Term Information

Effective Term	Spring 2021

General Information

Course Bulletin Listing/Subject Area	Statistics
Fiscal Unit/Academic Org	Statistics - D0694
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	3440
Course Title	Statistics in Quality
Transcript Abbreviation	Stat Qual
Course Description	Descriptive statistics; introduction to probability; Bayes theorem; discrete and continuous random variables, expected value, probability distributions; interval estimation for means and proportions; hypotheses tests for means and proportions; least squares regression; one- and two-way anova; control charts; process capability indices.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Lima, Mansfield, Marion, Newark

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: Math 1152, 1161.xx, 1172, 1154, 1155, or equiv, or permission of instructor.
Exclusions	Not open to students with credit for 3450, 3450.01, 3450.02, 3460, 3470, 3470.01 and 3470.02
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0501
Subsidy Level	Baccalaureate Course
Intended Rank	Sophomore, Junior, Senior

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Understand basic concepts of probability and statistics, and recognize the importance of statistical ideas.
- Comprehend statistical tools for organization, description and presentation of data.
- Understand the methods needed to collect, analyze and critically evaluate statistical arguments to improve processes.
- Recognize the importance of how to formulate, construct and interpret confidence intervals of the parameters in a statistical model
- Recognize the importance of how to formulate statistical hypotheses about the parameters in a statistical model, construct appropriate hypothesis tests, and interpret the results in both a statistical and practical context
- Learn statistical quality control methods to understand the sources of variations in manufacturing processes

Content Topic List

- Exploratory data analysis
- Probability and probability distributions
- Sampling distribution
- One-sample inference
- Two-sample inference
- Simple linear regression model
- Analysis of variance
- Quality control

Sought Concurrence

No

Attachments

- Syllabus_Stat_3440.pdf

  (Syllabus. Owner: Craigmile,Peter F)

- OSUSTATS3440BSETSupportLtr.pdf

  (Cover Letter. Owner: Craigmile,Peter F)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Craigmile,Peter F	07/01/2020 09:44 PM	Submitted for Approval
Approved	Craigmile,Peter F	07/01/2020 09:45 PM	Unit Approval
Approved	Haddad,Deborah Moore	07/02/2020 08:30 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	07/02/2020 08:30 AM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

June 30, 2020

Peter F. Craigmile, PhD
Department of Statistics
The Ohio State University
1958 Neil Avenue Columbus, OH 43210 USA

Dear Dr. Craigmile,

On behalf of The Ohio State University Bachelor of Science in Engineering Technology (BSET) program, we are writing to express our strong support for the proposed Statistics 3440: Statistics with Applications in Quality. The BSET program is a new 4-year degree program at Ohio State designed to prepare graduates to effectively transition into manufacturing/production engineering and similar technically based leadership roles in organizations. The goals for graduates of the program include mastery of systems thinking and problem solving, professional skills, business foundations and continuous improvement skills.

Statistics is a foundational course for the BSET program that involves an inquiry-based approach to give students not only the fundamental language and knowledge of statistics calculations, but how to analyze and derive meaning from data. Modern tools (Excel and Minitab) will be used to reduce the time for hand calculations and allow more time for meaning and interpretation. Open-ended problems with data sets can be used to help students learn how to identify which methods to use and what the results mean.

In summary, Statistics 3440 will strengthen the BSET program. We appreciate your thoughtful consideration of this course. Please feel free to contact us through Kathryn Kelley at kelley.81@osu.edu or (614)256-3724.

Sincerely,

Kathryn L. Kelley
Executive Director
Ohio Manufacturing Institute
The Ohio State University

Aimee Ulstad, PE
Associate Professor
Integrated Systems Engineering
College of Engineering

Statistics 3440
Statistics in Quality
3-semester-hour course

Class distribution: two 80-minute lectures per week with computer access available. Computer lab: There will be either a separate computer lab for data analysis using Minitab and Excel or it will be incorporated into regular lectures where it is applicable.

This course is designed for engineers focused on statistics to support quality processes. It is important for engineers to have a strong foundation in statistics to:

- Analyze data and communicate it effectively to their organization for good decision making,
- Lead efforts at process improvement,
- Evaluate risks and recommendations properly.

Because the course was specifically designed for the purpose of the BSET program, the course goals and outcomes have been aligned to the BSET accreditation program as follows.

ABET Student Outcomes - General Criteria	**Course Goals-Describe, Analyze, Explain, Apply epts in the course) to meet the ABET Outcome**	**Course Outcomes- A successful student will be able to do the following to demonstrate they can meet the goal :**
(1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problem appropriate to the discipline	A: Understand basic concepts of probability and statistics, and recognize the importance of statistical ideas.	A1- Compute and interpret the probability of statistical events. A2-Match common probability distributions with simple engineering data generating processes. A3-Model engineering data based on large-sample normal distribution assumptions, and identify when such models are appropriate for given data, A4- Use the Central Limit Theorem as the foundation of statistical inference.
(3) an ability to apply written, oral, and graphical communication in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature	B: Comprehend statistical tools for organization, description and presentation of data.	B1-Select and construct appropriate display procedures to provide graphical summaries of the data. B2- Use appropriate summary statistics to describe the distribution of data. B3- Use appropriate statistical terminology to describe data and distributions.

(4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes	C:1.Understand the methods needed to collect, analyze and critically evaluate statistical arguments to improve processes. 1. Recognize the importance of how to formulate, construct and interpret confidence intervals of the parameters in a statistical model 2. Recognize the importance of how to formulate statistical hypotheses about the parameters in a statistical model, construct appropriate hypothesis tests, and interpret the results in both a statistical and practical context	C1- Use correct procedures for designing experiments and observational studies. C2- Construct and interpret confidence intervals within the context of engineering problems. C3-Conduct and interpret hypothesis tests. C4- Build a simple linear regression model and perform diagnostic checks for bivariate data. C5- Construct one and two- way analysis of variance models and identify and interpret the source of variations.
Discipline Specific -SME Outcomes		
(d) knowledge, skills, and abilities in statistics, quality, continuous improvement, and industrial organization and management	D: Learn statistical quality control methods to understand the sources of variations in manufacturing processes	D1-Select appropriate statistical tools to monitor process quality. D2- Compute and interpret capability indices.

Course Description: The course covers descriptive statistics, introduction to probability, Bayes theorem; discrete and continuous random variables, expected value, probability distributions; interval estimation for means and proportions; hypotheses tests for means and proportions; least squares regression; one- and two-way anova; control charts; Process capability indices.

Prereq: Math 1152, 1161.xx, 1172, 1154, 1155, or equiv, or permission of instructor. Not open to students with credit for 3450, 3460 and 3470.

Required Text and Other Course Material

Applied Statistics and Probability for Engineers, 7th ed. Douglass C. Montgomery and George C. Runger (Wiley, ISBN 9781119400363), Minitab or Excel software will be used for data analysis.

Assignments

Homework will be assigned (approximately) biweekly, will be due on the dates announced in class, and will be graded. Assignments will consist of problems from the textbooks, industry partners or from other sources to reinforce learning the material covered in the lectures.

Exams

There will be three quizzes and one in-class midterm exam that cover the material from lectures, the assigned readings and homework. A final examination will be given during the university's examination period.

Grading Information

The final grade will be assigned based on homework assignments, quizzes, midterm exam and a comprehensive final examination. The weights of each component of the grade are

Homework	Quizzes	Midterm	Final Exam
30%	15%	25%	30%

Module	Area	Topics
1	Exploratory data analysis	1. Histogram and box plot, shape of the data 2. Location measures, mean, median, mode 3. Spread measures, standard deviation, IQR, range, empirical rule, outliers.
2	Probability and probability distributions	1. Statistical events, basic set theory, probability axioms and rules, probabilities of independent and conditional events, Bayes theorem. 2. Discrete random variable, probability mass function, expected value, variance, standard deviation. 3. Binomial distribution and Poisson distribution. 4. Continuous random variables, probability density function, normal distribution, exponential distribution.
3	Sampling distribution	1. Sampling distribution of sample mean and sample proportion and sample variance 2. Central limit theorem
4	One-sample inference	1. Confidence intervals for mean 2. Confidence interval for proportion 3. Hypothesis testing for mean 4. Hypothesis testing for proportion

5	Two-sample inference	1. Inference for the difference of population proportions 2. Inference for the difference of population means
6	Simple linear regression model	1. Scatter plots, correlation 2. Simple linear regression model 3. Statistical inference on regression parameters 4. Diagnostic checks
7	Analysis of variance	1. One-way anova model 2. Inference 3. Diagnostic checks 4. Two-way anova model 5. Inference 6. Diagnostic checks
8	Quality control	1. Control charts, X-bar, S, R charts 2. Control charts for attributes 3. Process capability index Cp 4. Process capability index Cpk

Statement on Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Special Accommodations

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.

Outline of ET Stats Course

Date	Lecture #	Topics	Assignment
8/23/22	1	Overview of the course and brief review of the syllabus, observational studies, experiment, simple random sample, types of variables	**Assignment 1**: Assign three to five data sets from engineering applications that have different shape, location and variation. Students will be asked to: 1- use appropriate graphical displays to summarize data. 2- use appropriate numerical descriptive measures to describe data. 3- interpret these numerical measures by connecting them to graphical displays. 4- write a summary report on the quality of data within the context of engineering applications. **Aligned Learning Outcomes: B1, B2, B3**
8/25/22	2	Histogram and box plot, shape of the data, location measure, mean, median and mode	
8/30/22	3	Measures of spread, standard deviation, IQR, empirical rule, outliers.	
9/1/22	4	Basic set operation, union, intersection, complement events. Probability axioms and rules	**Assignment 2**: Assign a set of problems to reinforce learning. Problems will include topics in probability axioms and rules, conditional and independent events, use of Bayes theorem, expected value, variance, standard deviations of random variables. These problems will be connected to engineering applications, such as probability of defective or non-conforming items, etc. Students will be asked to interpret these in the context of engineering applications. **Aligned Learning Outcomes: A1-A3**
9/6/22	5	Conditional probabilities, Bayes theorem, independent events	
9/8/22	6	Discrete random variable, probability mass function, Expected Value, Standard Deviation	
9/13/22	7	Binomial Distribution and Poisson Distribution	
9/15/22	8	Poisson distribution (continued)	
9/20/22	9	Continuous random variables, probability density function, Normal Distribution	**Quiz1 and Assignment 3**: Assign six to seven exercises from binomial, Poisson, normal and exponential distributions. Exercises for binomial distribution will be related to reliability and failure rates of engineering systems. Exercises for Poisson distribution will be tied to six sigma. It will ask to compute Defects per Million Opportunity and rolled throughput yield, etc. Exercises for normal distribution will be tied to six sigma using location (mean) and variation (standard deviation) measures. Students will check the assumptions to validate the use of these distributions . **Aligned Learning Outcomes: A1-A3**. **Aligned Learning Outcomes for Quiz 1: A1-A3, B1-B3**
9/22/22	10	Normal Distribution, Exponential Distribution	
9/27/22	11	Review for midterm exam	
9/29/22	12		**Midterm Exam: Aligned Learning Outcomes for Quiz: A1-A3, B1-B3**

10/4/22	13	Central limit theorem. Sampling distribution of mean and proportion.	**Assignment 4**: 1-Set of exercises for the sampling distribution of sample mean and sample proportion. 2- Set of exercises for confidence interval of population mean and proportion using normal distribution. Exercises will be tied to engineering applications through data sets provided by our local industry partners. Students will be asked to interpret confidence intervals in the context of engineering problems. **Aligned Learning Outcomes: A1-A4, C1-C3, B1-B3**
10/6/22	14	Confidence intervals for mean and proportion	
10/11/22	15	Hypothesis testing for mean	
10/13/22	Autumn Break		
10/18/22	16	Hypothesis testing for mean and proportion (continued)	**Assignment 5**: Set of six-to- eight exercise problems for hypotheses testing for one and two sample problems for population means and proportions. Exercise problems will be formulated to solve engineering problems with real data set provided by local industry partners if possible. Students will be asked to write a summary report for each problem to interpret the results in the context of engineering problems. **Aligned Learning Outcomes: A1-A4, C1-C3, B1-B3**
10/20/22	17	Inference for the difference of population means	
10/25/22	18	Inference for the difference of population proportions	
10/27/20	19	One-way anova modal	**Quiz 2, Assignment 6**: Set of exercises from one-way and two-way ANOVA models. For each problem, students will be asked to write appropriate model, required assumptions and hypothesis of interest. They will analyze the data, construct the ANOVA table, interpret results in the context of engineering problem. They will perform diagnostic checks if the required assumptions hold for the model they have written. **Aligned Learning Outcomes: A1-A4, C1, C2, C3, C5. Aligned Learning Outcomes for Quiz 2: A1-A4, B1-B3, C1-C3**
11/1/22	20	One-way anova, Multiple Comparisons, check assumptions	
11/3/22	20	Two-way anova	
11/8/22	21	Correlation	**Assignment 7**: In an Auto-manufacturing company, the Quality Control Department uses in-house-failure-rate (IHFR) to estimate the projected defective batteries sent to customer. The Customer Service Department uses projected volume of defectives (PVD) products sent to customers as a metric to predict the volume of calls expected to receive from the customers. A six-sigma team initiated a project to investigate relevance of IHFR as metric to estimate PVD products sent to customers. A part of data set collected by six sigma team is provided. Use appropriate graphical tools to display the association between IHFR and PVD. Build a simple linear regression model. Estimate the parameters of this model. Check the assumptions, write a report to communicate your results to the company's management. **Aligned Learning Outcomes: A1-A4, B1, B3, C2-C4**

11/10/22	22	Simple linear regression model	
11/15/22	23	Control charts, X-bar, S, R	**Assignment 8**: Set of exercises in quality control charts and process capability indices. If available data sets will be obtained from our local industry partners. Students will be asked to display the control charts and write a summary report to communicate the results with management team. **Aligned Learning Outcomes: A1-A4, B1, D1, D2**
11/17/22	24	Conrol charts, continued	
11/22/22		Control charts for attributes	
11/24/22	No Classes, Thanksgiving Day		
11/29/22	25	Process capability index Cp	
12/1/22	26	Process capability index Cpk	
12/6/20	27	Review for final exam	Quiz 3, Aligned Learning Outcomes: A1-A4, B1, C2-C5 D1, D2
12/9/22	28	Final Exam	**Aligned Learning Outcomes: A1-A4, B1-B3, C1-C5, D1, D2**