Model Thinking

University of Michigan

STUDENT NAME

Vlad Hayrapetyan

GRADE

100.0%

COMPLETION DATE

June 4th 2013

COURSE DETAILS

Instructor: Scott E. Page
Duration of course: 10 weeks

Time commitment: 4-8 hours/week

Description:
We live in a complex world with diverse people, firms, and governments whose behaviors aggregat
political uprisings, market crashes, and a never ending array of social trends. How do we make sen
think with models consistently outperform those who don't. And, moreover people who think with lot
Why do models make us better thinkers? Models help us to better organize information - to make s
metaphor) available on the Internet. Models improve our abilities to make accurate forecasts. They
effective strategies. They even can improve our ability to design institutions and procedures. In this
models of tipping points. I move on to cover models explain the wisdom of crowds, models that sho
and models that help unpack the strategic decisions of firm and politicians. The models covered in t
science classes, whether they be in economics, political science, business, or sociology. Mastering
courses. They also help you in life. Here's how the course will work. For each model, I present a sh
deeper. I'll go into the technical details of the model. Those technical lectures won't require calculus
lectures, I'll offer some questions and we'll have quizzes and even a final exam. If you decide to do
exam, you'll receive a certificate of completion. If you just decide to follow along for the introductory
free. And it's all here to help make you a better thinker!

Subtitles for all video lectures available in: Chinese (provided by Yeeyan), English, Ukrainian (P

Syllabus:

This course will consist of twenty sections. As the course proceeds, I will fill in the descriptions of th

Section 1: Introduction: Why Model?
In these lectures, I describe some of the reasons why a person would want to take a modeling cour

1. To be an intelligent citizen of the world
2. To be a clearer thinker
3. To understand and use data
4. To better decide, strategize, and design

There are two readings for this section. These should be read either after the first video or at the co

The Model Thinker: Prologue, Introduction and Chapter 1

Why Model? by Joshua Epstein

Section 2: Sorting and Peer Effects
We now jump directly into some models. We contrast two types of models that explain a single phe interact with people who look, think, and act like themselves. After an introductory lecture, we cover cover these phenomena. We follows those with a fun model about standing ovations that I wrote wi

In this second section, I show a computational version of Schelling's Segregation Model using NetL Wilensky or Northwestern University. I will be using NetLogo several times during the course. It can

NetLogo

The Schelling Model that I use can be found by clicking on the "File" tab, then going to "Models Libr arrow next to the Social Science folder and then scroll down and click on the model called Segrega

The readings for this section include some brief notes on Schelling's model and then the academic expecting you to read those papers from start to end, but I strongly encourage you to peruse them s interpret models.

Notes on Schelling

Granovetter Model

Miller and Page Model

Section 3: Aggregation
In this section, we explore the mysteries of aggregation, i.e. adding things up. We start by consideri Limit Theorem. We then turn to adding up rules. We consider the Game of Life and one dimensiona simple rules can combine to produce interesting phenomena. Last, we consider aggregating prefere be rational, but the aggregates need not be.

There exist many great places on the web to read more about the Central Limit Theorem, the Binon so on. I've included some links to get you started. The readings for cellular automata and for divers books *Complex Adaptive Social Systems and The Difference Respectively.*

Central Limit Theorem

Binomial Distribution

Six Sigma

Cellular Automata1

Cellular Automata2

Diverse Preferences

Section 4: Decision Models
In this section, we study some models of how people make decisions. We start by considering mult models of decision making and then decision trees. We conclude by looking at the value of informa

The reading for multi-criterion decision making will be my guide for the Michigan Civil Rights Initiativ technique. For spatial voting and decision models, there exist many great power point presentation are from Arizona State University's Craig Kirkwood.

Multi Criterion Decision Making Case Study

Spatial Models

Decision Theory

Section 5: Models of People: Thinking Electrons
In this section, we study various ways that social scientists model people. We study and contrast th *actor* approach,*behavioral models* , and *rule based models* . These lectures provide context for mar reading for these lectures though I mention several books on behavioral economics that you may w bottom game interesting just type "Rosemary Nagel Race to the Bottom" into a search engine and y introductions to "Zero Intelligence Traders" by typing that in as well.

Here is a link to a brief primer on behavioral economics that has more references.

Short Primer on Behavioral Economics

Section 6: Linear Models
In this section, we cover linear models. We start by looking at categorical models, in which data get framework to introduce measures like mean, variance, and R-squared. We then turn to linear mode regression output (a valuable skill!) and how to fit nonlinear data with linear models. These lectures are used and perhaps to motivate you to take a course on these topics. I conclude this section by h Coefficient thinking and New Reality thinking. The readings for this section consist of two short piec resources on the web on linear models, R-squared, regression, and evidence based thinking.

Categorical Models

Linear Models

Section 7: Tipping Points
In this section, we cover tipping points. We focus on two models. A percolation model from physics diseases. The disease model is more complicated so I break that into two parts. The first part focus The readings for this section consist of two excerpts from the book I'm writing on models. One cove technical paper on tipping points that I've included in a link. I wrote it with PJ Lamberson and it will b *Science*. I've included this to provide you a glimpse of what technical social science papers look like recommend the introduction. It also contains a wonderful reference list.

Tipping Points

DIffusion and SIS

Lamberson and Page: Tipping Points (READ INTRO ONLY)

Section 8: Economic Growth

In this section, we cover several models of growth. We start with a simple model of exponential gro
with a focus on Solow's basic growth model. I simplify the model by leaving out the labor componer
types of growth: growth that occurs from capital accumulation and growth that occurs from innovatio

Growth Models

Section 9: Diversity and Innovation

In this section, we cover some models of problem solving to show the role that diversity plays in inn
representations) and heuristics enable groups of problem solvers to outperform individuals. We also
landscapes" and "local optima". In the last lecture, we'll see the awesome power of recombination a
this chapters consist on an excerpt from my book *The Difference* courtesy of Princeton University P

Diversity and Problem Solving

Section 10: Markov Processes

In this section, we cover Markov Processes. Markov Processes capture dynamic processes betwee
a process in which countries transition between democratic and dictatorial. To be a Markov Process
other and the probabilities of moving between states must remain fixed over time. If those assumpti
equilibrium. In other words, history will not matter. Formally, this result is called the Markov Converg
Processes, we will also see how the basic framework can be used in other applications such as det
drug protocol.

Markov Processes

Section 11: Lyapunov Functions

Models can help us to determine the nature of outcomes produced by a system: will the system pro
complexity? In this set of lectures, we cover Lyapunov Functions. These are a technique that will er
equilibrium. In addition, they enable us to put bounds on how quickly the equilibrium will be attainec
of Lyapunov Functions and see how to apply them in a variety of settings. We also see where they
knows whether or not the system goes to equilibrium or not.

Lyapunov Functions

Section 12: Coordination and Culture

In this set of lectures, we consider some models of culture. We begin with some background on wh
scientists. In the analytic section, we begin with a very simple game called the pure coordination ga
the same action. Which action they choose doesn't matter -- so long as they choose the same one.
right side of the road is not important, but what is important is that you drive on the same side as ev
people play multiple coordination games and study the emergence of culture. In our final model, we
in a model that produces the sorts of cultural signatures seen in real world data. The readings for th
games and then the Bednar et al academic paper. In that paper, you see how we used Markov Proc
Axelrod Net Logo Model.

Coordination Games

Bednar et al. 2010

Axelrod Culture Model in Netlogo

Section 13: Path Dependence

In this set of lectures, we cover path dependence. We do so using some very simple urn models. Tl
These models are very simple but they enable us to unpack the logic of what makes a process path
increasing returns and to tipping points. The reading for this lecture is a paper that I wrote that is pu

Path Dependence

Section 14: Networks

In this section, we cover networks. We discuss how networks form, their structure -- in particular so
function. Often, networks exhibit functions that emerge, but that we mean that no one intended for t
the network. The reading for this section is a short article by Steven Strogatz.

Strogatz

Section 15:Randomness and Random Walks

In this section, we first discuss randomness and its various sources. We then discuss how performa
modeled as randomness. We then learn a basic random walk model, which we apply to the Efficien
contain all relevant information so that what's left is randomness. We conclude by discussing finite r
model competition. The reading for this section is a paper on distinguishing skill from luck by Micha
Mauboussin: Skill vs Luck

Section 16: The Colonel Blotto Game

In this section, we cover the Colonel Blotto Game. This game was originally developed to study war
from sports to law to terrorism. We will discuss the basics of Colonel Blotto, move on to some more
skill luck model from the previous section. The readings for this section are an excerpt from my boo
Russell Golman of Carnegie Mellon. You need only read the first four pages of the Golman paper.

Blotto from *The Difference*

Golman Page: General Blotto

Section 17:The Prisoners' Dilemma and Collective Action

In this section, we cover the Prisoners' Dilemma, Collective Action Problems and Common Pool Re
Prisoners' Dilemma and showing how individual incentives can produce undesirable social outcome
cooperation. Five of these will be covered in the paper by Nowak and Sigmund listed below. We con
common pool resource problems and how they require deep careful thinking to solve. There's a wo
winner Elinor Ostrom

The Prisoners' Dilemma in the *Stanford Encyclopedia of Philosophy*

Nowak and Sigmund: Five Ways to Cooperate

Ostrom: Going Beyond Panaceas

Section 18: Mechanism Design: Auctions

In this section, we cover mechanism design. We begin with some of the basics: how to overcome p
then turn to the more applied question of how to design auctions. We conclude by discussion how c
public projects. The readings for this section consist of a piece by the Eric Maskin who won a Nobe
slides on auctions by V.S. Subrahmanian. The Maskin article can be tough sledding near the end. D

everything. Focus on the big picture that he describes.

Maskin: Mechanism Design

V.S. Subrahmanian's auction slides

Section 19: Learning: Replicator Dynamics

In this section, we cover replicator dynamics and Fisher's fundamental theorem. Replicator dynamic evolution. Fisher's theorem demonstrates how the rate of adaptation increases with the amount of v sense of both Fisher's theorem and our results on six sigma and variation reduction. The readings f Fisher's theorem is rather technical. Both are excerpts from *Diversity and Complexity*

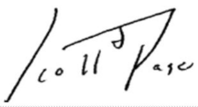
The Replicator Equation

Fisher's Theorem

Section 20: The Many Model Thinker: Diversity and Prediction

In our final section, we cover the value of ability and diversity to create wise crowds when making p models and linear models and how they can be used to make predictions. We then cover the Divers intuition for how collective prediction works. We conclude by talking about the value of having lots o explanation of the diversity prediction theorem.

Diversity Prediction Theorem



SCOTT PAGE
LEONID HUWICZ COLLEGIATE PROFESSOR
OF COMPLEX SYSTEMS, POLITICAL
SCIENCE, AND ECONOMICS UNIVERSITY OF
MICHIGAN

This Course Record Represents...

IDENTITY VERIFICATION WITH SIGNATURE TRACK

While enrolled in this course, this student voluntarily participated in identity verification measures th provided photo identification and created a keystroke profile at the time of course registration, and c keystroke analysis when submitting graded work. Coursera has verified the identity of the student a

Learn more about Signature Track and Identity Verification. →

COMPANY **FRIENDS**

Coursera empowers people to improve their lives, the lives of their families, and the communities they live in with education.

About
People
Leadership
Careers

Partners
Community
Programs
Developers
Translate

Google+
Twitter
Facebook
Blog
Tech Blog

Terms
Privacy
Help
Press
Contact