

Course Title: Research Methodology: Quantitative Methods in Science & Mathematics Education Research
Course Code: SCE110.2
Credits: 2
Core/FE/Elective: Core
Instructor(s): Akshat Singhal, Navaneetha M R, Aniket Sule

Course Starting Date: Preferably 8th January 2025
Preferred Day & Time: Wednesday, 2:30 - 4:30 pm
Course Duration: 8th January to 15th April 2025 (14 sessions, one per week, totalling 28 contact hours)

Course Outcomes

Upon completion of this course, students will be able to:

1. Understand and apply the experimental design process, including sampling methods and reliability considerations.
2. Calculate and interpret key descriptive statistics to summarize educational research data effectively.
3. Conduct inferential statistical tests and draw valid conclusions from data using these techniques.
4. Gain hands-on experience with programming tools (R, Python, XLSX) and platforms for statistical analysis.

Detailed Course Outline

Weeks 1-3: *Introduction and Foundations*

- Overview of quantitative research in education, observational studies, and experiment design.
- Sampling techniques, probability and non-probability samples, and sources of error.
- Ensuring validity and reliability in data collection methods, including surveys, experiments, and observations.

Weeks 4-5: *Data Organization and Study Design*

- Organizing qualitative and quantitative data, visualizations, and avoiding misrepresentations.
- Understanding survey designs and study types (cross-sectional, longitudinal, trend); effective survey planning.

Weeks 6-7: *Introductory Programming and Descriptive Statistics*

- Basics of data manipulation in R, Python, and spreadsheets (XLSX).
- Calculating and interpreting measures of central tendency, dispersion, and position; visualizing data.

Weeks 8-9: *Correlation, Regression, and Probability Distributions*

- Analyzing relationships between variables using correlation and linear regression.
- Introduction to probability distributions, focusing on binomial and normal distributions.

Weeks 10-11: *Advanced Programming and Hypothesis Testing*

- Intermediate programming techniques, data cleaning, and using ChatGPT for assistance.
- Constructing confidence intervals, basics of hypothesis testing, and interpreting p-values.

Weeks 12-13: *Comparative Analysis and Advanced Procedures*

- Comparing two samples, Chi-square tests, and goodness-of-fit.
- Advanced analysis techniques: ANOVA, factor analysis, cluster analysis, and selecting appropriate tests.

Week 14: *Capstone and Review*

- Final project discussions, comprehensive review of methods, and preparation for the term project.

Tentative Assessment/Grading Scheme

1. **Class Participation:** 20%
2. **Presentations:** 20%
3. **Term Project:** 60%

References

- Cohen, Louis, Lawrence Manion, and Keith Morrison. *Research Methods in Education*
- Sullivan, Michael III. *Fundamentals of Statistics*
- Purohit, Sudha G., Sharad D. Gore, and Shailaja R. Deshmukh. *Statistics Using R*
- Slater, Stephanie J. "Conducting Astronomy Education Research: An Astronomer's Guide"