

OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER TWO EXAMINATIONS, 2003 – 2004

SECOND B.I.S EXAMINATION

QUANTITATIVE TECHNIQUES FOR BUSINESS (MA208)

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Time allowed: Two Hours.

Answer any *four* questions.

All questions, but not necessarily parts therein, carry equal marks.

All required statistical tables are available in the Mathematical ("log") tables.

1. (a) As part of a study of the distances commuted to work by its employees, the following data was collected by a company.

18	17	15	10	19	16	34	51	04	17
12	06	14	79	23	07	21	39	04	46
70	01	02	89	17	09	46	77	04	20
31	02	17	42	25	12	38	72	53	100
28	94	31	49	61	89	26	25	04	56
41	22	32	02	55	34	18	45	46	66

Illustrate the data with a histogram with intervals 0–20, 20–40, 40–60 and 60–100.

- (b) The value of shares of a company over a ten day period is as follows:

Value: 140 145 148 143 135 131 140 140 147 150

Find the mean, median, mode and the (population) standard deviation of the share prices

- (c) Name and outline the four basic sampling methods.

2. (a) The sample space of a random experiment consists of four, mutually exclusive events A,B,C and D. Which of the following assignments of probability to the four events are valid?
- i. 0.2, 0.4, 0.3, 0.2
 - ii. 0.2, 0.4, 0.3, 0.1
 - iii. 0.3,0.3,0.3, 0.11
 - iv. $\frac{1}{4}, \frac{2}{3}, \frac{1}{48}, \frac{1}{16}$
 - v. 1, 0, 0, 0
 - vi. 0.2, 0.7, 0.3, -0.2.
- (b) The probability distribution for damage claims paid by a car insurance company is as follows:

Payment (Euro)	0	1000	2000	3000	4000	5000
Probability	0.8	0.14	0.03	0.01	0.01	0.01

What is the mean value of a damage claim?

- (c) A building contractor bids for two contracts. Assuming that the probability that the contractor gets the first contract is 0.6, the probability that the contractor gets the second contract is 0.5, and the probability that (the contractor gets both contracts is 0.3, find the probability that the contractor will
- i. get at least one of the contracts.
 - ii. get neither of the contracts.
- (d) A committee of five is to be picked at random from seven men and six women. What is the probability that the committee will:
- i. Consist entirely of women?
 - ii. Will contain at least one man?
 - iii. Will contain *exactly* one man?
 - iv. Will contain at most two men?

3. (a) i. The number of phone calls that Harry receives is Poisson distributed with a mean of $\lambda = 1.7$ per hour. Find the probability that:
 - A. Harry receives no phone calls in a given hour,
 - B. Harry receives more than one phone call in a given thirty minute period,
 - C. Harry receives no phone calls in one hour, but receives exactly three phone calls in the next hour.
- ii. If the number of phone calls that Jane receives is Poisson distributed with a mean of $\lambda = 1.3$ per hour, what is the possibility that neither Tom nor Jane receive a phone call in a given one hour period.
- (b) Records show that 30% of students in a given school study German.
 - i. If a random sample of 8 students is taken, find the probability that:
 - A. *Exactly* three of them will study German,
 - B. At least one of them will *not* study German.
- (c) A lifetime of a given brand of washing machine is known to be normally distributed with a mean of $\mu = 250$ weeks and a variance of $\sigma^2 = 900$ weeks. If one of these washing machines is selected at random, what is the probability that the lifetime of this machine will be:
 - i. between 230 and 270 weeks,
 - ii. less than 200 weeks?
- (d) Suppose that 90% of the above washing machines have a lifetime of less than x weeks. Calculate x .

4. (a) A factory manager believes that the mean weight of "one kilogram gram bags of sugar" being produced in fact differs from 1,000 grams. He takes a random sample of 100 such bags, and finds that the bags in the sample have mean weight of $\mu = 1,002$ grammes with a standard deviation of 4 grams.
- State a suitable null (H_0) and alternative (H_1) hypothesis.
 - May the null hypothesis be rejected at a significance level of $\alpha = 0.05$.
 - If a *type one error* was made above, what, in terms of this specific case, would this mean.
- (b)
- State two conditions that should hold for an independent samples t-test to be valid.
 - A researcher believes that the ratio of current assets to current liabilities is greater for "healthy" firms than for failed firms. Random samples of such firms are taken, and the following summary statistics are obtained.

Firms	n	\bar{x}	s
Healthy	8	1.7256	0.6393
Failed	12	0.8236	0.4811

- Perform an independent samples t-test to test the hypothesis that the mean asset/liability ratio is greater for healthy firms than for failed firms. Interpret your findings.
- Construct a 95% confidence interval for the ratio of current assets to current liabilities for healthy firms.

5. (a) i. What is meant by the term *least squares regression line*.
 ii. Explain what is meant by saying that two variables are *weakly, negatively, linearly* correlated.
 iii. Does the fact that two variables are strongly correlated necessarily imply that one is causing the other? Illustrate your answer with an example other than that given in lectures.
- (b) The following data relates to traffic flow along a certain stretch of road regarded as a bottle neck. The first row gives the traffic density, in number of vehicles per km, during 20 different 5 minute intervals that were randomly chosen during a particular weekday. The second row gives the corresponding traffic speed.

Density (x_i)	48	62	46	59	44	37	57	37	49	24
Speed (y_i)	31	25	32	28	39	45	30	39	30	55

Continued:

Density (x_i)	51	65	48	61	47	40	58	38	46	22
Speed (y_i)	28	22	36	26	32	37	22	43	32	55

- i. Plot a scatter plot to represent these data.
 ii. Using a calculator, or otherwise, calculate an estimate, r , for ρ , (the population linear correlation between x and y).
 iii. From your scatterable. does the value of r that you calculated appear to be correct. Justify your answer.
 iv. Compute the least squares regression line $y = \hat{\alpha} + \hat{\beta}x$.
 v. Based on your answer above write down a point estimate of $\mu_{Y|48}$, interpret this figure.
 vi. In the table above, the traffic speed that corresponds to a traffic density of 48 is 31. Explain why this differs from your answer to the previous part of this question.

6. i. It is wished to investigate if the heights of Irish adult women (in inches) are uniformly distributed over the intervals 60-62, 62-64, 64-66, 66 - 68 and > 68. A sample of 200 such women is taken. The height profile of the students as follows:

60-62	62-64	64-66	66-68	> 68
25	39	60	39	37

May we reject H_0 : Distribution of the heights of such women is in the ratio 1:1:1:1:1 at $\alpha = 0.05$?

- ii. In a study to determine whether there is a relationship between bank employees' standard of dress and their professional advancement a random sample of size $n = 500$ such employees was taken. The results of the sample are summarised below.

	Advancement		
	Slow	Average	Fast
Very Well Dressed	38	135	129
Well Dressed	32	68	43
Poorly Dressed	13	25	17

At a significance level of $\alpha = 0.05$, is there evidence of a relationship between bank employees standard of dress and their professional advancement?