# Statistics I

Week 8: Graded Assignment Practice Session

# Plan for this session

- How to join?
  - Join on webex - click on link sent to you
  - Join on pear deck - joinpd.com (enter code seen on top right)
  - Keep a notebook and pen ready for solving problems
- For every question - 15 minutes allotted
  - Question will be shown in a slide for solving - 5 minutes
  - If you are done solving, enter your answer at joinpd.com
  - Presenter will provide a solution - 5 minutes
  - Questions and discussion - 5 minutes
- Prelude questions - 5 or 10 minutes allotted
  - Help to prepare for the main question

How to participate?
joinpd.com
code: see above

# Sample Question - your screen on joinpd.com

Description of the problem.

Question to be answered.

Desktop

Answer box

enter a number or a choice or some text

Mobile

Answer question

# Example Screenshots

How to participate?
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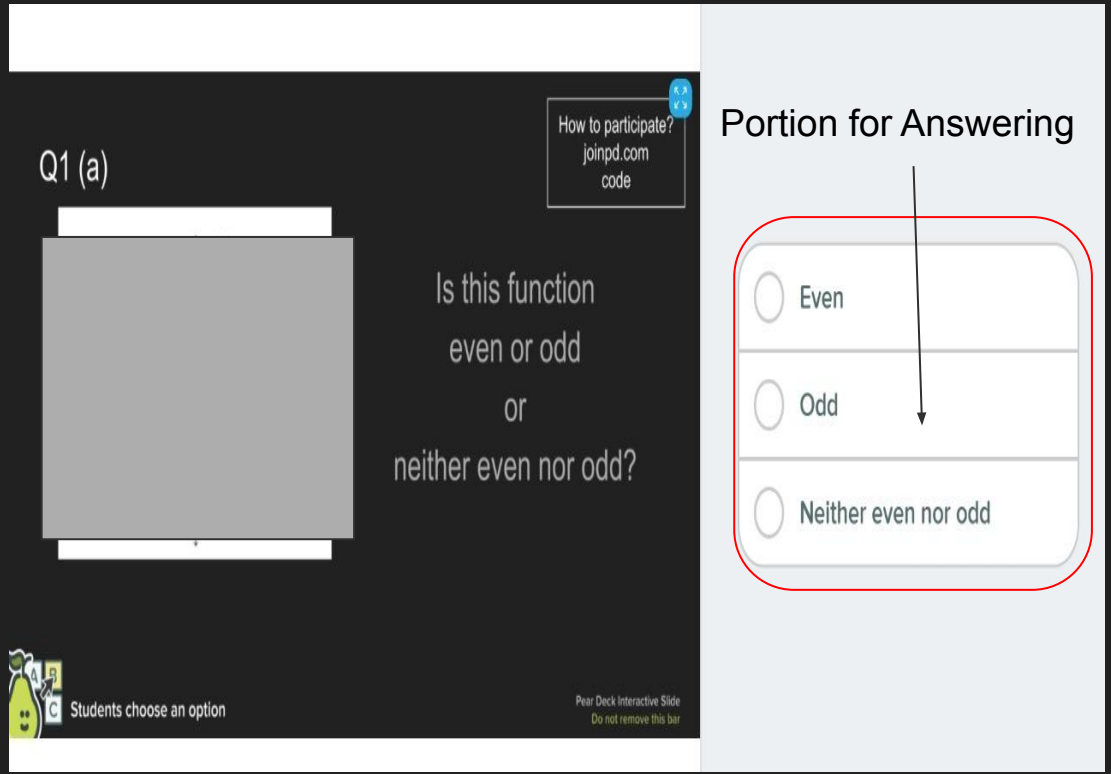
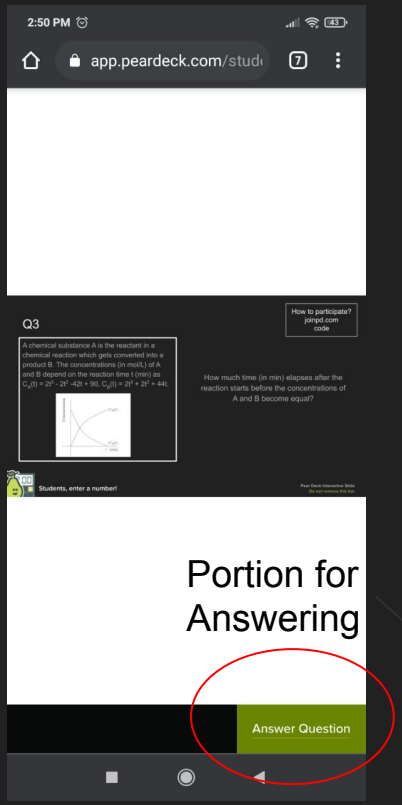
Laptop/Desktop




Mobile



# Q.1

Rajat is having 15 marbles in his pocket. Out of which 6 are green, 3 are red and 6 are yellow.

Let X be a random variable that denotes the number of red marbles Rajat will draw randomly from his pocket.

He draws two marbles randomly from his pocket.

What is the value of P(X=2)?

# Solution

Concept targeted in the question: Random Variable

X = Random variable which represents number of random variables that Rajat will draw randomly.

So X can take values either 0 or 1  or 2 or 3.

Number of ways Rajat draw 2 marbles out of total 15 marbles  =  15C2 = 105

P(X =2) that means probability that Rajat draws exactly 2 red marbles.

Number of ways Rajat can draw 2 red marbles out of total 3 red marbles  =  3C2= 3

The probability that X can take value 2 = P(X=2) = 3/105

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# Q2

Throw a 6-sided biased die with following probability distribution :

| X | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| P(X=x) | 0.1 | 0.23 | 0.23 | 0.20 | 0.12 | 0.12 |

What is the probability that X takes value more than 3?

(enter in decimal)

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# Solution:

Fundamental concept related to the problem: Probability Mass Function (pmf)

To check pmf:

1) Sum of probabilities of all outcomes should be 1.
2) P(X=x) >= 0 for all x.

| X | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| P(X=x) | 0.1 | 0.23 | 0.23 | 0.20 | 0.12 | 0.12 |

Experiment: Throw a biased die

Outcomes: { 1, 2, 3, 4, 5, 6 }, with different probabilities as given in a table.

Think: Can the given table be a pmf?

1. 0.1 + 0.23 + 0.23 + 0.20 + 0.12 + 0.12 = 1
2. P(X=1), P(X=2),.. P(X=6) are all greater than 0

The given table is a pmf

# Solution:

$P(X>3) = P(X=4) + P(X=5) + P(X=6) = 0.2 + 0.12 + 0.12 = 0.44$

**OR**

$P(X>3) = 1 - [P(X=2) + P(X=1) + P(X=0)] = 1 - [0.23 + 0.23 + 0.1] = 1 - 0.56 = 0.44$

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# Q3

A discrete random variable X has the following pmf.

$$P(X=x)=\begin{cases} kx & \text{for } x=1 \\ k(x-1) & \text{for } x=2 \\ k(x-2) & \text{for } x=3 \\ 0 & \text{otherwise} \end{cases}$$

What is the value of k?

(enter in decimal)

Students, enter a number!

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# Solution:

Finding the individual properties by putting values of x in probability mass function given in question.

$$P(X = x) = \begin{cases} kx & \text{for } x = 1 \\ k(x-1) & \text{for } x = 2 \\ k(x-2) & \text{for } x = 3 \\ 0 & \text{otherwise} \end{cases}$$

| | x=1 | x=2 | x=3 |
|---|---|---|---|
| P(X=x) | k.1 =k | k.(2-1) = k | k.(3-2) = k |

# Solution:

Using the properties of probability mass function(pmf) as explained in previous question,

$\Sigma P(X=x) = 1$ and $P(X=x) >= 0$

$\Rightarrow k+k+k = 1, k>=0$

$3k = 1, k>=0$

$k=1/3$

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# Prelude to Q4

Let X be the random variable with the following pmf:

$$P(X = x) = \begin{cases} 0.1 & \text{for } x = 0 \\ 0.15 & \text{for } x = 1 \\ 0.3 & \text{for } x = 2 \\ 0.45 & \text{for } x = 3 \end{cases}$$

A new random variable Y is defined as 2X + 3.

Find the values Y can take.

Students, enter a number!

How to participate?
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code: see above

# Solution: account for first step in a two-step experiment

From pmf for a random variable X, we know X can take values 0, 1, 2, 3.

To find the values Y can take, we need to insert values of X in a function 2X +3.

Therefore, Y = 2X + 3 = 2*0 + 3= 3, where X = 0

Similarly, Y = 2X + 3 = 2*1 + 3= 5, where X = 1

Y = 2X + 3 = 2*2 + 3= 7, where X = 2

Y = 2X + 3 = 2*3 + 3= 9, where X = 3

Therefore, Y = {3,5,7,9}

How to participate?
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# Q4

The cumulative distribution function for a discrete random variable is given below:

$$F(x) = \begin{cases} 0 & \text{for } x < 0 \\ 0.1 & \text{for } 0 \leq x < 1 \\ 0.25 & \text{for } 1 \leq x < 2 \\ 0.45 & \text{for } 2 \leq x < 3 \\ 0.65 & \text{for } 3 \leq x < 4 \\ 1.00 & \text{for } 4 \leq x \end{cases}$$

What is the probability mass function for Y = (2X +1)?

Students, enter a number!

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# Solution: First step of a solution to find pmf of random variable X

Cumulative distribution function (cdf) is a addition of probabilities of a discrete random variable X.

From cdf given in question, we can see that X takes a constant value between an interval that is there are no values of probabilities in between an interval.

# Solution:

Given: F(x) = 0, for x<0 and F(x) = 0.1, for 0<=x<1

Therefore, P(X<0) = 0

Similarly, P(X=0) = 0.1

Since, P(X=0) + P(X=1) = 0.25,

hence,  P(X=1) = 0.25 - 0.1 = 0.15

Similarly,

P(X=2) = 0.2

P(X=3) = 0.2

P(X=4) = 0.35

$$F(x) = \begin{cases} 0 & \text{for } x < 0 \\ 0.1 & \text{for } 0 \leq x < 1 \\ 0.25 & \text{for } 1 \leq x < 2 \\ 0.45 & \text{for } 2 \leq x < 3 \\ 0.65 & \text{for } 3 \leq x < 4 \\ 1.00 & \text{for } 4 \leq x \end{cases}$$

# Solution: Second step of a solution to find pmf of a new random variable Y = 2X+1

First, we will calculate the values that Y can take. From previous problem, we know how to find the values that a new random variable Y can take.

$Y = \{1,3,5,7,9\}$

# Solution:

Now, we calculate probabilities of each value which a new random variable can take.

P(Y=1) = P([2X+1] = 1) = P(X=0) = 0.1

P(Y=3) = P([2X+1] = 3) = P(X=1) = 0.15

P(Y=5) = P([2X+1] = 5) = P(X=2) = 0.2

P(Y=7) = P([2X+1] = 7) = P(X=3) = 0.2

P(Y=9) = P([2X+1] = 9) = P(X=4) = 0.35

$$P(Y=y) = \begin{cases} 0.1 & \text{for } y=1 \\ 0.15 & \text{for } y=3 \\ 0.2 & \text{for } y=5 \\ 0.2 & \text{for } y=7 \\ 0.35 & \text{for } y=9 \end{cases}$$

# Thank You