.25}$ seen commonly but not always evaluated.

Applying Mathematics Paper 1 UOM4/1

General

It was evident that the majority of candidates had prepared for the paper by working with the preliminary material and were able to relate the mathematics to the situation that was being modelled. On the whole candidates often worked better with the recurrence relations than the exponential functions.

Many candidates did not give enough attention to their use of notation to gain full credit from the marks available for presenting their work accurately using correct notation. For example, when working with recurrence relations a substantial number of candidates used notation such as C_{n+1}, C_{n+2}, C_{n+3} for successive terms.
Very few candidates presented their work carefully enough to gain substantial credit under the category of marks awarded for mathematical arguments presented clearly and logically. Indeed some candidates' work was difficult to follow.

Question 1

Many candidates were able to correctly substitute the required value ($t = 8$) into the expression $C = 1000e^{-0.3466t}$ to answer the first part of this question. However, the second part of the question was less often tackled successfully although it involved the only function in the preliminary material and candidates may have suspected that they would have to work with it to find a value for t given a value of C.

Question 2

This question could be answered by direct reference to the preliminary material where a number of factors that would affect the half-life of paracetamol were given. Many candidates managed this successfully but a substantial minority did not seem to have grasped the significance of what might affect the half life.

Question 3

This question required candidates to complete the missing steps in the mathematical argument that leads from $C = 1000e^{-kt}$ to give $k = \frac{1}{2}\ln 2$. Very few candidates were able to give a correct mathematical argument although it might have been spotted from the pre-release material that this was a likely question. Many were able to make a start but were not familiar enough with the laws of logarithms to give a convincing argument.

Question 4

This question invariably provoked one of three responses with two gaining partial or full credit. The most sophisticated response that related the 0.25 to the fact that 4 hours was equivalent to two half lives and therefore the amount of drug had decayed by half and then half again gained full credit, whereas the response that the 0.25 gave the fraction of the drug remaining in a person's body after 4 hours gained partial credit. However, a number of candidates guessed that the 0.25 was related to the four hours as a reciprocal with apparently no understanding of the decay process.

Question 5

The majority of candidates showed what was required clearly and correctly. However, some referred to the table of Figure 4 and showed only the final step in the sequence.

Question 6

In part (a) many candidates were able to correctly substitute $T = 8$ into the function $C_{n+1} = (0.5)^{\frac{T}{2}} C_n + 250T$ although a substantial number did not simplify 0.5^4 and others either omitted the C_n in their answer or substituted the value 1000 for C_n.

Those candidates who appeared comfortable working with the function $C_{n+1} = (0.5)^{\frac{T}{2}} C_n + 250T$ were able to show the required result successfully. However, in part (b), those who were less secure in their understanding often substituted $T = 16$ into the function not realising that thy were expected to carry out two iterations of the recurrence relation they had just developed.

Question 7

Only the better candidates were able to answer this question successfully and were able to differentiate between the two parts of the relation $C_{n+1} = (0.5)^{\frac{T}{2}} C_n + 250T$ and explain how the first becomes small as T becomes large and the second becomes large in such situations. A general explanation was required but partial credit was given to answers based on the substitution of a large value of T into the expression.

Question 8

Many candidates were able to answer this question correctly although a minority gave the values of initial dose and the half life for the new drug but did not compare these with the values for paracetamol as required and consequently did not gain full credit.

Applying Mathematics Paper 2 UOM4/2

General

Many candidates appeared to engage fully, and make substantial progress with each of the questions on this paper. It was particularly clear that many were carefully relating the mathematics to the real world situation being modelled.
It was disappointing that some candidates appeared to be not well prepared in their use of a graphic calculator when asked to sketch a graph.

Question 1

The graphical and interpretation parts of this question were generally tackled with greater success than those parts requiring the use of algebra.
Part (a) required candidates to substitute the value 1 for the variable l. Many did this successfully but a number were then unable to cope with taking the square root correctly, with some removing g from within the square-root sign. Part (b) was only successfully tackled by the candidates who were most confident in their use of algebra.
The majority of candidates were able to successfully draw the sketch graphs required for the first parts of sub-questions (c) and (d). It was clear that many achieved correct graphs by substituting numerical values into the expressions: in many cases this led to an appropriate sketch graph but candidates who may have used extreme values occasionally produced inappropriate sketches such as straight lines.
Many candidates were able to interpret the results of their sketch graphs to correctly answer the second parts of each of these questions.
A correct answer to part (e) was only achieved by the best performing candidates although a substantial number realised that the two expressions for the time periods of the different pendulums should be equated.

Question 2

Many candidates were able to successfully use the recurrence relations for the two different savers. However, although the question made clear that values should be rounded to the nearest penny, and that this required one to work with values correct to 3 or more decimal places, a number of candidates failed to do this. Most of these candidates gave too many decimal places.
The interpretation parts of the question were less well done. In part (c) many candidates did not explain that the factor 1.05 *increased* B_n by 5%, instead suggesting that it just *calculated* 5% of B_n. In part (d) a substantial number of candidates did not appear to understand the significance of $100n$, with some appearing to suggest that the n was in some way associated with recurrence notation.
In the final part of the question some candidates did not recognise that they were required to find when the second saver had first earned more *total interest* than the second saver. These candidates gave an answer based on the total amount in each account.

Question 3

This question was the least well answered question on the paper with many candidates appearing to have little knowledge of the nature of sinusoidal functions.
The first part of question (a) was answered correctly by many but the second part, requiring the substitution of 9 into the expression, was rarely answered correctly.
Few candidates appeared to have an understanding of how the amplitude and period of the sine wave were related to the values of the parameters of the function. Many suggested that the amplitude of the wave was 2 and that the period was 30.
The responses to part (c) of the question were disappointing, particularly since candidates have access to a graphic calculator. Of those who managed to sketch a sine wave rather than a straight line many did not give sufficient detail in their sketches to gain full credit. For example, it should have been clear from the sketch that the central value was 4, and that the period of the wave was 12 hours.
Many candidates were unable to correctly state the greatest depth of the water predicted by the model and when this maximum depth occurred; not having a correct sketch graph was clearly problematic here.
Very few candidates were able to use algebra correctly in the final part of the question. Although many realised that the first step was to equate the expression to 5.5 few were able to make any progress to reach the step giving $0.75 = \sin 30(t-12)^{\circ}$.

Question 4

Many candidates gained a substantial number of marks on this question apparently being well prepared to handle what was in some respects a large amount of information and a relatively complex simulation.
In part (a) although almost all candidates recognised that the two randomly generated integers were related to the probability of 0.2, some did not explain carefully that this resulted in 2 from 10 integers (0 – 9) being designated to simulate four passengers arriving.
The table on the answer sheet was almost always correctly completed. One error which did occur was for candidates to incorrectly complete the final column giving the time at which the passenger has bought a ticket, by failing to take into account that this cannot possibly be before the passenger has arrived.
There were many good answers from candidates in response to parts (g) and (h) of the question showing that they had fully understood all aspects of the simulation.

Mark Ranges and Award of Grades

6990 Using & Applying Statistics (862 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6990/1: Coursework Portfolio	51	51	26.2	10.2
6990/2: Written Paper	60	51	28.9	11.0
6990: Using & Applying Statistics	111	102	50.8	17.1

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	47	41	36	31	26
	scaled	51	40	35	31	26	22
Unit Scaled Boundary Mark		102	80	68	56	44	32

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	4.1	17.6	39.2	62.1	83.1

6991 Working with Algebraic and Graphical Techniques (1142 candidates)

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
6991/1: Coursework Portfolio	51	51	27.8	9.8
6991/2: Written Paper	60	51	31.6	11.2
6991: Working with Algebraic & Graphical Techniques	111	102	54.7	16.3

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	44	39	35	31	26
	scaled	51	37	33	29	26	22
Unit Scaled Boundary Mark		102	77	65	54	43	32

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	9.0	29.2	50.3	74.6	90.9

6992 Modelling with Calculus (229 candidates)

Unit/Component	**Maximum Mark (Raw)**	**Maximum Mark (Scaled)**	**Mean Mark (Scaled)**	**Standard Deviation (Scaled)**
6992/1: Coursework Portfolio	51	51	29.3	11.0
6992/2: Written Paper	60	51	20.8	11.4
6992: Modelling with Calculus	111	102	47.0	17.8

		Max. mark	A	B	C	D	E
Coursework Portfolio Boundary Mark	raw	51	40	32	24	17	10
	scaled	51	40	32	24	17	10
Written Paper Boundary Mark	raw	60	44	38	33	28	23
	scaled	51	37	32	28	24	20
Unit Scaled Boundary Mark		102	77	65	53	41	30

Provisional statistics for the award

	A	B	C	D	E
Cumulative %	4.8	19.7	39.3	62.4	80.3

UOM4 Applying Mathematics (947 candidates)

Unit/Component	**Maximum Mark (Raw)**	**Maximum Mark (Scaled)**	**Mean Mark (Scaled)**	**Standard Deviation (Scaled)**
UOM4/1: Written Paper	30	30	13.9	6.2
UOM4/2: Written Paper	70	70	33.6	10.9
UOM4: Applying Mathematics	100	100	47.5	15.5

		Max. mark	A	B	C	D	E
Paper 1 Boundary Mark	raw	30	23	20	17	15	13
	scaled	30	23	20	17	15	13
Paper 2 Boundary Mark	raw	70	53	47	42	37	32
	scaled	70	53	47	42	37	32
Unit Scaled Boundary Mark		100	76	68	60	52	45

Advanced Subsidiary Awards

Use of Mathematics

Provisional statistics for the award (874 candidates)

	A	B	C	D	E
Cumulative %	2.6	13.3	33.5	58.4	82.3

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).