

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

CBE 508 PROBABILITY AND STATISTICS FOR BIOTECHNOLOGY

INSTRUCTOR: Dr. Wen K. Shieh

TEXTBOOK: The course materials will be posted on Canvas. The following textbook is recommended as a reference book: *Engineering Statistics* (5th Edition, 2011) by D.C. Montgomery, G.C. Runger, and N.F. Hubele, John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012.

SYLLABUS: CBE 508 covers topics in probability and statistics. In addition to the course materials, lecture notes that are prepared using materials from various sources will be used. This course will emphasize the applications of probability theories and statistical techniques to practical problems relevant to the subject areas of biotechnology. However, mathematical derivations of theorems will be presented whenever it is necessary to illustrate the concepts involved.

INTRODUCTION

PROBABILITY THEORY

- ☐ Definition and Terminology.
- ☐ Discrete and Continuous Sample Spaces.
- ☐ Axioms of Probability.
- ☐ Conditional Probability and Bayes' Theorem.
- ☐ Independence, Independent Events, and System Reliability.
- ☐ Counting Techniques (Permutations & Combinations).
- ☐ Combinatorial Probability.
- ☐ Random Variables (Discrete and Continuous).
- ☐ Discrete and Continuous Probability Functions.
- ☐ Expected Values and Variances.
- ☐ Properties of Expected Values and Variances
- ☐ Binomial Random Variable.
- ☐ Hypergeometric Random Variable.
- ☐ Poisson Random Variable.
- ☐ Exponential Random Variable.
- ☐ Normal Random Variable.
- ☐ Moment-Generating Functions (MGFs).
- ☐ Sum of Independent Random Variables.

DESCRIPTIVE STATISTICS

- ☐ Random Sample of Size n .
- ☐ Central Limit Theorem (CLT).
- ☐ Order Statistics (Discrete Case) - Time Series Plots and Plotting-Position Plots (Probability Plots).

- ☐ Stem-and-Leaf Diagrams.
- ☐ Unbiased Estimators.
- ☐ Student's t -Distribution, the χ^2 (Chi-Square) Distribution, and the F Distribution.

MATHEMATICAL STATISTICS

- ☐ Rejection of Outliers.
- ☐ Maximum Likelihood Estimations.
- ☐ Level of Significance and Level of Confidence.
- ☐ Interval Estimations.
- ☐ Hypothesis Testings and Decision Making.
- ☐ Type I and II Errors.
- ☐ Hypothesis Testings on Single Mean and Variance.
- ☐ Comparison of Variances and their Properties.
- ☐ Comparison of Means (Independent Populations and Pair Data) .
- ☐ Goodness-of-Fit Tests.
- ☐ Contingency Tables.
- ☐ Analysis of Variance (ANOVA) – Single Factor Design.
- ☐ Regression Analyses and Correlations.
- ☐ Hazard Rate and Lifetime Testing.
- ☐ Statistical Quality Control (Control Chart and Acceptance Sampling).
- ☐ Non-Parametric Estimations.
- ☐ Interval Estimations Based on Percentile Values.

RULES:

- ☐ Submit each homework assignment in class on the due date. **Late homework assignments will not be accepted unless the permission is obtained from the instructor.**
- ☐ In all homework assignments submitted for this course, please show how all answers are developed.
- ☐ Read the course materials and class notes **before** class lectures.

GRADES:

- ☐ Homework: 20%.
- ☐ Examinations: 40% (1st) and 40% (2nd).
- ☐ Total: 100%.