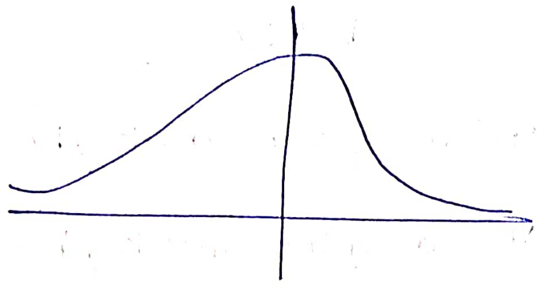
✱ Statistics →

understanding normal distribution

Eg:- 1, 2, 3, 4, 5.

mean = 3



$\mu = 3$

$$S.D(\sigma) = \sqrt{\frac{\sum_{i=1}^{N} (x-\mu)^2}{N}} = \sqrt{2} = 1.41.$$

→ S.D says how close it is to mean.

So, total data lies as (3 ± 1.41)

which gives $1.58 - 4.41$

→ But, 1, 5 lies outside the range.

→ If incase we take $2 \times S.D$,

total data → $3 \pm (2 \times 1.41)$

→ $\boxed{0.18 - 5.32}$

now its perfect.

Note:-

→ one thing we can understand is,

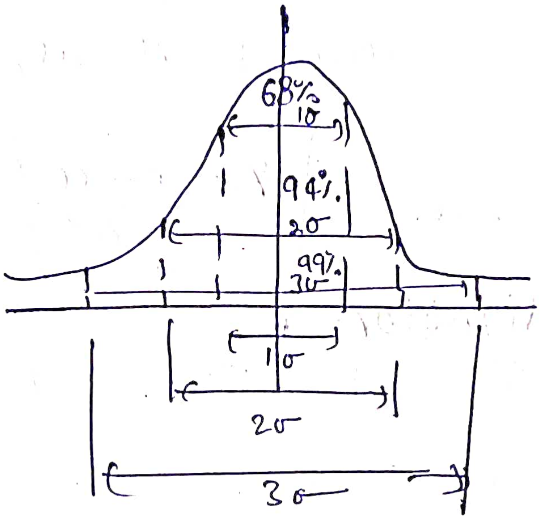
with $\mu \pm S.D$ we are not getting 100% of data

i.e. only 68%.

$\boxed{\mu \pm S.D}$ → 68% of dat → $\boxed{\text{All the data is not available here}}$

$\boxed{\mu \pm 2S.D}$ → 94% of date

$\boxed{\mu \pm 3S.D}$ → 99% of data



Standard normal distribution :-

→ Data with $\mu = 0$ & $\sigma = 1$

That means complete data lie b/w $\mu \pm S.D$

0 ± 1

i.e. [-1, 1] → total data.

converting normal data to SNDF

1, 2, 3, 4, 5 → $\mu = 3$, $\sigma = 1.41$

$\boxed{z\,value = \frac{x - \mu}{\sigma}}$

z_1, z_2, z_3, z_4, z_5

$\left(\frac{1-3}{1.41}\right)$ $\left(\frac{2-3}{1.41}\right)$ $\left(\frac{3-3}{1.41}\right)$ $\left(\frac{4-3}{1.41}\right)$ $\left(\frac{5-3}{1.41}\right)$

So,

for the new data.

$-1.41, -0.70, 0, 0.70, 1.41$

$\boxed{\mu = 0}$ → so, to bring them like this

$\boxed{S.D = 1}$ we convert it as,

So, converting this is called $\boxed{z = \frac{x - \mu}{\sigma}}$

"standardization"

Note:

1) Normalization — scaling the data. To bring close μ, mean...

2) Standardization — making μ = 0, SD = 1. Converting data to [0, 1]

$\boxed{z_i = \frac{x - \mu}{\sigma}}$

Q.) The time reqd. to build a computer is normally distributed with mean of 50 min & a SD of 10 min.

What is probability that a computer is assembled in a time b/w 45 & 60 min?

Sol

we can't fit this in Poisson / binomial.

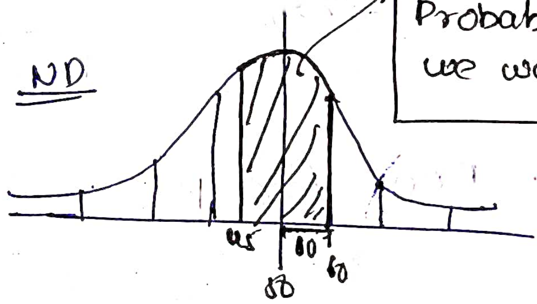
Avg time. = 50 min } to build a
SD = 10 min } computer

ND

45 min < Probability < 60 min.

?

ND



This is the area of Probability we want.

But, we can calculate the area if we convert it to SND - standard normal distribution

{ → But, in normal distribution we have random mean & SD
→ So, difficult to calculate that area.

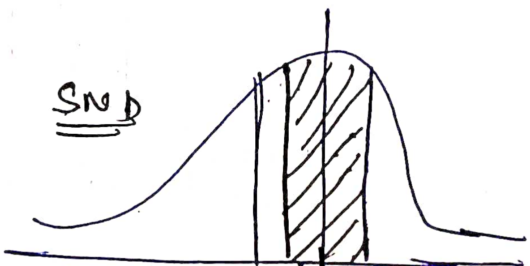
As it's area is (0, 1) always.

SND

$$\frac{45-50}{10} < P < \frac{60-50}{10} \Rightarrow -0.5 \le P \le 1$$

we need area b/w -0.5 to 1

SND



Estimation Theory

⊙ **Estimation:**

1) Point Estimation
2) Interval Estimation

Estimation formula → $\underbrace{\bar{x} \pm z_{\frac{\alpha}{2}}\left(\frac{\sigma}{\sqrt{n}}\right)}$

→ It is the probability distribution for $(1-\alpha)$ confidence interval.

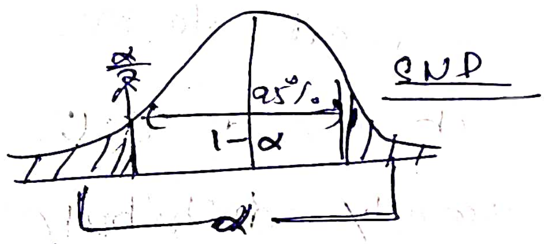
where, α – level of significance.

→ $\boxed{\text{Lets take } 95\%}$

$1-\alpha = 0.95$

$\alpha = 0.05$

$\boxed{\frac{\alpha}{2} = 0.025}$



	...	0.06
1.9		0.025

→ And here $\frac{\alpha}{2}$ is the area value in z-table.

→ So in reverse, find for the '$\frac{\alpha}{2}$' area & see the z-value in it.

Hence, here for 0.025 area we have '1.96'

→ $\boxed{\text{As the } \underline{CL(\uparrow)} \text{ the range gets } \boxed{\text{wider}}}$

Notes

Notes

1) As C.L ↑ then range gets wider.

2) For low C.L, Risk of failure is less.

For High C.L, Risk of failure is High.

Q.) A lumber company must estimate the mean dia of tree to determine whether or not there is suff. lumber to harvest in an area of forest. They need to estimate this to with in 1 inch at a C.L of 99%. The tree dia are normally distributed with a SD of 6 inches. How many trees need to be sampled

Sol:

we have

$1-\alpha = 0.99$

$\alpha = 0.01 \rightarrow \frac{\alpha}{2} = 0.005 \qquad z_{\frac{\alpha}{2}} = 2.575$

Formula $\rightarrow \bar{x} \pm \underbrace{\left(z_{\frac{\alpha}{2}} \cdot \frac{\sigma}{\sqrt{n}}\right)}$

$\hookrightarrow$ width is 1 inch,

i.e; $z_{\frac{\alpha}{2}} \cdot \frac{\sigma}{\sqrt{n}} = 1 \rightarrow 2.575 \frac{(6)}{\sqrt{n}} = 1$

$n = 239$ ∴ we need atleast 239 trees.

⊛ Hypothesis

$H_0: \mu = \mu_0$

$H_1: \mu \neq \mu_0$ → if we disapprove this, then automatically H_0 is true.

two tail test – $\mu \neq \mu_0$ → here either it could be $\mu < \mu_0$ (or) $\mu > \mu_0$. It could be any one of them which we DON'T KNOW.

one tail test – $\mu < \mu_0$ / $\mu > \mu_0$ — only one is possible

critical region → where H_0 fails
↳ it could lie only left / right side, or it could also lie on both side

confusion matrix

	Expected	
Predicted	T	F
T	TP	FP
F	FN	TN

FP → Type I error — Actually false, but predicted as true.

FN → type II error.

Type I error – person is <u>not guilty</u> yet jury says he is convicted.

type II error – Person is guilty yet jury says he is not

Q.) A manfacturer of printer cartridge claims that a certain cartridge manufacture by firm has a mean printing capacity of atleast 500 pages. A wholesale purchaser selects a sample of 100 printers & tests them the mean printing capacity of the sample came out to be 490 pages with a SD of 30 pages.

Should the purchaser reject the claim of manufacturer at a 5% L.O.S.?

Sol

H_0:- mean pages $\geq$ 500

H_1:- mean $<$ 500

one-tail test.

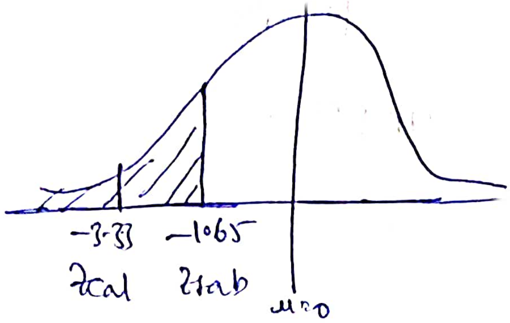
$\alpha = 5\%$ $\mu = 500$, $\bar{x} = 490$, $n = 100$, $\sigma = 30$

$$Z_{value} = \frac{\bar{x} - \mu}{SE} \Rightarrow \frac{\text{Sample mean} - \text{Pop. mean}}{\text{Std. Error}}$$

$$\frac{30}{\sqrt{100}} = \frac{SD \text{ of sample}}{\sqrt{n}}$$ no. of samples cases.

$$Z_{value} = \frac{490 - 500}{3} = -3.33$$

$$Z_{tab} = Z_{0.05\%} = -1.65$$



we can see Zcal is in critical region.

So, Reject H_0.

∘ mean is less than 500pages.

Notes

If variance of population is not given. then we will go for t-test & normal distribution.

Sample size	Population variance	Normality of sample	Sample variance	type of test
Large (>30)	known	normal / Non-normal	-	Z-test
Large (>30)	unknown	Normal	use this to calculate t-score	t-test
Large (>30)	unknown	unknown	use this to calculate Z-score	Z-test
Small (<30)	known	Normal	-	Z-test
Small (<30)	unknown	Normal	use this to calculate t-score	t-test

Z-test :-

→ Z-test when normality, SD of Popl^n is not known & we know SD of sample.

Then,

$$Z_{val} = \frac{SM - PM}{\left(\frac{\sigma}{\sqrt{n}}\right)} \longrightarrow \text{std. error.}$$

→ Z-test for TWO DIFFERENT POPULATIONS

$$Z_{val} = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \longrightarrow \frac{\text{sample mean of 1} - \text{sample mean of 2}}{\sqrt{\frac{(SD_1)^2}{n_1} + \frac{(SD_2)^2}{n_2}}}$$

1) A company used a specific brand of Tube lights in the past which has an avg. life of 1000 hours. A new brand has approached the company with new tube lights with same power "at a lower price."

A sample of 120 light bulbs were taken for testing which yielded an avg. of 1100 hours with SD of 90 hours. Should the company give the contract to this new company at a 1% L.O.S. Also find CI.

Sol:

one tail test.

H_0: price $\leq$ original price (claim)

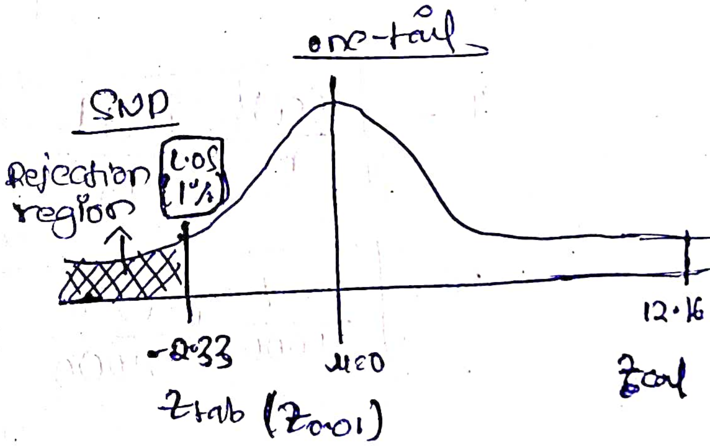
H_1: price $>$ original price.

$$z = \frac{SM - PM}{SE} = \frac{1100-1000}{\left(\frac{90}{\sqrt{120}}\right)}$$

$SE = \left(\frac{SD}{\sqrt{n}}\right)$

$$z_{cal} = \frac{100}{8.22} = 12.16$$

z_{tab} @ 0.01 L.O.S which is -2.33



→ we can clearly see,

z_{cal} is in acceptance region

$\boxed{\text{So, accept } H_0}$ i.e; what they claim is true.

$\boxed{\text{They offer with same power at low price}}$

Accept Project.

Q.) In two samples of men from diff states A & B, the height of 1000 men & 2000 men respectively are 76.5 & 77 inches. If population SD for both states is same & is 7 inches, can we assume mean heights of both states can be regrade same at 5% L.O.S.

$\boxed{\text{Two popl. Sum}}$

Sol:

→ Here what they want is to check whether they are same, so, we have to check on both tails

$H_0 : \mu = \mu_0$ (Both mean equal)
$H_1 : \mu \neq \mu_0$ (not equal)

two-tail test

$$SE = \sqrt{\frac{(\sigma_1)^2}{n_1} + \frac{(\sigma_2)^2}{n_2}}$$

$$SE = \sqrt{\frac{(7)^2}{1000} + \frac{(7)^2}{2000}} = 0.27$$

$$z_{cal} = \frac{x_1 - x_2}{SE}$$

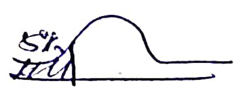
$$z_{cal} = \frac{76.5 - 77}{0.27}$$

$$\boxed{z_{cal} = -1.85}$$

we want z_{tab} at 5% L.O.S. for two tail.

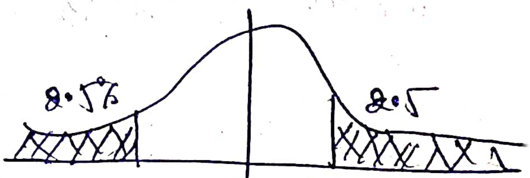
→ Actually z_{tab} at 5% L.O.S for one-tail is.

$z_{0.05} = -1.64$

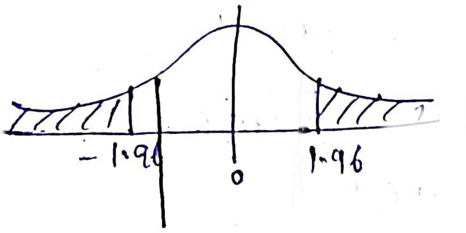


→ But, here as it is two tail. we got to divide the 5% for both tails.

i.e, 2.5% (left) + 2.5% (right)



$z_{0.025} = +1.96$, $z_{0.025} = -1.96$ } so, for the z_{tab} at 5% L.O.S for two tail is $z = 1.96$.



(zcal) so, accept H_0 → $\boxed{\text{It is not in critical region}}$

∴ Both means are equal.

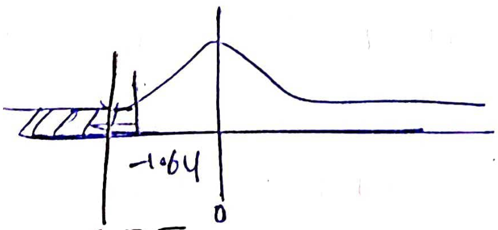
Notes

1) make it sure whether it is two-tail / one-tail.

If in case in above sum it is one-tail.

then,

z_{tab} @ 5% L.O.S (for one tail) = $z_{0.05} = -1.64$.



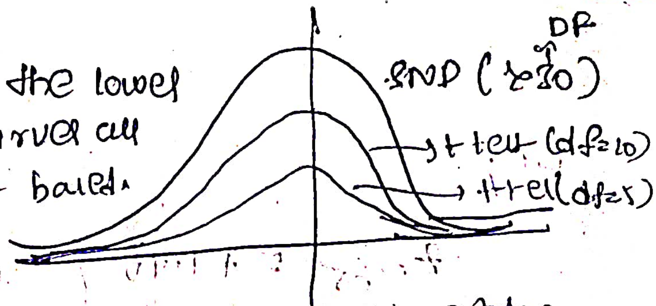
(zcal) → (Reject H_0)

$\boxed{\text{So, if it is one-tail, we would have rejected } H_0}$

$\boxed{z_{tab} \text{ @ 5\% L.O.S (for two tail)} = z_{0.025} = 1.96}$

T-test *

All the lower df curves are t-test based.



→ when the sample is small, the assumption of normal distribution doesn't hold good & as such z-test will not be appropriate. Instead another test known as 't-test' is used.

→ Procedure is all the same except we use the t-table values.

$$\boxed{t_{cal} = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}}$$

⊛ For two diff populations,

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_c^2}{n_1} + \frac{\sigma_c^2}{n_2}}}$$

$$\boxed{\sigma_c \text{ (common S.D)} = \sqrt{\frac{(S_1)^2 + (S_2)^2}{n_1 + n_2 - 1}}}$$

Problr

1) A tyre manufacturer claims that the avg. life of a particular category of its tyre is 18000 km when used under normal driving condo. A random sample of 16 tyres was tested. The mean & SD of life of tyres in the sample were 20,000 km & 6000 km respectively. Assuming that the life of the tyres is normally distributed, test the claim of manufacture at 1% L.O.S.

Solⁿ

→ claims it is 18000. They are not taking about less or more. Hence, two-tail.

$H_0 : \mu = 18,000$
$H_1 : \mu \neq 18,000$

Small sample as $16 < 30$.
$D.O.F = n-1 = 16-1 = 15$

$t_{cal} = \frac{SM-PM}{SE}$ → $\frac{\sigma}{\sqrt{n}} = \frac{6000}{\sqrt{16}} = 1500$

$t_{cal} = \frac{20,000-18000}{1500}$

$\boxed{t_{cal} = 1.33}$

t_{tab} @ 1% L.O.S (for two-tail)

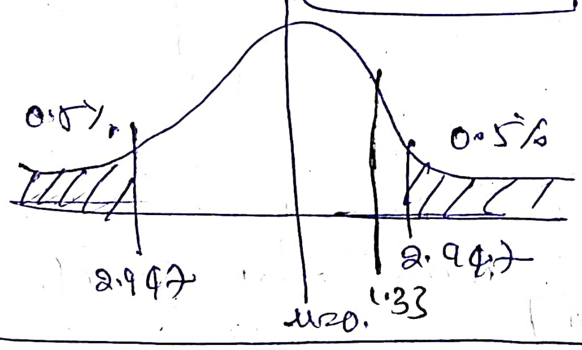
(or) t_{tab} @ 0.5% L.O.S (for one-tail)

i.e; (1%) → on tail
0.5% left + 0.5% right.

So, t_{tab} at 1% L.O.S (two-tail)

$\boxed{t_{tab} = 2.947}$

Accept H_0



2.) The means of two random samples of size 10 & 8 from two normal popl. is 210.4 & 208.92. The sum of square of deviations from their means is 26.94 & 24.50 respec. Assuming populations with equal variances, can we consider the normal populations have eq. mean? (L.O.S = 5%)

Soln

σ_c [common sd of sample] $= \sqrt{\dfrac{S_1^2 + S_2^2}{n_1+n_2-2}} = \sqrt{\dfrac{26.94+24.5}{10+8-2}} = 1.79.$

$SE = \sqrt{\dfrac{1.79^2}{10} + \dfrac{1.79^2}{8}} = 0.84.$

$H_0 : P_1\mu = P_2\mu$ } two-tail

$H_1 : P_1\mu \neq P_2\mu$

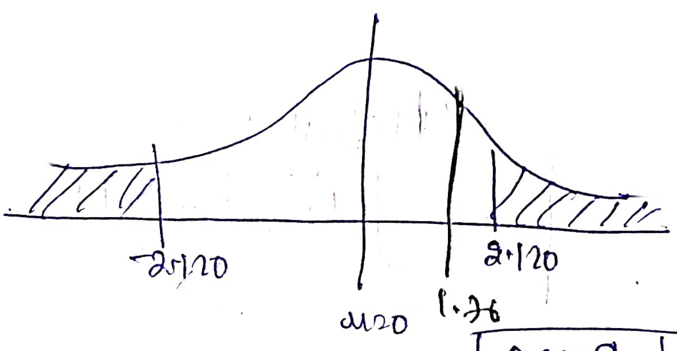
$t_{cal} = \dfrac{210.4 - 208.92}{0.84}$

$\boxed{t_{cal} = 1.76}$

t_{tab} at 5% L.O.S for two-tail

$t_{0.05}$ at $(10+8-2)$ 16 D.O.F $= 2.120.$

$\boxed{t_{0.05} = 2.120}$



mean are equal

$\boxed{\text{Accept } H_0}$

(χ^2) chi-squared test :-

→ It is a non-parametric test which means that it doesn't need any paramaters to test, like mean, median etc...

→ And it is widely used to test the hypothesis involving "categorical" data mainly 'NOMINAL'

→ It highly depends on the 'degree of freedom'. For a smaller D.O.F it gets 'skewed'. mostly skewed distribution. As the DF approaches or ≥ 30 the it becomes normal distn.

→ Right skewed, χ^2 → non-negative.

Tests that can be performed

① Tests the hypothesis about the 'variance' & SD of a population. $\boxed{\chi^2 = \frac{(n-1)s^2}{\sigma^2}}$

② Tests the hypothesis for more than two categories called 'Goodness of fit test'. $\boxed{\chi^2 = \Sigma \frac{(\text{observed}-\text{Expected})^2}{\text{Expected}}}$

③ Tests of hypothesis about contingency tables called 'χ^2 test of independence & also or homogeneity tests/contingency table.

$\boxed{\text{Expected} = \frac{(RT)(CT)}{GT}}$ $\boxed{DF = (r-1)(c-1)}$

Problems

model① - HT of variance

1) the variance of a certain size of towel produced by a machine is 7.2 over a long period of time. A random sample of 20 towels gave a variance of 8. You need to check if the variability for towel has increased at 5% L.O.S, assuming a normally distributed sample.

Sol:

Population variance $(\sigma^2) = 7.2$

Sample size $(n) = 20$, sample variance $(s^2) = 8$

→ need to check whether sample derived from pop.

→ You would check something when you have a 'doubt' on it. And there, it is not what you want.

$$\boxed{\begin{array}{l} H_0 : \text{var.} < 7.2 \\ H_1 : \text{var} \geq 7.2 \end{array}}$$

$$\chi^2_{cal} = \frac{(n-1)s^2}{\sigma^2}$$

$$\chi^2_{cal} = \frac{(20-1)(8)}{7.2}$$

$$\boxed{\chi^2_{cal} = 21.11}$$

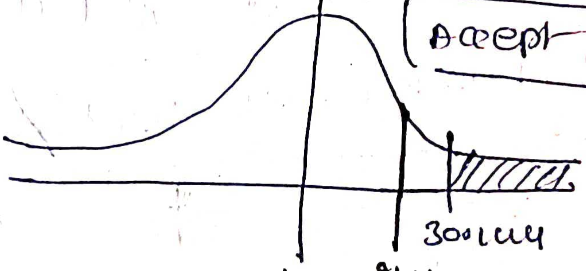
χ^2 tab at 5% L.O.S

for one-tail at $20-1 = 19$ DF

$$\boxed{\chi^2_{tab} = 30.144}$$

$\chi^2_{cal} < \chi^2_{tab}$

Accept H_0



2) A survey conducted by a pet food company determined that 60% of dog owners have 1 dog, 28% have 2 dogs, 12% have 3 dogs / more, you were not convinced by survey & decided to conduct your own survey & have collected data :- out of 129 dog owners, 73 - 1 dog, 38 - 2 dogs. Determine whether your data supports the results of the survey by the pet. use a 5% L.O.S.

Sol:

H_0 :- Survey justifies the pet survey (Both are same convinced)

H_1 :- Both are not same.

This is model ② - Goodness of fit by.

	observed	Expected
1)	73	60% of 129 = 77.4
2)	38	28% of 129 = 36.12
3)	18	12% of 129 = 15.48

$$\chi^2_{cal} = \sum_{i=1}^{3} \frac{(\text{observed} - \text{Expected})^2}{\text{Expect}}$$

$$\chi^2_{cal} = \frac{(73-77.4)^2}{77.4} + \frac{(38-36.12)^2}{36.12} + \frac{(18-15.48)^2}{15.48}$$

$\boxed{\chi^2_{cal} = 0.7533}$

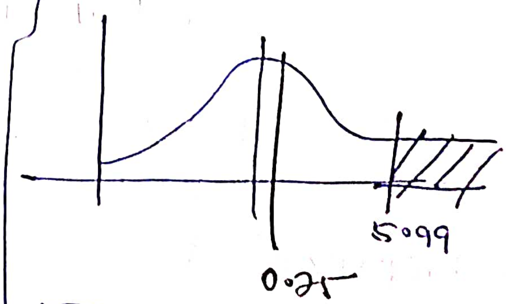
χ^2tab at 5% L.O.S

$\boxed{\text{two-tail - but it doesn't matter.}}$

χ^2 - always right skewed.

D.O.F = 3 - 1 = 2.

$\boxed{\chi^2_{0.05} = 5.99}$ tab.



convinced with the pet survey ← $\boxed{\text{Accept } H_0}$

(3) out of 8000 graduates in a town 800 are females & out of 1600 graduate employees 120 are females. Use χ^2 to determine if any distribution is made in appointment on basis of sex. Use 5% L.O.S.

Sol)

	unemployed graduates	employed graduates	row total
male	5720	1480	7200
female	680	120	800
column total	6400	1600	8000

D.O.F = (r-1)(c-1)

DF = (2-1)(2-1)

$\boxed{DF = 1}$

H_0: Employment depends on sex

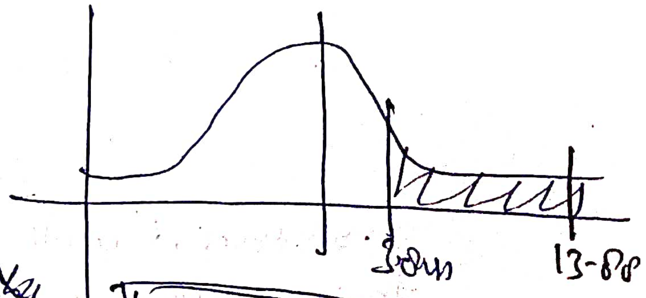
H_1: doesn't depend.

observed	Expected	$(O_i - E_i)^2 / E_i$
5720	5760	0.277
1480	1440	1.111
680	640	2.5
120	160	10

Formula for Expected = $\dfrac{(\text{row total})(\text{column total})}{\text{grand total}}$.

$\chi^2_{cal} = 13.88$

χ^2_{tab} at 1 DF, 5% L.O.S = 3.841



∴ Employment doesn't depend on sex.

$\boxed{\text{Reject } H_0}$

F-test

$$\boxed{F = \frac{\sigma_1^2}{\sigma_2^2}} \quad \nu_1 \to n_1 - 1, \; \nu_2 \to n_2 - 1 \quad (\nu_1 > \nu_2)$$

It is designed to test if two population variances are equal.

→ It is simply the ratio of two variances.

(larger one on numerator)

→ we can use F-tests...

i) To test the overall significance for a Regression model.

ii) To compare the fits of diff models.

iii) To test specific regression terms.

iv) To test the equality of means.

→ mainly used in ANOVA.

→ we choose F-test when we only have S.D.

∴ $\boxed{F = \frac{\sigma_1^2}{\sigma_2^2}}$

$$\sigma_1^2 = \frac{n_1 \cdot s_1^2}{n_1 - 1}, \quad \sigma_2^2 = \frac{n_2 \cdot s_2^2}{n_2 - 1}$$

$$s_1 = \frac{(\Sigma x)^2}{n} - \left(\frac{\Sigma x}{n}\right)^2, \quad S_2 = \frac{(\Sigma y)^2}{n} - \left(\frac{\Sigma y}{n}\right)^2$$

$\boxed{s_1 > s_2}$ must

4

ANOVA (analysis of variance)

→ It is basically you're testing groups to see if there's a diff b/w them.

→ observing the dependency of groups based on one/more variables.

Eg:

1) Students from diff. colleges takes the same exam, you want to see if one college outperforms the others.

2) A manufacture has two diff. process to make light bulbs. they want to know if one is better than the other.

3) A group of psychiatric patients are trying 3 diff therapies: counselling, medication & bio feedback.
You want to see if one better than the other.

→ It uses F-test.

If they depend on one-variable: one-way test
two-variables: two-way test
many-variables: MANOVA.

Q.) In a survey conducted to test the knowledge of mathematics among diff schools in city

School	maths marks						
School ①	8	6	7	5	9		
School ②	6	4	6	5	6	7	
School ③	6	5	5	6	7	8	5
School ④	5	6	6	7	6	7	

Sol:- there is a procedure for ANOVA.
Here it is ONEWAY ANOVA as it only depends on marks.

$\boxed{\begin{array}{l} H_0: \text{mean of all schools is same} \\ H_1: \text{it's not same} \end{array}}$

Procedure:-

School(1)	S2	S3	S4	$(S1-S1(mean))^2$	$(S_2-\bar{S}_2)^2$	$(S_3-\bar{S}_3)^2$	$(S_4-\bar{S}_4)^2$
8	6	6	5	1	0.0111	0	1.36
6	4	5	6	1	2.777	1	0.02
7	6	5	6	0	0.0111	1	0.02
5	5	6	7	4	0.444	0	0.69
9	6	7	6	4	0.111	1	0.02
	7	8	7		1.777	4	0.69
		5				2	
Total 35	34	42	37	10	5.333	8	2.83
mean 7	5.67	6	6.167				

$\boxed{\text{Grand mean} = 6.208}$

(i) Sum squared between (SS b/w) $= \sum n_i (\text{data}_i\text{ mean} - \text{Grand mean})^2$

$SS_{b/w} = 5(7-6.208)^2 + 6(5.67-6.208)^2 + 7(6-6.208)^2 + 6(6.16-6.20)^2$

$SS_{b/w} = 4.99$

(ii) Mean sum squared b/w (MSST) $= \dfrac{SS_{b/w}}{\text{no. of group} - 1} = \dfrac{4.99}{4-1} = 1.666$

(ii) Sum of squares within $= \Sigma(S_i - \bar{S}_i)^2$

$= 10 + 5.33 + 8 + 2.83$

$= 26.16$

(x) mean sum squares within (MSSE) $= \dfrac{\text{SS within}}{\text{no. of observations} - \text{no. of groups}}$

$= \dfrac{26.16}{24-4} = \dfrac{26.16}{20} = 1.308.$

And by F-test,

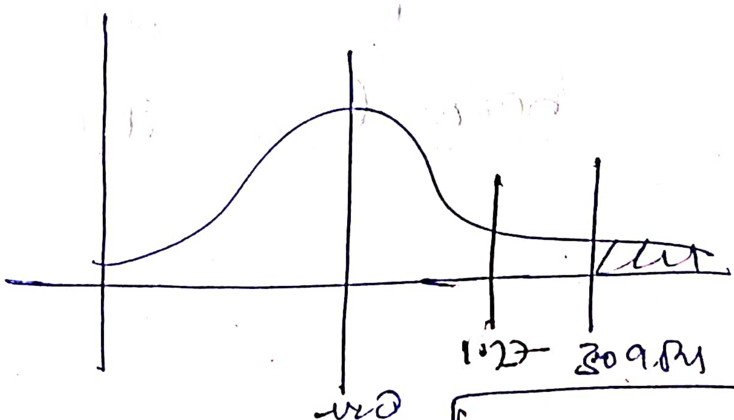
$F_{cal} = \dfrac{MSST}{MSSE}$

$F_{cal} = \dfrac{1.666}{1.308}$

$\boxed{F_{cal} = 1.27}$

F_{tab} @ γ_1, γ_2 at 0.05

$\boxed{F_{tab} = 3.0984}$



$\boxed{\text{Accept } H_0}$

⊛ Central Limit Theorm (CLT)

→ The CLT states that the sampling distribution of the sample "means" approaches a 'normal distribution' as the sample size gets larger – ⊛ no matter what the shape of popl' distribution.

[sample size > 30]

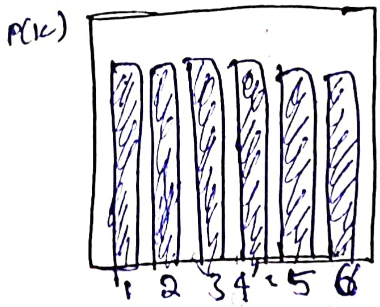
In other words,

→ You take more samples especially large ones, your graph of the "sample mean" will look more like a normal distribution.

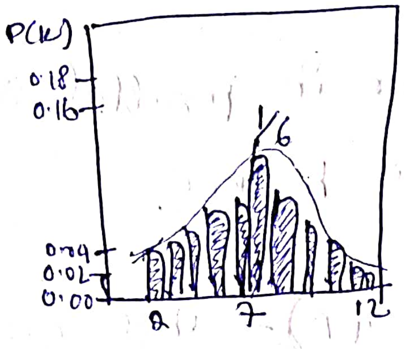
Eg:

→ Here's what the CLT is saying, graphically. Rolling a fair die. The more times you roll the die, the more likely the shape of the distribution of the means tends to look like a normal distribution graph!

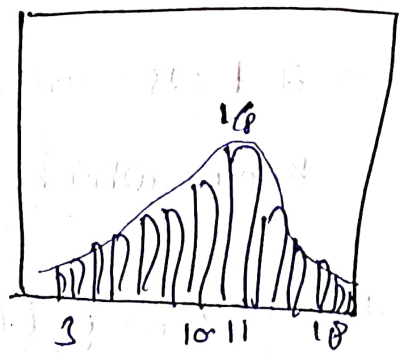
n=1



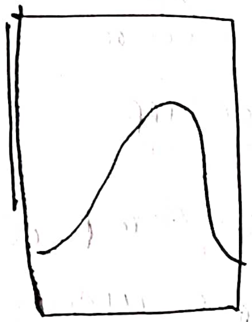
n=2



n=3



n=4 ..



In n=2

possibilities

1 1	1	2 1	1.5	3 1	2	4 1	2.5	5 1	3	6 1	3.5
1 2	1.5	2 2	2	3 2	2.5	4 2	3	5 2	3.5	6 2	4
1 3	2	2 3	2.5	3 3	3	4 3	3.5	5 3	4	6 3	4.5
1 4	2.5	2 4	3	3 4	3.5	4 4	4	5 4	4.5	6 4	5
1 5	3	2 5	3.5	3 5	4	4 5	4.5	5 5	5	6 5	5.5
1 6	3.5	2 6	4	3 6	4.5	4 6	5	5 6	5.5	6 6	6

"sample means"

gives normal distribution

Notes

1) An essential component of CLT is that Avg. of your sample means will be the actual population mean.

Similarly for SD.

P-value

→ P-value is the smallest level of significance at which a null hypothesis can be rejected. That's why many tests now a days gives p-value & it is more preferred since it gives out more information than the critical value.

For right-tailed test

P-value = P [Test statistics >= observed value of test statistic.]

For left-tailed test

P-value = P [Test statistic <= observed value of test statistic]

For two-tailed test

P-value = 2 * P [Test statistic >= |observed value of test statistic|]

Decision making with p-value

→ The p-value is compared to the significance level (alpha) for decision making on Ho.

① If p-value > α , Accept H_0

② If p-value < α , Reject H_0 //

Note

→ P-value is the area, caveat.

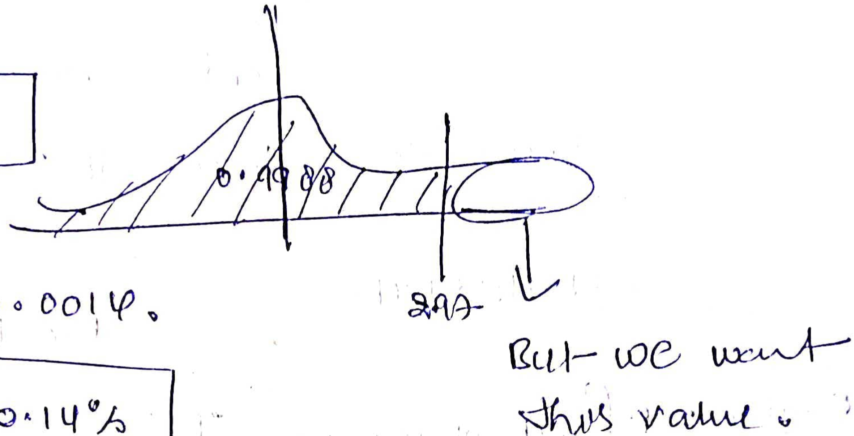
Findy p-valu

1) Find z statistic value

Eg1

$z = 2.97$

$\boxed{z_{2.97} = 0.9988}$



$1 - 0.9988 = 0.0014$.

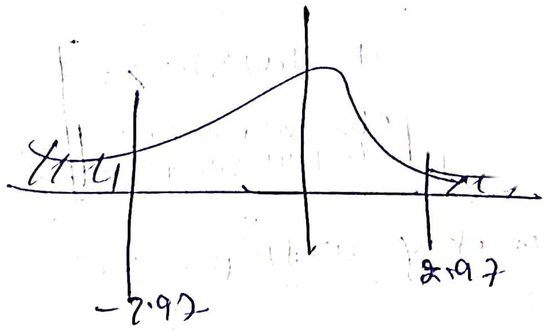
i) $\boxed{\text{P-value} = 0.14\%}$

If right tail

ii) If two-tail

p-value $= 2 \times 0.014$

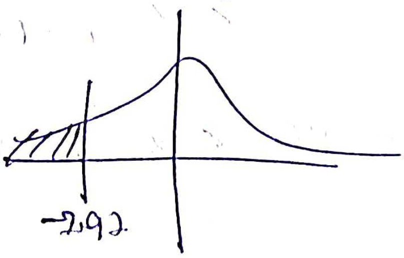
p-value $= 0.28\%$



iii) If $z = -2.97$

$P_{-2.97} = 0.0014$.

$\boxed{\text{P-value} = 0.14\%}$



For left tail,
no need to subtract

Notes

P-values

The probability that the test statistic is that the value or more extreme in dirn of alternate hypothesis.

* Area of critical region
  Pval in

Test Statistics

A measurement of how far a sample statistic is from the assumed parameter if Ho is true.

A/B testing :-

→ 2 tests are run in parallel to know which is better.

1) treatment Group (Group A) - This group is exposed to new web page

2) control Group (Group B) - No change from current setup.

→ the goal of the A/B test is then to compare the 'conversion rates' of two groups using statistical inference.