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Statistics 1389

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Examiners' Report

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# 1. PRINCIPAL EXAMINER'S REPORT - PAPER 1389 / 1F

## 1.1. GENERAL POINTS

- 1.1.1. The paper seemed to be accessible to most candidates and they appeared to have adequate time to complete it. There were some questions that individual candidates did not tackle but this was probably more because they could not do the question rather than through lack of time. It was noticeable that a sizeable minority of candidates had difficulty in giving answers, based on the statistics, to some of the interpretative questions. It also seemed that weaker candidates did not take enough time reading what the question answered. They homed in on the first line only and put what they thought was required. An example of this was 'when asked to give an advantage of using closed questions' they gave an example of one.

## 1.2. REPORT ON INDIVIDUAL QUESTIONS

### 1.2.1. Question A1

Virtually all candidates could place an A at a probability of 0.5 but many had difficulty with placing the B and C. It was common to see all three letters at 0.5 or B at 0 and C at 1.

Candidates did not seem to appreciate the need for accuracy. Few measured the line. Had they done so they would have found it was 14 cm in length. This should have made placing B at  $\frac{2}{7}$  and C at  $\frac{5}{7}$  easy.

### 1.2.2. Question A2

Most candidates liked this question and produced good answers. Part (b) sometimes caused problems. An answer of 'detached housing is expensive' was given in quite a number of cases. This of course was a matter of opinion and was not a conclusion that could be drawn from the bar chart. While many candidates did appreciate the need for 'a comparative statement' a number homed in on the word 'average' and worked the meaningless average price of a detached house. Generally part (c) was done well.

### 1.2.3. Question A3

This was done badly. Many candidates realised that the thick line and shading was misleading but this was not a suitable answer for part (a). The question asks about the increase looking bigger than it was. An answer referring to the scale or pence was required.

Most candidates did not appreciate that the 2003 on the horizontal axis was badly placed. Many candidates answered this question by saying such things as 'the line is wiggly'.

#### 1.2.4. Question A4

Parts (a) (b) and (c) were quite well done although some candidates had no idea how to get estimated figures off the graph by using the line of best fit.

Part (d) was only done correctly by the more able. Most candidates gave answers that were not based on the available statistics. Long essays on muscles, weight lifting and beer bellies were very common.

#### 1.2.5. Question A5

It is disappointing to find that many candidates can still not deal with a question that is really only 'book work'. A number of candidates said that a census would be quick to do. In (b) rather than giving an advantage of a closed question candidates gave an example of a closed question. In part (c) answers suggesting one manager should read it through were common. One manager is not enough. Part (d) was done well although some candidates did not put in boxes even though the question told them to include them. Others copied out the leading question in the text but did not put in boxes.

#### 1.2.6. Question A6

A number of candidates seemed to be confused about what was involved in the survey. They thought that the van colours of the employees were what was to be surveyed.

Part (a) was well done although some interesting spellings were used. In part (b) a sizeable minority of candidates chose A because workers were going to work at that time. They did not appreciate that this would give a biased sample. Part (c) was done well. Candidates clearly had experience of using tally charts and realised how easy they are to use.

#### 1.2.7. Question A7

All parts of this question were done well. A few candidates wrote the probabilities in the form of a ratio rather than a fraction, decimal or percentage.

#### 1.2.8. Question B1

Most candidates could do this question. In a few cases rather than give the source in (b) they gave the figures. It is important to read the question carefully and candidates could be advised to use a ruler to help them scan across a table that is the page width.

Most candidates understood how to describe the trend but some still quote figures for each year.

### 1.2.9. Question B2

It was quite obvious that many centres had not covered this part of the specification. Most candidates made a guess which was always incorrect. Those candidates who had covered the work often got high marks for this question. The main error came in part (a) where a number of candidates divide 70000 by 86000 rather than the other way round. Some candidates got this correct but then failed to multiply by 100 and got an answer of 1.228. A very few candidates forgot to give the answer to the nearest whole number.

Some candidates often involved themselves in dividing by the base year.

### 1.2.10. Question B3

Most candidates could tackle some parts of the question. The mode was almost always correct but a number of candidates got the median and the mean muddled. Some hedged their bets by putting in an answer for each of (b) and (c) and then joining them with double ended arrows. In some cases candidates rounded the answer when finding the mean. They should only do that when told to do so.

Part (e) was badly done. The expression statistical measure was not understood and answers of 'graphs' or 'box plot' were common. The question also says **other** statistical measure but many candidates gave the ones already calculated in the question.

### 1.2.11. Question B4

It is surprising how many candidates do not understand what is meant by cumulative frequency. They commonly use it in coursework but don't seem to recognise the words on the question paper. In part (b) many candidates plotted points at the half way mark rather than the end and those that did join their points often forgot to join them to (0, 0). Others lost marks for being very careless in joining their points.

Part (c) was done well by very few candidates. They did not remember that halfway up the cumulative frequency gives the median. Many drew a line across at 55 which is half way up the graph; others drew their line from half way along the x axis. Many of those who did manage to get the line in the correct place seemed to have little idea of how to use it to find the median time. Candidates commonly rounded the value up to 2 and lost both marks unless there was a correct method mark on the graph.

Part (d) was generally done well although a few candidates added up all the minutes late and said as that was more than 12 minutes the train was very late and performed badly. 'It was never late' scored no marks as it is an incorrect statement.

### 1.2.12. Question B5

Part (a) was very well done but the rest was done very badly. Many candidates have no idea how to use a tree diagram and 'added down the branches' instead of multiplying.

A common answer to part (b) was  $0.9 + 0.9 = 1.8$  and to part (c)  $0.9 + 0.1 = 1$ .

Candidates who knew how to tackle the question generally got full marks for (b) but only completed half of (c). A common answer from these candidates was  $0.9 \times 0.1 = 0.09$  - they did not realise that two branches were needed.

### 1.2.13. Question B6

A few candidates do not know how to find the lower and upper quartile. They gave the lower and upper limits as answers to (a). Many candidates coped well with drawing a box plot but could not do part (c). Long answers about fat in eggs were given but it was not realised that actual comparisons of the box plots was needed.

Answers to this type of questions should really compare measures of centrality and of spread. In this case medians and ranges (or inter-quartile ranges) should be compared. Some candidates considered skew and this was accepted as a comparison but many could not remember the difference between positive and negative skew - a common problem at all levels of statistics.

### 1.2.14. Question B7

Most candidates knew the advantages of sampling and overall this question was well done. A few candidates did not have a protractor so lost marks in part (d). Others shifted the centre slightly which led to inaccuracies. A few did not label with words - they just put the angle size or nothing which again lost them a mark.

Part (c) was well done.

### 1.2.15. Question B8

Most candidates could draw a trend line although a few just joined the points together covering the dotted line. Parts (b) and (c) were done well.

Part (d) caused much difficulty. Few candidates understand the unreliability of extrapolation. We did not expect use of the word 'extrapolation' but some idea of how the past can not necessarily affect the future was required. Many candidates gave none statistical answers such as 'there may be a war'.

Part (e) was done a little better. Those candidates who understood how to use the trend line did well. Others managed to get a mark by writing 'no' but failed to say why.

## 2. PRINCIPAL EXAMINER'S REPORT - PAPER 1389 / 1H

### 2.1. GENERAL POINTS

- 2.1.1. This paper was accessible to the majority of candidates, many of whom were able to make significant progress in questions throughout the paper.
- 2.1.2. The presentation of work was generally good, though candidates should be reminded to work within the space provided.
- 2.1.3. An increasing number of candidates are showing the intermediate stages in their calculations, but the poor use of calculators, or the inaccurate application of formulae such as Spearman's correlation coefficient, was an issue for many candidates.
- 2.1.4. Clear unambiguous responses continue to be a problem for many candidates, but there was a significant improvement in the answers to some of the more familiar questions.

### 2.2. REPORT ON INDIVIDUAL QUESTIONS

#### 2.2.1. Question A1

This question proved to be a good introduction to the paper. The vast majority of candidates were able to extract the required information from the table in parts (a) and (b), and most were able to describe the trend in part (c). "Decreasing" and "going down" were popular correct answers. A small number of candidates calculated the year-to-year differences in the energy units.

#### 2.2.2. Question A2

In part (a), a large number of candidates did not appreciate the significance of the different sizes of the pie charts. Many thought that there was no change in the number of senior male players as half of the pie chart was being used in each year. A small number thought that it was impossible to say because there were no numbers given in the pie charts.

Part (b) was not answered well. Many candidates described how to take a stratified sample rather than explain why it was appropriate in the given context.

Part (c) was done quite well, with many candidates being able to calculate the number of junior players selected for the sample. The majority of candidates gave their final answer as 8, but there were some who gave 9.

### 2.2.3. Question A3

In part (a), only the best candidates related the ratio of the marked fish in the sample to the ratio of the marked fish in the population. A very popular error was to add 35, the number of marked fish in the second sample, to the original 40 marked fish. Many of those candidates who correctly wrote down the ratio  $\frac{5}{40}$  were then unable to proceed to the final answer 320.

Many candidates were able to give a suitable assumption about the population of fish in the lake, often when part (a) was wrong. A popular correct answer here was "stays the same"; whilst a popular incorrect answer was "there are a lot of fish".

### 2.2.4. Question A4

Part (a) was done well by many candidates, with only a few confusing census with Census.

In part (b), most candidates understood the difference between a closed question and an open question, but many had difficulty in expressing themselves clearly. A popular incorrect answer was "gets the answer they want".

Part (c) was done well. Many simply wrote "pilot survey", "pre-test" or "test it". Some insufficient responses referred to the necessity of checking individual questions to make sure they weren't leading or embarrassing; an activity belonging to an earlier stage in the design of the questionnaire.

Part (d) was generally done well, but some candidates, despite the demand in the question, did not give any response boxes. A small number of candidates did not rewrite the question in a suitable form, but gave a question unrelated to the given context.

### 2.2.5. Question A5

Only the best candidates were able to do part (a) well. A significant number of candidates, having achieved  $\sum d^2 = 20$ , were then unable to use the formula correctly to find the correlation coefficient; typically forgetting to subtract from 1, or combining 1 with the numerator of the fraction.

In part (b), only a small number of candidates were able to give a real world interpretation of their correlation coefficient, most just simply stated "positive correlation", or "good correlation". A surprising number of candidates seemed to be unaware that the magnitude of Spearman's correlation coefficient can not be greater than 1.

### 2.2.6. Question A6

This question was done well by the majority of candidates.

In part (a), most candidates were able to identify the word to complete each sentence.

In part (b), most candidates identified option C as the best method for conducting the survey, but the reasons for this were not always correct; often suggesting some advantage, or otherwise, to the employees.

In part (c), most candidates suggested that option Z was the best method for recording the data, with the majority stating that it was quicker and easier. Some candidates also explained the limitations of the other methods, and thus ran out of space for their response.

### 2.2.7. Question A7

Only the best candidates were able to make much progress with this question.

In part (a), a significant number of candidates who remembered to use the formula did this the wrong way round, i.e.  $Z = \frac{\mu - x}{\sigma}$ ; some used 100 and 400 for  $x$ .

In part (b), many candidates were unable to interpret their standardised scores, not realising that a negative value for the time of a race was a better result than a positive value, and that the larger the negative value the better the performance.

### 2.2.8. Question A8

In part (a), few candidates were able to recognise this method of sampling as systematic. Most thought that it was simply a random sample.

In part (b), many candidates were able to write down 95%. Some common incorrect answers were 50%, 75% and 98%.

In Part (c), many candidates were able to score 2 marks for calculating a critical value for the allowable limit, but a surprising number of these were unsure about what should happen next. Common incorrect answers were "take another sample", "top-up the sample to the right amount" and "re-start the machine".

### 2.2.9. Question B1

This question was done well by the majority of candidates.

In part (a), the majority of candidates were able to draw a suitable line of best fit. In part (b), virtually all the candidates were able to interpret the trend line as an increase in the total exports, but some stated "positive correlation".

In part (c), most candidates were able to use the trend line to predict the exports in 2004, but some were confused by the number of zeros their answer should have.

Part (d) was not done well. Although most candidates thought that the prediction was unreliable, only a small number of these thought that it was due to the problems associated with extrapolation. Many thought that it was due to the unpredictability of the economic market.

Part (e) was done well by most candidates, many spotted that the exports for 2005 did not follow the trend and gave a sensible reason for their answer—usually “it is too low” or equivalent.

#### 2.2.10. Question B2

In part (a), many candidates were able to identify the skew shown in the box plot as negative, but “positive”, and less frequently, “even spread”, were popular incorrect answers.

In part (b), fewer than half the candidates were able to write down the percentage of ages between the upper and lower quartiles; 25% was a popular incorrect answer.

Part (c) was done well by the majority of candidates. The number of centres using  $\frac{n+1}{4}$  and  $\frac{3(n+1)}{4}$  to work out the upper and lower quartiles is increasing.

In part (d), only the best candidates were able to show that 86 is an outlier for the data. A significant number of those candidates who remembered to use  $1.5 \times \text{IQR}$  to find the critical value added this to the median instead of the upper quartile.

In part (e), many candidates scored 2 marks for drawing an accurate box plot, but only the best were able to score the mark for the correct representation for the outlier. Many simply removed 86 from the data and terminated their whisker at 70.

In part (f), most candidates were able to score a mark for either comparing the medians, or comparing either the range or the interquartile range. A significant number of candidates compare point values, such as the highest or lowest value in each box plot, rather than the distribution as a whole.

#### 2.2.11. Question B3

Part (a) was done well by the vast majority of the candidates, most simply stating “negative”, but some giving a practical interpretation.

In part (b), most candidates were able to calculate the mean point of the data accurately, and then in part (c) plot this correctly on the graph. Many of those candidates who plotted a wildly incorrect mean point on their graph did not go back to check their calculations in part (b). Most of those candidates that plotted their mean point accurately then used this to help them draw their line of best fit.

Part (d) was done well by the vast majority of candidates.

In part (e), most candidates recognised that the specimen skull was not typical for this species of ape, and most were able to give a sensible reason for their answer. Statistical reasons were most common, such as "it's a long way from the rest of the data", but practical reasons were often given too, such as "it may be a baby".

In part (f), most candidates thought that the line of best fit would be unreliable when predicting the volume of the skull, many giving the reason that the line in some way goes off the scale at this point, e.g. "it's negative there".

Only the very best candidates were able to score full marks in parts (g) and (h).

In part (g), some candidates recognised the mathematical meaning of the value  $a$  and the value of  $b$  and attempted to find the gradient and intercept of their line of best fit. Many candidates using the correct method to determine the gradient either made an error in interpreting the scale of the graph or neglected to include a minus sign with their final answer.

In part (h), only a very small number of candidates were able to give a practical interpretation for their gradient, many simply stating that " $a$  is the gradient".

#### 2.2.12. Question B4

Part (a) was done well by most candidates.

In part (b) many candidates recognised the need to multiply the probabilities and did so accurately; but a significant number of candidates, having shown an intention to multiply the probabilities, then added them.

In part (c), most candidates were able to score a mark for multiplying two relevant probabilities, but few achieved full marks. A significant number of candidates made either an error in the multiplication of the fractions, or were confused about the operations they were using- multiplying instead of adding and vice versa.

Only the best candidates were able to score many marks in parts (d), (e) and (f).

In part (d), few candidates were able to identify the binomial distribution, “normal” or, less often, “uniform” were the most common incorrect answers.

Most candidates were unable to calculate any of the probabilities in parts (e) and (f), but many scored a mark for writing 0.2 in part (e). A common error in part (f) was to use the expectation formula  $n \times p$  to calculate the most likely number of hits.

### 2.2.13. Question B5

In part (a), only the best candidates were able to score full marks. Many knew that they were required to calculate  $\bar{fx}$  using the midpoint of each interval, but a significant number of candidates divided the sum of these by 5. A common error for weaker candidates was to simply add the frequencies and divide by 5.

Of the candidates who knew how to draw a histogram in part (b), by far the most popular method was to calculate the heights of the bars by frequency/class width. The most popular incorrect method was to simply draw a bar chart. Candidates should be encouraged to either label the vertical axis of a histogram or give a key.

Few candidates were able to score both marks in part (c), but many scored one mark for realising that they were required to find the 100th (or 100.5th) value of the data.

In part (d), many candidates thought that as the distribution was very nearly symmetrical than this was sufficient to describe it as normally distributed. Of the candidates who described the distribution as having skew, there were as many who thought the distribution had a negative skew as those who thought it had a positive skew. Few candidates justified their assertions by comparing their answers to parts (a) and (c).

### 2.2.14. Question B6

Part (a) was done well by most candidates, though some had difficulty providing an appropriate disadvantage. A common incorrect answer here was “that data could be wrong”.

In Part (b), only the best candidates were able to calculate the chain base index numbers for the data. A common error here was to calculate the fixed base index number.

Many candidates attempted part (c), but few were able to calculate the appropriate mean. By far the most common error was to calculate the arithmetic mean, but some candidates added the data and took the fourth root, whilst others wrote down the correct calculation but were unable to it on their calculator.

In part (d), only the very best candidates were able to give an adequate interpretation of their geometric mean.

### 3. PRINCIPAL MODERATOR'S REPORT - PAPER 1389 / 02

#### 3.1. GENERAL POINTS

- 3.1.1. The administrative work was generally managed well by most of the centres. Generally the work arrived with the moderator on time and was accompanied by the task sheets signed by the teacher and candidate to authenticate the work. Only a few centres failed to ensure these sheets were signed and that the sample contained the pieces of work with the lowest and highest marks. Failure to include these can distort adjustments if they are required.
- 3.1.2. Some centres had withdrawn the candidates but did not send work of comparable candidates even on request. Having the samples in the order on the Optems does help in the checking process.
- 3.1.3. A few centres sent in only the marks for GCSE Mathematics Data Handling or only an overall marks. It is essential that the task sheet with the breakdown of marks for GCSE Statistics is present for each candidate in the sample.
- 3.1.4. Moderation time is saved if candidates use treasury tags or string to secure their projects, numbered pages also helps. Plastic wallets take more time to deal with and are often overfilled.

#### 3.2. COURSEWORK TASKS

The coursework submitted was generally appropriate and covered the requirements of the specification.

Very few centres allowed the candidates to choose their own topic for their projects. The work produced by candidates following a topic of interest to them selves generally allowed them to demonstrate creativity and enthusiasm. These candidates often produced some very thorough and excellent work.

A number of candidates seem to believe that it is quantity of coursework rather than quality that is needed for a high mark. They are often restricted by teacher suggestion to tackling a statistically limiting hypothesis. In some cases, it was a classroom exercise and not a project at all. Usually a number of undemanding tasks were set up to demonstrate techniques. The methods used were the same and correspondingly, many candidates ended up being moderated to similar outcomes. In many cases it is unclear how much original thought candidates have put into their own work! It is very difficult for candidates to achieve 'A' Grade marks with this amount of direction.

Handwriting was not a very big issue this year but centres should carry on encouraging the candidates to make use of word processor and other software.

## ASSESSMENT

Some centres made a very good effort to provide annotated guidance on a separate paper under each strand and others provided it on the coursework.

A few did not provide any annotation. Many centre were generous with marks at higher level and rather harsh with lower achieving candidates.

Many centres went out of tolerance or became inconsistent for not carrying out the internal moderation required when a centre has more than one assessor. In a minority of cases, centres did not understand how to mark using the published criteria. It is easier for the moderator to provide feedback if he or she can see where the centre is awarding marks. Centres who are unsure should look at the coursework guide, which exemplifies the criteria and provides additional exemplar material.

### STRAND 1a: Planning

Many centres marked the first strand inconsistently. A mark of four in the first strand was often awarded where it was not warranted. Only the best candidates gave sensible reasons for their choice of hypothesis/es.

The overview of a demanding problem, which requires the hypothesis to be broken down into several strands together with a strategy for dealing with each strand using appropriate techniques, is required. Students often did not have a strategy. Many chose the project as an opportunity to practice A-grade techniques without reasons. They failed to give reasons for their choices and simply listed a large number of techniques they were going to use. Duplication of methods and more worryingly superfluous use of techniques were all too evident. A more creative and sophisticated approach is needed to achieve marks of 4 or 5. Few candidates could anticipate problems and plan for ways to overcome them. Hardly any planned to compare their results with and without outliers.

### STRAND 1b: Collecting

Sampling detail was wanting in many cases.

Candidates awarded a mark of 3/4 would state that they would 'press' the random button (or equivalent).

Justification of all techniques was 'to avoid bias'. Why data might be biased and how the technique used may avoid it was not discussed.

Many candidates are still calling proportional sampling stratified sampling. A stratified sample is one with strata or layers with in it.

e.g. To produce a stratified sample comparing a sample of girls with a sample of boys, you might stratify the samples to ensure each age group is represented proportionally. The individuals are then picked randomly from within each stratum.

Outliers and the affect they have on the distribution are often overlooked. There was also a significant amount of confusion between 'outliers' and 'anomalies'.

### **Strand 2a**

In strand 2a, centres were more consistent up to assessment at mark 6.

Many candidates used their diagrams to make comparisons well this year, although they were not necessarily planned for.

There are still many cases of candidates drawing lines of best fit where they are not appropriate.

Many candidates had been instructed to include comparative box plots in their work, but relatively few could make more than superficial comparisons of medians, and sometimes inter-quartile range. It was noticed that that box plots were often poorly set up for comparison, e.g. on different pages and non-aligned axes. In the worst cases not even like with like!

Whilst the use of software is to be encouraged candidates must ensure that sensible scales are used and axes labelled if they are to be awarded marks in this strand.

Too many candidates who were assessed at a mark of 7 and above did not demonstrate that they understood what they were doing.

The sketch of the normal distribution with out discussion is worth very little.

Using histograms with unequal class intervals must be justified. Why were equal class intervals not used? Why use a percentage scale rather than raw scores?

### **Strand 2b**

Some centres seem to have encouraged candidates to demonstrate their use of ICT as well as performing their calculations by hand. Consequently, many candidates showed how they had calculated Spearman (for example) as well as being able to discuss what the result actually meant.

The use of the equation function in EXCEL ensured that candidates were able to obtain the equation for the line of best fit for their data, but these were often not used to enrich the analysis of the work. Some candidates inappropriately related the gradient of the line to the strength of the correlation. This apart the candidates who did use their equations of Line Of Best Fit used them well.

Many centres awarded credit for calculations, such as the standard deviation, which were then either not used, or used superficially. These "higher" calculations were rarely planned or justified- e.g. why use the standard deviation in preference to the inter-quartile range? Some centres still

encourage their students to use the product moment correlation coefficient without justification often when it is not really appropriate.

Some candidates made good use of statistical calculations such as spearman and standard deviation but centres must realise that any marks above 7 given for these are dependent on how they are used and the justification made. Numerical comparison without justification and interpretation are worth little above foundation level.

### Strand 3

Most candidates were able to make some kind of conclusion to their work. This was often a simple statement relating to their hypothesis. Lower ability candidates were often treated rather harshly, not being given credit for simple statistical statements. Interpretation was often good and many of the candidates tried to bring all the features of the project together. Some made a good effort to evaluate their strategy.

The weaker candidates described their calculations and or diagrams with out relating this back to the original problem and making an interpretation in context.

Candidates should be encouraged to discuss skew and symmetry from box plots. Some of the candidates plotted normal distribution curves but lacked discussion on  $2/3$  standard deviations.

Many candidates did not evaluate the significance, or the limitations, of their conclusion(s).

### 3.3. CONCLUSION

The general level of the coursework was very similar to last year though even more centres are stifling creativity by adopting a regimented approach with their most able candidates. Too much guidance is still preventing the best candidates producing work commensurate with their considerable ability.

A few candidates are still producing a massive volume of repetitive work instead of looking at a problem in depth and producing the quality required. More of the same provides additional evidence only to confirm the existing mark.

Some of the candidates produced exceptional work, which really impressed the moderator and left us feeling privileged to see it. The appreciation of statistics is improving. Thank you to all who have contributed to this.

## 4 STATISTICS

### 4.1 MARK RANGES AND AWARD OF GRADES

Unit/Component	Maximum Mark (Raw)	Mean Mark	Standard Deviation	% Contribution to Award
1389 / 1F	80	46.7	12.2	75
1389 / 1H	100	56.2	18.4	75
1389 / 02	40	20.7	5.5	25

### 4.2 GRADE BOUNDARIES

The table below gives the minimum raw marks required for each component grade

	Max	A*	A	B	C	D	E	F	G
1F	80				50	41	32	24	16
1H	100	76	60	44	29	18			
02	40	30	26	22	18	15	13	11	9

### 4.3 OVERALL GRADE BOUNDARIES

The table below gives the minimum subject marks required for each overall grade.

	A*	A	B	C	D	E	F	G
Foundatin				57	46	35	24	13
Higher	75	61	47	33	23			