Lecture 15
Course Review & Coursework Preview

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University of Minnesota
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Daily Icebreaker

- Attendance via prompt:
  - Name
  - Program and track
  - Daily icebreaker subject...

Overview

1. Logic & Proofs
2. Sets & Topology
3. Derivatives
4. Integration
5. Multi-variate Calculus
6. Matrices
7. Linear Algebra
8. Numbers & Functions
9. Optimization
10. Probability
11. Statistics
12. Time Series & Dynamic Programming

1. Logic and Proofs

- Logic:
  - Logical statements
  - Necessary vs. sufficient
- Proofs:
  - Proof by Deduction/Construction (Direct Proofs)
  - Proof by Contrapositive
  - Proof by Contradiction
  - Proof by Induction

2. Sets and Topology

- Set Theory:
  - Set Operators
  - de Margan's Law
  - Cartesian Product
  - Convex Sets
  - Bounded Sets
  - Compact Sets
- Topology:
  - Supremum and Infimum
  - Separating Hyperplane Theorem

3. Derivatives

- Derivatives:
  - Continutity & Differentiability
  - First & Second Derivatives
  - Derivative Rules
  - Implicit Function
  - l'Hopital's Rule
  - Taylor Series Approximation
  - Mean Value Theorem
  - Convexity

4. Integration

- Integration:
  - Definite Integral
  - Fundamental Theorem of Calculus
  - Integration Rules
  - Integration by Substitution
  - Integration by Parts

5. Multi-variate Calculus

- Multi-variate Calculus:
  - Partial Derivatives
  - Total Differentiation
  - Multi-variable Chain Rule
  - Implicit Function Theorem
  - Multi-variable Concavity

6. Matrices

- Matrices:
  - Matrix Operators
  - Rank Trace
  - The Determinant
  - Positive and Negative Definite Matrices
  - Linear Independence

7. Linear Algebra

- Linear Algebra:
  - Gaussian Elimination
  - Linear Operators
  - Existence of a Solution
  - Cramer's Rule
  - Eigenvalues
  - Regression as a Matrix

8. Numbers and Functions

- Numbers:
  - Triangle Inequality
  - Neighborhoods
- Functions:
  - Homogeneity
  - Euler's Theorem
  - Quasiconcavity & Quasiconvexity
  - Concavity & Convexity
  - Continuity
  - Upper- and Lower-Hemicontinuity
  - Brouwer's Fixed-point Theorem
  - Kakutani's Fixed-point Theorem

9. Optimization

- Unconstrained Optimization:
  - First Order Conditions
  - Second Order Conditions
- (Equality) Constrained Optimization:
  - Lagrangian Method
  - Bordered Hessian
- (Inequality) Constrained Optimization:
  - Kuhn Tucker Conditions
  - Concavity, Convexity, and Optimization
- Comparative Statics & Envelope Theorem:
  - The Multiplier
  - Comparative Statics
  - Unconstrained Envelope Theorem
  - Constrained Envelope Theorem

10. Probability

- Probability:
  - Probability Limits
  - Independence
  - Law of Total Probability
  - Conditional Probability
  - Cumulative Distribution Function
  - Probability Distribution Function
  - Joint & Marginal Distributions
  - Gaussian (Normal) Distribution
  - Bayes Rules
  - Moments of a Distribution
  - Covariance
  - Correlation

11. Statistics

- Statistics:
  - Population, Parameters, and Distributions
  - Discrete & Continuous Variables
  - Law of Iterated Expectations
  - Sampling
  - Estimate, Estimator, & Estimand
  - Conditional Expectation Function
  - Law of Large Numbers
  - Central Limit Theorem
  - Continuous Mapping Theorem
  - Delta Method
  - Hypothesis Testing

12. Time Series & Dynamic Programming

- Time Series:
  - Stochastic Processes
  - Discrete & Continuous Time Markov Chain
  - Poisson Processes
  - Stationarity
  - Ergodicity
  - Unit Root or Random Walk
- Dynamic Programming:
  - Dynamic Programming Problem
  - Theory of the Maximum
  - Bellman Equation with Finite Horizon
  - Bellman's Principle of Optimality
  - Backward Induction
  - Bellman Equation with Infinite Horizon

As Concepts Arise...

Please reference these slides as topics arise in class. They may be helpful in refreshing concepts and re-establishing how to interpret terminology within an economics context.

Overview

1. 1st Year Sequence
2. Electives and Tracks
3. Microeconomics Preliminary Examination
4. Advisors
5. APEC Student Activities
6. Economics Outside the Department
7. Life Outside School
8. The Winter

1. 1st Year Sequence

- Microeconomics
  - Consumer Behavior (Paul Glewwe)
  - Production Theory (Rodney Smith / Terry Hurley)
  - Game Theory (Steve Polasky)
  - Welfare, Social Choice, & Public Goods (Jay Coggins)
- Econometrics
  - Metrics 1 and 2 – Statistics & Regression (Joe Ritter)
  - Metrics 3 – IV, GMM, and Time Series (Paul Glewwe)
  - Metrics 4 – Causal Inference (Marc Bellemare)
- Suggestion:
  - Programming for Economists (Ali Joglekar)
  - Big Data for Economists (Justin Johnson)

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2. Electives and Tracks

- After 1st year:
  - Macroeconomics (optional) in Economics department
  - PhD qualifying paper
  - Courses in your concentration
- Tracks:
  - Agriculture
  - Environment
  - Development
  - Labor
  - Health

3. Microeconomics Preliminary Examination

- The first milestone.
- 4 hours. 8 questions.
  - 2 questions and 1 hour for each section.
  - Select 1 question to be graded for each section.
- Offered each May/June and Aug/Sept
- Attempts:
  - 1st is free.
  - 2nd is free.
  - 3rd requires a request.
  - 4th is rare occurrence, and a special case.
- Study:
  - Start early (Mar/Apr).
  - Study independently and in groups.
  - Find previous exams, and practice old problem sets.
  - Have a game plan **and** simulate the environment.

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4. Advisors

- You will be assigned an intake advisor (randomly assigned).
- Picking an advisor:
  - Chat with professors about your research ideas.
  - Talk with their advisees about their opinion of working with them.
- Common advisors by field (non-exhaustive):
  - **Agriculture:** Terry Hurley, Charlotte Ambrozek, Marc Bellemare, Mike Boland, Metin Cakir, Marin Bozic, Yuan Chai, Chengyan Yue, Hikaru Peterson, Ford Runge
  - **Development:** Marc Bellemare, Paul Glewwe, Jay Coggins, Jason Kerwin, Pamela Smith
  - **Environment:** Jay Coggins, Frances Homans, Justin Johnson, Steve Polasky, Rodney Smith
  - **Labor:** Joe Ritter, Liz Davis, Jason Kerwin, Elton Mykerezi
  - **Health:** Jason Kerwin
  - **Population:** Jason Kerwin
  - **Education:** Paul Glewwe
  - **Behavior:** Chengyan Yue

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5. APEC Student Activities

- A newly established graduate student labor union (GLU-UE).
- Many students join the Minnesota Population Center (MPC).
- Occasional happy hours hosted by APEC student group.
- APEC Slack channel
- APEC Github organization
- Seminars:
  - APEC Student Seminar
  - Development Seminar
  - Environment Seminar
  - Agricultural Seminar
- Main events
  - APEC visits the State Fair (Aug)
  - APEC welcome picnic (Sept)
  - End of the Year gathering (Jan)
  - International dinner (Mar/Apr)

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6. Economics Outside the Department

- Organizations worth joining:
  - American Economics Association (AEA)
  - Agriculture and Applied Econoimics Association (AAEA)
  - Econometrics Society
  - Field based organization (i.e., AERE, SABE, NABE)
- Major annual conferences:
  - ASSA meeting
  - AAEA meeting
  - NBER Summer Institute
  - Main conference in your sub-field
- Major annual awards:
  - John Bates Clark Award
  - Nobel Prize
- The main forum currently remains #EconTwitter.

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6. Economics Outside the Department

- Top Economics journals to follow:
  - Econometrica
  - American Economic Review
  - Journal of Political Economy
  - Quarterly Journal of Economics
  - Review of Economics and Statistics
- Top adjacent journals to follow:
  - Nature
  - Science
  - Proceedings of the National Academy of the Sciences (PNAS)
  - Journal of the American Statistical Association
  - American Journal of Political Science
  - The Lancet

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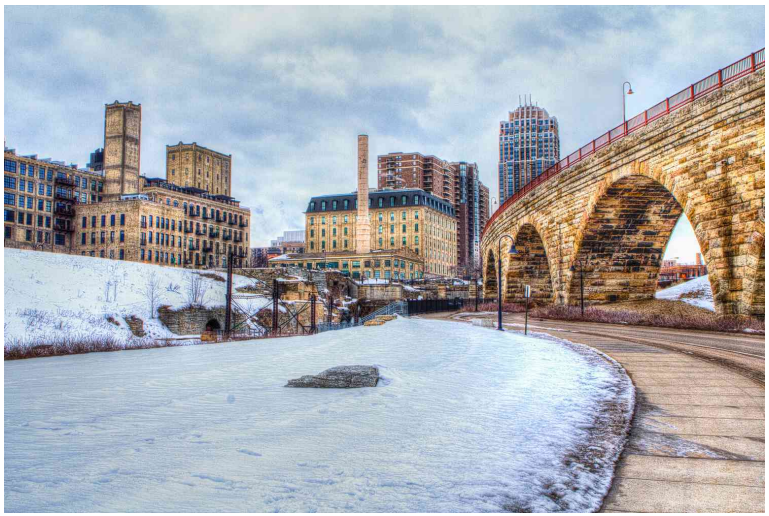
  - Journal of the American Statistical Association
  - American Journal of Political Science
  - The Lancet

7. Life Outside School

- You will get stressed. You will get lonely.
- Get your mental health in order. Get mental health support (therapist) if you need.
- Try to have a friend. Someone to talk to.
- Stay physically healthy. It will keep your mind healthy.
- Get a hobby. Ideally something that has nothing related to your self-worth or academic achievements.

8. The Winter

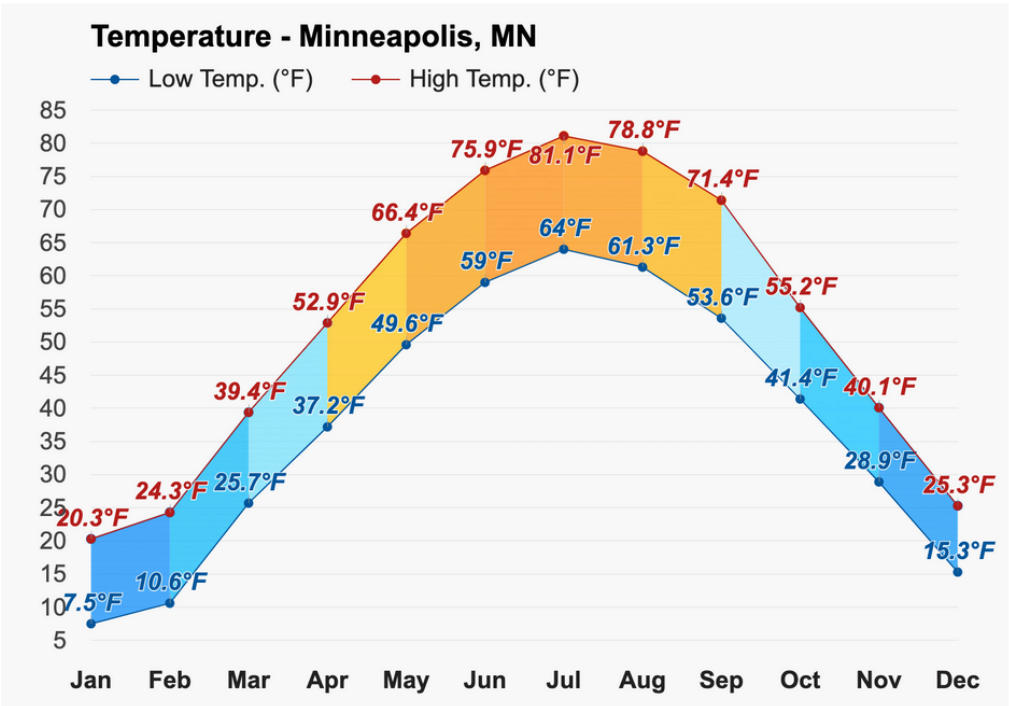


- Go outside while it is warm...
- The season is typically Oct/Nov to Mar/Apr

- Sign up for Minneapolis and Saint Paul snow alerts.
  - Minneapolis (Click Me)
  - Saint Paul (Click Me)
- Find hobbies for the winter.
- The gear you need:
  - Winter boots
  - Winter jacket (puffy)
  - Wool socks
  - Gloves
  - Winter beanie
  - Scarf

8. The Winter

- 30 year average:
  - Daily temperature: 10° F (Low) to 40° F (High)
  - Snow days: 38 days
  - Snowfall: 51 inches (130 centimeters)
  - Snowstorms (> 5 inches): 2 days
  - Days with snow depth (> 1 inch): 89 days



Thank You for Your Time!