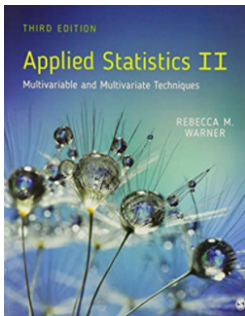


San José State University
COSS/Psychology
Statistics 235-01, Multivariate Statistics, Spring 2024

Course and Contact Information

Instructor:	Gregory J. Feist
Office Location:	DMH 313
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Office Hours:	TU- TH 11am-12noon
Class Days/Time:	TH 1:30 to 4:15pm
Classroom:	DMH 359
Final:	Friday, May 17 (9am to 11:59pm, online)
Prerequisites:	Stat 245

Required Texts/Readings (Required)



Rebecca M. Warner (2021). *Applied Statistics II: Multivariable and Multivariate Techniques*. Sage

ISBN 978-1-0718-1631-8

\$89-\$110; \$45-\$70 eTextbook rental
\$71 print rental; \$104 Print; \$90 Digital Purchase

Amazon
SJSU Textbook Store

- **Other technology requirements**
- R (<http://cran.r-project.org/>)
- R Studio (<http://www.rstudio.com>)
- R Markdown <https://rmarkdown.rstudio.com/index.html> [optional]

Course Information/Description

This course introduces several of the most common multivariate procedures: simple and multiple regression and correlation (MRC), and analysis of covariance (ANCOVA), multivariate analysis of variance (MANOVA), and exploratory factor analysis (EFA), structural equations modeling (SEM). We will also briefly go over the general linear model (GLM). Leading to the discussion of these topics are *extremely* brief reviews of Pearson correlation and analysis of variance (ANOVA) - **this course assumes you have learned these procedures in previous courses**. We're going to cover a fair amount of somewhat complex material relatively quickly. You must have taken Stat245 or its equivalent to enroll in this course.

As the primary goal of this course is to help you become an informed consumer and practitioner of research by being comfortable with data, we'll address these statistical procedures from a conceptual approach. Rather than getting caught up in their mathematical (i.e., matrix algebra) foundations, we'll focus on application and interpretation. For each procedure, we will cover three basic questions: what is it, why/when might one use it,

and how might one appropriately conduct, interpret, and communicate it. More specifically, for each procedure we'll address the following:

- defining the procedure (what is it)
- describing research situations where the procedure may be appropriate (why and when use it)
- discussing underlying requirements and assumptions of the procedure (how use it appropriately)
- conducting the analysis using computer software packages (how to conduct the analysis)
- interpreting computer output (how to interpret the analysis)
- identifying and addressing issues and problems that may arise in using the procedure
- communicating the results of the analysis in standard APA format (how to communicate the analysis)

A critical component of the class is the use of statistical software to conduct the procedures covered. As *R* is the most popular and readily available opensource software, we'll use it to create and execute files that define data and conduct statistical analyses. We'll go over the output generated from these analyses during class.

Faculty Web Page and MYSJSU Messaging

Unless otherwise announced in class, all graded assignments will be accepted only in electronic form using the Canvas learning management system assignments page ([Canvas](https://sjsu.instructure.com/) is available at <https://sjsu.instructure.com/>). Having access to the Internet is your responsibility, so have backup plans in case you have problems with your primary computer. I cannot accept excuses about technology problems as valid, unless the entire University network or all of Canvas is offline.

Supplementary course material will be made available on Canvas regularly. Communication regarding the course will be sent via the e-mail address linked to your MySJSU account or posted to Canvas. It is your responsibility to make sure you are enrolled in Canvas and receiving my e-mails.

Program Learning Outcomes (PLOs)

Upon successful completion of the requirements for the MA in Research and Experimental Psychology, students will be able to:

Goal 1. Knowledge Base – Students completing the MA in Psychology program will understand the major theoretical perspectives and research methods across areas of experimental psychology, i.e., Developmental, Social, Cognitive, and Physiological.

- PLO 1.1 – Understand the major theoretical perspectives and research methods across areas of experimental psychology, i.e., Developmental, Social, Cognitive, and Physiological.

Goal 2. Research Methods & Scholarship – Graduates of our program will possess an advanced level of competence in research methods, statistical techniques, and technical writing skills. Students completing the MA in Psychology program are required to complete a thesis. The thesis will:

- PLO 2.1 – demonstrate creative problem-solving in the design, implementation of empirical research.
- PLO 2.2 – demonstrate project management skills in the implementation of empirical research.
- PLO 2.3 – demonstrate advanced competency in the statistical analysis and interpretation of empirical research findings.
- PLO 2.4 – be able to communicate (oral and written) their research findings at a professional level.

Goal 3. Career Enhancement – Graduates of our program will experience career enhancement through placement in a doctoral program or acceptance of a position requiring a master’s in psychology in the public or private sector. Students completing the MA in Psychology program will:

- PLO 3.1 – achieve career enhancement through placement in a doctoral program or acceptance of a position requiring a master’s in psychology in the public or private sector

STAT 235 contributes to PLOs 2.1, 2.3, 2.4 and 3.1.

Course Learning Outcomes

The goals of this course are to help you: build a solid conceptual understanding of statistics in research, develop the practical skills to use statistics in your own research, and become a self-directed learner.

Upon successful completion of this course, you will be able to:

- CLO 1 – Define statistical procedures, including those associated with: multiple regression, logistic regression, general linear model, analysis of covariance, multivariate analysis of covariance, principle components and factor analysis, and structural equations modeling.
- CLO 2 – Describe which statistical procedures are appropriate for a given research situation
- CLO 3 – Discuss the underlying requirements and assumptions of statistical procedures
- CLO 4 – Conduct and interpret statistical analysis using computer software (R)
- CLO 5 – Communicate results of statistical analysis in APA style for scientific publication.

The learning objectives will be assessed via written assignments and exam questions.

The course learning objectives were adapted from those of Dr. Sean Laraway, Dr. Howard Tokunaga, and if applicable, for General Education (GE), American Institutions (AI), and Graduation Writing Assessment Requirement (GWAR) courses. Information may be found in [Guidelines for GE, AI, GWAR](http://www.sjsu.edu/senate/docs/2014geguidelines.pdf) (<http://www.sjsu.edu/senate/docs/2014geguidelines.pdf> per [University Policy S14-5](http://www.sjsu.edu/senate/docs/S14-5.pdf), at <http://www.sjsu.edu/senate/docs/S14-5.pdf>) effective Fall 2014

Additional Readings will be made available on the Canvas site.

Course Requirements and Assignment

Homeworks (16.87% of grade - 135 pts)

Throughout this semester, there will be two main types of homework assignments. Both types of assignments will be submitted via Canvas as GoogleDoc, Word or PDF files.

1. Statistical Analyses Homeworks (11.25%) due @ 11:59pm (90 points)

The first type of homework, designed to help teach you to conduct and interpret the results of statistical analyses, asks you open data files in R, run analyses in R, and bring the output of these analyses to class to facilitate discussion. There will be **9 of these** assignments, each worth a maximum of **10 points**. NOTE: Depending on the assignment, **late homework** (turned in no later than one class past its original due date) may be accepted with a **deduction of 5 points/day**.

2. Evaluation/Questions/Comments on Readings (5.6%) due @ 11:59pm on CANVAS (45 points)

The second type of assignment consists of reading for that chapter and providing questions or comments you have about it. Have at least 2 questions/comments/observations per most weeks. There will be **9 of these question assignments, each worth 5 points**. Because of the nature of these assignments, **late questions will not be accepted**.

Class participation (6.25% of grade – 50 pts)

Active student participation during class sessions is an essential component in graduate school, which means you need to make every effort to attend all class sessions. Missing more than 1 or 2 classes will result in a lower participation score. Discussion will also revolve around your weekly questions or comments so will also be considered part of “participation.” There may be times when you feel confused, bemused, frustrated, or perturbed. I need and expect you to express your questions, thoughts, and feelings during class. There is no such thing as a stupid question – really! Class participation will be a determining factor for students whose course grade is 'borderline' (ie, slightly below the cutoff for the next highest grade).

Exams (37.5% of grade - 300 pts)

There will be two midterm exams, each worth 150 points. The exams will address the ability to interpret computer output as well as discuss relevant conceptual and statistical issues. There will be no make-up exams without prior notification and agreement. Exams will be ONLINE (Canvas) from 12pm to 11:59pm day of exam.

Final examination (18.75% of grade - 150 pts) – May 17th. The final examination is non-cumulative (since 2nd exam). It is really a third mid-term.

Paper (20.63% of grade - 165 pts)

There will be one paper, **due Tue May 14th**. The first part of this assignment is to turn proposal for your final paper. The **proposal is due April 26th and is worth 15 points**. The purpose of this full paper (approximately 8-10 pages in length) is to give you practice in conducting analyses on a set of data, interpreting the results of these analyses, and writing up the findings in standard APA format. It is worth **150 points**.

You will pick a data set from class of your choosing and conduct any series of analyses we covered during the semester, write up the results with APA Tables and Figures. Make sure the analysis is not exactly one we did already in class or is in the book. That is, choose some variables in a data set not already chosen. That doesn't mean ALL variables must be completely new, but at least half of them. You may choose to do more than one statistical analysis on your dataset (e.g., factor analysis and sequential regression) but that is not required. You will need to include a full copy of your R syntax and output files. **Late papers may be accepted with substantial penalty (10 points a day).**

It will be a full style APA paper, with intro, method, results, and discussion. Include Title page and Reference page in APA format (7th edition).

- **Intro** should be only about 2 pages and review **at least 10 citations** (of your own finding) on that topic. Summarize the main findings and lead to the research questions you will be addressing in this paper. The intro should end with a clear statement of predictions or research questions.
- **Method** section needs to match the sample and sample size in the data set, but the procedures (when and how data were collected) can be your own creation. If the data set describes and uses specific measures, then find them in the literature and describe them (and cite creators/original source) (also about 2 pages).
- **Results** Write up full description of results as per Schumacker & APA Guide. Include at least one APA style table or figure (about 1.5 pages). *Include your R-scripts in an Appendix.*
- **Discussion** (about 2 pages). Given your introduction and predictions, summarize your results, describe the implications of your findings. Also, describe the limitations of your design and results, and end with any unanswered questions and/or what is the next step in this line of research.

The paper (150 points) will be graded on

- **APA format:** including title page, tables, results, citations, and references (10%)
- **Content:** do you have all of the parts, including R-scripts in Appendix (15%)

- **Statistical Analysis:** were your statistics appropriate ones to answer your question/test your prediction? Were they done correctly? (20%)
- **Interpretations:** were your conclusions and interpretations of the output correct? (15%)
- **Writing Style:** how clearly do you write? Grammatical clarity? Need much editing? (40%)

Grading criteria (of 800 points)

<u>Grade</u>	<u>%</u>
A+	95.0<
A	91.5 – 94.9
A-	89.5 – 91.4
B+	86.5 – 89.4
B	81.5 – 86.4
B-	79.5 – 81.4
C+	76.5 – 79.4

Rounding is Included in the Grading Scale

The point totals reflect rounding up to the nearest percentage. For example, an A- would normally require 90%. With rounding, it only requires 89.5%. Because rounding is built in to the grading scale, your grade will be based on your final point total, rounded to the nearest whole percentage point (so 89.5% is an A-, but 89.4% is a B+). **To be fair to everyone in the class, these are firm cutoffs, so please don't ask for additional bumping up.**

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>

You must obtain the instructor's permission to make any audio or video recordings in this class. Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Diversity

Consistent with the mission of San José State University, I welcome persons of differing backgrounds and experiences including, but not limited to, age, disability and health status, ethnicity and race, family.

Course Schedule

Wk	Date	Chapter*/Topic/Reading	Homeworks due Sunday Questions due Wed
1	Jan 25	Lec 1 Introduction to Multivariate Statistics Ch1 Lec 2: NHST & Bivariate v Multivariate Statistics	
2	Feb 1	Ch1 Lec 2: NHST & Bivariate v Multivariate Statistics Ch1 Lec 3 Effect Size, Meta-Analysis	1. Multivariate Stats Questions Jan 31
3	Feb 8	Ch1 Lec 3 Effect Size, Meta-Analysis	2. Effect Size Meta-analysis Questions Feb 7 HW1: Ch 1 Meta-analysis Feb 11
4	Feb 15	Lec 4. The General Linear Model (GLM) Lecture only (no reading) Lec 5: Issues & Assumptions in Multivariate Statistics; Lecture only, no reading	3. GLM Questions Feb 14 HW 2: GLM & Raincloud, Feb 18
5	Feb 22	Ch2 Lec 6. Data Cleaning: Outliers, Skewness & Imputations <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=kpx6MljSQik • https://datasciencebeginners.com/2018/11/11/a-brief-introduction-to-mice-r-package/ Review	4. Data Cleaning Imputation Questions Feb 21 HW3: Data Cleaning Imputations, Feb 25
6	Feb 29	Exam 1 Introduction, New Statistics, GLM, Assumptions, Data Cleaning, Missingness (9am- 11:59pm Canvas)	
7	Mar 7	Ch5 Lec 7 Multiple Regression (MR)	5. Multiple Regression Questions, Mar 13 HW4: Multiple Regression, Mar 10
8	Mar 14	Ch5 Lec 8 Hierarchical Multiple Regression (HMR) Ch 8: Lec 9 Analysis of Covariance (ANCOVA)	HW5: Hierarchical Multiple Regression, Mar 17
9	Mar 21	Ch 8: Lec 9 Analysis of Covariance (ANCOVA) Ch11 Lec 10: Oneway Multivariate Analysis of Variance (MANOVA)	6. ANCOVA Questions March 20 HW 6: ANCOVA, Mar 24
10	Mar 28	Ch11 Lec 10: Oneway Multivariate Analysis of Variance (MANOVA)	7. MANOVA questions, Mar 27 HW7: MANOVA Mar 31

Wk	Date	Chapter*/Topic/Reading	Homeworks due Sunday Questions due Wed
11	April 4	SPRING BREAK	
12	Apr 11	Exam 2 Regression, ANCOVA, MANOVA (9am-11:59pm on Canvas)	
13	Apr 18	Ch 12: Lect 12: Exploratory Factor Analysis (EFA) (skip pages 12.7 pp. 408-410)	8. EFA Questions Apr 24 HW8: EFA Sunday April 28
14	Apr 25	Ch 12: Lect 12: Exploratory Factor Analysis (EFA) WPA/SPARC is Late APRIL	Final Paper Proposal due April 26
15	May 2	Ch15 Lec 14: Structural Equations Modeling SKIP Sections in Warner: <ul style="list-style-type: none"> • 15.5 Amos (pp. 545-546) • 15.7-15.11 (pp. 547-562) • 15.16 (pp. 574-576) Optional read: Violato & Hecker 2007 (Canvas)	9. SEM Questions May 1
16	May 9	Ch15 Lec 14: Structural Equations Modeling	HW9: Ch 15 SEM May 12
	May 14 Tue	Paper Due 11:59pm	
	May 17 Friday	Final Exam (EFA, SEM) (9am to 11:59pm on Canvas)	

* Chapter number refers to Warner, *Applied Statistics II*