

# Problem Set 1

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submit your solution and code files on Blackboard page.

## Question 1. Analytical solution for the cake-eating problem with no income flows

An agent starts life with an asset  $a_1$  and live for  $T$  periods. Saving is allowed. Flow utility function is the CRRA utility function. Derive an equation for the optimal consumption plan. (Derive equation (2) in slide Lecture 1, page 14)

## Question 2. Understanding numerical errors

*Note : this question was intended to use an exogenous grid for asset. you may compare solutions using exogenous grids and an endogenous grid in the Bonus question below.*

In this question, you are asked to solve for the policy function (consumption plan)  $c_t(a_t)$  for the cake-eating problem with no income flow using various solution methods.

The flow utility function is CRRA.

$$u(c) = \frac{c^{1-\gamma}}{(1-\gamma)} \quad (0.1)$$

The structural parameter values are as follows :

Parameter	Description	Value
$T$	Lifetime	40
$r$	interest rate	0.03
$\beta$	time discount	0.95
$\gamma$	CRRA parameter	1.5
$a_0$	initial asset	1
$\underline{c}$	minimum consumption	$10^{-5}$

When you set an asset grid, use age-specific grid and use an unequal grid point generated from log transformation and use the  $N_A = 20$  gridpoints.

When you need to interpolate any function, use "linear" interpolation.

(a) Compute  $c_t(a_t)$  using value function.

(b) Compute  $c_t(a_t)$  using Euler equation without linear transformation of marginal utility function.

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(c) Compute  $c_t(a_t)$  using Euler equation with linear transformation of marginal utility function.

Show in one graph the true analytical solution for  $t = 20$  derived in Question 1 and the solution (a) - (c) for age  $t=20$ . Discuss the differences.

**Question 3. Simulating consumption and asset path using the solution**

Using the policy function solution (c) computed in Question 2, simulate the consumption and saving decision and plot them in the same graph.

**[Bonus Question] You are not required to do this, but if you successfully solve this question, you get extra bonus points [+5 pts in your final grade].**

Compare the computation time to solve Question 2 using exogenous grid points (graph (a), (b), (c) respectively) and using endogenous grid point. Add a policy function  $c_t(a_t)$  computed from endogenous grid point method and discuss the differences from solutions for Question 2.