Dynamic Macroeconomics
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In-class Worksheet 1

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Question 1

$$\begin{aligned}
\max_{\langle c_t\}_{t=0}^{T-1},\{\alpha_t\}_{t=1}^{T-1}} U &= \sum_{t=0}^{T-1} \beta^t \frac{c_1^{1-\sigma}}{1-\pi}, \\
\text{s.t. } a_{t+1} &- (1+r)\left(a_t + y_t - c_t\right), \\
y_t &= \begin{cases} \bar{y} & \text{if } t < t_r \\ \kappa\bar{y} & \text{if } t \geqslant t_r \end{cases} \\
a_0 &\text{ given}, \\
a_T &= 0, \\
c_t &> 0,
\end{aligned}$$

where $t = 1, 2, ...,$

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Solution. The Dynamic Programming Problem is given that consumers are finitely-lived, the presentative consumer maximizes lifetime utility.

The Bellman Equation

We define the value function $V_t(a_t)$ as:

$$\begin{aligned}
V_t\left(a_t\right) &= \max_{c_t}\left\{\frac{c_t^{1-\sigma}}{1-\sigma} + \beta V_{t+1}\left(a_{t+1}\right)\right\} \\
\text{s.t. } a_{t+1} &= (1+r)\left(a_t + y_t - c_t\right)
\end{aligned}$$

The remaining answers to the sub-questions are in the Matlab code files included