# ECO 6353: Consumption & Investment PS1 Writeup

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## (a) Bugs and their error explanation

The enumeration below denotes the number of the bug in the order in which it occurs in the Matlab code file - Buggy_VFI_for_Distribution.m.

1. Missing value of rho in the income grid setup. It led to Y not having a defined input and the first part of the computation process throwing an error.
2. (Line 13) Removing xxxxxxx in the argument to get the AR(1) income process with a normally distributed income shock. I inserted the 'Rouwenhorst' method to calculate the discretized AR(1) income process and the transition matrix P.
3. (Line 64) Preallocation of guess function V0 needs to be changed by removing NaN from the replication of the 3-dimensional matrix for utility.
4. (Line 67) Setting $a\_prime = c$ gives us an incorrect preallocation for the asset choice policy function. To fix this, using the period budget constraint, we can set $a' = (1 + r)a + exp(y) - c$. Appropriate code with the correct number of dimensions in the matrix and repetition of matrices have been provided in the code file.
5. (Line 76) Inserting a guess for $V\_candidate$ for the if statement to work correctly. I created a vector of ones and removed NaN. Moreover, I reduced the dimensions to 1x1000 instead of 1000x1000 to let the guess be calculated correctly in the VFI loop.
6. (Line 79) Adding an if statement to make the VFI loop understand the conditions under which $V\_candidate$ should be further calculated or halted at *-inf.*

7. (Line 81) $[V1(:,y), a\_prime(:,y)] = max(V\_candidate')$; throws an error of incorrect dimensions in V1 and $a\_prime$. To fix the error, we can ignore the transpose of matrix $V\_candidate$ to get a 1000x5 dimension matrix for the assigned variables.

8. (Line 85) $V0 = V\_candidate$ would still give us an answer but it won't be correct. We want our initial guess to converge to the true value of the value function, which in this case is V1. It satisfies the value function $V\_candidate$ as well since V1 is the max value of $V\_candidate$ (inferred from the code snippet). Therefore, I set $V0 = V1$.

9. (Line 91) The recovery of consumption policy function needs to be inside a for loop for us to get a 3-dimensional matrix, like the one we created before the VFI loop. Indexing A with $a\_prime$ doesn't work because the index cannot be a negative value.

10. (Line 123) To compute $c\_sim(t)$, indexing A with $a\_prime$ doesn't work because the index cannot be a negative value. Moreover, since $a\_index(t+1)$ uses $a\_prime$ for computation, we need to change the index in the simulated consumption series to (t) instead of $a\_index(t)$.

## (b) Explain how the simulated results $(c, a')$ would qualitatively change if the borrowing constraint was set to 0

When the borrowing constraint is set to 0, simulated consumption and asset choices change significantly. For simulated consumption, the results begin near zero which implies that agents consume zero in the starting period since they cannot borrow to consume. Further, they consume their earned income with their natural debt limit being 0, preventing them from incurring any debt in that state.

For simulated asset choices, when there is no borrowing, asset choices are positive in the starting period, compared to when there is a natural debt limit. It implies that consumers don't use their assets to pay back the debt incurred or balance consumption in case of high borrowing limits. They save their assets for uncertainty in the future.

## (c) Explain how the simulated results $(c, a')$ would qualitatively change if the risk aversion parameter was doubled

When the risk aversion parameter is doubled, i.e., $\sigma = 0.08$, consumers trigger more precautionary savings to prepare for uncertainty in the future. Therefore, simulated consumption is slightly lower in the starting period, compared to when $\sigma = 0.04$. This is true since consumers want to consume less and save more in the form of risk-free assets.

For simulated asset choices, we see a slightly higher initial point estimate and an increase at a higher rate when $\sigma = 0.08$. It implies that consumers are investing more in risk-free assets when the risk aversion parameter is doubled, therefore, coherent with the results for simulated consumption.

**Part (d) and (e) are at the end of the Code_wo_bugs.m file uploaded in this repository.**