AQA

AS
STATISTICS
Unit Statistics 2

Wednesday 15 June 2016   Morning   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 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.

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 The heights of a sample of 240 female students and 240 male students were measured.

The data for the female students are summarised as a box plot in **Figure 1**.

The data for the male students are summarised as a cumulative frequency graph in **Figure 2**.
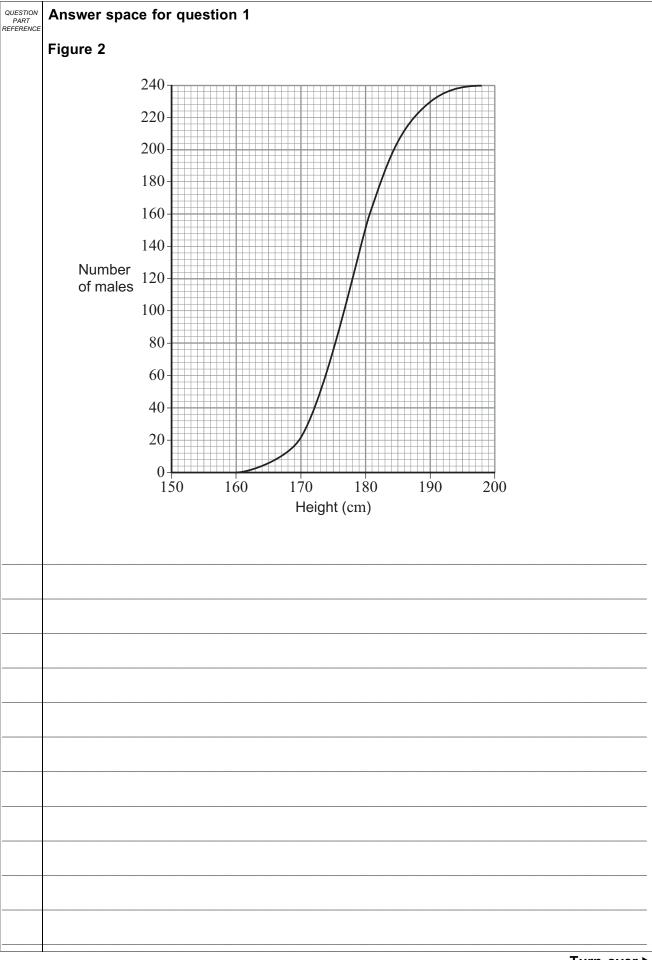
Using the information in the two figures, compare the distribution of heights for the female students with that for the male students. You should make reference to the difference, if any, between:

(a) the average values of height;

(b) the values of a measure of spread;

(c) the symmetry, or otherwise, of the two distributions.

[6 marks]

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Figure 1

Height (cm)

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Figure 2

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2 A ticket purchased at a car park allows parking for a period of up to 1, 2, 3, 4, 8 or 24 hours. The ticket must be displayed in the parked car. The percentage of purchases of each type of ticket are shown in the table.

Type of ticket	Percentage
Up to 1 hour	12
Up to 2 hours	19
Up to 3 hours	18
Up to 4 hours	21
Up to 8 hours	10
Up to 24 hours	20

(a) (i) Find the probability that the ticket displayed in a randomly chosen car at this car park allows parking for a period of more than 3 hours.

[1 mark]

(ii) There are two yellow cars in the car park each displaying a ticket.

Calculate the probability that the two tickets displayed are of the same type.

[2 marks]

(b) The charge for parking at this car park is 50p **per hour** for any period up to 4 hours. There are fixed charges of £3 for up to 8 hours and £5 for up to 24 hours.

(i) Find the mean amount paid for a parking ticket at this car park and show that the standard deviation is £1.53 correct to three significant figures.

[5 marks]

(ii) Find the probability that the amount paid for a parking ticket is within one standard deviation of the mean.

[2 marks]

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3 The table opposite shows, by mode of travel for the period 1980 to 2013, the numbers of visits abroad by UK residents and the amounts that they spent.

(a) The total number of visits tabulated for 1983 is less than the sum of the tabulated number of visits by air and by sea in 1983. Give a reason why this has happened.

[1 mark]

(b) Calculate the average amount spent per visit by UK residents travelling abroad by sea in 1999. Give your answer to the nearest pound (£).

[2 marks]

(c) Calculate the **percentage reduction** in total spending by UK residents travelling abroad in 2009, compared with that in 2008.

[2 marks]

(d) Kayla wants to draw two comparative pie charts for **1980** and **2013**, to illustrate the **numbers of visits** and the modes of travel. She will use a circle with radius 5 cm for the 1980 chart.

(i) Calculate the angle that Kayla should use for the sector representing air travel in 1980.

[2 marks]

(ii) Calculate the radius of the circle that Kayla should use for the 2013 pie chart.

[3 marks]

QUESTION PART REFERENCE	Answer space for question 3

UK residents' visits and spending abroad: by mode of travel 1980 to 2013

	Air		Sea		Channel Tunnel		Total	
	Visits (thousands)	**Spending** (£ million)	**Visits** (thousands)	**Spending** (£ million)	**Visits** (thousands)	**Spending** (£ million)	**Visits** (thousands)	**Spending** (£ million)
1980	10 748	2 029	6 759	710			17 507	2 738
1981	11 374	2 361	7 672	911			19 046	3 272
1982	12 031	2 656	8 580	984			20 611	3 640
1983	12 361	2 959	8 634	1 131			20 994	4 090
1984	13 934	3 524	8 137	1 139			22 072	4 663
1985	13 732	3 695	7 878	1 176			21 610	4 871
1986	16 380	4 632	8 569	1 451			24 949	6 083
1987	19 369	5 739	8 077	1 541			27 447	7 280
1988	21 026	6 655	7 802	1 560			28 828	8 216
1989	21 925	7 457	9 105	1 900			31 030	9 357
1990	21 368	7 747	9 782	2 139			31 150	9 886
1991	20 408	7 740	10 401	2 211			30 808	9 951
1992	23 357	8 891	10 479	2 352			33 836	11 243
1993	25 354	10 316	11 366	2 656			36 720	12 972
1994	27 624	11 595	11 991	2 768	14	2	39 630	14 365
1995	28 097	12 250	11 311	2 718	1 937	419	41 345	15 386
1996	27 907	12 926	10 686	2 509	3 457	788	42 050	16 223
1997	30 341	13 402	11 522	2 791	4 095	739	45 957	16 931
1998	34 283	15 397	10 498	2 726	6 092	1 367	50 872	19 489
1999	37 510	17 623	10 427	2 958	5 944	1 439	53 881	22 020
2000	41 392	19 905	9 646	2 766	5 799	1 580	56 837	24 251
2001	43 011	20 934	9 651	2 844	5 619	1 554	58 281	25 332
2002	43 990	22 273	10 038	3 206	5 349	1 482	59 377	26 962
2003	47 101	23 846	9 200	3 096	5 123	1 607	61 424	28 550
2004	50 435	25 879	8 950	2 991	4 809	1 415	64 194	30 285
2005	53 626	27 994	8 102	2 750	4 713	1 410	66 441	32 154
2006	56 460	29 655	8 411	3 242	4 665	1 515	69 536	34 411
2007	56 329	30 507	8 473	2 937	4 649	1 570	69 450	35 013
2008	56 041	31 497	8 145	3 535	4 825	1 806	69 011	36 838
2009	46 657	27 044	7 559	3 105	4 398	1 545	58 614	31 694
2010	43 239	26 357	8 056	3 910	4 267	1 553	55 562	31 820
2011	44 723	26 555	7 857	3 610	4 255	1 537	56 836	31 701
2012	44 916	27 543	6 755	3 096	4 867	1 811	56 538	32 450
2013	46 543	29 480	7 166	3 621	4 798	1 798	58 507	34 900

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4   A hospital records data about the causes of injuries suffered by people who are treated at its Accident and Emergency department. The data show that injuries associated with duvets occur at an average rate of 6 per year, and that injuries associated with cushions occur at an average rate of 5 per year.

(a)   Assuming that all such injuries are random and independent, find the probability that, at this hospital:

(i)   during a period of 1 year, exactly 4 people are treated for **duvet**-associated injuries;

[2 marks]

(ii)   during a period of 4 months, no more than 2 people are treated for **duvet**-associated injuries;

[2 marks]

(iii)   during a period of 2 years, at least 8 people are treated for **cushion**-associated injuries;

[2 marks]

(iv)   during a period of 1 year, more than 5 people but fewer than 15 people are treated for injuries associated with duvets or cushions.

[3 marks]

(b)   Given that duvets are used more during the winter months than the summer months, explain why your answer to part **(a)(ii)** may not be valid.

[1 mark]

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5   The mean blood cholesterol level of the adult residents of a particular country has been found to be 5.8 millimoles per litre (mmol/l).

Monica is a researcher who believes that the daily consumption of yoghurt can reduce blood cholesterol level. She selected a sample of 80 such residents who consumed yoghurt daily and measured the blood cholesterol level, X mmol/l, of each resident, obtaining the following summarised results.

$$\sum x = 452.8 \quad \text{and} \quad \sum (x - \bar{x})^2 = 33.552$$

(a)   Show that the results support Monica's belief at the 10% significance level.

[8 marks]

(b)   Monica would like to publish the result of her research with the following statement.

"The belief that eating yoghurt daily can reduce blood cholesterol level was supported by my research at the $\alpha\%$ significance level."

State the smallest integer value of α that Monica can use, quoting probabilities to justify your answer.

[2 marks]

(c)   Given that the daily consumption of yoghurt actually has no significant effect on blood cholesterol levels, state whether Monica made a Type I error, a Type II error or no error.

[1 mark]

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6 Wedlock council is responsible for three villages: Lower Wedlock, Middle Wedlock and Upper Wedlock. A recent census has shown that the adult populations of the three villages are as in the table.

	Male	Female
Lower Wedlock	254	327
Middle Wedlock	844	897
Upper Wedlock	1185	1243

The council has to consider a proposal for a supermarket to be built somewhere near the three villages and wishes to discover the opinions of the residents.

(a) Other than bias introduced by the difference in the sizes of the populations of the three villages, give a reason why a questionnaire delivered to each household would be likely to give a biased view of the residents' opinions.

[1 mark]

(b) The council considers conducting interviews with a sample of 80 residents to determine their opinions. The electoral register, which lists the residents of the three villages separately by household, would be used as the sampling frame.

(i) Describe, in detail, how the table of random numbers in the booklet of formulae and statistical tables (Table 13) could be used to select the sample of 80 residents from the electoral register.

[4 marks]

(ii) Explain why a random sample from this register may not provide a representative view of the residents' opinions.

[1 mark]

(iii) Explain why a sample selected systematically from this register may be more representative than a random sample, but may not be completely representative.

[2 marks]

(c) In fact, the council decides to conduct interviews with a stratified sample of 80 residents, reflecting the proportions of males and females and the populations of the three villages. The sample will be collected by quota sampling of residents as they visit the post office in each village.

Describe, in detail, how this sample could be chosen, including the numbers of residents in the various quotas.

[5 marks]

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7   Rodney runs a market stall every Monday, Wednesday and Friday in a small town. The stall is less busy during the winter months.

Rodney kept a record of his takings each day in October. The values of his takings, in £, for the first three weeks are shown in the table, together with an appropriate moving average.

Day	Date	Takings	Moving average
Monday	1	323	
Wednesday	3	400	368
Friday	5	381	361
Monday	8	302	344
Wednesday	10	349	329
Friday	12	336	315
Monday	15	260	305
Wednesday	17	319	m
Friday	19	294	

(a)   Calculate the value of the missing moving average, m.

[2 marks]

(b)   The values of the takings have been plotted on **Figure 3**, opposite.

Plot the moving averages on this figure and draw a trend line.

[2 marks]

(c) (i)   Name the type of variation shown by the moving averages about the trend line.

   (ii)   Name the type of variation shown by the takings about the trend line.

[2 marks]

(d)   Using the data and the trend line, find the seasonal effect for:

   (i)   Monday;
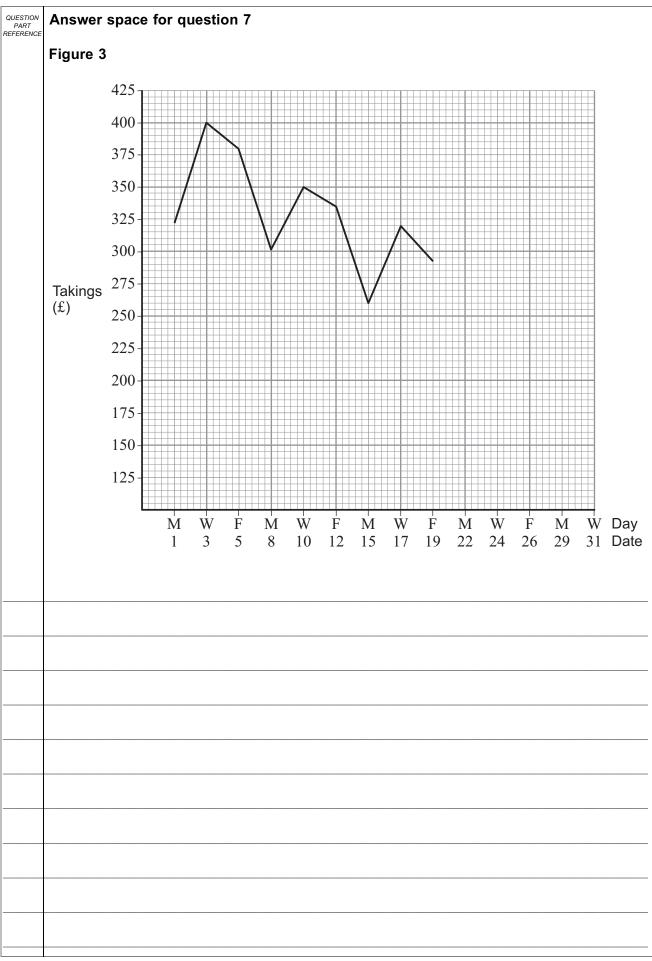
   (ii)   Friday.

[3 marks]

(e)   Showing your method, estimate the takings on Friday 26 October.

[3 marks]

(f)   Rodney will stop running his stall if the takings for any day fall below £200. Assuming that the current trend continues, estimate on which day this will occur. Show calculations to support your estimate.

[3 marks]

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Figure 3

Takings (£)

Day / Date: M 1, W 3, F 5, M 8, W 10, F 12, M 15, W 17, F 19, M 22, W 24, F 26, M 29, W 31

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END OF QUESTIONS