

PSFML Session 3 Homework

Full Name: _____

Group No.: _____

Lecturer Name: _____

Submission date: __/__/__

Grade: __/30

Please write down all the steps not the final answer only

Questions (30 points):

1. (4 points) Let X be a discrete random variable with the following PMF

X	0.2	0.4	0.5	0.8	1	Otherwise
$P(X)$	0.1	0.2	0.2	0.3	0.2	0

- a) Write the random variable space of X
- b) Find $P(X \leq 0.5)$
- c) Find $P(0.25 < X < 0.75)$

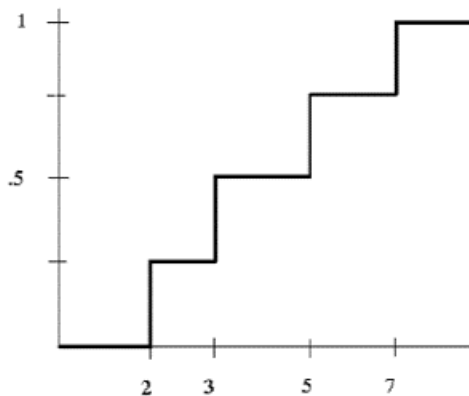
2. (5 points) Let X be a discrete random variable with the following PMF

$$P_X(k) = \begin{cases} 0.1 & \text{for } k = 0 \\ 0.4 & \text{for } k = 1 \\ 0.3 & \text{for } k = 2 \\ 0.2 & \text{for } k = 3 \\ 0 & \text{otherwise} \end{cases}$$

- a) Find $E[X]$.
- b) Find $\text{Var}(X)$.
- c) If $Y = (X-2)^2$, find $E[Y]$.

3. (3 points) Let X and Y be two independent random variables. Suppose that we know $\text{Var}(2X-Y)=6$ and $\text{Var}(X+2Y)=9$. Find $\text{Var}(X)$ and $\text{Var}(Y)$.

4. (5 points) You take an exam that contains 20 multiple-choice questions. Each with four choices. You know the answer to 10 questions, and you choose random answers to the other 10 questions. Your score X on the exam is the total number of correct answers. Find the PMF of X . What is $P(X > 15)$?
5. (4 points) The number of customers arriving at a grocery store is a Poisson random variable. On average 10 customers arrive per hour. Let X be the number of customers arriving from 10am to 11:30am. What is $P(10 < X \leq 15)$?
(hint: look up the Probability mass function of Poisson distribution)
6. (4 points) Given the discrete CDF, $F(X)$, shown; What are the probabilities $P(X = 5)$, $P(2 < X < 5)$, and $P(X \geq 3)$?



7. Find the mean and variance of the Binomial distribution.

Readings:

- Discrete Probability Distributions (with solved examples): https://learn.lboro.ac.uk/archive/olmp/olmp_resources/pages/workbooks_1_50_jan2008/Workbook37/37_1_dscrt_prob_distn.pdf
- PMF and PDF: <https://towardsdatascience.com/probability-concepts-explained-probability-distributions-introduction-part-3-4a5db81858dc>
- Joint, marginal and conditional probability: <https://towardsdatascience.com/deep-learning-book-series-3-4-and-3-5-marginal-and-conditional-probability-8c6239e453b8>
- Bayes rule: <https://www.mathsisfun.com/data/bayes-theorem.html>
- Naïve Bayes Classifier with examples: <https://web.iitd.ac.in/~bspanda/BY.pdf>

- Naïve Bayes Classifier with python implementation:
<https://www.analyticsvidhya.com/blog/2021/01/a-guide-to-the-naive-bayes-algorithm/>
- Maximum likelihood: <https://www.mygreatlearning.com/blog/maximum-likelihood-estimation/>
- List of all Probability distributions <https://www.statisticshowto.com/probability-distribution/>