Inferential Statistics:
Hypothesis Testing

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References

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Learning Objectives

At the end of this presentation we should be able to

- **LO1:**Give real-life scenario problem to be solved by Statistics
- **LO2:**Classify statistical analysis methods with its purpose
- **LO3:**Define the process of hypotheses testing
- **LO5:**List standard test used in hypotheses test
- **LO4:**Make decision using hypotheses testing

Key Concept(s) to be covered

- Statistical measures
- Statistical analysis methods
- Hypotheses testing

Need for performing statistical analysis

Need for performing statistical analysis of experimental observations

- no proper sampling procedures and design of experiments
- don't know entire sample space and parameters of distribution
- want to derive conclusion form finite sample (observation) set
- sample set is assumed to be representative of entire s-space

Important terms

- Population: set of all possible outcomes
- Sample set: finite set of observations in an experiment
- Inference: conclusion derived regarding population s-set

Statistical Analysis

Descriptive Statistics

- Graphical: Organizing and presenting the data
  - Example: histogram, box plot, probability plot
- Numerical: Summarizing the sample set
  - Example: mean, median, mode, range, quartile, variance, standard deviation

Inferential Statistics

- Estimation: Estimate parameters of the pdf along with its confidence region
- Hypotheses testing: Making judgements about f(x) and its parameters

Descriptive Statistics

Descriptive Statistics: Numerical

- Numerical: Summarizing the sample set

Descriptive Statistics: Graphical

- Graphical: Organizing and presenting the data

Motivation for Hypotheses Testing

Motivation for Hypotheses Testing

- Social case: Are women more likely to change the mobile service provider than men?
- Medical case: Is the incidence of diabetes greater among males than females?
- Engineering case: Has the performance of HDD decreases from its original value due to # write operations?
- Business case: Will an investment in mutual fund yield annual returns greater than desired value?

Hypotheses Testing

A statement or postulate about the parameters of a distribution

- Null Hypothesis (H_0): default postulate (rejected if s-set provide sufficient evidence)
- Alternate Hypothesis($H_1 0 or H_a$): accepted if the H_0 is rejected

Procedure in Hypotheses Testing

- Identify parameter of interest which we wish to test
- State the null and alternative hypotheses
- Choose kind of test need to perform
- Find test statistics (is a function of the s-set of observations)
- Choose test criterion (threshold)
- Compare the t-statistics to reject or accept the null hypothesis

Types of Hypotheses Test

No hypotheses test is perfect. Test performance depends on

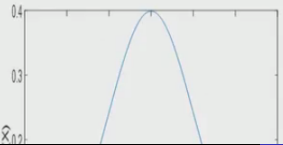
- Extent of variability in data
- Sample size (# of observations)
- Test statistics (function of observations)
- Threshold (test criterion)

- Two sided test

$H_0: \mu = 0$

$H_1: \mu \neq 0$

- Test statistic standard normal RV z



- One sided test

$H_0: \mu = 0$

$H_1: \mu > 0$

- Test statistic standard normal RV z

Error in Hypotheses Testing

Two types of error

- Typically the Type 1 error probability is controlled
- Test statistics (function of observations)
- Controlled by choosing the criterion (Threshold) from distribution of test statistic

Decision → / Truth ↓	H_0 is not rejected	H_0 is rejected
H_0 is true	Correct Decision Pr = 1 - α	Type I error Pr = α
H_1 is true	Type II error Pr = β	Correct Decision Pr = 1 - β

Hypotheses Testing: How?

Graphical: Organizing and presenting the data

Justify why the above is an active learning strategy

Active Learning Strategy: Think-Pair-Share

- They are required to think deeply about the content they were familiarized in out-of-class and do higher order thinking.
- Students are actively engaged in classroom by discussing their answer with their neighbour.
- Students learn from each other.
- Students tackle large and ill-structured problems.
- Students are able to consider multiple points of view.
- Feedback is provided either through peer discussion or Teacher summary.

Thank You.