

ADRAN MATHEMATEG / DEPARTMENT OF MATHEMATICS

ARHOLIADAU SEMESTER 2 / SEMESTER 2 EXAMINATIONS

MAI / MAY 2020

MA00910 - Introduction to Statistics

The questions on this paper are written in English.

If you have questions about the paper during the exam, contact the module co-ordinator, Mrs Patience Jones, on paj26@aber.ac.uk.

Amser a ganiateir - 2 awr

Mae'n rhaid cyflwyno eich atebion erbyn 11:30 (amser y DU).

- Rhoddir marciau llawn am atebion cyflawn i bob cwestiwn.
- Dylai myfyrwyr roi cynnig ar bob cwestiwn **ar bapur**.
- Dylai myfyrwyr **yna** gyflwyno eu hatebion ar safle Blackboard y modiwl hwn.

Time allowed - 2 hours

Submission must be completed by 11:30 (UK time).

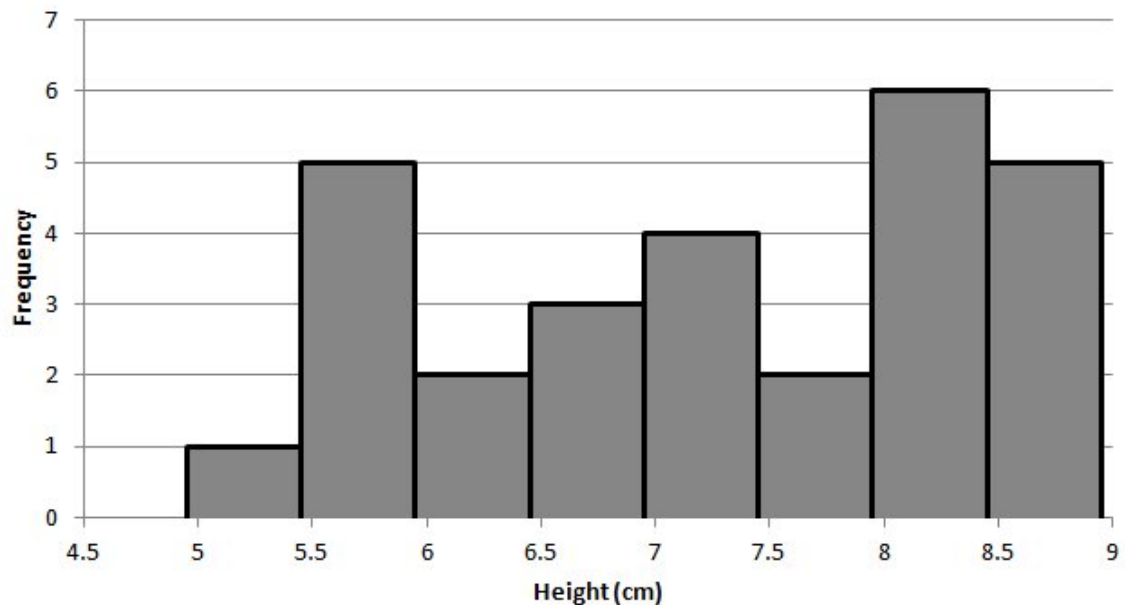
- Full marks will be given for complete answers to all questions.
- Students should attempt all questions **on paper**.
- Students should **then** submit their answers on the Blackboard site for this module.

Questions

1. The following data, x , gives the heights of 27 plants (in cm).

5.2	5.5	5.7	5.8	5.9	5.9	6.1	6.2	6.6
6.7	6.7	7.0	7.0	7.4	7.6	7.6	8.0	8.1
8.2	8.2	8.3	8.3	8.5	8.8	8.8	8.8	8.9

(a) Terry represents the data in the following histogram.



(i) Which of the bars of Terry's histogram is not the correct height?

- [4.95, 5.45)
- [5.45, 5.95)
- [5.95, 6.45)
- [6.45, 6.95)
- [6.95, 7.45)
- [7.45, 7.95)
- [7.95, 8.45)
- [8.45, 8.95)

[2 marks]

(ii) What is the correct height of this bar?

Free text answer – Blackboard will allow you to type an answer.

[3 marks]

(b) Find:

(i) the median;

Free text answer – Blackboard will allow you to type an answer.

[1 mark]

(ii) the upper quartile;

Free text answer – Blackboard will allow you to type an answer.

[2 marks]

(iii) the lower quartile;

Free text answer – Blackboard will allow you to type an answer.

[2 marks]

2. (a) Fred has 6 blue socks, 4 black socks, and 8 green socks in his drawer. If he chooses two socks at random, what is the probability that they are a pair of the same colour?

0.00 0.68 0.32 0.30 [3 marks]

(b) If A and B are mutually exclusive events, what is the probability that either A or B occurs?

Free text answer – Blackboard will allow you to type an answer.

[2 marks]

3. Sam has a 25% chance of winning a family game of Monopoly. Sam plays 5 games of Monopoly with his family.

(a) What is the distribution of the number of games Sam wins?

Normal Poisson Geometric Binomial [1 mark]

(b) What is the probability that he wins exactly 2 games?

Free text answer – Blackboard will allow you to type an answer.

[3 marks]

(c) How might Pascal's triangle help you to answer this question?

Free text answer – Blackboard will allow you to type an answer.

[1 mark]

4. A manufacturer produces nails, the weight of which is Normally distributed with a mean of 10g and a variance of 0.25g^2 . What is the distribution of the weight of a bag of 40 nails? Make sure you include any relevant parameters in your answer.

Free text answer – Blackboard will allow you to type an answer.

[5 marks]

5. (a) What does Spearman's rank correlation co-efficient measure?

Free text answer – Blackboard will allow you to type an answer.

[2 marks]

- (b) A researcher measures the weights and lengths of 8 sheep, shown in the table below:

Weight (kg)	90.3	85.6	81.4	77.5	75.9	69.2	63.1	61.7
Length (cm)	143.7	110.8	125.4	119.8	117.9	108.5	106.5	85.5

What is Spearman's rank correlation coefficient, r_s , for this data?

0.857 0.834 0.143 0.816 0.184 [3 marks]

6. A manufacturer wishes to establish a $100(1 - \alpha)\%$ confidence interval for the mean weight of a tin of salmon. They weigh 144 tins of salmon. The standard deviation of the weight is 3g. If the width of the confidence interval is 1.29g, then what is

(a) $Z_{\frac{\alpha}{2}}$;

Free text answer – Blackboard will allow you to type an answer.

[3 marks]

(b) $100(1 - \alpha)\%$?

99% 98% 95% 90%

[2 marks]

7. The weight of bags of flour nominally weighing 500g is Normally distributed, with a standard deviation of 5g. A worker responsible for filling bags becomes concerned that they are being underfilled. He weighs 16 randomly chosen bags, and discovers that the mean weight is 497g. Fill in the blanks in the following hypothesis test at a 5% significance level to establish whether the worker is right to be concerned.

$$H_0: \mu = \underline{\hspace{2cm}}$$

$$H_1: \mu \underline{\hspace{1cm}} 500$$

$$\text{One tail test; } Z_{\alpha} = \underline{\hspace{2cm}}$$

$$Z = \frac{497 - 500}{\frac{5}{\sqrt{16}}} = -2.4 < Z_{\alpha}.$$

We (can or cannot) reject the null hypothesis. The worker is to be concerned.

[5 marks]

8. The following table shows the population of Wales aged 3 and above in 2011, by gender, age, and ability to speak Welsh.

Age Group	Female			Male		
	Welsh Speaker	Not Welsh Speaker	Total	Welsh Speaker	Not Welsh Speaker	Total
3 to 14	79,257	121,234	200,491	74,631	136,391	211,022
15 to 24	51,819	149,069	200,888	43,952	166,204	210,156
25 to 44	61,342	319,136	380,478	52,142	324,002	376,144
45 to 64	56,699	357,209	413,908	51,242	348,968	400,210
Over 64	51,183	260,039	311,222	39,749	211,573	251,322
Total	300,300	1,206,687	1,506,987	261,716	1,187,138	1,448,854

Source: 2011 Census, Office for National Statistics

- (a) Fill in the gaps in the following contingency table:

	Female	Male	Total
Speaks Welsh	300,300	<i>i</i>	<i>ii</i>
Does not speak Welsh	1,206,687	1,187,138	2,393,825
Total	1,506,987	<i>iii</i>	<i>iv</i>

[4 marks]

- (b) When carrying out a χ^2 test to find whether there is a significant relationship between gender and Welsh speaking ability, which of the following would you calculate for each cell?

- $\frac{(\text{Observed} - \text{Expected})^2}{\text{Observed}}$
 $\frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$
 $\frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}^2}$
 $\frac{(\text{Observed} - \text{Expected})^2}{\text{Observed}^2}$

[1 mark]

- (c) The χ^2 test statistic for this test is:

- 10.8 2.7 1665.9 2955841 687.8

[4 marks]

- (d) Is there a significant relationship between gender and Welsh speaking ability?

- Yes No

[1 mark]