

Probability & Statistics (MS-301)

Software Engineering

Lecture # 1 (Statistics)

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COURSE INFORMATION SHEET

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| Course Code | : | MS-301 |
| Course Title | : | Probability and Statistics |
| Credit Hours | : | 3+0 |
| Prerequisites | : | MS-103: Calculus & Analytical Geometry |
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COURSE OUTLINE :

Descriptive Statistics: Basic definitions, measures of central tendency and variation, z-scores, frequency distribution, graphical representation of data, symmetry and skewness, quintiles (percentiles, deciles and quartiles).

Regression and correlation: Linear regression models and correlation coefficient.

Probability theory: Basic definitions and rules of probability, conditional probability, counting techniques.

Random variable: Concept of random variable, discrete and continuous random variable.

Discrete and continuous probability distributions: Uniform, binomial, multinomial, negative binomial, geometric, Poisson, Normal; normal approximation and exponential distributions and their applications.

Statistical inference: Estimation of parameters such as mean and variance.

Sampling theory: Sampling distribution of mean, t-distribution and sampling procedures.

Hypothesis testing: z-test, t-test and goodness of fit test.

COURSE LEARNING OUTCOMES (CLOs):

Upon completion of this course, students will be able to:

| CLO # | CLO Statement | Bloom's Taxonomy (Maximum level) |
|--------------|--|---|
| CLO-1 | Understanding the concept of group and ungroup descriptive statistics, correlation and regression. Analyze and apply these concepts on real life problems | C4 (Analyzing) |
| CLO-2 | Understanding the concept of probability, random variables, probability distribution functions (discrete and continuous) and probability distributions (discrete and continuous). Evaluating and applying these concepts to real life problems | C5 (Evaluating) |
| CLO-3 | Compute hypothesis, sampling and testing for understanding real life and engineering problems | C3 (Applying) |

COURSE PLAN



| Week # | Date | Course plan | Recommended Reading | Assessment Tools |
|---------------|-------------|---|----------------------------|-------------------------|
| Week 1 | | Introduction to Statistics: Basic definitions, Classification of data, frequency distribution. | | |
| | | Construction of frequency distribution table | Notes will be provided | |
| | | Graphical Representation: Histogram, Bar chat, Multiple bar chart, Polygon, Ogive, Pie chart, Stem and Leaf, and dot plot | *1.2 Page 24 | |
| Week 2 | | Measures of Central Tendency (Group and Ungroup Data): Mean, Mode, Median (ungroup data) | *1.3 Page 34 | |
| | | Mean, Mode, Median (group data) | 1.20-1.22 Page 31 | |
| | | Measures of Variation: Variance, Standard Deviation | 1.13-1.17 Page 30-31 | |
| Week 3 | | Deviation about mean | Notes will be provided | |
| | | Deviation about mean Median | Notes will be provided | Assignment 1 |

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| | | Quintiles (Quartiles, Deciles and Percentiles) | continued | |
| Week 4 | | Regression and Correlation: Linear Regression and Scatter diagram, Regression line. | 11.1-11.14 Page 398-399 | Quiz 1 |
| | | Correlation coefficient. | continued | |
| Week 5 | | Counting Techniques: | 11.43,11.44 Page 435 | |
| | | Multiplication rule, factorial, arrangements with and without replacements | 2.21-2.47 Page 51-52 | |
| | | Permutation and Combination. | continued | |
| Week 6 | | Probability Theory: Basic definition, axioms, Sample space, Events, types of events, relationship between events. | 2.1-2.10 Page 42-43 | |
| | | Rules of Probability: Additive rule, Conditional Probability, Multiplication rule, Baye's rule | 2.49-2.69 Page 59-61 | |
| | | Continued... | 2.73-2.94 Page 70-71 | |
| Week 7 | | Continued... | continued | Quiz 2 |
| | | Random Variable: Concept of random variable, discrete and continuous random variable | 3.1-3.4 Page 91 | |

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|---------|-----------------------------|--|---------------------------|-----------------|
| | | and continuous random variable | | |
| | | Discrete Probability Distributions functions | 3.5-3.18 Page 91-93 | |
| Week 8 | MID TERM EXAMINATION | | | |
| Week 9 | | Continuous Probability Distributions functions | continued | |
| | | Cumulative probability distribution (discrete and continuous) | 3.19-3.36 Page 93-94 | |
| | | Joint Probability Distributions (discrete) | 3.37-3.60 Page 104-105 | |
| Week 10 | | Joint Probability Distributions (continuous) | continued | Assignment 2 |
| | | Marginal and Conditional Probability Distributions | continued | |
| | | Statistical Independence | continued | |
| Week 11 | | Discrete Probability Distributions: Uniform Distribution | 5.1 Page 150 | |
| | | Binomial Distribution | 5.2-5.18 Page 150-151 | |
| | | Negative Binomial Distribution | 5.49-5.55 Page 164-165 | |

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|--------------------------|--|---|--------------------------------|-----------------|
| Week 12 | | Geometric Distributions. | continued | |
| | | Multinomial Distribution | 5.19-5.23 Page 151-152 | Quiz 3 |
| | | Poisson Distribution | 5.56-5.68 Page 165 | |
| Week 13 | | Continuous Probability Distributions: Normal Distribution | 6.4-6.17 Page 186-187 | |
| | | Continued... | continued | |
| | | Continued... | continued | |
| Week 14 | | Normal approximation to Binomial and its applications | 6.24-6.38 Page 870 & 878 | |
| | | Continued... | continued | Assignment 3 |
| | | Continued... | continued | |
| Week 15 | | Sampling Theory: Sampling Distribution, Sampling Distribution of Mean, t- Distribution | 8.17-8.30 Page 241-242 | |
| | | Sampling Distribution of Mean t- Distribution | continued | |
| | | continued | | |
| Week 16 | | Hypothesis Testing: z-test, t-test and goodness of fit | Notes will be provided | |
| | | Continued... | 12.5 Page 887-888 | |
| | | Review | | |
| FINAL EXAMINATION | | | | |

WHAT IS STATISTICS?

1.1 ORIGIN AND INTRODUCTION OF STATISTICS

The word Statistics has been derived from the Latin word "Status" or an Italian word "Statistica" both of these words mean a political state. In old days kings and queen employed a person known as statistician to maintain the record of their wealth and armaments. With the passage of time this word changes its shape and now being used as "Statistics".

1.2 WHAT STATISTICS IS?

In statistics 1st of all we collect the data regarding the field of our interest. Then to derive some conclusion from the collected data certain statistical methods are applied.

1.2.1 MEANING OF STATISTICS

Statistics is a social science and different statistician used it in different meanings. Now a days the word "Statistics" is used to convey three different meanings:-

1.3 DEFINITION OF STATISTICS

Since statistics is a social science, therefore, it does not have a unique definition. Every one have defined it in his own way.

Some says statistics is a science of counting. An other is of the views that statistics deals with estimates and probabilities. Yet an other statistician says that in statistics we play with figures. All those definitions have their own importance but they donot cover the entire scope of statistics.

After going through the above definition a complete definition given by Horace, Secrist:

"Statistics are the aggregate of facts, affected to a marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according a reasonable standard of accuracy, collected in systematic manner for a pre-determined purpose and place in comparison".

DATA

ungroup
data/
Raw data

2, 4, 8, 9, 10,
11, 13, ...

group data

data consist of two
columns

| | | | | |
|-----|---|---|---|---|
| 0-1 | 1 | 2 | 3 | 4 |
| f | 5 | 6 | 7 | 9 |

frequency ↪ f

| | | | |
|-----|-----|-----|------|
| C.I | 2-4 | 5-7 | 8-10 |
| f | 8 | 10 | 11 |

PRESENTATION OF DATA

In the last chapter, we started to discuss the stages of statistical enquiries. We have already discussed the first stage of statistical enquiry i.e. collection of data either from primary or secondary source in previous chapter. The next stage of a statistical enquiry is presentation of collected data (raw data) in a way that it will:

- (i) Point out the most significant features of the data at a glance;
- (ii) Condense the mass of data in such a manner that similarities and dissimilarities can easily be cleared;
- (iii) Facilitate comparison; and
- (iv) Provide basis for further statistical analysis.

To achieve the above mentioned objectives, we usually use the following two methods for presentation of data:

1. Classification and tabulation.
2. Graphical or diagrammatic presentation of data.

CLASSIFICATION AND TABULATION

The two separates heading "Classification" and "Tabulation" should not lead the readers to assume that these are two distinct processes. Infact, they go together, classification is the first step in tabulation. Before the data are put in tabular form they have to be classified in different classes or group having common characteristics. After this step the data are displayed under different columns and rows so that their relationship can be easily understood. For example data given in the statement of example 1 is classification of data whereas the procedure of placing given facts in form of table like that given in the solution, is tabulation.

Discrete Frequency Distribution

| Class Number | No. of Servants (Variable) | No. of Families (Frequency) |
|--------------|----------------------------|-----------------------------|
| 1 | 0 | 39 |
| 2 | 1 | 20 |
| 3 | 2 | 6 |
| 4 | 3 | 4 |
| 5 | 4 | 1 |
| Total | — | 70 |

Continuous Frequency Distribution

| Class Number | Height (inches) (Variable) | No. of Students (Frequency) |
|--------------|----------------------------|-----------------------------|
| 1 | 60 – 63 | 10 |
| 2 | 63 – 66 | 16 |
| 3 | 66 – 69 | 14 |
| 4 | 69 – 72 | 7 |
| 5 | 72 – 75 | 3 |
| Total | — | 50 |

Questions?

