NORMAL DISTRIBUTION.

1. The heights of boys at a particular age follow a normal distribution with mean 150·3 cm and standard deviation 5 cm. Find the probability that the height of a boy picked at random from this age group is
(i) less than 153·2 cm (ii) more than 158 cm.
(iii) between 150 cm and 158 cm.
(Ans. (i) 0·719 (ii) 0·0618 (iii) 0·4621).

2. The masses of packages from a particular machine are normally distributed with mean 200 g and standard deviation 2 g. Find the probability that a randomly selected package from the production line of this machine weighs (i) less than 197 g (ii) more than 200·5 g.
(iii) between 198·5 g and 199·5 g.
(Ans (i) 0·0668 (ii) 0·4013 (iii) 0·1747.).

3. The lifetime in hours, of a certain make of electric light bulb is known to be normally distributed with mean 2000 and standard deviation 120. Find the probability that the lifetime of a bulb of this make will be
(i) greater than 2150 hrs. (ii) greater than 1910 hrs.
(iii) between 1850 hrs and 2090 hrs.
(Ans (i) 0·1056 (ii) 0·7734 (iii) 0·6678)

4. A normal distribution has mean μ and standard deviation σ. 1000 observations are taken from the distribution. How many you expect to be more than $\mu + 1\cdot5\sigma$.
(Ans: 67).

5. $X \sim N(12, 2)$. Find (i) $P(X > 14)$ (ii) $P(X < 9)$ (iii) $P(10 < X < 13)$.
(Ans: (i) 0·0787 (ii) 0·0170 (iii) 0·6814.

6. The masses of a certain type of cabbages are normally distributed with mean 1200 g and standard deviation 150 g. Estimate the number of cabbages in a batch of 800 with a mass greater than 1200 g.
(Ans: 73).

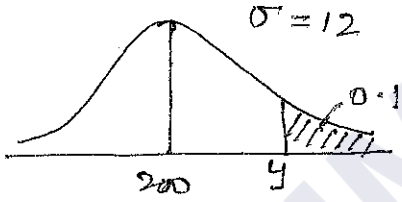
7. The lengths of metal rods produced by a machine are normally distributed with mean 120 cm and standard deviation 5 cm. 10% of the rods are longer than L cm. Find the value of L. (Ans. 126.4 cm)

8. The heights of male students at a particular college are normally distributed with mean 160 cm and standard deviation 4 cm. 5% of these male students have a height greater than h cm, find the value of h. (Ans 166.6 cm.).

9. The time, in minutes, taken by pupils in a particular class to do their maths homework follows a normal distribution with mean 25 and standard deviation 8. 10% of the pupils are taking less than x minutes, find the value of x. (Ans. 14.76 min.).

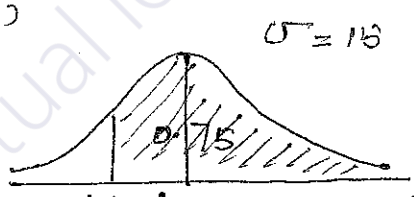
10. $X \sim N(500, 64)$. (i) If $P(X > a) = 0.25$, find a
(ii) If $P(X < b) = 0.15$, find b. (Ans. $a = 505.36$
$b = 491.68$)

11. (i)



Find the value of y
(Ans $y = 215.36$)

(ii)



Find the value of m.
(Ans. $m = 389.95$)

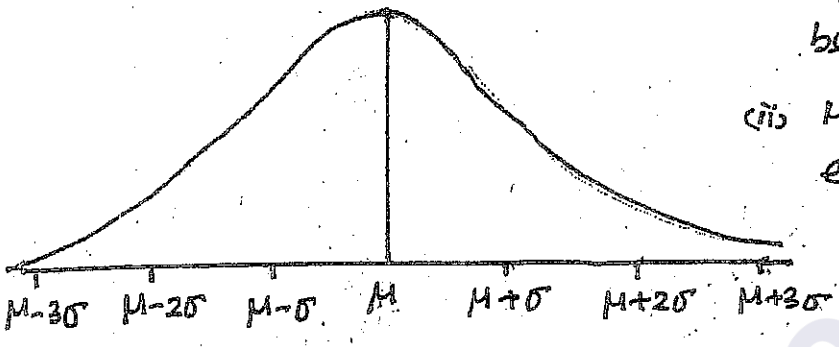
12. The time spent by customers in a particular supermarket is normally distributed with mean 16.3 min. and standard deviation 4.2 min.
(i) Find the probability that a customer spends less than 5 min. in the supermarket. (Ans. 0.0036)
(ii) 20% of the customers spend more than t min. Find the value of t. (Ans 19.9 min.).

NORMAL DISTRIBUTION

: Normal Distribution is the most important distribution in statistics. Many measured quantities such as heights, weights, Age, time, examination marks etc. distribute normally.

PROPERTIES OF NORMAL DISTRIBUTION

Normal distribution curve is as shown in the diagram given below.



(i) Normal distribution curve is bell-shaped.

(ii) Mean, Mode, Median are equal.

(iii) Normal distribution curve is symmetrical about the mean μ.

(iv) The total area under the curve is 1.

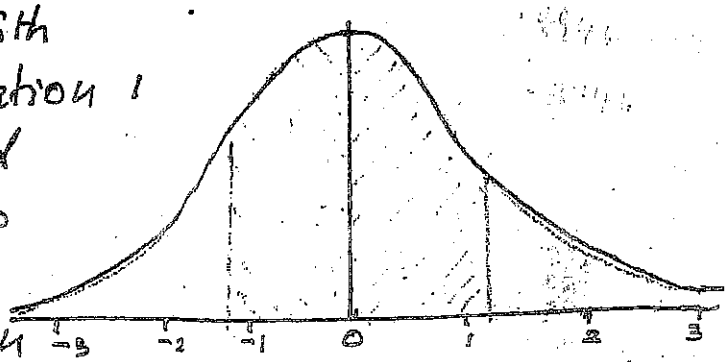
(v) The curve touches the x-axis at $+\infty$ and $-\infty$.

NORMAL DISTRIBUTION NOTATION

$X \sim N(\mu, \sigma^2)$ means the variable X distributes normally with mean μ and standard deviation σ. μ and σ are the parameters of Normal Distribution.

STANDARD NORMAL DISTRIBUTION.

The normal distribution with mean 0 and standard deviation 1 is known as the standard normal distribution and is denoted by $Z \sim N(0, 1^2)$.



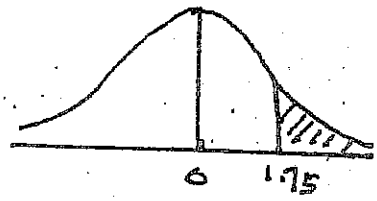
Standard normal distribution curve is as shown in the diagram. The areas under the

standard normal curve are given in tables. Areas for negative z values are not given seperately. These areas can also be found by using the positive z values according to the symmetrical property. For example, the area between z=0 and z=-1.25 is same as the area between z=0 and z=+1.25 and is equal to .

To convert x variable to z variable, $\boxed{z = \frac{x-M}{\sigma}}$ is used.

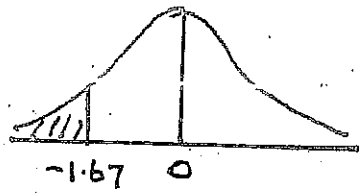
USE OF STANDARD NORMAL DISTRIBUTION TABLES

(i) $P(z > 1.75) =$

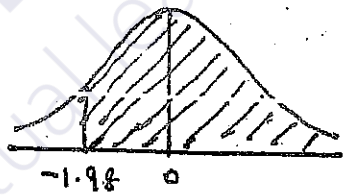


(ii) $P(z < 1.58) =$

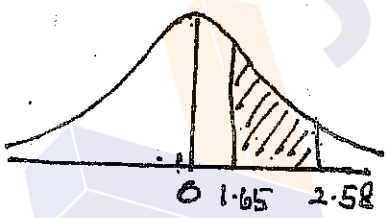
(iii) $P(z < -1.67)$



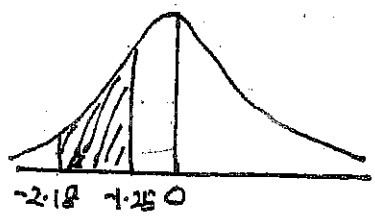
(iv) $P(z > -1.98) =$



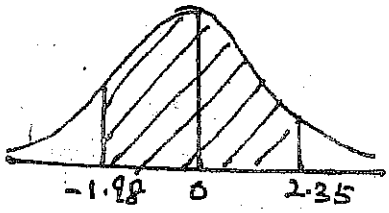
(v) $P(1.65 < z < 2.58) =$



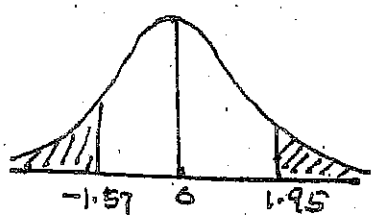
(vi) $P(-2.18 < z < -1.25) =$



(vii) $P(-1.98 < z < 2.35) =$

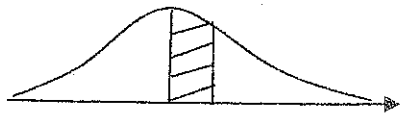


(viii) $P(-1.57 > z > 1.95) =$



AREA UNDER THE STANDARD NORMAL CURVE

This table gives the area under the normal curve between the mean and a point of Z score above the mean. The corresponding area for deviations below the mean can be found by symmetry



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990,	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983