**STAT 335 – Principles of Study Design**

**Fall 2018**

**INSTRUCTOR**: Chris Malone

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**OFFICE HOURS:** TBD / See course website: <http://www.statsclass.org>

**TEXT:** There is no text required for this course. Course materials will be posted on the website.

**COURSE LEARNING OUTCOMES:** Successful completion of this course will promote your abilities to…

* correctly use data gathering techniques and understand their limitations in research studies. A successful student will be knowledgeable of basic data gathering techniques and the implications of using these methods for research studies.
* recognize the strengths and weaknesses of research designs used in research studies.
* correctly design and implement a research study. A successful student will be able to design an ethical and valid study to evaluate a hypothesis of interest.
* report and communicate conclusions effectively. A successful student will be able to communicate essential features and results of a research study in a manner which is understandable to both technical and non-technical audiences.
* Students will learn to recognize and reflect critically on ethical issues commonly encountered in research studies.
* use appropriate technology to describe and analyze data from research studies. A successful student will be able to use statistical software packages to perform analyses and interpret the results from the given output.

**GRADED WORK:** To both achieve and demonstrate the above learning outcomes, you will be asked to complete the following tasks. Your grade earned in the course will be based on the following items.

1. Homework Assignments/Projects

Written homework assignments will be given throughout the course. Some of these assignments will ask you to critically analyze the research of others; other assignments/projects may involve designing and/or carrying out your own research studies.

HOMEWORKS/PROJECTS:

* A **hard copy** of each completed homework assignment is due at the beginning of class on its assigned due date.
* Late homework assignments/projects will be assessed a 10% penalty for being late and will not be accepted after graded assignments are returned to other students or after solutions have been posted.

1. Exams  
   There will be two exams throughout this course – a midterm and final exam. Exams may consist of an in-class and out-of-class portion. These exams will require you to demonstrate your understanding of the material as opposed to your ability to memorize certain concepts. Exams will evaluate your ability to make conclusions and/or extensions to the methods/techniques presented in class.

EXAM POLICY: The date will be announced at least one week in advance. If you know you are going to miss an exam, the exam must be taken early. Makeup exams will be given in extreme (my judgment) cases only.

**GRADES:** I will use the following guidelines for assigning final grades.

* 90% and above guarantees at least an A
* 80% and above guarantees at least a B
* 70% and above guarantees at least a C
* 60% and above guarantees at least a D
* Below 60% will likely result in failure of the course

**ACADEMIC INTEGRITY POLICY:** All students must abide by Winona State University’s Academic Integrity Policy: <http://www.winona.edu/sld/academicintegrity.asp>.   
 **EXTRA STUFF:**

* I encourage you to use a 3-ring binder for this class because class material will be a combination of note taking, handouts, and possible some computer output.
* Attendance in mandatory.  If you miss class, it is your responsibility to get the material and get yourself caught up.
* If necessary, I reserve the right to make policy changes for this course as the semester progresses.

**COURSE OUTLINE:**

1. Research Cycle
   1. Formulating a research question
   2. Variables (Qualitative and Quantitative)
   3. Design of study
   4. Data collection
   5. Descriptive analysis
   6. Inferential analysis
   7. Drawing conclusions
      1. Actionable outcomes
      2. Policy development
      3. Future research
2. Types of Studies
   1. Designed Experiments
   2. Observational Studies
   3. Surveys
3. Design of Experiments
   1. Basic definitions (factors, treatments, experimental units)
   2. Confounding variables
   3. Fundamental design concepts: control, randomization, replication
   4. Placebos
   5. Single- and double-blind experiments
   6. Completely randomized designs
   7. Randomized block designs
   8. Cross-over studies
   9. Longitudinal studies
4. Observational Studies
   1. Descriptive vs. analytic studies
   2. Types of observational studies
      1. Prospective
      2. Retrospective
      3. Cross-sectional
   3. Effects of confounding variables
   4. Matching methods
5. Surveys
   1. Sampling Methods
      1. Probability sampling (simple random sampling, stratified sampling, cluster sampling, multistage sampling)
      2. Non-probability sampling (convenience sampling, purposive sampling, quota sampling)
      3. Comparison of sampling error estimates for different sampling methods
      4. Oversampling
   2. Questionnaire Design
      1. Open- vs. closed-ended questions
      2. Rating questions (e.g., Likert scale, visual analogue scale)
      3. Ranking questions
      4. Select all that apply questions
      5. Wording of individual questions
      6. Ordering of questions
   3. Reliability
      1. Test-retest reliability (Pearson’s correlation, inter-class correlation coefficient, kappa coefficient)
      2. Parallel forms reliability
      3. Internal Consistency (inter-item correlations, split-half reliability, Cronbach’s alpha)
   4. Validity
      1. Face validity
      2. Content validity
      3. Criterion-related validity (predictive, concurrent, convergent, discriminant)
   5. Types of bias
      1. Non-response bias
      2. Coverage bias
      3. Self-selection/volunteer bias
      4. Social desirability bias (can discuss the randomized response survey technique)
      5. Interviewer effects
      6. Errors in transfer of findings
      7. Survey format effects (e.g., wording/ordering of questions)
6. Ethical Considerations in the Design of Studies
   1. Ethical treatment of research subjects
      1. Belmont report/ Nuremberg code
      2. Institutional Review Boards
      3. Clinical trial considerations
   2. Responsibility to apply sampling and analysis procedures scientifically, without pre-determining the outcome
   3. Responsibility to clearly report the intent of a study, how it was performed, and any limitations on its validity