Final project (10 hours)

Computational Tools for Macroeconomics (MATLAB)

For May June 2026 exam only

Who: students who did not submit weekly homework (type 3 students)
When: By 11:00 on 07/06/2026 here
Time budget: about **10 hours total**
Instruction: complete **as much as you can** of the three subprojects below (they increase in difficulty).
Submission: upload **one .zip** with your code + figures. Then come to the **oral exam** on the 02/02/2026 to discuss your work. **Remember to book your exam on infostud in advance**.
No submission by the deadline no exam!

What to submit (mandatory)

- Your MATLAB code (`.m` files). Organise it as you prefer, but it must run without manual edits.
- A short `README.md` explaining how to run your code and what files/figures it produces.
- A `Figures/` folder with exported figures (`.png`) and (optionally) tables (as `.png` or `.pdf`).

Reproducibility: set random seeds using `rng(...)` whenever you simulate random numbers.

Subproject 1 (about 2.5 hours) — Linear system + correlated shocks

Goal: solve and simulate a simple linear macro model with correlated shocks using matrix algebra and Cholesky.

Model (given)

Let $y_t = \begin{bmatrix} x_t \\ \pi_t \end{bmatrix}$ and assume the equilibrium each period satisfies:

$$Ay_t = b + \varepsilon_t, \quad A = \begin{bmatrix} 1 & -0.4 \\ -0.2 & 1 \end{bmatrix}, \quad b = \begin{bmatrix} 0 \\ 0 \end{bmatrix}.$$

Shocks are jointly normal:

$$\varepsilon_t \sim \mathcal{N}(0, \Sigma), \quad \Sigma = \begin{bmatrix} 1.0 & 0.6 \\ 0.6 & 1.5 \end{bmatrix}.$$

Tasks

- Simulate $T = 200$ periods of shocks ε_t using Cholesky: $\varepsilon_t = Lu_t$, where $LL' = \Sigma$ and $u_t \sim \mathcal{N}(0, I)$.
- For each t, solve $y_t = A\backslash(b + \varepsilon_t)$.
- Produce: (i) time series plot of x_t and π_t, (ii) scatter plot of x_t vs π_t, (iii) mean/std/corr of (x_t, π_t).

Subproject 2 (about 4 hours) — Deterministic consumption–saving (VFI)

Goal: solve a deterministic infinite-horizon saving problem using Value Function Iteration (VFI).

Model (given)

A household chooses consumption c and next-period assets a' to maximize:

$$V(a) = \max_{a' \geq a_{\min}} \{\log(c) + \beta V(a')\}$$

subject to the budget constraint:

$$c = y + (1 + r)a - a', \quad c > 0.$$

Parameters (use these)

Parameter	Value	Description
β	0.96	Discount factor
r	0.02	Interest rate
y	1.0	Income per period
$a_{\min}$	0	Borrowing constraint
Grid	$[0, 20]$	Asset range
N	400	Grid points

Tasks

- Implement VFI for $V(a) = \max_{a' \geq a_{\min}} \{\log(c) + \beta V(a')\}$.
- Construct a feasibility/utility matrix and set infeasible choices to $-\infty$.
- Converge to tolerance 10^{-6} (or tighter) and extract the policy $a'(a)$ and consumption $c(a)$.
- Simulate a deterministic path of length 60 starting from $a_0 = 0$ using interpolation on your policy.

Outputs

- Policy plot $a'(a)$ with 45-degree line.
- Consumption plot $c(a)$.
- Simulated asset path a_t.

Subproject 3 (about 3.5 hours) — Comparative statics: varying the discount factor

Goal: investigate how the discount factor β affects household saving behavior by reusing your VFI code for policy analysis.

Tasks

- Solve the VFI problem for three values of $\beta \in \{0.90, 0.96, 0.99\}$.
- Create comparison plots for the savings policies $a'(a)$ and consumption policies $c(a)$ on the same figures.
- Simulate and compare: for each β, simulate a 60-period path starting from $a_0 = 5$. Plot all three asset paths on the same figure.
- Report a summary table with final asset levels a_{60} and average consumption for each β.
- Provide an economic interpretation of how $\beta(1 + r)$ determines saving behavior and steady states.

Outputs

- `Figures/sub3_policies_comparison.png`: three savings policies on one plot.
- `Figures/sub3_paths_comparison.png`: three simulated asset paths on one plot.

Oral exam: you should be ready to explain everything in the code you submitted. Examples:

- How Cholesky decomposition works and why $\varepsilon = Lu$ has covariance Σ.
- The structure of the Bellman equation and how VFI finds the solution.
- Why infeasible choices are set to $-\infty$.
- How $\beta(1 + r)$ determines saving behavior (patience vs impatience).
- How you set up grids, constructed the utility matrix, and extracted policies.