Hypothesis Testing

We studied (Review)

1. Testing for single mean (Large sample)
2. Testing for two means (")
3. Testing for single sample proportion (L.S)
4. Testing for two sample proportion (L.S)
5. Chisquare test for attributes (3 – cases)

1) $$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \sim N(0,1)$$

2) $$z = \frac{\bar{x} - \bar{y}}{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \sim N(0,1)$$

3) $$z = \frac{p - P}{\sqrt{\frac{PQ}{n}}} \sim N(0,1)$$

4) $$z = \frac{p_1 - p_2}{\sqrt{PQ\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \sim N(0,1)$$

5) $$\chi^2 = \sum \frac{(O - E)^2}{E} \overset{df}{\sim} \chi^2_{(r-1)\times(c-1)}$$

$$\overset{df}{\sim} \chi^2_{(n-1)}$$

Let us discuss about n – means

(3 or more sample Means)

Testing the significance differences b/w three or more groups with help of Variances (F – test)

The name of test is ANOVA

ie "Analysis of Variance"

Means → The variation due to any specific factor is compared with the residual variation for significance by applying the F-test and thus test the homogeneity of the observed data.

Techniques:

1. ANOVA for one way classification

2. ANOVA for two way classification.

ANOVA Table

Source of Variation (S.V)	degrees of freedom (d.f)	Sum of Squares (S.S)	Mean Sum of Squares (MSS)	F_{cal}	F_{table}
Between Class (treat)	$K-1$	TrSS	$M_{Tr} = \frac{TrSS}{K-1}$	$F_{cal} = \frac{M_{Tr}}{ME}$	$F(K-1, n-K)$
Within Classes (Error)	$n-K$	ESS	$ME = \frac{ESS}{n-K}$		
Total	$n-1$	TSS			

I: One way ANOVA:

Formulae:

Correction factor (c.f) $= \frac{G^2}{n}$ (G – Grand total) (n – no of observations)

Between Classes (Treatment sum of squares) (Trss) $= \frac{\Sigma y_{i.}^2}{r} - c.f$

Total sum of squares (TSS) $= \Sigma\Sigma y_{ij}^2 - c.f$

Within classes (Error sum of squares) (ESS) $= TSS - Trss$

Eg:- The following table shows the lives in hours of 4 brands of electric lamps

A	17	26	35	41	50
B	8	12	—	20	14
C	11	12	—	—	8
D	16	13	12	4	6

Perform an ANOVA and test the homogeneity of the mean lives of the 4 brands of lamps at 5% LOS.

Sol:

	A	B	C	D	
	17	8	11	16	
	26	12	12	13	
	35	—	—	12	
	41	20	—	4	
	50	14	8	6	
Total	169	54	31	51	= 305
$\frac{y_{i.}^2}{r}$	= 5712.2	729	320.33	520.2	= 7281.73

$$\Sigma\Sigma y_{ij}^2 = 7993$$

$$C.f = \frac{G^2}{n} = \frac{(305)^2}{17} = 5472.05$$

Total sum of Squares (TSS) $= \Sigma\Sigma y_{ij}^2 - C.f$

$$= 7993 - 5472.05$$

$$= 2520.94$$

Treatment sum of Squares (TrSS) $= \frac{\Sigma y_{i.}^2}{r} - Cf$

$$= 7281.73 - 5472.05$$

$$= 1809.68$$

Error sum of Squares (ErSS) $=$ TSS $-$ TrSS

$$= 2520.94 - 1809.68$$

$$= 711.26$$

ANOVA Table:

S.V	d.f	S.S	M.S.S.	F cal	F tab
Treatment (Trss)	$K-1 = 4-1 = 3$	$Trss = 1809.68$	$M_{Tr} = \frac{Trss}{K-1} = \frac{1809.68}{3} = 603.22$	$F_{cal} = \frac{M_{Tr}}{M_E} = \frac{603.22}{54.712} = 11.025$	$F_{(3,13)} = 3.41$
Error (Erss)	$n-K = 17-4 = 13$	$Erss = 711.26$	$M_E = \frac{Erss}{n-K} = \frac{711.26}{13} = 54.712$		
Total (Tss)	$n-1 = 17-1 = 16$	$Tss = 2520.94$			

$F_{cal} = 11.025$

$\left.\begin{array}{l} F_{tab}(3,13) \\ \text{at } 5\% \text{ LOS} \end{array}\right\} = 3.41$

Inference: Since F cal value is greater than F tab at (3,13) in 5% LOS our null Hypothesis is rejected.