Hypothesis Testing Part I

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Parametric Tests

- Powerful tests
- Used if basic assumptions met.
- Assumptions based on nature of the population distribution & type of scales used to quantify data observations

Assumptions of parametric tests

- The observations are independent. The selection of one case is not dependent on the selection of any other case.
- The samples have equal or nearly equal variances. The condition is particularly important to determine in case of small samples.
- The variables expressed in interval or ratio scales. Nominal & ordinal measures not qualify for parametric tests
- E.g. t test, Pearson correlation test

t test

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

where $\bar{X}_1$ = mean of experimental sample

$\bar{X}_2$ = mean of control sample

N_1 = number of cases in experimental sample

N_2 = number of cases in control sample

S_1^2 = variance of experimental sample

S_2^2 = variance of control sample

Non Parametric Test

- Non-parametric tests are “distribution-free”.
- The nonparametric test is defined as the hypothesis test which is not based on underlying assumptions, i.e. it does not require population’s distribution to be denoted by specific parameters.
- They do not assume that the scores under analysis are drawn from a population distributed in a certain way, e.g., from a normally distributed population.
- The test is mainly based on differences in medians. Hence, it is alternately known as the distribution-free test.
- The test assumes that the variables are measured on a nominal or ordinal level. It is used when the independent variables are non-metric.
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BASIS FOR COMPARISON	PARAMETRIC TEST	NONPARAMETRIC TEST
Meaning	A statistical test, in which specific assumptions are made about the population parameter is known as parametric test.	A statistical test used in which population distribution does not require to be denoted by specific parameter; assumption is made about case of non-metric independent variables, is called non-parametric test.
Basis of test statistic	Distribution	Arbitrary
Measurement level	Interval or ratio	Nominal or ordinal
Measure of central tendency	Mean	Median
Information about population	Completely known	Unavailable
Applicability	Variables	Variables and Attributes
test	t test, Pearson correlation test	Chi square, Spearman correlation test, Mann Whitney

Chi Square Test

Chi-Square Test Formula

The chi-squared test is done to check if there is any difference between the observed value and expected value. The formula for chi-square can be written as;

$$X^2 = \sum \frac{(Observed\ Value - Expected\ Value)^2}{Expected\ Value}$$

The Null Hypothesis

- No significant difference or relationship between two or more parameters.
- Concerned with a judgment that apparent differences between parameters are true or result of sampling error
- In an experimental study it is hypothesized that there is difference between means of control and experimental groups due to sampling error.
- For statistical purposes null hypothesis/ no difference hypothesis is formed. There is no difference between mean achievements of experimental and control group.
- If differences found, the alternative hypothesis takes place of null hypothesis.

NULL HYPOTHESIS PROVIDES STRONGER TEST OF LOGIC

- Testing null hypothesis provides stronger test of logic.
- For a positive hypothesis, there may be equally plausible and competing hypothesis. e.g. Mean achievement of control group is higher than mean achievement of Experimental group or vice versa.
- Explain taking an example

Level of Significance

- The rejection or acceptance of null hypothesis is based on some level of significance as criterion
- 5% (.05) or α level of significance used as criterion to accept or reject hypothesis.
- Explain meaning of 5% level of significance
- More rigorous level is 1% (.01) level.
- Explain 0.01 level

Comparing Mean of Experimental & Control groups

Experimental Group	Control Group
$N_1 = 32$	$N_2 = 34$
$\overline{X_1} = 87.43$	$\overline{X_2} = 82.58$
$S_1^2 = 39.40$	$S_2^2 = 40.80$

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_1^2}{N_2}}} = \frac{87.43 - 82.58}{\sqrt{\frac{39.40}{32} + \frac{40.80}{34}}}$$

$$t = \frac{4.85}{\sqrt{1.23 + 1.20}} = \frac{4.85}{\sqrt{2.43}} = \frac{4.85}{1.56} = 3.11$$

- In a large sample (more than 30) t critical value approaches z score. If z value equals or exceeds 1.96, difference between means significant at 0.05 level. If z value exceeds 2.58, difference significant at 0.01 level
- Explain significance in the above t= 3.11

Decision Making

- To take decision for accepting or rejecting hypothesis, there are 4 possible outcomes:
- 1. Reject null hypothesis when it is false- correct decision (Method A ≠ Method B) correct decision
- 2. Not reject null hypothesis when it is true (Method A = Method B) correct decision
- 3. Reject null hypothesis when it is true (Method A = Method B) wrong decision
- 4. Not reject null hypothesis when it is false (Method A ≠ Method B) wrong decision

ISSUES TO BE DISCUSSED IN THE NEXT PART

- Type I & Type II Errors
- One tailed test & two tailed test of significance
- Degrees of freedom

THNK YOU

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