AE04: Assignment 2 (MATLAB)

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1. Write a script that calculates the growth of an initial investment under compound interest over N years using a for loop. Assume an annual interest rate r and yearly contributions C.
2. Given a time series of GDP growth rates, compute a rolling moving average using a for loop.
3. Write a for loop to simulate random points inside a square and estimate the value of π using the ratio of points inside a quarter-circle.
4. Look up the Cobb-Douglas model from Walter Enders book on applied econometric time series. Implement a recursive function to model total output given capital (K) and labor (L) inputs over multiple time periods.
5. (Exploration) Download the Nifty 50 data for the December 2024. Fit an AR(1) model for daily returns, using a window of your choice, using the econometric toolbox. Forecast the average returns for January first week. Come up with a strategy to take trades based on the forecasts. Report the Profit & Loss (in percentage) for your trading strategy.

Samuelson's model

Consider a simple macroeconomic model where output (Y_t) evolves according to the equation:

$$Y_{t+1} = aC_t + bI_t$$

where:

- Consumption: $C_t = cY_t$ (a fraction c of output is consumed). •
- Investment: $I_t = (1 - c)Y_t$ (the remaining fraction is invested).
- The parameters a and b govern the effect of consumption and investment on future output.

Assume the following parameters for the simulation:

- $a = 0.8, \quad b = 0.2, \quad c = 0.6$.
- Initial output is $Y_0 = 100$.
- The economy is simulated over $T = 30$ time periods.

Implement the following

1. Simulation:
   (a) Write a MATLAB script to simulate the evolution of output Y_t over T periods using a for loop.
   (b) Store the output values in an array and plot Y_t over time.
2. Recursive Implementation
   (a) Implement a recursive function $Y_t = income(t)$ that calculates output for any given period t using the recurrence relation.
   (b) Compare the recursive results with the for-loop results.
3. Impact of Changing Parameters

(a) Modify the values of c (propensity to consume) and analyze its impact on long-run output.

(b) Run simulations for $c = 0.5, 0.6, 0.7$ and plot the results.

4. Monte Carlo Simulation of Economic Shocks

(a) Assume that investment I_t is subject to random shocks:

$$I_t = (1 - c)Y_t + \epsilon_t, \quad \text{where } \epsilon_t \sim \mathcal{N}(0, \sigma^2)$$

Simulate the output trajectory for $N = 1000$ trials and plot the average trajectory with confidence intervals.

5. Long-Run Stability Analysis

(a) Derive the equilibrium condition for Y_t as $t \to \infty$.

(b) Implement a MATLAB script to check whether the system stabilizes, grows, or collapses depending on a, b, and c.