MATH 321: Mathematical Statistics

Spring 2024, Ball State University

Course Information (MATH 321-1)

Class:	MTRF 11:00 - 11:50 AM, Robert Bell 115
Instructor:	Colton Gearhart (email: colton.gearhart@bsu.edu) You can expect a response to emails within 24 - 48 hours
Office Hours:	MF 1:00 - 2:00 PM or by appointment, Office RB 411 **Please make appointment for office hours**

Course Materials

Textbook:	Probability and Statistical Inference, 10th ed., Hogg, Tanis, and Zimmerman, Pearson 2020 (Recommended)
Calculator:	TI-30XS MultiView or TI-84 Graphing Calculator
Course Website	Assignments, solutions and some other class materials will be posted on Canvas

Course Description

Random sampling, statistical inference, and sampling distributions, point and interval estimation, matching moments, maximum likelihood, mean square error, consistency, efficiency, uniformly minimum-variance unbiased estimator (UMVUE), Neyman-Pearson Lemma, Likelihood ratio tests, classical tests of significance, goodness-of-fit, contingency tables, correlation, regression, nonparametric methods, Bayesian methods.

Prerequisites: C- or better in MATH 320 or permission of the department chairperson.
4 Credit hours (4 Lecture hours).

Course Objectives

Students will become familiar with both the theory and applications of the three steps a statistician faces - model selection, model verification, and model interpretation. Students will practice selecting the appropriate model to fit a real-life problem. Students will analyze and evaluate the reasonableness of the model. Students will draw appropriate conclusions from the model to solve the proposed problem.

Course Rationale

Mathematical statistics is the study of how to deal with data by means of probability models. It grew out of methods for treating data that were obtained by some repetitive operation such as those encountered in games of chance and in industrial processes. These methods soon found application in such diverse fields as medical research, insurance, marketing, agriculture, chemistry, and in industrial experimentation. This course is, therefore, a required course for statistics and actuarial science majors and is an excellent course for those who may need in their work statistical methods at a reasonably sophisticated level.

Course Content

The following is a list of subjects to be taught in the course given sufficient time:

1. Estimation

   Maximum Likelihood Estimation, Properties of Estimators, Confidence Intervals for Means, Confidence Intervals for Variances, Confidence Intervals for Proportions, Sample Size, Sufficient Statistics, Chebyshev's Inequality.

2. Tests of Statistical Hypotheses

   Critical Region, Type I and type II Errors, Power, Best Critical Regions, Neyman-Pearson Theorem, Likelihood Ratio Tests, Tests About Means and Proportions, Test About Variance, Tests About Difference of Means.

3. Nonparametric Methods

   Order Statistics, Confidence Intervals for Percentiles, Binomial Tests for Percentiles, Wilcoxon Test, Two-Sample Distribution-Free Tests, Chi-square Tests for Models, Testing Probabilistic Models, Comparisons of Several Distributions, Contingency Tables.

4. Linear Statistical Models

   Simple Regression, Tests of Equality of Means, Two-Factor Analysis of Variance.

5. Bayesian Decision Theory

   Compound distributions, Decision Theory, Bayesian Methods.

In-Class Activities

Throughout the semester, there will be in-class activities worth a total of 15% of your grade. The lowest score of these activities will be dropped. The in-class tasks will be mainly designed to practice what you studied recently.

If you miss class when there is an in-class activity, you will receive a zero unless there is a legitimate reason pre-approved by me.

Homework

Homework assignments will account for 20% of the course grade.

- The lowest homework assignment score will be dropped.
- Any assignment turned in within one week after the deadline may be given a 50% grade reduction. After that, it will not be accepted. An exception to this reduction policy will be considered for legitimate circumstances that are presented to me (via e-mail or in person) *before the due date*.
- Submissions must be neat and stapled.
- Unorganized and/or illegible work will be considered incorrect.

Collaboration: Feel free to work together, but the work you turn in should be your own. For example, if you solve a problem with a friend and the two of you write down identical solutions, you both will be in violation of this policy. Instead, after solving the problem together, you might re-solve it on your own so that it is evident the work is yours. If your work is not clearly independent of others', a score of 0 may be awarded for the entire offending assignment.

Requesting help: The homework is essential to success in this class because it forms the foundation of knowledge and problem-solving skill upon which exam success can be built. I am glad to help you with the homework, but it is in your own best interest to work on a problem for awhile before you come for help, even if you are stuck on it.

Showing work: In this class, correct answers are typically not enough to get full credit. Any work that you turn in (whether homework, in-class assignments, tests or final) must demonstrate the process by which the solution was obtained. This means that if you write down the correct answer with no supporting work you may receive partial credit or no credit at all.

Tests and Final

There will be three Tests that together account for 45% of the total grade (15% per Test), each will be held during the entire class period.

At the end of the semester, there will be a comprehensive Final worth 20% of the total grade. It will be held on Thursday, May 2 from 9:45 AM to 11:45 AM.

Grading

Your final grade will be comprised of the following elements:

In-Class Assignments	15%
Homework	20%
Tests	45% (3 Tests, each worth 15%)
Final	20%

Letter grades:

$[93-100]$	A	$[87-90)$	B+	$[77-80)$	C+	$[67-70)$	D+	<60	F
$[90-93)$	A-	$[83-87)$	B	$[73-77)$	C	$[63-67)$	D		
		$[80-83)$	B-	$[70-73)$	C-	$[60-63)$	D-		

I may lower the grade thresholds, but will not raise them.

Attendance Policy

The pace of this class is such that it will not be advisable to miss any sessions. If you know you will be absent, please inform me in advance. When you are absent, it will be your responsibility to look on Canvas for the uploaded notes and announcements.

I really want to encourage you to ASK QUESTIONS and take part in the lectures! This is part of the learning process and benefits others in the class who may have the same questions.

Important Dates

January 8, Monday	Classes begin
January 15, Monday	MLK Day, no class
March 4 – 8, Monday – Friday	Spring Break, no class
March 21, Thursday	**Last day to drop with "W"**
April 29, Monday	Last day of class
May 2, Thursday	Final Exam at 9:45 AM

Withdrawal Statement

The course withdrawal period ends **Thursday, March 21, 2024 at 5:00 PM**. Before this date, students can elect to receive a "W" for the course by completing and submitting the proper form. The instructor's permission is not required. For details, see here as well as Degree Requirements and Time Limits in the current Undergraduate Catalog OR Withdrawal Procedures in the current graduate catalog.

Disability Statement

Do not hesitate to contact me with any questions or concerns. If you need course adaptations or accommodations because of a disability, please contact me as soon as possible. The Office of Disability Services coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

If you are experiencing mental health concerns, telehealth services are available ? here is a link to the Counseling Center website.

Diversity Statement

Ball State University aspires to be a university that attracts and retains a diverse faculty, staff, and student body. We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse as expressed in our Pledge Beneficence and through university resources found here.

Important Links

Student Academic Ethics Policy

Code of Student Rights and Responsibilities

Syllabus is subject to change