Module 2

Normal Distribution

Normal distribution is perhaps the most important and useful distribution in statistics. Many stastical data concerning business and economic problems can be displayed in the form of normal distribation.

Normal distribution was 1st discovered by De-Moivre in 1733 as limiting form of the binomial distribution.

Numerous phenomina such as the age distribution of a given species of animals, height of adult persons, the intelligent test scores of school children and many other distributions are considered to be normally distributed. Normal distribution is related to the distribution of errors, made by chance in experimental measurement.

Consider the following eg :- A company manufactures screws of a particular diameter. There may be some variations in the measurement. But most of the screws have diameter very near to what is required. Few of them are either much larger or much smaller. If we draw a histogram of the frequency distribution of measurements, we see that the histogram has maximum height at the centre and the height decreased on either side on almost same rate. So if the ~~class and~~ class interval of the frequency distribation is made smaller and smaller we get a curve of the shape of the bell. It is the normal curve.

Definition :-

A continuous random variable x is said to follow Normal distribution if ~~the~~ its probability function is

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

$-\infty < M < \infty$ and $\sigma > 0$

We write,

$X \sim N(M, \sigma^2)$

Normal distribution as a limiting case of binomial distribution

Binomial distribution is an important theoretical distribution for discrete variables. Binomial distribution tends to Normal distribution under the following conditions :

1) No. of trials (n) is very large
2) P and q (Probability for success in a single trial and the probability for its failure) are almost equal.

Then the binomial distribution can be approximated to normal.

Properties of Normal Distribution

1- Normal curve is a continuous curve

2- Normal curve is ~~not~~ the bell shaped.

3- Normal curve is symmetric about the mean.

4- Mean, median, mode are equal for a normal distribution. (mean = ~~mean~~ median = mode)

5- The hight of normal curve is ~~maximum~~ maximum ~~lies~~ at its mean.

6- Coefficient of skewness is zero ($\beta_1 = 0$).

7- Normal curve is unique. It has only one model.

8- The ~~points~~ points of ~~[illegible]~~ inflection occure at $M \pm \sigma$. At the point of inflection the curve changes from concavity to convexity.

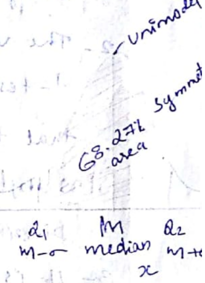
9. Q_1 and Q_3 are equ distant from median.

10. Mean deviation,

$$MD = \frac{4}{5}\sigma$$

& Quartile deviation,

$$QD = \frac{2}{3}\sigma$$



11. Normal distribution is messo Kurtic (~~$\beta = 3$~~) (ie ; $\beta_2 = 3$, $\gamma_2 = 0$)

12. Odd order central moments are zero.

13- Area under the normal curve is distributed as follows :

→ $M \pm \sigma$ covers 68.27% area.

→ $M \pm 2\sigma$ covers ~~40~~ 95.45% area

→ $M \pm 3\sigma$ covers 98.73% area.

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14- If x and y are 2 normal variables, then there some sum is also a normal variable (additive property)

$x_1 \sim N(\mu_1, \sigma_1^2)$
$x_2 \sim N(\mu_2, \sigma_2^2)$

Importance of Normal Distribution

1- Most of the descrete probability distributions tend to normal distribution as 'n' becomes large.

2- The various tests of significance like t-test, F-test etc are based on the assumption that the parent population from which the samples have been drawn follows Normal Distribution.

3- It is extensively used in large sampling theory to find the estimates of parameters from statistics, confidence limits etc.

4- Normal distribution has the remarkable property stated in the central limit theorem. As per the theorem, when the sample size increased, the sample means will tend to be normally distributed.

5- Normal distribution finds application in statistical quality control and industrial experiments. Many distributions in social and Economic data are approximately normal. Eg: birth, deaths etc. are normally distributed in psychological and Educational data many distributions are of normal type.

Merits and Demerits of ND

Merits:

1- Normal distribution is the mostly used distribution in inferential statistics.

2- Most of errors measurements and a large variety of physical observations have approximately Normal distributions.

3- The normal distribution has a no. of mathematical properties.

4- Most of the distributions in nature are either normal or that can be approximated to normal.

Demerits :

1 - The variables which are not continuous cannot be normally distributed. Therefore many distributions in Economics like distribution no. of children per family, cannot be studied under Normal distribution.

2 - It cannot be applied to situation where distribution is highly skewed. For eg:- distribution in income is very much skewed. Therefore here Normal distribution will not be appropriate.

Standard Normal Distribution

If x is a random variable following Normal Distribution with mean (M) and standard deviation σ. Then the variable, $\boxed{z = \frac{x-M}{\sigma}}$ is known as standard normal variable. The distribution of 'z' is known as standard Normal Distribution. The probability density function of z is,

$$\boxed{f(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}z^2}} \quad -\alpha < z < \alpha$$

$$\boxed{\begin{aligned} E(ax+b) &= aEx+b \\ V(ax+b) &= a^2 V(x) \end{aligned}}$$

$$z = \frac{x-M}{\sigma}$$

$$E(z) = E\left(\frac{x-M}{\sigma}\right)$$

$$= E\left(\frac{x}{\sigma} - \frac{M}{\sigma}\right) \qquad a = \frac{1}{\sigma}$$

$$b = -\frac{M}{\sigma}$$

ie,

$$E\left(\frac{x}{\sigma} - \frac{M}{\sigma}\right) = E\left(\frac{1}{\sigma}x + -\frac{M}{\sigma}\right)$$

$$= \frac{1}{\sigma}Ex + -\frac{M}{\sigma}$$

$$= \frac{1}{\sigma} M - \frac{M}{\sigma}$$

$$\boxed{\begin{aligned} Ex &= M \\ Vx &= \sigma^2 \end{aligned}}$$

$$E(z) = \frac{M}{\sigma} - \frac{M}{\sigma} = 0$$

$$V(z) = V\left(\frac{x-M}{\sigma}\right)$$

$$= V\left(\frac{x}{\sigma} - \frac{M}{\sigma}\right)$$

$$= V\left(\frac{1}{\sigma}x + -\frac{M}{\sigma}\right)$$

$$= \left(\frac{1}{\sigma}\right)^2 V(x)$$

$$= \left(\frac{1}{\sigma}\right)^2 \times \sigma^2$$

$$= \frac{1}{\sigma^2} \times \sigma^2$$

$$V(z) = \frac{\sigma^2}{\sigma^2} = 1$$

Standar normal,

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

② $E(z) = 0$, $V(z) = 1$

$z \sim N(0, 1)$

③ $x \sim N(m, \sigma)$

$z = \frac{x-m}{\sigma} \sim N(0, 1)$

Ex, $X_1 \sim N(30, 4)$

Then, $\frac{x-30}{2} \sim N(0,1)$

If $X_2 \sim N(40, 16)$

Then, $\frac{x_2 - 40}{4} \sim N(0,1)$

The standard Normal distribution Table.

This is a table showing the probability for 'z' taking values b/w zero and given value. The probability thus, obtain is the area of the standard normal curve between the ~~oddinatesoo~~ ordinates at $z=0$ and at the given value. For eg:-

when $z = 1.17$ table value equal to 0.3790

This table value is the area between zero and 1.17. That is,

$P(0 < z < 1.17) = 0.3790$

Q. Find

Find 1) $P(0 < z < 1.44)$

2) $P(0 < z < 1.5)$

3) $P(0 < z < 2.6)$

4) $P(0 < z < 0.45)$

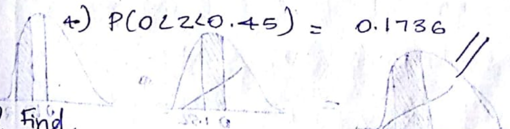
where $z \sim N(0,1)$.

Ans: 1) $P(0 < z < 1.44) = 0.4251$

2) $P(0 < z < 1.5) = 0.4332$ //

3) $P(0 < z < 2.6) = 0.4953$ //

4) $P(0 < z < 0.45) = 0.1736$ //



Q. Find,

1) $P(-1.78 < z < 1.78)$

2) $P(1.52 < z < 2.01)$

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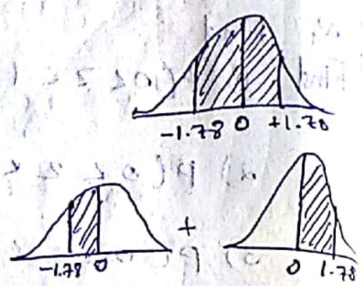
3) $P(-1.52 < z < -0.75)$

4) $P(z > 1.8)$

5) $P(z < -1.5)$

Ans:- 1) $P(-1.78 < z < 1.78) =$



$= P(-1.78 < z < 0) + P(0 < z < 1.78)$

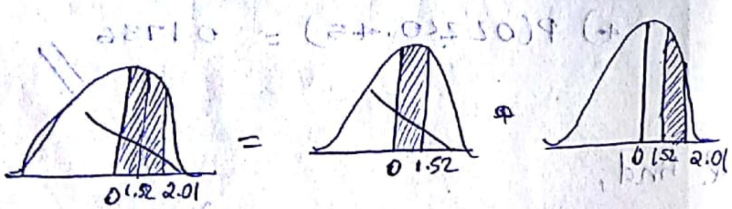
$= P(0 < z < 1.78) + P(0 < z < 1.78)$

$= 2P(0 < z < 1.78)$

$= 2 \times 0.4625$

$= 0.9250$

2) $P(1.52 < z < 2.01)$



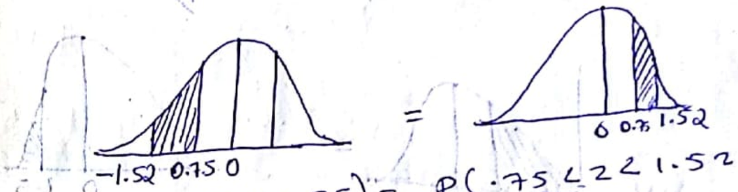
$= \cancel{P(0 < z < 1.52)}$

$= P(0 < z < 2.01) - P(0 < z < 1.52)$

$= 0.4778 - 0.4357$

$= 0.0421$

3) $P(-1.52 < z < -0.75)$



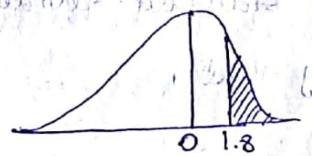
$P(-1.52 < z < 0.75) = P(.75 < z < 1.52)$

$= P(0 < z < 1.52) - P(0 < z < 0.75)$

$= 0.4357 - 0.2734$

$= 0.1623$

4) $P(z > 1.8)$

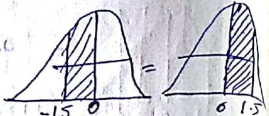


$= P(0 < z < \infty) - P(0 < z < 1.8)$

$= 0.5 - 0.4641$

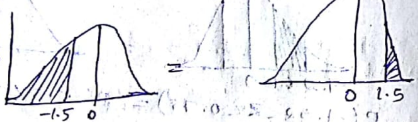
$= \cancel{0.1641}\ 0.0359$

5) $P(Z < -1.5)$



$P(\cancel{0 < Z < -1.5}) = P(\cancel{0 < Z < 1.5})$

$= \cancel{0.4332}$



$P(Z > 1.5) = P(0 < Z < \infty) - P(0 < Z < 1.5)$

$= 0.5 - 0.4332$

$= 0.0668$

Q. The variable X follows a normal distribution with mean 45 and standard deviation = 10.

Find the probability that,

1- $X > 60$

2- $40 < X < 56$

Ans Here x is normal distribution

$X \sim N(45, 10)$

1) $P(X > 60)$

$= P(X - 45 > 60 - 45)$

$= P\left(\frac{x-45}{10} > \frac{60-45}{10}\right)$

$= P\left(Z > \frac{15}{10}\right)$

$= P(Z > 1.5)$

$Z = \frac{x-m}{\sigma} = \frac{x-45}{10}$

$x \sim N(0,1)$

$= P(0 < Z < \infty) - P(0 < Z < 1.5)$

$= 0.5 - 0.4332$

$= 0.0668$

2) $P(40 < X < 56)$

$\cancel{P(40 < x)}$

$= P(\cancel{40 < x - 45 < 56 - 45})$

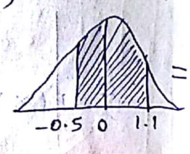
$= P\left(\cancel{\frac{40 < x - 45}{10}} < \cancel{\frac{56 - 45}{10}}\right)$

$= P(40 - 45 < x - 45 < 56 - 45)$

$= P\left(\frac{40-45}{10} < \frac{x-45}{10} < \frac{56-45}{10}\right)$

$= P\left(\frac{-5}{10} < Z < \frac{14}{10}\right)$

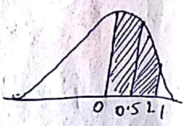
$$= P(-0.5 < z < 1.1)$$



$$= P(0 < z < 0.5) + P(0 < z < 1.1)$$

$$= 0.1915 + 0.3643$$

$$= \underline{\underline{0.5558}}$$



Q. The scores of students in a test follow normal distribution with mean = 80 and standard deviation = 15. A sample of 1000 students has been drawn of the ~~poutals~~ population find,

1) Appropriate number of student scores in b/w 65 & 95

(2) the probability that random choose the students has scores greater than 100.

Ans: 1) $z = \dfrac{x - \mu}{\sigma} = \dfrac{x - 80}{15}$

$P(65 < x < 95)$

$$= P(65 - 80 < x - 80 < 95 - 80)$$

$$= P\left(\frac{65-80}{15} < \frac{x-80}{15} < \frac{95-80}{15}\right)$$

$$= P\left(\frac{-15}{15} < z < \frac{15}{15}\right)$$

$$= P(-1 < z < 1)$$

$$= P(0 < z < 1) + P(0 < z < 1)$$

$$= \underline{2P(0 < z < 1)}$$

$$= 2 \times 0.3413$$

$$= \underline{0.6826}$$

(2) - No. of students scores b/w ~~65 and 95~~ 65 & 95 $= 1000 \times 0.6826$

$$= 682.6$$

$$= \underline{\underline{683}}$$

2) $P(x > 100) = P\left(\frac{x-80}{15} > \frac{100-80}{15}\right)$

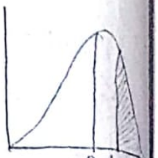
$$= P\left(z > \frac{20}{15}\right)$$

$$= P(z > 1.33$$

$= 0.5000 - P(0 < z < 1.33)$

$= 0.5000 - 0.4082$

$= 0.0918$



No. of students greater than 100

$= 1000 \times 0.918$

$= 91.8$

$= 92$

Q. The hieght of the school children of a institution is normally distributed with mean 54 & and $\sigma = 12$. What percentage of students are height b/w 46 & 56.

Ans:- 1) $z = \frac{x - \mu}{\sigma} = \frac{x - 54}{12}$

$P(46 < x < 56) = P(46-54 < x-54 < 56-54)$

$= P\left(\frac{46-54}{12} < \frac{x-54}{12} < \frac{56-54}{12}\right)$

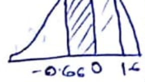
$= P\left(\frac{-8}{12} < z < \frac{2}{12}\right)$

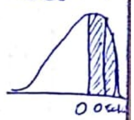
$= P(-0.66 < z < 0.16)$

$= P(0 < z < 0.66) + P(0 < z < 0.16)$

$= 0.2454 + \cancel{0.4515}\ 0.0636$

$= 0.309$





percentage of students are height b/w 46 & 56 $= 0.309 \times 100$

$= 30.9\%$

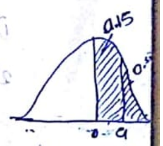
$= 31$

Locate value of 'z' when the area (P) is given

Q. If $P(0 < z < a) = 0.4332$ find a?

Ans:- $a = 1.5$

Q. If $P(z > a) = 0.35$ Find a ?



Ans $P(z > a) = 0.35$

$P(0 < z < a) = 0.15$

$\therefore$ From standard table $a = 0.39$

$0.15 + 0.35$

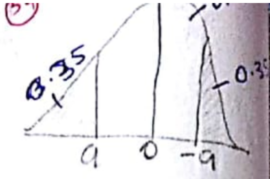
$= 0.5000$

$0.5000 -$

$P(0 < z < a) =$

0.15

Q. If $P(z < a) > 0.35$



$P(z < a) = 0.35$

ie, $P(z > -a) = 0.35$

$P(0 < z < -a) = 0.15$

From the statistical table, =

$-a = 0.39$

$a = -0.39$

If $z >$ value =

$> .5 = -ve$ side

$< .5 = +ve$ side

If $z <$ value =

$> .5 = +ve$ side

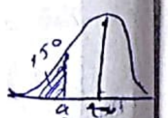
$< .5 = -ve$ side

Q, Given, a normal distribution with mean = 40 and SD = 10. Find the value of x that has

1) 15% of the area to its left

2) 20% of the area to its right

Ans. 1) $z = \frac{x - \mu}{\sigma} = \frac{x - 40}{10}$



If the 15% of the area its left

$P(x < a) = 15\% = 0.15$

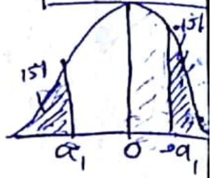
$P(x - 40 < a - 40) = 15\%$

$P(x < a) = P\left(\frac{x-40}{10} < \frac{a-40}{10}\right) = 15\%$

$= P\left(z < \frac{a-40}{10}\right) = 0.15$

$\boxed{a_1 = \left(\frac{a-40}{10}\right)}$

$= P(z < a_1) = 0.15$



ie $= P(z > -a_1) = 0.15$

ie $= P(0 < z < -a_1) = 0.35$

$= 0.5 - .15 =$

$= 0.35$

from the normal standard table,

$-a_1 = 1.03$

$a_1 = -1.03$

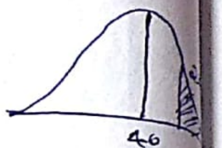
ie, $\frac{a-40}{10} = -1.03$

$a - 40 = 10 \times -1.03$

$= -10.3$

$a = 40 - 10.3 = 29.7$

2) The 20% of the area is the right

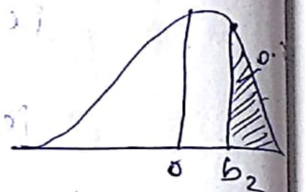


$P(X > a) = 20\% = 0.2$

$P(X > a) = P\left(\frac{x-40}{10} > \frac{b-40}{10}\right) = 0.2$

$= P\left(z > \frac{b-40}{10}\right) = 0.2$

$= P(z > b_2) = 0.2$



ie, $P(z > b_2) = 0.2$

$P(0 < z < b_2) = 0.5 - 0.2$

$= 0.3$

from the standard table,

$b_2 = \cancel{0.804}\ 0.84$

ie, $\frac{b-40}{10} = \cancel{0.804}\ 0.84$

$b-40 = 10 \times \cancel{0.804}\ 0.84$

$= \cancel{804}\ 8.4$

$b = 40 + 8.4 = \cancel{124}\ 48.4$

Q. In a normal distribution 17% of the items are below 30 and ~~17%~~ 17% of the area above 60. Find the mean & SD ?

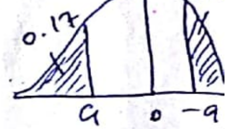
A. Here, Given, $P(x < 30) = 17\% = 0.17$

Let, a be the corresponding value of z

such that, $P(z < a) = .17$

ie, $P\left(\frac{x-M}{\sigma} < \frac{30-M}{\sigma}\right) = 0.17$

ie, $P\left(z < \frac{30-M}{\sigma}\right) = 0.17$



$P(z < a) = 0.17$

ie $P(z > -a) = 0.17$

$P(0 < z < -a) = 0.5 - 0.17$

$= 0.33$

From the standard table,

$-a = 0.95$

$a = -0.95$

ie, $\frac{30-M}{\sigma} = -0.95$

$30 - M = \cancel{\sigma \times}\ -0.95\,\sigma$

$M - 0.95\,\sigma$

1

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$\cancel{m = 30 - (\sigma\ 0.95)}$

$30 = m - 0.95\sigma$

On other hand, given,

$P(x > 60) = 17\% = 0.17$

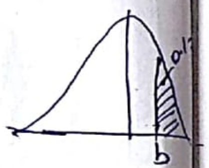
Let 'b' be the corresponding value of z

ie, $P(z > b) = 0.17$

ie $P\left(\frac{x-m}{\sigma} > \frac{60-m}{\sigma}\right) = 0.17$

ie, $P\left(z > \frac{60-m}{\sigma}\right) = 0.17$

$P(z > b) = 0.17$



$P(0 < z < b) = 0.5 - 0.17$

$= 0.33$

From the standard table,

$\therefore b = \cancel{0.33}\ 0.95$

ie, $\frac{60-m}{\sigma} = 0.95$

$60 - m = 0.95 \times \sigma$

$m = 60 - (\cancel{\sigma \times 0.95})$

(1) — $60 = m + 0.95\sigma$

From eqt (1) & (2),

$m - 0.95\sigma = 30$

$m + 0.95\sigma = 60$

$2m + 0 = 90$

$2m = 90$

$m = \frac{90}{2} = 45$

substitut $m = 45$ in eqt (1)

$45 - 0.95\sigma = 30$

$45 - 30 = 0.95\sigma$

$15 = 0.95\sigma$

$\frac{15}{0.95} = \sigma$

$\sigma = 15.8$

Thus, $m = 45$

$\sigma = 15.8$

Q, The following table is frequencies of occurance of varient x between certain limits.

x	f	f
<40	30	30
40 or more but less than 50		33
50 and more		37
		100

the distribution is exactly normal. Find the average & SD of x.

$P(f) = \frac{f}{N} = \frac{f}{100}$

Ans: Here Given,

$P(x<40) = \frac{30}{100} = 0.3$

$\cancel{P(40>x>5}=$

$P(40<x<50) = \frac{33}{100} = 0.33$

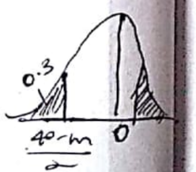
$P(x>50) = \frac{37}{100} = 0.37$

That is,

$P(x<40) = 0.3$

$P\left(\frac{x-m}{\sigma} < \frac{40-m}{\sigma}\right) = 0.3$

$P\left(z < \frac{40-m}{\sigma}\right) = 0.3$



ie, $P\left(z > -\left(\frac{40-m}{\sigma}\right)\right) = 0.3$

$P\left(0 < z < -\left(\frac{40-m}{\sigma}\right)\right) = \cancel{0.3}$

$= 0.5 - 0.3$

$= 0.2$

$\begin{array}{r} 0.5+ \\ 0.2 \\ \hline .50 \end{array}$

From the standard table,

$-\left(\frac{40-m}{\sigma}\right) = 0.52$

$\frac{40-m}{\sigma} = -0.52$

ie $\frac{40-m}{\sigma} = -0.52$

$40-m = -0.52\sigma$

$40 = m - 0.52\sigma$ — (1)

On the other hand,

$\begin{array}{r} 0.50- \\ 37 \\ \hline 13 \end{array}$

$P(x>50) = 0.37$

ie, $P\left(\frac{x-m}{\sigma} > \frac{50-m}{\sigma}\right) = 0.37$

$P\left(z > \frac{50-m}{\sigma}\right) = 0.37$

$P\left(0 < z < \frac{50-m}{\sigma}\right) = \cancel{0.37}$

$= 0.5 - 0.37$

$= \cancel{0.13}$

0.13

From the standard table,

$$\frac{50-m}{\sigma} = \cancel{0.62}\ 0.34$$

ie. $50 - m = \cancel{0.62\sigma}\ 0.34\sigma$

$$50 = m + 0.34\sigma \qquad -(2)$$

From eqt (1) & (2)

~~$40 = m - 0.52\sigma$~~

~~$50 = m + 0.62\sigma$~~

~~$90 = 2m + \sigma$~~

(1) − (2)

$$m - 0.52\sigma = 40 \qquad -(1)$$

$$m + 0.34\sigma = 50 \qquad -(2)$$

$$0 - 0.86\sigma = \cancel{90}\ -10$$

$$-0.86\sigma = \cancel{90}\ -10$$

$$\sigma = \frac{\cancel{90}}{-0.86}$$

$$\sigma = \frac{-10}{-0.86}$$

$$= 11.63$$

Substitute $\sigma = 11.63$ in eqt (1)

$$m - 0.52 \times 11.63 = 40$$

$$m = 0.52 \times 11.63 + 40$$

$$= 46.0476$$

Then, ie,

$$\sigma = 11.63$$

$$m = 46.0476$$

Log normal Distribution

Definition:-

A random variable x is said to follow Log normal distribution, if $\log_e x$ follows normal distribution. That is, x follows Log normal distribution implies $\log x$ follows Normal Distribution.

The probability density function is,

$$\boxed{f(x) = \frac{1}{x\sqrt{2\pi}\sigma}\, e^{-\frac{1}{2}\left(\frac{\log x - M}{\sigma}\right)^2} \quad x > 0}$$

$-\infty <$ M $< \infty$ $\sigma > 0$

Properties of Lognormal distribution

1- Lognormal variant is a continous variable

2- The range of variable values of the variable are +ve i.e., $x \geq 0$

3- Mean of the lognormal distribution is

$$\text{Mean} = e^{M + \frac{1}{2}\sigma^2}$$

and SD is, $SD = e^{M+\frac{1}{2}\sigma^2}\sqrt{e^{\sigma^2}-1}$

4- Lognormal distribution is positevely skewed, $\beta_1 > 0$ or $\gamma_1 > 0$ $\boxed{\gamma_1 = \text{gama}}$

5- Log distribution is unimodel.

$$\text{Mode} = e^{M - \frac{1}{2}\sigma^2}$$

$$\text{Median} = e^{M}$$

6- Mean > median > Mode

7- Product of 2 independent lognormal also follows a lognormal distribution.

8- Lower and upper (Q_1 & Q_2) of the quartail of the distribution are $e^{M - 0.67\sigma}$ and $e^{M + 0.67\sigma}$ respectively.

9- The lognormal distribution posess moments of any ~~normal b_1, b_2, b_3~~ order while putting $r = 1, 2, 3$ etc.

$$e^{rM + \frac{1}{2}r^2\sigma^2}$$

Uses (applications) of Logarithnormal Distribution

In the field of Economics, it is of very great use. ~~Macro econo~~ Most of the economic data are not suitable for approximating to normal distribution.

Lognormal distribution is the appropriate distribution for approximating them. The economic distributions like distribution of income, price, & expenditure on particular commodities etc... are skew in nature. They all follow lognormal distribution. Further, these variables take only positive values, which is a restriction required as per the Lognormal Distribution. Thus in the field of economics, the movements of many variables can be studied by applying Lognormal Distribution. Lognormal

Distribution can be used for the study of income distribution. Similarly Bank Deposits and total wealth possessed by individual persons can also be studied with the help of Lognormal Distributions. For the study of the relation b/w the demand for a commodity and consumer income, Lognormal distribution can be used. Prices paid for commodities, Expenditure on particular commodities, Savings, behaviours etc.. approximate to Lognormal Distribution.

In other fields;

In Biology the Lognormal Distribution is extensively used. It is seen that the size of a growing organism follows Lognormal Distribution. The study of heights or weights of human beings can be made with the help of Lognormal distribution. In physical and industrial fields also the Lognormal ~~di~~ Distribution is used. It can be seen that the ages of men and women at their first marriage follow Lognormal Distribution. In Quality control also, the Lognormal Distribution is used.

Merits & Demerits

Lognormal Distribution can be applied to situations where a no. of independent factors influence a variable in a multiplicative model. The Lognormal Distribution is the best approximation for skew distributions. Many of the economic variables have skew distribution. Thus the study of these economic variables can be made by using Lognormal Distribution.

The Lognormal Distribution can be used for the study of many variables where Normal Distribution is not a good approximation. The variables like income, price, land owning etc.. are the examples. ~~of~~ Frequency curves drawn to those variables come in no way near to normal distribution. But the logarithm values of these variables give a normal curve. So they obey Lognormal law.

Distinguish b/w Normal & Lognormal

1- Normal Distribution is symmetric while LD is positively skewed.

2- When a distribution drawn on a graph paper, it gives a symmetrical curve then it is normal Distribution. When the logarithmic values of the variable are plotted on a graph if it gives a symmetrical distribution then it follows a LD.

3- The ND arises from a theory of elementary error in an additive fashion, while LD arises from a theory of elementary errors in multiplicative fashion.

4- The ND is symmetric and therefore mean, median and mode are equal. If a population follows LD its mean, median & mode are not equal.

5- The Arithmetic Mean of 'n' independent normal variates follows a ND while Geometric Mean of 'n' independent Lognormal variates follows a LD

Module 3 Sampling Distributions

Population

In any statistical distribution ~~then~~ we are interested in studying the various characteristics of individuals (items) of a particular group. This group of individuals under study is known as population. Any population can be considered as the set of ~~elements~~ all distinct value of a random variable. The distribution of this random variable is called the distribution of population. ~~If we~~

Eg: If we want study the expenditure habit of the family in a city then the population will consist of whole the household in that city.

A population contain to finite no. of objects or items is known as finite population.

Eg: ~~R~~ students in a college → population in a city