

PAPER B

Advanced Higher Statistics Practice Prelim

1. Let the random variable X be the score of one throw of a tetrahedral die. Calculate
 - a) the mean and variance of X **2**
 - b) the mean and variance of $4X - 3$. **2**

2. The probability that a certain type of seed germinates is 0.7. The seeds undergo a new treatment and when a packet is tested, 24 of the 30 seeds germinate. Is there evidence, at the 10% level, of an increase in the germination rate? **5**

3. Ten children compete in a throwing the cricket ball competition and the table below shows the height of the child (x cm) and the distance to which they can throw the ball (y m). A scatter graph is drawn and a linear model is considered appropriate.

Calculate the product moment correlation coefficient for this data and comment on your answer.

Child	A	B	C	D	E	F	G	H	I	J
Height x	122	124	133	138	144	156	158	161	164	168
Throw y	41	38	52	56	29	54	59	61	63	67

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4. A multiple-choice test has 12 questions, each of which is allocated four possible answers with only one being correct in each case. In order to pass the test a candidate has to answer at least 8 questions correctly. Calculate the probability that a candidate who answers all the questions passes, given that:

- (a) the candidate has no knowledge of the topic; **3**
- (b) the candidate has sufficient knowledge to discount two of the four answers to each question but has to guess between the remaining two alternatives. **2**

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5.

Following complaints from customers, an electronics manufacturing company initiated an improvement project with a view to reducing the mean cycle time for order processing (days). Analysis of the records for a large number of orders indicated that the cycle time for order processing could be adequately modelled by the $N(29, 3^2)$ distribution. Following completion of the project, the cycle times for a sample of orders were:

28 31 27 24 22 27 31 24 30 23.

Stating two assumptions required, evaluate the evidence that the project has been successful in reducing mean cycle time.

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6.

A spinning frame in a textile factory is used to spin monofilament nylon yarn and has a large number of spinnerets. Yarn breakages at the spinnerets require spinning to be stopped in order to enable the operator to mend the breakages. The number of stoppages per hour, X , may be modelled by the Poisson distribution with mean 4.

(a) Obtain the probability that the number of stoppages in an hour is more than two standard deviations above the mean.

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(b) Obtain the smallest integer k such that $P(X > k) < 0.001$.

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7.

Sentence-length in the known works of a medieval author has mean 24.9 words with standard deviation 4.6 words. A random sample of 30 sentences from a medieval work of unknown authorship has mean length 23.3 words. Stating any assumption required, obtain a 95% confidence interval for the mean sentence length for the unknown author and comment on the authorship of the manuscript sampled.

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8.

A scuba diver and her buddy intend making a series of dives to a depth of 15 metres. At that depth their gas cylinders provide breathing times of X minutes and Y minutes respectively, where $X \sim N(52.0, 1.5^2)$ and $Y \sim N(55.0, 2.0^2)$. Stating any assumption required, calculate the probability that her buddy will require to switch to his reserve gas supply before the diver switches to her reserve.

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9.

Every year in Scotland each police authority completes a statistical return that provides details of the circumstances for all the accidents in its own area, involving injury, between a motor vehicle and a bicycle, over the past five years.

- (a) Given that you have access to a database containing the details of all 793 accidents involving injury between a motor vehicle and a bicycle in one such area over the past five years, outline the steps involved in selecting a random sample of 120 accidents for detailed study. 2

From a random sample of 120 accidents it was established that, of those cyclists wearing helmets, 33 sustained a head injury and 64 did not. Amongst those not wearing helmets, 16 sustained a head injury.

- (b) Display the data in a contingency table. Carry out an appropriate statistical test on this data set and report your findings in terms of the benefit to cyclists of wearing a helmet. 5

10.

An ultrasonic scanner is used to check concrete beams for voids. The scanner is designed to give a signal if a beam contains a void. The following probabilities were determined for beams produced by a particular manufacturer.

		<i>Scanner Response</i>	
		<i>Signal</i>	<i>No Signal</i>
<i>Beam Status</i>	<i>Contains a void</i>	0.04	0.02
	<i>Void free</i>	0.01	0.93

The table indicates, for example, that $P(\text{Void free and Signal}) = 0.01$.

- (a) Show that Scanner Response and Beam Status are not independent. 2
- (b) For a beam selected at random which gives a signal on being scanned, find the probability that it is void free. 2
- (c) For a beam selected at random which contains a void, write down the probability that it gives no signal. 1