## MATH 241: PROBABILITY AND STATISTICS I (L/P 45/0; CF 3.0)

Course Purpose

The purpose of this course unit is to enable learners to apply probability and statistics skills in management and decision making.

**Learning Objectives**

1. Discuss the axioms of univariate probability distribution functions
2. Identify different types of discrete and continuous random variables.
3. Explore the impact of expectations on decision-making and statistical modeling
4. Construct confidence intervals for population parameters
5. Carry out hypothesis testing
6. Apply hypothesis testing techniques to practical situations

Expected Learning Outcomes

By the end of this course unit, the learner should be able to:

1. Discuss the axioms of in univariate probability distribution functions and their practical implications.
2. Distinguish between different types of discrete and continuous random variables in data sets and solve related problems
3. Explore the impact of expectations on decision-making and statistical modeling.
4. Construct and interpret confidence intervals for population parameters using sample data.
5. Relate hypothesis testing to real-world scenarios, such as medical trials or quality control.
6. Appreciate the importance of probability distributions (normal, t-, and chi-square) in solving real-world scientific research problems and decision-making.

Course Content

Random variable and probability distributions. Moments and moment generating functions. Statistical Independence of random variables. Confidence intervals for population parameter. Special univariate distributions; discrete and continuous cases. Expectations and variances of special univariate distributions. Approximations of univariate distributions. Applications of univariate distributions.

Teaching and Learning Methods

Lectures, Tutorials, Blended Learning (Online Educational Materials with Face-To-Face Instruction), Computer Assisted Instruction), Question/ Answer Approach, Project-Based Approaches, Group Discussions & Assignments, Presentations, Cooperative Learning, Case Studies and Experiential Learning Where Applicable.

Instructional Materials and Equipment

Overhead Projector, Power Point, Hand-Outs, Charts, Felt Pens, Computer Laboratories, Computers, Learning Resource Centre, and Core Reading Resources.

**Course Assessment**

CATs and Assignments 40%, Final examinations 60%, Total marks 100%

References

Foadoddini, M., & Mofrad, S. A. (2020). Effect of Aloe vera extract on depression in people with prediabetes. *Modern Care Journal*, *17*(2). <https://doi.org/10.5812/modernc.100927>

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## MATH 242: PROBABILITY AND STATISTICS II (45/0 C.F.3.0)

**COURSE PURPOSE**

To enable learners to apply the knowledge of getting probability distribution and problem solving and statistical decision making.

Learning objectives

1. Discuss bivariate probability distributions and their relevance:
2. Recognize statistical independence and implications in bivariate data analysis.
3. Explore conditional expectations in decision-making and prediction.
4. Comprehend cumulative distribution functions (CDFs) and transformations concepts.
5. Construct probability distributions from the normal distribution family.
6. Solve bivariate normal distribution problems

**Expected learning outcomes**

By the end of the course, the learner should be able to

1. Understand bivariate probability distributions functions of random variables, bivariate expectations, and characteristic functions and explore their relevance in statistical theory and applications in studying the relationships between random variables.
2. Promote an understanding statistical independence and its implications in bivariate data analysis.
3. Identify the importance of conditional expectations and their role in decision-making and prediction.
4. Explore techniques such as cumulative distribution functions (CDFs) and transformations.
5. Construct probability distributions arising from the normal distribution family, including the Chi-square, t-distribution, and F-distribution and to solve related problems.
6. Appreciate the importance of bivariate normal distribution in solving real world problems.

**Course content**

1. BIVARIATE PROBABILITY DISTRIBUTIONS

* Joint probability distributions (J.p.d.f) and Joint cumulative probability distributions(J.c.d.f)
* Marginal distribution functions
* Conditional distribution functions
* Statistical independence

1. BIVARIATE EXPECTATIONS

* Bivariate moments, covariance and correlation
* Conditional expectation and variance
* Joint moment generating functions

1. DISTRIBUTION FUNCTIONS OF RANDOM VARIABLES

* CDF Technique
* Method based on transformation of variables
* Method based on moment generating functions

1. DISTRIBUTIONS ARISING FROM NORMAL DISTRIBUTION

* The Chi-square distribution
* The t-distribution
* The F- distribution

1. CHARACTERISTIC FUNCTIONS

* Discrete and Continuous cases
* Mean and variance applying characteristics function
* Applications in univariate discrete and continuous distributions

1. BIVARIATE NORMAL DISTRIBUTION

* Density function
* Marginal and conditional densities
* Stochastic independence

1. LIMITING DISTRIBUTION THEORY

* Limit theory
* Convergence theorem

Teaching and Learning Methods

Lectures, Tutorials, Blended Learning (Online Educational Materials with Face-To-Face Instruction), Computer Assisted Instruction), Question/ Answer Approach, Project-Based Approaches, Group Discussions & Assignments, Presentations, Cooperative Learning, Case Studies and Experiential Learning Where Applicable.

Instructional Materials and Equipment

Overhead Projector, Power Point, Hand-Outs, Charts, Felt Pens, Computer Laboratories, Computers, Learning Resource Centre, and Core Reading Resources.

**Course Assessment**

CATs and Assignments 40%, Final examinations 60%, Total marks 100%

**References**

Abebe, T. H. (2019). The Derivation and choice of appropriate test statistic (z, t, f and chi-square test) in research methodology. *J. Math. Lett*, *5*(3), 33-40. <https://doi.org/10.11648/j.ml.20190503.11>

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## MATH 341: SAMPLING METHODS I (L/P 45/0; CF 3.0)

Course Purpose

The purpose of this course is to help learners design effective surveys, estimate population parameters, and make informed decisions based on sampled data..

Learning objectives

1. Discuss the importance of sampling methods.
2. Identify sources of errors in surveys
3. Explore sample size determination techniques
4. Construct sampling designs.
5. Appreciate statistical approximation and accuracy assessment

Expected Learning Outcomes

By the end of this course, the learner should be able to:

1. Discuss the importance of sampling methods and how sampling impacts data quality and statistical inference.
2. Identify sources of errors in surveys (sampling bias, non-response, measurement error, etc.) and understand their impact on data quality and survey results.
3. Explore adequate sample size determination techniques to ensure reliable statistical inference.
4. Construct sampling designs using methods like simple random sampling, stratified random sampling, and systematic selection.
5. Value the role of statistical approximation and accuracy assessment in solving mathematical and scientific problems.

Course Content

General principles of a sample survey, Sources of errors in survey, Confidence interval, Simple size determination, Sampling techniques; Simple random sampling; with replacement and without replacement. stratified random sampling; proportional and optimal allocations. Systematic sampling. Sampling theory. Sample selection with probability proportional to size. Modern sampling techniques and applications.

Teaching and Learning Methods

Lectures, Tutorials, Blended Learning (Online Educational Materials with Face-To-Face Instruction), Computer Assisted Instruction), Question/ Answer Approach, Project-Based Approaches, Group Discussions & Assignments, Presentations, Cooperative Learning, Case Studies and Experiential Learning Where Applicable.

Instructional Materials and Equipment

Overhead Projector, Power Point, Hand-Outs, Charts, Felt Pens, Computer Laboratories, Computers, Learning Resource Centre, and Core Reading Resources.

**Course Assessment**

CATs and Assignments 40%, Final examinations 60%, Total marks 100%

**References**

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