STATISTICS

Paper 4040/11

Paper 11

General comments

The overall standard of work showed some improvement over last year. Some high marks were obtained, and there were few exceptionally low marks. As was noted last year, there were again instances of marks being lost as a result of final answers not being given to the required accuracy in cases where this was stated in the question. It appears sometimes as though these errors are a consequence of candidates not understanding clearly the difference between significant figures and decimal places. Also, as has been noted in the past, there are still too many answers of a very general nature to those parts of questions requiring comment or reasons related to the situation in the question. Candidates need to be aware that marks in these cases can only be earned if what is said relates specifically to the particular situation considered in the question.

It may seem obvious to remark that a question must be read carefully to decide what is required, and the instructions given then followed closely. This was commonly not done in one particular question, referred to below, and resulted in needless loss of marks.

This is the second year of the new format for the question paper, with the requirement to write all answers on the question paper in the spaces provided. Extra paper should not be requested by candidates, or given to them, at the start of the examination. Extra paper should only be issued if a candidate genuinely needs it, for example, to draw a graph again on which a mistake has been made. Where an answer line is provided, that is where the final answer should be written, and that is the answer which will be marked. Careful thought is given in the preparation of the paper to ensure that plenty of space is provided for giving good answers. It is a waste of space (and time) to use some of this space by repeating the words of the question.

Comments on specific questions

Section A

Question 1

Almost all obtained the three values in part **(i)**. Candidates have clearly learned about the advantages and disadvantages of the different measures of central tendency, but in part **(ii)** these were often recited with no apparent reference to the particular data presented. The most appropriate measure to use here is the median. The mean is rejected because it would be affected by the large values of 19 and 25, and the mode is rejected because it is the smallest value present (only one of these needed to be mentioned).

For data containing extreme values, the interquartile range (or semi-interquartile range) is the most appropriate measure of dispersion. In part **(iii)**, some candidates lost marks by not offering any measure of dispersion, but a measure of central tendency instead.

Answers: **(i)(a)** 4; **(b)** 7; **(c)** 9.

Question 2

Many good accurate pie charts were drawn. There was generally good understanding that total frequency is proportional to the square of the radius for determining the size of the comparable pie chart. Some candidates lost marks in parts **(i)** and **(iii)** by ignoring the given accuracy instructions.

Answers: **(i)** 74°, 106°; **(iii)** 3.6 cm.

Question 3

Most candidates understood that for part **(i)**, the value 31 represents the number of households which own a dog, but not a cat or a rabbit. Alternatively, as many also said, it is the number of households which own only a dog. The other parts were generally well done, and marks were allowed in parts **(iv)** and **(v)** even with earlier errors, provided work was consistent. Marks were not allowed however for impossibly large answers (anything larger than 98).

Answers: **(ii)** 8; **(iii)** 11; **(iv)** 5; **(v)** 52.

Question 4

Most candidates understood that for part **(i)** there was more to the question than simply reading off the heights of the columns, though it was fairly common, and incorrect, to double the heights for the unknown classes. It would perhaps have been possible to give more reward for wrong answers on the final class if more work had been shown demonstrating an understanding of frequency density. Often no work was shown at all.

In part **(ii)** the method tested is that which uses intersecting diagonal lines within the highest column, drawn from the top corners of the highest column to the top corners of the adjacent columns. These lines were sometimes drawn incorrectly. The question asks for an estimate of the modal height (a specific value), and not the modal class, as many supplied.

Answers: **(i)** 6, 10, 9; **(ii)** 156.5 to 157.0 cm.

Question 5

This type of question is about understanding information given in textual form, and presenting it in summary tabular form. It is important first of all that the candidate clearly understands what the cells in the given table represent, and some time needs to be given to thinking about this at the outset. Once the table has been completed correctly, it is possible to say for part **(ii)** that the grade was likely to be higher than predicted, because 112 candidates obtained a higher grade than predicted, whilst only 21 candidates obtained a lower grade than predicted. Credit was also given where an answer was justified by reference to only one particular grade, but no credit was given for an answer without a reason.

Answers: **(i)(a)** 33 (second cell third row), 4 (fourth cell third row); **(b)** six 0s (third and fourth cells first row, fourth cell second row, first cell third row, first and second cells fourth row); **(c)** 34 (third cell fourth row); **(d)** 12 (second cell first row); **(e)** 45 (first cell second row), 5 (third cell second row).

Question 6

The concept tested in part **(a)** is how the symmetry of a distribution, or lack of it, affects the relative positions in the distribution of mean, median and mode. The three are equal in a perfectly symmetrical distribution having the shape of a normal distribution, and this was the type of sketch expected in part **(ii)**. When the distribution is skewed, the measures are different. For part **(i)** the distribution is skewed negatively, that is the mode is in the upper half of the distribution. It was essential in both these cases to give a sketch with a single clear mode (peak) for full credit to be obtained. It seemed as though many candidates were not familiar with these standard sketches.

More familiarity was shown with the typical shape of a cumulative frequency curve in question **(b)**. To earn both marks it was necessary for the sketch to have the steepest gradient in the correct place, around a variable value of 1.5–2.5. An accurate way to obtain the curve, as some candidates did, is to first form a simple frequency distribution from the given curve, and from this to obtain the cumulative frequency distribution. No marks were awarded for any sketches having parts with a negative gradient, as this is impossible on a cumulative frequency curve. The curve also had to pass through (0, 0).

Section B

Question 7

In a probability question involving an experiment or game it is most important at the start to make sure the rules are clearly understood. In part **(a)** the rules clearly say that the experiment may stop after one throw, two throws or three throws, so in part **(i)** the possible sequences must show outcomes for one throw, two throws and three throws. For three throws, the last throw may be either head or tail. A significant number of candidates who started the question could not manage this, and made little progress with the remainder of the question. Few of those who were successful with part **(i)** were also successful with part **(ii)**. The best method here is to add the three probabilities in part **(i)** which end with head, and then square the resulting probability.

In part **(b)** it is important to appreciate that, after the first game, each game is started by the loser of the previous game. Candidates need to be aware that if words are given emphasis in a question it is for their benefit, to help them to avoid making unnecessary mistakes. So consideration has to be given to who starts a game as well as the outcome. For example, for part **(ii)(a)**, the answer is given by 0.7×0.2×0.2 and not by 0.7×0.7×0.7. For the situation in part **(iii)(a)**, John can win the first, second or third games. As the question says, there are only three possible sequences, not four, as some thought. Candidates who had made good progress up to this point often lost marks in part **(iii)(b)** through considering only one of the three cases from part **(iii)(a)**.

Probability questions may involve careful reading and thought to understand the situation described, but once this is thoroughly grasped, solutions can often be written out quickly, since there is usually much less computational work compared with other topics. Nevertheless, some candidates offered probabilities with values greater than one.

Answers: **(a)(i)** H 1/2, TH 1/4, TTH 1/8, TTT 1/8; **(ii)** 49/64; **(b)(i)** 5; **(ii)(a)** 0.028; **(b)** 0.008;
(iii)(a) JZZZ, ZJZZ, ZZJZ; **(b)** 0.1512 or 0.151.

Question 8

The calculation parts of this question were well answered, and a good source of marks for many. A few lost a mark in part **(iv)** through not following the 2 decimal places instruction, and a few lost accuracy in part **(iv)** as a result of using insufficiently accurate values from part **(ii)**. In any numerical work it is clear that accuracy will be lost whenever a prematurely rounded value from earlier working is used in subsequent calculations. In part **(ii)** it happens that two of the rates work out exactly, and these exact values should be used. The other rate does not. It is not necessary to use all the decimals for this rate, but at least two decimal places should be used. Rounding the 4.23 to 4, or the 2.5 to 3, is both unnecessary and results in significant loss of accuracy.

Good understanding was shown for part **(vi)** that town Y has the healthier environment because its standardised death rate is lower than that of town X. A comparative statement needs to be given, and it was pleasing to see many candidates doing this.

Few good answers were seen to part **(vii)**. A minority showed some understanding by recognising that this had something to do with the different age structures of the populations. To say only this, however, was not enough, because it does not address the “higher than” in the question. The reason is that both towns have a higher proportion of young people (or smaller proportion of old people) than the standard population. The final column in the second table can help here. The numbers have not been used anywhere in the calculations, and candidates might have asked themselves why the data had been given.

Answers: **(ii)** 4.23, 2.5, 50; **(iii)** 7.5; **(iv)** 12.28; **(v)** 8.15.

Question 9

The first three parts were well done, and many candidates obtained marks here with apparent ease. Accurate calculations were given in part **(ii)**, and many clearly drawn accurate graphs were produced. Most also knew how to find the equation of the line of best fit. There was some misreading of the scale in part **(iv)**, with 102 days being used instead of 110 days.

The remaining parts were less well done. The line for public transport goes from (0, 0) to (160, 800), and the answer to part **(vi)** is the number of working days at the intersection point of the two lines. In order to answer part **(vii)** properly, reference must be made to the practical situation considered. So an answer given in purely mathematical terms, referring to proportionality or intercepts, is not sufficient. The answer must refer to the modes of transport. The fact of the matter is that, if the man does not use public transport, it costs him nothing. But with a car there will be overheads such as maintenance expenses before he even makes a journey. Some candidates were able to make a valid comment on one of the forms of transport, but comments on both were required for the mark.

Answers: **(ii)** line through at least two of (50, 310), (90, 420), (130, 530);
(iii) m = 2.65 to 2.75, c = 170 to 190;
(v) line through (0, 0) with gradient 5 (For **(iv)** and **(vi)** Examiners checked the candidate's answers against the candidate's own graph when deciding whether or not to award marks).

Question 10

This question was designed to lead the candidate through the steps in finding the mean and standard deviation of a grouped frequency distribution by first scaling the original variable, *m*, to another variable, *x*. At the end of the question values obtained for the mean and standard deviation of *x* have to be converted back to values for *m.* The first step is to close the lowest and highest classes. A value of 0 needs to be used for the lower limit of the lowest class as distances cannot be negative. A suitable upper limit for the highest class is either 80 or 100, so that the highest class either has the same width as the previous class, or twice the width of the previous class. Answers given below are for use of 80 as the upper limit, with those given in brackets being for use of 100.

Most candidates started well, and obtained a good proportion of the first eight marks. Often, however, no further marks were earned, simply because the instruction given in the question was not followed. In part **(iii)(b)**, the instruction is to find the mean and standard deviation of *x*, the variable in the final column of the table. Many candidates ignored the instruction, and worked out the mean and standard deviation of *m* instead. No credit could be given for this. In part **(iii)(c)** the answers from part **(iii)(b)** must then be converted back, by appropriate use of the 25 and 5, to answers for *m*, in order to find the mean and standard deviation of the distance travelled. It is necessary to emphasise again the importance of doing what the question asks for marks to be earned.

There were also other mistakes which cost candidates marks. The data form a frequency distribution of 300 items, not a small set of 6 as many assumed. Sometimes when the squares of data values were found, negative values were given. And 3 significant figure answers were not always presented for parts **(iii)(b)** and **(iii)(c)**.

Answers: **(i)(a)** 0; **(b)** 80 (or 100); **(ii)** 15, 25, 35, 50 (four middle classes); **(iii)(a)** –2, 0, 2, 5 (four middle classes); **(b)** mean = 3.30 (or 3.68), s.d. = 3.46 (or 4.13); **(c)** mean = 41.5 (or 43.4), s.d. = 17.3 (or 20.6 or 20.7).

Question 11

Generally good progress was made through the first four parts of the question. Marks which were lost here were usually a consequence of not using upper class boundaries when drawing the cumulative frequency curve. Some candidates used class mid-points, or even lower class boundaries. It is important to draw the cumulative frequency curve properly so that accurate answers are obtained when it is used to read off other values.

Good answers give some indication on the graph (for example with lines drawn and labelled) of how the required information is being found. Credit can then be given for method, even if the answer is incorrect. If no indication of method is given, and the answer is incorrect, it is impossible to award marks for method. Some very clear answers were seen, with method clearly visible, throughout the question. Others gave no indication whatsoever on the graph as to how it was being used.

In part **(v)(a)** some candidates tried to argue that the interquartile range would be unchanged by the addition of another 11 data items. This is not what the question was asking, and in fact the interquartile range would change, because the total frequency for the distribution would change. The question simply asked why it would still be possible to find it. The reason is that the quartiles would now be found corresponding to cumulative frequencies of 1/4×99 (=24.75) and 3/4×99 (=74.25), and these can be found from the curve which has already been drawn, as both of the cumulative frequencies are less than 88. These cumulative frequencies are then used to answer part **(v)(b)**. Using cumulative frequencies of 1/4×88 (= 22) and 3/4×88 (= 66), as many candidates did, is incorrect.

Answers: **(i)** 8, 20, 34, 47, 63, 79, 88; **(iii)** 48 to 49.5; **(iv)** 80.5% to 83%; **(v)(b)** 29 to 33.

STATISTICS

Paper 4040/12

Paper 12

General comments

The overall standard of work showed some improvement over last year. Some high marks were obtained, and there were few exceptionally low marks. As was noted last year, there were again instances of marks being lost as a result of final answers not being given to the required accuracy in cases where this was stated in the question. It appears sometimes as though these errors are a consequence of candidates not understanding clearly the difference between significant figures and decimal places. Also, as has been noted in the past, there are still too many answers of a very general nature to those parts of questions requiring comment or reasons related to the situation in the question. Candidates need to be aware that marks in these cases can only be earned if what is said relates specifically to the particular situation considered in the question.

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Answers: **(i)(a)** 0; **(b)** 80 (or 100); **(ii)** 15, 25, 35, 50 (four middle classes); **(iii)(a)** –2, 0, 2, 5 (four middle classes); **(b)** mean = 3.30 (or 3.68), s.d. = 3.46 (or 4.13); **(c)** mean = 41.5 (or 43.4), s.d. = 17.3 (or 20.6 or 20.7).

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Answers: **(i)** 8, 20, 34, 47, 63, 79, 88; **(iii)** 48 to 49.5; **(iv)** 80.5% to 83%; **(v)(b)** 29 to 33.

STATISTICS

Paper 4040/13

Paper 13

General comments

As in previous sessions, there were again numerous examples of marks being lost through final answers not being given to the levels of accuracy required by questions, when this was stated. Where a question clearly asks for a comment within the context of a question, candidates have tended just to produce standard 'bookwork' answers. There were very few places in this paper in which this could be done, as the specific comments required did not fit any general 'bookwork answer'. Possibly the best example of this occurred in **Question 9(a)(ii)**. In preparing for the examination, candidates should acquire the habit of determining exactly what a question is asking, and then considering the context of the information provided in drafting their answer.

In general, candidates found certain questions/parts of ***Section A*** quite simple, but others rather difficult, **Questions 2**, **3** and **6(i)** being examples of the former, and **4** and **6(ii)** of the latter. However, the cause of **Question 5** being the one on which fewest marks of all were scored was that most candidates did not read the question sufficiently carefully to realise the method they were being instructed to use.

This was the second year of papers in this subject being in their new format, where answers are written on the question paper, and all candidates appeared to be familiar with the format, and to know how to present their answers.

Comments on specific questions

Section A

Question 1

While almost all candidates scored a few marks on this question, hardly any obtained full or nearly-full marks. Candidates need to be familiar with the expression 'sampling frame'. On some scripts the number of times answers had been crossed out and replaced suggested that the final answer presented was the result of guesswork rather than knowledge.

Answers: **(i)** Quota; **(ii)** Quota; **(iii)** Quota; **(iv)** Systematic; **(v)** Simple random, stratified; **(vi)** Quota, stratified.

Question 2

High marks were obtained by most candidates. It was pleasing to see both parts requiring comment being answered well. A common error was the use of a denominator of 30 (the number of symbols in the pictogram), rather than the correct 20 (the number of men), in the calculation in part **(v)**.

Answer: **(v)** 30%.

Question 3

The quality of answers to questions on this topic has improved consistently in recent years, and this trend was continued. A majority of candidates were able to interpret correctly the number 6 given in the diagram.

Answers: **(i)** 15; **(iii)** Foxtrot 19.

Question 4

The small number of candidates who interpreted the given information correctly scored well. For the majority of others the answers presented appeared to be guesswork.

Answers: **(i)(a)** D; **(b)** E; **(ii)** 25%; **(iii)** 16.3; **(iv)(a)** Possibly true; **(b)** Possibly true.

Question 5

Hardly any candidates scored any marks at all on this question, seemingly because the candidates needed to read the question more carefully; as a result, the method required by the question had not been used. As many hints as possible were given to the candidates to indicate that this was a question on scaling, involving the comparison of the values of the variable given in the initial table with those in each of the subsequent tables. Almost without exception though, candidates tried to obtain the required values 'from scratch'. Provided the fully correct answers were obtained using this method, credit was given, (because candidates would have penalised themselves by the amount of time taken), but not otherwise.

Answers: **(i)** 15.16, 33.1776; **(ii)(a)** 5, 8, 11, 14; **(b)** 8.6, 2.9.

Question 6

Most candidates scored some or all of the first three marks, but very few marks were obtained in the final part. The answers offered tended to be 'explanations' in a general context of why the two variables were not independent. Such answers score no marks. What is required is use of one of the two numerical methods involving probabilities for showing non-independence.

Answers: **(i)(a)** 5/24; **(b)** 1/3.

Section B

Question 7

Although the topics being tested in the different parts of this question were of a very standard nature, the marks obtained were generally low. Almost no candidates at all were able to deduce the units on the vertical axis of the histogram. Work related to the basic principle of histogram construction (area is proportional to frequency) was, however, on the whole correct. Candidates need to improve their ability to work correctly through the method for obtaining the mean and standard deviation of a grouped frequency distribution. It may be that candidates can be somewhat careless in their use of calculators, or that they are uncertain of the method required. Equally, it is possible that in their everyday work candidates use pre-programmed buttons which give the mean and standard deviation automatically, and so have become unfamiliar with the procedure for obtaining them 'manually'. Some of the very few who worked through the calculations correctly then lost at least one mark by not giving their results to the required level of accuracy.

Answers: **(iv)** 20, 27.5, 32.5, 40, 55; **(v)** 32.4, 11.3.

Question 8

The majority of candidates were successful with the earlier parts of this question, which required 'standard' use of a cumulative frequency curve. However, part **(iv)**, requiring interpretation and application of the information given in the question about the cost of manufacture of the different categories of rods, proved very challenging to all but a very few.

Answers: **(ii)(a)** 58 to 59 mm; **(b)** 70 mm; **(iii)(a)** 20; **(b)** 8; **(c)** 132; **(iv)** \$5.6.

Question 9

As is common for questions on this topic, those parts requiring calculation were answered extremely well, those requiring comment and interpretation far less so. In part **(a)(ii)** only one candidate made any mention at all of the point which was being looked for, that the population size would depend on immigration/emigration as well as the number of births and deaths. Of the twelve marks available for calculation, the two most frequently lost by those candidates who were clearly familiar with the required methods were the two awarded in part **(b)(ii)** for giving the result to the required level of accuracy and for stating the units.

Answers: **(a)(i)** 4032; **(b)(i)** 8000, 7000, 112, 16; **(ii)** CDR =10.5 per thousand SDR = 9.8 per thousand.

Question 10

To score the first four marks candidates had to be able to interpret correctly the data presented to them in tabular form in the question. Some did this extremely well; for a few it clearly presented considerable difficulties. Graphical work was, in general, extremely good, the most common error being the plotting of the original figure for July 22, rather than the correct value which had been obtained in part **(iii)(b)**. One very pleasing improvement on recent years was that the majority of candidates split the data into the 'correct two halves' for calculation of the semi-averages. Work involving use of the graph was also generally quite good, except that very few realised that what was required in part **(vii)(b)** was the gradient of the line of best fit.

Answers: **(i)** 40 litres (45 allowed); **(ii)** July 15, 22, 24, 26; **(iii)(a)** July 18; **(b)** 205 km;
(v) (28.8125, 373.75), (19.25, 248.75), (38.375, 498.75); **(vii)(a)** 390 km; **(b)** 13.1 km/litre.

Question 11

This question was the source of a considerable number of marks for a majority of candidates. The pie chart and bar charts were generally well drawn and annotated, and most knew how to use the square of the radius correctly in the calculation required in part **(a)(ii)**. In part **(b)(ii)**, while most made a valid comment about the gender-related nature of the 'skilled percentages', few were able to make a second suitably appropriate comment about the other figures. Many did, however, give a valid reason for preferring to use bar charts for comparison in part **(b)(iii)**.

Answers: **(a)(ii)** 4.14 cm.

STATISTICS

Paper 4040/21

Paper 21

General comments

The overall standard of work submitted was better than that of last year and of a similar standard to that in 2008 and in recent, previous years. There were noticeably fewer instances of very low marks, although extremely high marks were also quite rare as many candidates struggled with questions requiring written explanations. In particular, questions that required candidates to justify the use of a particular statistical technique or to define a statistical concept proved difficult even for the most able candidates (see below **Question 3(i)** and **Question 10(v)** for examples of these).

There were a few instances of candidates offering more than one solution to a particular question, which usually prevents them from scoring marks which they might otherwise be able to obtain. Centres should therefore encourage candidates to cross out additional solutions, once they have decided which they think is correct, rather than leaving more than one solution to a question, and also to ensure that their final answer is represented on or as close to the answer line as possible.

In ***Section B*** there was no one particular question that proved particularly unpopular, as has sometimes been the case in the past. **Question 11**, on linear interpolation, proved to be the most popular, with **Question 10**, on sampling, also being tackled by the majority of candidates.

Finally, candidates must once again be commended for the excellent standard of most of the diagrammatic work presented.

Comments on specific questions

Section A

Question 1

Correct answers of P(A) + P(B) = P(AUB) or P(A∩B) = 0, for part **(i)**, and P(C∩D) = P(C) x P(D) or equivalent, for part **(ii)**, were sometimes seen, but it was rare for a candidate to score full marks in this question. Common errors were to say that the probabilities of A and B should sum to 1 in part **(i)** and to simply quote the addition rule of probability in part **(ii)**. There was evidence that some candidates had confused the ideas of mutually exclusive events and independent events.

In part **(iii)** it was necessary to use the addition rule of probability to show that events E and F were not mutually exclusive and not independent. Those candidates that attempted a calculation using the addition rule of probability were able to score at least some of the marks. Evidence of an actual calculation, using the values provided, was required in support of the candidate's conclusion; a statement that the events were not mutually exclusive or not independent was insufficient on its own, and did not score any marks.

Question 2

Most candidates were able to score some marks in this question. It was very rare for a candidate to score full marks, however, with part **(i)** and the upper class limits in parts **(ii)** or **(iii)** causing the most difficulty.

Answers: **(i)** 59.5, 69.5; **(ii)** 60, 70; **(iii)** 60, 69.

Question 3

Part **(i)** of this question required candidates to justify the use of a bar chart by stating either that the data is discrete or that it is qualitative. This is an example of one of the questions, mentioned in the general comments of this report, where candidates found it difficult to justify the use of a particular statistical technique.

Most candidates scored full, or almost full, marks in parts **(ii)** and **(iii)** of this question, finding correct percentages in part **(ii)** and drawing accurate sectional bar charts with sensible scales in part **(iii)**. Occasionally a mark was lost for incomplete annotation of the graph, with the labelling of the vertical axis sometimes missing or inaccurate.

Answers: **(ii)** 25, 22.5, 12.5, 40 and 40, 35, 5, 20.

Question 4

There were many accurate calculations of the mean in part **(i)** of this question.

In part **(ii)** candidates needed to recognise that they had not been given any information regarding the original dispersion and therefore it is not possible to tell if the standard deviation will have changed or not. Many candidates incorrectly thought that this question was something to do with scaling, and mentioned that the standard deviation is not affected by addition. This suggests these candidates were misunderstanding the difference between adding a constant to each value of a variable and adding additional values to the set of variables.

Answer: **(i)** 2.6.

Question 5

A significant number of candidates were able to score full marks in this question. Those that did not score full marks usually managed to score part marks by writing down at least one half of the equation to be solved. The most common error in part **(ii)** was to have two correct standardised quantities but in different, rather than the same, unknown.

Answers: **(i)** 31; **(ii)** 74.

Question 6

Many candidates were able to score the first mark in part **(i),** by correctly stating the probability that Raoul would hit the target on his first throw, but it was much less common to see correct answers for the second and third probabilities in the table.

Candidates who had got part **(i)** correct usually went on to score full marks in part **(ii)** as well. Those who had made errors in part **(i)** often went on to score marks in part **(ii)** by applying the correct expectation method. It was pleasing to see that many candidates understood the concept of a fair game.

Answers: **(i)** 0.2, 0.16, 0.128; **(ii)** $3.44.

Question 7

In general the numerical parts of this question were answered very well and the parts requiring comments less well. In part **(i)(b)**, for example, it was very rare to see candidates who had successfully calculated the simple average in part **(i)(a)** going on to explain that this average took no account of the relative importance, or the weights, of the items.

Calculations were usually correct in part **(ii)**, with the most common error being, as has been the case in previous years, that the answer was not given to the required degree of accuracy. Many correct answers were seen to part **(iii)** with most candidates including all the working required.

In part **(iv)** it was rare to see candidates showing an understanding that weights are proportional to expenditure. In part **(v)(a)** many candidates were able to score some of the marks by appreciating that the base date had changed, but often did not provide the additional detail that prices had increased from January to June. To score full marks in part **(v)(b)** candidates needed to comment on the fact that the base date and the date on which the weights had been calculated were different and that therefore these weights may not have remained accurate for the new base date.

Answers: **(i)(a)** 109; **(ii)** 109.

Question 8

This question, on moving averages, was generally well answered with the exception of part **(i)**. Here, many candidates did not express that moving average values should occur at the same points in time as the original data.

Many candidates were able to plot points accurately on the given scale in parts **(ii)** and **(iv)(a)**. The three-point moving average values were often correct in part **(iii),** although they were not always placed in the correct positions on the table and sometimes a full calculation for one of the values was missing. In part **(iv)(b)** the majority of candidates were able to interpret that the trend line showed an increase in the number of days lost.

More correct attempts to parts **(v)** and **(vi)** were seen than have been evident in similar questions in the past. Most candidates appreciated that the seasonal components must sum to zero and those that had made errors in part **(v)** were often able to score follow-through marks in part **(vi)** by correctly adding the value obtained from the graph to their seasonal component.

Answers: **(iii)** 333, 336, 343, 345, 348, 361, 366; **(v)** –47.

Question 9

This question on probability caused more difficulties, even for the most able candidates, than has been the case in the past. Most candidates were able to score at least some of the marks, and there were very few errors in parts **(i)** and **(ii)(a)**. Part **(ii)(b)**, however, caused difficulties with many candidates ending up with an answer for this probability greater than 1.

In part **(iii)** many candidates correctly dealt with the fact that this question involved a 'with replacement' scenario and thus scored some of the marks, but did not consider in how many ways one person could be selected from each of the age groups.

Candidates were often successful with part **(iv)(b)**, where they correctly dealt with the fact that this question involved a 'without replacement' scenario. In part **(iv)(a)**, however, incorrect denominators of 70 were often seen. Some candidates were successful with **(v)(a)**, but it was quite rare to see a correct solution to **(v)(b)**, with an incorrect answer of 15/130 quite often seen.

It was pleasing to see that the vast majority of candidates followed the instruction to give answers either as exact fractions or as decimals correct to 3 decimal places.

Answers: **(i)** 40, 50, 40, 60, 70, 130; **(ii)(a)** 0.462; **(b)** 0.808; **(c)** 0.517; **(iii)** 0.218; **(iv)(a)** 0.158; **(b)** 0.153; **(v)(a)** 0.362; **(b)** 0.319.

Question 10

This question on sampling proved to be both more popular and more successfully completed than similar questions on this topic have been in the past.

Most candidates were able to find the simple random sample in part **(i)**. A common error in part **(ii)(a)** was to state that the largest possible two-digit number for the systematic sample was 06 rather than 05. Such candidates had often got the smallest possible two-digit number correct and were therefore able to complete this part of the question, although some tried to use numbers from the random number table to find the remaining residents for the systematic sample.

Most candidates were able to find the sizes of the strata in part **(iii)** and use the random number table to find the members of the stratified sample. In part **(iv)** there were many more attempts at answers which correctly referred to the specific samples that had been chosen than have sometimes been seen in the past. Unfortunately some of the answers lacked sufficient detail to score full marks. Candidates needed to note that the simple random sample over-represented Jamaica Drive or under-represented Liberia Avenue and that the systematic and stratified samples represented the streets exactly.

Part **(v)** is an example of the sort of question, referred to in the general comments of this report, where candidates had to define a statistical concept. In defining an unbiased sample, candidates needed to state that it is one which represents a population exactly. In defining an unbiased method of sampling, candidates needed to state that it is one in which every item has an equal chance of being selected.

Answers: **(i)(a)** 00, 14, 50, 10, 29, 11, 01, 43, 45; **(b)** Jamaica 5, Liberia 1, Malawi 3; **(ii)(a)** 00, 05; **(b)** 00; **(c)** 06, 12, 18, 24, 30, 36, 42, 48; **(iii)(a)** Jamaica 4, Liberia 2, Malawi 3; **(b)** 25, 07, 50, 22, 11, 05, 26, 40, 46.

Question 11

This question was attempted by almost all candidates. Many scored the majority of the first 13 marks, with errors tending to be arithmetic rather than in the method. However, only a minority knew how to approach part **(iv)**.

In part **(i)** candidates needed to comment on the existence of extreme values and conclude that the median was therefore the more appropriate measure in this case.

Most candidates were successful in parts **(ii)** and **(iii)** with errors tending to be arithmetical. Some candidates did not give answers to the stated degree of accuracy.

Many candidates struggled with part **(iv)**, often considering all 40 invoices in the '$150 – under $200' class as being over $160, rather than attempting to find the correct proportion of this amount.

Answers: **(ii)** 44, 238, 395, 526, 595, 635, 693, 700; **(iii)(a)** 41.40; **(b)** 82.87; **(iv)** 13.9.

STATISTICS

Paper 4040/22

Paper 22

General comments

The overall standard of work submitted was better than that of last year and of a similar standard to that in 2008 and in recent, previous years. There were noticeably fewer instances of very low marks, although extremely high marks were also quite rare as many candidates struggled with questions requiring written explanations. In particular, questions that required candidates to justify the use of a particular statistical technique or to define a statistical concept proved difficult even for the most able candidates (see below **Question 3(i)** and **Question 10(v)** for examples of these).

There were a few instances of candidates offering more than one solution to a particular question, which usually prevents them from scoring marks which they might otherwise be able to obtain. Centres should therefore encourage candidates to cross out additional solutions, once they have decided which they think is correct, rather than leaving more than one solution to a question, and also to ensure that their final answer is represented on or as close to the answer line as possible.

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Answers: **(i)(a)** 00, 14, 50, 10, 29, 11, 01, 43, 45; **(b)** Jamaica 5, Liberia 1, Malawi 3; **(ii)(a)** 00, 05; **(b)** 00; **(c)** 06, 12, 18, 24, 30, 36, 42, 48; **(iii)(a)** Jamaica 4, Liberia 2, Malawi 3; **(b)** 25, 07, 50, 22, 11, 05, 26, 40, 46.

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Many candidates struggled with part **(iv)**, often considering all 40 invoices in the '$150 – under $200' class as being over $160, rather than attempting to find the correct proportion of this amount.

Answers: **(ii)** 44, 238, 395, 526, 595, 635, 693, 700; **(iii)(a)** 41.40; **(b)** 82.87; **(iv)** 13.9.

STATISTICS

Paper 4040/23

Paper 23

General comments

As in previous sessions, there were again numerous examples of marks being lost through final answers not being given to the levels of accuracy required by questions, when this was stated. The general standard of comments did, however, show a slight improvement from previous years, and there were two occasions on which it was very pleasing to see the attempts at relevant comment being made. Numerical work tended to be good, and the limited amount of graphical work required was of a high standard.

This was the second year of papers in this subject being in their new format, where answers are written on the question paper, and all candidates appeared to be familiar with the format, and to know how to present their answers.

In recent years it has been noticeable that fewer and fewer candidates are able to calculate a standard deviation accurately, or even apply a valid method. Both in Paper 1 (where the data was in the form of a grouped frequency distribution) and Paper 2 (individual values, but all relevant totals either given or evaluated in earlier parts of the question) the number of candidates who obtained a standard deviation correctly and accurately was very small. While the standard deviation is not the most simple measure of dispersion to obtain, it is certainly the most important, and candidates need to be able to obtain it 'manually', making at the very most a minor numerical error in their calculations. It is difficult to deduce the reasons for this trend, but it is possibly because in their everyday work and study candidates use a button on their calculators which obtains a standard deviation automatically, and hence do not get sufficient practice in performing the relevant calculations themselves; teachers are advised to encourage practice of the full method.

Comments on specific questions

Section A

Question 1

There were a number of commendable attempts at this question, and provided that an offered explanation gave the impression of attempting to make the appropriate point it was credited. Part **(iii)** was most frequently explained correctly.

Answers: **(i)** C; **(ii)** A; **(iii)** B.

Question 2

There was some confusion about independence and mutual exclusivity, in that answers offered for the two parts of **(a)** were often the wrong way round. Part **(b)** was generally not answered very well, and few candidates realised that, because of the symmetrical nature of the scenario, the answer to part **(c)** would be the same as that to **(b)**.

Answers: **(a)(i)** A&D or B&D; **(ii)** A&B or A&C or B&C; **(b)** 5/12; **(c)** 5/12.

Question 3

The correct determination of true class limits plays an important part in the calculation of statistics based on grouped frequency distributions, and it is something on which teachers would be advised to concentrate. The two issues which candidates should take into account when considering their answer to any part are the level of accuracy to which the data has been recorded, and whether the variable concerned is discrete or continuous.

Answers: **(i)** 45 55; **(ii)** 44.5 54.5; **(iii)** 45 54.

Question 4

Most candidates had little difficulty in obtaining the first three marks, but, as mentioned in the general comments, there was an almost total absence of correct calculation of the standard. In this question, relevant summations had either been given, or were easily obtainable in the first three parts of the question, and yet few attempts at even the correct method were seen in part **(iv)** and even fewer correct results.

Answers: **(i)** 520; **(ii)** 13; **(iii)** 11523; **(iv)** 10.9.

Question 5

Both parts of this question were generally very well answered. Unfortunately, a number who had correctly worked through the calculations required in part **(i)** then lost a mark by not giving their final answer to the required level of accuracy. What was particularly pleasing, given how frequently answers requiring comment and/or interpretation are of a far lower standard than those requiring calculation, was the general standard of answers offered to part **(ii)**. The vast majority of candidates realised that they firstly had to compare their answer to part **(i)** with 11%, and then draw an appropriate conclusion.

Answer: **(i)** 13.1%.

Question 6

This question was on the same general topic, index numbers, as the previous question, and answers presented for that indicated that candidates were able to deal with the numerical side of the topic well. However, whereas little difficulty was experienced by almost all candidates in calculating a price relative, for example, very few were able to put into words an explanation of exactly what a price relative is. The two 'sides' of the topic need to be studied equally thoroughly, so that they are complementary.

Section B

Question 7

Questions on the topic of expectation have always been relatively unpopular, and so it was pleasing to see a higher proportion than usual of candidates attempting this question, particularly given that the other four questions in ***Section B*** were all of a very standard type on the topics they were testing. As usual, some candidates worked a few parts, only to decide that they did not wish to proceed further with the solution, but there were quite a number who worked right through the question, getting many of the answers correct.

Answers: **(i)** and **(iv)**

Possible total scores	6	8	10	12	13	14	15	17	20
Probability	1/9	2/9	2/9	1/9	1/9	1/36	1/9	2/36	1/36

(ii) 1/36; **(v)** \$13.89;

(vi) and **(vii)**

Possible total scores	6	8	10	13	15	20
Probability	1/9	2/9	1/9	2/9	2/9	1/9

(viii)(b) Expert's expected prize = \$25.

Question 8

This was a very standard question on the topic of moving averages, and most candidates who attempted it scored highly. The only part which was not answered well was part **(vi)**. Examination of the quarterly components needed to involve consideration of their sign and size, with comments then being made for each quarter indicating whether the actual cost of electricity would be more or less than that indicated by the trend line, and by what order of quantity.

Answers: **(i)** 201, 757, 1504, 188; (**v)** 10.4.

Question 9

Although this question was very typical of the 'pure probability' question which has appeared in Paper 2 in previous years, attempts at it were not as good as the usual high standard. Surprisingly few candidates realised that the answer to part **(a)(ii)** was simply 1 minus the answer to **(a)(i)**. In part **(a)(iv)** few candidates appreciated that when evaluating the probabilities of each combination of three people arriving they also had to include the probability that the fourth person did not arrive. Very few marks were scored in part **(b)**. The explanation being looked for was that the given probabilities were those of the outcomes of four separate events, not of four different outcomes of one event.

Answers: **(a)(i)** 3/10; **(ii)** 7/10; **(iii)** 4/15; **(iv)** 11/45.

Question 10

This question was very typical of the sampling questions which have appeared in Paper 2 in recent years, and many candidates have clearly become very proficient in applying the different sampling methods requested. Most candidates managed to score at least ten marks. There are still some, however, who need to learn to apply the method of systematic sampling correctly, and not make the mistake of taking values at regular intervals from the random number table. Comments in part **(v)** on how well each sample represented the population tended to be more appropriate than in previous years, possibly partly because the question asked about each one separately, but some still need to improve their answers by putting their comments into context. It was very pleasing, however, to see some good attempts at part **(vi)** as this was something which had not been asked in previous papers.

Answers: **(i)** 82, 60, 12, 02, 69; **(ii)(a)** 00, 19; **(b)** 02; **(c)** 22, 42, 62, 82; **(iii)(a)** 3 male, 2 female;
(b) 21, 02, 08, 91, 65; **(iv)(a)** Group I – 1, Group II – 2, Group III – 2; **(b)** 14, 45, 74, 01, 51.

Question 11

High marks were scored by many candidates on the four numerical parts of this question, a very standard one on the topic of estimating numerically various measures associated with the median. The various 'definitions' of these measures for a grouped frequency distribution were all catered for in the tolerances allowed in the final answers. Only a small number of candidates were able to supply the comment being looked for in part **(iii)**, which was that it should not have been surprising that the mean and the median were very similar in value as the distribution was not far from being symmetrical.

Answers: **(i)** 3 20 70 115 161 218 241 250 **(ii)** 58.38 or 58.41 **(iv)** Any value in the range 6.45 to 6.50 inclusive **(v)** 39.6% or 39.74%