# Mathematical Methods

- Unit- II : Test of hypothesis –large sample tests- mean test- standard deviation test- proportion test- correlation test – z transformation test- small sample test- student's T test- F test- $x^2$ test.

# Meaning

## What is Hypothesis Testing?

Hypothesis testing refers to

1. Making an assumption, called hypothesis, about a population parameter.
2. Collecting sample data.
3. Calculating a sample statistic.
4. Using the sample statistic to evaluate the hypothesis (how likely is it that our hypothesized parameter is correct. To test the validity of our assumption we determine the difference between the hypothesized parameter value and the sample value.)

# Test of hypothesis

## Testing of Hypothesis

The procedure to decide whether to accept or reject the null hypothesis is called **Testing of hypothesis.**

# Meaning for large sample test

- The **sample** size n is greater than 30 ($n \geq 30$) it is known as **large sample**. For **large samples** the sampling distributions of statistic **are** normal(Z **test**).
- A study of sampling distribution of statistic for **large sample** is known as **large sample** theory.

# Large sample test

## Large Sample test

- Test of Single Mean
- Test of significance of difference between two means
- Test of significance of difference between two std. deviation
- Test of Single Proportion
- Test of significance of difference between two proportions

# Proportion test

- The One-Sample **Proportion Test** is used to assess whether a population **proportion** (P1) is significantly different from a hypothesized value (P0).
- The hypotheses may be stated in terms of the **proportions**, their difference, their ratio, or their odds ratio, but all four hypotheses result in the same **test** statistics.

# Z –test



## Z-Test for testing means

**Test Condition**

- Population normal and infinite
- Sample size large or small,
- Population variance is known
- Ha may be one-sided or two sided

**Test Statistics**

$$Z = \frac{\bar{X} - \mu_{H_0}}{\sigma_p / \sqrt{n}}$$

# Z- test

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## Z-Test for testing means

### Test Condition

- Population normal and finite,
- Sample size large or small,
- Population variance is known
- Ha may be one-sided or two sided

### Test Statistics

$$z = \frac{\bar{X} - \mu_{H_0}}{\sigma_p / \sqrt{n} \times \left[\sqrt{(N-n)/(N-1)}\right]}$$

# Z –test

## Z-Test for testing means



### Test Condition

- Population is infinite and may not be normal,
- Sample size is large,
- Population variance is unknown
- Ha may be one-sided or two sided

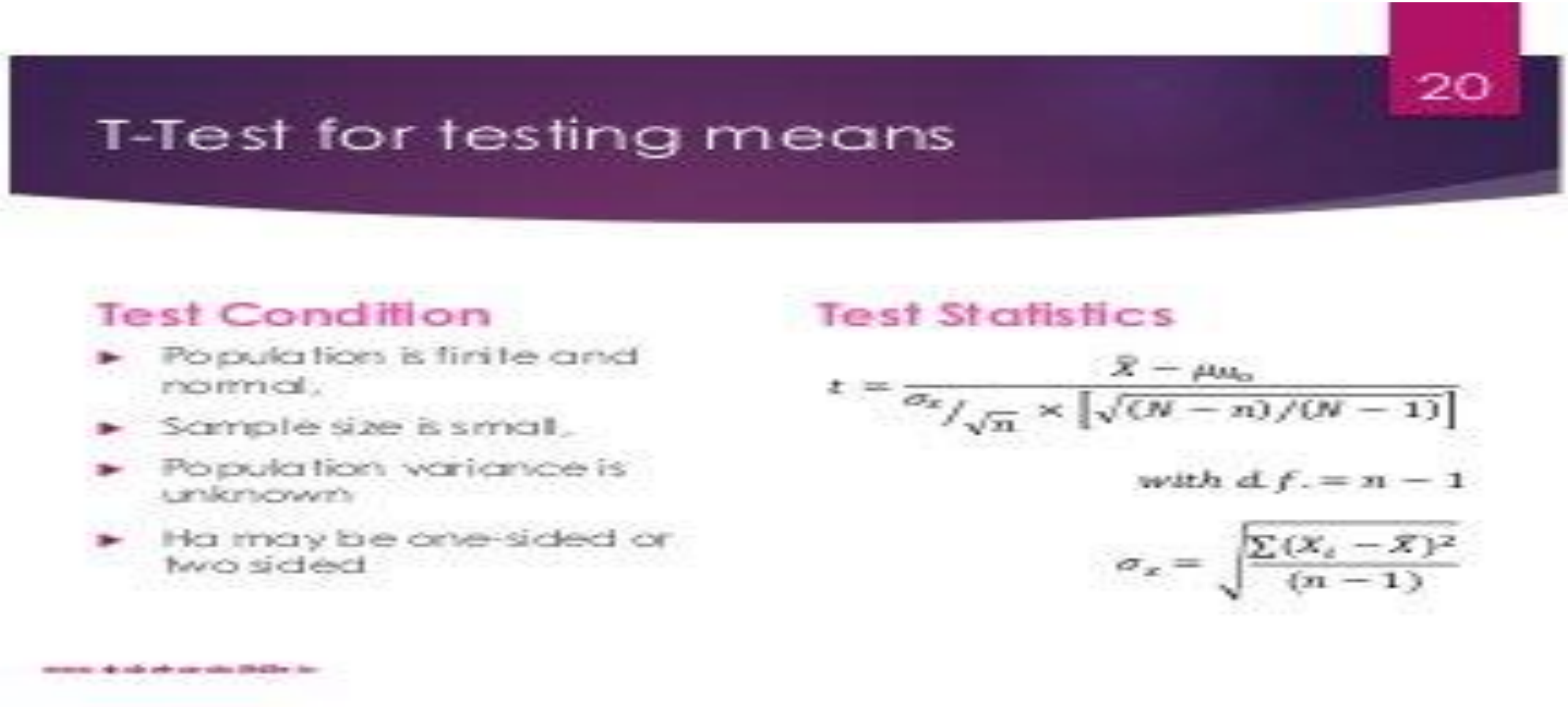
### Test Statistics

$$Z = \frac{\bar{X} - \mu_{H_0}}{\sigma_S / \sqrt{n}}$$

# SMALL SAMPLE TEST

- If the **sample** size n ils less than 30 ($n<30$), it is known as **small sample**. For **small samples** the sampling distributions are t, F and $\chi 2$ distribution.
- A study of sampling distributions for **small samples** is known as **small sample** theory.

# T-test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T-Test for testing means
Test Condition
► Population is finite and normal.
► Sample size is small.
► Population variance is unknown
► Ha may be one-sided or two sided
Test Statistics
$t = \frac{\bar{X} - \mu_0}{\sigma_x/\sqrt{n} \times \left[\sqrt{(N-n)/(N-1)}\right]}$
$with\ d.f. = n - 1$
$\sigma_x = \sqrt{\frac{\sum (X_i - \bar{X})^2}{(n-1)}}$

# T-test

## T-Test for testing means

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### Test Condition

- Population is finite and normal,
- Sample size is small,
- Population variance is unknown
- Ha may be one-sided or two sided

### Test Statistics

$$t = \frac{\bar{X} - \mu_{H_0}}{\sigma_s/\sqrt{n} \times \left[\sqrt{(N-n)/(N-1)}\right]}$$

$$with\ d.f. = n - 1$$

$$\sigma_s = \sqrt{\frac{\sum (X_i - \bar{X})^2}{(n-1)}}$$

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# Z-test

## Z-Test for testing difference between means

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**Test Condition**

- Populations are normal
- Samples happen to be large,
- Population variances are known
- Ha may be one-sided or two sided

**Test Statistics**

$$z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_{p1}^2}{n_1} + \frac{\sigma_{p2}^2}{n_2}}}$$

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# Z-test

## Z-Test for testing difference between means



### Test Condition

- Populations are normal
- Samples happen to be large,
- Presumed to have been drawn from the same population
- Population variances are known
- Ha may be one-sided or two sided

### Test Statistics

$$z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\sigma_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

# T-test

## T-Test for testing difference between means

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**Test Condition**

- Samples happen to be small,
- Presumed to have been drawn from the same population
- Population variances are unknown but assumed to be equal
- Ha may be one-sided or two sided

**Test Statistics**

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)\sigma_{s1}^2 + (n_2 - 1)\sigma_{s2}^2}{n_1 + n_2 - 2}} \times \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$with\ d.f. = (n_1 + n_2 - 2)$$

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# Chi-square test

## INTRODUCTION

- The chi-square test is an important test amongst the several tests of significance developed by statisticians.
- Is was developed by Karl Pearson in1900.
- CHI SQUARE TEST is a non parametric test not based on any assumption or distribution of any variable.
- This statistical test follows a specific distribution known as chi square distribution.
- In general The test we use to measure the differences between what is observed and what is expected according to an assumed hypothesis is called the chi-square test.

# Chi-square test

- The **chi-square distribution** arises in tests of hypotheses concerning the independence of two random variables and concerning whether a discrete random variable follows a specified distribution.

# Chi square

## CALCULATION OF CHI SQUARE

$$X^2 = \sum \frac{(o-e)^2}{e}$$

**Where,**
**O = observed frequency**
**E = expected frequency**
**If two distributions (observed and theoretical) are exactly alike, $\chi 2 = 0$; (but generally due to sampling errors, $\chi 2$ is not equal to zero)**

# F-test

- An ***F*-test** is any statistical test in which the test statistic has an *F*-distribution under the null hypothesis. It is most often used when comparing statistical models that have been fitted to a data set, in order to identify the model that best fits the population from which the data were sampled.
- Exact "*F*-tests" mainly arise when the models have been fitted to the data using least squares. The name was coined by George W. Snedecor, in honour of Sir Ronald A. Fisher. Fisher initially developed the statistic as the variance ratio in the 1920s.[1]

# F- test

- The ***F*-distribution** arises in tests of hypotheses concerning whether or not two population variances are equal and concerning whether or not three or more population means are equal.
- F Test to Compare Two Variances
- A **Statistical F Test** uses an F Statistic to compare two variances, $s_1$ and $s_2$, by dividing them. The result is always a positive number (because variances are always positive). The equation for comparing two variances with the f-test is:
  $F = s^2_1 / s^2_2$

# References


- https://www.slideshare.net/shakehandwithlife/hypothesis-testing-z-test-ttest-ftest
- https://www.slideshare.net/shakehandwithlife/hypothesis-testing-z-test-ttest-ftest
- https://www.slideshare.net/parth241989/chi-square-test-16093013