

Applied Quantitative Techniques for Educational Research
PhD – Compulsory course for Innovations & Management in Education Specialization
Indian Institute of Management Ahmedabad
Credits: 1

Course outline

Instructor: Prof. Kathan Shukla (Wing 11-J)

Course Description:

This applied course builds on the insights and knowledge obtained in the first-year research methodology courses (Survey of Statistical Methods, and Statistics). Regression analysis is one of the most commonly used quantitative techniques used across various fields such as economics, education, psychology, sociology, and business. The course is designed to help students become more informed consumers of research and be able to apply these analytic techniques in educational/psychological research. The course will be based on a combination of theoretical and practice-oriented sessions that will provide working knowledge of statistical software like SPSS, STATA and R.

Topics covered in the course will include: univariate and multivariate analysis of variance (ANOVA & MANOVA), simple regression, multiple regression (MR) analysis, regression diagnostics, the use of categorical independent variables, curvilinear regression analysis, modelling binary outcomes (logistic regression), Poisson and negative binomial regression, direct and indirect effects of predictor on the outcome variable of interest.

Learning Objectives:

Upon the completion of this course, the participants would be able to:

1. Understand and apply the quantitative techniques of ANOVA, MANOVA, simple regression, multiple regression (MR) analysis, curvilinear regression, logistic regression, Poisson and negative binomial regression used in social science research.
2. Identify which analytic technique(s) to use for a given research question and data structure.
3. Infer findings from data analysis and to draw conclusions about study population.
4. Use the statistical packages like SPSS, STATA and/or R in their quantitative research.
5. Communicate methods and results of a research study in writing with appropriate tables and figures.

Course Duration and Pedagogy:

A combination of lectures, presentation and class-room exercises will be used. Participants are expected to familiarize themselves with the assigned readings and come to class prepared to participate in the class discussions.

Textbooks and reading material:

Course Mat: Course material will be given at the beginning of the course. This will contain notes on various topics covered throughout the course.

Reference Texts:

RT1: Agresti, A., & Finlay, B. (2007). *Statistical Methods for the Social Sciences* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

RT2: Cohen, J., Cohen, P., West, S., & Aiken, L. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (3rd ed). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

General Reading:

Wilkinson, L. (1999). Statistical methods in psychology journals: Guidelines and explanations. *American psychologist*, 54(8), 594.

Evaluation:

- **Assignments: 25%:** The course will involve several assignments throughout the term including devising analytic plans and conducting analyses for given data sets, critically assessing specific research questions for various quantitative techniques discussed in the class.
- **Data Analysis Project & Presentation: 40%:** The course requirements include the completion of a project where participants will choose a set of hypotheses of interest, develop research questions and analyze real data to test the hypotheses. A paper based on this project as well as a class presentation will be required. Various sections of the paper will be due during the course of the semester. The project will involve application of course material in designing the method for a study and providing rationale for it. The paper should be written in APA Style and be **NO** more than **6-double spaced pages**. Your data analysis should address multiple research questions and have these minimum requirements: (a) Descriptive statistics for sample demographics and variables of interest, (b) graphs that highlight important features of the data and/or illustrate your results, (c) inferential statistics must be accompanied by effect sizes and/or confidence intervals, (d) application of any of the analytic techniques discussed in class that answers proposed research question(s). Data collection is encouraged but not necessary. Students may use secondary data sets.
- **End Term Examination: 30%**
- **Class participation: 5%** – You are expected to attend class and contribute to class discussions. If we observe you browsing the web, using Facebook, texting or using the computer or phone for anything unrelated to class, we will deduct points here.

Sessions Plan:

**Each session is of 2 hour 30-minute duration*

Sessions 1-2: Hypotheses testing

- Understand the idea of hypothesis testing, why test null hypothesis, how science progresses (philosophical understanding of hypothesis testing), generating statistical hypothesis from research hypothesis, sampling distributions, CLT, understanding standard errors, Type-I error, Type-II error, statistical power, z-test, t-test, paired-t, F-test, chi-square, interpreting the meaningfulness of effect sizes
- Application of concepts to analysing social science problems
- Hands-on exercises using SPSS, R

Sessions 3-4: Univariate and Multivariate Analysis of Variance

- Understand the idea of analysis of variance (ANOVA), one-way ANOVA, two-way ANOVA, multiple-factor ANOVA, analysis of covariance (ANCOVA), multivariate

ANOVA (MANOVA), statistical assumptions of ANOVA and their associated tests, Post-hoc procedures, and interpreting the meaningfulness of effect sizes.

- Application of concepts to analysing social science problems
- Hands-on exercises using SPSS, R

Readings: RT1: Chapters 12-13

Egyed, C. J., & Short, R. J. (2006). Teacher self-efficacy, burnout, experience and decision to refer a disruptive student. *School Psychology International*, 27(4), 462-474.

Dvir, T., Eden, D., Avolio, B. J., & Shamir, B. (2002). Impact of transformational leadership on follower development and performance: A field experiment. *Academy of Management Journal*, 45(4), 735-744.

Session 5: Repeated-measures ANOVA

- Understand the idea of repeated-measures ANOVA, statistical assumptions of repeated-measures ANOVA and their associated tests, interpreting the meaningfulness of effect sizes.
- Application of concepts to analysing social science problems
- Hands-on exercises using SPSS, R

Reading:

Jovanovic, J., & King, S. S. (1998). Boys and Girls in the Performance-Based Science classroom: Who's doing the performing?. *American Educational Research Journal*, 35(3), 477-496.

Sessions 6-7: Simple Linear Regressions & Multiple Regressions

- Understand the idea of regressions, the ordinary least squares regression analysis, including the estimation process, statistical assumptions and model building, measuring the fit of a model, interpretation of information that a linear regression model yields, and the meaningfulness of effect sizes, examining outliers and multicollinearity.
- Application of concepts to analysing social science problems
- Hands-on exercises using SPSS, R

Readings: RT1: Chapter 9 - 11

Shukla, K., & Wiesner, M. (2015). Direct and indirect violence exposure: relations to depression for economically disadvantaged ethnic minority mid-adolescents. *Violence and victims*, 30(1), 120.

Datta, D. K., Guthrie, J. P., & Wright, P. M. (2005). Human resource management and labor productivity: does industry matter?. *Academy of management Journal*, 48(1), 135-145.

Session 8: Moderation Effect, Regressions with categorical independent variables

- Understand the idea of regression with dummy variables, moderation in social sciences, interaction effects, interpretation of moderation testing results, visualizing moderation, centring for moderation, and the meaningfulness of effect sizes.
- Application of concepts to analysing social science problems
- Hands-on exercises using SPSS, R

Readings: RT2: Chapter 7-9

Dumay, X. (2009). Origins and consequences of schools' organizational culture for student achievement. *Educational Administration Quarterly*, 45(4), 523-555.

O'malley, M., Voight, A., Renshaw, T. L., & Eklund, K. (2015). School climate, family structure, and academic achievement: A study of moderation effects. *School Psychology Quarterly*, 30(1), 142.

Session 9: Curvilinear Regression, Logistic Regression

- Understand the idea of curvilinear and logistic regressions, quadratic and cubic models in regressions, probit and logit models of regressions, interpretation of regression results, visualizing the results and the meaningfulness of effect sizes.
- Application of concepts to analysing social science problems.
- Hands-on exercises using SPSS, R

Readings: RT1: Chapter 14 (462-473) & 15 (483 – 501); RT2: Chapter 6

McCoach, D. B., & Siegle, D. (2003). Factors that differentiate underachieving gifted students from high-achieving gifted students. *Gifted child quarterly*, 47(2), 144-154.

Barrick, M. R., & Zimmerman, R. D. (2009). Hiring for retention and performance. *Human Resource Management*, 48(2), 183-206.

Session 10: Poisson & Negative Binomial Regression, Direct & Indirect Effects

- Understanding the idea of Poisson and negative binomial regressions, interpretation of regression results and the meaningfulness of effect sizes, Direct and Indirect effects of predictors on the outcome variable of interest.
- Application of concepts to analysing social science problems.
- Hands-on exercises using SPSS, R.

Readings: RT2: Chapter 13

Shukla, K., & Wiesner, M. (2016). Relations of delinquency to direct and indirect violence exposure among economically disadvantaged, ethnic-minority mid-adolescents. *Crime & Delinquency*, 62(4), 423-445.

Ross, J. A., & Gray, P. (2006). School leadership and student achievement: The mediating effects of teacher beliefs. *Canadian Journal of Education*, 798-822.