
Higher Certificate in Computer Applications Year 1

Quantitative Methods (ACCS) Summer Examination 2005

Date : May, 2005

Duration : 2 hours

Examiner : Mr Jonathan Brazil (2922)

Instructions to candidates:

- **Answer five questions of your choice**
 - **Attempt each part of each question you answer**
 - **All questions carry equal marks**
 - **Write clearly**
 - **Read the questions carefully**
 - **Show all rough work**
 - **Calculators are allowed**
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Question 1

- (a) A section of an aircraft's take-off path is given by the equation

$$-12x + 3y = 21, \text{ which is a straight line.}$$

Draw this line on suitable axis, showing clearly how you established the points which the line was drawn through and also indicate the slope of the line in the form of $m=?$

(4 marks)

- (b) Use simultaneous equations to find the point where these lines intersect. You may use any method of solving the simultaneous equations that you wish.

(i) $-5x + 8y = -14$

(ii) $12y + 3x = 36$

(6 marks)

- (c) Graph the following functions within the range of $-4 \leq t \leq 2$

$$f(t) = 2t^2 - 6t$$

$$g(t) = -4t^2 + 3t$$

(6 marks)

- (d) Convert the following numbers to the specified number base.
(Note: you must show all workings for full marks)

(i) 1101_{16} to Decimal (ii) 10010011_2 to Hexadecimal

(iii) 21 to Binary

(5 marks)

Question 2

- (a) Perform the following matrix operations (show all workings)

$$(i) \begin{pmatrix} -5 & 6 \\ 0 & 2 \end{pmatrix} + 4 \begin{pmatrix} -2 & 2 \\ 5 & -7 \end{pmatrix} =$$

$$(ii) \begin{pmatrix} 6 & 4 \\ 9 & 3 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} =$$

(8 marks)

- (b) Find the inverse of $\begin{pmatrix} -9 & 6 \\ 5 & -4 \end{pmatrix}$

(6 marks)

- (c) Hence solve the simultaneous equations below using matrices

$$\begin{aligned} 6y &= 9x - 15 \\ -4y &= -5x + 20 \end{aligned}$$

(6 marks)

Question 3

The following table is a presentation of the number of doctor visits per year by each of a sample of 20 randomly chosen people. Examine the data and answer the questions which follow:

7	0	5	4	8
0	2	6	3	4
0	4	9	4	2
1	3	2	4	5

Table 3.1 number of doctor visits

- (a) Present this data in a cumulative frequency distribution table. (3 marks)
- (b) Construct an ogive to represent the data. (4 marks)
- (c) Calculate the mode and mean of the data set. (5 marks)
- (d) Calculate the standard deviation. (6 marks)
- (e) Give a brief description of multistage sampling. (2 marks)

Question 4

- (a) Explain **in your own words** and name the two main types of depreciation.
(2 marks)
- (b) Explain **in your own words** the meaning of the term “effective rate of interest”.
(2 marks)
- (c) Jane is buying a house. The net cost of the house will be €220,000. Assuming that she gets a mortgage for the full amount from her bank at a rate of 3.6% per annum, compounded monthly over 25 years, calculate Jane’s monthly repayment.
(8 marks)
- (d) Robert wants to buy a new car in 2 year’s time. The car he wants will cost €36,995. As Robert is a dedicated saver, he decides to open a special 2 year, monthly instalment savings plan. Every month, Robert will lodge €1400 into the account. The rate of interest on the account is 2.1% per annum calculate on a monthly basis. Will the total balance of this account, in 2 year’s time, be enough for Robert to buy the car?
(8 marks)

Question 5

The following table represents the age at which a sample of Irish people retired from full-time work in the year 2003. Examine the data and answer the questions which follow:

63	63	65	65	58	64	61
63	60	62	60	65	63	65
55	65	63	59	65	62	64
63	65	57	60	63	65	65

Table 5.1 retiring age of sampled workers

- (a) Present this data in a frequency distribution table. (2 marks)
- (b) Calculate the mean and median of this data. (6 marks)
- (c) Calculate the inter-quartile range and the standard deviation. (6 marks)
- (d) Give a brief description of multistage sampling. (2 marks)
- (e) Assuming that 30% of the population works in office jobs and 48% of the population is male. Given this data, construct a stratified sampling plan for a sample of 1400 people. (4 marks)

Question 6

An independent research team, who conduct unusual surveys, trying to prove the most unlikely of relationships to be true, have conducted the following survey and tabulated the results below. The survey relates the number of votes received by an election candidate to the cost of the government car supplied to that candidate upon successful election! Could there really be a link? You are presented below with the results obtained from the research, examine them and answer the questions that follow:

Number of Votes	12000	13000	12500	14000	13250	14500
Cost of Car	40000	55000	50000	55000	56000	65000

Table 6.1 number of votes received vs. cost of car

- (a) Calculate and draw the regression line that relates the number of votes received and the cost of the car. (6 marks)
- (b) Calculate the correlation coefficient. (4 marks)
- (c) Estimate the expected cost of a car when the number of votes received is:
- (i) 12900
 - (ii) 16000

Which of these would you regard to be more accurate and why?

(6 marks)

- (d) Imagine the number of votes went up by 90%, would you expect the cost of the car to increase by 90% also? Why?

(4 marks)

Question 7

- (a) Explain the primary reason why Boolean logic became the accepted foundation for most programming languages and computer systems. Your answer should be to the order of three or four lines and give a detailed description of why. (2 marks)

- (b) Provide the truth tables for the logical IMPLIES and the logical EXCLUSIVE OR operations. (4 marks)

- (c) Use truth tables to solve the following logical sentence:

$$p \vee q \vee \neg(p \wedge q)$$

(6 marks)

- (d) The following truth table presents the activation criteria for a hi-tech home alarm system. The alarm system has three sensors (A, B, C) and depending on the combination of these sensors being active or inactive, the alarm will be activated and the siren will sound. Examine the table and produce a logical sentence for F (the activation combination).

A	B	C	F
1	0	1	1
0	0	0	0
1	1	0	1
0	1	1	1

(4 marks)

- (e) Use truth tables to prove the correctness of this logical statement:

$$\neg r \vee s = s \rightarrow r$$

(4 marks)

Linear Regression

1. Linear regression parameters **a** and **b**

$$S_{xy} = \frac{\sum xy}{n} - (\bar{x})(\bar{y})$$

$$S_{xx} = \frac{\sum x^2}{n} - (\bar{x})^2$$

$$S_{yy} = \frac{\sum y^2}{n} - (\bar{y})^2$$

$$b = \frac{S_{xy}}{S_{xx}} \quad a = \bar{y} - b\bar{x}$$

2. Correlation coefficient

$$r^2 = \frac{S_{xy}^2}{S_{xx}S_{yy}}$$

Financial Mathematics

1.
$$FV = \frac{R(1+r)((1+r)^t - 1)}{r}$$

2.
$$PV = \frac{R\left(1 - \frac{1}{(1+r)^t}\right)}{r}$$

Statistics

1. Standard Deviation

$$\sigma = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$$