15 Scripts for the presentation

1. Good afternoon, everyone! I am Shu, and my advisor is John Stachurski. My topic today is about a conjecture on firm size distribution under firm dynamic setting. There are 7 sections in my talk.
    - 1st part introduce power law distribution, firm size distribution, firm dynamic and my question.
    - My conjecture and work are in the section 6. Before we get to there,
    - I will briefly summarize Markov matrix/chain and their properties, and illustrate them with a simple example in the section 2-3.
    - briefly introduce basic ideas of the entry/exit model in section 4
    - Really introduce my work in section 5 & 6 and plan as well in section 7
2. Power law distribution is very common both in natural and social science. Its survival function has this special form. Firm size distribution is also important theoretically and practically. E.g., when design progressive taxation policy, it can be dangerous if we don't know the firm size distribution and ingnore large firms' effects. Many Economists try to find their relationships, and Axtell, as many, found the firm sizes follow Pareto distribution. But it is more realistic to discuss it under dynamic setting. My question comes from this idea: how prevalent the Pareto distribution and firm size distribution are in Hopenhayn's entry/exit model.
3. To easily understand my work, I will briefly introduce basic ideas about Markov matrix/chain and settings in Hopenhayn's model.
    - Markov matrix is a n*n matrix with nonnegative elements and each row summing up to 1.
    - We have learnt state space in micro's course, which is S-element set.
    - Markov property means today's event only depends on yesterday's event, but on not older histories.
        - This implies that people have no memory on older things.
    - Markov chain is a series of random variables on state space, but with Markov property.
    - Its dynamics depends on its Markov matrix.
    - In Example.
        - Consider a worker with transition probabilities.
        - Sample space
        - State space is
        - Markov chain/matrix
4. Markov chain has two most important properties: irreducibility and aperidicity, and must have a stationary distribution.
    - P is irreducible if we can find a positive integer n such that when taking P to the power n, all its elements are positive.
    - P is aperiodic if we have the element (x, x) in P are positive.

- Since X_t is a r.v., it follows a distribution ψ_t. Each X_t's distribution evolves by P.
- Stationary distribution of P shows a fixed-point feature.
- Proposition 1 gives a sufficient condition for distribution's existence, which can be proved by Banach FP theorem.
- Proposition gives a sufficient condition for distribution's uniqueness.
- E.G.,
  - Communicates and irreducible
  - Period and aperiodic.

5. Basic idea of the exit/enter model is that at period t, there are incumbents and entrant with S different firm sizes. Incumbents' firm size follows a Pareto distribution, and entrant's firm size follows a certain distribution. With the law of motion and a threshold s^*, incumbents below it should exit the industry and entrants above it can enter the industry. Surviving firms of incumbents and new entering firms at period t forms the incumbents at period t+1.
6. Carvalho & Grassi draw a conclusion that with the above setting, if entrants's firm size distribution also follows Pareto, then stationary firm size distribution should also follow Pareto, as firm size φ^S goes to infinity.
   - I think this condition might be too strong.
   - I put forward my conjecture for a more generalised case:
     - This conclusion might also hold for any entrants' firm size distribution other than Pareto.
   - First, I have proved the stationary distribution is unique in my conjecture.
     - The sufficien condition for this provided by proposition 1 & 2, I show that Q is markov, irreducible and aperiodic, regardless of s^* and G.
     - I don't have time to talk about the proof but, to give you some idea
       - for irreducibility, remember that I need to show all states communicate, and this happens because firms can both grow and shrink under Q.
       - for aperiodicity, I need to show period of all states is 1 and this happens because firms can remain the same size under Q.
   - After proving its uniqueness, I am confident to do some simulations about stationary distribution so that I can graphically examine my conjecture.
     - Since the stationary distribution is Pareto, recall my first slide, I can use double-log plots to examine the right-hand tail of its double-log counter cumulative distribution.
       - Recall my conjecture, counter cdf of Pareto distribution have form
       - Take the log to both sides, we will get log c-cdf linear in log firm size with negative slope.
     - We are expecting to see a downward straight line on Right-hand tail.
     - Algorithm
       - Step 1: calculate Q by law of motion with 9 types of entrants' dist.
       - Step 2: generate stationary dist's c-cdf based on Proposition 2 by iteration methods;
       - Step 3: generate and plot log-log graphs for stationary dist's c-cdf.

            - Step 4: focus on upper tail of log-log graphs.
        - I will show results of step 3 & 4 for each entrant type.
        - Value assignments are given in this table, and please note that without notice, I will use these as default parameters.
    - Simulations
        - 1 Entrants are uniformly distributed
        - 2 Entrants are Zipf distributed
        - 3 Entrants are Logarithmic distributed
        - 4 Entrants are Binomial distributed
        - 5 Entrants are Poisson distributed
        - 6 Entrants are Geometric distributed
        - 7 Entrants are Negative Binomial distributed
        - 8 Entrants are Beta-binomial distributed
        - 9 Entrants are Benford distributed.
7. In the next step, I will focus these 3 things with John.
    - First, work on proving the rest parts of my conjecture.
    - Second, work on other interesting parts of firm dynamic model.
    - Third, quantitatively analyse my conjecture and firm dynamic model with some real world data.