Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination	**Spring 2020**	**4th Year 1st Semester**
Course Code: CSE 401	**Course Title: Mathematics for Computer Science**	**Credits: 3**
Full Marks: 120* (Written)		**Duration: 2 Hours**

* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30)

Instructions:

1. There are **Four (4)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. **a)** Suppose, you are playing a game of "Ludo" where you can not do anything until you roll the dice and the outcome is a "6". Now, you want to use a Random Variable ***X***, to store the number of times you need to roll the dice to get the first "6". 3+8+4

What is the type of random variable ***X***?

What is the probability that you will need to roll the dice ***i*** times to get the first "6"?

How many times are you expected to roll the dice in order to get the first "6"?

Here, ***i*** **= ((last 3 digits of your student id)%5 + 2)**

b) Suppose, the rule of "Ludo" changed and now initially you will roll the dice ***N*** times, and you have to get a "6" exactly ***i*** times. Now, you want to use a Random Variable ***Y***, to store the number of times you rolled a "6". 3+8+4

What is the type of random variable ***Y***?

What is the probability that if you roll the dice ***N*** times, you will get a "6" ***i*** number of times?

How many times are you expected to get a "6", if you roll the dice ***N*** times?

Here, ***N*** **= ((last 3 digits of your student id)%6 + 5)**

Here, ***i*** **= ((last 3 digits of your student id)%4 + 3)**

2. **a)** Suppose there are 3 possible states to classify a Covid-19 patient: Asymptotic (A), Moderate (M) and Critical (C). If a patient is Asymptotic today, the probabilities that he/she will be in A or M state the next day are 0.74 and 0.24 respectively. If the patient is in Moderate (M) state today, the probabilities that he/she will be in A or C state the next day are 0.58 and 0.13 respectively. Lastly, if the patient is in Critical (C) state today, the probabilities that he/she will be in M or C state the next day are 0.37 and 0.17 respectively. 4

Now, you want to model this scenario using Markov Chain. Write down the transition matrix for this.

b) Assume that, Asymptotic is state 0, Moderate is state 1 and Critical is state 2. 13
Now using the transition matrix from (a), find out if a patient is in state ***i*** today, what is the probability that he will be in state ***j*** after ***N*** days?
Here, ***i*** = **(last 3 digits of your student id)%3**
j = **(last 3 digits of your student id + 2)%3**
N = (**(last 3 digits of your student id)%4 + 3)**

c) What is the probability that a patient will be in state ***i*** after 100 days? 13
Here, ***i*** = **(last 2 digits of your student id)%3**

3. a) Suppose there are 3 manufacturing companies that produce PPE. If company 1 produces a PPE, there is a 20% chance that it is defective. If company 2 produces a PPE, there is a 12% chance that it is defective. If company 3 produces a PPE, there is a 18% chance that it is defective. 15
Now, you bought a PPE and found out that it is defective. What is the probability that it was made by company ***i***?
Here, ***i*** = **(last 3 digits of your student id)%3 + 1**

b) Corona test is 70 percent effective in detecting Covid-19 when it is, in fact, present. However, the test also yields a "false positive" result for 5 percent of the healthy persons tested. (That is, if a healthy person is tested, then, with probability 0.05, the test result will imply he has CoronaVirus .) If ***n*** percent of the population actually has CoronaVirus now, then what is the probability a person has CoronaVirus given that his test result is positive? 15
Here, ***n*** = **(last 3 digits of your student id)%3 + 4**

4. a) Suppose, there are ***N*** people in a party and they all have unique hats. Now, they put all of their hats in a bowl and mixed them. Then all of them take a hat randomly from the bowl one by one. What is the probability that exactly ***k*** people will get back their own hat? 15
Here, **N** = (**(last 3 digits of your student id)%4 + 10)**
k = (**(last 3 digits of your student id)%5 + 4)**

b) Suppose, in an open-book exam, there are a total of 3 text books and the answer to a certain question can only be found in the **ith** textbook(If i=2, that means the answer is in the 2nd text book). Now, a student wants to find the answer to this question, so he starts searching. It takes ***x*** hours for him to go through the 1st textbook, ***y*** hours to go through the 2nd textbook and ***z*** hours to go through the 3rd textbook. Also, assume that this student has short time memory and after searching a book, he forgets which book he has searched. 15
Now, find out the expected time that the student will need to find the answer.
Here, ***i*** = **(last 3 digits of your student id)%3**
***x* = (last 3 digits of your student id)%3 + 3**
***y* = (last 3 digits of your student id)%5 + 5**
***z* = (last 3 digits of your student id)%7 + 7**

OR

a) Suppose, there are 2 coffee shops. On average, ***i*** number of customers come to the 1st coffee shop and ***j*** number of customers come to the 2nd coffee shop in a day. On one day, the total number of customers in shop 1 nad shop 2 combined is ***N***. 15

Find out the expected number of customers that came to shop ***k***.

Here, ***i*** = **(last 3 digits of your student id)%6 + 40**

j = **(last 3 digits of your student id)%7 + 30**

N = **(last 3 digits of your student id)%4 + 80**

k **= (last 3 digits of your student id)%2 + 1**

b) If a customer enters the coffee shop, there is a 70% chance that he/she will actually order a coffee. 15

Find out the probability that the coffee shop ***k*** will sell ***N*** cups of coffee.

Here, ***N*** = **(last 3 digits of your student id)%6 + 20**

k = **(last 3 digits of your student id + 1)%2 + 1**