

STATISTICS 642 – Methods of Statistics, II - Spring 2022

STAT 642 is intended for statistics graduate students who are planning a career as an applied statistician in industry or academia. The course will provide an introduction to design of experiments and analysis of variance. The prerequisites are STAT 641 and knowledge of SAS and R.

Course Information

Time and Place:	Lectures: Monday, Wednesday, Friday, 8–8:50am Central in blocker 457 Question & Answer: Wednesday, 6:15 pm Central via Zoom
Instructor:	Derya Akleman.
Office:	Blocker 450B, 979-845-3141.
E-mail:	akleman@tamu.edu
Office Hours:	MWF 9:10 am –10:10 am Central in person or via ZOOM.
Grader:	Jiyoung Park (wldyddl5510@tamu.edu)
Office Hours:	TBA Central via ZOOM
Class Web Pages:	canvas.tamu.edu (canvas for lectures, homework assignments, discussion board, review materials), See Assignments on canvas webpage for instructions on how to submit homework
Supplemental Textbook:	Angela Dean, Daniel Voss, Danel Draguljić, <i>Design and Analysis of Experiments, 2nd Ed</i> , Springer Texts in Statistics (Supplemental, not required)
Prerequisite:	STAT 641 and knowledge of SAS and R
Computing:	The SAS and R statistical programming software.
Homework:	Homework will be assigned and collected regularly. Selected homework problems will be graded, and solutions will be provided for all assigned problems. Homework is worth 20% of the total term score. <i>Please see the homework policy next page.</i>
Exams:	There will be two midterm exams worth 25% each and a final exam worth 30%. <i>Please see the exam policy next page.</i>
Exam Dates:	Exam 1: Wednesday, March 2, 2022 at 8am Central in blocker 457 Exam 2: Wednesday, April 6, 2022 at 8am Central in blocker 457 Final Exam: Thursday, May 5, 2022 at 10am Central in blocker 457 The exam times for section 700 is at 6pm Central the same date via Zoom
Grading scale:	A: 85%–100%. B: 70%–84%. C: 60%–69%.

Course Information

Disabilities Help: Americans with Disabilities Act (ADA) Policy Statement - The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit <http://disability.tamu.edu/>

Academic Integrity: *"An Aggie does not lie, cheat, or steal or tolerate those who do."* You are expected to maintain the highest integrity in your work for this class, consistent with the university rules on **academic integrity**. This includes not passing off anyone else's work as your own, even with their permission. Please see the homework and exam policies below for specifics. Further information at <http://aggiehonor.tamu.edu>

Copyright: Faculty members own copyright in their educational work at Texas A&M University, as stated in the Texas A&M University System Policy for Intellectual Property Management and Commercialization (<http://policies.tamus.edu/17-01.pdf>).

Students are not allowed to post or share any materials created by a faculty member unless given permission by that faculty member. This includes but is not limited to homework assignments, homework solutions, exams, exam solutions, lecture notes and any other supplemental materials.

Any violation of this copyright policy could result in disciplinary actions as described in

Student Rule 20.2: Procedures in Scholastic Dishonesty Cases and

Student Rule 20.1.2.3.1 Cheating:

Intentionally using or attempting to use unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise. Unauthorized materials may include anything or anyone that gives a student assistance and has not been specifically approved in advance by the instructor.

Texas A&M complies fully with the Digital Millennium Copyright Act ("DMCA"). Users of the Texas A&M network found to have engaged in repeated infringement of copyright are subject to termination of their network access and may be reported to the appropriate Dean or Human Resources officer for disciplinary action.

Please see TAMU's Copyright Infringement Policies and Sanctions Notification for additional information.

https://security.tamu.edu/protect_myself/Copyright_Infringement_Policies_and_Sanctions_Notifications.php

Course Policies

Homework Policy:	<p>Homework assignments will be available in the Homework Assignments folder on canvas under Files.</p> <p>There will be weekly assignments with due date posted on the assignments in the canvas Homework Assignments folder.</p> <p>Homework solutions <i>must</i> be in a single PDF file</p> <p>Students will upload solutions to canvas.</p> <p>You should be identified on the initial page with your TYPED Name, Course and Email address.</p> <p>Your homework solutions must be your own work, not from outside sources, consistent with the university rules on academic integrity. I expect you to follow this policy scrupulously. Your chances for a good performance on the exams will be higher if you follow this policy.</p> <p>You may use:</p> <ul style="list-style-type: none">• Your textbook and notes from class.• Your notes, homework, etc., from a related class that you took or are taking.• References listed on the syllabus.• Discussion with the instructor or grader.• Voluntary, mutual and cooperative discussion with other students currently taking the class. There will be an online discussion board. <p>You may not use:</p> <ul style="list-style-type: none">• Solutions manuals (printed or electronic) and copies of pages from solutions manuals.• Solutions notes, homework, etc., from previous classes.• Solutions, notes, homework, etc., from students who took this class previously.• Copying from students in this class, including expecting them to reveal their solutions in “discussion”.
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Course Policies

Exam Policy:

The three exams must be taken at the listed times and on the listed days as given below.

Exam 1: Wednesday, March 2, 2022 at 8am Central in blocker 457

Exam 2: Wednesday, April 6, 2022 at 8am Central in blocker 457

Final Exam: Thursday, May 5, 2022 at 10am Central in blocker 457

The exam times for section 700 is at 6pm Central the same date via zoom

Exam solutions *must* be scanned into a single portable document format (PDF) file only and uploaded to canvas for section 700.

You should be identified on the initial page with your PRINTED Name, Course and Email Address.

Your exam solutions must be your own work, consistent with the university rules on **academic integrity**.

You will be allowed to use a self generated formula sheet. As a part of your solutions to problems, you will need to:

- Show all your work. This does not necessarily mean showing every individual algebraic or calculus step – but it must be clear what those steps are.
- Clearly identify the solution to all problems.

You may use a calculator but it cannot have capability to phone, text, or access Web except for downloading exam and uploading solutions

Copies of old exams will be available for you to review under **Review Materials for Exams** folder on canvas.

Makeup Policy:

- If you missed a homework assignment or exam, see the university rule on Attendance website Rule 7: <http://student-rules.tamu.edu/rule07>
- If you fail to submit a homework assignment by the due date because of a university excused absence or due to illness or circumstances beyond your control, notify me in writing or by email (before, if feasible, otherwise within two working days after you return). If your absence is approved, I will notify you on how you may make up the missed assignment.
- If you must miss an exam because of a university excused absence or due to illness or circumstances beyond your control, notify me in writing or by email (before, if feasible, otherwise within two working days after you return). If your absence is approved, I will notify you on how you may make up the exam.
- If you miss a homework assignment or an exam and your reason for missing the assignment or exam is not accepted, then you will receive a score of 0 for the assignment or exam.
- A temporary grade of I (Incomplete) at the end of a semester indicates that the student has **completed the course with the exception of a major quiz, final exam, or other work**. The instructor shall give this grade only when the deficiency is due to an authorized absence or other cause beyond the control of the student.

Instructions for Installing R and Obtaining SAS

All students will need to download and install the latest R and SAS software.

R and SAS are statistical programming languages that we will use for data analysis, graphics and power calculations.

R may be obtained at the CRAN website, as described below.

1. It is recommended that you first uninstall previous versions of R, if you have any.
2. Go to <http://lib.stat.cmu.edu/R/CRAN> and click your choice of platform (Linux, MacOS X or Windows) for the precompiled binary distribution. Note the FAQs link to the left for additional information.
3. Follow the instructions for installing the *base* system software (which is all you will need).

You can obtain a copy of SAS as follows:

Click on **Pages** in Canvas

Click on **University Resources**

Click on **Help Desk Central**

Click on **Search the Knowledge Base**

Type **SAS** in the **Search Box**

Examples using SAS and R, that you can mimic, will be given in the lecture notes and Files folder on Canvas.

Course Outline

Topic - Handouts - Lectures

1. Introduction to Experimental Design - HO 1& 2 - Lectures 1-7

- A. Planning for the experiment: What is the goal of experiment
- B. Selection of Variables, Factors, EU's, Cost, Number of Replications
- C. Treatment structure: Single factor, crossed, nested, random, fixed
- D. One way randomization (CRD)
- E. Blocking and covariates:
 - a. Randomized Complete Block Designs(RCBD)
 - b. Balanced Incomplete Block Designs
 - c. Latin Square Designs (LSD)
 - d. Analysis of Covariance
- F. Split Plot Design
- G. Repeated Measures Design
- H. Crossover Design

2. Completely randomized model with single factor - HO 3 - Lectures 8-10

- A. How and what to randomize
- B. Statistical models: Effects Model vs Cell Means Model
- C. ANOVA and Sum of Squares
- D. Power and sample size selection

3. Treatment Comparisons: Contrasts & Multiple Comparisons - HO 4 - Lectures 11-14

- A. Research questions specify the type of comparisons
- B. General contrasts: Bonferroni and Scheffe
- C. Multiple Comparisons: All pairs, vs control, finding Best treatment
- D. Which error rate is being controlled
- E. Response curves for quantitative treatment factors

Exam 1 - Wednesday, March 2, 8am for section 600 and 6pm Central for section 700 - Handouts 1-4

4. Assumptions, Diagnostics, Transformations, Alternative AOV - HO 5 - Lectures 15-17

- A. Residuals analysis to evaluate model assumptions
- B. Robustness of statistical tests and C.I.'s
- C. Alternative analyses: Transformations, Kruskal-Wallis, Bonferroni Wilcoxon rank sum

5. Variance Components - HO 6 - Lectures 18-20

- A. Random factor levels
- B. Methods for finding point estimators
- C. C.I.'s for variance components
- D. Subsampling

6. Factorial Treatment Designs - HO 7, 8, &9 - Lectures 21-30

- A. Fixed factor levels, equal reps
- B. Fixed factor levels, unequal reps
- C. Fixed factor levels, missing trts
- D. Decomposition of SS's using contrasts
- E. Mixed models
- F. Nested factors
- G. Comparing methods of obtaining variance components
- H. Expected MS rules

Exam 2 - Wednesday, April 6, 8am for section 600 and 6pm Central for section 700 - Handouts 1-8

7. Fractional Factorial Treatments - HO 10 - Lectures 31-32

- A. Confounding and Alias Groups
- B. Design resolution
- C. 2^{n-p} Designs
- D. Screening designs: Plackett-Burman designs
- E. Analysis of experiments with no reps

8. Blocking Designs - HO 11 - Lectures 33-36

- A. Blocking to increase precision
- B. Rank-based test: Friedman
- C. Latin Squares
- D. Incomplete Block Designs
- E. Analysis of Covariance

10. Split Plot, Crossover & Repeated Measures Experiments - Lectures 37-40

- A. Split Plot Design - Different size EU's
- B. Split Block design, Split-Split-Plot design
- C. Repeated measures design
- D. Crossover designs

Final Exam (Comprehensive) - Thursday, May 5, 8am for section 600 and 6pm Central for section 700