Philadelphia University
Faculty of Engineering

Marking Scheme

Examination Paper

Department of Communication & Electronics Engineering

Probability and Random Variables

(*650364*)

First Exam First semester Date: 25/11/2019

Section 1

Weighting 20% of the module total

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Marking Scheme

Probability and Random Variables (650364)

The presented exam questions are organized to overcome course material through 4 questions.
The *all questions* are compulsory requested to be answered.

Marking Assignments

Question 1: This question is attributed with 6 marks if answered properly, the answer is the following:

1) The type of probability that uses **sample spaces** is called

a) Classical probability **b) Subjective probability**
c) Empirical probability **d) Relative probability**

2) When a **coin** is tossed and then a **die** is rolled, the probability of getting a **tail** on the coin and an **odd** number on the die is

a) 1/2 **b) 1/4**
c) 3/4 **d) 1/6**

3) $P(A \cap B) = P(A) \cdot P(B)$, then **A** and **B** are

a) Mutually Exclusive Events **b) Independent Events**
c) Dependent Events **d) Equally Likely Events**

4) At a high school with **300** students, **62** play football, **33** play baseball, and **14** play both sports. If a student is selected at random, find the probability that the student plays football or baseball.

a) 109/300 **b) 14/300**
c) 19/60 **d) 27/100**

5) In binomial distribution **n=6** and **p=0.9**, then the value of **P(X=7)** is

a) Zero **b) More than zero**
c) Less than zero **d) One**

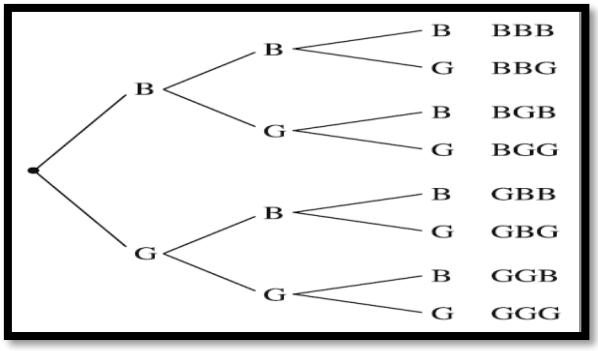
6) For a probability density function (**PDF**), the probability of a **single point** is

a) Constant **b) 0**
c) 1 **d) 2**

Question 2: This question is attributed with 7 marks if answered properly, the answer is the following:

a) ***(2 marks)***

Solution



- P(3 girls) =1/8
- P(2 boys and one girl in any order) = 3/8

b) ***(1.5 marks)***

Solution

$$n = 8,\ x = 3,\ p = \frac{1}{2}$$

$$P(3 \text{ heads}) = {}_8C_3 \left(\frac{1}{2}\right)^3 \left(\frac{1}{2}\right)^5$$
$$= 56\left(\frac{1}{8}\right)\left(\frac{1}{32}\right)$$
$$= 56 \cdot \frac{1}{256}$$
$$= \frac{7}{32} = 0.21875$$

c) ***(1.5 marks)***

Solution

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

$$\begin{aligned} P(A \cap B) &= P(A) + P(B) - P(A \cup B) \\ &= \tfrac{1}{2} + \tfrac{2}{3} - \tfrac{5}{6} \\ &= \tfrac{1}{3}. \end{aligned}$$

d) ***(2 marks)***

Solution

A= {1,3,5}, B={1,2,3}

$$P(A) = \frac{|A|}{|S|} = \frac{|\{1,3,5\}|}{6} = \frac{1}{2}$$

$$P(A|B) = \frac{|A \cap B|}{|B|} = \frac{2}{3}.$$

Question 3: This question is attributed with 4 marks if answered properly, the answer is the following:

a) ***(2 marks)***

Solution

$$F_X(x) = \begin{cases} 0 & \text{for } x < 3 \\ P_X(3) = 0.3 & \text{for } 3 \le x < 5 \\ P_X(3) + P_X(5) = 0.5 & \text{for } 5 \le x < 8 \\ P_X(3) + P_X(5) + P_X(8) = 0.8 & \text{for } 8 \le x < 10 \\ 1 & \text{for } x \ge 10 \end{cases}$$

b) ***(2 marks)***

Solution

we can use $\int_{-\infty}^{\infty} f_X(u)du = 1$:

$$\begin{aligned} 1 &= \int_{-\infty}^{\infty} f_X(u)du \\ &= \int_{-1}^{1} cu^2 du \\ &= \tfrac{2}{3}c. \end{aligned}$$

Question 4: This question is attributed with 3 marks if answered properly, the answer is the following:

Solution

H = {Student has long hair"}.
N = {Student is female"}.
M = {Student is male"}.
N and M decompose the sample space, so the formula of total probability yields

$$\begin{aligned} P(H) &= P(N)P(H|N) + P(M)P(H|M) \\ &= 0.27 \cdot 0.75 + 0.73 \cdot 0.15 \\ &= 0.312 \end{aligned}$$

Recall: $P(H|N) = 0.75$, $P(N) = 0.27$, $P(H) = 0.312$.
Bayes' formula yields

$$P(N|H) = P(N)\frac{P(H|N)}{P(H)} = 0.27 \cdot \frac{0.75}{0.312} \approx 65\%.$$