**MATH 301: Probability & Statistics II (Spring 2008)** ___ – 5:10-6:25 in Ambrose 413C

Instructor: Brad Thiessen
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Office Hours: MWF 12–1, 3:30-4:30; R 3:30-4:30

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**Overview**:

This course will build upon the statistical concepts, skills, and techniques you learned in Probability & Statistics I to introduce new statistical analysis procedures. In MATH 300, we learned how to conduct statistical analyses involving one or two treatment groups measured on one dependent variable (independent and dependent samples t-tests). In this course, we will learn techniques used to analyze more than two groups (One-way, AxB, and repeated measures ANOVA) as well as analyses involving two or more variables (bivariate/correlational analyses). We will also learn a wide variety of regression techniques we can use to better understand the underlying relationship among variables. Time permitting, we will learn nonparametric methods and introduce multivariate statistics. A good amount of time will be spent actively analyzing real data from a variety of fields (education, industry, economics, healthcare, and psychology)

**Required Materials**:

*Probability & Statistics for Engineering & the Sciences* by Jay L. Devore (7th edition) -- ISBN: 978-0-495038217-1
Binder for course notes, activities, and assignments
Calculator

**Prerequisites**:

Since you successfully completed MATH 300, you should have a conceptual understanding of sampling distributions, the Central Limit Theorem, statistical inference, confidence intervals, and hypothesis testing. As in MATH 300, a strong background in algebra, geometry, and calculus will be to your benefit.

**Outline of Major Topics**:

1) Brief review of MATH 300 (sampling distribution of the sample mean, CLT, statistical inference)
2) Chi-Squared and F-distributions (inferences regarding population variances)
3) ANOVA & Post hoc Procedures (comparing two or more treatment groups)
4) AxB ANOVA (comparing two or more treatment groups on two variables)
5) Experimental Design (repeated measures and groups-within-treatments designs)
6) Bivariate Analysis (correlation, covariance, joint distributions, goodness-of-fit tests)
7) Linear Regression (using an independent variable to predict a dependent variable)
8) Multiple Regression (model selection procedures)
9) Logistic regression
10) Nonparametric statistics
11) Multivariate statistics (multivariate normal distributions, principal components analysis, multidimensional scaling)

**Course Procedures**:

The important concepts and reasoning for each topic will be introduced through guided classroom activities. Since statistics is best learned actively, it is important that you attend class and take part in these activities. Once we have an understanding of the topic, we will use our new skills to analyze a simple dataset by hand. After we have gained a computational understanding of the topic, we will use SPSS, a statistical software package, to analyze real data. Finally, you will be asked to analyze some datasets on your own in order to solidify the concepts. Keep in mind that the focus of this course will be on the concepts, logic, and real applications of each topic, not the specific procedures themselves.

The exams will be somewhat similar to the exams in the previous course. You can expect true-false and multiple-choice questions to check your understanding of concepts and short-answer questions to see if you understand the statistical methods we learn in class. You will be allowed to use your notes, the textbook, and your calculator on each exam. As a general rule, you will not be able to use the computer during exams. Towards the end of the semester, when we're all comfortable using SPSS, I may ask questions on the exam that will allow you to use the computer.

Let me state once again that I want you to learn the concepts, logic, and applications of statistics. To do this, you will need to come prepared to class every day. This means you should: read the lecture notes before class, actively participate in class discussions, complete your assigned work, and review your notes. Don't fall behind in this class.

**Student Expectations**:

1) Attend class. We're not going to learn step-by-step analysis techniques in this class; we will be studying broad statistical concepts. Because of this, it will be extremely difficult to learn this on your own (there won't be a lot of homework in this course). While I won't penalize you for missing class, I can assure you that your grade will suffer if you are absent. If you must miss class, I'd appreciate it if you let me know in advance.

2) Actively participate in class discussions. Current research on teaching statistics to undergraduate students stresses the importance of active learning. If you actively participate in class (answering questions and analyzing data), you will learn the material.

3) Complete all assigned readings, analyses, portfolios, and projects by the scheduled due dates. Late work will receive a grade no higher than a C.

4) Successfully complete all projects and exams. All exams will be open-book, open-note. If you fail an exam, you will be assigned an additional project to prove that you have learned the material. Students who earn a grade lower than a C on a project must resubmit the project for a higher grade.

**Student Evaluation**:

| | | No Homework Option | Homework Option |
|---|---|---|---|
| Unit: | Exam | 65% | 55% |
| | Assignments/Participation | 20% | 20% |
| | Quizzes | 15% | 15% |
| | Homework | -- | 10% |

Students scoring lower than 70% on the exams will be assigned additional data analysis projects.

**Data Analysis Assignments**:

In each unit, you will be asked to completely analyze a dataset in order to answer a research question. The datasets and research questions will be given to you. Grading rubrics for the analyses will be handed-out in class.

**Plagiarism**:

Don't cheat. You can work with other students on the homework, but the exams should only represent your level of understanding. Review the Policy on Academic Dishonesty in the University Catalog.

**Accommodations**:

Students with disabilities who believe they may need accommodations in this class are encouraged to contact the Office of Services for Students with Disabilities at 333-6275 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Note: Students should complete all unanswered activity questions as homework

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|---|---|---|
| Week 1<br>1/16 – 1/18 | Course Overview; Introductions<br>Activity #1: Review of hypothesis testing (t-tests)<br>Activity #2: Distributions of sample variances (Chi-square) | Read 9.2: 65, 75 (on page 364)<br>Read 7.4: 43, 45<br>**Graded chi-square activity (question #17)** |
| Week 2<br>1/21 – 1/25 | Monday: Martin Luther King, Jr. Day -- No class<br>Activity #3: Testing two variances (F-distribution)<br>Activity #4: Analysis of Variance (ANOVA) | **Graded F-distribution activity (question #15)**<br>Read 9.5: 57, 61<br>Read 10.1: 1, 3, 5, 7, 9 |
| Week 3<br>1/28 – 2/1 | Activities #4a,b,c: ANOVA Assumptions | Read 10.3: 25, 27<br>**Graded ANOVA exercises (#4d)** |
| Week 4<br>2/4 – 2/8 | Activity #5: Post-hoc comparisons (Bonferroni method)<br>Activity #6: Post-hoc comparisons (Tukey/Scheffe) | Read 10.2: 11<br>**Graded Post-hoc exercises** |
| Week 5<br>2/11 – 2/15 | Review chi-square, F-distribution, ANOVA, and post-hoc methods<br>**Exam #1: Analysis of Variance** | Complete examples in class<br>**Homework portfolios due** |
| Week 6<br>2/18 – 2/22 | Activity #7: AxB ANOVA (two-way ANOVA)<br>Activity #8: AxB ANOVA interaction & simple effects tests | Read 11.1: 1, 3, 5<br>**Graded AxB ANOVA (Activity #9)** |
| Week 7<br>2/25 – 3/1 | Activity #10: AxS ANOVA (Repeated measures)<br>In-class experiment (effect of environment on memory) | **Graded Activity #10a (examples)**<br>**Graded analysis of in-class data** |
| Week 8<br>3/3 – 3/7 | Spring Break | |
| Week 9<br>3/10 – 3/14 | *Activity #10a: Exp. Design: Split-plot, Latin-square, GwT (optional)*<br>Review ANOVA, experimental design | *Read 11.4: 38, 39 (optional)*<br>**E.C.: Histamine levels in dogs** |
| Week 10<br>3/17 – 3/21 | **Exam #2: Experimental design**<br>Friday: Good Friday – No class | **Homework portfolios due** |
| Week 11<br>3/24 – 3/28 | Monday: Easter Monday – No day classes<br>Activity #11: Chi-square goodness-of-fit and independence tests<br>Activity #12: Correlations | Read 14.1: 1, 3, 7<br>Read 14.3: 25, 27, 31<br>**Graded Activity 11a: Exercises**<br>Read 12.5: 57, 59, 61, 65<br>Read 12.1: 1, 3, 5<br>**Graded Correlation activity in-class** |
| Week 12<br>3/31 – 4/4 | Activity #13: Simple linear regression<br>Activity #14: More linear regression | Read 12.2: 15cd, 17, 19, 21, 23<br>**Graded Activity 13a: Exercises**<br>Read 12.3: 31, 33 |
| Week 13<br>4/7 – 4/11 | Activity #15: Multiple linear regression<br>Activity #16: More multiple linear regression | Read 13.4: 37, 39, 41, 43, 47 |
| Week 14<br>4/14 – 4/18 | Activity 16b: Multiple linear regression exercises<br>Activity #17b: Data to practice ANOVA, t-tests, chi-square, regression | |
| Week 15<br>4/21 – 4/25 | Work on data analysis project<br>Activity #18: Multidimensional Scaling | **Complete data analysis project**<br>**Write conclusions from MDS analysis** |
| Week 16<br>4/28 – 5/2 | Activity #19: Logistic Regression & Bootstrap methods<br>Activity #20: Multivariate normal distributions | **Graded logistic regression exercises (13.2)**<br>Matrix algebra introduction/review |
| Final Exam: | | |