We live in a society in which many of the decisions that affect our lives are based on data analysis and information processing. Thus, a major goal of this course is to help you to become "consumers" of statistical decision-making methods - to give you the background that will allow you to be able to analyze data and interpret results or conclusions based upon the data. This will involve two main themes: (1) the informal exploration of data sets to reach informal, but informed, conclusions and (2) formal statistical methods that are used to reach formal conclusions about the source (or population) from which the data was taken.

The examples used to motivate the material in this course will all be taken from topics that relate to social justice; we will be looking at data that gives us some insights into specific instances in which it is possible to make decisions about the fairness and/or equality of the situation presented. Much of the course will be motivated by these social justice examples. A variety of different social justice topics will be explored in this course; many of the issues that we will consider will involve the comparing countries and related groups of countries with respect to certain numerical measures.

The main focus of this course, data analysis, yields many excellent examples of how to reason quantitatively. With regard to quantitative reasoning we will see that probability plays a key role. Within the study of probability, we will make generous use of simulations to help us understand our data and to draw approximate conclusions from that data. The essential topic of statistical inference will be discussed throughout the entire course by making use of simulations and a basic understanding of probability.

As we progress through the course, you will obtain answers to the following fundamental questions (among others):

1. Where does data come from?
2. When is data “good” or “bad?”
3. What is a statistic? (Of course!)
4. What is a parameter?
5. What is a sample?
6. What is a population?
7. What is an observed significance level? What does “significantly different” mean?
8. What is the sampling distribution for a statistic?

Once you have completely understood these ideas you will know what it means to analyze data, how to analyze data, and also be able to interpret data analyses that are done by others. In particular, from this course you should:

- Gain a working understanding of the term “statistically significant.”
- Gain an appreciation for the idea that variation is the most important statistical property to measure, even when “averages” are being compared.
- Gain the ability to interpret the various formal methods for making decisions that will be introduced in this course.
- Gain an appreciation for the appropriate role of statistical evidence, when used to gain insight into an relevant issue.

Other Reading Material:

1. Various handouts from your instructor, mostly related to in-class activities in which randomization/simulation methods will be used to explore quantitative reasoning.
2. D. Hacker, A Writer’s Reference
Computer Software

We will be using the open source statistical package, R, which is available to download to your computers for free. This software may be downloaded from the web site below by following the instructions that you find there. Instructions for downloading this software will also be given in class.

http://www.r-project.org/index.html

Course Topics (More or less, in this order, but some items may be done “out of order.”) (Social Justice Topics and/or activity topics are in **bold type**. If necessary, these topics may be adjusted so that the material from the text is covered.)

1. Producing Data
   Using randomization/simulation for quantitative reasoning from statistical evidence. (This topic will be “weaved into” much of the course via class activities.)
   **Children in Poverty:** from the Kids Count Data Center
   Where Do Data Come From?
   **Euthanasia:** Sample Surveys
   What is a Sample? What is a Good Sample?
   The Gettysburg Address
   What types of Experiments and Sample Surveys are Used to Obtain Data? What are the Desirable Properties of these Experiments/Surveys? What is meant by “Causation vs. Correlation?”
   Does “Dolphin Therapy” Work? Was the Nurse Murderous?
   What Numbers Should be Measured? How Should Numbers be Measured?

2. Organizing Data
   (More randomization/simulation activities)
   **Gender Comparisons:** from the United Nations Human Development Project
   What Graphs and Tables are used? Which are best for which type of data?
   How do we describe Distributions with Numbers?
   Is there statistical evidence of Global Warming?
   What is the Normal Distribution? What is its Role in Data Analysis?
   **Case Study:** Same-Sex Marriages
   How do We Describe the Relationship between Two Variables Graphically? Numerically?
   Public School Expenditures vs. SAT scores (and The Data of Poverty and Inequality)
   (Return to “Causation vs. Correlation”)

3. Probability
   What are the Correct Ways to Use and Interpret Probabilities?
   How and why are Probabilities Calculated when Analyzing Data?
   What is a Sampling Distribution and Why is this one of the Most Important Concepts from this Course?

4. Statistical Inference
   What is a Hypothesis Test? (Also known as a “Test of Significance.”) What is a Confidence Interval? How are they used? How are they Interpreted? What is the Traditional Method of doing Statistical Inference? How does it compare to the Randomization/Simulation methods we have been using throughout this course?
   Return to (1) Children in Poverty: from the Kids Count Data Center,
   (2) Euthanasia: Sample Surveys and (3) Is there statistical evidence of Global Warming?
5. (Other statistical procedures will be covered, if time permits)
Some considerations for successful completion of this course.

1. Although there will be numerical formulas and methods introduced in this course, this will not be the main emphasis. The emphasis will be on the ideas and concepts related to data-based decision-making. Be very careful that you do **not** attempt to understand the material presented simply by memorizing formulas and processes. It is human nature to do so, but please try to avoid this!

2. You will often be asked to write rather than compute, to demonstrate your understanding of material. Usually the writing will consist of a short statement or two. The main exception to this will be the writing that you will need to do in the required final project. In any writing that you are required to do, please take the time to carefully consider the question being asked and to respond as clearly as you possibly can. Grading of this type of work will often have a lot of weight given to the thought which you have put into it in addition to its correctness.

3. When you are asked to read something, please do so carefully, and determine whether or not there is anything in the reading about which you have a question. (This includes the reading assignments from the text, which will be given on most days.) There will be some time in class to answer such questions and I am happy to have you come to my office to ask these questions as well. This is a natural part of the learning process and you don’t want to miss out on it!

4. We will be using software (**R**) that you are probably not familiar with before this course. Please be sure to let me know, if you run into difficulties. I will be happy to help. Also, for any assignments that require the use of this software, don’t wait until the last minute to begin work on it. Get an early start so that if some issue should arise, you will have time to get me to help.

5. Whenever you are doing work for this course, please do it thoughtfully; **always** be thinking about you are doing and **why** you are doing it. This will, of course, benefit you when it comes time for you to take a test. (For those who might be wondering, this is the best way to study for the tests!) It will also benefit you beyond this course, since you are more likely to recall the ideas presented here when you need them.

6. Many of our in-class activities will involve the use of a computer and the software **R**. If you have a laptop, please bring it to class each day, just in case. (Also, be sure to install **R** on your computer.) There is a “rolling lab” of laptops that will be available some days, but don’t depend on it – bring your own, please! In case the situation calls for it, you may share a computer with another student, but usually it will be to your (learning) advantage to have your own!

7. **Last but not least!** On many days we will be engaged in activities that will be used to help with understanding the material. Some of the activities will be small group activities, some will not. If you are not in class, you will not experience the benefit of these activities, which will be aimed at the main emphasis of the course – understanding the ideas and concepts of data analysis. Also, there will be some graded homework exercises that will be assigned based directly on these activities. The bottom line: **ATTENDANCE IN CLASS IS ESSENTIAL!**

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**Co-curricular Requirement**

You will be required to attend one Mathematics Department sponsored co-curricular event and to write a report (one to two paragraphs) about the event. Your report should include:

(1) a summary of the information from the event, and

(2) discussion of one specific detail from the event that particularly stood out to you (either positively or negatively.)

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**Daily Homework**

On almost every class day there will be some work that you will need to hand in for a grade. Some days this will be a follow-up to a previous day’s in-class activity; on other days it might be the results of the activity itself. There will also be selected exercises from the text book that will be handed in, as well. (Be sure that you work on all the assigned exercises from the text, not just the ones that are to be handed in!)

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**Attendance Policy**
Attendance in all classes is extremely important and is expected. You are responsible for all classes missed. Be sure to read the attendance policy in the catalog.

**Course Project**

The purpose of this project is to put together the various concepts regarding the analysis of data that will be covered in this course. You are to choose your data for this project in order to study what you believe to be a social justice issue on the Roanoke College campus. Methods for choosing data will be either by sample survey or by random experiment. Both of these topics will be discussed fairly early in the course. The methods of analysis will be discussed as we go through this course and the formal requirements will be handed out separately in three parts. There will be both data analysis and explanatory writing required for this project. There will be a date early in the semester in which you will be required to submit a description of your intended project. There will be other dates at which other portions of the project will need to be handed in for me to examine. This project may be done by individuals or by “teams” of two.

**Make-Up Tests**

Please note that make-up tests will not be given. If you do miss a test, and can produce a reasonable justification, it will then be possible to use your work on the final exam to replace the missed score.

**Late Homework**

This is an undefined term! Homework assignments are due at the beginning of class on the due date and will not be accepted late. If you anticipate a problem, you certainly may hand the assignment in early!

**Grading Policy**

Your grade in this course will be based on two tests, daily hand-in assignments, the co-curricular requirement, a course project, and a comprehensive final:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in-class tests @ 20%</td>
<td>40%</td>
</tr>
<tr>
<td>Daily Homework/Activities</td>
<td>22%</td>
</tr>
<tr>
<td>Co-curricular requirement</td>
<td>3%</td>
</tr>
<tr>
<td>Course Project</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Comprehensive final examination</strong></td>
<td>20%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Grading scale** (Percent of total):

<table>
<thead>
<tr>
<th>Grade</th>
<th>92-100 A</th>
<th>88-89 B+</th>
<th>78-79 C+</th>
<th>68-69 D+</th>
<th>Below 60 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-91 A-</td>
<td>82-87 B</td>
<td>72-77 C</td>
<td>62-67 D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-81 B-</td>
<td>70-71 C-</td>
<td>60-61 D-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Test schedule**

<table>
<thead>
<tr>
<th>Test</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test #1</td>
<td>Friday, February 5</td>
</tr>
<tr>
<td>Test #2</td>
<td>Friday, March 26</td>
</tr>
<tr>
<td><strong>FINAL</strong></td>
<td>Wednesday, April 21, 2:00 to 5:00</td>
</tr>
</tbody>
</table>

**Academic Integrity**

Absolute academic integrity is expected of all students at all times; the details of this policy are given in the brochure, "Academic Integrity at Roanoke College." In particular, all of your work on tests and graded assignments is expected to be your own. Also see "Technology Policy" below.

“**Statistical Writing**”
Much of the required work in this course will be interpretive in nature, and you will regularly be asked to explain what your computed results mean or explain what computations you would need to do (and why!) to answer a particular question. Be certain that any statements that you make in this regard are related to the data that you have been working with and the results that you have calculated. In other words, your written interpretations must be consistent with the “evidence” you see in the data. This also means that you should not include other opinions or biases that you might have when your interpretation is to be based on your statistical analysis only.

There will be opportunities for you to provided written statements that include your own thoughts/opinions (but still backed up by at least some concrete examples.) These opportunities will definitely occur during the final project in which you will do a statistical analysis of a social justice data set from the campus or nearby community.

**Technology Policy**

You may (and should!) certainly use a calculator (or computer!) to aid you with any of your work. However, during tests, **you may not, under any circumstances share a calculator with another student.** If you are concerned about battery failure or some other malfunction, please feel free to bring extra batteries or extra calculators! Also, **cell phones, laptops, and all other electronic devices may not be used during and exam** and any other similar devices must be turned off and **out of sight** (yours!) during tests. This includes Palm Pilots, Pocket PCs and Blackberrys. Any use of one of these devices during a test will be considered a violation of academic integrity.

**Participation in a Research Study:**

This class is part of a project funded by the U.S. Department of Education to revise and improve general education courses. As part of this project, we need to assess some student papers, administer a survey, and arrange a focus group discussion to see whether certain aspects of the course are effective. Your participation will give us helpful information about student learning at Roanoke and how we can improve it. However, if you do not wish to participate in this study, there will be no penalty.

If you participate in the paper assessment, your instructor will make copies of some of your writing assignments during the semester. After the semester is over, a group of Roanoke College faculty and staff will read these assignments in order to assess some possible changes in course design. No student names will be on the papers at that time, nor will the results reported to the College and to the U.S. Department of Education contain names or any identification of students, faculty, or staff.

If you have any questions about the research study, contact Susan Kirby, 9 North College, kirby@roanoke.edu, 375-2519 or the Roanoke College Institutional Review Board, Hamilton@roanoke.edu, Trout 112, 375-2409.