Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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TOTAL	

General Certificate of Education
Advanced Level Examination
June 2013

Mathematics MS03

Unit Statistics 3

Tuesday 18 June 2013 9.00 am to 10.30 am

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed
- 1 hour 30 minutes

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.

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Answer **all** questions.

Answer each question in the space provided for that question.

1 The number of telephone calls per hour to an out-of-hours doctors' service may be modelled by a Poisson distribution.

The total number of telephone calls received during a random sample of 12 weekday night shifts, all of the same duration, was 392 .

(a) Calculate an approximate 98% confidence interval for the mean number of calls received per weekday night shift. *(5 marks)*

(b) The mean number of calls received during weekend shifts of 48 hours' total duration is 136.8 .

Comment on a claim that the mean number of calls **per hour** during weekend shifts is greater than that during weekday night shifts, which are each of **14** hours' duration. *(3 marks)*

QUESTION PART REFERENCE

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2 On a rail route between two stations, A and B, 90% of trains leave A on time and 10% of trains leave A late.

Of those trains that leave A on time, 15% arrive at B early, 75% arrive on time and 10% arrive late.

Of those trains that leave A late, 35% arrive at B on time and 65% arrive late.

(a) Represent this information by a fully-labelled tree diagram. *(3 marks)*

(b) Hence, or otherwise, calculate the probability that a train:

(i) arrives at B early or on time;

(ii) left A on time, given that it arrived at B on time;

(iii) left A late, given that it was not late in arriving at B. *(7 marks)*

(c) Two trains arrive late at B. Assuming that their journey times are independent, calculate the probability that exactly one train left A on time. *(4 marks)*

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3 A builders' merchant's depot has two machines, X and Y, each of which can be used for filling bags with sand or gravel.

The weight, in kilograms, delivered by machine X may be modelled by a normal distribution with mean μ_X and standard deviation 25.

The weight, in kilograms, delivered by machine Y may be modelled by a normal distribution with mean μ_Y and standard deviation 30.

Fred, the depot's yardman, records the weights, in kilograms, of a random sample of 10 bags of sand delivered by machine X as

1055 1045 1000 985 1040 1025 1005 1030 1015 1060

He also records the weights, in kilograms, of a random sample of 8 bags of gravel delivered by machine Y as

1085 1055 1055 1000 1035 1050 1005 1075

(a) Construct a 95% confidence interval for $\mu_Y - \mu_X$, giving the limits to the nearest 5 kg. *(7 marks)*

(b) Dot, the depot's manager, commented that Fred's data collection may have been biased.

Justify her comment and explain how the possible bias could have been eliminated. *(2 marks)*

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4 An analysis of a sample of 250 patients visiting a medical centre showed that 38 per cent were aged over 65 years.

An analysis of a sample of 100 patients visiting a dental practice showed that 21 per cent were aged over 65 years.

Assume that each of these two samples has been randomly selected.

Investigate, at the 5% level of significance, the hypothesis that the percentage of patients visiting the medical centre, who are aged over 65 years, exceeds that of patients visiting the dental practice, who are aged over 65 years, by more than 10 per cent. *(8 marks)*

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5 The schedule for an organisation's afternoon meeting is as follows.

Session A (Speaker 1)	2.00 pm to 3.15 pm
Session B (Discussion)	3.15 pm to 3.45 pm
Session C (Speaker 2)	3.45 pm to 5.00 pm

Records show that:

the duration, X, of Session A has mean 68 minutes and standard deviation 10 minutes;

the duration, Y, of Session B has mean 25 minutes and standard deviation 5 minutes;

the duration, Z, of Session C has mean 73 minutes and standard deviation 15 minutes;

and that:

$$\rho_{XZ} = 0 \qquad \rho_{XY} = -0.8 \qquad \rho_{YZ} = 0$$

(a) Determine the means and the variances of:

(i) $L = X + Z$; *(2 marks)*

(ii) $M = X + Y$. *(3 marks)*

(b) Assuming that L and M are each normally distributed, determine the probability that:

(i) the total time for the two speaker sessions is less than $2\frac{1}{2}$ hours; *(2 marks)*

(ii) Session C is late in starting. *(3 marks)*

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6 The demand for a *WWSatNav* at a superstore may be modelled by a Poisson distribution with a mean of 2.5 per day. The superstore is open 6 days each week, from Monday morning to Saturday evening.

(a) (i) Determine the probability that the demand for *WWSatNav*s during a particular week is at most 18. *(2 marks)*

(ii) The superstore receives a delivery of *WWSatNav*s on each Sunday evening. The manager, Meena, requires that the probability of *WWSatNav*s being out of stock during a week should be at most 5%.

Determine the minimum number of *WWSatNav*s that Meena requires to be in stock after a delivery. *(2 marks)*

(b) (i) Use a distributional approximation to estimate the probability that the demand for *WWSatNav*s during a period of **2 weeks** is more than 35. *(4 marks)*

(ii) Changes to the superstore's delivery schedule result in it receiving a delivery of *WWSatNav*s on alternate Sunday evenings. Meena now requires that the probability of *WWSatNav*s being out of stock during the 2 weeks following a delivery should be at most 5%.

Use a distributional approximation to determine the minimum number of *WWSatNav*s that Meena now requires to be in stock after a delivery. *(3 marks)*

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7 It is claimed that the proportion, P, of people who prefer cooked fresh garden peas to cooked frozen garden peas is greater than 0.50.

(a) In an attempt to investigate this claim, a sample of 50 people were each given an unlabelled portion of cooked fresh garden peas and an unlabelled portion of cooked frozen garden peas to taste. After tasting each portion, the people were each asked to state which of the two portions they preferred.

Of the 50 people sampled, 29 preferred the cooked fresh garden peas.

Assuming that the 50 people may be considered to constitute a random sample, use a binomial distribution and the 10% level of significance to investigate the claim. *(6 marks)*

(b) It was then decided to repeat the tasting in part **(a)** but to involve a sample of 500, rather than 50, people.

Of the 500 people sampled, 271 preferred the cooked fresh garden peas.

(i) Assuming that the 500 people may be considered to constitute a random sample, use an approximation to the distribution of the sample proportion, $\widehat{P}$, and the 10% level of significance to again investigate the claim. *(4 marks)*

(ii) The critical value of $\widehat{P}$ for the test in part **(b)(i)** is 0.529, correct to three significant figures. It is also given that, in fact, 55 per cent of people prefer cooked fresh garden peas.

Estimate the power for a test of the claim that $P > 0.50$ based on a random sample of 500 people and using the 10% level of significance. *(5 marks)*

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