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CIT Semester 1 Examinations 2018/19

Note to Candidates:	Check the Programme Title and the Module Description to ensure that you have received the correct examination. If in doubt please contact an Invigilator.
Module Title:	**Management Decision Making**
Module Code:	**MATH6034**
Programme Title(s):	BBus Accounting Y2 BBus Hons Accounting Y2
Block Code(s):	**BACCT_7_Y2** **BACCT_8_Y2**
External Examiner(s):	Dr. Katarina Domijan
Internal Examiner(s):	Ms. Marie Nicholson
Instructions:	Answer all five questions. All questions carry equal marks. Show all calculations and workings in full.
Duration:	2 Hours
Required Items:	Log/Formulae Tables

1. (a) Two banks in a local town quote the following nominal interest rates: bank A charges interest at 8.80% per annum compounded semi-annually and bank B charges 8.75% per annum compounded quarterly. Which bank charges the most interest?

[5 marks]

(b) Acme Corporation has the option of proceeding with a project that would entail the following cashflows:

Year	**Cashflow (€)**
0	-5000
1	-2000
2	1000
3	3000
4	5000

i. Calculate the Net Present Value of this project, assuming that the annual rate of interest is 6%.

ii. Should Acme Corporation invest in this project?

[8 marks]

(c) A loan of €$50,000$ is to be repaid in equal quarterly instalments over a period of five years. If interest is 7.5% per annum, calculate:

i. the amount of each quarterly payment,

ii. the total amount of interest paid.

[7 marks]

2. (a) The probability that a driver must stop at any one traffic light driving to CIT from the city center is 0.2. There are 15 sets of traffic lights on the journey.

i. What is the probability that a driver must stop at exactly 2 of the 15 sets of traffic lights?

ii. What is the probability that a driver will be stopped at 1 or more of the 15 sets of traffic lights?

[5 marks]

(b) A radioactive source emits 4 particles on average during a five-second period.

i. Calculate the probability that it emits 3 particles during a 5-second period.

ii. Calculate the probability that it emits at least one particle during a 5-second period.

iii. During a ten-second period, what is the probability that 6 particles are emitted?

[8 marks]

(c) Suppose the time required to assemble a computer is normally distributed with a mean of 50 minutes and a standard deviation of 10 minutes. What is the probability for the assembly time of a computer to be between 45 and 60 minutes?

[7 marks]

3. (a) In order to ensure efficient usage of a server, it is necessary to estimate the mean number of concurrent users. According to records, the sample mean and sample standard deviation of the number of concurrent users at 100 randomly selected times is 37.7 and 9.2, respectively. Construct a 90% confidence interval for the mean number of concurrent users.

[8 marks]

(b) Explain briefly when the $t-$distribution is used instead of the normal distribution.

[4 marks]

(c) It is claimed that a vacuum cleaner expends 46 kWh per year. A random sample of 12 homes indicates that vacuum cleaners expend an average of 42 kWh per year with standard deviation 11.9 kWh. At a 0.05 level of significance, does this suggest that, on average, vacuum cleaners expend less than 46 kWh per year? Assume the population to be normally distributed.

[8 marks]

4. (a) Callers to a telephone helpline typically need to wait before being connected to a service staff member. The average time between consecutive calls is 3 minutes and the average time a caller spends speaking to the staff member is 1.25 minutes. Assuming that the situation is modelled by the $M/M/1$ queue, find:

i. the average number of callers on the line at a given time,

ii. the average length of time spent by customers waiting to get through to a staff member,

iii. the probability that a random caller will spend longer that 8 minutes in the system in all,

iv. the probability that there are more than two callers on the line at a given time,

v. the proportion of time each day that there is nobody waiting to get through to the staff member.

[20 marks]

5. (a) Minimize $Z = 4x_1 + 3x_2 + x_3$ subject to the constraints:

$$\begin{aligned} 3x_1 + 2x_2 - x_3 &= 0 \\ x_1 + 3x_2 + 2x_3 &\leq -6 \\ -2x_1 + x_2 &\leq 5 \\ x_1 &\geq 0 \\ x_2 &\leq 0 \\ x_3 &\geq 0 \end{aligned}$$

Write the problem in standard form.
(**Note:** There is no need to solve the problem.) [**8 marks**]

(b) Consider the following linear programming problem. Maximise $4x_1 + 3x_2$ subject to:

$$\begin{aligned} x_1 + x_2 &\leq 3 \\ 2x_1 - x_2 &\leq 4 \\ x_1, x_2 &\geq 0 \end{aligned}$$

Use the graphical method to solve this problem.

[**12 marks**]

Formulae

Compound interest: $F = P(1+i)^n$

Present value: $P = \dfrac{F}{(1+i)^n}$

Annuity formulae: $F = A\left[\dfrac{(1+i)^n - 1}{i}\right]$ and $P = A\left[\dfrac{1-(1+i)^{-n}}{i}\right]$

Binomial distribution: $\binom{n}{k} p^k q^{n-k}$

Poisson distribution: $\dfrac{e^{-\lambda}\lambda^k}{k!}$

Standard normal varible: $Z = \dfrac{X-\mu}{\sigma}$

Sample standard deviation: $\dfrac{\sigma}{\sqrt{n}}$

Confidence intervals: $\bar{x} \pm z^* \dfrac{\sigma}{\sqrt{n}}$ and $\bar{x} \pm z^* \dfrac{s}{\sqrt{n}}$ and $\bar{x} \pm t^* \dfrac{s}{\sqrt{n}}$

Little's formula: $L = \lambda W$

$M/M/1$ **formulae:** $L_s = \dfrac{\lambda}{\mu - \lambda}$ and $L_q = \dfrac{\lambda^2}{\mu(\mu-\lambda)}$ and $p_{\geq n} = \left(\dfrac{\lambda}{\mu}\right)^n$

$P(S > T) = e^{(\lambda-\mu)t}$

$P(Q > T) = \dfrac{\lambda}{\mu} e^{(\lambda-\mu)t}$