(Q) The distribution of resistance for resistors of a certain type is known to be normal, with 10% of all resistors have a resistance exceeding 10.256 Ω and 5% having a resistance smaller that 9.671 Ω. Calculat mean value and standard ~~distribution~~ deviation of resistance distribution.

X = resistance of a resistor

$\therefore P(X > 10.256) = 0.1$

$\therefore P(X < 9.671) = 0.05$.

Now put substitution $Z = \frac{X-\mu}{\sigma} \Rightarrow X = \sigma Z + \mu$

$$\therefore P\left(Z > \frac{10.256-\mu}{\sigma}\right) = 0.1 = 1 - \Phi\left[\frac{10.256-\mu}{\sigma}\right]$$

$$\therefore P\left(Z < \frac{9.671-\mu}{\sigma}\right) = 0.05 = \Phi\left(\frac{9.671-\mu}{\sigma}\right)$$

Now go to tables and see what values gives 0.1 and 0.05.

Now since 0.1 and 0.05 are < 0.5 means they are given by (-ve) values, hence go for (-ve) tables

$\therefore$ $0.9 = \phi\left(\frac{10.256-\mu}{\sigma}\right) = \phi(1.28)$

$\therefore$ $0.05 = \phi\left(\frac{9.671-\mu}{\sigma}\right) = \phi(-1.645)$

$\therefore$ $(1.28)(\sigma) = (10.256-\mu)$ and $(-1.645)(\sigma) = (9.671-\mu)$

Hence now you can solve, two equation, two variable $\Rightarrow$ $\boxed{\mu = 10}$, $\boxed{\sigma = 0.2}$

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(Q) A automatic opening device of a military cargo parachute has been designed to open when the parachute ~~has bee~~ is 200m above the ground. Suppose opening altitude (X) actually has a normal distribution with mean value 200m and standard deviation as 30m. Equipment damage occurs if the parachute opens at an altitude of less than 100m.

(a) Calculate probability that there is equipment damage to the payload of at least one of five independently dropped parachutes.

$\hookrightarrow$ countable $\Rightarrow$ discrete random variable (Y)

$\therefore$ success = equiment damage to payload.

$\Rightarrow$ BINOMIAL DISTRIBUTION.

$\therefore$ The probability that there is an equipment damage to payload $= P(X<100)$

$$= P\left(Z < \frac{100-\mu}{\sigma}\right)$$

$$= P(Z < -3.33)$$

$$= \phi(-3.33)$$

$$= \boxed{0.0004}$$

Let Y be number of independently dropped parachutes having equipment damage to payload.

Then, $Y \sim Bin(n, p)$ with $n=5$ and $p = 0.0004$.

$\therefore$ The probability that there is equipment damage to payload of atleast one of five independently dropped parachutes

$$= P(Y \geq 1)$$
$$= 1 - P(Y < 1)$$
$$= 1 - P(Y = 0)$$
$$= 1 - (0.9996)^5 \boxed{\approx 0.002} \text{ -ans.}$$

- Relation between discrete distribution and continuous distribution.

Now we know any distribution can be converted to standard normal distribution.

Normal distribution provides a very accurate approx to the binomial dist. when n is large and p is not extremely close to 0 and 1 but also provides a fairly good approx even when n is small and p is reasonably close to $1/2$.

If X is a binomial random variable with $\mu = np$ and variance $(\sigma^2) = npq$, then

$$\boxed{Z = \frac{X - np}{\sqrt{npq}} \sim N(0, 1)} \text{ as } \boxed{n \to \infty}$$

approx adequate when $\boxed{np \geq 10}$ and $\boxed{(n)(1-p) \geq 10 \text{ or } (n)(q) \geq 10}$

Q) In response to concerns about nutritional contents of fast food, Mc Donald's has announced that it will use a new cooking oil for its French Fries that will decrease substantially turns fatty acid levels and increase the amount of more beneficial poly unsaturated fat. The company claims that 97 out 100 ppl cannot detect a difference in taste b/w the new and old oils.
Assuming that this figure is correct, what is $\boxed{\text{approx prob}}$ that in a random sample of 1000 individuals who have purchased fries at Mc-Donald's

$\therefore n = 1000$, p = success prob $= 97/100 = 0.97$
success = ppl cannot detect difference.

Now there is only two possibility i.e. a person can detect or a person cannot detect (i.e. success or failure) and decision of one person will not depend on other
$\Rightarrow$ independent
$\Rightarrow$ Binomial.

But we can see $np = (1000)(0.97) = 970 > 10$
and $(p)(1-p) = (1000)(0.03) = 30 > 10$
thought this cause already given approx. prob.

$\therefore$ we can use standard normal distribution as binomial distribution.

$\therefore \mu = np = 970$ $\therefore \sigma^2 = npq = (1000)(0.97)(0.03)$
$\Rightarrow \sigma = 5.39$

(a) Atleast 40 can taste the difference between two oils.

(m1) ⇒ atmost 960 cannot taste the difference b/w two oils.

X = probability of success.

$\Rightarrow P(X \leq 960)$ $\cancel{\neq 1 - P(X \ngtr 960)}$

$= P(0 \leq X \leq 960)$

$= B(960; n, p)$

$= B(960; 1000, 0.97) = \boxed{}$

↳ table not available used calculator.

(m2) using normal distribution

$P(X \leq 960) = P\left(Z \leq \frac{960 - \mu}{\sigma}\right) = P(Z \leq -1.855)$

$= \phi(-1.855)$

$= \phi(-1.86)$

$= \boxed{0.0314}$ – ans.

(b) Atmost 5 % can taste the difference between the oils.

⇒ atmost 50 ppl can taste the difference

⇒ atleast 950 ppl cannot taste the difference

X = prob of success

$\therefore P(X \geq 950)$ $\cancel{= 1 - P(X \leq 500)}$

$= P(\sigma Z + \mu \geq 950)$

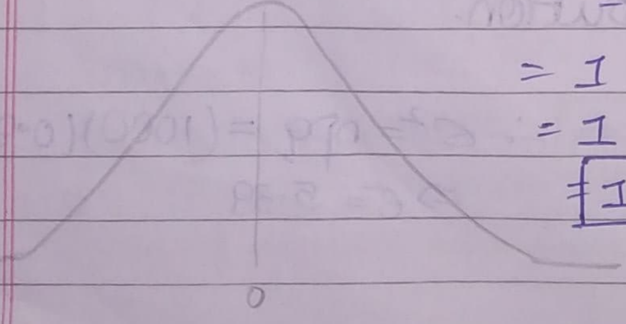
$= P\left(Z \geq \frac{950 - \mu}{\sigma}\right) = P\left(Z \geq \frac{950 - 970}{5.39}\right)$

$= P(Z \geq -3.71)$

$= 1 - \phi(-3.71)$

$= 1 - (\approx 0)$ ↳ nearly negligible from graph

$= \boxed{1}$ – ans.



~~87.15~~

−3.71

- In normal approximation to binomial, if we seek the area under the normal curve to the left of, say x, it is more accurate to use $\boxed{(x+0.5)}$. This is a correction to accomodate the fact that a discrete distribution is being approx by a continuous dist. The correction $+0.5$ is called $\boxed{\text{continuity correction}}$

let $X \sim B(n,p)$ in limiting case

$$P(a \leq X \leq b) = P(a-0.5 \leq X \leq b+0.5)$$

$$= P(a-0.5 \leq \sigma Z + \mu \leq b+0.5)$$

$$= P\left(\frac{a-0.5-\mu}{\sigma} \leq Z \leq \frac{b+0.5-\mu}{\sigma}\right)$$

$$= P\left(\frac{a-0.5-np}{\sqrt{npq}} \leq Z \leq \frac{b+0.5-np}{\sqrt{npq}}\right)$$

$$= \phi\left(\frac{b+0.5-np}{\sqrt{npq}}\right) - \phi\left(\frac{a-0.5-np}{\sqrt{npq}}\right).$$

(Q) Suppose only 75% of all drivers in a certain state regularly wear a seat belt. A random sample of 500 drivers is selected. Find prob that.

X = success = wearing a seat belt.

p = prob of success $= 0.75 \Rightarrow q = 0.25$.

$n = 500$

$\therefore np = 500 \times 0.75 = 375 > 10$ & $nq = (0.25)(500) = 125 > 10$

$\therefore$ we can convert our binomial distribution to normal distribution with mean value $\boxed{\mu = np = 375}$ and $\boxed{\sigma = \sqrt{npq} = 9.68}$

We use binomial distribution coz there is only two possibility i.e. wearing a seat belt / not wearing a seat belt and wearing of an individual would not depend on any other individual
$\Rightarrow$ "independent"

(a) Between 360 and 400 (inclusive) of the drivers in sample space wear a seat belt

$\therefore$ Find $P(360 \leq X \leq 400)$

$$= P(360-0.5 \leq X \leq 400+0.5)$$

$$= P\left(\frac{360-0.5-\mu}{6} \leq Z \leq \frac{400+0.5-\mu}{6}\right)$$

$$= P(-1.6 \leq Z \leq 2.63)$$

$$= \phi(2.63) - \phi(-1.6)$$

$$= (0.9957) - 0.0548$$

$$= \boxed{0.9419} \text{ - ans.}$$

(b) Fewer than 400 of those in sample regularly wear a seat belt.

$\Rightarrow P(X < 400) = P(X < 400+0.5)$

$$= P\left(Z < \frac{400.5-\mu}{6}\right)$$

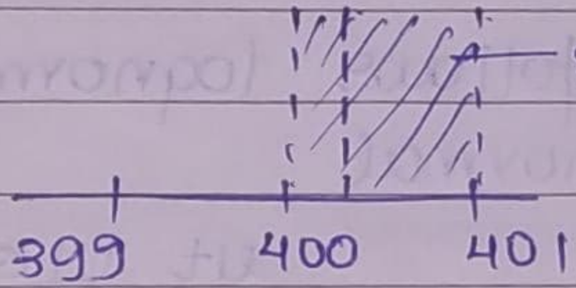
$$= P(Z < 2.63)$$

$$= \phi(2.63)$$

$$= \boxed{0.9957} \text{ - ans.}$$

cause said less than 400 so if we do 400+0.5 it becomes 400.5 which is invalid so we do $P(X < 400-0.5) = P(X < 399.5)$

But remembe if it would have been given fewer than or equal to 400 then we would have done 400+0.5.



should not be included in this quoestion.