

5 marks

CHAPTER 16

THEORETICAL DISTRIBUTIONS

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Theoretical Probability Distributions

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graph TD; A[Theoretical Probability Distributions] --> B[Discrete Probability Distributions]; A --> C[Continuous Probability Distributions]; B --> D[Binomial Distribution]; B --> E[Poisson Distribution]; C --> F[Normal Distribution];
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Discrete Probability Distributions

**Binomial
Distribution**

**Poisson
Distribution**

Continuous Probability Distributions

**Normal
Distribution**



NOTE

RANDOM VARIABLE	PROBABILITY FUNCTION
Discrete	Probability mass function
Continuous	Probability Density function

BINOMIAL DISTRIBUTION

- It is derived from a particular type of random experiment known as Bernoulli process named after the famous mathematician

CHARACTERISTICS OF BERNOULLI TRIALS

- i. Each trial is associated with two mutually exclusive and exhaustive outcomes (one is 'success' and other is 'failure')
- ii. The trials are independent.
- iii. The probability of a success (p) and failure, ($q = 1-p$), remain unchanged throughout the process.
- iv. The number of trials is a finite positive integer.

BINOMIAL DISTRIBUTION

(bi - parametric
discrete probability distribution)

- A **discrete random variable X** is defined to follow binomial distribution with parameters n and p ,

$$X \sim B(n, p),$$

Probability Mass Function

$$f(x) = p(X = x) = {}^n c_x p^x q^{n-x} \text{ for } x = 0, 1, 2, \dots, n$$

BINOMIAL DISTRIBUTION

(bi - parametric
discrete probability distribution)

Mean

$$\mu = n p$$

Variance

- The variance of the binomial distribution is given by

$$\sigma^2 = n p q$$

Variance of a binomial variable is **always less** than its **mean**.

Variance of X attains its **maximum value** at **p = q = 0.5** and

this maximum value is **n/4**.

BINOMIAL DISTRIBUTION

MODE

$$(n+1)p$$

INTEGER

- $\mu_0 = (n+1)p$
- $\mu_0 = (n+1)p - 1$

Bi - Modal

NON - INTEGER

$\mu_0 =$ the largest integer
contained in $(n+1)p$

Uni- Modal



ADDITIVE PROPERTY

If X and Y are two independent variables such that

$$\mathbf{X \sim B(n_1, p) \text{ and } Y \sim B(n_2, p)}$$

$$\mathbf{\text{Then } (X+Y) \sim B(n_1 + n_2, p)}$$

Example 16.1: A coin is tossed 10 times. Assuming the coin to be unbiased, what is the probability of getting

- (i) 4 heads?
- (ii) at least 4 heads?
- (iii) at most 3 heads?

Example 16.2 : If 15 dates are selected at random, what is the probability of getting two Sundays?

Example 16.3: The incidence of occupational disease in an industry is such that the workmen have a 10% chance of suffering from it. What is the probability that out of 5 workmen, 3 or more will contract the disease?

Example 16.4 : Find the probability of a success for the binomial distribution satisfying the following relation $4 P(x = 4) = P(x = 2)$ and having the parameter n as six.

Example 16.5 : Find the binomial distribution for which mean and standard deviation are 6 and 2 respectively.

Example 16.8: An experiment succeeds thrice as often as it fails. If the experiment is repeated 5 times, what is the probability of having no success at all ?

Example 16.9 : What is the mode of the distribution for which mean and SD are 10 and 5 respectively.

Example 16.10: If x and y are 2 independent binomial variables with parameters 6 and $1/2$ and 4 and $1/2$ respectively, what is $P(x + y \geq 1)$?

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 1 What is the standard deviation of the number of recoveries among 48 patients when the probability of recovering is 0.75?

(a) 36.

(b) 81.

(c) 9.

(d) 3.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 2 X is a binomial variable with $n = 20$. What is the mean of X if it is known that x is symmetric?

(a) 5.

(b) 10.

(c) 2.

(d) 8.

Write down the correct answers. Each question carries 2 marks.

Que. 3 If $X \sim B(n, p)$, what would be the greatest value of the variance of x when $n = 16$?

(a) 2.

(b) 4.

(c) 8.

(d) $\sqrt{5}$

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 4 If x is a binomial variate with parameter 15 and $1/3$, what is the value of mode of the distribution?

(a) 5 and 6.

(b) 5.

(c) 5.50.

(d) 6.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 5 What is the number of trials of a binomial distribution having mean and SD as 3 and 1.5 respectively?

(a) 2.

(b) 4.

(c) 8.

(d) 12.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 6 What is the probability of getting 3 heads if 6 unbiased coins are tossed simultaneously?

(a) 0.50.

(b) 0.25.

(c) 0.3125.

(d) 0.6875.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 7 If the overall percentage of success in an exam is 60, what is the probability that out of a group of 4 students, at least one has passed?

(a) 0.6525.

(b) 0.9744.

(c) 0.8704.

(d) 0.0256.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 8 What is the probability of making 3 correct guesses in 5 True – False answer type questions?

(a) 0.3125.

(b) 0.5676.

(c) 0.6875.

(d) 0.4325

EXERCISE- Set (C)

Answer the following questions. Each question carries 5 marks.

Que. 1 If it is known that the probability of a missile hitting a target is $\frac{1}{8}$, what is the probability that out of 10 missiles fired, at least 2 will hit the target?

(a) 0.4258.

(b) 0.3968.

(c) 0.5238.

(d) 0.3611.

Que. An example of a bi-parametric discrete probability distribution is

[2018-MAY]

- (a) binomial distribution
- (b) Poisson distribution
- (c) normal distribution
- (d) both (a) and (b)

Ans : a

Que. In a binomial distribution $B(n, p)$, $n = 4$

[2019-NOV]

$P(x = 2) = 3P(x = 3)$ find p

(a) $1/3$

(b) $2/3$

(c) $6/4$

(d) $4/3$

Ans : a

Que. Mean and Variance of a binomial variance are 4 and $4/3$ respectively then $P(x \geq 1)$ will be _____.

[2014-JUNE]

- (a) $728/729$
- (b) $1/729$
- (c) $723/729$
- (d) None of the above.

Ans : a

Que. Find mode when $n = 15$ and $p = 1/4$ in binomial distribution?

[2019-NOV]

- (a) 4
- (b) 4 and 3
- (c) 4.2
- (d) 3.75

Ans : b

Que. The mean of the Binomial distribution $B(4, \frac{1}{3})$ is equal to

[2018-NOV]

- (a) $\frac{3}{5}$
- (b) $\frac{8}{3}$
- (c) $\frac{3}{4}$
- (d) $\frac{4}{3}$

Ans : d

Que. If mean and variance are 5 and 3 respectively then relation between p and q is:

[2019-JUNE]

- (a) $p > q$
- (b) $p < q$
- (c) $p = q$
- (d) p is symmetric

Ans : b

Que. The variance of a binomial distribution with parameters n and p is:

[2018-MAY]

- (a) $np^2(1 - p)$ (b) $\sqrt{np - (1 - p)}$
(c) $nq(1 - q)$ (d) $n^2p^2(1 - P)^2$

Ans : c

Que. If x is a binomial variate with $P = 1/3$, for the experiment of 90 trials, then the standard deviation is equal to:

[2021-JULY]

- (a) $\sqrt{5}$
- (b) $\sqrt{5}$
- (c) $2\sqrt{5}$
- (d) $\sqrt{15}$

Ans : c

Que. The Standard Deviation of Binomial distribution is:

[2022-DEC]

- (a) npq
- (b) $\sqrt{npq}$
- (c) np
- (d) $\sqrt{np}$

Ans : b

Que. If 'x' is a binomial variable with parameter 15 and $\frac{1}{3}$, then the value of the mode of the distribution:

[2015-DEC]

- (a) 5
- (b) 5 and 6
- (c) 5.50
- (d) 6

Ans : a

POISSON DISTRIBUTION

(UNI-parametric
discrete probability distribution)

- Poisson distribution is applied when the total number of events is pretty large but the probability of occurrence is very small.
- A **discrete random variable** X that follows Poisson Distribution denoted as

$$X \sim P(m)$$

POISSON DISTRIBUTION

- A **discrete random variable** X that follows Poisson Distribution denoted as

$$X \sim P(m)$$

Probability Mass Function

$$f(x) = P(X = x) = \frac{e^{-m} \cdot m^x}{x!} \text{ for } x = 0, 1, 2, \dots, \infty$$

where ,

$$e = 2.71828$$

$$m = n p$$

POISSON DISTRIBUTION

Mean

- The mean of Poisson distribution is given by

$$\mu = m$$

Variance

- The variance of Poisson distribution is given by

$$\sigma^2 = m$$

Standard Deviation

$$\sqrt{m}$$

POISSON DISTRIBUTION

MODE

m

INTEGER

- $\mu_0 = m$
- $\mu_0 = m - 1$

Bi - Modal

NON - INTEGER

$\mu_0 =$ the largest integer
contained in m

Uni- Modal



ADDITIVE PROPERTY

- If X and Y are two independent variables such that

$$X \sim P(m_1) \quad \text{and} \quad Y \sim P(m_2)$$

$$X + Y \sim P(m_1 + m_2)$$

Poisson Model

- **Let us think of a random experiment under the following conditions:**
 - I. **The probability of finding success in a very small time interval $(t, t + dt)$ is kt , where $k (>0)$ is a constant.**
 - II. **The probability of having more than one success in this time interval is very low.**
 - III. **The probability of having success in this time interval is independent of t as well as earlier successes.**

Application of Poisson distribution

- **Poisson distribution is applied when the total number of events is pretty large but the probability of occurrence is very small. Thus we can apply Poisson distribution, rather profitably, for the following cases:**
 - a. The distribution of the no. of printing mistakes per page of a large book.*
 - b. The distribution of the no. of road accidents on a busy road per minute.*
 - c. The distribution of the no. of radio-active elements per minute in a fusion process.*
 - d. The distribution of the no. of demands per minute for health centre and so on.*

Example 16.11: Find the mean and standard deviation of x where x is a Poisson variate satisfying the condition $P(x = 2) = P(x = 3)$.

Example 16.12: The probability that a random variable x following Poisson distribution would assume a positive value is $(1 - e^{-2.7})$. What is the mode of the distribution?

Example 16.13 : The standard deviation of a Poisson variate is 1.732.

What is the probability that the variate lies between -2.3 to 3.68 ?

Example 16.15: Between 9 and 10 AM, the average number of phone calls per minute coming into the switchboard of a company is 4. Find the probability that during one particular minute, there will be,

1. no phone calls

2. at most 3 phone calls (given $e^{-4} = 0.018316$)

Example 16.16: If 2 percent of electric bulbs manufactured by a company are known to be defectives, what is the probability that a sample of 150 electric bulbs taken from the production process of that company would contain

1. exactly one defective bulb?
2. more than 2 defective bulbs?

Example 16.17: The manufacturer of a certain electronic component is certain that two per cent of his product is defective. He sells the components in boxes of 120 and guarantees that not more than two per cent in any box will be defective. Find the probability that a box, selected at random, would fail to meet the guarantee? Given that $e^{-2.40} = 0.0907$.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 9 If the standard deviation of a Poisson variate X is 2, what is $P(1.5 < X < 2.9)$?

(a) 0.231.

(b) 0.158.

(c) 0.15.

(d) 0.144.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 10 If the mean of a Poisson variable X is 1, what is $P(X \geq 1)$?

- (a) 0.456.
- (b) 0.821.
- (c) 0.632.
- (d) 0.254.

Write down the correct answers. Each question carries 2 marks.

Que. 11 If $X \sim P(m)$ and its coefficient of variation is 50, what is the probability that X would assume only non-zero values?

(a) 0.018.

(b) 0.982.

(c) 0.989.

(d) 0.976.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 12 If 1.5 per cent of items produced by a manufacturing units are known to be defective, what is the probability that a sample of 200 items would contain no defective item?

(a) 0.05.

(b) 0.15.

(c) 0.20.

(d) 0.22.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 13 For a Poisson variate X , $P(X = 1) = P(X = 2)$. What is the mean of X ?

(a) 1.00.

(b) 1.50.

(c) 2.00.

(d) 2.50.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 14 If 1 percent of an airline's flights suffer a minor equipment failure in an aircraft, what is the probability that there will be exactly two such failures in the next 100 such flights?

(a) 0.50.

(b) 0.184.

(c) 0.265.

(d) 0.256.

EXERCISE- Set (B)

Write down the correct answers. Each question carries 2 marks.

Que. 15 If for a Poisson variable X , $f(2) = 3 f(4)$, what is the variance of X ?

(a) 2.

(b) 4.

(c) $\sqrt{2}$.

(d) 3.

Que. Which one of the following is an uniparametric distribution?

[2021-JAN]

- (a) Poisson
- (b) Normal
- (c) Binomial
- (d) Hyper geometric

Ans : a

Que. If x is a Poisson variable and $P(x = 1) = P(x = 2)$, then $P(x = 4)$ is

[2021-JAN]

(a) $\frac{2}{3}e^{-2}$

(b) $\frac{2}{3}e^4$

(c) $\frac{3}{2}e^{-2}$

(d) $\frac{3}{2}e^4$

Ans : a

Que. For a Poisson distribution:

[2019-NOV]

- (a) mean and SD are equal
- (b) mean and variance are equal
- (c) SD and Variance
- (d) both a and b

Ans : b

[2012-DEC]

Que. If parameters of a binomial distribution are n and p then, this distribution tends to a Poisson distribution when

(a) $n \rightarrow \infty, p \rightarrow 0$

(b) $p \rightarrow 0, np = \lambda$

(c) $n \rightarrow \infty, np = \lambda$

(d) $n \rightarrow \infty, p \rightarrow 0, np = \lambda$

Ans : d

Que. If the parameter of Poisson distribution is m and

[2020-NOV]

(Mean + S. D.) = $6/25$ then find m :

(a) $3/25$

(b) $1/25$

(c) $4/25$

(d) $3/5$

Ans : b

Que. If a Poisson distribution is such that $P(X = 2) = P(X = 3)$ then the variance of the distribution is:

[2022-DEC]

- (a) 3
- (b) $\sqrt{3}$
- (c) 6
- (d) 9

Ans : a

[2021-DEC]

Que. A renowned hospital usually admits 200 patients everyday. One percent patients, on an average, require special room facilities. On one particular morning, it was found that only one special room is available. What is the probability that more than 3 patients would require special room facilities?

- (a) 0.1428
- (b) 0.1732
- (c) 0.2235
- (d) 0.3450

Ans : a



NORMAL DISTRIBUTION

(BI-parametric
CONTINUOUS probability distribution)

- A **continuous random variable** x is defined to follow normal distribution with parameters μ and σ^2 , to be denoted by

$$x \sim N(\mu, \sigma^2)$$

NORMAL OR GAUSSIAN DISTRIBUTION

(BI-parametric
CONTINUOUS probability distribution)

Probability Density Function

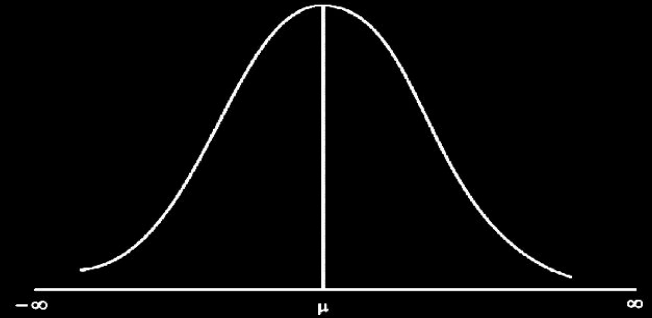
$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

for $-\infty < x < \infty$.

- $e = 2.71828$
- X = random variable
- μ = mean of normal random variable x
- σ = standard deviation of the given normal distribution

NORMAL CURVE

- The normal curve is **bell shaped**.
- The line drawn through $x = \mu$ has divided the normal curve **into two parts** which are equal in all respect.
- Normal distribution is **symmetrical** about $x = \mu$. As such, **its skewness is zero**
- The two tails of the normal curve extend indefinitely on both sides of the curve and **both the left and right tails never touch the horizontal axis**.
- The **total area of the normal curve** or for that any probability curve is taken to be **unity i.e. one**.



Normal curve /probability curve,

The area under this curve gives us the probability .

The area between $-\infty$ to μ = the
area between μ to ∞ = 0.5

NORMAL DISTRIBUTION

MEAN = MEDIAN = MODE = μ (Symmetric distribution)

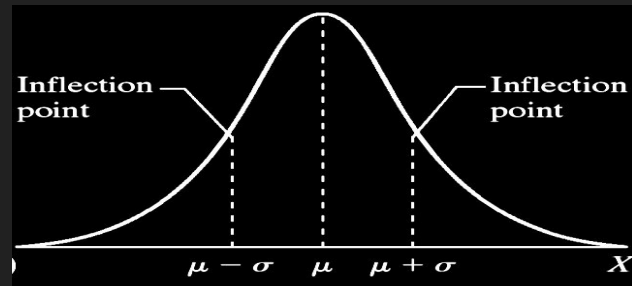
VARIANCE σ^2 (given in question)

Standard deviation σ

Mean deviation 0.8σ

Quartile Deviation 0.675σ

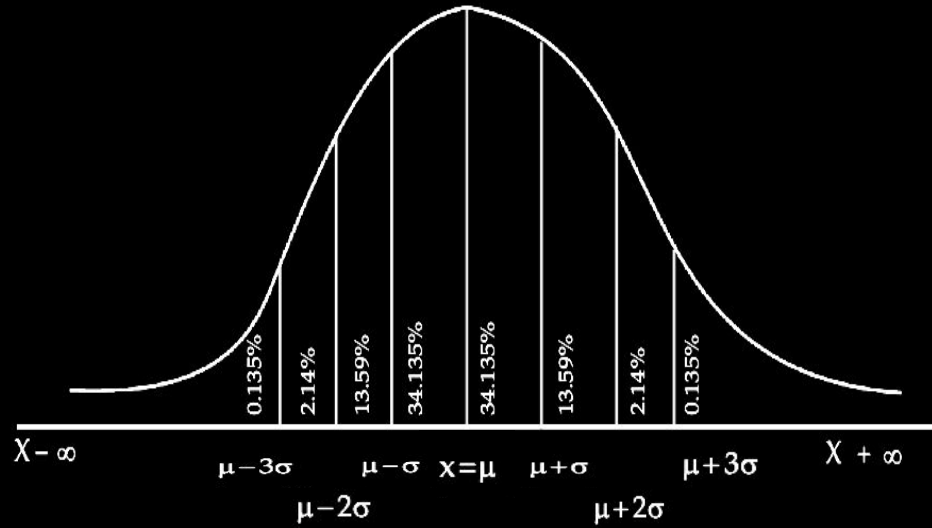
Quartiles
 $Q_1 = \mu - 0.675\sigma$
 $Q_3 = \mu + 0.675\sigma$



Two points of inflexion

- $\mu - \sigma$ and $\mu + \sigma$

NORMAL CURVE



$$P(\mu - \sigma < x < \mu + \sigma) = 0.6828$$

$$P(\mu - 2\sigma < x < \mu + 2\sigma) = 0.9546$$

$$P(\mu - 3\sigma < x < \mu + 3\sigma) = 0.9973$$

NORMAL CURVE

- If x and y are independent normal variables with means and standard deviations as μ_1 and μ_2 and σ_1 and σ_2 , respectively, then $z = x + y$ also follows normal distribution with
$$SD = \sqrt{\sigma_1^2 + \sigma_2^2} \text{ respectively.}$$
- mean $(\mu_1 + \mu_2)$ and

Example 16.32: x and y are independent normal variables with mean 100 and 80 respectively and standard deviation as 4 and 3 respectively. What is the distribution of $(x + y)$?

STANDARD NORMAL DISTRIBUTION

- If we take $\mu = 0$ and $\sigma = 1$

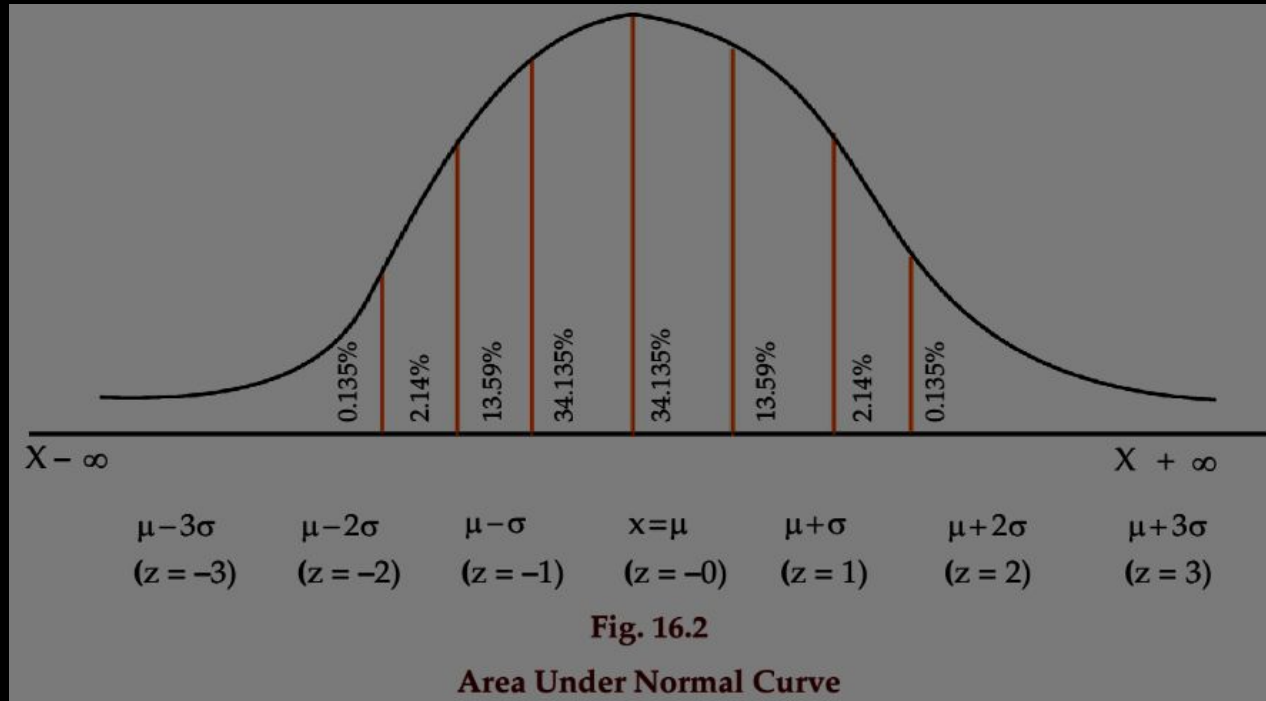
$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2} \quad \text{for } -\infty < z < \infty$$

- The random variable z is known as standard normal variate (or variable) or standard normal deviate.
- It is given by $z = \frac{x - \mu}{\sigma}$

IMPORTANT RESULTS of STANDARD NORMAL DISTRIBUTION

- **Mean = Median = Mode = 0**
- **The standard normal distribution is symmetrical about $z = 0$**
- **Variance = 1**
- **Standard deviation = 1**
- **Point of Inflexion = -1 and 1**
- **Mean deviation = 0.8**
- **Quartile deviation = 0.675**

Properties of Normal Distribution



Cumulative Distribution Function

$$P(z \leq k) = \Phi(k)$$

$$\begin{aligned} P(x < a) &= P\left[\frac{x - \mu}{\sigma} < \frac{a - \mu}{\sigma}\right] \\ &= P(z < k), (k = a - \mu/\sigma) \\ &= \Phi(k) \dots\dots\dots (16.27) \end{aligned}$$

Also $P(x \leq a) = P(x < a)$ as x is continuous.

$$\Phi(-k) = 1 - \Phi(k)$$

$$\begin{aligned} P(x > b) &= 1 - P(x \leq b) \\ &= 1 - \Phi(b - \mu/\sigma) \dots\dots\dots (16.28) \end{aligned}$$

$$P(a < x < b) = \Phi(b - \mu/\sigma) - \Phi(a - \mu/\sigma)$$

- $\Phi(k)$ gives the area from $-\infty$ to the point K
- Z table gives us the probability of values $z = 0$ to any value of z

Example 16.24 : X follows normal distribution with mean as 50 and variance as 100. What is $P(x \geq 60)$? Given $\phi(1) = 0.8413$

Example 16.27 : In a sample of 500 workers of a factory, the mean wage and SD of wages are found to be ₹ 500 and ₹ 48 respectively. Find the number of workers having wages:

(i) more than ₹ 600

(ii) less than ₹ 450

(iii) between ₹ 548 and ₹ 600.

Example 16.20: For a random variable x , the probability density function is given by

$$f(x) = \frac{e^{-(x-4)^2}}{\sqrt{\pi}}$$

for $-\infty < x < \infty$.

Identify the distribution and find its mean and variance.

Example 16.21: If the two quartiles of a normal distribution are 47.30 and 52.70 respectively, what is the mode of the distribution? Also find the mean deviation about median of this distribution.

Example 16.22: Find the points of inflexion of the normal curve

$$f(x) = \frac{1}{4\sqrt{2\pi}} \cdot e^{-(x-10)^2/32}$$

for $-\infty < x < \infty$

Write down the correct answers. Each question carries 2 marks.

Que. 16 What is the coefficient of variation of x , characterised by the following probability density

function: $f(x) = \frac{1}{4\sqrt{2\pi}} e^{-(x-10)^2/32}$ for $-\infty < x < \infty$

(a) 50.

(b) 60.

(c) 40.

(d) 30.

Write down the correct answers. Each question carries 2 marks.

Que. 17 What is the first quartile of X having the following probability density function?

function: $f(x) = \frac{1}{\sqrt{72\pi}} e^{-(x-10)^2/72}$ for $-\infty < x < \infty$

(a) 4.

(b) 5.

(c) 5.95.

(d) 6.75.

Write down the correct answers. Each question carries 2 marks.

Que. 18 If the two quartiles of $N(\mu, \sigma^2)$ are 14.6 and 25.4 respectively, what is the standard deviation of the distribution?

(a) 9.

(b) 6.

(c) 10.

(d) 8.

Write down the correct answers. Each question carries 2 marks.

Que. 19 If the mean deviation of a normal variable is 16, what is its quartile deviation?

(a) 10.00.

(b) 13.50.

(c) 15.00.

(d) 12.05.

Write down the correct answers. Each question carries 2 marks.

Que. 20 If the points of inflexion of a normal curve are 40 and 60 respectively, then its mean deviation is

(a) 40.

(b) 45.

(c) 50.

(d) 60.

Write down the correct answers. Each question carries 2 marks.

Que. 21 If the quartile deviation of a normal curve is 4.05, then its mean deviation is

(a) 5.26.

(b) 6.24.

(c) 4.24.

(d) 4.80.

Write down the correct answers. Each question carries 2 marks.

Que. 22 If the 1st quartile and mean deviation about median of a normal distribution are 13.25 and 8 respectively, then the mode of the distribution is

(a) 20.

(b) 10.

(c) 15.

(d) 12.

Write down the correct answers. Each question carries 2 marks.

Que. 23 If the area of standard normal curve between $z = 0$ to $z = 1$ is 0.3413, then the value of $\phi(1)$ is

(a) 0.5000.

(b) 0.8413.

(c) -0.5000.

(d) 1.

Write down the correct answers. Each question carries 2 marks.

Que. 24 If X and Y are 2 independent normal variables with mean as 10 and 12 and SD as 3 and 4, then $(X+Y)$ is normally distributed with

- (a) mean = 22 and SD = 7.**
- (b) mean = 22 and SD = 25.**
- (c) mean = 22 and SD = 5.**
- (d) mean = 22 and SD = 49.**

Que. An example of a bi-parametric continuous probability distribution:

[2016-DEC]

- (a) Binomial
- (b) Poisson
- (c) Normal
- (d) (a) and (b)

Ans : c

Que. Skewness of Normal Distribution is:

[2022-DEC]

- (a) Negative
- (b) Positive
- (c) Zero
- (d) Undefined

Ans : c

Que. The normal curve is:

- (a) Positively skewed**
- (b) Negatively skewed**
- (c) Symmetrical**
- (d) All these**

[2016-JUNE]

Ans : c

Que. If x and y are independent normal variates with Mean and Standard Deviation as μ_1 and μ_2 and σ_1 and σ_2 respectively, then $z = x + y$ also follows normal distribution with

[2016-DEC]

(a) Mean = $\mu_1 + \mu_2$ and S.D. = 0 respectively

(b) Mean = 0 and S.D. = $\sigma_1^2 + \sigma_2^2$

(c) Mean = $\mu_1 + \mu_2$ and S.D. = $\sqrt{\sigma_1^2 + \sigma_2^2}$

(d) None of these.

Ans : c

Que. In a normal distribution, variance is 16 then the value of mean deviation is.

[2022-JUNE]

- (a) 4.2
- (b) 3.2
- (c) 4.5
- (d) 2.5

Ans : b

Que. In normal distribution, Mean, Median and Mode are:

[2021-JULY]

- (a) Zero
- (b) Not Equal
- (c) Equal
- (d) Null

Ans : c

Que. The quartile deviation of a normal distribution with mean 10 and standard deviation 4 is _____.

[2020-NOV]

- (a) 54.24
- (b) 23.20
- (c) 0.275
- (d) 2.70

Ans : d

Que. Area under $U \pm 3\sigma$

[2019-NOV]

(a) 99.73%

(b) 99%

(c) 100%

(d) 99.37%

Ans : a

Que. If the points of inflexion of a normal curve are 40 and 60 respectively, then its mean deviation is:

[2019-JUNE]

- (a) 8
- (b) 45
- (c) 50
- (d) 60

Ans : a

[2018-NOV]

Que. What is the mean of X having the following density function?

$$f(x) = \frac{1}{4\sqrt{2\pi}} \cdot e^{\frac{-(x-10)^2}{32}} \text{ for } -\infty < x < \infty$$

- (a) 10
- (b) 4
- (c) 40
- (d) None of the above

Ans : a

Que. If for a normal distribution $Q_1 = 54.52$ and $Q_3 = 78.86$, then the median of the distribution is

[2018-NOV]

- (a) 12.17
- (b) 39.43
- (c) 66.69
- (d) None of these

Ans : c

Que. If the area of standard normal curve between $z = 0$ to $z = 1$ is 0.3412, then the value of $\phi(1)$ is.

[2018-MAY]

- (a) 0.5000
- (b) 0.8413
- (c) -0.5000
- (d) 1

Ans : b

[2021- July]

Que. For a certain type of mobiles , the length of time between charges of the battery is normally distributed with a mean of 50 hours and a standard deviation of 15 hours . A person owns one of these mobiles and wants to know the probability that the length of time will be between 50 and 70 hours is $\phi(1.33) = 0.9082$, $\phi(0) = 0.5$

(a) - 0.4082

(b) 0.5

(c) 0.4082

(d) - 0.5

Ans : c

Write down the correct answers. Each question carries 1 mark.

Que. 1 A theoretical probability distribution.

- (a) does not exist.**
- (b) exists in theory.**
- (c) exists in real life.**
- (d) both (b) and (c).**

d

Write down the correct answers. Each question carries 1 mark.

Que. 2 Probability distribution may be

- (a) discrete.**
- (b) continuous.**
- (c) infinite.**
- (d) (a) or (b).**

Write down the correct answers. Each question carries 1 mark.

Que. 3 An important discrete probability distribution is

- (a) Poisson distribution.**
- (b) Normal distribution.**
- (c) Cauchy distribution.**
- (d) Log normal distribution.**

a

Write down the correct answers. Each question carries 1 mark.

Que. 4 An important continuous probability distribution

- (a) Binomial distribution.**
- (b) Poisson distribution.**
- (c) Geometric distribution.**
- (d) Normal distribution.**

Write down the correct answers. Each question carries 1 mark.

Que. 5 Parameter is a characteristic of

- (a) population.**
- (b) sample.**
- (c) probability distribution.**
- (d) both (a) and (b).**

Write down the correct answers. Each question carries 1 mark.

Que. 6 An example of a parameter is

- (a) sample mean.**
- (b) population mean.**
- (c) binomial distribution.**
- (d) sample size.**

Write down the correct answers. Each question carries 1 mark.

Que. 7 A trial is an attempt to

- (a) make something possible.**
- (b) make something impossible.**
- (c) prosecute an offender in a court of law.**
- (d) produce an outcome which is neither certain nor impossible.**

d

Write down the correct answers. Each question carries 1 mark.

Que. 8 The important characteristic(s) of Bernoulli trials

- (a) each trial is associated with just two possible outcomes.**
- (b) trials are independent.**
- (c) trials are infinite.**
- (d) both (a) and (b).**

Write down the correct answers. Each question carries 1 mark.

Que. 9 The probability mass function of binomial distribution is given by

(a) $f(x) = p^x q^{n-x}$.

(b) $f(x) = {}^n C_x p^x q^{n-x}$.

(c) $f(x) = {}^n C_x q^x q^{n-x}$..

(d) $f(x) = {}^n C_x p^{n-x} q^x$.

b

Write down the correct answers. Each question carries 1 mark.

Que. 10 If x is a binomial variable with parameters n and p , then x can assume

- (a) any value between 0 and n .
- (b) any value between 0 and n , both inclusive.
- (c) any whole number between 0 and n , both inclusive.
- (d) any number between 0 and infinity.

Write down the correct answers. Each question carries 1 mark.

Que. 11 A binomial distribution is

- (a) never symmetrical.**
- (b) never positively skewed.**
- (c) never negatively skewed.**
- (d) symmetrical when $p = 0.5$.**

d

Write down the correct answers. Each question carries 1 mark.

Que. 12 The mean of a binomial distribution with parameter n and p is

(a) $n(1-p)$.

(b) $np(1-p)$.

(c) np .

(d) $\sqrt{np(1-p)}$.

Write down the correct answers. Each question carries 1 mark.

Que. 13 The Variance of a binomial distribution with parameter n and p is

(a) $np^2(1 - p)$.

(b) $\sqrt{np(1 - p)}$.

(c) $nq(1 - q)$.

(d) $np^2pp^2(1 - p)p^2$

Write down the correct answers. Each question carries 1 mark.

Que. 14 An example of a bi-parametric discrete probability distribution is

- (a) binomial distribution.**
- (b) poisson distribution.**
- (c) normal distribution.**
- (d) both (a) and (b).**

Write down the correct answers. Each question carries 1 mark.

Que. 15 For a binomial distribution, mean and mode

- (a) are never equal.
- (b) are always equal.
- (c) are equal when $q = 0.50$.
- (d) do not always exist.

Write down the correct answers. Each question carries 1 mark.

Que. 16 The mean of binomial distribution is

- (a) always more than its variance.**
- (b) always equal to its variance.**
- (c) always less than its variance.**
- (d) always equal to its standard deviation.**

a

Write down the correct answers. Each question carries 1 mark.

Que. 18 The maximum value of the variance of a binomial distribution with parameters n and p is

- (a) $n/2$.
- (b) $n/4$.
- (c) $np(1 - p)$.
- (d) $2n$.

Write down the correct answers. Each question carries 1 mark.

Que. 19 The method usually applied for fitting a binomial distribution is known as

- (a) method of least square.**
- (b) method of moments.**
- (c) method of probability distribution.**
- (d) method of deviations.**

Write down the correct answers. Each question carries 1 mark.

Que. 20 Which one is not a condition of Poisson model?

- (a) the probability of having success in a small time interval is constant.**
- (b) the probability of having success more than one in a small time interval is very small.**
- (c) the probability of having success in a small interval is independent of time and also of earlier success.**
- (d) the probability of having success in a small time interval $(t, t + dt)$ is kt for a positive constant k .**

Write down the correct answers. Each question carries 1 mark.

Que. 21 Which one is uniparametric distribution?

- (a) Binomial.**
- (b) Poisson.**
- (c) Normal.**
- (d) Hyper geometric.**

Write down the correct answers. Each question carries 1 mark.

Que. 22 For a Poisson distribution,

- (a) mean and standard deviation are equal.**
- (b) mean and variance are equal.**
- (c) standard deviation and variance are equal.**
- (d) both (a) and (b).**

Write down the correct answers. Each question carries 1 mark.

Que. 24 Poisson distribution is

- (a) always symmetric.**
- (b) always positively skewed.**
- (c) always negatively skewed.**
- (d) symmetric only when $m = 2$.**

Write down the correct answers. Each question carries 1 mark.

Que. 25 A binomial distribution with parameters n and p can be approximated by a Poisson distribution with parameter $m = np$ is

(a) $n \rightarrow \infty$

(b) $p \rightarrow 0$.

(c) $n \rightarrow \infty$ and $p \rightarrow 0$.

(d) $n \rightarrow \infty$ and $p \rightarrow 0$ so that np remains finite..

Write down the correct answers. Each question carries 1 mark.

Que. 26 For Poisson fitting to an observed frequency distribution,

- (a) we equate the Poisson parameter to the mean of the frequency distribution.**
- (b) we equate the Poisson parameter to the median of the distribution.**
- (c) we equate the Poisson parameter to the mode of the distribution.**
- (d) none of these.**

Write down the correct answers. Each question carries 1 mark.

Que. 27 The most important continuous probability distribution is known as

- (a) Binomial distribution.**
- (b) Normal distribution.**
- (c) Chi-square distribution.**
- (d) Sampling distribution.**

Write down the correct answers. Each question carries 1 mark.

Que. 28 The probability density function of a normal variable x is given by

$$(a) f(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \quad \text{for } -\infty < x < \infty,$$

$$(b) f(x) = \frac{1}{\sigma\sqrt{2\pi}} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad \text{for } 0 < x < \infty,$$

$$(c) f(x) = \frac{1}{\sqrt{2\pi}\sigma} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad \text{for } -\infty < x < \infty,$$

(d) none of these.

a

Write down the correct answers. Each question carries 1 mark.

Que. 29 The total area of the normal curve is

- (a) one.
- (b) 50 per cent.
- (c) 0.50.
- (d) any value between 0 and 1.

a

Write down the correct answers. Each question carries 1 mark.

Que. 30 The normal curve is

- (a) Bell-shaped.**
- (b) U- shaped.**
- (c) J-shaped.**
- (d) Inverted J-shaped.**

Write down the correct answers. Each question carries 1 mark.

Que. 31 The normal curve is

- (a) positively skewed.
- (b) negatively skewed.
- (c) symmetrical.
- (d) all these.

Write down the correct answers. Each question carries 1 mark.

Que. 32 Area of the normal curve

- (a) between $-\infty$ to μ is 0.50.
- (b) between μ to ∞ is 0.50.
- (c) between $-\infty$ to ∞ is 0.50.
- (d) both (a) and (b).

d

Write down the correct answers. Each question carries 1 mark.

Que. 34 The mean and mode of a normal distribution

- (a) may be equal.
- (b) may be different.
- (c) are always equal.
- (d) (a) or (b).

Write down the correct answers. Each question carries 1 mark.

Que. 35 The mean deviation about median of a standard normal variate is

(a) 0.675σ .

(b) 0.675.

(c) 0.80σ .

(d) 0.80.

d

Write down the correct answers. Each question carries 1 mark.

Que. 36 The quartile deviation of a normal distribution with mean 10 and SD 4 is

(a) 0.675.

(b) 67.50.

(c) 2.70.

(d) 3.20.

Write down the correct answers. Each question carries 1 mark.

Que. 37 For a standard normal distribution, the points of inflexion are given by

(a) $\mu - \sigma$ and $\mu + \sigma$.

(b) $-\sigma$ and σ .

(c) -1 and 1 .

(d) 0 and 1 .

Write down the correct answers. Each question carries 1 mark.

Que. 38 The symbol $\Phi(a)$ indicates the area of the standard normal curve between

(a) 0 to a .

(b) a to ∞ .

(c) $-\infty$ to a .

(d) $-\infty$ to ∞ .

Write down the correct answers. Each question carries 1 mark.

Que. 39 The interval $(\mu - 3\sigma, \mu + 3\sigma)$ covers

- (a) 95% area of a normal distribution.**
- (b) 96% area of a normal distribution.**
- (c) 99% area of a normal distribution.**
- (d) all but 0.27% area of a normal distribution.**

d

Write down the correct answers. Each question carries 1 mark.

Que. 40 Number of misprints per page of a thick book follows

- (a) Normal distribution.**
- (b) Poisson distribution.**
- (c) Binomial distribution.**
- (d) Standard normal distribution.**

Write down the correct answers. Each question carries 1 mark.

Que. 41 The results of ODI matches between India and Pakistan follows

- (a) Binomial distribution.**
- (b) Poisson distribution.**
- (c) Normal distribution.**
- (d) (b) or (c).**

a

Write down the correct answers. Each question carries 1 mark.

Que. 42 The wage of workers of a factory follow

- (a) Binomial distribution.**
- (b) Poisson distribution.**
- (c) Normal distribution.**
- (d) Chi-square distribution.**

Write down the correct answers. Each question carries 1 mark.

Que. 43 If X and Y are two independent normal random variables, then the distribution of $(X+Y)$ is

- (a) normal.
- (b) standard normal.
- (c) T.
- (d) chi-square.