Department of Commerce (CA)

COURSE : I M.Com (CA)

SEMESTER : II

SUBJECT : BUSINESS RESEARCH METHODS

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SYLLABUS

UNIT-V

Test of significance - ‘T’ Test- large sample and ‘F’ Test , Test of significance for attributes, analysis of variance –Business forecasting - Chi-Square Test.

UNIT-V

TEST OF SIGNIFICANCE:-

- Test of significance for attributes.
- Test of significance for Variables (Large Samples).
- Test of significance for Variables (Small Samples).

Test of Significance for Attributes:

As distinguished from variables quantitative measurement of a phenomenon is possible

The various tests of significance for attributes are discussed under the following heads.

(i) Tests for Number of Success

(ii) Tests for Proportion of Successes

(iii) Tests for Difference between Proportions.

(i) Tests for Number of Success :

S.E. of no. of successes = $\sqrt{npq}$

Where n = size of sample

P = probability of success in each trial.

Q = (1-p), i.e., probability of failure

Sum No: 1

A coin was tossed 400 times and the head turned up 216 times. Test the hypothesis that the coin is unbiased.

(ii) Tests for Proportion Success :

$$\mathbf{S.E._p = \sqrt{\frac{pq}{n}}}$$

Sum No: 2

500 apples are taken at random from a large basket and 50 are found to be bed. Estimate the proportion of bad apples in the basket and assign limits within which the percentage most probably lies.

(iii) Tests for Difference between Proportion :

$$\text{S.E. } (p_1 - p_2) = \sqrt{pq\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$p = \frac{n_1 p_1 + n_2 p_2}{n_1 + p_2}$$

Sum No: 3

In random sample of 1,000 persons from town A. 400 are found to be consumers of wheat. In a sample of 800 from town B. 400 are found to be consumers of wheat. Do these data reveal a significant difference between town A and town B, so far as the proportion of wheat consumers in concerned.

TEST OF SIGNIFICANCE FOR LARGE SAMPLES

$$\text{S.E. } \bar{X} = \frac{\sigma_p}{\sqrt{n}}$$

Sum No: 4

Calculate standard error of mean from the following data showing the amount paid by firms in Calcutta on the occasion of Durga Puja

Mid Value (Rs)	39	49	59	69	79	89	99
No of firms	2	3	11	20	32	25	7

T – Distribution:-

1. **To Test the Significance of the Mean of a Random Sample:**

$$t = \frac{(\bar{X} - \mu)\sqrt{n}}{S}$$

Where $\bar{X}$ = the mean of the sample

μ = the actual or hypothetical mean of the population

n = the sample size

S = the standard deviation of the sample

Where, $S = \sqrt{\frac{(X - \bar{X})}{n-1}}$

Sum No: 5

The life time of electric bulbs for a random sample of 10 from a large consignment gave the following data:

Item	1	2	3	4	5	6	7	8	9	10
Life in '000 Hours	4.2	4.6	3.9	4.1	5.2	3.8	3.9	4.3	4.4	5.6

Can we accept the hypothesis that the average life time of bulbs is 4,000 hours.

2. **Test Difference Between Mean of Two Samples (Independent Sample):**

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S} \times \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where $\bar{X}_1$ = the mean of the first sample

$\bar{X}_2$ = the mean of the second sample

n_1 = number of observations in first sample

n_2 = number of observations in second sample

S = combined standard deviation

Where, $\mathbf{S} = \sqrt{\frac{\sum(\bar{\mathbf{X}}_1 - \bar{\mathbf{X}}_1)^2 + \sum(\bar{\mathbf{X}}_2 - \bar{\mathbf{X}}_2)^2}{n_1 + n_2 - 2}}$

Sum No: 6

For a random sample of 10 persons, fed on diet, A the increased weight in pounds in a certain period were:

10, 6, 16, 17, 13, 12, 8, 14, 15, 9

For another sample of 12 persons, fed on diet B, the increase in the same period were:

7, 13, 22, 15, 12, 14, 18, 8, 21, 23, 10, 17

Test whether the diets A and B differ significantly as regards theireffect on increase in weight.

Degree of freedom	19	20	21	22	23
Value of t as 5% level	2.09	2.09	2.08	2.07	2.07

3. Test Difference Between Mean of Two Samples (Dependent Samples or Paired Observations):

$$\mathbf{t} = \frac{\bar{\mathbf{d}} - \mathbf{0}}{\boldsymbol{S}} \times \sqrt{\boldsymbol{n}} \text{ (or) } t = \frac{\bar{\mathbf{d}}\sqrt{\mathbf{n}}}{\boldsymbol{S}}$$

Where, $\bar{d}$ = the mean of the differences

S = the standard deviation of the differences.

$$\mathbf{S} = \sqrt{\frac{\sum(\mathbf{d} - \bar{\mathbf{d}})^2}{\boldsymbol{n} - \mathbf{1}}} \textbf{ (or) } \sqrt{\frac{\sum \mathbf{d}^2 - \mathbf{n}(\bar{\mathbf{d}})^2}{\boldsymbol{n} - \mathbf{1}}}$$

Sum No: 7

To verify whether a course in accounting improved performance, a similar test was given to 12 participants both before and after the course. The original marks recorded in alphabetical order of the participants were 44, 40, 61, 52, 32, 44, 70, 41, 67, 72, 53 and 72, after the course, the marks in the same order 53, 38, 69, 57, 46, 39, 73, 48, 73, 60 and 78 was the course usefull?

4. **Test the Significance of an observed correlation Coefficient:**

$$t = \frac{r}{\sqrt{1-r^2}} \times \sqrt{n-2}$$

Sum No: 8

A random sample of 27 pairs of observations from a population given a correlation coefficient of 0.42. Is it likely that the variables in the population are uncorrelated.

ANALYSIS OF VARIANCE

Assumptions in Analysis of Variance:

The assumptions in analysis of variance are the same as discussed earlier while taking of F-test

1. Normality
2. Homogeneity
3. Independence of error.

TECHNIQUE OF ANALYSIS OF VARIANCE

The analysis of variance frequently referred to by the contraction ANOVA is a statistical technique specially designed to test whether the means of more than two quantitative populations are equal.

THE F-TEST OR VARIANCE RATIO REST

$$F = \frac{S_1^2}{S_2^2}, \text{ where } S_1^2 = \frac{\Sigma(\bar{X}_1 - \bar{X}_1)^2}{n_{1-1}}$$

$$S_2^2 = \frac{\Sigma(\bar{X}_2 - \bar{X}_2)^2}{n_{2-1}}$$

It should be noted that S_1^2 **is** always the larger estimate of variance, i,e., $S_1^2 > S_2^2$

$$F = \frac{\text{Larger estimate of variance}}{\text{Smaller estimate of variance}}$$

$$v_1 = n_{1-1} \text{ and } v_2 = n_{2-1}$$

v_1 = degrees of freedom for sample having larger variance

v_2 = degrees of freedom for sample having smaller variance

Sum No: 9

Two random samples were drawn from two normal populations and their values are:

A :	66	67	75	76	82	84	88	90	92		
B :	64	66	74	78	82	85	87	92	93	95	97

Test whether the two populations have the same variance at the 5% level of significance.(F = 3.36) at 5% level for $v_1 = 10$ and v_2= 8.

Sum No: 10

In a sample of 8 observations, the sum of squared deviations of items from the mean was 84.4. In another sample of 10 observations, the value was found to be 102.6. Test whether the difference is significant at 5% level.

Your are given that at 5% level, critical value of F for $\upsilon_1 = 7$ and $\upsilon_2 = 9$ degree of freedom is 3.29 and for $\upsilon_1 = 8$ and $\upsilon_2 = 10$ degrees of freedom, its value is 3.07.

One Way Classification:

In one-way classification the data are classified according to only one criterion. The null hypothesis is:

$$H_0: \mu_1 = \mu_2 = \mu_3 \ldots \ldots \ldots \ldots .. = \mu_k$$

1. Calculate variance between the samples.
    a) Calculate the mean of each sample
    b) Calculate the grand average $\bar{\bar{X}}$, pronounced "X double bar". Its value is obtained as follows
    c) Take the difference between the means of the various samples and the grand average.
    d) Square these deviations and obtain the total which will give sum of square between the samples.
2. Calculate variance within the samples
3. Calculate the ratio F as follows:

$$F = \frac{\text{Between } -\text{column variance}}{\text{Within } -\text{column variance}}$$

$$F = \frac{S_1^2}{S_2^2}$$

4. Compare the calculated value of F with the table value of F for the degrees of freedom at a certain level.

Analysis of variance (ANOVA) Table : One Way Classification Model

Source of Variation	SS(Sum of Squares)	υ Degrees of freedom	MS Mean Square	Variance Ratio of F
Between Samples	SSC	υ_1 = c - 1	MSC = SSC/ (c-1)	
Within Samples	SSE	υ_2 = n - c	MSE = SSE/ (n-c)	MSC/MSE
Total	SST	n-1		

Sum No: 11

To assess the significance of possible variation in performance in a certain test between the grammar schools of a city, a common test was given to a number of students taken at random from the senior fifth class of each of the four schools concerned. The results are given below. Make analysis of variance of data :

Schools			
A	B	C	D
8	12	18	13
10	11	12	9
12	9	16	12
8	14	6	16
7	4	8	15

Two Way Classifications:

In a two way classification the data are classified according to two different criteria or factors. In two way classification the analysis of variance table takes the following form:

Source of Variation	SS(Sum of Squares)	Degrees of freedom	MS Mean Square	Ratio of F
Between Samples	SSC	(c- 1)	MSC = SSC/ (c-1)	MSC/MSE
Between Rows	SSR	(r – 1)	MSR = SSR/ (n-c)	MSR/MSE
Residual or Error	SSE	(c-1) (r-1)	MSE = SSE/(r-1) (c-1)	
Total	SST	n-1		

The sum of square for the source ‘Residual’ is obtained by subtracting from the total sum of square between columns and rows, SSE = SST – [SSC + SSR]

The total number of degrees of freedom = n-1 or cr-1

Where c refers to number of columns, r refers to number of rows.

Number of degrees of freedom between columns = (c – 1)

Number of degrees of freedom between rows = (r – 1)

Number of degrees of freedom for residual = (c – 1) (r – 1)

The F Values are calculated as follows:

$$F_{(v1.v2)} = \frac{MSC}{MSE}$$

Where, υ_1= (c-1) andυ_2 = (c-1) (r-1)

Sum No: 12

A tea company appoints four salesman A, B, C and D and observes their sales in three seasons – summer, winter and monsoon. The figures 9(in lakhs) are given in the following table:

Seasons	Salesman				Season`s Total
	A	B	C	D	
Summer	36	36	21	35	128
Winter	28	29	31	32	120
Monsoon	26	28	29	29	112
Salesman`s Total	90	93	81	96	360

(i) Do the salesmen significantly differ in performance?
(ii) Is there significant difference between the seasons?

CHI-SQUARE TEST

The χ^2 test (pronounced as chi-square test) is one of the simplest and most widely used non-parametric tests in statistical work.

$$\chi^2 = \sum = \frac{(O-E)^2}{E}$$

Where, O = Refers to be the observed frequencies.

E = Refers to the expected frequencies.

Steps,

(i) Calculate the expected frequencies.

$$\mathbf{E} = \frac{\boldsymbol{RT \times CT}}{\boldsymbol{N}}$$

E = Expected frequency.

RT = the row total for the row containing the call.

CT = the column total for the column containing the call.

N = the total number of observations.

(ii) Divide the values of $(O - E)^2$ and $\sum\ [(O - E)^2/E]$

Sum No: 13

In an anti a malarial campaign in a certain area, quinine was administered to 812 persons out of a total population of 3,248. The number of fever cases is shown below:

Treatment	Fever	No Fever	Total
Quinine	20	792	812
No Quinine	220	2,216	2,436
Total	240	3,008	3,248

BUSINESS FORECASTING

Meaning:

when estimates of future conditions are made on a systematic basis, the process is referred to as “forecasting” and the future or statement obtained is known as a “forecast”.

Steps in Forecasting:

1. Undertaking why changes in the past have occurrrd.
2. Determining which phases of business activity must be measured.
3. Selecting and compiling data to be used as measuring devices.
4. Analyzing the data.

Methods of Forecasting:

1. Business Barometers
2. Extrapolation
3. Regression Analysis
4. Economic Models
5. Forecasting by the use of time series analysis
6. Opinion Poling
7. Casual Models
8. Exponential Smoothing
9. Survey Method.

Theories of Business Forecasting:

1) Sequence or Time-leg Theory.
2) Action and Reaction Theory.
3) Economic Rhythm Theory.
4) Specific Historical Analogy.
5) Cross-section Analysis.

BOOKS REFERRED:

STATISTICAL METHODS, by S.P.GUPTA