Econ 690: Computational Economics/Numerical Methods

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- Intro Matlab Files
  - **Lecture 2 - Matlab Intro/MatlabIntro.m**: Lecture file that introduces the various commands of Matlab.
  - **Lecture 2 - Matlab Intro/GraphingExample**: Lecture file that introduces three different ways to plot.
  - **Lecture 2 - Matlab Intro/SampleFunction**: Lecture file introduces an external function.
- Value Function Iteration
  - **Lecture 2 - Matlab Intro/HelenofTroy**: Lecture file that introduces "Helen of Troy" discrete choice, finite horizon stochastic Value Function Iteration. Similar to a VFI exercise on the value of an American Option.
  - **Lecture 2 - Matlab Intro/CakeEating**: Lecture file that introduces a "Cake Eating" problem: finite horizon deterministic problem on consuming finite natural resource.
  - **Lecture 2 - Matlab Intro/CakeGrowth**: Lecture file that introduces a "Cake Eating" problem with stochastic growth: finite horizon stochastic problem on consuming stochastically-growing natural resource.
  - **Lecture 4 - VFI/VFI_Intro_Discrete**: Runs the standard simple Neoclassical Growth Model value function iteration problem (discrete time, discrete choice, deterministic).
  - **Lecture 4 - VFI/VFI_Intro_Continuous**: Same as above, but with continuous choice.
  - **Lecture 4 - VFI/VFI_Cheb**: Runs the standard simple Neoclassical Growth Model value function iteration problem (discrete time, discrete choice, deterministic) but using a Chebyshev Polynomial basis. Rather than using closed forms on Chebyshev nodes, it instead fits its cloud of points using least squares on a Chebyshev basis.
  - **Lecture 4 - VFI/VFI_polynomial.m**: Runs the standard simple Neoclassical Growth Model value function iteration problem (discrete time, discrete choice, deterministic) but using a Chebyshev Polynomial basis. Rather than using closed forms on Chebyshev nodes, it instead fits its cloud of points using least squares on a Chebyshev basis.
- Newton's Method
  - **Lecture 5 - Newton's Method** Mathematica (not Matlab) file NewtonsMethod.nb graphically shows Newton's Method on two 2-dimensional functions.
  - **Lecture 6 - Newton's Method Applied/Lecture_6_NewtonsMethod_DixitStiglitz.m** Applies Newton's Method/derivative-based minimization (fsolve) to a "light" Dixit-Stiglitz general equilibrium model with constant elasticity of substituion aggregators.
  - **Lecture 6 - Newton's Method Applied/Lecture_6_NewtonsMethod_LinReg.m** Applies Newton's Method/derivative-based minimization (fsolve) to a "light" Dixit-Stiglitz general equilibrium model with constant elasticity of substituion aggregators.

  - **Lecture 6 - Newton's Method Applied/ZerosandMinimization.m** Showcases the many equation solvers and minimizers available in matlab (including non-derivative based ones).

- Other Minimization Methods
  - **Lecture 7 - Other Methods/ConjugateGradientMethod.m** displays the conjugate-gradient method, useful when you don't want to take second derivatives but don't want to fall prey to the flaws of gradient descent.
  - **Lecture 7 - Other Methods/GeneticAlgorithm.m** displays Matlab's genetic algorithm, a "global" minimizer. Slow, but effective and can work with integer constraints, unlike most other methods.
  - **Lecture 7 - Other Methods/DifferentialEvolution.m** displays a differential-evolution based minimizer, comparable to the genetic algorithm.
  - **Lecture 7 - Other Methods/NelderMead.m** displays the "Nelder-Mead" simplex. Fast non-derivative based minmimizer.
  - **Lecture 7 - Other Methods/PatternSearch.m** displays the "Pattern-Search" minimizer. Fast non-derivative based minmimizer.
  - **Lecture 7 - Other Methods/SimulatedAnnealing.m** displays the "Simulated-Annealing" minimizer. Slow, and in my experience not great minimizer.

- Interpolation
  - **Lecture 8 - Interpolation/Bases.m** Graphs out the first nine Monomial and Chebyshev Bases.
  - **Lecture 8 - Interpolation/Simple_Interpolation.m** Displays simple interpolation commands and graphs them.
  - **Lecture 8 - Interpolation/ChebyChev_1D.m** One-dimensional Chebyshev interpolation.
  - **Lecture 8 - Interpolation/ChebyChev_2D.m** Two-dimensional Chebyshev interpolation.
  - **Lecture 8 - Interpolation/Monom_1D.m** One-dimensional monomial/Taylor interpolation.
  - **Lecture 8 - Interpolation/Monom_2D.m** Two-dimensional monomial/Taylor interpolation.

- Reinforcement Learning
  - **Lecture 9 - Reinforcement Learning/Discrete_VFI/Discrete_VFI.m** Standard VFI, copied from the discrete choice example. Used for graphing comparison in RL.
  - **Lecture 9 - Reinforcement Learning/Fitnet Example/Main.m** Displays a neural network used for fitting (think highly flexible nonlinear least squares.)
  - **Lecture 9 - Reinforcement Learning/NN_Example/Simple_5_Main.m** Shows a simple single-layer, 5 neuron network.
  - **Lecture 9 - Reinforcement Learning/NN_Example/Simple_N_Main.m** Shows a simple single-layer, N-neuron network.
  - **Lecture 9 - Reinforcement Learning/NN_Example/Deep_N_Main.m** Shows a deep-learning (2 layer)
    $$N, N$$
    -neuron network.
  - **Lecture 9 - Reinforcement Learning/NN_VFI/Actor_Critic_UpdateActor.m** Shows the actor-critic updating algorithm (specifically, updating the actor step).
  - **Lecture 9 - Reinforcement Learning/NN_VFI/Main.m** Uses the actor-critic algorithm to solve the standard neoclassical growth model.
  - **Lecture 9 - Reinforcement Learning/NN_VFI/myResetFunction.m** Called by Main.m, resets the problem.

  - **Lecture 9 - Reinforcement Learning/NN_VFI/myStepFunction.m** Called by Main.m, steps the problem forward in time.

- Sargent & Ljungqvist (1998)
  - **Lecture 10 - Sargent Ljungqvist/Sargent_Ljungqvist.m** Mostly (but not perfectly) replicates several figures in Sargent & Ljungqvist (1998).

- Neoclassical Growth Model
  - **Lecture 11 - NCG/NCG_New//Main.m** this file first calls the data cleaner, calibrates parameters, and solves the Neoclassical Growth Model.
  - **Lecture 11 - NCG/NCG_New/focs_NCGTrend.m**. this file contains the first order conditions the Main.m file has to zero.
  - **Lecture 11 - NCG/NCG_New/f_Kstock.m** this file contains two moments the initial capital stock/depreciation rate solver has to zero (calibrate initial capital stock+depreciation rate).
  - **Lecture 11 - NCG/NCG_New/Data_Preparation.m** this file cleans the data and calibrates the moments.

- Computable General Equilibrium models
  - **Lecture 12 - CGE/HarbergerwESIdecisio.xlsx** is an excel(!) file that solves the CGE model in Gallen & Mulligan 2018. Uses the Microsoft Excel derivative-based "solver" add-on.

- Generalized Method of Moments
  - **Lecture 13 - GMM/FittingFirmSize/Main_Firm.m** starts with a guess and calibrates the firm size model
  - **Lecture 13 - GMM/FittingFirmSize/Estimator_Firm.m** takes in parameter values, solves the general equilibrium model for firms & households (wages clear labor markets) and spits out moment error.
  - **Lecture 13 - GMM/MedicaidExample/Main_Pref** starts with a guess and calibrates the preference model
  - **Lecture 13 - GMM/MedicaidExample/Estimation_Pref** takes in parameter values, solves the household problem and returns moment errors.

- Simulation Estimation

- Dynamic Discrete Choice Estimation

- Markov Chain Monte Carlo
  - **Lecture 16 - MCMC/Metropolis_Hastings.m**

- Likelihoods and Filtering
  - **Lecture 17 - Likelihoods and Filtering/KalmanNew.m** this file runs through a Kalman Filter and Kalman Smoother problem to filter out permanent income based on income+consumption data from a permanent income hypothesis style problem.
  - **Lecture 17 - Likelihoods and Filtering/Kalman.m** this file straightforwardly applies the Kalman Filter to track a target whose movements are known with noise. (Basic Kalman problem)
  - **Lecture 17 - Likelihoods and Filtering/Kalman_Lemma1.m** this file simply shows the variance of x residual of control y $var(x - \hat{\beta}y)$ is equal to $var(x) - \frac{var(x)cov(xy)}{var(y)}$ (in matrix form). The most important fact for the Kalman filter (Kalman gain).
  - **Lecture 17 - Likelihoods and Filtering/Markov.m** Markov Chain example with Bayesian updating.

  - **Lecture 17 - Likelihoods and Filtering/Markov2.m** Another Markov Chain example with Bayesian updating.

- Heterogeneous Agent Models
  - **Lecture 18 - Heterogeneous Agents/Krusell_Smith.m**. Application of the basic Krusell-Smith (1998) heterogeneous agents algorithm.