

# Welcome to Math Camp (2018)

Dept. of Political Science  
University of Wisconsin–Madison

Instructors:  
Michael DeCrescenzo and Micah Dillard

August 20, 2018

# Math and Political Science

(Political Science and Math)

Why math?

In general...

# In general...

Math is explicit and specific

# In general...

Math is explicit and specific

Formalizing: lay out premises and assumptions, derive implications

# In general...

Math is explicit and specific

Formalizing: lay out premises and assumptions, derive implications

Discover hidden insights

# In general...

Math is explicit and specific

Formalizing: lay out premises and assumptions, derive implications

Discover hidden insights

Even if you don't do highly mathematical work, you will encounter it



For empirical research  
(data analysis...)

# For empirical research (data analysis...)

Principled measurement methods

# For empirical research (data analysis...)

Principled measurement methods

Formally describe patterns in observed data

# For empirical research (data analysis...)

Principled measurement methods

Formally describe patterns in observed data

Make judgments about statistically meaningful findings (vs. random noise)

# For empirical research (data analysis...)

Principled measurement methods

Formally describe patterns in observed data

Make judgments about statistically meaningful findings (vs. random noise)

Make causal inferences

For formal models  
(game theory...)

# For formal models (game theory...)

Define sets of actors, preferences, incentives

# For formal models (game theory...)

Define sets of actors, preferences, incentives

Derive actors' strategies for optimal payoffs



# For formal models (game theory...)

Define sets of actors, preferences, incentives

Derive actors' strategies for optimal payoffs

Describe trade-offs of certain actions

# For formal models (game theory...)

Define sets of actors, preferences, incentives

Derive actors' strategies for optimal payoffs

Describe trade-offs of certain actions

Dealing with limited information, probabilistic beliefs, learning from new information

# Objectives

# Objectives

Operationally...

# Objectives

Operationally...

- Preparation for methods courses
- Practicing essential arithmetic routines

# Objectives

Operationally...

- Preparation for methods courses
- Practicing essential arithmetic routines

Conceptually...

# Objectives

Operationally...

- Preparation for methods courses
- Practicing essential arithmetic routines

Conceptually...

- Show where political science needs math (using examples)
- Intuitive, conceptual understanding is most important

# Objectives

Operationally...

- Preparation for methods courses
- Practicing essential arithmetic routines

Conceptually...

- Show where political science needs math (using examples)
- Intuitive, conceptual understanding is most important

You won't memorize everything we cover this week,

but you need to be able to "roll with it" in class



# Reassurances

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

How do I know you will be fine?

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

How do I know you will be fine?

- I had a weak math background (never took calculus until grad school)

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

How do I know you will be fine?

- I had a weak math background (never took calculus until grad school)
- I skipped math camp (was out of town)

# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

How do I know you will be fine?

- I had a weak math background (never took calculus until grad school)
- I skipped math camp (was out of town)
- Different areas of research emphasize different areas of math (and specialization is the norm)



# Reassurances

Some material will be unfamiliar (and maybe scary) at first, but...

- Nobody expects you to be an expert by the end of math camp (that isn't the point)
- The point is intuition and application, not proofs or overly tricky examples

How do I know you will be fine?

- I had a weak math background (never took calculus until grad school)
- I skipped math camp (was out of town)
- Different areas of research emphasize different areas of math (and specialization is the norm)
- You get out what you put in

Questions so far?

# Agenda

# Mornings (9–12ish): math lessons

Lecture slides, definitions, examples

## Mornings (9–12ish): math lessons

Lecture slides, definitions, examples

## Afternoons (1–3ish): practice

Take-home exercises will be distributed

Instructors will be present to work through problems

## Mornings (9–12ish): math lessons

Lecture slides, definitions, examples

## Afternoons (1–3ish): practice

Take-home exercises will be distributed

Instructors will be present to work through problems

## Happy Hour (3ish--6ish)

## Mornings (9–12ish): math lessons

Lecture slides, definitions, examples

## Afternoons (1–3ish): practice

Take-home exercises will be distributed

Instructors will be present to work through problems

## Happy Hour (3ish--6ish)

Just kidding

## Mornings (9–12ish): math lessons

Lecture slides, definitions, examples

## Afternoons (1–3ish): practice

Take-home exercises will be distributed

Instructors will be present to work through problems

## Happy Hour (3ish--6ish)

Just kidding

Contact your instructors at any time

(But you should feel free to ask questions throughout)



Monday: Essential algebra and pre-calculus (Mike)

- Fundamentals, notation, functions

Monday: Essential algebra and pre-calculus (Mike)

- Fundamentals, notation, functions

Tuesday: Linear algebra (Micah)

- Vectors and matrices
- Useful for manipulating real data

Monday: Essential algebra and pre-calculus (Mike)

- Fundamentals, notation, functions

Tuesday: Linear algebra (Micah)

- Vectors and matrices
- Useful for manipulating real data

Wednesday: Calculus (Micah)

- Limits, derivatives, integrals
- How variables affect other variables

Monday: Essential algebra and pre-calculus (Mike)

- Fundamentals, notation, functions

Tuesday: Linear algebra (Micah)

- Vectors and matrices
- Useful for manipulating real data

Wednesday: Calculus (Micah)

- Limits, derivatives, integrals
- How variables affect other variables

Thursday: Finish calculus, Probability (Micah/Mike)

- Mathematical intuitions of independent and conditional probability
- Probabilistic processes (random variables), patterns in "real data"

Monday: Essential algebra and pre-calculus (Mike)

- Fundamentals, notation, functions

Tuesday: Linear algebra (Micah)

- Vectors and matrices
- Useful for manipulating real data

Wednesday: Calculus (Micah)

- Limits, derivatives, integrals
- How variables affect other variables

Thursday: Finish calculus, Probability (Micah/Mike)

- Mathematical intuitions of independent and conditional probability
- Probabilistic processes (random variables), patterns in "real data"

Friday: Finish probability, Maybe computer fun (Mike/Micah?)

- Potentially: fundamentals of data in the computer (using R)

# Deliverables?

Daily exercises (not collected)

No final exam (or grades of any kind)

You are in charge of yourselves

## Questions?

In the classroom

# In the classroom

- Covering lots of ground



# In the classroom

- Covering lots of ground
- Everyone has a different background

# In the classroom

- Covering lots of ground
- Everyone has a different background
- Please ask questions

# In the classroom

- Covering lots of ground
- Everyone has a different background
- Please ask questions
- Open and accepting environment

# In the classroom

- Covering lots of ground
- Everyone has a different background
- Please ask questions
- Open and accepting environment

Let us (Micah and me) know how we can make this work better

# In the classroom

- Covering lots of ground
- Everyone has a different background
- Please ask questions
- Open and accepting environment

Let us (Micah and me) know how we can make this work better

- Ask lots of questions! They help the entire class!
- Slow us down
- Ask why we are learning something

# Resources

The [Github repository](#):

- Slides, exercises
- Source code to build it all

Other resources:

- View [last year's materials](#)
- Gill, [Essential Mathematics for Political and Social Research](#)
- Moore & Siegal: [A Mathematics Course for Political & Social Research](#)

About your instructors

# Mike DeCrescenzo



Roots in St. Louis and Kansas City, Missouri.  
Short stints in Berkeley, CA

Studies American politics & political  
methodology (since 2014)

Primary elections, gender and voting, voter  
identification requirements

Comparative advantage: Bayesian analysis  
(probability and statistics)

Email: [decrescenzo@wisc.edu](mailto:decrescenzo@wisc.edu)



# Micah Dillard



A proud Ohio son (Columbus)

Studies international relations & political methodology (since 2014)

Economic sanctions, energy and foreign policy, non-traditional security

Comparative advantage: Formal theory (algebra and calculus)

Email: [micah.dillard@wisc.edu](mailto:micah.dillard@wisc.edu)

Let's get started