Problem Set 8

Paul Freed

December 3, 2021

Modified Model

The following presents a model for collecting relevant financial information in a high-information turnover market, such as the cryptocurrency market. In this model, an individual chooses how much time to spend studying relevant financial information in order to make purchase decisions in the market. Here, f represents the amount of relevant information that exists that can give the individual investor an edge, while w represents the amount chooses to acquire via study. There are trade-offs, such that delaying acquiring information is costly because the relevant financial information is more applicable the sooner it is applied (discount factor). On the other hand, studying is subject to diminishing marginal returns, such that as the individual begins to tire, they face an increasingly smaller benefit from each hour spent studying the institutional details within one period. This suggests it is also attractive to delay some studying, which means the individual faces trade-offs. In turn, studying more (consuming relevant financial information) reduces the amount of information to be studied in future periods.

In the model, the individual can leave more studying and analyzing work for the next period. One's choice is such that $w = (1+\delta)f - (1+\phi)f'^t$, and the individual has two qualities, δ and ϕ. δ is a measure of financial literacy, such that an individual with more resourcefulness can boost the amount of information available to them today by fully utilizing their resources and knowledge. ϕ is an individual measure of information access, such as insider knowledge, that impacts the amount of future information. In addition, given a rapidly evolving market, the amount of relevant future information is subject to time. The state variable is f, in this case it is how much relevant financial information is available to the individual. The control variable is w, the amount of studying done.

$$\begin{aligned} \max_{w_t} \sum_{t=1}^{\infty} \beta^t ln(w_t) \\ \text{s.t. } i)\ f_{t+1} = \left(\frac{(1+\delta)f_t - w_t}{(1+\phi)}\right)^{\frac{1}{t}} \\ ii)\ w, f \geq 0 \\ iii)\ w_0 > 0\ given \\ u' > 0, u'' < 0, u'(0) = \infty, u'(\infty) = 0 \end{aligned} \tag{1}$$

The Problem:

$$V(f_t) = max_{w_t}\ ln(w_t) + \beta V(f_{t+1}), \forall f \in [0, \bar{f}] \tag{2}$$

FOC's:

$$\frac{\partial V}{\partial f_{t+1}} = -\frac{t(1+\phi)f_{t+1}}{(1+\delta)f_t - (1+\phi)f_{t+1}^t} + \beta V'(f_{t+1})$$
$$\frac{\partial V}{\partial f_t} = \frac{(1+\delta)}{(1+\delta)f_t - (1+\phi)f_{t+1}^t} \tag{3}$$

Bellman Equation:

$$V(f_t) = max_{ft+1}\ ln((1+\delta)f_t - (1+\phi)f_{t+1}^t) + \beta V(f_{t+1}), \forall f \in [0, \bar{f}] \tag{4}$$

Summary:
1. Population of agents: I model individuals.
2. Utility function: I use log utility.
3. Productive technology: Individuals study (consume information) in order to operate in a financial market.
4. Information technology: The individual knows how much information is available to them and thus how much they need to study.
5. Enforcement actions: Not applicable.
6. Matching technology: Not applicable.

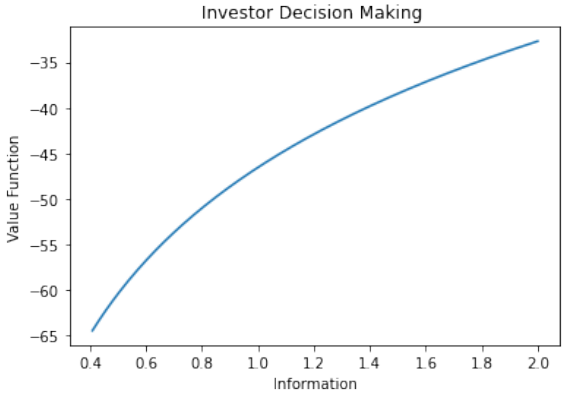

FIGURE 1: This is a representation of the value function. This shows the optimal relationship between the choice and state variables, in my case the amount of information and the choice of the amount of studying that needs to be done (the consumption of financial information).

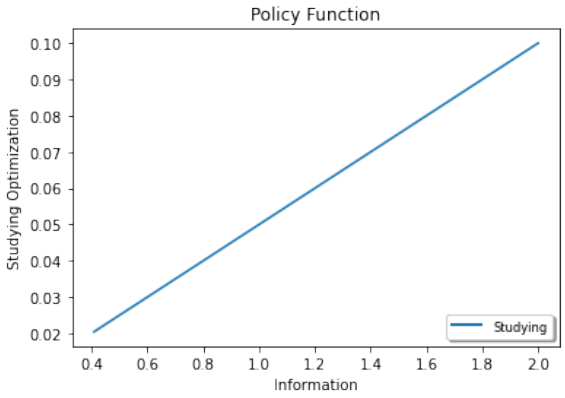

FIGURE 2: This is a representation of my policy function. The policy function relates to the optimal chosen amount of studying to be done in each state. This is such that the chosen action maximizes utility. In this case, the x-axis plots the state, while the y-axis plots the optimal choice.

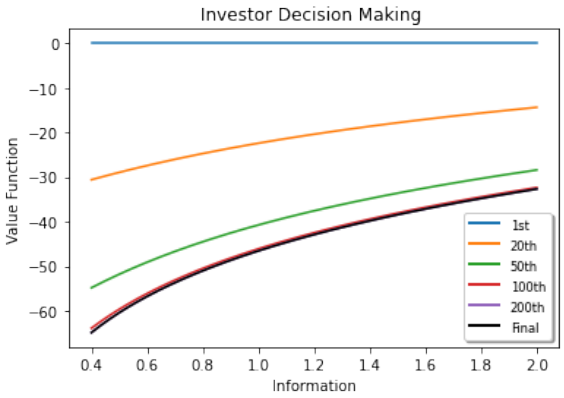

FIGURE 3: This is a representation of my value function across several iterations.