

Please write clearly in block capitals.			
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Surname			
Forename(s)			
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INTERNATIONAL A-LEVEL MATHEMATICS

(9660/MA04) Unit S2 - Statistics

Monday 10 June 2019

07:00 GMT

Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the Oxford International AQA booklet of formulae and statistical tables (enclosed).
- · 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.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks for method may be lost.

For Examiner's Use		
Question	Mark	
1		
2		
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8		
9		
TOTAL		



		1 -
	Answer all questions in the spaces provided.	
1	The number of phone calls an office receives in 1 hour can be modelled by a Poisson distribution with mean 60	
	Use an exponential distribution to find the probability that, after receiving a phone call, the next phone call the office receives is at least 2 minutes later. [4 marks]	
	Answer	l
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2	The height, \it{X} , of the female adults in a city can be modelled by a normal distribution wit mean 162 cm and standard deviation 5 cm		
2 (a)	Find the probability that a randomly selected female adult from the city has a height less than 152 cm		
	[2 marks]		
	Answer		



2	(b)	The height, Y , of the male adults in the same city can be modelled by a normal distribution with mean 175 cm and standard deviation σ cm	
		Of the male adults in the city, 5% have a height greater than 185 cm	
2	(b) (i)	Show that σ = 6.08 correct to three significant figures. [4	marks]
2	(b) (ii)	Assume that X and Y are independent.	
		Describe the distribution of $X+Y$. [2	marks]

3	The continuous	random variable	T has cumulative	distribution fun	ction

$$F(t) = \begin{cases} 0 & t \le 0 \\ kt^4 & 0 < t \le 5 \\ 1 & t > 5 \end{cases}$$

3	(a)	Show that $k =$	_1_
Ü	(u)	Onow that h	625

[2 marks]

State $P(T=3)$	[1 mark

Answer



3 (b)

c)	The constant c is such that $P(T \le c) = 0.75$	
	Find c .	
	Give your answer to four significant figures.	[2 marks]
	Answer _	

Turn over for the next question

4	The length, L cm, of bolts produced by a machine can be modelled by $L \sim \mathrm{N}(3.5,0.5)$		
	A random sample of n bolts is taken.		
4 (a)	Given that $n=20$, find $P(\overline{L}>3.65)$ [4 marks]		
	Answer		



4 (b)	Given that $P(\bar{L} < 3.6) > 0.99$, find the minimum possible value of n .	[4 marks]
	Answer	
	Turn over for the next question	

5	Over a period of time the mean score on a computer game is 500	
	There is a new version of the computer game. The scores of a random sample of 100 players are recorded and are found to have a mean of 492 and a standard deviation of 38.2	
5 (a)	Test at the 2% level of significance whether the mean score on the computer game has decreased since the new version was released.	
	[7 marks]	



5 (b)	Explain why it is not necessary to assume that the scores have a normal distribution to	Do not write outside the box
O (D)	carry out the test in part (a).	
	[2 marks]	
		9
	Turn over for the next question	
		I .

6		A manufactu	rer produce	es light bulb	S.				
		The lifetimes	, in years, o	of six light b	oulbs in a rai	ndom sampl	e were		
			3.21	3.42	3.84	3.91	4.11	4.85	
6	(a)	Calculate:							
6	(a) (i)	the sample n	nean;						
									[1 mark]
					Answer				
6	(a) (ii)	the sample v	ariance.						[2 marks]
					Answer				



The lifetime of light	bulbs can be mode	elled as a normal d	istribution.	
Investigate at the 19	% level of significa	nce whether the m	anufacturer's claim i	s va [7



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7		Emily counts the number of cars, X , going past her house during a 10-minute interval.
		Emily believes that the distribution of \boldsymbol{X} can be modelled by a Poisson distribution with mean 6.5
7	(a)	Find $P(X=4)$
		[2 marks]
		Answer
7	(b)	Emily also counts the number of lorries, Y , going past her house during a 10-minute interval. Emily believes that the distribution of Y can be modelled by a Poisson distribution with
		mean 0.5
		Assume X and Y are independent.
7	(b) (i)	Find the probability that the total number of cars and lorries going past Emily's house in 10 minutes is less than 3
		[3 marks]
		Answer



7 (b) (ii)	After a factory is built nearby, three lorries go past Emily's house in 10 minutes.						
	Emily claims that the mean of Y has increased.						
	Investigate Emily's claim at the 5% level of significance.						
	[6 ma	arks]					
	Question 7 continues on the next page						



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(b) (iii) Explain, in the context of the test in part (b)(ii), the meaning of a Type I error.	[2 marks
(b) (iv) Calculate the probability of making a Type I error in the test in part (b)(ii).	[2 marks
Answer	



8 The continuous random variable X has probability density function

$$f(x) = \begin{cases} \frac{1}{32}x^3 & 0 < x \le 2\\ \frac{1}{8}x + \frac{1}{16} & 2 < x \le 4\\ 0 & \text{otherwise} \end{cases}$$

8	(a)	Show that $E(X) =$	349
Ü	(α)	Onow that L(21)	120

[3 marks]



8 (b)	Find Var(X).		[5 marks]
		Answer	
8 (c)	Find $Var(2X+3)$.		
			[2 marks]
		Answer	

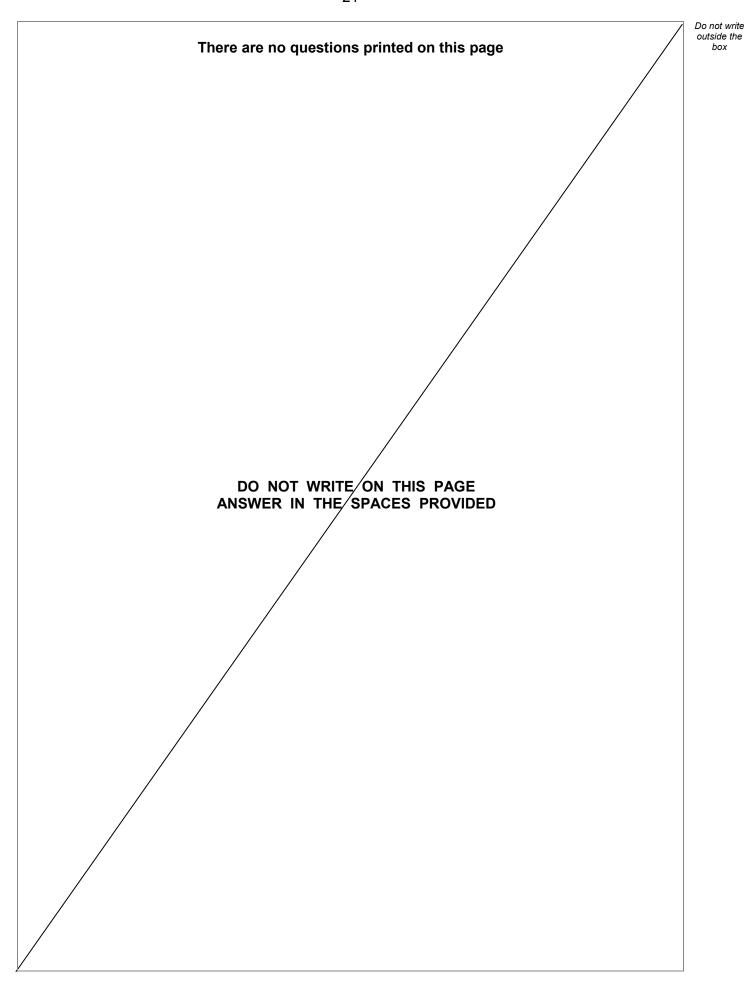


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•	Answer	
Turn over fo	or the next question	

9	A random sample X_1, X_2, X_3 and X_4 , is taken from a population with unknown mean μ .
9 (a)	State whether or not
	$X_1 + 2X_2 + 3X_3 + 4X_4$
	is a statistic, giving a reason for your answer. [2 marks]
9 (b)	State whether or not $\frac{\sum\limits_{i=1}^{4}X_{i}^{2}}{4}-\mu^{2}$
	is a statistic, giving a reason for your answer. [2 marks]
	END OF QUESTIONS







Question number	Additional page, if required. Write the question numbers in the left-hand margin.



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