INTERNATIONAL UNIVERSITY OF JAPAN

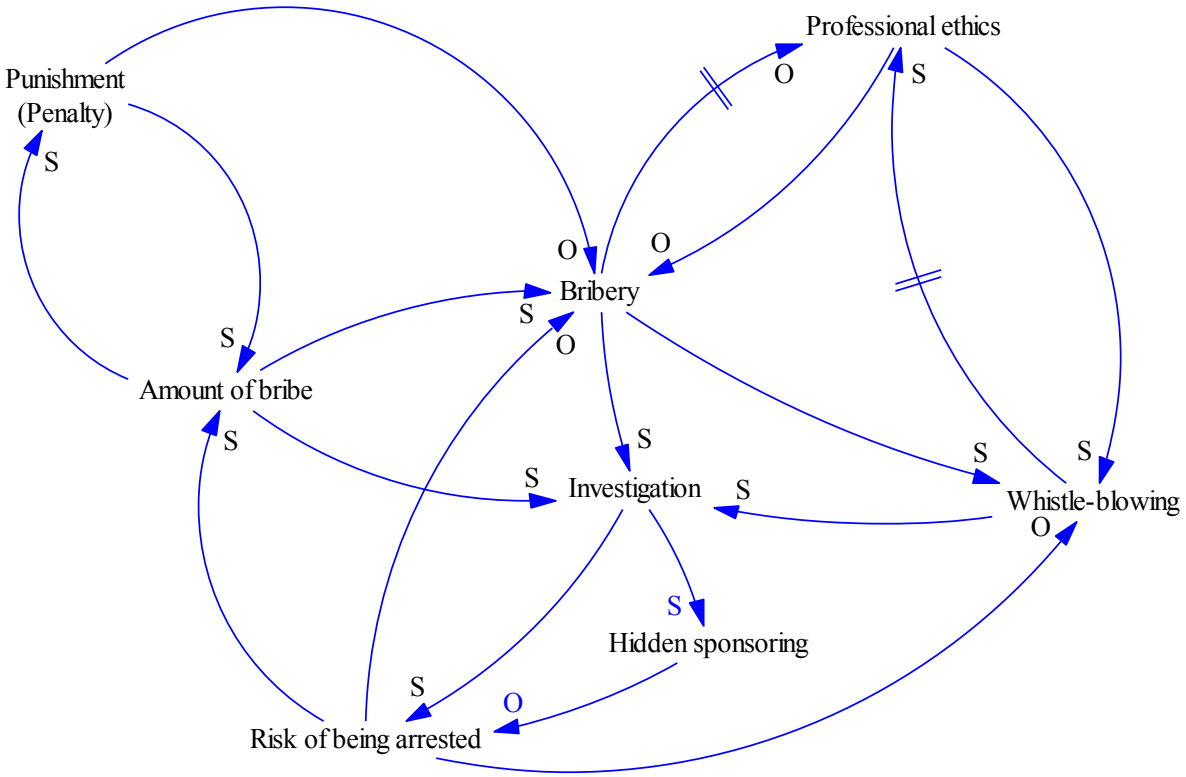
Public Management and Policy Analysis Program
Graduate School of International Relations

DCC5350 (2 Credits)
Public Policy Modeling
Spring 2017

Final Exam (100 points)

Instruction: Please write down your student ID and name at the top of your answer. You MUST ALWAYS show necessary calculation and your reasoning as clearly as possible. Each section of questions needs to start on new sheet of paper. Arrange your answers in the ascending order (1.1, 1.2, 1.3 …). Use 4 digits below the decimal point for factions.

Question 1. **(20 points)** Remember the corruption of the group project. Look at the following causal loop diagram carefully and then answer Q1.1 and Q1.2. Note that hidden sponsors are those who will release investigation information to corrupt civil servants and/or their clients.



1.1 (10 points) Identify all feedback loop(s) that contain both "Bribery" and "Whistle-blowing" without "Punishment" and "Hidden sponsoring." Explain the meaning of delay (how it works within a loop) if you find loops with delay. Evaluate (explain natures of) these feedback loop(s) and explain how well whistle-blowing will work.

1.2 (10 points) Identify all feedback loop(s) that contain both "Hidden sponsoring" and "Whistle-blowing" without "Amount of bribe" and/or delay. Evaluate these feedback loop(s) and explain how "Hidden sponsoring" will influence bribery and whistle-blowing.

Question 2. (40 points) An imaginary city with 1 million population suffers from drug addiction and missing issues and wants to estimate their social cost in the city using Markov chain (assuming that the Makovian property is satisfied in this case). States of residents are "home," "runaway," "addicted, "missing," and "dead" in order. Time period is year. On average 94 percent of residents stay home, 3 percent are runaway (road people), 2 percent are drug addicted, and 1 percent are missing. The annual unit cost (per person) of "runaway" is 100 Yang, 200 Yang for "addicted," and 300 Yang for "missing" (no cost for "home"). Q, R, and $(I-Q)^{-1}$ of this Markov chain are listed below.

$$Q = \begin{bmatrix} .90 & .05 & .04 & .00 \\ .10 & .65 & .15 & .07 \\ .02 & .20 & .60 & .10 \\ .01 & .09 & .10 & .75 \end{bmatrix} \quad R = \begin{bmatrix} .01 \\ .03 \\ .08 \\ .05 \end{bmatrix} \quad (I-Q)^{-1} = \begin{bmatrix} 18 & 7 & 5 & 4 \\ 10 & 8 & 5 & 4 \\ 8 & 6 & 7 & 4 \\ 7 & 6 & 5 & 7 \end{bmatrix}$$

2.1 (5 points) Draw the corresponding transition diagram of this Markov chain.
2.2 (10 points) Interpret the third and fourth columns of Q substantively.
2.3 (5 points) Report the n-step transition probability matrix of $P^{(\infty)}$ that shows steady state probabilities.
2.4 (10 points) Interpret the third and four rows of the fundamental matrix substantively.
2.5 (10 points) Report the expected amount of social cost of taking care of the drug addicted (state). Show me how you calculate the cost clearly.

Question 3. (40 points) Assume unlimited queue size (∞) and calling population (∞) and FCFS (first come, first served) service discipline.

3.1 (10 points) Take a look the handout and check the list of performance indicators of M/M/s/ of E 11.24 (see p. 482). The new CEO wants to find the optimal number of servers that satisfies (1) the utilization factor should be greater than .4 in order for efficiency, (2) the average waiting time in the queue should not be longer than 5 seconds, (3) the probability that the number of customers in the system exceed seven should not larger than six percent, and (4) At least 95 percent of the customers, the time spent in the queue should not exceed 30 seconds. Check each requirement and then report your answer (solution).
3.2 (10 points) Look at the performance indicators in Q3.1 and see 11.9 of the textbook (pp. 473-476). The unit service cost per server and minute is 10 Yang and unit waiting cost of a customer is 150 Yang. Calculate the expected service cost, waiting cost, and total cost per unit time as shown in Figure 11.17 (p. 476), and then determine the optimal number of tellers. Tell me your reasoning.
3.3 (10 points) Remember Q1.8 and Q1.9 of homework 5 and then look at M/M/1, M/G/1 and M/D/1 in the handout carefully. Why do M/G/1 and M/D/1 show better performance indicators than M/M/1? Compare natures of service probability distributions. Tell me theoretical and/or intuitive reasons. What will Charlie Chaplin in *Modern Times* (1936) comment on this result (his opinion about such M/G/1 and M/D/1)?
3.4 (10 points) Why does a waiting line of a government especially in developing countries tend to be longer than that of commercial firms? Do you think consideration of citizens' waiting cost or opportunity cost in the queue (e.g., adding more servers) will decrease social efficiency? Why and why not?

End of the final exam.