
National Certificate in Computer Applications Year 1

Quantitative Methods (ACCS) Summer Examination 2004

Date : May, 2004

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**
-

Question 1

- (a) Given the equation of a line $4x - 7y = 21$, draw the line showing how you established the points which the line was drawn through. (3 marks)

- (b) Use simultaneous equations to find the point where these lines intersect.

(i) $6x + 2y = 21$

(ii) $2y - 6x = 24$

(6 marks)

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

(i) 1001001_2 to Decimal

(ii) 36 to Hexadecimal

(iii) 29 to Binary

(iv) FF to Decimal

(v) 47_8 to Decimal

(5 marks)

- (d) Graph the following functions within the range of $-2 \leq x \leq 4$

$$f(x) = 2x^2 - 3x + 2$$

$$g(x) = -3x^2 + 2x$$

(6 marks)

Question 2

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

$$(i) \begin{pmatrix} 2 & 1 \\ 4 & 0 \end{pmatrix} + \begin{pmatrix} 4 & 12 \\ -2 & 13 \end{pmatrix} = \quad (ii) \begin{pmatrix} 2 & -2 \\ -3 & 1 \end{pmatrix} - \begin{pmatrix} -9 & 4 \\ 0 & 1 \end{pmatrix} =$$

$$(iii) 2 \begin{pmatrix} 4 & -1 \\ 2 & -5 \end{pmatrix} + 3 \begin{pmatrix} 4 & 6 \\ 1 & -2 \end{pmatrix} = \quad (iv) \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 3 & 5 \\ 4 & 12 \end{pmatrix} =$$

(8 marks)

(b) Find the inverse of $\begin{pmatrix} -2 & 7 \\ 6 & 2 \end{pmatrix}$

(6 marks)

(c) Hence solve the simultaneous equations below using matrices

$$7y = 2x + 14$$

$$2y = -6x - 22$$

(6 marks)

Question 3

The following table is a presentation of the number of pets owned by 20 randomly chosen people. Examine the data and answer the questions which follow:

1	10	5	4	4
6	1	7	8	8
5	1	8	5	7
6	10	1	6	3

Table 3.1 number of pets owned

(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** the term annual percentage rate. (2 marks)

(b) Explain **in your own words** the straight line method of depreciation. (2 marks)

(c) Joe is planning on buying his first house. He already has €12,000 which he can use as a deposit. The cost of the house will be €180,000. Assuming that he gets a mortgage for the remainder of the cost of the house from his bank at a rate of 4.3% per annum, compounded monthly. His two options for the duration of the mortgage are:

- (i) 25 years
- (ii) 30 years

A financial eagle has told Joe that his house will be worth €340,000 in 25 years and €365,000 in 30 years. Given that Joe plans to sell the house when the mortgage is repaid, which option will give him the greatest profit margin?

(8 marks)

(d) Elizabeth wishes to purchase a new car in 14 months time. The car will cost her €27,998. She currently has €25,500 in savings that she can put away for 14 months into a special savings account with a healthy 2.5% interest, compounded monthly. If she takes this option will her accumulated savings be enough to buy her the car in 14 months time? (4 marks)

(e) A car is purchased for a company at a cost of €32,400. The car is expected to have a life of 4 years. Assuming that the company employs the 150% declining balance method of depreciation:

- (i) How much will the car depreciate by in the first year?
- (ii) How much will the car be worth at the end of the 3rd year?

(4 marks)

Question 5

The following table represents the atmospheric pressure (in millibars) over a given 4 week period in a certain region of Ireland. Examine the data and answer the questions which follow:

1038	1040	1038	1038	1040	1030	1028
1036	1030	1038	1034	1030	1038	1040
1034	1038	1036	1040	1034	1038	1028
1038	1040	1036	1040	1040	1038	1034

Table 5.1 atmospheric pressure values

- (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 in your own words of cardinal data. (2 marks)
- (e) Assume that 8% of the population is unemployed and 54% of the population is female. Given this data, construct a stratified sampling plan for a sample of 3000 people. (4 marks)

Question 6

- (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.

(3 marks)

- (b) Provide the truth tables for the logical BIDIRECTIONAL and the logical IMPLIES operations.

(4 marks)

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

$$x \wedge y \vee \neg x$$

(5 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:

$$\neg j \vee k = j \rightarrow k$$

(4 marks)

Question 7

An independent research team who conduct bizarre surveys in a vain attempt to prove that links exist between the strangest of things have conducted the following survey and tabulated the results below. The survey carried out compares the number guitars purchased per year in Ireland over a 6 year period against the average number of people who go deaf each year in Ireland over the same time span! 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:

Deaf People	450	560	300	500	700	100
Guitar Purchases	120	150	70	90	160	60

Table 7.1 number of guitar purchases per year and number of people going deaf each year

- (a) Calculate and draw the regression line that relates the people turning deaf and the number of guitar purchases each year.

(6 marks)

- (b) Calculate the correlation coefficient.

(4 marks)

- (c) Estimate the expected number of people turning deaf per year when the number of guitar purchases is:

(i) 135

(ii) 20

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

(6 marks)

- (d) Imagine the number of guitar purchases went up by 10%, would you expect the number of people turning deaf to increase by 10% also? Why?

(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. Future value of annuity

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

2. Present value of annuity

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

Statistics

1. Standard deviation

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