Assignment #3

MACS 30000, Dr. Evans

Due Wednesday, Nov. 24 at 11:30am

1. Simulation in Sociology, Moretti (2002)

（a）

The multi-agent system consists of several autonomous agents. Through the simulation of this system, we want to learn about the macro social phenomena derived from micro approaches. However, according to the author, there are still three potential weaknesses in validity of multi-agent systems. Firstly, the definition of rationality in theories and models should be more realistic, understandable, and can be applied in the case of limited knowledge. In particular, theories of rationality need to be extended to learning and adaptation. Secondly, we need to supplement the formalization of all the aspects of psychological theories (emotions, motivations, desire, intent, consciousness). Thirdly, there is still a long way to go to realize the formalization of knowledge

As for the cellular automa model, in some respects, it can be asserted that cellular automa are similar to multi-agent systems, in the sense that cellular automa are a particular kind of multi-agent system in which the agents have a specific and determined position in a lattice and are homogeneous in their behavior and in their modality of interaction. However, the weaknesses of cellular automa are also obvious. One of its limitation is the use of synchronous updating of states. This assumption may not be found in real social processes, because individuals modify their attitudes and opinions at different moments. To resolve this problem, instead of applying transition rules simultaneously to all units, we can choose to modify only some units. Another important limitation regards the restrictions imposed by spatial structures, establishing that each individual interacts only with a subset of the whole population. It is very difficult to define the neighborhood of a unit. In the real world, interactions can also take place among individuals who are not “physically” close to one another. Furthermore, the neighborhood can change over time.

As for the ‘dynamic feedback’, when the author tries to introduce the application of genetic algorithms to sociology, he sites two models: game theory and cultural evolution. Considering that I majored in Economics, I'm more familiar with the game theory and the dynamic feedback in its simulation. In this paper, the author says that game theory deals with the rational behavior of individuals who aim to gain personal advantages: People prefer interacting with others only if this interaction can bring them some benefits. Therefore, when a person wants to gain some benefits from an interaction, he may change his behavior through time and finally lead to the change of whole. Suppose we have many study pairs in MACSS program. When Mike think study with Jerry is more efficient than study with Tom, Mike may change his partner to Jerry and Jerry may accept Mike's suggestion because he thinks that study with Mike is better than study with George. However, this change will also affect George and Tom who need to find new partner now, so the whole study pairs' structure might change due to Mike's change. That change could be viewed as a dynamic feedback example.

An interesting topic of the hot issue now is, 'How would the result of the investigation about the murder of Jamal Khashoggi affect Mr. Trump's mid-term election prospects?' The truth of this murder is still under investigation. Different results will definitely lead to different reactions by the White house. Mr. Trump could punish Saudi Arabia government or forgive them and different actions made by him will definitely affect his mid-term election prospects in the next few months. As time goes on, the truth of this murder will be gradually disclosed and the attitude of Mr. Trump might change through time and thus affect his public approval ratings. Seeing the change of his public approval ratings, whether increase or decrease, Mr. Trump could take further actions to cater or reverse that trend. Those actions will then affect the public approval ratings again and further affect Mr. Trump's judgement towards former actions and implementation of future actions. This is a dynamic feedback example in political science.

References

Moretti, Sabrina, "Computer Simulation in Sociology: What Contribution?,"

Social Science Computer Review, Spring 2002, 20 (1), 43-57.

All the above answers are cited from this paper.

SiyuanPeng

October 23, 2018

1 Assignment 3

1.0.1 MACS 30000, Dr. Evans

1.0.2 Siyuan Peng

In [1]:
```
# Import initial packages
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.ticker import MultipleLocator
```

1.0.3 1. Simulation in Sociology, Moretti (2002)

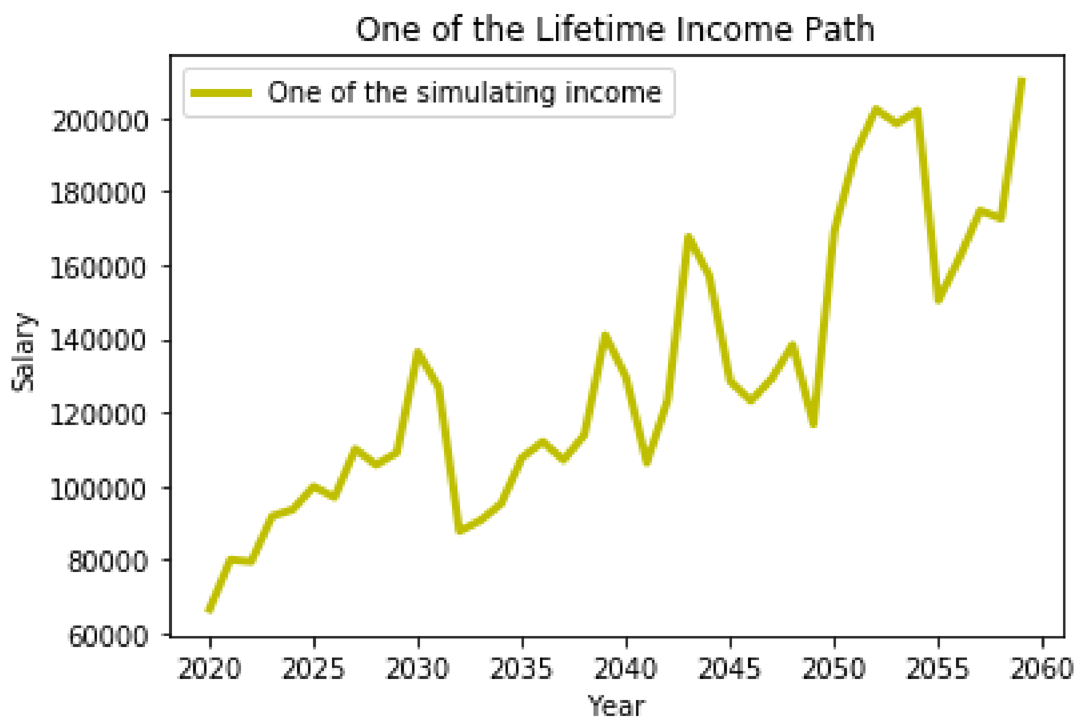
See the attached pdf.

1.0.4 2. Simulating your income

(a)

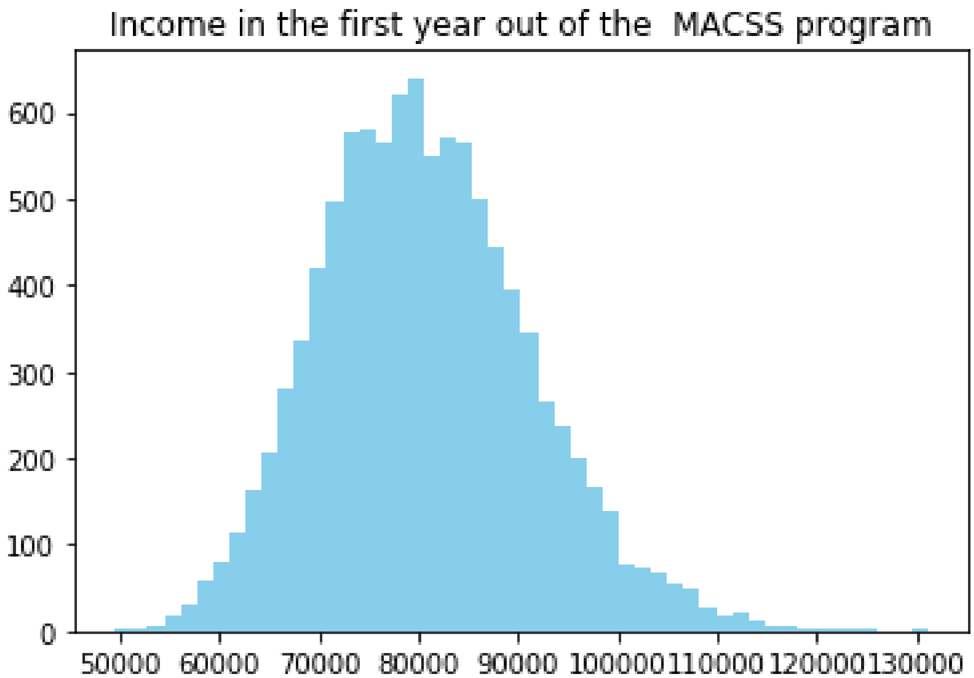
In [2]:
```
#  First, import the function defined in the question.
def future_inc(t, inc0, last_year_inc, , g, ):
    lninc = (1 - ) * (np.log(inc0) + g * (t-2020)) +  * np.log(last_year_inc) +
np.log()
    return np.exp(lninc)

# Then, create errors.
errors = np.zeros((10000,40))
 = 0.13
for i in range(10000):
    errors[i, :] = np.exp( * np.random.randn(40))

# Finally, use values provided in the question to compute the income.
inc = np.zeros((10000,40))
inc0 = 80000
 = 0.4
g = 0.025
for i in range(10000):
    inc[i, 0] = np.exp(np.log(inc0) + np.log(errors[i, 0]))
    for j in range(1, 40):
        inc[i, j] = future_inc(2020+j, inc0, inc[i, j-1], , g, errors[i, j])

# Draw the plot of one of the lifetime income path. Firstly, set up the time.
years = np.array(list(range(2020,2060)))

# Choose my birthday, Oct 7th as the lucky path.
fig, ax = plt.subplots()
ax.plot(years, inc[1007,:], 'y-', label = 'One of the simulating income',linewidth = 3)
ax.set_title('One of the Lifetime Income Path')
```

```
ax.set_xlabel('Year')
ax.set_ylabel('Salary')
ax.legend()
plt.show()
```



(b)

```
In [3]: fig, ax = plt.subplots()
        ax.hist(inc[:, 0], color='SkyBlue',bins = 50)
        ax.set_title('Income in the first year out of the  MACSS program')
        plt.show()
        percentile_high = len([i for i in inc[:,0] if i > 100000])/10000
        percentile_low = len([i for i in inc[:,0] if i < 70000])/10000
        print('%.2f%%' % (percentile_high * 100), 'of my class will earn more than $100,000 in
        the first year out of the program.')
        print('%.2f%%' % (percentile_low * 100), 'of my class will earn less than $70,000 in the
        first year out of the program.')
```

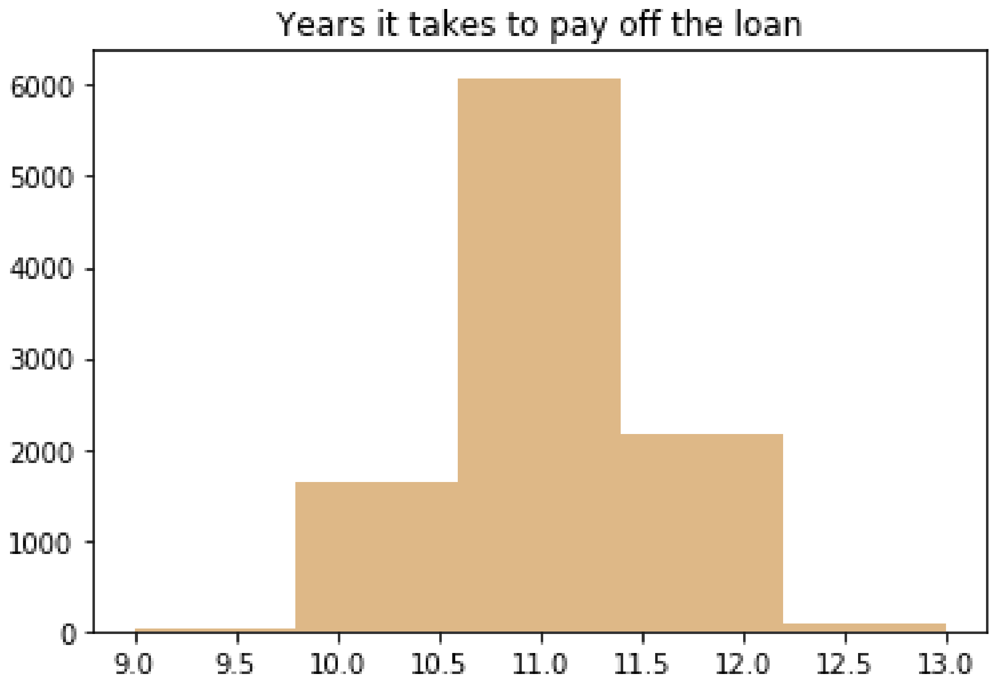



```
4.32% of my class will earn more than $100,000 in the first year out of the program.
15.14% of my class will earn less than $70,000 in the first year out of the program.
```

From the shape of this histogram, its distribution is normally distributed.

(c)

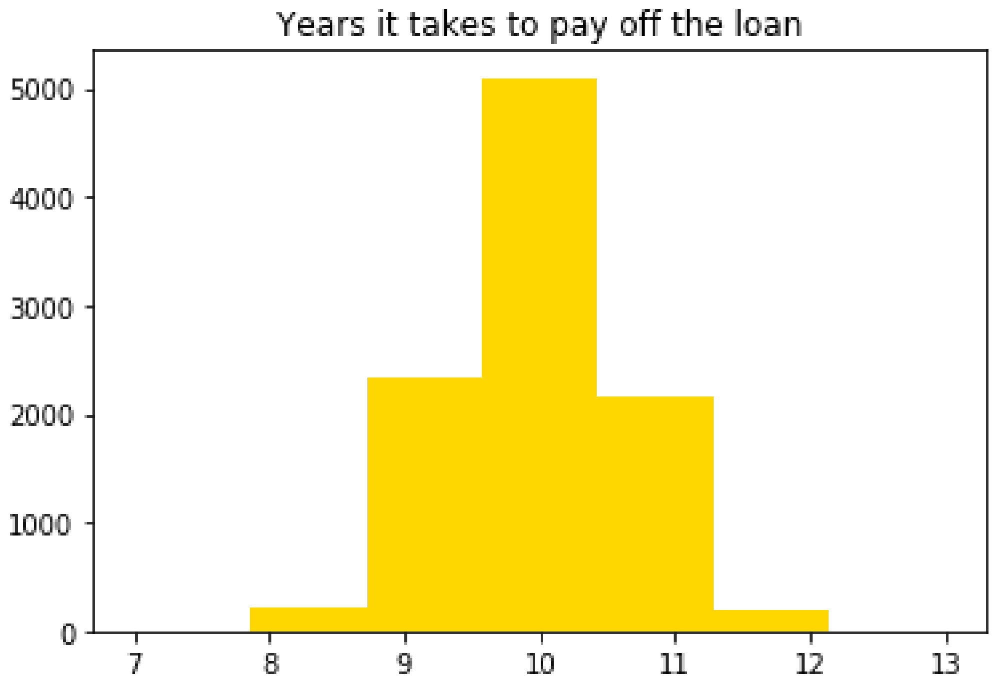
```
In [4]: def loan_period(inc):
            loan = 95000
            for i in range(40):
                loan -= inc[i] * 0.1
                if loan <= 0:
                    break
            return i+1
        loan_year = np.zeros((10000))
        for i in range(10000):
            loan_year[i] = loan_period(inc[i,:])
        fig, ax = plt.subplots()
        ax.hist(loan_year, color='burlywood', bins = len(set(loan_year)))
        ax.set_title("Years it takes to pay off the loan")
        plt.show()
        pay_off = len([i for i in loan_year if i <= 10])/10000
        print('%.2f%%' % (pay_off * 100), 'of the simulations are able to pay off the loan in 10
        years.')
```



16.71% of the simulations are able to pay off the loan in 10 years.

(d)

In [5]:
```
# First, set up the new errors.
new_errors = np.zeros((10000,40))
new_ = 0.17
for i in range(10000):
    new_errors[i, :] = np.exp(new_ * np.random.randn(40))

# Then, use new values provided in the question to compute new income.
new_inc = np.zeros((10000,40))
new_inc0 = 90000
for i in range(10000):
    new_inc[i, 0] = np.exp(np.log(new_inc0) + np.log(new_errors[i, 0]))
    for j in range(1, 40):
        new_inc[i, j] = future_inc(2020+j, new_inc0, new_inc[i, j-1], , g,
new_errors[i, j])

# Finally, draw the new plot.
new_loan_year = np.zeros((10000))
for i in range(10000):
    new_loan_year[i] = loan_period(new_inc[i,:])
fig, ax = plt.subplots()
ax.hist(new_loan_year, color='gold', bins = len(set(new_loan_year)))
ax.set_title("Years it takes to pay off the loan")
plt.show()
pay_off = len([i for i in new_loan_year if i <= 10])/10000
print('%.2f%%' % (pay_off * 100), 'of the simulations are able to pay off the loan in 10
years.')
```




```
76.44% of the simulations are able to pay off the loan in 10 years.
```