# Aggregate Uncertainty and Discrete Choice

## Computations and Quantitative Models in Macro

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# Aggregate Uncertainty and Discrete Choice

- I solved both questions in `Matlab`.
- Some details about the code and algorithms are described in the `README.md` file of each question (in my online repository). See them for more information.
- Questions 2 and 3 from the homework were joined in just one (Q2 in these slides).
- Codes of this homework can be found here:
- Also, I've updated the results of model *a la* Aiyagari from homework 1 (see the new PDF file here).

# Aggregate Uncertainty: Krusell-Smith Algorithm

# Q1: Aggregate uncertainty: Krusell-Smith algorithm

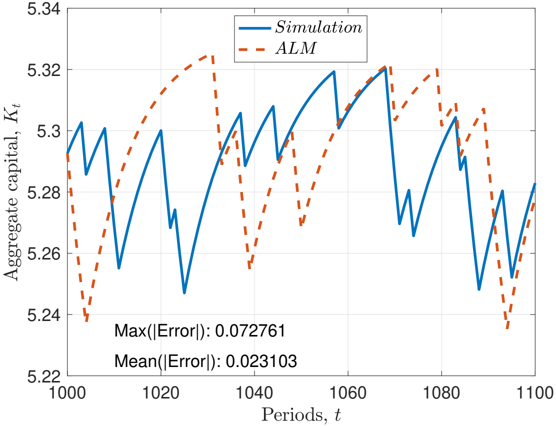
## Questions

1. *Use the Krusell-Smith algorithm to solve for the ALM*
   The estimated parameters of the ALM are the following:
   * low-idiosyncratic productivity shock: $\log(K_{t+1}) = 0.1491 + 0.9087 \log(K_t)$
   * high-idiosyncratic productivity shock: $\log(K_{t+1}) = 0.1556 + 0.9071 \log(K_t)$
2. *Calculate the R2 of the ALM*
   * low-idiosyncratic productivity shock: $R^2 = 0.999998803434357$
   * high-idiosyncratic productivity shock: $R^2 = 0.999998802891821$

# Q1: Aggregate uncertainty: Krusell-Smith algorithm

## Questions

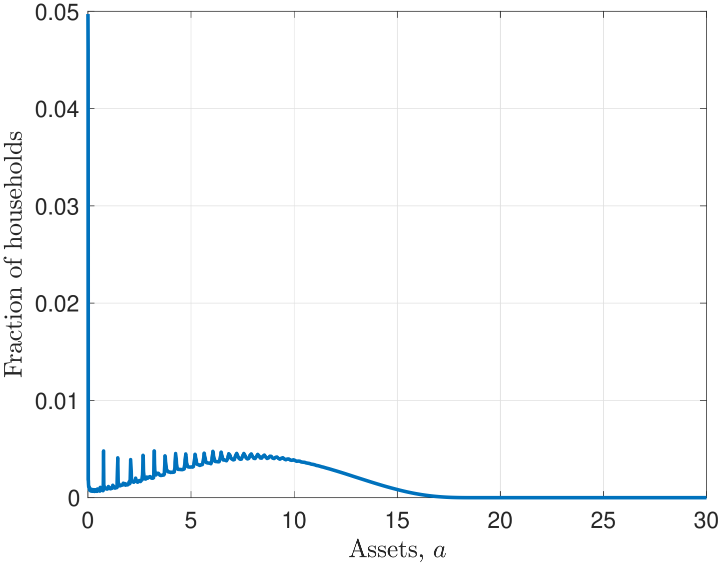
3. *Calculate the DenHaan measure using the existing time series from period 1000-1100*
   In the next figure, I plot both series of aggregate capital (non-stochastic simulation and ALM forecasting) and point out the maximum and average distance between both series.



# Q1: Aggregate uncertainty: Krusell-Smith algorithm

## Questions

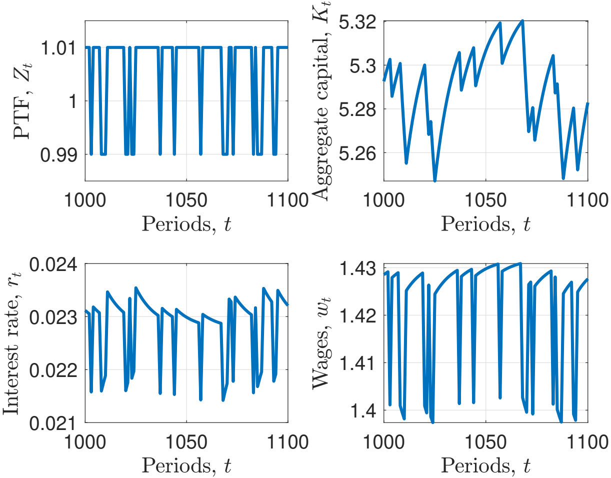
4.1 *Plot the distribution of aggregate capital*



# Q1: Aggregate uncertainty: Krusell-Smith algorithm

## Questions

4.2 *Plot the timeseries of aggregate capital, interest rate, wages and TFP*
In order to ease the visualization, I plot these timeseries only for the period 1000-1100 (as in the DenHaan's test).

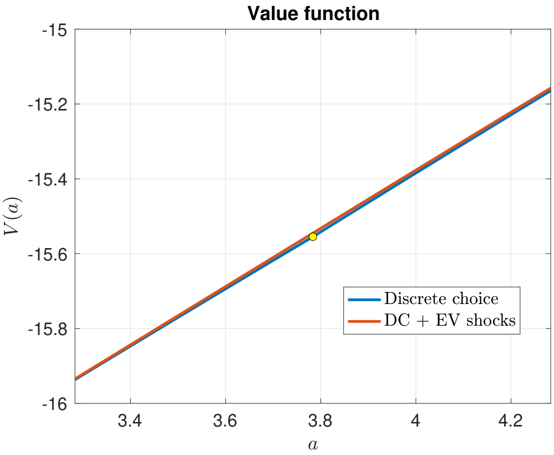


# SIM with Discrete Choice - Adding Extreme Value Taste shocks

# Q2: SIM with Discrete Choice and EV shocks

## Questions

1.1 *Plot the value function*

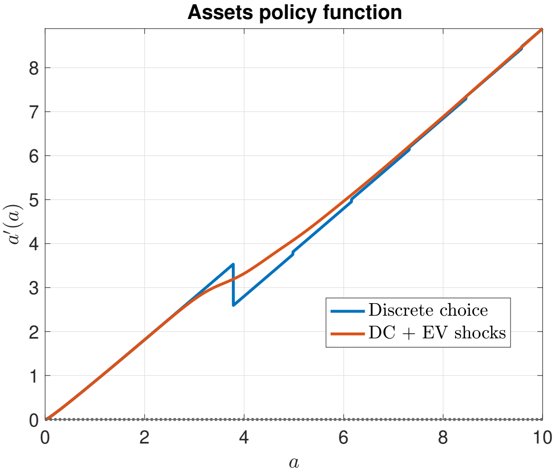



- I show value functions of the standard model with discrete choice (`Discrete choice`) and with extreme value shocks (`DC + EV shocks`).
- I graph both functions around the point where the value function changes (the round marker, although the difference in the curve's shape is not noticeable).
- At that point consumer decides to go out from the labor market.
- Adding extreme value shocks allows to "smooth" the value function.

# Q2: SIM with Discrete Choice and EV shocks

## Questions

1.2 *Plot the policy function for assets*

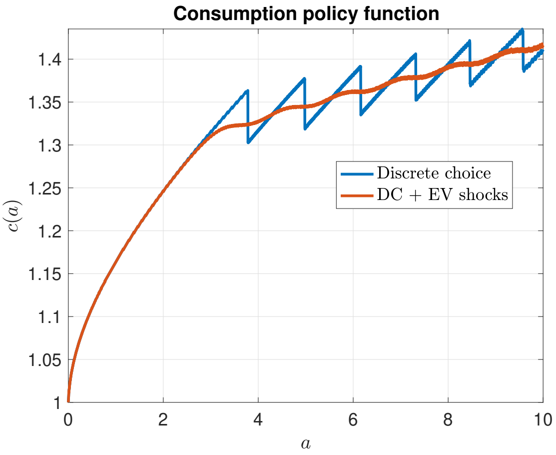



- In the standard model with discrete choice, we observe a sort of "regime change" at the point where the consumer decides not working. That point is $a = 3.7835$.
- If consumers don't supply labor, then they save less in order to finance consumption.
- Adding extreme value shocks makes the optimal choice of assets for the next period be smooth between both "regimes".

# Q2: SIM with Discrete Choice and EV shocks

## Questions

1.3 *Plot the policy function for consumption*

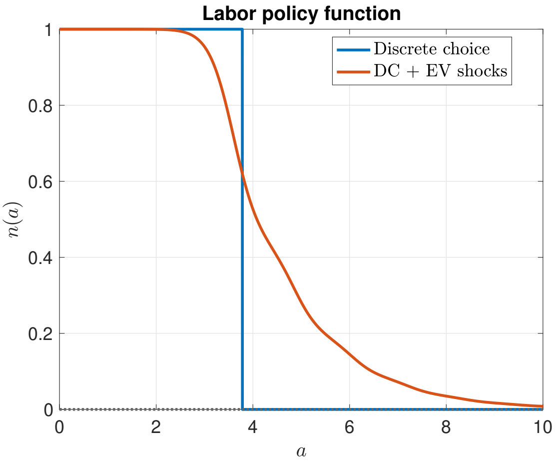



- In the standard model with discrete choice, we observe a change in its behavior for assets $a > 3.7835$ (not work), with ups and downs around a increasing trend.
- Consumption and assets policy functions are non-monotonic in assets and have discontinuities given by the participation in the labor market and the consumption smoothing behavior.
- As before, including extreme value shocks makes consumption policy function be smooth after that point.

# Q2: SIM with Discrete Choice and EV shocks

## Questions

1.4 *Plot the policy function for labor*




- The policy function for labor is totally different between both models. In the standard discrete choice model we observe a drastic change before (work) and after (not work) of $a = 3.7835$.
- The presence of extreme value shocks makes to obtain probabilities for the values in the assets grid instead of a discrete "regime change".

# Q2: SIM with Discrete Choice and EV shocks

## Questions

2. *Could you use EGM for either of the problems? Why / why not?*
No, we can't. For implementing the EGM we should obtain, as a first step, the FOC from the (recursive) consumer's problem:

$$V(a,n,z) = \max_{a',n} U(nwz + (1+r)a - a') - \phi n + \beta \mathbb{E} V'(a',n',z')$$

The FOC is:

$$U_{a'}(\cdot) = \beta \mathbb{E} V'_{a'}(\cdot)$$

For a log utility form:

$$nwz + (1+r)a - a' = \left(\beta \mathbb{E} V'_{a'}(\cdot)\right)^{-\frac{1}{\sigma}}$$

# Q2: SIM with Discrete Choice and EV shocks

## Questions

2. *Could you use EGM for either of the problems? Why / why not? (...continued)*

The EGM implies that:

$$a = \left[\frac{1}{1+r}\right]\left\{\left(\beta \mathbb{E} V'_{a'}(\cdot)\right)^{-\frac{1}{\sigma}} + a' - nwz\right\}$$

However, as we seen before, $a'$ is non-monotonic in $a$ and non-differentiable at $a = 3.7835$, then we cannot apply the Envelope theorem. Moreover, $V'(\cdot)$ is not concave so $V'_a(\cdot)$ is non-monotonic as well (in terms of Carroll (2006), $V'(\cdot)$ should be "well-behaved" ).

Therefore we cannot apply the EGM for either of the problems. A solution could be to implement the EGM method with an Upper Envelope algorithm, such that the two (or more) $a'$ solutions that we obtain applying the EGM by itself, are reduced to just one by the selection of the $a'$ that maximizes the value function.