

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

DCC5350/ADC5005 (2 Credits)
Public Policy Modeling
Spring 2018

Midterm Exam (100 points)

Instruction: Please write down your student ID and name at the top of your answer. You MUST ALWAYS show necessary computation and your reasoning as clearly as possible. This is an open-book and open-notebook exam. However, you may not communicate (including written, verbal, gestural, any other communication) with others during the exam.

1. (25 points) An imaginary city hosts the annual Naked Couple Festival, which is similar to the Naked Man Festival of Minami Uonuma City (two cities are very similar in various respects). But only couples older than 15 are allowed to participate in the event. Couples should be neither husband and wife nor close relatives. Voluntary participants are clad in (wear) big and colorful nappies to hide their hips and breasts, of course. Due to the decent tradition and culture of the city, there has not been any gender crime or similar problem in the event for the past 1,000 years. The city has been famous for its lowest divorce rate and crime rate in the country. The 70 percent of the local economy depends on tourism including hot spring, sky resort, unique food, and cultural properties.

Recently, the mayor of the city found that (1) the number of couple participants has declined by 40 percent; (2) the number of tourists has declined by 30 percent; (3) the amount of sales during the event has decreased by 35 percent, but the portion of liquor and cigarette of the total sales has increased by 20 percent. As a special policy analyst invited by the mayor, you had to analyze recent festival issues and submit a memorandum to the mayor (decision maker). You found that many visitors are not pure tourists but those who are looking for something interesting regardless of the event. Not only female participants but ordinary visitors also felt appalling by the lustful gazes of such “unwelcome visitors,” who were oftentimes drinking and smoking heavily on the street. Some of them were arrested for drug use and/or violent behavior during the festival.

- 1.1 (5 points)** What is your (mayor’s) public problem? How would you define it? **To revitalize the festival by removing barriers (e.g., bad behavior of unwelcome visitors)**
- 1.2 (5 points)** What level of knowledge (certainty, risk, uncertainty, or ignorance) is involved in this problem? Tell me your reasoning. **Uncertainty due to lack of probabilities**
- 1.3 (5 points)** List at least three decision variables including their units of measurement. Do NOT explain what they are. **# police patrol; # volunteers to monitor; # announcement (campaign) to discourage misbehavior**
- 1.4 (5 points)** List at least three environment variables. **budget for the festival; law and regulations regarding harassment, drug, alcohol, and smoking**
- 1.5 (5 points)** List at least two criterion variables. **# participants; # visitors**

2. Read Q2.23 on page 58 (25 points). Formulate Ralph Edmund’s healthy diet problem into LP. Use EA (each) as the unit of measurement of serving.

2.1 (5 points) Define decision variables clearly including the proper unit of measurement.

x_1 is the number of stake (EA); x_2 is the number of potato (EA)

2.2 (15 points) Formulate this LP problem (algebraically). $\text{Min } C = 4x_1 + 2x_2$; $5x_1 + 15x_2 \geq 50$; $20x_1 + 5x_2 \geq 40$; $15x_1 + 2x_2 \leq 60$; $x_1 \geq 0$ and $x_2 \geq 0$

2.3 (5 points) Check the unit of measurement of the objective function and constraint 1.

$\$/\text{Day} = (\$/\text{EA})(\text{EA}/\text{Day}) + (\$/\text{EA})(\text{EA}/\text{Day})$; $(\text{Grams}/\text{EA})(\text{EA}/\text{Day}) + (\text{Grams}/\text{EA})(\text{EA}/\text{Day}) \geq \text{Grams}/\text{Day}$

3. Read the Excel Solver's Answer Report and Sensitivity Report provided (50). The organization produces four types of product. There are three blank cells in the handout that you need to fill out.

3.1 (3 points) Report the optimal solution. $x_1=0$, $x_2=400$, $x_3=200$, $x_4=1000$

3.2 (7 points) Calculate the optimal value for the blank cell (1). The unit of measurement of the optimal value is \$. $3*0 + 11*400 + 18*200 + 26*1000 = 34,000$

3.3 (5 points) Calculate the slack of the second constraint for the blank cell (2). $6000-3000 = 3000$

3.4 (5 points) Report the shadow price of constraint 4 for the blank cell (3). Explain your reasoning. **0 due to complementary slackness**

3.5 (10 points) Report a nonzero reduced cost and explain its meaning substantively. **In order to produce at least one unit of x_1 , the coefficient 3 needs to be reduced by -25.**

3.6 (5 points) Explain the meanings of allowable increase and decrease of the coefficient of decision variable x_3 . You must report the allowable range. **As long as the coefficient 18 changes within $[18-12.5, 18+15]=[5.5, 33]$, the optimal solution remains unchanged.**

3.7 (5 points) Interpret shadow prices of the first two constraints (i.e., constraint 1 and 2) substantively. **For one labor hour increase, the optimal value will increase by 5 as long as RHS remains within $[3000-500, 3000+2000]=[2500, 5000]$; Increase in metal by one unit does not change the optimal value.**

3.8 (10 points) The organization consider three options of investment given the optimal solution: (1) increasing RHS of labor hours by 500, (2) increasing RHS of metal by 1,000 Kg, and (3) increasing RHS of wood by 900 Kg. Assume that each option incurs the same amount of investment (\$2,000). Evaluate how each option influences the value of objective function and then make a policy suggestion (only one option) to decision maker. **(1) $5*500 - 2000 = 500$; (2) $0*1000-2000 = -2000$; (3) $3*900-2000=700$. Therefore, (3) is suggested.**

End of the midterm exam.