

1. [Maximum mark: 10]

Eight students attend an Easter IB Maths revision course at Camford Revision Centre. Prior to the course they sit a Paper 1 test, and at the end of the course they sit the same Paper 1. The marks for a paper 1 test are out of 120. The marks of the students are shown below.

	A	B	C	D	E	F	G	H
Results before	72	51	63	91	84	33	61	64
Results after	80	70	69	110	87	57	59	71

- Write suitable hypotheses to test if the revision course has improved the results of the students.
- Use a suitable test at the 1% level of significance to test if the revision course has made a significant improvement in the results of the students.

2. [Maximum mark: 10]

It is thought that the random variable X follows a binomial distribution with a probability of 0.4.

To test this claim the variable is tested by 6 groups. Each group tests the variable 40 times and records the number of successes, x .

Group	A	B	C	D	E	F
Frequency	8	7	12	9	13	6

Carry out a chi-squared goodness of fit test at the 5% level of significance, to test the claim that the variable fits a binomial distribution with a probability of 0.4. [10 marks]

3. [Maximum mark: 13]

The first 100 runners in the London marathon times were recorded, with times given in minutes. The results were as follows:

$$\sum x = 15560 \quad \text{and} \quad \sum x^2 = 2506000$$

- a) Calculate the mean time of a marathon runner in minutes.
[1 mark]
- b) Calculate the standard error of this sample of 100 runners.
[3 marks]
- c) The New York marathon is to be run a month later. Calculate a 95% confidence interval, based on the London results for the mean time of the first 100 runners in the marathon.
[4 marks]
- d) What assumptions have you made in your calculations for c)?
[2 marks]

4. [Maximum mark: 9]

A spinner has 5 segment coloured as follows: two blue, one green, one red, and one yellow.

A game is played whereby the spinner is spun until it lands on Blue. Two players, Arnie and Bessie take turns to spin the spinner.

- a) Find the probability that Arnie wins if he spins the spinner first.
[3 marks]
- b) Find the probability that Arnie wins, given that he has the second go.
[3 marks]

The players' set up a model to calculate how many blues will appear in 20 throws.

- c) Calculate the probability that exactly 8 blues appear in 20 spins.
[2 marks]
- d) Calculate the probability that the 8th blue appears on the 20th spin.
[3 marks]

5. [Maximum mark: 16]

A shopper at Tesco supermarket is a keen statistician, and over the course of a year has discovered that the amount of time spent queuing at the checkout follows a normal distribution with a mean of 8 minutes and a variance of 4 minutes. She has also found that the queuing time at the petrol forecourt of Tesco is also normally distributed with a mean of 6 minutes and variance of 3 minutes.

- a) In one week, she shops on 3 separate days.
- i) Find the mean and variance of her total queuing time at the checkout.
 - ii) Hence, calculate the probability that she spends less than 15 minutes at the checkout in a queue in total for her 3 visits. [6 marks]
- b) On Saturday, she goes to the supermarket and then fills her car with petrol.
- i) Calculate the mean and variance of her total queuing time at the checkout and the petrol forecourt.
 - ii) Hence, find the probability that she queued for more than 17 minutes in total. [6 marks]
- c) Calculate the probability that she queued for longer at the garage than in the supermarket. [4 marks]

Answers

1. a) $H_0 : \mu_1 = \mu_2$ and $H_1 : \mu_2 > \mu_1$

b) $\bar{d} = 9.25, S_{n-1} = 7.52$

$$v = 7, \chi^2_{(1\%)} = 18.475$$

$$p = \frac{9.25 - 0}{\frac{7.52}{\sqrt{8}}} = 3.479$$

Do not reject the null hypothesis. At the 1% level there is no evidence that the revision course provides any significant improvement in results.

2. H_0 : The distribution fits a binomial distribution with a probability of a success of 0.4.

H_1 : The distribution does not fit the binomial model.

$$p = 4.3$$

$$v = 5, \chi^2_{5\%} = 11.07$$

Accept the null hypothesis, at this level of significance the distribution fits the binomial distribution with a success of 0.4.

3. a) 155.6

b) s.e=2.913

c) [149.9, 161.3]

d) Assuming that the course and conditions are the same. The runners will be the same standard.

4. a) $\frac{5}{8}$ b) $\frac{3}{8}$ c) 0.1797 d) 0.07188

5. a) i) mean = 24, variance = 36 ii) $p=0.06678$

b) $p=0.1284$ c) $p=0.224$