If he was less annoying in regard to his classmates, he was more so in his classrooms. He had learned from Gottlieb the trick of using the word "control" in reference to the person or animal or chemical left untreated during an experiment, as a standard for comparison: and there is no trick more infuriating. When a physician boasted of his success with this drug or that electric cabinet, Gottlieb always snorted, "Where was your control? How many cases did you have under identical conditions, and how many of them did not get the treatment?" Now Martin began to mouth it -- control, control, control, where's your control? -- till most of his fellows and a few of his instructors desired to lynch him.

*Arrowsmith* (1925) by Sinclair Lewis, first American to win the Nobel Prize for literature.

**COURSE GOALS:** Understanding and application of the linear regression model. This tool is essential in the study of relationships between two or more economic variables, testing hypothesis of economic behavior and forecasting economic outcomes. Economics and econometrics, unlike most sciences and statistics, is characterized by the unavailability of
controlled environments and repeated experimentation. Consequently, it is that much trickier to discover or test causal relationships, to measure the effects of a particular economic policy or an economic control on economic states, and other similar thought experiments. Econometrics not only provides adequate statistical methods but also clever solutions to overcome many of these obstacles.

**PRE-REQUISITES:** Statistics 13, Math 16A-16B, Econ 100 or 104, and 101 or 105, 102 or an upper division statistics course.

Statistics 13 is the most important. Algebra (though not matrix algebra) and some calculus are extensively used. Problem sets will require use of the computer, but no previous experience is assumed.


**COMPUTER SOFTWARE:** EViews. The computer sessions should provide you with enough time (and plenty of knowledge) to complete the assignments so I expect that you will not need to install the student version of EViews in your personal computer. Don’t worry, you will not need a manual either.

**ADDITIONAL RESOURCES:** Check the class web page for additional materials such as formula sheet, a brief overview of EViews, interesting web sites for econometricians, etc.

**COMPLEMENTARY LITERATURE:**

- R. J. Larsen and M. L. Marx, *An Introduction to Mathematical Statistics and its Applications*, Prentice Hall. This is an excellent text to review in more depth the statistical concepts presented in class and beyond. This is an undergraduate text, therefore very accessible.
- A. Spanos, *Statistical Foundations of Econometric Modelling*, Cambridge. This is a more advanced book than Larsen and Marx. However, it contains proofs and topics in great detail.
- R. Ramanathan, *Introductory Econometrics with Applications*, Dryden. It is very well written and gives a great number of useful examples. A little hard to navigate.
- W. Greene, *Econometric Analysis*, Prentice Hall. This is an advanced text. In addition to the topics we will cover in class, it contains a number of additional topics that give you a flavor of the discipline. A good resource book.

**COMPUTER ASSIGNMENTS:** Homework problems that require the computer will use the software program EViews (already installed in the computer lab). I will teach a lab session illustrating how the assignments can be completed. Check the lab schedule ([http://dsslab.ucdavis.edu/](http://dsslab.ucdavis.edu/)) to plan times when you can complete your assignment. The
day before assignments are due, the T.A. will be available during lab hours to address any lingering questions.

**COURSE GRADING:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework (5)</td>
<td>30%</td>
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<tr>
<td>Midterms (2)</td>
<td>35%</td>
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<tr>
<td>Final (Comprehensive)</td>
<td>35%</td>
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COURSE GRADING:

Homework must be handed on time. There is no credit for late homework. Please contact the T.A. at your convenience if you need special arrangements and rescheduling for midterms and final. All requests must be made by January 15. Make-up exams are not permitted. Consult the web for more details on homework due dates.

**REGRADE POLICY:**

I do not engage in grade bargaining: applying the same standard to everyone makes special considerations unfair to your peers. If you feel a question was unfairly graded or there was a mistake, *please submit it in writing* to your T.A. no later than a week after the exam. This allows your T.A. to go over the exam carefully and give your queries due consideration.

**CALENDAR**

*Problem Set Due Dates:*

- P.S. 1 – January 22
- P.S. 2 – February 5
- P.S. 3 – February 19
- P.S. 4 – March 4
- P.S. 5 – March 16

*Lab Sessions(4)*

- Session 1 – January 14
- Session 2 – January 28
- Session 3 – February 11
- Session 4 – February 25
COURSE OUTLINE:

1. STATISTICAL TOOLS FOR ECONOMETRICIANS

   1. RANDOM VARIABLES
      i. DISCRETE
      ii. CONTINUOUS

   2. UNIVARIATE PROBABILITY DENSITY FUNCTIONS
      i. DISCRETE PDF AND CDF
      ii. CONTINUOUS PDF AND CDF

   3. MULTIVARIATE PROBABILITY DENSITY FUNCTIONS
      i. THE JOINT DISTRIBUTION
      ii. THE MARGINAL DISTRIBUTION
      iii. THE CONDITIONAL DISTRIBUTION
      iv. INDEPENDENCE

   4. MOMENTS OF PROBABILITY DISTRIBUTIONS
      i. UNIVARIATE
         a. POPULATION MEAN, MEDIAN, AND MODE
         b. POPULATION VARIANCE
      ii. MULTIVARIATE
         a. CONDITIONAL MEAN
         b. COVARIANCE
         c. CORRELATION

   5. COMMON DISTRIBUTION FUNCTIONS
      i. THE NORMAL AND THE STANDARD NORMAL
      ii. THE $\chi^2$ DISTRIBUTION
      iii. THE T-DISTRIBUTION
      iv. THE F-DISTRIBUTION

   6. POPULATIONS, SAMPLES, STATISTICS AND ESTIMATION
      i. POPULATIONS VERSUS SAMPLES
      ii. MOMENTS VERSUS SAMPLE STATISTICS
iii. LARGE SAMPLE APPROXIMATIONS
   a. LAW OF LARGE NUMBERS
   b. CENTRAL LIMIT THEOREM
iv. PROPERTIES OF ESTIMATORS
   a. UNBIASEDNESS
   b. EFFICIENCY

7. HYPOTHESIS TESTING
   i. ELEMENTS OF A TEST
   ii. TESTING THE MEAN

II. TWO VARIABLE REGRESSION MODEL
1. MODEL ASSUMPTIONS
2. ESTIMATION
   i. METHOD OF MOMENTS
   ii. LEAST SQUARES
3. PROPERTIES OF OLS ESTIMATORS
   i. UNBIASEDNESS
   ii. EFFICIENCY
4. HYPOTHESIS TESTING
   i. CONFIDENCE INTERVALS
   ii. ONE-TAIL TESTS
   iii. TWO-TAIL TESTS
5. GOODNESS OF FIT - THE R²
6. PREDICTION
7. VARIABLE TRANSFORMATIONS
   i. CHANGES OF SCALE
   ii. CHANGES OF ORIGIN

III. MULTIPLE LINEAR REGRESSION MODEL
1. THE MODEL AND ADDITIONAL ASSUMPTIONS
2. ESTIMATION
3. HYPOTHESIS TESTING
   i. JOINT HYPOTHESIS TESTING
a. **SIGNIFICANCE OF SUBSETS OF REGRESSORS**

b. **OVERALL SIGNIFICANCE TESTS**

c. **TESTS OF LINEAR COMBINATIONS OF PARAMETERS**

4. **GOODNESS OF FIT**
   
   i. **THE R² AND THE ADJUSTED R²**

   ii. **MODEL SELECTION**

5. **PREDICTION**

6. **SPECIFICATION ERRORS**
   
   i. **OMITTED VARIABLES**

   ii. **IRRELEVANT VARIABLES**

   iii. **MULTICOLLINEARITY**

IV. **EXTENSIONS**

1. **DUMMY VARIABLES**
   
   i. **MULTIPLE DUMMY VARIABLES IN REGRESSION**

   ii. **INTERACTIVE DUMMY VARIABLES**

2. **THE MULTIPLE REGRESSION MODEL IN MATRIX NOTATION**

3. **MAXIMUM LIKELIHOOD ESTIMATION**