

550.400: Mathematical Modeling and Consulting

Lecture Notes

Instructor:

Dr. N. H. Lee

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Outline

Preliminaries

Principles

Tools

Arguments from Scale

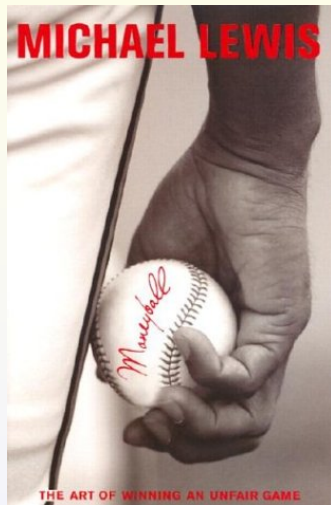
Graphical Methods

Basic Optimization

Syllabus

- Grade Policy
- Attendance
- *Tentative* Schedule
- Blackboard
- Misc.

What is Mathematical Modeling?



Money Ball

What is Mathematical Modeling?

[NOVA Online | Trillion Dollar Bet](http://www.pbs.org/wgbh/nova/stockmarket/)

www.pbs.org/wgbh/nova/stockmarket/

Welcome to the companion Web site to "**Trillion Dollar Bet**," originally broadcast on February 8, 2000. The film tells the fascinating story of the invention of the ...

[The Formula that Shook The ...](#) - [Transcripts](#) - [A Trader's Lexicon](#) - [Resources](#)

[Videos for trillion dollar bet](#) - [Report videos](#)



[Trillion Dollar Bet 1 - YouTube](#)

youtube.com

Jan 8, 2009



[The Trillion Dollar Bet - YouTube](#)

youtube.com

Sep 15, 2007



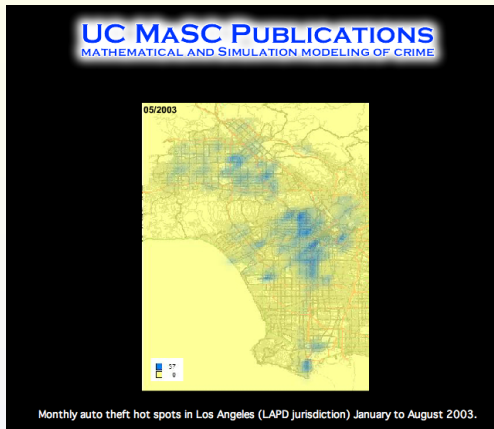
[The Midas Formula Stockmarket ...](#)

youtube.com

Aug 23, 2011

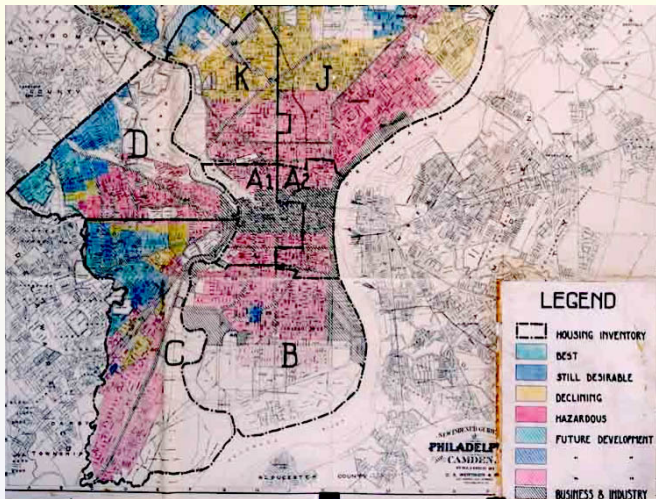
Trillion Dollar Bet

What is Mathematical Modeling?



LAPD Fighting Crime with Math

What is Mathematical Modeling?



Insurance Redlining

Example: Insurance Redlining

Insurance Redlining

Insurance redlining refers to the practice of refusing to issue insurance to certain types of people or within some geographic area.

FAIR

The **FAIR** plan was offered by the city of Chicago as a default policy to homeowner who had been rejected by the voluntary market.

Example: Insurance Redlining

Sponsor

*The **U.S. Commission on Civil Rights** examined charges by several Chicago community organizations that insurance companies were redlining their neighborhoods.*

Data

*The **number of FAIR plan policies** written and renewed in Chicago by zip code for the number of months of December 1977 through May 1978.*

Example: Insurance Redlining

Variables to consider:

- `race` Racial composition in percentage of minority,
- `fire` Fire per 100 housing units,
- `theft` Theft per 100 housing units,
- `age` Theft per 1000 population,
- `involact` New FAIR plan policies and renewal per 100 housing units,
- `income` Median family income in thousands of dollars,
- `side` North or South side of Chicago.

Example: Insurance Redlining

Frequently Recurring Elements of doing a Project in Industry:

1. Work Statement,
2. Midterm Presentation,
3. Progress Report,
4. Final Presentation,
5. Final Report.

What is Work Statement?

- The written proposal and definition of the project
- Your consulting team's "contract" with the sponsor
- It is ultimately given to the sponsor for review and signature

What is Work Statement?

It sets forth:

- the nature of the project,
- the specific objectives of the project,
- the result expected,
- the “deliverable” for the project.

What is Work Statement?

- The scope of the project must be within the time table for the course
- The deliverables are reasonable and appropriate

What is Work Statement?

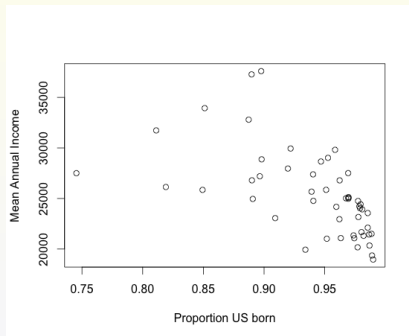
- Given the nature of research, it should not include promises that your consulting team cannot be certain to achieve
- It may be necessary after discussion and agreements among various parties to modify and renegotiate the work statement as the project progresses

Programmings in this class

- R:
 - `tikzDevice`
 - `lm`
- \LaTeX :
 - `moderncv`
 - `beamer`
 - `report`
 - `tikz`
- Git
 - `git gui`

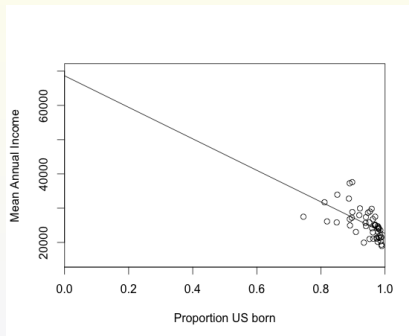
Demo: R

```
install.packages(faraway)
require(faraway)
data(eco)
plot(income ~ usborn,
     data=eco,
     xlab='Proportion US born',
     ylab='Mean Annual Income',
     )
```



Demo: R

```
g <- lm(income ~ usborn, eco)
summary(g)
plot(income ~ usborn,
     data = eco,
     xlab='Proportion US born',
     ylab='Mean Annual Income',
     xlim=c(0,1),
     ylim=c(15000,70000),
     xaxs='i')
abline(coef(g))
```



Tutorial: \LaTeX

\LaTeX is a computer language for writing a scholarly paper:

	HTML	\LaTeX
Code	<pre><html> . . . </html></pre>	<pre>\begin{document} . . . \end{document}</pre>
Compiler	Firefox and etc.	pdflatex and etc.
Output	Webpage	PDF file

Table: HTML vs \LaTeX

Tutorial: \LaTeX

- Demo on preparing a resume using \LaTeX `moderncv` package:
 - Install \LaTeX (MikTeX in Windows and MacTeX in OSX),
 - Download `moderncv` package files from the course folder,
 - Change file names to reflect you,
 - Edit the tex file,
 - Compile using your favorite \LaTeX editor,
 - Look at the resulting PDF file.

Tutorial: Git

```
sudo apt-get install git
```



An alternative: `git gui`

Tutorial: Git

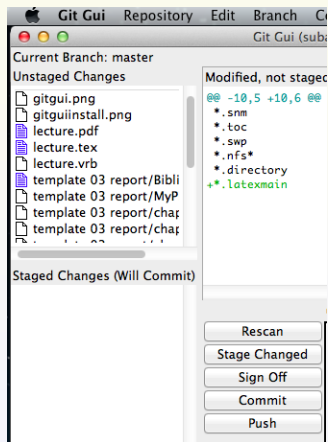
```
cd ~/
git clone http://cis.jhu.edu/~nhlee/550400.git
```



An alternative: `git gui`

Tutorial: Git

```
cd ~/550400.git  
git reset --hard HEAD  
git pull origin master
```



An alternative: git gui

Tutorial: Git

- Demo I: build a *personal* Git folder
 - Create some files
 - Stage the files
 - Commit the files
- Demo II: build the *course* Git folder

Seven Basic Principles

1. Set the context
2. Choose effective examples and analogies
3. Choose vocabulary to suit your readers
4. Decide whether to present #s in text, tables, or figures
5. Report and interpret #s in the text
6. Specify the direction *and* size of an association between variables
7. For many #s, summarize overall pattern

Creating Effective Tables

Example: Cost of Packaging

Example: The Nuclear Mission Arms Race

Example: Maintaining Inventory