RL for Macro Modelling

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Executive Summary

- RL recovers the solution to a range of baseline macroeconomic models
- Possible Extensions:
  - Change functional form of utility/production functions
  - Easy to extend to multiagent setting
  - RL agent can be trained in one regime and put in another e.g. agent that solves RBC model with given growth/productivity can be genuinely ‘shocked’ when it encounters an unseen regime

Models

Constrained PV

Consumer maximises discounted utility of consumption subject to constrained present value of wages

$$\text{objective: } \sum_{t=1}^{\infty} \beta^{t-1} u\left(c_t\right)$$

$$\sum_{t=1}^{\infty} R^{1-t} c_t \leq W_1 \qquad (1)$$

Capital Accumulation

Consumer maximises discounted utility of consumption subject to budget constraint based on capital accumulation

$$\text{objective: } \sum_{t=1}^{\infty} \beta^{t-1} u\left(c_t\right)$$

$$k_{t+1} = f\left(k_t\right) - c_t + (1-\delta)\, k_t \tag{3}$$

Simple Brock-Mirman

Consumer maximises discounted utility of consumption subject to capital accumulation and production function

NOTE: closed form solution based on assumption that depreciation of capital is 100%

$$\max \quad \mathbb{E}\left[\sum_{n=0}^{\infty} \beta^n \log C_{t+n}\right]$$

$$\text{s.t.}$$

$$K_{t+1} = Y_t - C_t$$

$$Y_{t+1} = A_{t+1} K_{t+1}^{\alpha}$$

Brock-Mirman

Consumer maximises discounted utility of consumption and work subject to capital accumulation and production function

NOTE: closed form solution based on assumption that depreciation of capital is 100%

$$\max_{\{C_t,N_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, 1 - N_t)$$

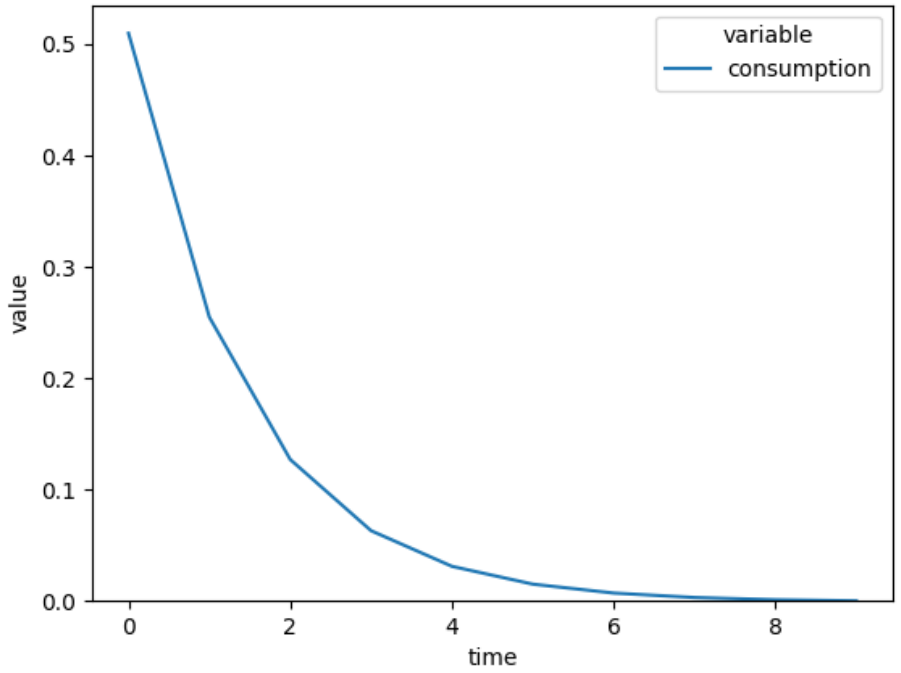
$$K_{t+1} = (1 - \delta)K_t + Y_t - C_t$$

$$Y_t = K_t^{1-\alpha}(A_t N_t)^{\alpha}$$

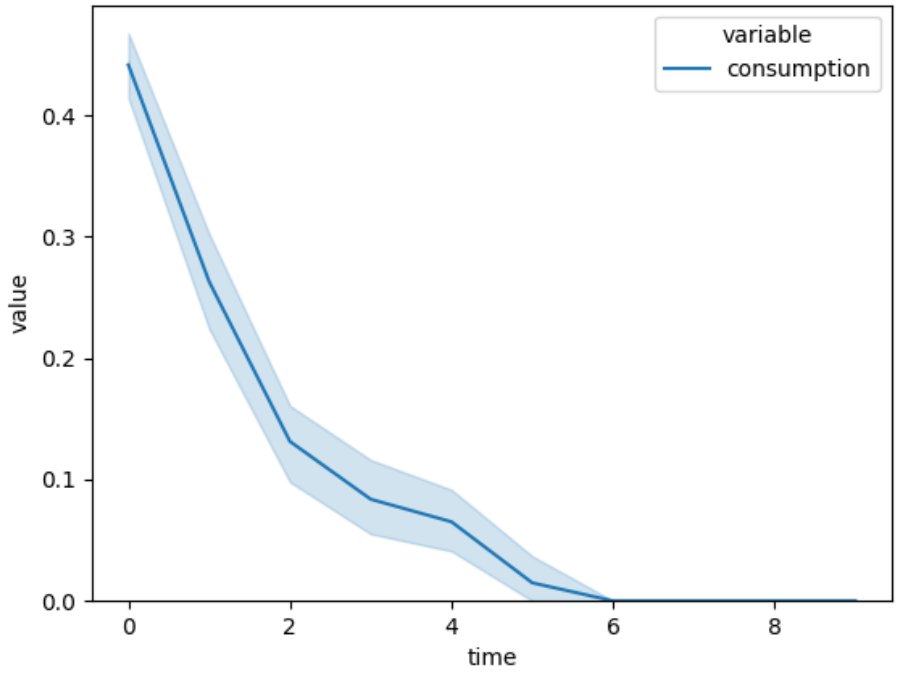
Results

Constrained Present Value

Classical



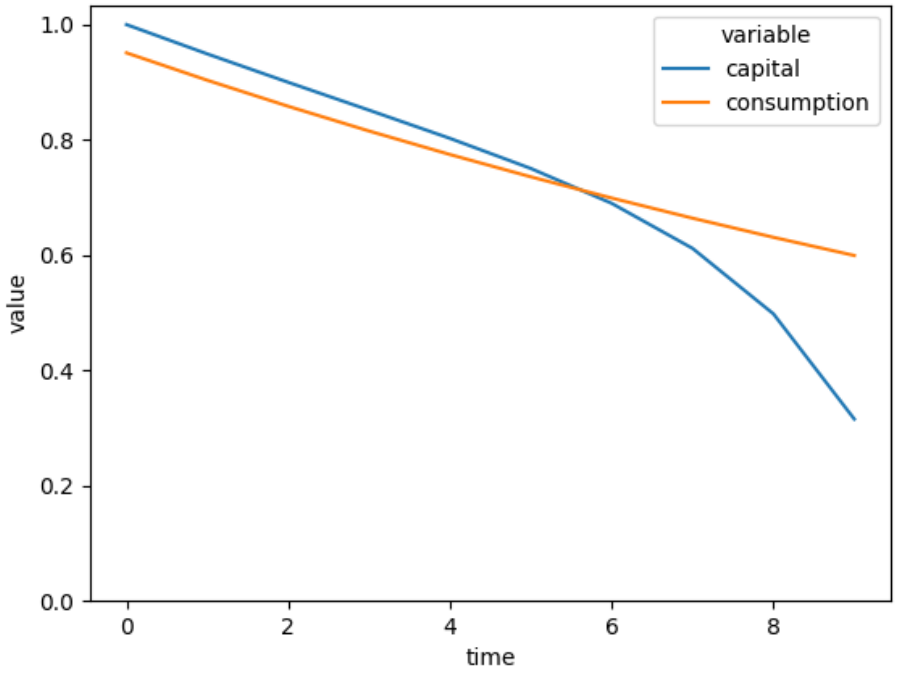
RL



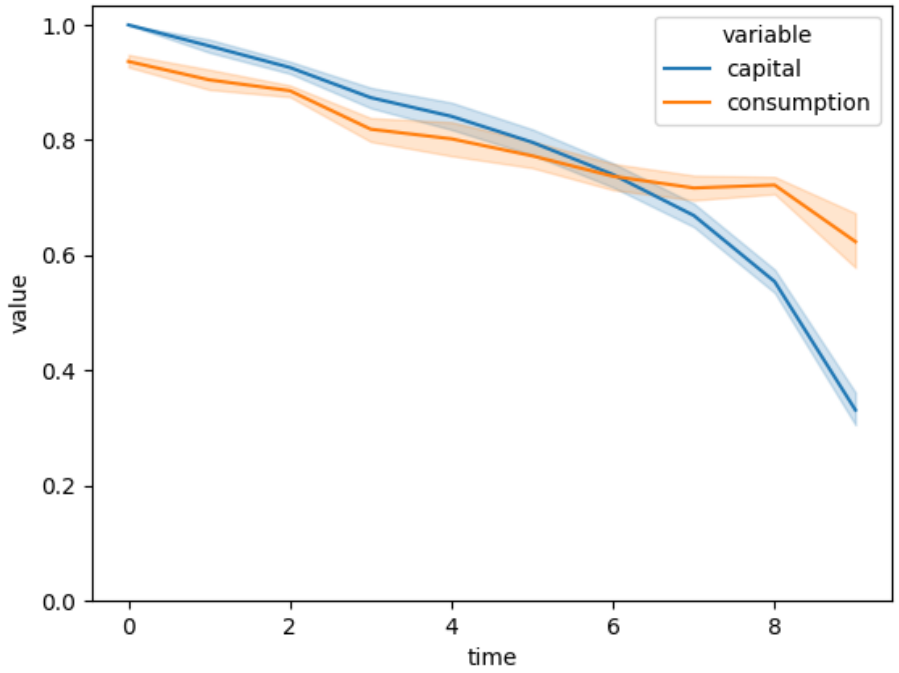
Capital Accumulation

RL finds a qualitatively similar solution to least squares residual method

Classical



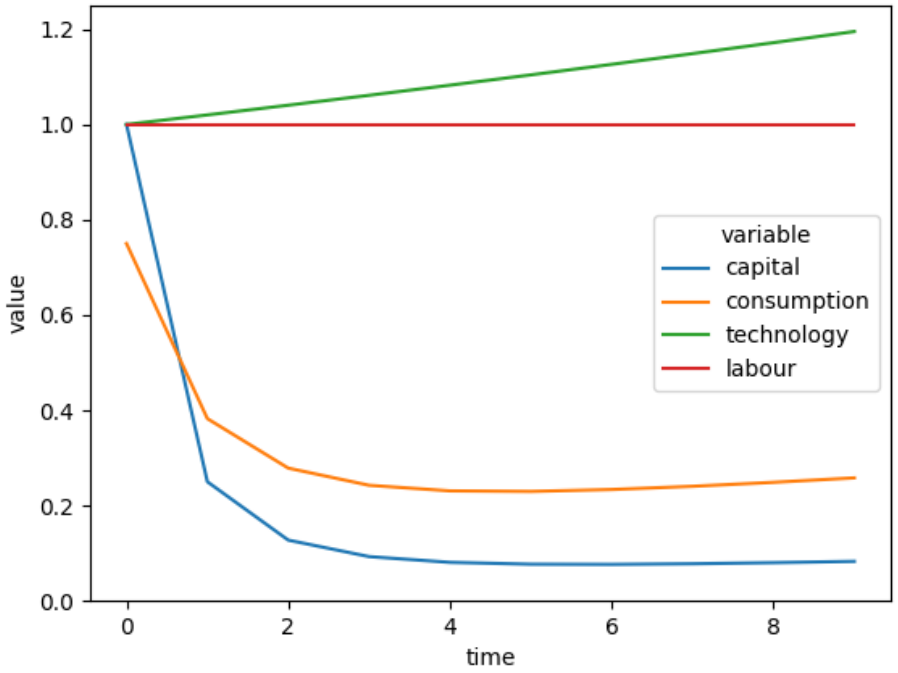
RL



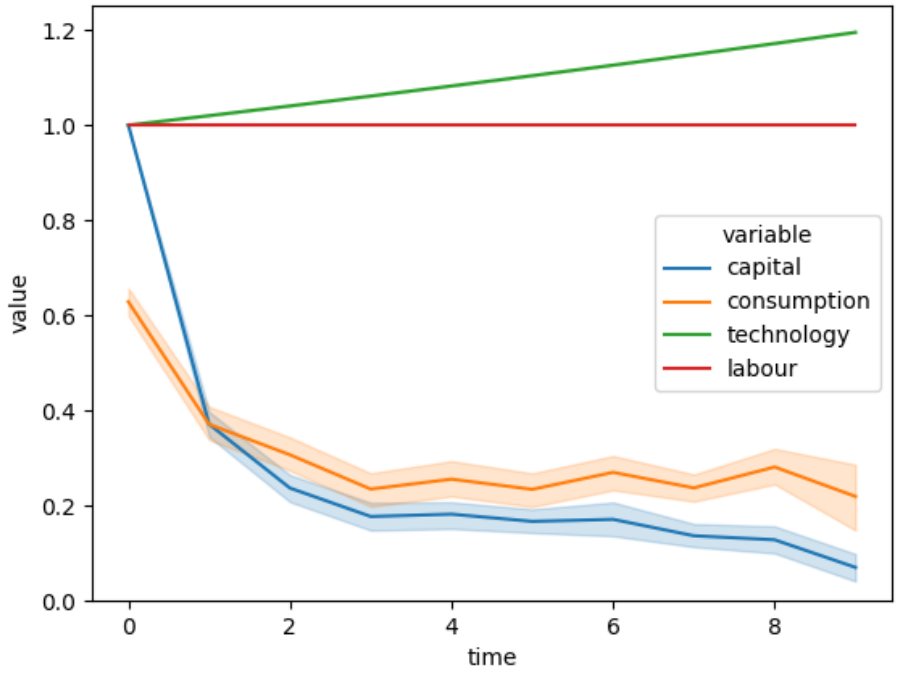
Simple Brock-Mirman RBC Model

RL finds a qualitatively similar solution to the closed-form classical B-M model

Classical



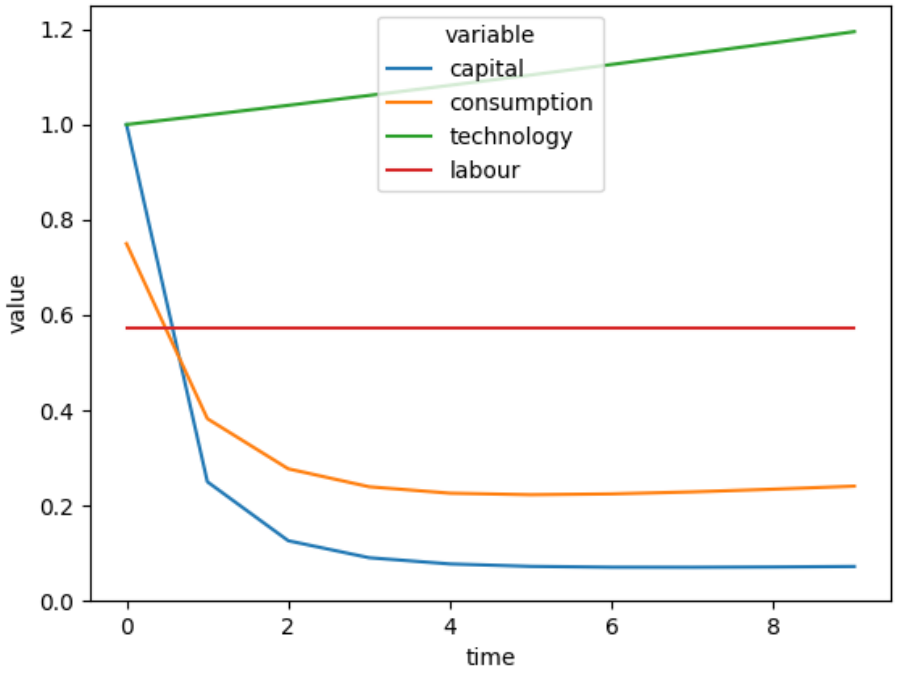
RL



Brock-Mirman with Leisure

RL finds a qualitatively similar solution to the closed-form classical B-M model – even when it must decide on both labour and consumption

Classical



RL