# INTERNATIONAL UNIVERSITY OF JAPAN
Public Management and Policy Analysis Program
Graduate School of International Relations

DCC5350 (2 Credits)
Public Policy Modeling
Spring 2018

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 2 digits below the decimal point for factions.

Question 1. **(30 points)** Suppose you are expected to decide whether or not to hire a candidate (Yes=hire, No=not hire). The probability that the candidate is good is .4: P(Good)=.4 and P(Poor)=.6. One consulting company argues that its report is very informative to distinguish good performers from poor performers. The report concludes with three results: red, green, and blue. If a candidate's ability is actually good, for instance, there is 30 percent chance that the report will return red: P(Red|Good)=.3. Other conditional probabilities are P(Green|Good)=.3, P(Blue|Good)=.4, P(Red|Poor)=.6, and P(Green|Poor)=.3 The following decision tree illustrates the decision situation under this imperfect information. Pay attention to the payoff at the end of decision tree.
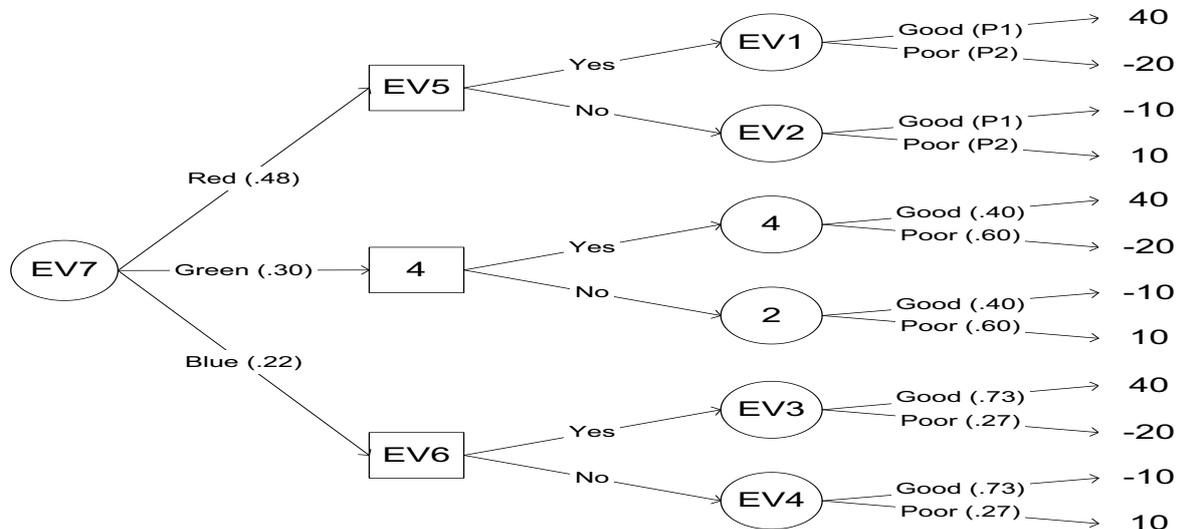
1.1 **(5 points)** Construct a decision table assuming no (perfect/imperfect) information. Provide prior probability and payoffs. Make a decision using the expected monetary value (Would you like to recruit a candidate?).
1.2 **(5 points)** Calculate the expected value under perfect information and then the expected value of perfect information (EVPI). Draw a corresponding decision tree.
1.3 **(10 points)** Calculate the posterior probabilities when the report returns red result: P1=P(Good|Red) and P2=P(Poor|Red).
1.4 **(10 points)** Calculate EV1 through EV7 (some of them just need comparison) and then calculate the expected value of imperfect information (EVII).

Question 2. (35 points) Farrell (1983) extended Hirschman (1970) and discussed four types of responses to job dissatisfaction in an organization. Exit option is to quit or leave the job and the organization (turnover); Voice is "any attempt at all to change rather than to escape from an objectionable state of affairs" (Hirschman, 1970, p. 30). Examples of voice are talking to supervisor, making some suggestions, and writing a letter (email); Loyalty is to "stick with the firm for a period of time before reacting to the problem" (Farrell, 1983, p. 598) with "confiden[ce] that things will soon get better" (Hirschman, 1970, p.38); The final option of neglect is to lax, disregardful, and inattentive behavior such as absenteeism, lateness, low commitment, and error-prone output (Farrell, 1983, p.598). See the following paper and book for the details.

Farrell, Dan. 1983. Exit, voice, loyalty, and neglect as responses to job dissatisfaction: A
    multidimensional scaling study. *Academy of Management Journal*, 26(4): 596-607.
Hirschman, Albert O. 1970. *Exit, voice, and loyalty: Responses to decline in firms,
    organizations, and states*. Cambridge, MA: Harvard University Press.

The states are arranged from loyalty, voice, neglect, (natural/voluntary) exit, and (unwilling and forced) lay-off and time interval is year. Of course, exit and lay-off are absorbing states. The annual cost of loyalty is $0, $10K (10,000) for voice, and $50K for neglect per employee.

$$Q = \begin{bmatrix} .75 & .15 & .05 \\ .10 & .75 & .12 \\ .02 & .03 & .93 \end{bmatrix} R = \begin{bmatrix} .05 & .00 \\ .01 & .02 \\ .01 & .01 \end{bmatrix} (I-Q)^{-1} = \begin{bmatrix} 8 & 7 & 18 \\ 6 & 10 & 21 \\ 5 & 6 & 29 \end{bmatrix} (I-Q)^{-1}R = \begin{bmatrix} .67 & .33 \\ .59 & .41 \\ .59 & .41 \end{bmatrix}$$

2.1 (10 points) Draw the transition diagram of this Markov chain.
2.2 (5 points) Interpret the <u>third row</u> of Q and R substantively.
2.3 (10 points) Explain all elements in the <u>first row</u> of the fundamental matrix and all
    elements in the <u>second column</u> of the absorption probability matrix substantively.
2.4 (10 points) Calculate the average cost that the organization will spend for an
    employee in the loyalty state before he or she exits or is laid-off eventually. Do the
    same calculation for an employee in the neglect state. Based on 2.3-2.4, how would
    you evaluate this organization? Is it a good organization? Why and why not?

Question 3. (35 points) Suppose you are the director of an agency that provides innovative public services to the poor in poverty. Past records reveal that <u>on average 7 clients</u> are expected to arrive in the agency per hour (no peak time is assumed) and a public servant on the front-desk spends <u>on average 17 minutes</u> to serve a poor client. The opportunity cost of a client is estimated to be $30 <u>per hour</u> and the wage of a front-desk public servant is $100 <u>per hour</u>. A policy analyst reported the following performance indicators and you are expected to determine the optimal level of service provision. This queueing system is M/M/s/FCFS/∞/∞.

3.1 (10 points) Report the mean arrival rate (λ, lambda) and mean service rate (μ, mu).
    Unit time is an hour. Report the utilization factor ρ of each queuing system. A
    regulation says that employees should be given reasonable relaxing time to protect
    them from overwork ($\rho<.5$). What is the best queueing system in this respect?
3.2 (10 points) Look at 11.9 (pp. 473-476). Calculate the expected service cost <u>per hour</u>
    (SC) and expected waiting cost <u>per hour</u> (WC). Then calculate the expected total cost

per hour (TC=SC+WC). Determine the optimal level of server provision (s) and explain why.

3.3 (10 points) The president elected wants to have a service provision system (1) whose probability of having less than or equal to 5 customers ($n \leq 5$) is higher than 95 percent and (2) whose probability of waiting in the queue longer than 15 minutes is less than 1 percent. What will be the best choice for you?

3.4 (5 points) Considering 3.1-3.3, tell me how regulations (laws) and constrains (top manager's preference and policy) influence the economic efficiency.

$s =$	2	3	4	5
$L_q =$	117.5146	0.8518	0.1670	0.0381
$L =$	119.4979	2.8352	2.1504	2.0214
W_q (hours) =	16.7878	0.1217	0.0239	0.0054
W (hours) =	17.0711	0.4050	0.3072	0.2888
$P(W>15 \text{ min}) =$	0.9878	0.5721	0.4547	0.4237
$P(W_q>15 \text{ min}) =$	0.9731	0.1781	0.0287	0.0040
$P(n > 5) =$	0.9550	0.1262	0.0418	0.0230

End of the final exam.