**Course title: Introduction to Statistics for Chemistry Students**

**Course code: Stat 270**

**Credit hours: 3**

**Contact Hours: Lecture 3 hours per week, Tutorial 2 hours per week**

**Pre-requisite:**

**Course description**

Meaning of statistics; Methods of data collection; Methods of data presentation; Measures of location; Measures of variation; Moments, skewness and kurtosis; Counting Techniques; Concepts of Probability (classical approach); Probability distributions: Binomial, Poisson, Normal, t and Chi-square; Sampling and Sampling Distribution of the mean and proportion; Elementary description of the tools of statistical inference: Basic concepts; Estimation: (Point and Interval) for the population mean and proportion; Hypothesis testing on the population mean and proportion; Chi-square test of association. Each topic should begin with motivating examples.

**Objectives**

* to introduce students the basic statistical knowledge on data collection and presentation methods, Measures of Central Tendency and Variation, probability and probability distributions, one sample inference, regression and correlation;
* introduces the basic concepts of statistical thinking and reasoning;
* to enable students apply the methods of statistics in scientific research, decision making and future career;
* to demonstrate the importance and practical usefulness of probability in real life;
* to show how probability is a necessary foundation for understanding statistics;
* to demonstrate the importance and usefulness of statistics in real life and on real data;
* to show how to present data informatively and clearly;
* to equip students to apply probability and statistical methods to solve standard problems from a wide range of disciplines;
* to give students an appreciation of the limitations of these standard techniques;
* to enable students to communicate the results of their analyses in clear non-technical language;

**Learning outcomes**

At the end of the course students are expected to:

* have a broad knowledge of the basic understanding of statistical techniques demonstrated through principles of data collection, descriptive statistics, probability, probability and sampling distributions, statistical inference and linear regression.
* understand the methods of data collection, organization, presentation, analysis and interpretation;
* know what is meant by sample space, event, relative frequency, probability, conditional probability, independence, random variable, probability distribution, probability density function, expected value and variance;
* be familiar with some standard discrete and continuous probability distributions;
* be able to use standard statistical tables for the Normal t, chi-square distributions;
* be able to differentiate between common types of data, and display them appropriately;
* learn some desirable properties of point estimators;
* recognize the additional benefits of calculating interval estimates for unknown parameters;
* understand the framework of hypothesis testing for carrying out statistical inference;
* be able to produce and interpret interval estimates and tests of hypotheses correctly in some simple cases;
* be able to present their results correctly and in non-technical language;
* have basic skills in exploratory data analysis.

**Course Outline**

* + - 1. **Introduction (3 lecture hours)**
  1. Definition and classification of Statistics
  2. Stages in statistical investigation
  3. Definition of Some Basic terms
  4. Applications, uses and limitations of Statistics
  5. Types of variables and measurement scales
     + 1. **Methods of Data Collection and Presentation (4 lecture hours)**
  6. Methods of data collection

2.1.1 Sources of data

2.1.2 Methods of collection

* 1. Methods of Data Presentation

2.2.1 Motivating examples

* + 1. Frequency Distributions: qualitative, quantitative: absolute, relative and

Percentage.

* + 1. Tabular presentation of data
    2. Diagrammatic presentation of data: Bar charts, Pie-chart, Cartograms
    3. Graphical presentation of data: Histogram, and Frequency Polygon
       1. **Measures of Central Tendency (5 lecture hours)**
  1. Motivating example
  2. Objectives of measures of central tendency
  3. Summation notation
  4. Important Characteristics of a good average
  5. Mean

3.5.1.Arithmetic Mean

3.5.2.Geometric Mean

3.5.3.Harmonic Mean

3.6 Median

3.7 Mode

* + - 1. **Measures of variation (Dispersion), Skewness and Kurtosis (5 lecture hours)**
  1. Motivating examples
  2. Objectives of measures of central tendency
  3. Measures of Dispersion (Variation)
     1. Range
     2. Variance, Standard Deviation and coefficient of variation
     3. Standard scores
  4. Moments
  5. Skewness
  6. Kurtosis
     + 1. **Elementary Probability (5 lecture hours)**
  7. Introduction
  8. Definition & some concepts (Experiment, sample, event, equally likely outcomes, mutually exclusive events, independent events)
  9. Random experiments
  10. Counting rules: addition, multiplication rules, permutation and combination
  11. Definitions of probability (probability of an event)
  12. Some rules of probability
      + 1. **Probability Distributions (7 lecture hours)**
  13. Definition of random variables (discrete and continuous) and probability distributions
  14. Introduction to expectation: mean and variance of random variable
  15. Common discrete distributions: binomial and Poisson
  16. Common continuous distributions: Normal, t, and chi-square distribution
      + 1. **Sampling and Sampling Distributions of the Mean (3 lecture hours)**
  17. Basic concepts (population, sample, parameter, statistic, sampling frame,

Sampling unit, sampling error, sample size)

* 1. Reasons for Sampling
  2. Different types of Sampling (Probability vs Non probability Sampling Techniques)
  3. Simple random sampling (lottery method, table or computer generated random numbers)
  4. Sampling distribution of the sample mean and proportion
  5. Central limit theorem
     + 1. **Estimation and Hypothesis Testing (10 lecture hours)**

8.1 Estimation

8.1.1 Motivating examples

8.1.2 Point estimation: mean and proportion

8.1.3 Interval estimation: mean and proportion

8.2 Hypothesis Testing

8.2.1 Motivating examples

8.2.2 Important concepts in testing a statistical hypothesis

8.2.3 Steps in testing a hypothesis

8.2.4 Hypothesis testing about the population mean

8.2.5 Hypothesis testing about the population proportion

8.2.6 Chi-square test of association

* + - 1. **Simple Linear Regression and Correlation (6 lecture hours)**
  1. Motivating examples
  2. Introduction: regression and correlation
  3. Simple Linear Regression

9.4 Correlation Coefficient

**Textbook**

Bluman, A.G. (1995). Elementary Statistics: A Step by Step Approach (2nd edition). Wm. C. Brown Communications, Inc.

**References**

1. Coolidge, F.L.(2006). Statistics: A Gentle Introduction (2nd edition).
2. David, S.M., McCabe, P. and Craig, B. (2008). Introduction to the Practice of Statistics (6th edition). W.H. Freeman.
3. Eshetu Wencheko (2000). Introduction to Statistics. Addis Ababa University Press.
4. Freund, J.E and Simon, G.A. (1998). Modern Elementary Statistics (9th Edition).
5. Gupta, C.B. and Gupta, V. (2004). An Introduction to Statistical Methods. Vikas

Publishing House, Pvt. Ltd, India.

1. Snedecor, G.W and Cochran, W.G. (1980). Statistical Methods (7th edition).
2. Spiegel, M.R. and Stephens, L.J. (2007). Schaum's Outline of Statistics, Schaum's Outline Series (4th edition). McGraw-Hill.
3. Woodbury, G. (2001). Introduction to Statistics. Duxbury press.

**Teaching and learning methods**

Lectures, tutorials, discussions, demonstration and assignments.

**Modes of Assessment**

Two or more tests and assignments 20%

Mid Semester Examination 30%

Final Examination 50%

Total 100%