Advanced Topics in Macro 1
Problem Set 1

Due date: November 3, 2020, at 12.00pm
Total points: 100 (+10 bonus)

Problem 1 (required) Consider the deterministic growth model described in class.

(a) Solve the model by value function iteration. *[11 points]*

(b) Exploit monotonicity of the policy function and evaluate its performance. *[13 points]*

(c) Exploit concavity of the value function and evaluate its performance. *[13 points]*

(c) Code Howard's policy iteration and evaluate its performance. *[13 points]*

[To get the code to work, it may be helpful to use the analytic example we used in class.]

Problem 2 (required) Again for the model described in class (with TFP as an extra parameter). Calculate its steady state. Now suppose that by surprise, TFP doubles. Compute the new steady state and the transition from the old to the new, assuming that it has completed in 200 periods. Compute such transition three ways and specify how long it takes to solve it each way. The first way is a system of 200 equations and unknowns, the second by guessing first period capital until the system gets the right capital in period 201, and the third by guessing capital in the period 200 until, by moving backwards, you obtain the right initial capital. *[50 points]*

Problem 3 (optional) Write a routine that linearly interpolates. Apply it by storing the value of $\exp(x)$ between 0 and 1 in intervals of 0.1 and assess the value by interpolation in intervals of 0.05. Plot the function and what results from using the approximation. *[3 bonus points]*

Problem 4 (optional) Show that the Bisection method converges linearly at a rate of $1/2$. *[3 bonus points]*

Problem 5 (optional) Solve $\sin 2\pi x - 2x = 0$ using bisection, Newton's method, the secant method, and the fixed-point iteration. For what values of the initial guess $x_0 \in [-2, 2]$ does each of these methods converge? Repeat for $\sin 2\pi x - x = 0$. Repeat for $\sin 2\pi x - 0.5x = 0$. *[4 bonus points]*

[This one is fun but time consuming, I suggest you only do it if you have completed the required ones]