

**THE OPEN UNIVERSITY OF SRI LANKA
COMMONWEALTH EXECUTIVE MASTER OF BUSINESS/PUBLIC
ADMINISTRATION
FINAL EXAMINATION – 2021**

MSP9407/ MCP1607 - QUANTITATIVE TECHNIQUES

Duration: Three (03) hours

DATE: 19.09.2021

TIME: 9.30 AM – 12.30 PM

Instructions:

1. Answer **ALL** questions.
2. **THE OPTION OF THE QUESTIONS THAT YOU HAVE TO ANSWER IS BASED ON THE DIFFERENT DIGITS OF YOUR STUDENT REGISTRATION NUMBER.**
3. The **relevant** digit of the Student Registration number for each question will be mentioned at the beginning of each question.

Example:

Question 1 - Select the relevant option of the question according to the FORTH (4TH) DIGIT of your Student Registration number - (Total 20 marks)

4. **Carefully select the option of questions, according to the relevant digit of your Student Registration number, as shown in the following table.**

Table 1

Relevant digit of the Student Registration number	Option
0, 1, 4, 5, 8	A
2, 3, 6, 7, 9	B

5. **Clearly write the question together with the option that you have selected at the beginning of each question in your answer script.**

Example:

When the registration number is 114531253,

Table 2

1	1	4	5	3	1	2	5	3
First Digit	Second Digit	Third Digit	Forth Digit	Fifth Digit	Sixth Digit	Seventh Digit	Eighth Digit	Ninth Digit

If the FORTH (4TH) DIGIT of the Student Registration number should be considered for Question 1, the relevant digit is 5, and you must answer option A, as per *Table 1*.

At the beginning of the answer, you must write **‘Question 1 – Option A’**

- 6. If you answered any other option which is not assigned to you based on your Student Registration number, you will not get marks for that question.**
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Question 1

Select the relevant option of the question according to the FORTH (4TH) DIGIT of your Student Registration number - (Total 20 marks)

Question 1 - Option A

1. An investor assesses 3 investment opportunities. The cost and net cash flow for the 3 investments named as Inv1, Inv2, and Inv3 are stated below. The rate of discount is 6.5%.

Investment	Cash Flow	
	Initial payment (Rs.)	Value at the end of 3 rd Year (Rs.)
Inv1	200,000	248,000
Inv2	250,000	296,500
Inv3	300,000	375,000

- i) Which investment is better? (Show workings) (6 marks)
ii) Briefly explain the reason for the above answer. (2 marks)
iii) What is the second-best investment alternative? Why? (2 marks)

2. The **costs** of producing a new product are given below. Based on similar products, you can expect the revenue function of the product.

Fixed cost	700
Variable cost per product	X- 60

Revenue function	$250 + 15X - X^2$
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- i) Write a mathematical function for total cost if the number of products that can be sold is X. (2 marks)
 - ii) Find the marginal revenue of the company. (2 marks)
 - iii) Find the marginal cost of the company (2 marks)
3. Given below are the systolic blood pressure levels (mm Hg) of 20 graduates, following a course in mathematics and statistics.

110	113	106	131	98	106	118	91	112	85	104	111	135	130	91	123	88	124	90	126
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Calculate the following:

- i) Mean (01 mark)
- ii) Median (01 mark)
- iii) Mode (01 mark)
- iv) Range (01 mark)

Question 1 - Option B

1. An investor assesses 3 investment opportunities. The cost and net cash flow for the 3 investments named as Inv1, Inv2, Inv3 are stated below. The rate of discount is 7.5%.

Investment	Cash Flow	
	Initial payment (Rs.)	Value at the end of 4 th Year (Rs.)
Inv1	200,000	280,000
Inv2	250,000	350,000
Inv3	300,000	410,000

- i) Which investment is better? (Show workings) (6 marks)
- ii) Briefly explain the reason for the above answer. (2 marks)
- iii) What is the second-best investment alternative? Why? (2 marks)

2. The **costs** of producing a new product are given below. Based on similar products, you can expect the revenue function of the product.

Fixed cost	550
Variable cost per product	$X-80$
Revenue function	$400 + 20X - X^2$

- i) Write a mathematical function for total cost if the number of products that can be sold is X . (2 marks)
- ii) Find the marginal revenue of the company. (2 marks)
- iii) Find the marginal cost of the company (2 marks)

3. Given below are the systolic blood pressure levels (mm Hg) of 20 graduates, following a course in mathematics and statistics.

112	112	100	125	101	110	115	85	89	105	103	121	130	128	92	120	83	128	89	120
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Calculate the following:

- i) Mean (01 mark)
- ii) Median (01 mark)
- iii) Mode (01 mark)
- iv) Range (01 mark)

Question 2

Select the relevant option of the question according to the **FIFTH (5TH) DIGIT** of your Student Registration number - (Total 20 marks)

Question 2 – Option A

The LeFleur Garden Center chain purchases Christmas trees for the sale during the holiday season. The trees are purchased at Rs.100 each and are sold at Rs.200 each. The trees not sold by Christmas day can be disposed at Rs.20 each. The Garden Center estimates that four levels of sales demand are possible, i.e., 100, 200, 500 and 1000 trees. The probability for the demand for the different number of trees are as follows.

Demand (number of trees)	Probability
100	0.2
200	0.5
500	0.2
1000	0.1

- i) Compute the expected monetary value for purchasing 100,200,500 and 1000 trees. (6 marks)
- ii) Compute the expected opportunity loss for purchasing 100,200,500 and 1000 trees. (6 marks)
- iii) Based on the results obtained for (i) and (ii), which would you choose to purchase, 100,200,500 or 1000 trees? Explain why. (4 marks)
- iv) Explain the meaning of expected value of perfect information (EVPI) for this problem and compute the EVPI. (4 marks)

Question 2 – Option B

Silviya's Jewelers sells watches for Rs 5,000 each. The watches are bought for Rs 3,000 each. During the next season, they estimate that they will sell 60, 100, 140, or 180 watches with respective probabilities of 0.25, 0.4, 0.25 and 0.1. Every season, Silviya's has a clearance sale to get rid of any unsold watches for Rs 2,400 (watches are only in style for a given season and so they have to buy the latest models for next season).

- i) Compute the expected monetary value for purchasing 60, 100, 140, or 180 watches. (6 marks)
- ii) Compute the expected opportunity loss for purchasing 60, 100, 140, or 180 watches. (6 marks)
- iii) Based on the results obtained for (i) and (ii), which would you choose to purchase, 60, 100, 140, or 180 watches? Explain why. (4 marks)
- iv) Explain the meaning of expected value of perfect information (EVPI) for this problem and compute the EVPI. (4 marks)

Question 3

Select the relevant option of the question according to the SIXTH (6TH) DIGIT of your registration number - (Total 20 marks)

Question 3 – Option A

The data on the performance at final examinations and place lived of a sample of school students are given below.

Performance at final examination	Place lived				Total
	Home	Hostel	Boarding house	Relatives' place	
High	115	15	35	83	248
Medium	72	20	55	54	201
Low	23	85	78	15	201
Total	210	120	168	152	650

1. What is the name of the procedure that can be used to check the association between the performance in final examinations and place lived? (2 marks)
2. What are the hypotheses to be checked in the said procedure? (4 marks)
3. Briefly describe the procedure to test the above association at 5% significance level? Is there an association? (6 marks)
4. One of these 650 students was selected randomly. What is the probability that the selected student is staying at a boarding house? (2 marks)
5. A randomly selected student was found to be staying at a hostel. What is the probability that the student has performed 'low' at the final examination? (2 marks)
6. A randomly selected student was found to be performed higher at the final examination. What is the probability that the student has lived at a boarding house? (2 marks)
7. Find the probability of a student living at a relatives' place and performing low at the final examination. (2 marks)

Question 3 – Option B

The data on the regular attendance to school and place lived of a sample of school students are given below.

Regular attendance to school	Place lived				Total
	Home	Hostel	Boarding house	Relatives' place	
Very Good	123	21	42	72	258
Satisfactory	65	29	65	48	207
Unsatisfactory	32	78	82	21	213
Total	220	128	189	141	678

1. What is the name of the procedure that can be used to check the association between the regular attendance to school and place lived? (2 marks)
2. What are the hypotheses to be checked in the said procedure? (4 marks)
3. Briefly describe the procedure to test the above association at 1% significance level? Is there an association? (6 marks)
4. One of these 678 students was selected randomly. What is the probability that the selected student is staying at a boarding house? (2 marks)
5. A randomly selected student was found to be staying at a hostel. What is the probability that the student has satisfactory level of regular attendance to school? (2 marks)
6. A randomly selected student was found to have unsatisfactory level of regular attendance to school. What is the probability that the student has stayed at a boarding house? (2 marks)
7. Find the probability of a student living at a relatives' place and has a very good level of regular attendance to school. (2 marks)

Question 4

Select the relevant option of the question according to the SEVENTH (7TH) DIGIT of your registration number - (Total 20 marks)

Question 4 - Option A

1. Consider the following outputs.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896 ^a	.803	.792	.2590399

a. Predictors: (Constant), Empathy, Assurance, Tangibles, Responsiveness, and Reliability

b. Dependent Variable: Customer Loyalty

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.678	.232		2.922	.004
Tangibles	.257	.075	.310	3.444	.001
Reliability	.122	.082	.177	1.499	.137
Responsiveness	.257	.081	.304	3.179	.002
Assurance	.206	.082	.189	2.503	.014
Empathy	-.001	.077	-.001	-0.12	.991

Dependent Variable: Customer Loyalty

- i) Determine the regression equation based on the given outputs. (3 marks)
- ii) The researcher claims that the customer loyalty increases with the level of tangibles. Is this statement correct? Justify your answer. (2 marks)
- iii) Interpret the coefficient of the variable of 'responsiveness'. (Its strength and how it may affect the customer loyalty) (3 marks)
- iv) Estimate the customer loyalty when the scores for each dimension are 3.57, 4.26, 3.20, 2.99 and 3.88 for tangibles, reliability, responsiveness, assurance, and empathy respectively. (2 marks)

2. Comment on the correlation coefficient values (i.e. the relationship and its strength) given in the following table. (6 marks)

Dimension	Coefficient of correlation with variable F	Sig (p)
A	0.025	0.250
B	0.542	0.000
C	-0.841	0.000

3. An online delivery shop claims that the mean delivery time is less than 3 days. A random selection of 40 delivery times has a sample mean of 2 days and a standard deviation of 2 days. Consider that the data are distributed as Normal and a level of significance of 0.05. Briefly explain the procedure to check the claim. (4 marks)

Question 4 - Option B

1. Consider the following outputs.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896 ^a	.803	.792	.2590399

a. Predictors: (Constant), Empathy, Assurance, Tangibles, Responsiveness, Reliability

b. Dependent Variable: Customer Loyalty

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.678	.232		2.922	.004
Tangibles	.257	.075	.310	3.444	.001
Reliability	.122	.082	.177	1.499	.137
Responsiveness	.257	.081	.304	3.179	.002
Assurance	.206	.082	.189	2.503	.014
Empathy	-.001	.077	-.001	-0.12	.991

Dependent Variable: Customer Loyalty

- i) Determine the regression equation based on the given outputs. (3 marks)

- ii) The researcher claims that the customer loyalty increases with the empathy. Is this statement correct? Justify your answer. (2 marks)
- iii) Interpret the coefficient of the variable of ‘assurance’. (Its strength and how it may affect the customer loyalty) (3 marks)
- iv) Estimate the customer loyalty when the scores for each dimension are 2.8, 3.78, 4.63, 3.5 and 4.02 for tangibles, reliability, responsiveness, assurance and empathy respectively. (2 marks)

2. Comment on the correlation coefficient values (i.e. the relationship and its strength) given in the following table. (6 marks)

Dimension	Coefficient of correlation with variable F	Sig (<i>p</i>)
A	-0.053	0.300
B	0.821	0.000
C	-0.755	0.000

3. In a television commercial, the manufacturer of a toothpaste claims that more than four out of five dentists recommended the ingredients in his product. To test that claim, a consumer – protection group randomly sampled 400 dentists and asked each dentist whether he or she will recommend the toothpaste with the said ingredients. The results showed that 82.3 % of the dentists surveyed recommended the toothpaste. Considering 1% significance level, briefly explain the procedure to check the claim. (4 marks)

Question 5

Select the relevant option of the question according to the EIGHTH (8TH) DIGIT of your registration number - (Total 20 marks)

Question 5 – Option A

1. The quarterly sales data of a company are available for past 4 years. An analysis is required to predict the future sales.

Period	Year	Quarter	Sales (Rs. '000)	Quarterly Moving Averages	Centered Moving Averages (CMA)	Sales/CMA
1	2017	1	165	} 255.25	266.75	1.18
2		2	253			
3		3	316			
4		4	287			
5	2018	1	257	} 292.00	299.50	(6)
6		2	308			
7		3	376			
8		4	351			
9	2019	1	318	352.75	360.75	(7)
10		2	366			
11		3	440			
12		4	419			
13	2020	1	383	418.25	(5)	(8)
14		2	431			
15		3	510			
16		4	486			

- i. Calculate the values for (1) – (8). (4 marks)
- ii. Find the adjusted seasonal index values. (4 marks)
- iii. If the trend line equation is, Sales = 210.73+16.71*Period, find the forecasted sales for the four quarters of year 2021. (2 marks)
- iv. Can you assure the forecast calculated for quarter 4 in 2021? In what instances this value may be deviated from the forecast? (4 marks)

2. A sandwich stall is to make sandwiches for a function. It will serve three types of sandwiches as A, B and C. Sandwich A has 1 serving of vegetables, 4 slices of onion, 1 slice of cheese, and 2 slices of bread. Sandwich B has 2 servings of vegetables, 2 slices of onion, 1 slice of cheese and 2 slices of bread. Sandwich C has 3 servings of vegetables, 2 slices of cheese, and 2 slices of bread. A total of 10 bags of onions are available, each of which has 40 slices; 18 loaves of bread are available, each with 14 slices; 200 servings of vegetables are available, and 15 bags of cheese, each with 60 slices.

Given the resources, the goal is to maximize the number of sandwiches produced. The price of each sandwich is Rs 100/-. Formulate a linear programming model for the above situation. (Key: Use X1, X2 and X3 for the number of sandwiches produced in types A, B and C respectively).
(6 marks)

Question 5 – Option B

1. The quarterly sales data of a company are available for past 4 years. An analysis is required to predict the future sales.

Period	Year	Quarter	Sales (Rs. '000)	Quarterly Moving Averages	Centered Moving Averages (CMA)	Sales/CMA			
1	2017	1	178	}	}				
2		2	274						
3		3	320				262.50	271.00	1.18
4		4	278				279.50	284.00	0.98
5	2018	1	246	}	}				
6		2	310				(1)	306.50	1.01
7		3	359				314.75	(4)	(7)
8		4	344				328.00	332.50	1.03
9	2019	1	299	}	}				
10		2	346				(2)	369.25	0.94
11		3	450				378.75	(5)	(8)
12		4	420				401.50	411.88	1.02
13	2020	1	390	}	}				
14		2	429				422.25	431.38	0.90
15		3	523				440.50	450.00	0.95
16		4	496				(3)		

- i. Calculate the values for (1) – (8). (4 marks)
- ii. Find the adjusted seasonal index values. (4 marks)
- iii. If the trend line equation is, $\text{Sales} = 211.2 + 16.62 * \text{Period}$, find the forecasted sales for the four quarters of year 2021. (2 marks)
- iv. Can you assure the forecast calculated for quarter 4 in 2021? In what instances this value may be deviated from the forecast? (4 marks)

2. A farmer has 1000 perches of land in which he can grow corn, millet, or cowpea. Each perch of corn costs Rs 100/- for preparation, requires 7 man-hours of work and yields a profit of Rs 300/-. A perch of millet costs Rs 120/- for preparation, requires 10 man-hours of work and yields a profit of Rs 400/-. A perch of cowpea costs Rs 70/- for preparation, requires 8 man-hours of work and yields a profit of Rs 200/-. The farmer has Rs 100,000/- for cost of preparation and can count on 8,000 man-hours.

The farmer wishes to maximize the profit. Formulate a linear programming model for the above problem. (Key: Use X1, X2 and X3 as the number of perches used for corn, millet, and cowpea respectively). (6 marks)

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