**Assignment 1**

Subject: **Probability & Statistics (MAS291)**

Group: SE1302

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**NOTE:**

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**Question 1** (**10** marks). If $P(A) = 0.3$, $P(B) = 0.2$, and $P(A \cap B) = 0.1$, determine the following probabilities:

**a.** $P(A')$ **b.** $P(A \cup B)$ **c.** $P(A' \cap B)$

**d.** $P(A \cap B')$ **e.** $P[(A \cup B)']$ **f.** $P(A' \cup B)$.

**Question 2** (**10** marks). Suppose the manufacturer's specifications for the length of a certain type of computer cable are 2000 ± 10 millimeters. In this industry, it is known that small cable is just as likely to be defective (not meeting specifications) as large cable. That is, the probability of randomly producing a cable with length exceeding 2010 millimeters is equal to the probability of producing a cable with length smaller than 1990 millimeters. The probability that the production procedure meets specifications is known to be 0.99.

(a) What is the probability that a cable selected randomly is too large?

(b) What is the probability that a randomly selected cable is larger than 1990 millimeters?

**Question 3 (20** marks). Pollution of the rivers in the United States has been a problem for many years. Consider the following events:

$A$: the river is polluted,

$B$: a sample of water tested detects pollution,

$C$: fishing is permitted.

Assume $P(A) = 0.3$, $P(B|A) = 0.75$, $P(B|A) = 0.20$, $P(C|A \cap B) = 0.20$, $P(C|A \cap B) = 0.15$, $P(C|A \cap B) = 0.80$, and $P(C|A \cap B) = 0.90$.

(a) Find $P(A \cap B \cap C)$.

(b) Find $P(B \cap C)$.

(c) Find $P(C)$.

(d) Find the probability that the river is polluted, given that fishing is permitted and the sample tested did not detect pollution.

**Question 4** (1**0** marks). Suppose that the four inspectors at a film factory are supposed to stamp the expiration date on each package of film at the end of the assembly line. John, who stamps 20% of the packages, fails to stamp the expiration date once in every 200 packages; Tom, who stamps 60% of the packages, fails to stamp the expiration date once in every 100 packages; Jeff, who stamps 15% of the packages, fails to stamp the expiration date once in every 90 packages; and Pat, who stamps 5% of the packages, fails to stamp the expiration date once in every 200 packages. If a customer complains that her package of film does not show the expiration date, what is the probability that it was inspected by John?

**Question 5** (1**0** marks). A large chain retailer purchases a certain kind of electronic device from a manufacturer. The manufacturer indicates that the defective rate of the device is 3%.

(a) The inspector randomly picks 20 items from a shipment. What is the probability that there will be at least one defective item among these 20?

(b) Suppose that the retailer receives 10 shipments in a month and the inspector randomly tests 20 devices per shipment. What is the probability that there will be exactly 3 shipments each containing at least one defective device among the 20 that are selected and tested from the shipment?

**Question 6** (1**0** marks). Heart failure is due to either natural occurrences (87%) or outside factors (13%). Outside factors are related to induced substances or foreign objects. Natural occurrences are caused by arterial blockage, disease, and infection. Assume that causes of heart failure for the individuals are independent.

**a.** What is the probability that the first patient with heart failure who enters the emergency room has the condition due to outside factors?

**b.** What is the probability that the third patient with heart failure who enters the emergency room is the first one due to outside factors?

**c.** What is the mean number of heart failure patients with the condition due to natural causes who enter the emergency room before the first patient with heart failure from outside factors?

**Question 7** (**20** marks). Traffic flow is traditionally modeled as a Poisson distribution. A traffic engineer monitors the traffic flowing through an intersection with an average of six cars per minute. To set the timing of a traffic signal, the following probabilities are used.

**a.** What is the probability that no cars pass through the intersection within 30 seconds?

**b.** What is the probability that three or more cars pass through the intersection within 30 seconds?

**c.** Calculate the minimum number of cars through the intersection so that the probability of this number or fewer cars in 30 seconds is at least 90%.

**d.** If the variance of the number of cars through the intersection per minute is 20, is the Poisson distribution appropriate? Explain.

**Question 8** (**10** marks). According to a study published by a group of University of Massachusetts sociologists, about twothirds of the 20 million persons in this country who take Valium are women. Assuming this figure to be a valid estimate, find the probability that on a given day the fifth prescription written by a doctor for Valium is
(a) the first prescribing Valium for a woman;

(b) the third prescribing Valium for a woman.

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