COURSE # & TITLE:	MATH 1530-201 - Probability and Statistics
TIME & Place:	TR 3:45 - 5:05 in the Stat Cave
COURSE DIRECTOR:	Robert Price
DESIGNATED TEXT:	Basic Practice of Statistics by David S. Moore, 4^{th} Edition, W.H. Freeman"
INSTRUCTOR:	Scott La Voie lavoiemath@comcast.net

GOALS & OBJECTIVES FOR THIS COURSE:

To develop a basic understanding of probability and statistics and how they relate to the world around us. Topics are illustrated by using current newspaper, magazine articles, and the world wide web.

Objectives and comments/suggestions for each chapter appear below. Also, see the **Chapter Summary** sections at the end of each chapter or the course Web page; these, with appropriate deletions, serve as specific course objectives. In addition, the following topics will be incorporated into the course (See: Utts, J. (2003), "What Educated Citizens Should Know About Statistics and Probability," *The American Statistician*, 57, 74-79.) Seven topics that she lists that are important are the following

1. When can it be concluded that a relationship is one of cause and effect and when it cannot.
2. The difference between statistical significance and practical significance, especially when using large sample sizes.
3. The difference between finding "no effect" or "no difference" and finding no statistically significant effect or difference, especially when using small sample sizes.
4. Common sources of bias in surveys and experiments.
5. The idea of coincidences and seemingly rare events are not uncommon because there are so many possibilities.
6. Conditional probability in one direction is confused with the conditional probability in the other direction.
7. Understanding that variability is natural, and that "normal" is not the same as "average."

METHODS OF INSTRUCTION:

Instruction will not be solely lecture type, but a combination of lecture and activity-based worksheets. Class notes/worksheets will be available for the students on Blackboard. We will use Minitab and applets using the computer in the lab.
http://www.etsu.edu/math/price/1530/1530link.htm

TECHNOLOGY REQUIRED OF STUDENTS:

MINITAB, a statistical software package, will be introduced and used in the class.

A calculator that does basic math is sufficient.

PREREQUISITE:

two years of high school algebra

STUDENT SUCCESS:

- **S**tudy and read before attending the lectures. Keep up with the course.
- Devote a little **T**ime to studying statistics each day, rather than a large amount of time once a week.
- Take an **A**ctive role in learning. Come to class and participate.
- **T**utor each other. If you feel that you are lost help is out there; see your instructor/tutor early. Don't wait until the last minute!

TEXT PACKAGE:

- The Basic Practice of Statistics (BPS), by David S. Moore, 4^{th} Ed., Freeman, 2006.
- MINITAB 14 Student version DISC
- The Basic Practice of Statistics 4e (BPS) CD-ROM contains: Statistical Applets, Quizzes, Datasets, Companion Chapters, Tables and Formulas. Crunchit! and EESEE are available via access-code-protected Web site. The access code is available behind the CD.

CONTENTS:

Chapter 1: Picturing Distributions with Graphs

1. Understand data: Who, What, Why, When, Where, and How (At the least the Who, What and Why!)
2. Distinguish between a categorical and quantitative variable
3. Describe data with graphs: bar charts, pie charts, histograms, stemplots, and timeplots
4. Use Minitab to draw graphs; focus on interpretation.
5. Be able to distinguish between the various shapes for distributions.
6. When examining a distribution look for center, spread, shape, outlier(s).
7. Plot your data!
8. Recommended exercises: $1.1, 1.2, 1.4-1.9, 1.11-1.22, 1.24, 1.26, 1.32-1.34, 1.37, 1.44$

Chapter 2: Describing Distributions with Numbers

1. Introduce different numerical summaries: Mean, Median, Mode, Standard deviation, Range, Quartiles, IQR, Five-Number summary
2. Understand how the mean and median are related depending on the shape of the distribution.
3. Understand the effect of extreme values on numerical summaries.
4. Understand how to construct and interpret a boxplot.
5. Compare plots; boxplot vs. histogram vs. stemplot vs. timeplot
6. Relate standard deviation with a histogram.
7. Introduce a four-step process in organizing a statistical problem.
    - State: What is the practical question, in the context of the real-world setting?
    - Formulate: What specific statistical operations does this problem call for?
    - Solve: Make the graphs and carry out the calculations needed for this problem.
    - Conclude: Give your practical conclusion in the setting of the real-world problem.
8. Plot your data!
9. Recommended exercises: $2.1-2.5, 2.8, 2.10-2.22, 2.25, 2.26, 2.30-2.32, 2.34, 2.36, 2.38, 2.40, 2.44, 2.46$

Chapter 3: The Normal Distribution

1. Understand how to compute and the meaning of a standard score.
2. The 68-95-99.7 rule
3. The standard Normal distribution
4. Find proportions and percentiles for a Normal distribution using the Table and Minitab.
5. Use the Normal curve applet from BPS
6. Plot!
7. Recommended exercises: $3.1, 3.2, 3.4-3.8, 3.10, 3.14-3.24, 3.27-3.29, 3.32-3.43, 3.48, 3.50, 3.52$

Chapter 4: Scatterplots and Correlation

1. Understand the difference between a response variable and explanatory variable.
2. Understand how to display relationships between two quantitative variables.
3. Look for direction, form, and scatter in a scatterplot.
4. An applet on matching correlations with scatterplots (guessing exercise) can be found at
   http://www.stat.uiuc.edu/ stat100/java/GCApplet/GCAppletFrame.html
5. In this applet you can watch how the correlation changes as you place points on a graph. You can use this applet to illustrate how outlier(s) affect the correlation.
   http://www.stat.uiuc.edu/ stat100/java/guess/PPApplet.html
6. Compare a scatterplot vs. a histogram. What do we see in a scatterplot that is not revealed in a histogram? What do we see in a histogram that is not revealed in a scatterplot?
7. You may want to compute the correlation coefficient (r) by hand once. After that use Minitab to do your calculations.
8. Stress knowing the facts about the correlation coefficient.
9. Plot your data!
10. Recommended exercises: $4.1 - 4.9, 4.11 - 4.21, 4.23, 4.25, 4.28 - 4.30, 4.33, 4.35 - 4.37, 4.40$

Chapter 5: Regression

1. You may want to find the least-squares regression equation by hand once. Use Minitab to do your calculations and graphs.
2. Plot the regression line on the scatterplot.
3. Explain that the regression line to a scatterplot is like the mean is to a histogram.
4. Use the Correlation/Regression applets from BPS or
   http://www.stat.uiuc.edu/ stat100/java/guess/PPApplet.html
5. Stress interpretation rather than computation.
6. Be able interpret the meaning of the slope (don't forget about the units "*y-units* per *x-unit*") and the intercept (when appropriate).
7. Be able to use the least-squares regression equation for prediction.
8. Be able to interpret the square of the correlation coefficient (R-sq).
9. Recognize outliers and potentially influential observations from a scatterplot with the regression line drawn on it. Use the applet
   http://www.stat.uiuc.edu/ stat100/java/guess/PPApplet.html
10. A residual plot helps to check the model. Look for unusual patterns.
11. Association does not imply causation. Experiment is the best way to get good evidence that *x* causes *y*.
12. Discuss extrapolation and lurking variables.
13. Plot your data!
14. Recommended exercises: $5.1 - 5.3, 5.5, 5.7, 5.9, 5.11, 5.14 - 5.23, 5.24, 5.28, 5.32, 5.34, 5.36, 5.38, 5.39, 5.41, 5.42, 5.44, 5.47, 5.50, 5.54, 5.55$

Chapter 6: Two-Way Tables

1. Displaying relationships between two categorical variables; frequency tables or contingency tables.
2. Understand how to find the marginal distribution for each variable. Minitab can give overall, marginal, and conditional distributions.
3. Use the tattoo worksheet. This example also shows how to get a segmented bar chart in Minitab.
4. An association or comparison that holds for all of several groups can reverse direction when the data are combined to form a single group. This reversal is called *Simpson's Paradox.* See exercises $6.7, 6.8, 6.30, 6.31$
5. Plot your data!
6. Recommended exercises: $6.1 - 6.3, 6.5, 6.7 - 6.18, 6.24, 6.28, 6.30, 6.31$

Chapter 7: Exploring Data: Part I Review

Recommended exercises: $7.1, 7.2, 7.6, 7.9, 7.11, 7.13, 7.15, 7.16, 7.19 - 7.23, 7.25, 7.26, 7.36, 7.38, 7.39 - 7.41, 7.45, 7.46$

Chapter 8: Producing Data: Sampling

1. Use the Counting Es Activity which can be found at
   http://Faculty.etsu.edu/pricejr/Math1530/Worksheets/Prod_Data _Samp/Counting Es Activity.doc
2. Know the difference between a population and a sample.
3. Understand how bias can enter into samples or results.
4. Be able to identify the various types of sampling methods; simple random sampling, stratified random sampling, systematic sampling, cluster sampling, multistage sampling
5. Recommended exercises: $8.1 - 8.5, 8.7, 8.8, 8.14 - 8.26, 8.31, 8.32, 8.37, 8.39, 8.46, 8.50.$
   The following exercises require the use of random number tables, applet, or other software: $8.9, 8.11, 8.12, 8.36, 8.44.$

Chapter 9: Producing Data: Experiments

1. Know the difference between an observational study and an experiment.
2. Be able to identify the subjects, factors, treatments in a study.
3. Understand what constitutes a randomized comparative experiment.
4. Know the three principles of experimental design: Control, Randomize, Replication.
5. Understand the meaning of statistical significance and when does it imply causation.
6. Understand what is a matched pairs design and block design. Blocking in another form of control.
7. Recommended exercises:$9.1 - 9.4, 9.9, 9.10, 9.12, 9.13, 9.16 - 9.26, 9.36, 9.39, 9.41, 9.45, 9.47.$ The following exercises require the use of random number tables, applet, or other software: $9.5, 9.29, 9.32$

Chapter 10: Introducing Probability

1. Know that chance behavior is unpredictable in the short run but has a regular and predictable pattern in the long run.
2. Use the flipping of the coin applet from the BPS Web site.
3. Use computer simulation worksheets.
4. Know the probability rules.
5. Find the probability of an event for the Normal probability model.
6. Recommended exercises: $10.4, 10.5, 10.8 - 10.13, 10.15 - 10.17, 10.19 - 10.28, 10.31, 10.39, 10.40, 10.43, 10.44,$ $10.46, 10.49, 10.51, 10.53.$ The following exercises require the use of an applet or other software: $10.3b, 10.35, 10.55$

Chapter 11: Sampling Distributions

1. Tough chapter! This Chapter is important to understand statistical inference i.e., confidence intervals and tests of hypotheses.
2. Be able to distinguish between a parameter and a statistic.
3. What does the law of large numbers tell us? Use the BPS applet.
4. Use the applet to illustrate the sampling distribution of the sample mean.
   http://www.ruf.rice.edu/%7Elane/stat_sim/sampling_dist/index.html
5. Use Minitab to illustrate the sampling distribution of the sample proportion.
6. Know what the distribution of the sample mean is for the two cases: x is normal & we don't know if x is normal
7. Be able to apply the central limit theorem. For example, what is the probability that the sample mean takes a value greater (lower) than some value?
8. Understand the relationship between sample size and the variability of the sample mean: $\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}}$ where σ_x is the standard deviation of the underlying population.
9. Skip statistical process control and $\bar{x}$ charts.
10. Recommended exercises: $11.1 - 11.3, 11.5, 11.7 - 11.13, 11.17 - 11.24, 11.26, 11.31 - 11.34, 11.36, 11.38, 11.41, 11.42$. The following exercises require the use of random number tables, applet, or other software: $11.6, 11.29, 11.44$

Chapter 12: General Rules of Probability

1. Know the basic rules.
2. Use tables to learn about conditional probability. The formula is difficult for the students.
3. Use tree diagrams and Venn diagrams.
4. Use the AIDS exercise: http://www.etsu.edu/math/price/1530/Aidsprob.pdf This exercise defines false positive (Type I error), false negative (Type II error), and other terms that may be used in diagnostic testing.
5. Recommended exercises:$12.5, 12.6, 12.14, 12.16, 12.20 - 12.23, 12.37, 12.41, 12.42, 12.52 - 12.55$

Chapter 13: Binomial Distributions

1. Know the Binomial setting
2. Be able to find Binomial probabilities using a Table or Minitab.
3. Know the Binomial mean and standard deviation.
4. Rare event? Use Minitab to solve the *one_in_a_million.doc* exercise.
   http://www.etsu.edu/math/price/1530/one_in_a_million.doc
5. Recommended exercises:$13.1-13.9, 13.12-13.22, 13.25, 13.28, 13.30-13.32, 13.36$.
   For additional Binomial problems see
   http://www.etsu.edu/math/price/1530/Binomial.pdf

Chapter 14: Confidence Intervals: The Basics

1. Know how to calculate and interpret confidence intervals for the population mean.
2. Know the meaning of 'confidence'.
3. Understand how the width of the confidence interval and the 'margin of error' depend on sample size, variability and confidence.
4. Be able to find the appropriate sample size knowing the standard deviation of the population and given the desired confidence and margin of error.
5. Use the BPS applet on confidence intervals.
6. Recommended exercises: $14.1-14.3, 14.6-14.20, 14.25, 14.27, 14.29-14.32, 14.34, 14.38$

Chapter 15: Tests of Significance: The Basics

1. Be able to identify and write the null and alternative hypotheses in a given story.
2. Know how to perform a test of hypotheses about the population mean.
3. Be able to make a decision about the null hypothesis based on the p-value and to interpret the value of the p-value.
4. Be familiar with the basic vocabulary of hypothesis testing (one-sided & two-sided hypothesis, test statistic, p-value, statistical significant, significance level)
5. Know the connection between a test of hypothesis and a confidence interval.
6. Try the following mnemonic: *If the P is high the null will fly; if the P is low the null must go!*
7. Recommended exercises: $15.1-15.5, 15.7, 15.9, 15.10-15.17, 15.19, 15.23-15.37, 15.39, 15.40, 15.44, 15.45, 15.48, 15.52, 15.53, 15.55$.

Chapter 16: Inference in Practice

1. Be aware that the 'margin of error' only accounts for the 'sampling error' (the fact that not all the elements of the population are in the sample), it does not account for errors in the design and implementation of the survey such as undercoverage or low response rate.
2. Be aware of the difference between statistical significance and practical significance.
3. Skip "The Power of a test."
4. Understand the Type I and Type II errors that can occur in testing and be able identify these errors in a story.
5. Recommended exercises: $16.1-16.5, 16.6$ (You can use Minitab 1-sample z test.),$16.8, 16.9, 16.14, 16.15, 16.19-16.27, 16.31, 16.32, 16.34(a), (b), 16.35, 16.36, 16.38, 16.41, 16.42, 16.45$

Chapter 17: From Exploration to Inference: Part II Review

1. Review the following topics from Chapters 8 to 16.
   (a) Sampling
   (b) Experiments
   (c) Probability
   (d) Sampling Distributions
   (e) The Sampling Distribution of a Sample Mean
   (f) General Rules of Probability
   (g) Binomial Distributions
   (h) Confidence Intervals
   (i) Significance Tests
2. Recommended exercises: $17.1, 17.6, 17.7, 17.10 - 17.13, 17.21, 17.22, 17.25, 17.26, 17.29, 17.38, 17.43, 17.49, 17.52(Minitab), 17.54(Minitab), 17.58, 17.64$

Chapter 18: Inference about a Population Mean

1. Have a general idea what the t-distribution is and its relationship to the normal distribution.
2. Know the necessary conditions to apply the t-test and t-confidence interval.
3. Know what the standard error is $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$.
4. Know how to perform and interpret the results (Minitab output) of one sample t-test.
5. Know how to perform and interpret the results (Minitab output) of a matched pairs t-test.
6. Be able to calculate and interpret a t-confidence interval.
7. Be aware of the robustness of t procedures. This has to do with the lack of Normality.
8. Recommended exercises: (When possible use Minitab to solve.) $18.1, 18.6, 18.7, 18.10 - 18.24, 18.26 - 18.28, 18.30, 18.32, 18.36, 18.39, 18.41, 18.43, 18.45$

Chapter 20: Inference about a Population Proportion

1. Recall that the sampling distribution of the sample proportion $\hat{p} \approx N\left(p, \sqrt{\frac{p(1-p)}{n}}\right)$ as $n \to \infty$.
2. Know how to calculate a confidence interval for the population proportion (normal approx.) and be aware of its limitations. If the number of successes or the number of failures is less than 15 then use one of the following options.
   (a) Add 2 successes and 2 failures to your data so that

   $$\tilde{p} = \frac{\text{count of successes in the sample } + 2}{n+4}$$

   Hence, an approximate level C confidence interval for p is

   $$\tilde{p} \pm z^* \sqrt{\frac{\tilde{p}(1-\tilde{p})}{n+4}}$$

   This interval can safely be used when C is at least 90% and the sample size n is at least 10.
   (b) An 'Exact' interval for p exists but it is hard to compute by hand so use MINITAB. This method can be used for any sample size n. The interval tends to be on the conservative side.

3. Be able to calculate the appropriate sample size when the purpose of the study is to estimate the population proportion, given the desired confidence and precision (margin of error)
4. Do the New Duck worksheet to introduce testing.
5. Know how to perform tests of hypotheses about a population proportion
6. Recommended exercises: $20.1 - 20.9, 20.11, 20.13, 20.16, 20.17 - 20.27, 20.31, 20.32, 20.38, 20.40, 20.41$

Chapter 22: Inference about Variables: Part III Review

1. Review the topics from Chapters 18 and 20.
2. Recommended exercises: $22.3, 22.4, 22.7, 22.8, 22.17, 22.36 - 22.38, 22.45$

Chapter 23: Two Categorical Variables: The Chi-Square Test

1. Know how to write the null and alternative hypotheses given a research question about independence
2. Know how the expected values are calculated in a test of independence and what they mean.
3. Understand the formula of the chi-square statistic.
4. Be able to fully interpret the results (Minitab output) of a chi-square test
5. The file Labchisq.doc discusses the following

Test of goodness of fit	H_0 : a certain model is true
Test of independence	H_0 : two categorical (or categorized) variables are independent
Test of homogeneity	H_0 : two groups have similar behavior with respect to a categorical variable

6. Recommended exercises: $23.1, 23.2, 23.6, 23.11, 23.16, 23.18 - 23.28, 23.37, 23.40, 23.41$

ADDITIONAL EXERCISES:

1. For additional Normal/Binomial problems see
   http://www.etsu.edu/math/price/1530/Additproblem.pdf
   and the solution to these problems can be found in
   http://faculty.etsu.edu/pricejr/Math1530/Worksheets/Exercises/Additprobsol.pdf
2. For additional testing/interval estimation problems see
   http://www.etsu.edu/math/price/1530/addit_test_ci_probs.pdf

EVALUATION:

DEPARTMENTAL FINAL EXAMINATION REQUIREMENT FOR MATH 1530:

1. A comprehensive departmental final examination will be administered in MATH 1530 (Probability & Statistics). For Fall 2006 the exam will be held Saturday, December 9, 2006 at 1:00 p.m. Rooms will be announced during dead week.
2. Important: each student must have a current, official ETSU ID card to take final exam.
3. The Final Examination will count 25% of each students grade. For extremely low scores on the Final Examination (less than 100 points), the student will be assigned a semester grade of F.
4. The purposes of this program are to increase learning, enhance quality control and minimize grade disparity among instructors.

GRADING FOR THE COURSE:

The grade will be based on a possible 1000 points (250 from the Final Examination, 700 determined by the instructor (Exams/Quizzes/Homework), and 50 participation points (see below)).

The scale follows:

A	950 - 1000	A-	900 - 949	B+	880 - 899	B	820 - 879
B-	800 - 819	C+	780 - 799	C	720 - 779	C-	700 - 719
D+	650 - 699	D	600 - 649	F	less than 600		

PARTICIPATION POINTS:

All instructors will administer quizzes (quiz for each chapter) thru blackboard. There should be no time commitment to complete these quizzes. Students that participate be given course credit (suggested amount 3 points for each quiz for a total of 50 points) for participation, not performance. To get these quizzes on your Blackboard site add Michelle Byrd (byrdt@etsu.edu) as an instructor to your section and request from her to copy the quizzes into Course Documents or Assignments. You will have to make these quizzes available.

BONUS FOR PERFECT ATTENDANCE (after the first week of classes):

50 points will be added to the above total before the grade is assigned. However, the 50 points may be decreased. There will be no deductions for absences during the first week of classes. After the first week, the bonus will be reduced as follows: For classes meeting 2 times per week: 10 points will be deducted per absence.

DEPARTMENTAL ATTENDANCE REQUIREMENTS:

(approved by department vote on February 28, 1994; revised July 1999*)

The Department of Mathematics strongly advises students to attend all mathematics classes when physically able. Because there is a positive correlation between attendance and student success in mathematics, the following attendance guidelines will be used in all mathematics courses. Regardless of the reasons for the absences, should a student exceed the following limits, the instructor has the authority to assign a grade of FN or W; this policy takes precedence over the grade assignment policy for MATH 1710 and MATH 1530:

7	absences for classes scheduled for MWF."
5	absences for classes scheduled for TR or MW classes or any other 2 day/night classes.
3	absences for classes scheduled for one evening per week
9	absences for all daytime sections of 4-hour classes
5 absences for classes scheduled MTWRF (*Summer Courses).	

Math 1530 Final Examination Procedures

1. The examination will be given on Saturday, December 9, 2006 (rooms to be announced). The exam will begin promptly at 1:00 p.m. All papers must be turned in by 3:30 p.m.
2. A card containing tables and formulas will be provided for the examination. Please do not write on this card and return the card when you return other test materials.
3. Any type battery powered calculator may be used. Students may not share calculators during examination. Calculator instructional materials may not be used.
4. No paper other than what is provided is allowed.
5. Students must show official ETSU student ID to instructor and/or proctor at examination. Students not having an official ETSU ID will not be permitted to take the exam.
6. Students must have a sufficient supply of #2 pencils for marking the scantron answer sheet.
7. Instructors will not interpret questions on examination or discuss course content during exam.
8. Students must turn in tests, tables, scratch paper and scantron sheets before leaving room.
9. Information needed on scantron: Name, color of test, instructor, & section number.
10. Caps or hats may not be worn while taking exam.
11. Please do not congregate near exits following exam.
12. Recent final exams (with answers) are on the Math 1530 Web page.