MS1S461 Mathematics and Statistics for Computing – 2017/18

This **Referral Coursework** is worth 50% of the module mark. It needs to be submitted as a **Typed Report** via Turnitin on Blackboard before **11:59pm on 1st August 2018**.

Show ALL non-trivial calculations and answer All 6 questions.

Let α be the last, β the second to last and γ the third to last digits of your student ID number, so for example, if your student ID number is 16023824 then $\alpha = 4$, $\beta = 2$ and $\gamma = 8$.

1. (a) Determine the smallest number of calculations to obtain x^p & y^q. (3 marks)

α	0	1	2	3	4	5	6	7	8	9
p	91	105	106	116	151	154	157	163	171	172
q	61	53	43	67	58	101	75	85	103	109

(b) Using Euclids algorithm, determine the lcm of s & t, then obtain $\phi(s)$. (4 marks)

β	0	1	2	3	4	5	6	7	8	9
s	38243	27359	40363	20777	31921	41989	27233	24929	39271	30353
t	99866	98318	86156	80738	83433	90545	87801	95739	98610	86614

2. The cpu times (in minutes) an algorithm takes to solve 42 problems are below:

61.2	57.1	62.3	65.0	42.8	49.1	53.9	71.1	44.6	57.3	58.9	48.3	58.8	48.9
26.9	53.1	34.6	67.0	92.7	30.0	42.3	34.6	36.7	89.8	61.5	29.5	76.8	48.3
48.2	30.3	32.7	92.3	72.3	54.4	43.1	40.9	88.2	28.6	81.0	45+α	50+β	55+γ

(a) Find the mean and population standard deviation to 2 d.p. (2 marks)

(b) Group the data into 7 classes starting from 26.45 and ending with 92.95. Illustrate this on a histogram. (3 marks)

(c) Determine the median and interquartile range of the grouped data to 2 d.p. Hence, determine the Pearson coefficient of Skewness. (3 marks)

3. I throw a coin in the air $2\alpha + 3\beta + \gamma$ times. Using the Binomial distribution, determine the probability to 4 d.p. that it lands with heads up exactly $\alpha + \beta$ times. (2 marks)

4. Two students create their own algorithms (D and E) to solve 7 different test problems. The resulting cpu times in minutes are given below. Use a paired t-test to determine whether the mean cpu times of the algorithms differ significantly. (4 marks)

Test	1	2	3	4	5	6	7
D	121	156	78	23	94	88	98+γ
E	117	140	84	30	93	83	99+β

5. The number of goals scored by the home and away teams in the 2015-16 football Premiership league are given below:

		Goals by Away Team						
		0	1	2	3	4	5	6
Goals by Home Team	0	32	33	9	14	3	0	1
	1	37	41	28	11	3	1	0
	2	27	25	29	7	2	1	0
	3	18	15	10	5	2	0	0
	4	9	6	3	0	0	1	0
	5	0	4	0	0	0	0	0
	6	0	1	2	0	0	0	0

(a) Consider the number of games with a fixed number of goals scored in a game.

(i) Create a frequency table of the number of games with a fixed number of goals scored, from 0 to 9 goals. [Hint look at the sum of the diagonals (top right to bottom left)]. (2 marks)

(ii) Determine the mean and sample standard deviation of the number of goals scored in a game. (2 marks)

(iii) Supposing the number of goals scored in a game follows a Poisson distribution. Using this distribution, create a frequency table to predict the number of games with a fixed number of goals scored, from 0 to 9 goals, in 380 games. Give the predicted frequencies to 4 d.p. (3 marks)

(iv) Let X_i represent the actual number of games with i goals obtained in (i) and let Y_i represent the predicted number of games with i goals obtained in (iii). Obtain the correlation coefficient and the equation of the regression line. (4 marks)

(v) Perform a χ^2 test to determine if the difference between the actual distribution and the predicted distribution is significant. (3 marks)

(b) Consider the number of games with a fixed goal difference in a game.

Goal difference = number of Home goals − number of Away goals.

(i) Create a frequency table of the goal difference scored in a game, from -6 to 6. [Hint look at the sum of the diagonals (top left to bottom right)]. (2 marks)

(ii) Determine the mean and sample standard deviation of the goal difference in a game. (2 marks)

(iii) Suppose $\mu = 0.28$ and $\sigma = 1.72$ and that the goal difference in a game follows a Normal distribution. A member of FIFA thinks last years data looks suspicious. Perform a two-tailed hypothesis test using the z-test to determine if the mean goal difference in last years Premiership League was significant. (3 marks)

6. (a) I have 4 algorithms W, X, Y and Z for solving a computational problem. There are 4 different types of possible problems: logarithmic, linear, polynomial or exponential. The type of problem is not known in advance. Below are the likely amount of cpu time (in hours) for each algorithm to solve each type of problem:

	Problem Type			
Algorithms	Logarithmic	Linear	Polynomial	Exponential
W	0.3	1.0	1.6	5.0
X	0.1	1.4	3.0	4.0
Y	0.2	0.5	2.7	4.3
Z	1.0	2.0	2.0	3.4

Evaluate which algorithm should be used according to the following criteria:
(i) Laplace, (ii) Maximax, (iii) Maximin, (iv) Minimax regret. (4 marks)

(b) A computer company wishes to buy some chips from a large electronics manufacturer. The chips are currently on sale for £1 million. The computer company believes the chips true value is £1.1 million. From past experience, the company knows that if the chips are not sold within a month the manufacturer will reduce the price to £0.97 million. If the chips are not sold during this second month the price will be further reduced to £0.87 million. In the event of the chips still not being sold by the end of the third month the manufacturer will recycle the chips for raw materials to be used to make lower quality chips. The probabilities that the chips will be sold in months 1, 2 and 3 are 12%, $(20+\gamma)$% and $(55-2\gamma)$%, respectively. Construct a decision tree to determine when the company should attempt to buy the chips. (4 marks)

Total (50 marks)