## AQA

Please write clearly in block capitals.

Centre number


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## MATHEMATICS

## Unit Statistics 1B

## Wednesday 7 June 2017 Morning <br> Time allowed: 1 hour 30 minutes

## Materials

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

## Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer all questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do not use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want

| For Examiner's Use |  |
| :---: | :---: |
| Question | Mark |
| 1 |  |
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| TOTAL |  | to be marked.

- The final answer to questions requiring the use of tables or calculators should normally be given to three significant figures.


## Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75 .
- Unit Statistics 1B has a written paper only.


## Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.


## Answer all questions.

Answer each question in the space provided for that question.

1 A tennis ball was dropped onto a concrete floor from 12 different heights between 25 cm and 300 cm . In each case, the height, $x \mathrm{~cm}$, from which the ball was dropped and the height, $y \mathrm{~cm}$, above the floor to which the ball bounced were measured.

The results are summarised as follows.

$$
S_{x x}=89375 \quad S_{x y}=44725 \quad \bar{x}=162.5 \quad \bar{y}=83.0
$$

(a) Calculate the equation of the least squares regression line of $y$ on $x$.
(b) (i) Estimate the height to which the tennis ball bounces when it is dropped from a height above the floor of 175 cm .
(ii) Explain why your equation may not be appropriate to estimate the height to which the tennis ball bounces when it is dropped from a height above the floor of 4 metres.
[2 marks]

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2 The durations, in minutes, of a sample of 10 telephone calls to a helpline were as follows.

$$
\begin{array}{llllllllll}
32 & 15 & 10 & 17 & 32 & 8 & 20 & 38 & 25 & 18
\end{array}
$$

The duration of calls to the helpline has a known standard deviation of 7.5 minutes.
(a) Stating two necessary assumptions, construct a $95 \%$ confidence interval for the mean duration of telephone calls to the helpline.
(b) Hence comment, with justification, on a claim that the mean duration of telephone calls to the helpline is 25 minutes.

| QUESTION <br> REFERTNCE | Answer space for question 2 |
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3 The heights, in centimetres, of a sample of 80 men were measured. For each man, his height in excess of $\mathbf{1 7 5} \mathbf{~ c m}$ was recorded. The results are summarised in the table.

| Height (cm) | Number of men |
| :---: | :---: |
| $0-2$ | 5 |
| $2-4$ | 9 |
| $4-6$ | 11 |
| $6-8$ | 21 |
| $8-10$ | 17 |
| $10-12$ | 10 |
| $12-14$ | 7 |
| Total | $\mathbf{8 0}$ |

(a) Calculate estimates for the mean and the variance of the heights in the table.
(b) Hence find estimates for the mean and the variance of the actual heights of the 80 men.
[2 marks]
(c) Given that 1 foot is equal to 30.48 cm , find, in feet, estimates for the mean and the variance of the actual heights of the 80 men. Give your answers to three significant figures.

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4 Every week, Hilda buys four apples and three bananas from her local greengrocer. The table shows the total weight, $x$ grams, of the four apples and the corresponding total weight, $y$ grams, of the three bananas for each of a random sample of 13 weeks.

| $\boldsymbol{x}$ | 562 | 633 | 578 | 621 | 558 | 593 | 607 | 638 | 527 | 623 | 579 | 588 | 524 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\boldsymbol{y}$ | 366 | 320 | 379 | 407 | 422 | 394 | 325 | 369 | 387 | 395 | 446 | 364 | 457 |

(a) Calculate, to three decimal places, the value of the product moment correlation coefficient, $r$, between $x$ and $y$.
(b) Interpret, in context, your value for $r$.
(c) Howard, Hilda's husband, claims that each week she buys either big apples and big bananas or small apples and small bananas.

Comment on Howard's claim.

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5 The weight, $X$ grams, of a bar of PureAV soap may be modelled by a normal distribution with mean 105 grams and standard deviation 4 grams.
(a) Determine the probability that the weight of a randomly selected bar is:
(i) less than 105 grams;
(ii) not exactly 100 grams;
(iii) more than 110 grams;
(iv) between 102 grams and 108 grams.
(b) The weight, $Y$ grams, of a bar of RichAV soap may be modelled by a normal distribution with mean 160 grams, unknown standard deviation $\sigma$ grams and $\mathrm{P}(Y<150)=0.05$.
(i) Determine the value of $\sigma$. Give your answer to two decimal places.
(ii) RichAV soap is sold in packs of 3 bars. The bars in a pack may be assumed to be a random sample.

Determine the probability that:
(A) the weight of each of the 3 bars in a randomly selected pack is more than 150 grams;
(B) the mean weight of the 3 bars in a randomly selected pack is more than 162.5 grams.

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6 When a patient takes the painkilling drug PD1, the patient may have no side effects (event $A$ ), slight side effects (event $B$ ) or severe side effects (event $C$ ).

It has been established that $\mathrm{P}(A)=0.85, \mathrm{P}(B)=0.10$ and $\mathrm{P}(C)=0.05$.
(a) A doctor prescribes PD1 to three unrelated patients.

Calculate the probability that:
(i) all three patients have no side effects;
(ii) two patients have no side effects and one patient has slight side effects;
(iii) one patient has no side effects, one patient has slight side effects and one patient has severe side effects.
(b) Other painkilling drugs are available.

Of patients taking PD1, none of those who suffer no side effects will change to another drug, 25 per cent of those who suffer slight side effects will change to another drug, and 90 per cent of those who suffer severe side effects will change to another drug.

A second doctor prescribes PD1 to a patient.
Calculate the probability that:
(i) the patient does not change to another drug;
(ii) the patient changes to another drug, given that the patient experienced side effects from taking PD1.

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7 In a certain country, 25 per cent of the adult population have blond hair.
(a) A random sample of 30 adults is selected.

Determine the probability that the number of adults with blond hair in the sample is:
(i) exactly 5 ;
(ii) fewer than 10 ;
(iii) at least 6 but at most 12 ;
(iv) more than the mean of the distribution $\mathrm{B}(30,0.25)$.
(b) The random variable $Y$ has a binomial distribution with parameters $n$ and $p$.
(i) Given that $Y$ has a mean of 16 and a standard deviation of 2.4 , find values for $n$ and $p$.
[5 marks]
(ii) Hence determine $\mathrm{P}(Y=20)$.
[2 marks]

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## END OF QUESTIONS

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