Economics 300, Mathematica Demonstrations by Topic

Professor Cramton

These Mathematica demonstrations are intended to illustrate a particular topic in the course. Mathematica 8 (player or the full program) is required to make use of the demonstrations. If you download the source program, you will not only be able to use the demonstration, but you will be able to see the code that makes it work, and modify the code to do other things.

Date Topic

Jan 25 Ch. 1 – The Mathematical Framework of Economic Analysis

Jan 27 Ch. 2 – An Introduction to Functions

Multivariate functions

Cobb-Douglas production functions

Tinbergen-Solow production function (a modified version of Cobb-Douglas)

Constant elasticity of substitution production

An example of a production function

Bubble chart comparisons of countries

Edgeworth box

Gordon-Schaefer model

Properties of functions

Limits and continuity

Discontinuity

Uniform continuity

Limit laws

Finite limit at a finite point

Infinite limit at a finite point

Finite limit at infinity

Infinite limit at infinity

Rate of change

Instantaneous rate of change

Average rate of change: exploring more functions

Instantaneous rate of change: exploring more functions

Graphing Derivatives

Secant and tangent lines (an example relating instantaneous and average rate of change)

Useful functions

Cubic equation

Annotated quadratic polynomial

Polynomial graph generator

Continuous exponential growth

Exploration versus consumption (*no source code*)

Feb 3 Ch. 3 – Exponential Functions

Continuous exponential growth

Rule of 72 (an example of interest rate)

[To do: Different interest compounding (p5)]

Discounted present value

Net present value

NPV and its contributions

The present value of future gas use

Price-yield curve

Feb 8 Ch. 3 – Logarithmic Functions

[To do: Different log functions (p18)]

Rules for logarithms

Feb 10 Ch. 4 – Section 1 only - Systems of Equations and Comparative Statics

Basic supply and demand

Supply and demand

Per unit tax (an example of supply and demand)

Shifts in the demand curve

Consumer and producer surplus

Price controls

Hazards of propping up: bubbles and chaos

Feb 15 Ch. 6 – Basics of Differential Calculus

Average rate of change and quotient

Instantaneous rate of change

Average rate of change: exploring more functions

Instantaneous rate of change: exploring more functions

Graphing Derivatives

Secant and tangent lines (an example relating instantaneous and average rate of change)

Polynomials and derivatives

Limits and continuity

Discontinuity

Uniform continuity

Limit laws

Finite limit at a finite point

Infinite limit at a finite point

Finite limit at infinity

Infinite limit at infinity

Mar 1 Ch. 7 – Univariate Calculus

Derivative as a function

Derivatives of exponential functions

Rules of differentiation

Product rule

Quotient rule

Chain rule

Second derivatives

Instantaneous rate of change: exploring more functions with the first and second derivatives

Mar 3 Ch. 7 – Univariate Calculus - Elasticity

Revenue and elasticity

Elasticity, total revenue, and the linear demand curve

Long-run average total cost

Short-run cost curves

Mar 8 Ch. 8 – Multivariate Calculus

Partial derivatives

Partial derivatives in 3D

Cobb-Douglas production functions

Implicit functions

Implicit function game

Differential of multivariate functions

Slope fields

Chain rule

Mar 15 Ch. 9 – Extreme Values of Univariate Functions

Global extrema on an interval

Maximizing the area of a rectangle with fixed perimeter

Population selector

Mar 17 Ch. 10 – Extreme Values of Multivariate Functions

Tangent planes on a 3D graph

Tangent Circles

Tangent planes to quadratic surfaces

Tangent to a surface

Saddle points and inflection points

Apr 7 Ch. 11– Constrained Optimization

Constrained optimization
Demand for insurance (Lagrangian method)
Envelope theorem: numerical examples
Changes in the budget line
Minimizing the surface area of a cylinder with a fixed volume
Convergence of minimization methods
Graphical linear programming for two variables
Income and substitution effects
Optimal bin packing with random lengths
Profit maximization in perfect competition

Apr 19 Probability

Monty hall problem
Venn diagrams
The perfect Venn diagram
Venn diagrams for two sets
Conditional probability (partly contain independence)

Apr 21 Decision making under Uncertainty

Expected returns of the Dow industrials, beta model
Stock market returns by party
Sample versus theoretical distribution
Sector chart applied to GDP
Purchasing power calculator
Rank plots for countries

Apr 26 Risk Theory

Constant risk aversion utility functions
Premium Ratios With Capital Costs Included
Risk aversion, load, and optimal insurance
Risk premiums
Certainty equivalent wealth
Investment leverage effect
Adverse selection
Moral hazard and least-cost contracts: impact of changes in agent preferences
Moral hazard and least-cost contracts: impact of changes in conditional probabilities

Apr 28 Game Theory

Prisoner's dilemma

Stable marriage

Nash equilibria in 3×3 games

Set of Nash equilibria in 2x2 mixed extended games

Nash equilibria with continuous strategies

May 10 Market Games

Merger guidelines

Monopoly profit and loss

Walrasian equilibrium or disequilibrium