

WELSH JOINT EDUCATION COMMITTEE CYD-BWYLLGOR ADDYSG CYMRU

General Certificate of Education

Tystysgrif Addysg Gyffredinol

Advanced Level/Advanced Subsidiary

Safon Uwch/Uwch Gyfrannol

MATHEMATICS S2

Statistics

Specimen Paper 2005/2006

(1½ hours)

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

INFORMATION FOR CANDIDATES

A calculator may be used for this paper.

A formula booklet is available and may be used.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. An automatic machine dispenses soft drinks. The amount discharged each time can be modelled by a normal random variable with adjustable mean μ ml and standard deviation 5 ml.
- (a) The cups used have capacity 200 ml.
- (i) What proportion of cups will overflow if μ is set to 195?
- (ii) To what value should μ be set to ensure that only 1% of the cups overflow? [6]
- (b) A customer wants to fill a bottle of capacity 1000 ml so he decides to make five independent discharges into the bottle. Given that $\mu = 196$, find the probability that the bottle overflows. [5]
2. The number of breakdowns per week experienced by a certain type of machine can be assumed to follow a Poisson distribution with mean 0.5. There are five of these machines in a workshop.
- (a) Find the probability that, during a randomly chosen week, there is a total of 2 breakdowns on all these machines. [3]
- (b) Use an appropriate approximation to find the probability that, during a period of 50 weeks, the total number of breakdowns on these machines is less than 100. [6]
3. Ann drives to work and she records the times taken over a 10-day period with the following results (in minutes):

72 76 69 77 81 74 71 69 72 74

You may assume that the time taken to drive to work can be modelled by a normally distributed random variable with standard deviation 4 minutes,

- (a) Calculate a 95% confidence interval for the mean time. [6]
- (b) Explain what is meant by a 95% confidence interval. [2]

4. A circle has radius R cm, where R is uniformly distributed on the interval $[4,10]$. The area of the circle is A cm².

(a) Determine $P(A > 36\pi)$. [3]

(b) Calculate

(i) $E(A)$,

(ii) $\text{Var}(A)$. [10]

5. When an instrument is used to measure the concentration of a fluid, the reading obtained can be assumed to be a normally distributed random variable with mean equal to the actual concentration and standard deviation 5 units. The instrument is used to make 10 measurements (x) on Fluid A and 10 measurements (y) on Fluid B. The results obtained are summarised as follows.

$$\Sigma x = 526, \Sigma y = 498.$$

Investigate the null hypothesis that the concentrations of the fluids are equal against a two-sided alternative, and using a 1% significance level. [7]

6. Dafydd thinks that he can predict the outcome when a fair coin is tossed more often than not. In order to investigate this theory, he sets up the following hypotheses:

$$H_0 : p = 0.5 \text{ versus } H_1 : p > 0.5$$

where p denotes the probability that he predicts the outcome, that is 'heads' or 'tails', correctly.

(a) He decides initially to ask a friend to toss a fair coin 20 times. Then if x denotes the number of correct predictions, he will accept H_1 if $x \geq 14$.

(i) Find the corresponding significance level.

(ii) Find the probability of reaching the correct conclusion if $p = 0.7$. [7]

(b) He now decides to ask a friend to toss a fair coin 200 times. He predicts the outcome correctly on 120 occasions.

(i) Find the p -value of this result.

(ii) Interpret your value in context. [7]

7. The number of video recorders, X , sold by a shop per day may be assumed to follow a Poisson distribution. In the past, the mean value of X has been 3. The manager wishes to increase this mean and she reduces the price in the hope of doing that.
- (a) During the following 5-day week, the shop sells 20 video recorders.
- (i) State the hypotheses required to determine whether or not the mean has increased.
 - (ii) Calculate the p -value of this result and interpret it. [5]
- (b) In the longer term, the shop sells 330 video recorders in 100 days.
- (i) Calculate the p -value of this result.
 - (ii) State, with a reason, whether or not the result is significant at the 5% level. [8]