

**CORK INSTITUTE OF TECHNOLOGY  
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

**Semester 2 Examinations 2010/11**

**Module Title: Probability & Financial Mathematics**

**Module Code: STAT 6005**

**School: School of Computing & Mathematics**

**Programme Title:**

Bachelor of Science in Computing – Year 1

Higher Certificate in Science in Computing – Year 1

**Programme Code:**

KITMN\_8\_Y1

KCOMP\_7\_Y1

KCOME\_6\_Y1

**External Examiner(s): Mr. J. Reilly**

**Internal Examiner(s): Dr. D. Flannery, Ms. F. Wood**

**Instructions: Answer THREE questions. All questions carry equal marks.**

**Duration: 2 HOURS**

**Sitting: Summer 2011**

**Requirements for this examination:**

**Note to Candidates:** Please check the Programme Title and the Module Title to ensure that you are attempting the correct examination.  
If in doubt please contact an Invigilator.

Q.1(a) Codes for tagging equipment in a college department consist of three letters of the alphabet followed by three numbers, e.g., SZB 381.

(i) How many codes are possible? (2 marks)

(ii) If the letter O is not allowed at all and if the code cannot start with the letter I and if numbers cannot be repeated, how many different codes are possible? (2 marks)

(b) One hundred car loans were made by a credit union last year. The amounts were as shown:

Size of loan (€s)	No. of loans
under 3,000	5
3,000 but under 5,000	20
5,000 but under 10,000	60
10,000 but under 20,000	15

Two of the borrowers files are chosen at random by the credit union loans committee. What is the probability that

(i) both loans are for amounts under €5,000?

(ii) only one of the loans is under €5,000 ?

(4 marks)

(c) A new monthly magazine called “Green Ways” has come on the market.

A particular newsagent has placed an order for 30 copies to be delivered to his shop monthly. He pays the publisher €3.40 per copy and sells the magazine for €5.80 per copy. Any copies unsold at the end of the month can be returned by the newsagent for a refund of €0.90. The newsagent pays a penalty cost of €1.50 for each dissatisfied customer.

The demand for the magazine is expected to follow the probability distribution:

Demand per month:	20	23	26	29	32	35	38
Probability:	0.04	0.23	0.29	0.25	0.12	0.06	0.01

Using the following set of random numbers:  
56, 61, 30, 94, 72, 18, 26, 51, 83, 02

- (i) Simulate 10 months of demand for the magazine. (4 marks)
- (ii) Calculate the average monthly profit or loss associated with the sale of the magazine. (5 marks)
- (iii) Calculate the expected level of demand for the magazine. (3 marks)

Q.2(a) A recall of certain models of CAMKO cookers is taking place as they may have a design fault leading to production of dangerous levels of carbon monoxide. To date, 35% of cookers returned have been found to be faulty. Out of 10 cookers due for recall collection, what is the probability that

- (i) 3 or 4 will be faulty? (3 marks)
- (ii) at most 3 will be faulty? (4 marks)

(b) Enquiries regarding these models of cookers are received by the manufacturers at an average rate of 16 per five-day week. Assuming a Poisson distribution, find the probability that on any given day the manufacturers receive

- (i) 2 or 3 enquiries; (3 marks)
- (ii) more than 3 enquiries. (3 marks)

(c) Some customers have received compensation for damages caused by the faulty product. The level of compensation has been found to be approximately normally distributed with a mean of €5,800 and a standard deviation of €2,400. Determine the proportion of claimants who receive

- (i) between €5,000 and €7,000 in compensation; (4 marks)
- (ii) €4000 at most. (3 marks)

Q.3(a) A survey was carried out to determine the proportion of people living in Ireland who use the Internet to make hotel bookings when planning a holiday and also to determine how much they pay for accommodation. Out of 120 people surveyed, 81 indicated that they used the Internet to make bookings and the mean cost of accommodation per person was found to be €58 with a standard deviation of €12.

(i) Calculate a 95% confidence interval for the cost of accommodation and interpret your results.

(5 marks)

(ii) Calculate a 99% confidence interval for the proportion of all holiday makers who use the Internet to make bookings and interpret your result.

(4 marks)

(b) A staff member is considering buying a new car. The car will cost €23,400. If he makes a down payment of €5,000 and borrows the balance over 3 years, what monthly repayment will he have to make if interest is at 4.8% compounded monthly?

(5 marks)

(c) On the birth of their first grandson the Breens began a savings plan putting €40 every month into an account which will pay 2.4% compounded monthly. They plan to leave all monies in the account until their grandson's twenty-first birthday. How much will be in the account

(i) after 10 years;

(ii) on his twenty-first birthday?

(4 marks)

What is today's value of the sum which their grandson will receive?

(2 marks)

Q.4(a) A company manufactures external hard drives. If the price is €60 they sell 400 drives. However for every €1 the price is lowered, the number of drives sold increases by 8.

(i) Show that the revenue function is

$$R(x) = 24000 + 80x - 8x^2$$

where  $x$  is the number of Euro by which the price differs from 60.

(3 marks)

(ii) Find the number of drives which should be sold in order to achieve maximum revenue and give the cost of a drive in this case.

(3 marks)

(iii) State the maximum revenue available.

(2 marks)

(b) BIGJOYS has developed two types of handcrafted games which are sold to selected department stores. GAME 1 makes a net profit of €28 and GAME 2 makes a net profit of €31. Details for the weekly manufacture of these games are outlined in the table shown:

Process	Time GAME 1	Time GAME 2	Hours available per week
Production	180	240	7200
Finishing	25	12	600

There is a demand for the provision of at least 10 of GAME 2 per week.

(i) State the objective function to maximise weekly profit. (1 mark)

(ii) Use inequalities to state all of the constraints facing the company. (2 marks)

(iii) Graph these inequalities. (4 marks)

(iv) How many of each game should be produced in order to maximise profit?  
What is the profit in this case?

(5 marks)

## Relevant Formulae

1. Binomial Distribution  $P(r,n) = {}^n C_r p^r q^{n-r} \equiv \binom{n}{r} q^{n-r} p^r$

2. Poisson Distribution  $P(r) = \frac{\lambda^r e^{-\lambda}}{r!} \quad ; \quad P(r) = \frac{\mu^r e^{-\mu}}{r!}$

3. Normal Distribution Standard Units  $z = \frac{\bar{x} - x}{s} = \frac{x - \mu}{\sigma}$

4. Standard Errors

$$\text{Standard Error of the mean} = \frac{s}{\sqrt{n}}$$

$$\text{Standard Error of the proportion} = \sqrt{\frac{pq}{n}}$$

5. Compound Interest

$$A = P(1+r)^t$$

$$A = P(1+i)^n$$

6. Periodic Payment of an Annuity

$$R = \frac{Pi}{1 - (1+i)^{-n}}$$

7. Amount of an Annuity

$$A = \frac{R[(1+i)^n - 1]}{i}$$