

**(III) Area of Specialization Courses in Statistics**  
**TEACHING STATISTICS**

**Course code: EDBER356**

**Credit Hours: 3**

**Capsule statement**

Statistics is becoming increasingly important in modern society, the relevance of developing statistical thinking in students across all levels of education has grown. Changes in what is expected in the teaching of statistics do not just concern the amount but also the quality of the content. The experts' recommendations, suggest a data oriented approach to the teaching of statistics where students are expected to: design investigations; formulate research questions; collect data using observations, surveys, and experiments; describe and compare data sets; and propose and justify conclusions and predictions based on data. Learners are expected to deal with data in significant contexts and to take a critical stance on the analysis and interpretation of data and especially the abuse of data and statistics. The importance of developing statistical thinking and reasoning and not just statistical knowledge in students is being emphasized. The learners will also learn how to teach different concepts of statistics?

**Learning Outcomes of the course**

On successful completion of the course, prospective teachers/novice researchers will be able to:

1. Understand the need of teaching statistics
2. Use practical examples related to teaching statistics
3. Apply different techniques for teaching statistics
4. Engage in different activities related to statistics.
5. Motivate students as active learners

**Contents**

**1. Introduction**

- 1.1 The challenge of teaching introductory statistics
- 1.2 Fitting demonstrations, examples, and projects into a course
- 1.3 What makes a good example?
- 1.4 Why is statistics important?
- 1.5 The best of the best
- 1.6 General methods and techniques of teaching statistics

**2. Familiarity with Data**

- 2.1 Guessing ages
- 2.2 Where are the cancers?
- 2.3 Estimating a big number
- 2.4 What's in the news?
- 2.5 Collecting data from students

**3. Descriptive Statistics**

- 3.1 Teaching descriptive statistics
- 3.2 Displaying graphs on the blackboard
- 3.3 Time series
  - 3.3.1 World record times for the mile run
- 3.4 Numerical variables, distributions, and histograms
  - 3.4.1 Categorical and continuous variables
  - 3.4.2 Handedness

- 3.4.3 Soft drink consumption
- 3.5 Numerical summaries
  - 3.5.1 Average soft drink consumption
  - 3.5.2 The average student
- 3.6 Data in more than one dimension
  - 3.6.1 Guessing exam scores
  - 3.6.2 Who opposed the Vietnam War
- 3.7 The normal distribution in one and two dimensions
  - 3.7.1 Heights of men and women
  - 3.7.2 Heights of conscripts
  - 3.7.3 Scores on two exam
- 4. Linear Regression and Correlation**
  - 4.1 Teaching correlation and linear regression
  - 4.2 Fitting linear regressions
    - 4.2.1 Simple examples of least squares
    - 4.2.2 Tall people have higher incomes
    - 4.2.3 Logarithm of world population
  - 4.3 Correlation
    - 4.3.1 Correlations of body measurements
    - 4.3.2 Correlation and causation in observational data
  - 4.4 Regression to the mean
    - 4.4.1 Mini-quizzes
    - 4.4.2 Exam scores, heights, and the general principle
- 5. Data Collection**
  - 5.1 Sample surveys
    - 5.1.1 Sampling from the telephone book
    - 5.1.2 2 First digits and Benford's law
    - 5.1.3 Wacky surveys
    - 5.1.4 An election exit poll
    - 5.1.5 Simple examples of bias
    - 5.1.6 How large is your family?
  - 5.2 Class projects in survey sampling
    - 5.2.1 The steps of the project
    - 5.2.2 Topics for student surveys
  - 5.3 Experiments
    - 5.3.1 An experiment that looks like a survey
    - 5.3.2 Randomizing the order of exam questions
    - 5.3.3 Taste tests
    - 5.3.4 The Surgeon General's report on smoking
    - 5.3.5 Large population studies
    - 5.3.6 Coaching for the SAT
- 6. Probability**
  - 6.1 Constructing probability examples
  - 6.2 Ways to teach probability
  - 6.3 Random numbers via dice or handouts
    - 6.3.1 Random digits via dice

- 6.3.2 Random digits via handouts
- 6.3.3 Normal distribution
- 6.3.4 Poisson distribution
- 6.4 Probabilities of compound events
  - 6.4.1 Babies
  - 6.4.2 Real vs. fake coin flips
  - 6.4.3 Lotteries
- 6.5 Probability modeling
  - 6.5.1 Lengths of baseball World Series
  - 6.5.2 Voting and coalitions
  - 6.5.3 Space shuttle failure and other rare events
- 6.6 Conditional probability
  - 6.6.1 What's the color on the other side of the card?
  - 6.6.2 Lie detectors and false positives
- 6.7 You can load a die but you can't bias a coin flip.
  - 6.7.1 7.6.1 Demonstration using plastic checkers and wooden dice
  - 6.7.2 Sporting events and quantitative literacy
  - 6.7.3 Physical explanation
- 7. Statistical Inference**
  - 7.1 Weighing a "random" sample
  - 7.2 From probability to inference: distributions of totals and averages
    - 7.2.1 Where are the missing girls?
    - 7.2.2 Real-time gambler's ruin
  - 7.3 Confidence intervals: examples
    - 7.3.1 Biases in age guessing
    - 7.3.2 Comparing two groups
    - 7.3.3 Land or water?
    - 7.3.4 Poll differentials: a discrete distribution
    - 7.3.5 Golf: can you putt like the pros?
  - 7.4 Confidence intervals: theory
    - 7.4.1 Coverage of confidence intervals
    - 7.4.2 Noncoverage of confidence intervals
  - 7.5 Hypothesis testing: z, t, and  $\chi^2$  tests
    - 7.5.1 Hypothesis tests from examples of confidence intervals
    - 7.5.2 Binomial model: sampling from the phone book.
    - 7.5.3 Hypergeometric model: taste testing
    - 7.5.4 Benford's law of first digits
    - 7.5.5 Length of baseball World Series
  - 7.6 Simple examples of applied inference
    - 7.6.1 How good is your memory?
    - 7.6.2 How common is your name?
  - 7.7 Advanced concepts of inference
    - 7.7.1 Shooting baskets and statistical power
    - 7.7.2 Do-it-yourself data dredging
    - 7.7.3 Praying for your health

### Teaching-learning Strategies

The instructional strategies will focus on constructionist learning approach. These strategies will be diverse in line with the course contents. Therefore, these strategies will include but not limited to demonstration, cooperative learning, collaborative learning, teacher and student-led discussion, individual and group presentations, reflective practices and classroom activities.

### Assessment and Examinations

The students will be assessed according to the following criteria

Examination	Marks Distribution
Sessional Work	25%
Mid-Semester	35%
Final Semester	40%

### Suggested Readings

- Gelman, A., & Nolan, D. (2017). *Teaching statistics: A bag of tricks*. Oxford University Press.
- Bakker, A. & Gravemeijer, K.R. E. (2004). Learning to reason about distributions. In, D. Ben-Zvi & J. Garfield (Eds.), *The challenge of developing statistical literacy, reasoning, and thinking* (pp. 147-168). Dordrecht: Kluwer Academic.
- Bland, J. M. (2004). Teaching statistics to medical students using problem-based learning: the Australian experience. *BMC Medical Education*, 4(1), 31.
- Cobb, G. (1992). Teaching statistics. *Heeding the Call for Change: Suggestions for Curricular Action*, 22, 3-43.
- Dofinsky, B. (2001). An active learning approach to teaching statistics. *Teaching of Psychology*, 28(1), 55-56.
- Everson, M., Zieffler, A., & Garfield, J. (2008). Implementing new reform guidelines in teaching introductory college statistics courses. *Teaching Statistics*, 30(3), 66-70.
- Garfield, J., & Ben Zvi, D. (2007) How students learn statistics revisited: A current review of research on teaching and learning statistics. *International Statistical Review*, 75(3), 372-396.
- Moss, J. D. (2003). A theoretical framework for teaching statistics. *Teaching Statistics*, 25(2), 56-58.
- Pratt, D., Davies, N., & Connor, D. (2011). The role of technology in teaching and learning statistics. In *Teaching statistics in school mathematics-challenges for teaching and teacher education* (pp. 97-107). Dordrecht: Springer.