# Maths & Stats Pre-Sessional Tutorial

## Topic 2: Probability Distributions

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### Exercise 1

A fund manager is considering investing in a new software firm based in India. The manager's assessment of probabilities for rates of return on this stock over the next year is summarised in the accompanying table. Let A be the event "Rate of return will be more than 10%" and B be the event "Rate of return will be negative."

| **Event** | a | b | c | d | e |
|---|---|---|---|---|---|
| **Rate of return** | $<-10\%$ | $-10\%$ to $0\%$ | $0\%$ to $10\%$ | $10\%$ to $20\%$ | $>20\%$ |
| **Probability** | 0.04 | 0.14 | 0.28 | 0.33 | 0.21 |

(a) Find the probability of event A

(b) Find the probability of event B

(c) Describe the event that is the complement of A

(d) Find the probability of the complement of A

(e) Describe the event that is the intersection of A and B

(f) Find the probability of the intersection of A and B

(g) Describe the event that is the union of A and B

(h) Find the probability of the union of A and B

(i) Are A and B mutually exclusive?

(j) Are A and B collectively exhaustive?

### Exercise 2

The probability of A is 0.80, the probability of B is 0.10, and the probability that either A or B occur is 0.82.

(a) What is the probability that both A and B occur?

(b) What is the conditional probability of A given B?

(c) Are A and B independent in a probability sense?

## Exercise 3

Consider the joint probability distribution:

| | | X | |
|---|---|---|---|
| | | 1 | 2 |
| Y | 0 | 0.20 | 0.25 |
| | 1 | 0.30 | 0.25 |

(a) What is the probability P(X = 1, Y = 1)?

(b) Compute the marginal probability distributions for X and Y

(c) Compute the covariance and correlation for X and Y

## Exercise 4

The profit for a production process is equal to $6,000 minus three times the number of units produced. The mean and variance for the number of units produced are $1,000 and $900, respectively. Find the mean and variance of the profit.

## Exercise 5

A random variable is normally distributed with mean of μ=50 and a standard deviation of 5.

(a) Sketch a normal curve for the probability density function. Label the horizontal axis with values of 35,40,45,50,55,60 and 65.

(b) What is the probability the random variable will assume a value between 45 and 55?

(c) What is the probability the random variable will assume a value between 40 and 60?

# Check your knowledge:

Test your knowledge with the following multiple-choice questions.

For each question, select the correct answer. Explain your decision.

### Question 1

The qualities of discrete data can be:

a) Measured
b) Counted
c) Both
d) None

### Question 2

The qualities of continuous data can be:

a) Measured
b) Counted
c) Both
d) None

### Question 3

Which of these is NOT continuous data?

a) An item's weight
b) The time spent every day on Instagram
c) The number of students in a classroom
d) None of these

### Question 4

What is the difference between a discrete random variable and a continuous random variable?

a) A discrete random variable takes only negative numbers while a continuous random variable takes both positive and negative numbers.
b) A discrete random variable takes both positive and negative numbers while a continuous random takes only negative numbers.
c) A discrete random variable takes all values in an interval of numbers while a continuous random variable has a fixed set of possible values with gaps between.
d) A discrete random variable has a fixed set of possible values with gaps between while a continuous random variable takes all values in an interval of numbers.

## Question 5

A marketing survey compiled data on the number of cars in households. If X = the number of cars, and we omit the rare cases of more than 5 cars, then X has the following probability distribution:

| $x$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| P(X=$x$) | 0.24 | 0.37 | 0.20 | 0.11 | 0.05 | 0.03 |

What is the probability that a randomly chosen household has at least two cars?

(a) 0.20
(b) 0.29
**(c) 0.39**
(d) 0.81

**Explanation:** P(X >= 2) = P(X=2)+P(X=3)+P(X=4)+ P(X=5) = 0.2+0.11+0.05+0.03 = 0.39

## Question 6

A stockbroker estimates that at the end of the year, there is a 40% chance a stock will be worth $50, a 35% chance it will be worth $60 and a 25% chance it will be worth $70.

What expected value does this broker assign to this stock's end-of-the-year price?

(a) $58.50
(b) $60.00
(c) $62.50
(d) $65.00

## Question 7

Find the missing value for P(X=5) in the probability distribution:

Number of Toys | Probability
**0| 0.03**
**1| 0.16**
**2| 0.30**
**3| 0.23**
**4| 0.17**
**5| ?**

a) 0.11
b) 0.21
c) 0.01
d) 0.31

## Question 8

What is the probability that a student does play a sport given they do not play an instrument?

Middle School Music and Sports Survey

| | Plays Team Sport | Does Not Play Team Sport | Total |
|---|---|---|---|
| Plays Instrument | 8 | 3 | 11 |
| Does Not Play Instrument | 2 | 7 | 9 |
| Total | 10 | 10 | 20 |

a) 0.20
b) 0.2222
c) 0.10
d) 0.50

## Question 9

What is the probability that a student plays an instrument?

Middle School Music and Sports Survey

| | Plays Team Sport | Does Not Play Team Sport | Total |
|---|---|---|---|
| Plays Instrument | 8 | 3 | 11 |
| Does Not Play Instrument | 2 | 7 | 9 |
| Total | 10 | 10 | 20 |

a) 0.55
b) 0.50
c) 0.45
d) 0.40

**Question 10**

Which of these values below is a marginal frequency?

| Concession Stand Sales | | | | |
|---|---|---|---|---|
| | Soda | Water | No Drink | Total |
| Hot Dog | **50** | 62 | 46 | **158** |
| Pizza | **120** | 58 | **4** | **182** |
| No Food | 30 | 20 | **10** | 60 |
| Total | **200** | **140** | 60 | **400** |

a) 182
b) 120
c) 46
d) 10

**Question 11**

Which of the following mentioned standard Probability density functions is applicable to discrete Random Variables?

a) Gaussian Distribution (Normal Distribution)
b) Poisson Distribution
c) t-student Distribution
d) Exponential Distribution

**Question 12**

What is the area under a conditional Cumulative density function?

a) 0
b) Infinity
c) 1
d) Changes with CDF

**Question 13**

When do the conditional density functions get converted into the marginally density functions?

a) Only if random variables exhibit statistical dependency
b) Only if random variables exhibit statistical independency
c) Only if random variables exhibit deviation from its mean value
d) If random variables do not exhibit deviation from its mean value

**Question 14**

Mutually Exclusive events _____

a) Contain all sample points.
b) Contain all common sample points.
c) Does not contain any sample point.
d) Does not contain any common sample point.

**Question 15**

What would be the probability of an event 'G' if H denotes its complement, according to the axioms of probability?

a) P (G) = 1 / P (H)
b) P (G) = 1 – P (H)
c) P (G) = 1 + P (H)
d) P (G) = P (H)

**Question 16**

A variable that can assume any value between two given points is called _____

a) Continuous random variable
b) Discrete random variable
c) Irregular random variable
d) Uncertain random variable

**Question 17**

If a variable can certain integer values between two given points is called _____

a) Continuous random variable
b) Discrete random variable
c) Irregular random variable
d) Uncertain random variable

**Question 18**

The expected value of a discrete random variable 'x' is given by _____

a) P(x)
b) ∑ P(x)
c) ∑ x P(x)
d) 1

**Question 19**

If ‘X’ is a continuous random variable, then the expected value is given by _____

a) P(X)
b) ∑ x P(x)
c) ∫ X P(X)
d) No value such as expected value

**Question 20**

Out of the following values, which one is not possible in probability?

a) P(x) = 1
b) ∑ x P(x) = 3
c) P(x) = 0.5
d) P(x) = – 0.5

**Question 21**

If E(x) = 2 and E(z) = 4, then E(z – x) =?

a) 2
b) 6
c) 0
d) We cannot calculate it due to Insufficient data

**Question 22**

The expected value of a random variable is its _____

a) Mean
b) Standard Deviation
c) Mean Deviation
d) Variance

**Question 23**

The covariance of two independent random variable is _____

a) 1
b) 0
c) -1
d) Undefined

**Question 24**

If P(x) = 0.5 and x = 4, then E(x) = ?

a) 1
b) 0.5
c) 4
d) 2

**Question 25**

If the values taken by a random variable are negative, the negative values will have _____

a) Positive probability
b) Negative Probability
c) May have negative or positive probabilities
d) Insufficient data

**Question 26**

How is called a variable that assigns a real number value to an event in a sample space ?

Answer: _____

**Question 27**

Binomial Distribution is a _____

a) Continuous distribution
b) Discrete distribution
c) Irregular distribution
d) Not a Probability distribution

**Question 28**

In a Binomial Distribution, if 'n' is the number of trials and 'p' is the probability of success, then the mean value is given by _____

a) np
b) n
c) p
d) np(1-p)

**Question 29**

The shape of the Normal Curve is _____

a) Bell Shaped
b) Flat
c) Circular
d) Spiked

**Question 30**

Normal Distribution is symmetric around the _____

a) Variance
b) Mean
c) Standard deviation
d) Covariance

**Question 31**

The standard normal curve is symmetric about the value _____

a) 0.5
b) 1
c) ∞
d) 0

**Question 32**

For a standard normal distribute variable, the value of Standard Deviation is _____

a) 0
b) 1
c) ∞
d) not defined

**Question 33**

The variance of a random variable X ,Var(X), is defined by _____

a) $Var(X) = E(X^2) - (E(X))^2$
b) $Var(X) = E(X) - E(X)$
c) $Var(X) = E(X^2) - E(X)$
d) $Var(X) = E(X^2) - E(X^2)$

**Question 34**

For a random variable X, $Var(aX + b) = a^2 Var(X)$, is true or false?

a) True
b) False

**Question 35**

The variances of two independent random variables X and Y are 0.2 and 0.5 respectively.

Let Z= 5X-2Y. The variance of Z is?

a) 3
b) 4
c) 5
d) 7

**Question 36**

A continuous random variable X has uncountable many values in the interval [a, b]. If C is a values in the interval [a, b], then P{ X = C }

a) Is zero
b) Is strictly non-zero
c) depends on the limit [a,b]
d) is less than one, but non-zero