
National Certificate in Computer Applications Year 1

Quantitative Methods (ACCS) Summer Examination 2003

Date : May, 2003

Duration : 2 hours

Examiner : Jonathan Brazil

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**
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Question 1

- (a) Draw the following lines using the same axes for each
- (i) $x - y = 3$
 - (ii) $3y - 5x = 10$
- (6 marks)
- (b) Use a suitable method of calculation to find the point of intersection of these lines. (Write your answer in the correct form)
- (4 marks)
- (c) If a car is travelling along a road for 20 miles and it takes 20 minutes to complete the first 25% of the journey, 30 minutes to complete the next 50% of the journey and 10 minutes to complete the last 25% of the journey. What is the average speed of the car for the journey?
- (4 marks)
- (d) Which of the following lines are increasing? (i.e. have a positive slope)
- (i) $-3x - 4y = 13$
 - (ii) $3x + 2y = 9$
 - (iii) $-4x = -2y + 6$
- (6 marks)

Question 2

- (a) Perform the following matrix operations (show all workings)
- (i) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} + \begin{pmatrix} -2 & -4 \\ 3 & 6 \end{pmatrix} =$
 - (ii) $\begin{pmatrix} 8 & 0 \\ -4 & 6 \end{pmatrix} - \begin{pmatrix} 3 & 5 \\ -3 & 2 \end{pmatrix} =$
 - (iii) $2\begin{pmatrix} 2 & 4 \\ -1 & 2 \end{pmatrix} + 3\begin{pmatrix} 1 & 5 \\ -3 & 4 \end{pmatrix} =$
 - (iv) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 4 & 7 \\ 5 & 9 \end{pmatrix} =$
- (8 marks)
- (b) Find the inverse of $\begin{pmatrix} 3 & 2 \\ -1 & 4 \end{pmatrix}$
- (6 marks)
- (c) Hence solve the simultaneous equations below using matrices
- $$\begin{aligned} 3x + 2y &= 9 \\ -x + 4y &= -15 \end{aligned}$$
- (6 marks)

Question 3

- (a) I invest €1000 for 5 years at a rate of 6% per annum. If simple interest is paid to me directly at the end of each year, how much interest will I have received after five years?
(4 marks)
- (b) €10,000 is invested at an interest rate of 4% per annum calculated monthly. What is the value of the investment after 5 years, assuming that compound interest is applied?
(4 marks)
- (c) Jack is buying a house as a long-term investment. He already has €35,000, which he can use as a deposit. The cost of the house will be €135,000 so he will have to borrow €100,000. The mortgage rate will be 4.5% per annum, compounded monthly. His two options for the duration of the mortgage are:
- (i) 15 years
 - (ii) 20 years

A financial wizard has told Jack that his house will be worth €250,000 in 15 years and €285,000 in 20 years. Given that Jack plans to sell the house when the mortgage is repaid, which mortgage option will give him the greatest profit margin?

(12 marks)

Question 4

- (a) Describe the declining balance method of depreciation.
(3 marks)
- (c) A company buys a photocopier with a physical life of 2 years. It costs €3,600 and can be sold for parts for €800. How much should it be depreciated each month?
(5 marks)
- (d) John buys a new car for €18,000. His new car will have a useful life of 8 years. Calculate the amount of depreciation for each of the first 5 years of the new car, assuming that the car has a scrap value of €3,000.
(6 marks)
- (e) A government car for a minister is valued at €90,000. If it has a life span of 5 years and is depreciated at the 125% declining balance rate, how much is it worth in 5 years time?
(6 marks)

Question 5

An independent research team have discovered that the average number of dogs suspiciously killed per year seems to be in some way related to the average number of cats purchased each year! 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:

# of suspicious dog deaths per year	980	1010	870	890	990	960
# of cats purchased per year	280	283	265	272	281	275

Table 5.1 number of suspicious dog deaths and number of cats purchased, per year

- (a) Calculate and draw the regression line that relates the cat purchases and the number of dog deaths per year.
- (6 marks)

- (b) Estimate the expected number of dog deaths per year when the number of cats purchased per year is:
- (i) 220
(ii) 275

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

(6 marks)

- (c) Calculate the correlation coefficient.
- (4 marks)

- (d) Imagine the number of cat purchases per year went up by 10%, would you expect the number of suspicious dog deaths to increase by 10% also? Why?
- (4 marks)

Question 6

The following table is a presentation of the marks out of ten in a pop quiz for a sample of students in a certain Irish college. 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 6.1 marks of students

- (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 15% of the population is unemployed and 45% of the population is male. Given this data, construct a stratified sampling plan for a sample of 3000 people. (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 give a detailed description of why.

(5 marks)

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

(4 marks)

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

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

(5 marks)

- (d) Use truth tables to prove or disprove the correctness of this logical statement:

$$p \vee q \wedge \neg q = p \rightarrow q$$

(6 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

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

2. Present value of annuity

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

Statistics

1. Arithmetic mean

$$\bar{x} = \frac{\sum f(x)}{\sum f}$$

3. Standard deviation

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

Speed

1. Speed * Time = Distance