STAT 4150 STATISTICAL INFERENCE AND MODELLING (3 credit hours)

Elmira College

SPRING 2025

Required Text:
Freund, R. J., Wilson, W. J., & Mohr, D. L. (2010), ***Statistical Methods***, 3rd Edition, Elsevier.
James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013), ***An Introduction to Statistical Learning: with Applications in R***, 1st Edition, Springer.

Pre-requisites: STAT 1100 Introduction to Statistics

Course Description
This course serves as an introductory exploration into the fundamental principles and applications of statistics, designed to equip students with essential skills for analyzing and interpreting data. The course covers a range of core topics, including descriptive statistics, probability theory, and basic inferential statistics. A significant portion of the course is dedicated to inferential statistics, where students will be introduced to methods for making inferences about populations based on sample data. This includes hypothesis testing, confidence intervals, and the interpretation of p-values. Students will learn how to conduct hypothesis tests for means and proportions, understand Type I and Type II errors, and apply these concepts to real-world scenarios.

Course Objectives and Goals

- Summarize data using appropriate graphical displays (e.g., histograms, box plots) and numerical measures (e.g., mean, median, standard deviation);
- Understand and apply the concepts of random variables, probability distributions;
- Perform hypothesis testing for population means and proportions, including selecting the appropriate test statistic and interpreting p-value;
- Interpret the results of regression models, including the slope, intercept, and coefficient of determination;
- Recognize the importance of statistics in various fields, including science, engineering, social sciences, and business.

Evaluation of Performance
Your grade will be based upon your performance on exams, assignments, and participation.

6 Assignments	20%
2 Quizzes	15%
8 Labs	15%
2 Project and Reports	20%
Midterm Exam	10%

Final Exam	20%
Total	100%

Grades will be assigned as follows:

A	93% and above	B-	80 - 82%	D+	67 - 69%
A-	90 - 92%	C+	77 - 79%	D	63 - 66%
B+	87 - 89%	C	73 - 76%	D-	60 - 62%
B	83 - 86%	C-	70 - 72%	F	59% or below

Withdrawal Policy: Please see Elmira College Bulletin for information on this policy.

Academic Honesty: Please read the section on Academic Honesty in the **Code of Conduct**. Briefly, academic dishonesty includes: cheating, fabrication, facilitating academic dishonesty, and plagiarism. Ask if you have any questions on whether something constitutes as academic dishonesty. All work must be original and new. Past assignments from current or other courses will not be accepted. Academic dishonesty will not be tolerated. It will result in zero on the assignment, and a report will be filed with the school. Continued practice will result in failure of the class. Institutional penalties may also apply with repeated acts of academic honesty.

Student Responsibility:

- It is your responsibility to keep track of assignments and due dates.
- You should ask questions concerning assignments and lectures, if you need any clarifications.
- If you are struggling in class, have concerns, and/or unsure about expectations, please stop by during office hours or make an appointment for another time.

Tentative Schedule of Topics

Topic	Materials	Tasks & Evaluations
Course Overview and Motivating Examples	Chapter 1	
Basic Statistical Concepts	Chapter 2	Assignment 1
Hypothesis Testing and Confidence Intervals	Chapter 3	Lab 1
Types of Errors	Chapter 4	
Random Variables and Probability Distributions	Chapter 5	Assignment 2
Expectation, Variance, and Covariance	Chapter 6	
Common Probability Distributions	Chapter 7	Lab 2
Joint and Conditional Distributions	Chapter 8	
Sampling Distributions and Central Limit	Chapter 9	Assignment 3
Theorem	Chapter 10	
Simple Linear Regression	Chapter 11	Quiz 1
Multiple Linear Regression	Chapter 12	Lab 3
Model Selection and Validation	Chapter 13	
Virtue Ethics and Eudaimonia	Chapter 14	Lab 4
Diagnostics for Linear Models	Chapter 15	
Structure and Principles of GLMs	Chapter 16	Project and Report 1
Logistic Regression for Binary Data	Chapter 17	Midterm Exam

Poisson Regression for Count Data	Chapter 18	
Model Fitting and Interpretation	Chapter 19	Assignment 4
Categorical Data Analysis	Chapter 20	Lab 5
Analysis of Variance (ANOVA)	Chapter 21	
Nonlinear Regression Models	Chapter 22	Assignment 5
Time Series Analysis and Forecasting	Chapter 23	
Bayesian Linear Models	Chapter 24	Lab 6
Bayesian GLMs and Hierarchical Models	Chapter 25	
Markov Chain Monte Carlo (MCMC) Methods	Chapter 26	Assignment 6
R Programming	Chapter 27	
Data Manipulation and Visualization in R	Chapter 28	Quiz 2
Simulation Studies and Resampling Methods	Chapter 29	Lab 7
Optimization Techniques and Numerical Methods	Chapter 30	
High-Performance Computing in R	Chapter 31	Lab 8
Survival Analysis	Chapter 32	
Machine Learning and Statistical Models	Chapter 33	Project and Report 2
Real-World Data Analysis Projects	Chapter 34	Final Exam