**Averages and Spread**

**Q1, (Edexcel 6683, Jan 2008, Q2)**

Cotinine is a chemical that is made by the body from nicotine which is found in cigarette smoke. A doctor tested the blood of 12 patients, who claimed to smoke a packet of cigarettes a day, for cotinine. The results, in appropriate units, are shown below.

| Patient | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* | *I* | *J* | *K* | *L* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cotinine level, $x$ | 160 | 390 | 169 | 175 | 125 | 420 | 171 | 250 | 210 | 258 | 186 | 243 |

[You may use $\sum x^2 = 724\ 961$]

(a) Find the mean and standard deviation of the level of cotinine in a patient's blood.

**(4)**

(b) Find the median, upper and lower quartiles of these data.

**(3)**

A doctor suspects that some of his patients have been smoking more than a packet of cigarettes per day. He decides to use $Q_3+1.5(Q_3-Q_1)$ to determine if any of the cotinine results are far enough away from the upper quartile to be outliers.

(c) Identify which patient(s) may have been smoking more than a packet of cigarettes a day. Show your working clearly.

**(4)**

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**Q2, (AQA SS1B, Jan 2007, Q1)**

The times, in seconds, taken by 20 people to solve a simple numerical puzzle were

17 19 22 26 28 31 34 36 38 39
41 42 43 47 50 51 53 55 57 58

(a) Calculate the mean and the standard deviation of these times. *(3 marks)*

(b) In fact, 23 people solved the puzzle. However, 3 of them failed to solve it within the allotted time of 60 seconds.

Calculate the median and the interquartile range of the times taken by all 23 people. *(4 marks)*

(c) For the times taken by all 23 people, explain why:

(i) the mode is **not** an appropriate numerical measure;

(ii) the range is **not** an appropriate numerical measure. *(2 marks)*

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**Q3, (Edexcel 6683, Jan 2012, Q4)**

The marks, $x$, of 45 students randomly selected from those students who sat a mathematics examination are shown in the stem and leaf diagram below.

| Mark | | Totals |
|---|---|---|
| 3 | 6 9 9 | (3) |
| 4 | 0 1 2 2 3 4 | (6) |
| 4 | 5 6 6 6 8 | (5) |
| 5 | 0 2 3 3 4 4 | (6) |
| 5 | 5 5 6 7 7 9 | (6) |
| 6 | 0 0 0 0 1 3 4 4 4 | (9) |
| 6 | 5 5 6 7 8 9 | (6) |
| 7 | 1 2 3 3 | (4) |

| Key | (3\|6 means 36) |
|---|---|

(a) Write down the modal mark of these students.

**(1)**

(b) Find the values of the lower quartile, the median and the upper quartile.

**(3)**

For these students $\sum x = 2497$ and $\sum x^2 = 143\ 369$

(c) Find the mean and the standard deviation of the marks of these students.

**(3)**

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**Q4, (OCR 4732, Jun 2006, Q7)**

In a UK government survey in 2000, smokers were asked to estimate the time between their waking and their having the first cigarette of the day. For heavy smokers, the results were as follows.

| Time between waking and first cigarette | 1 to 4 minutes | 5 to 14 minutes | 15 to 29 minutes | 30 to 59 minutes | At least 60 minutes |
|---|---|---|---|---|---|
| Percentage of smokers | 31 | 27 | 19 | 14 | 9 |

Times are given correct to the nearest minute.

**(i)** Assuming that 'At least 60 minutes' means 'At least 60 minutes but less than 240 minutes', calculate estimates for the mean and standard deviation of the time between waking and first cigarette for these smokers. [6]

**(ii)** Find an estimate for the interquartile range of the time between waking and first cigarette for these smokers. Give your answer correct to the nearest minute. [4]

**(iii)** The meaning of 'At least 60 minutes' is now changed to 'At least 60 minutes but less than 480 minutes'. Without further calculation, state whether this would cause an increase, a decrease or no change in the estimated value of

**(a)** the mean, [1]

**(b)** the standard deviation, [1]

**(c)** the interquartile range. [1]

**Q5, (AQA SS1B, Jan 2008, Q6a-bi)**

For each of the Premiership football seasons 2004/05 and 2005/06, a count is made of the number of goals scored in each of the 380 matches. The results are shown in the table.

| Number of goals scored in a match | Number of matches | |
|---|---|---|
| | 2004/05 | 2005/06 |
| 0 | 30 | 32 |
| 1 | 79 | 82 |
| 2 | 99 | 95 |
| 3 | 68 | 78 |
| 4 | 60 | 48 |
| 5 | 24 | 30 |
| 6 | 11 | 9 |
| 7 | 6 | 6 |
| 8 | 2 | 0 |
| 9 | 1 | 0 |
| **Total** | **380** | **380** |

(a) For the number of goals scored in a match during the **2004/05** season:

(i) determine the median and the interquartile range; *(4 marks)*

(ii) calculate the mean and the standard deviation. *(4 marks)*

(b) Two statistics students, Jole and Katie, independently analyse the data on the number of goals scored in a match during the **2005/06** season.

- Jole determines correctly that the median is 2 and that the interquartile range is also 2.
- Katie calculates correctly, to two decimal places, that the mean is 2.48 and that the standard deviation is 1.59.

(i) Use your answers from part (a), together with Jole's and Katie's results, to compare briefly the two seasons with regard to the average and the spread of the number of goals scored in a match. *(2 marks)*

**Q6, (AQA SS1B, Jun 2011, Q1)**

The number of matches in each of a sample of 85 boxes is summarised in the table.

| Number of matches | Number of boxes |
|---|---|
| Less than 239 | 1 |
| 239–243 | 1 |
| 244–246 | 2 |
| 247 | 3 |
| 248 | 4 |
| 249 | 6 |
| 250 | 10 |
| 251 | 13 |
| 252 | 16 |
| 253 | 20 |
| 254 | 5 |
| 255–259 | 3 |
| More than 259 | 1 |
| **Total** | **85** |

**(a)** For these data:

**(i)** state the modal value; *(1 mark)*

**(ii)** determine values for the median and the interquartile range. *(3 marks)*

**(b)** Given that, on investigation, the 2 extreme values in the above table are 227 and 271 :

**(i)** calculate the range; *(1 mark)*

**(ii)** calculate estimates of the mean and the standard deviation. *(4 marks)*

**(c)** For the numbers of matches in the 85 boxes, suggest, with a reason, the most appropriate measure of spread. *(2 marks)*