



PSYC 380: Advanced Experimental Design & Statistical Analysis

Term: Fall 2026

Credits: 3.0

Lecture Times & Location: Tuesday & Thursday 2:30–3:45 p.m., Lovell Hall 325

Modality: In-Person

Alkimi University is a fictional institution created by Alkimi AI to demonstrate its products. It does not admit students, grant degrees, employ faculty, or accept payments. All people, places, policies, and figures in this document are invented.

Instructor Information

- **Instructor:** Dr. Leah Carver (Assistant Professor of Psychology)
- **Email:** lcarver@university.alkimi.ai
- **Office:** Lovell Hall 162
- **Office Hours:**
 - Tuesday & Friday: 1:00–2:30 p.m. (In person, Lovell Hall 162)
 - Monday: 9:00–10:00 a.m. (Virtual via Zoom; link posted in Canvas)
 - Also available by appointment.

Course Description

Factorial and repeated-measures designs, analysis of variance and covariance, multiple regression, mediation and moderation, power analysis, and reproducible analysis in R for behavioral research. PSYC 380 provides advanced methodological and statistical training for behavioral science majors preparing for graduate study or empirical research careers. Emphasizing open science and reproducible workflow practices, students formulate complex experimental and quasi-experimental designs and conduct sophisticated hypothesis testing using R and R Markdown. Core analytical topics include factorial analysis of variance (ANOVA), repeated-measures and mixed ANOVA, analysis of covariance (ANCOVA), multiple linear regression, mediation and moderation models, statistical power estimation, effect size reporting, and nonparametric alternatives.

Prerequisites

PSYC 205 and STAT 205.

Measurable Student Learning Outcomes

Upon successful completion of PSYC 380, students will be able to:

1. **Implement Reproducible Data Workflows in R:** Write clean, annotated R scripts and compile R Markdown reports conforming to open-science standards and APA 7th edition formatting.
2. **Design and Analyze Factorial Experimental Designs:** Compute main effects, interaction contrasts, and simple effects for between-subjects, repeated-measures, and mixed-model ANOVA designs.

3. **Execute Multiple Regression and Moderation Models:** Test hierarchical multiple regression models, evaluate multicollinearity and residual assumptions, and probe interactions using spotlight and floodlight analysis.
4. **Conduct Statistical Mediation and Path Analyses:** Estimate direct, indirect, and total effects using bootstrapping techniques in R to evaluate psychological mediation mechanisms.
5. **Perform A Priori and Post Hoc Power Analyses:** Calculate required sample sizes and statistical power using G*Power and R packages for diverse experimental effect sizes.
6. **Interpret and Report Statistical Findings:** Synthesize complex statistical findings into clear, APA-compliant results sections complete with confidence intervals, effect sizes, and data visualizations.

Required Course Materials & Approximate Costs

1. **Field, Andy, Jeremy Miles, and Zoë Field. *Discovering Statistics Using R*. SAGE Publications, 2012.** Approx. \$50 for digital rental; approx. \$85 for print purchase.
2. **Navarro, Danielle. *Learning Statistics with R: A Tutorial for Psychology Students and Other Beginners*. Free open-access digital edition.** Free.
3. **R (v4.3+) and RStudio Desktop development environment.** Free open-source software.
4. **Total estimated cost:** \$0 to \$85.

Generative AI Policy (AI Level 2: AI Permitted with Disclosure for Specified Tasks)

In accordance with Alkimi University Academic Policies (Student Handbook §5.8), PSYC 380 operates under **AI Level 2**.

- **What is permitted:** You may use AI tools to troubleshoot R syntax errors, explain statistical package error messages (e.g., from car, lme4, or mediation), generate practice datasets, and refine R Markdown documentation formatting.
- **What is prohibited:** You may not submit AI-generated statistical interpretation text, automated data analysis write-ups, or unverified R code. The use of generative AI tools is strictly prohibited during exams and in-class data analysis challenges.
- **Disclosure:** For each empirical problem set and the reproducible research project, include an AI disclosure appendix specifying which tools were consulted, prompts entered, and how you verified the statistical output, or state that no AI was used.

Grading Components and Weights

- **Midterm Exam 1:** 15% (In class, Thursday, September 24)
- **Midterm Exam 2:** 15% (In class, Thursday, October 29)
- **Weekly R Problem Sets & Reproducible Scripts:** 25% (Due Fridays at 11:59 p.m. in Canvas (weeks 2–13; lowest dropped))
- **Reproducible Empirical Research Project:** 20% (Due Friday, November 20 at 11:59 p.m.)
- **In-Class Data Analysis Challenges:** 5% (Canvas and R coding checks administered alternate Thursdays; lowest dropped)
- **Final Comprehensive Examination:** 20% (Thursday, December 17, 2026, 1:00–3:00 p.m.)

Grading Scale (Alkimi University Standard)

- **A:** 93–100% | **A-:** 90–92%
- **B+:** 87–89% | **B:** 83–86% | **B-:** 80–82%
- **C+:** 77–79% | **C:** 73–76% | **C-:** 70–72%
- **D+:** 67–69% | **D:** 60–66% | **F:** Below 60%
- **Extra credit:** Students can earn up to 2% extra credit by participating as a research subject in university-approved psychology experiments via SONA Systems or by attending designated psychology research colloquia.

Course Schedule (Fall 2026)

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 1	Aug 27	Open Science, Reproducibility, and the R Environment: Replication crisis in psychology, preregistration, RStudio project setup, tidyverse packages, and dynamic reproducible authoring with R Markdown. <i>Reading: Field Ch. 1 & 3</i>	<i>First day of classes: Wed Aug 26.</i>
Week 2	Sep 1, 3	Exploratory Data Analysis and Data Visualization: Data wrangling with dplyr, descriptive statistics, distribution normality checks, outlier detection, and publication-ready figures in ggplot2. <i>Reading: Field Ch. 4 & 5</i>	<i>Wed Sep 2: Add/section change deadline.</i>
Week 3	Sep 8, 10	The General Linear Model and Parametric Assumptions: Linear model formulation, ordinary least squares, homoscedasticity, normality of residuals, multicollinearity, and data transformation strategies. <i>Reading: Field Ch. 6</i>	<i>Mon Sep 7: Labor Day (no classes). Wed Sep 9: Census date (last day to drop without a W).</i>
Week 4	Sep 15, 17	One-Way Independent ANOVA and Contrast Testing: Partitioning variance (SS_between, SS_within), F-distribution, orthogonal planned comparisons, trend analysis, and post-hoc adjustments (Tukey, Bonferroni). <i>Reading: Field Ch. 10.1–10.3</i>	—
Week 5	Sep 22, 24	Factorial Independent ANOVA & Midterm Exam 1: Two-way and three-way factorial designs, main effects, disordinal and ordinal interactions, simple main effects; Midterm Exam 1 in class. <i>Reading: Field Ch. 12</i>	Midterm Exam 1 (in class).
Week 6	Sep 29, Oct 1	Repeated-Measures ANOVA and Sphericity: Within-subjects variance partitioning, Mauchly's test of sphericity, Greenhouse-Geisser and Huynh-Feldt corrections, and repeated-measures contrasts. <i>Reading: Field Ch. 13</i>	—
Week 7	Oct 6, 8	Mixed-Design (Split-Plot) ANOVA: Between- and within-subjects factors, interaction partitioning, simple simple effects, and error term selection in mixed ANOVA models. <i>Reading: Field Ch. 14</i>	—
Week 8	Oct 15	Analysis of Covariance (ANCOVA): Controlling extraneous variance, covariate selection criteria, adjusted means, and testing the assumption of homogeneity of regression slopes. <i>Reading: Field Ch. 11</i>	<i>Oct 12–Oct 13: Fall break (no classes).</i>
Week 9	Oct 20, 22	Multiple Linear Regression and Diagnostics: Simultaneous regression, standardized coefficients (beta), semi-partial correlations, R-squared change, leverage, Cook's distance, and VIF. <i>Reading: Field Ch. 7.1–7.6</i>	—
Week 10	Oct 27, 29	Hierarchical Regression & Midterm Exam 2: Theoretical block entry, incremental variance accounted for, model comparison tests; Midterm Exam 2 in class. <i>Reading: Field Ch. 7.7–7.12</i>	Midterm Exam 2 (in class).
Week 11	Nov 3, 5	Moderation Analysis and Probing Interactions: Continuous by continuous interactions, mean centering, simple slopes analysis, Johnson-Neyman technique (floodlight analysis), and PROCESS macro in R. <i>Reading: Field Ch. 10 & Hayes</i>	<i>Fri Nov 6: Last day to withdraw (W) or elect Pass/No Pass.</i>
Week 12	Nov 10, 12	Mediation Analysis and Bootstrapping: Baron and Kenny causal steps approach, contemporary indirect effect estimation, non-normal sampling distributions, and percentile bootstrapping. <i>Reading: Field Ch. 10 & Hayes</i>	—
Week 13	Nov 17, 19	Statistical Power Analysis and Effect Sizes: Type I and Type II errors, alpha and beta, Cohen's d, partial eta-squared, omega-squared, and power calculation with G*Power and pwr package. <i>Reading: Navarro Ch. 11</i>	Reproducible Empirical Research Project due Fri Nov 20 at 11:59 p.m.
Week 14	Nov 24	Nonparametric Alternatives to ANOVA: Rank-based hypothesis testing, Mann-Whitney U, Wilcoxon signed-rank, Kruskal-Wallis test, Friedman test, and robust statistical alternatives. <i>Reading: Field Ch. 15</i>	<i>Nov 25–Nov 27: Thanksgiving break (no classes).</i>

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 15	Dec 1, 3	Introduction to Linear Mixed-Effects Models: Random intercepts and slopes, clustered data, handling missing repeated measurements, and estimating models using the lme4 and lmerTest packages. <i>Reading: Field Ch. 19</i>	—
Week 16	Dec 8	Reproducible Science, Preregistration, and Project Showcase: Preregistration workflows, data sharing repositories (OSF), code transparency, and final student empirical project research presentations. <i>Reading: Navarro Ch. 17 & Review</i>	<i>Wed Dec 9: Last day of classes. Thu Dec 10: Reading Day.</i>
Finals	Dec 17	Final Comprehensive Examination: Thursday, December 17, 2026, 1:00–3:00 p.m., Lovell Hall 325.	Comprehensive examination covering experimental design, ANOVA, multiple regression, mediation, and statistical power.

Course Policies

Attendance Policy

Mastering advanced statistical analysis in R requires active, hands-on computer lab participation during class sessions. If an illness or university-approved absence arises, email Dr. Carver in advance. More than three unexcused absences will negatively affect your final course grade. Students who miss the first two class meetings without notifying the instructor may be dropped. Students may miss class for religious observance without penalty if they notify the instructor in writing within the first two weeks of the semester (by Wednesday, September 9, 2026). Absences for university-sponsored activities (athletics, performances, conferences) are excused with a letter from the sponsoring office at least one week in advance.

Late Work Policy

R problem sets submitted after the Friday deadline lose 10% per day and will not be accepted more than three days late. Complete solution scripts are posted after that window. The single lowest weekly problem set score is automatically dropped at the end of the semester.

Final Exam Policy

The final examination (Thursday, December 17, 2026, 1:00–3:00 p.m.) is scheduled by the University Registrar and can't be moved without the Dean's written approval (Faculty Handbook §5.5). A student with three or more final exams on the same calendar day may reschedule one of them. Requests go to the instructor of the middle exam by the last day of classes. For this term, send the request by Wednesday, December 9, 2026 (Student Handbook §6.4).

Academic Integrity

Alkimi University is an academic community devoted to rigorous scholarship, open intellectual inquiry, and uncompromising ethical conduct. All students are subject to the regulations of the Alkimi University Academic Integrity Policy. Academic dishonesty—including plagiarism, cheating on examinations, unauthorized collaboration, fabrication of empirical data, and unauthorized submission of academic work generated by artificial intelligence—undermines the integrity of the university and carries severe disciplinary sanctions. Sanctions range from a failing grade on an assignment or exam to an administrative course failure recorded as an 'XF' on the official transcript, academic suspension, or expulsion. Suspected violations are formally investigated and resolved through the Office of Academic Integrity in accordance with Faculty Handbook §6. For detailed information, consult the Office of Academic Integrity, Lovell Hall 315, (555) 555-0163, integrity@university.alkimi.ai.

Accessibility Services

Alkimi University is committed to providing equitable educational access and reasonable accommodations for all students with documented disabilities, including physical, sensory, psychological, learning, and chronic health conditions. Students requesting academic accommodations must formally register with the Office of Accessibility Services, Harlan Hall 204, (555) 555-0155, access@university.alkimi.ai. Once approved, students will receive an official Faculty Accommodation Letter detailing approved accommodations. Students should present this letter to the instructor as early in the semester as possible, and at least one week prior to any exam or assignment requiring accommodation. Accommodations cannot be applied retroactively.

Student Wellness and Mental Health

Your physical health, psychological well-being, and mental health are essential to your academic success. If you experience heightened stress, anxiety, depressive symptoms, personal trauma, or academic burnout, free, confidential counseling and medical care are available through the Hollis Health & Counseling Center, located in the Hollis Center. Routine appointments are available Monday–Friday 8:00 a.m.–6:00 p.m. and Saturday 10:00 a.m.–2:00 p.m. during the semester by calling (555) 555-0190 or emailing health@university.alkimi.ai. Urgent, 24/7 crisis psychological counseling is accessible immediately at (555) 555-0199.

Campus Student Support Services

- **Academic Advising Center:** Lovell Hall 101 | (555) 555-0158 | advising@university.alkimi.ai
- **Writing Center:** Whitcombe Library 3rd Floor | Free consultations on papers, reports, and research projects at any stage.
- **Whitcombe Library:** Whitcombe Library, Main Floor | (555) 555-0170 | askalibrarian@university.alkimi.ai
- **Hollis Health & Counseling Center:** Hollis Center | (555) 555-0190 | 24/7 Counseling Line: (555) 555-0199 | health@university.alkimi.ai
- **Psychology Data Analysis & R Tutoring:** Drop-in peer tutoring and R coding support are available Monday through Thursday from 3:00 to 6:00 p.m.