Math Camp

Module #0 Introduction

Why are we here?

Who are we?

What is economics?

What is math?

Why is there math in economics?

There's not.

Definition. A *theory* is a set of assumptions together with the necessary implications.

Two approaches to forming theories

1. Construct a narrative to explain behavior witnessed in data

   - Pro: language allows for nuance and therefore realistic modeling assumptions

   - Con: language is imprecise so assumptions and their implications can be unclear

About math in economics (continued)

2. Use math to lay out precise assumptions and deduce necessary implications

- Pro: meaning of assumptions and what implications follow cannot be debated; debate is limited to appropriateness of assumptions

- Con: tractable assumptions are necessarily restrictive, limiting reach of theory

About this course

Four important points

- New concepts in mathematics are completely mysterious until they are trivial
- Simply reading the lecture slides/text may not be enough to understand the concepts
- Your ability to apply course concepts only comes through self practice
- Don't skip the exercises

Prereqs: Logic

Let P and Q be statements

- "A declarative sentence that is either true or false but not both"

- We can use logical operators to create new compound statements that are either true or false.

Logical Operators

- **Conjunction:** the conjunction of P and Q is the statement "P *and* Q", denoted $P \wedge Q$. Is only true if **both** P and Q are true.

- **Disjunction**: the disjunction of P and Q is the statement "P *or* Q", denoted $P \vee Q$, and is only true if **either** P or Q are true.

Prereqs: Logic

Logical Operators cont.

- **Negation**: the negation of a statement P is the statement "*not* P", denoted $\neg P$, and is only true if P is false, and is only false if P is true.

- **Conditional**: the conditional statement is the statement "*If* P *then* Q, denoted $P \rightarrow Q$, means that Q must be true whenever P is true, and is only false when P is true and Q is false.

Prereqs: Numbers

- What about $\mathbb{R}$?
  - $\mathbb{R}$ is the completion of the rational numbers
  - Let $A \subset \mathbb{R}$. The *supremum* of A, denoted $\sup A$ is the least upper bound of A (may be infinite).
  - If $A \subset \mathbb{R}$ is bounded above then $\sup A \in \mathbb{R}$. (!!!!!)
- What about $\mathbb{C}$?
  - $\mathbb{C}$ is algerbraically closed: every non-constant polynomial has a root in $\mathbb{C}$
  - Every polynomial equation has a solution in $\mathbb{C}$

$\sim$

Definition. A *relation* on a set X is a subset R of $X \times X$

- if $(x,y) \in R$ then we write $x \sim y$
- R is an equivalence relation if it has the following properties
  - reflexivity $x \sim x$
  - symmetry $x \sim y \Rightarrow y \sim x$
  - transitivity $x \sim y$ and $y \sim z$ implies $x \sim z$
- the collection of all elements related to a given element is called an equivalence class

partition

Definition. A *partition* of a set X is a collection of non-intersecting subsets whose union is X.

More formally, $\{X_\lambda\}_{\lambda\in\Lambda}$ is a partition of X provided

- $X_\lambda \subset X$ for all $\lambda \in \Lambda$
- $X = \cup_{\lambda\in\Lambda} X_\lambda$
- $\lambda_1 \neq \lambda_2 \Rightarrow X_{\lambda_1} \cap X_{\lambda_2} = \emptyset$