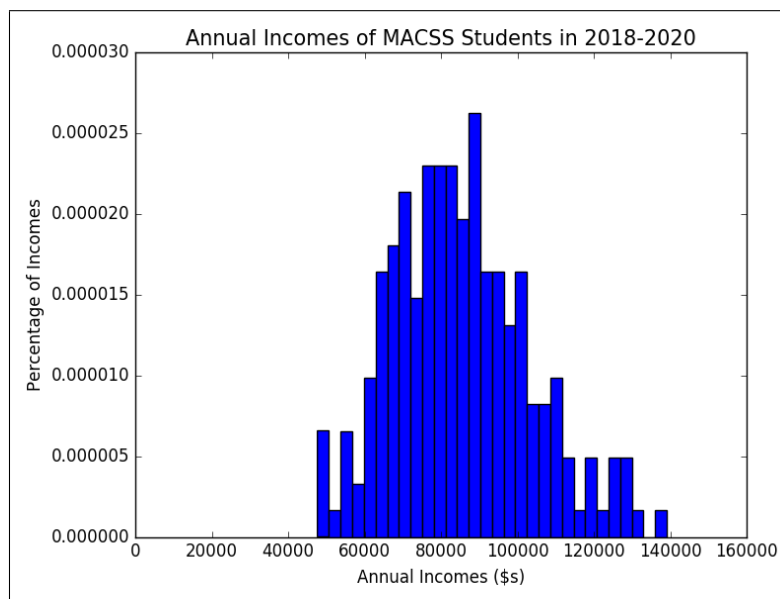# Problem Set #4

MACS 30100, Dr. Evans

Tong Ju

Part (a). A histogram plot of annual incomes of students who graduated in 2018, 2019, and 2020 from the University of Chicago M.A. Program in Computational Social Science.

Figure 1: Histogram Plot

Part (b). Write function for the lognormal PDF.

When μ is 5.0 and σ is 1.0, The PDF value for the given array is shown as below:

$$\begin{bmatrix} 0.0019079 & 0.00123533 \\ 0.00217547 & 0.0019646 \end{bmatrix}$$

Part (c). Estimate the parameters of the lognormal distribution by simulated method of moments (SMM), seed =1234, Method = 'L-BFGS-B'

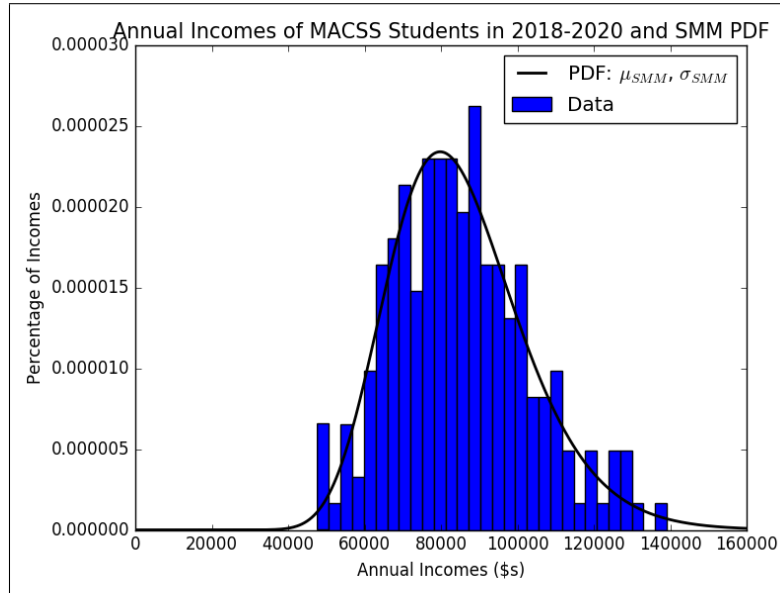The resulted criterion value is 1.52004132708e-15. The estimated parameters are as follows:

μ_{SMM1}= 11.3306372212;

σ_{SMM1}= 0.209229359913;

Error Vector 1 = $\begin{bmatrix} 3.52293958\text{e-}08 & \text{-}1.67012274\text{e-}08 \end{bmatrix}$

moments	mean	std.
data	85276.8236063	17992.542128
model	85276.8266105	17992.5418275
data - model	-0.00300425097521	0.000300497536955

Figure 2: 1-step SMM by mean and std.

Part (d). Two step SMM based on (c)

In this part, based on the error matrix in (c), I tried various methods of estimation ('TNC', 'L-BFGS-B' and 'SLSQP'), no obvious improvement is found. Here, I report the result by using 'L-BFGS-B' method: The resulted criterion value is 0.630049923211 . The estimated parameters are as follows:

μ_{SMM2}= 11.3306371414;

σ_{SMM2}= 0.209229361554;

Error Vector 2 = $\begin{bmatrix} 3.52293958\text{e-}08 & \text{-}1.67012274\text{e-}08 \end{bmatrix}$

moments	mean	std.
data	85276.8236063	17992.542128
model	85276.8198373	17992.5405425
data - model	0.00376898607647	0.00158551204368

Figure 3: Comparison between 1-setp and 2-step SMM

Annual Incomes of MACSS Students in 2018-2020 and SMM PDF