AGEC 641 - HOMEWORK
Chapter 13 Price Endogenous Programming

1. Given the problem

$$\begin{array}{lll} \text{Max} & CX+0.5*X'QX - dY & \\ \text{s.t.} & X - EY & \leq 0 \\ & AY & \leq b \\ & X, Y & \geq 0 \end{array}$$

where X is a vector of quantities consumed
C is the vector of intercepts of the demand equations for X
Q is the matrix of slopes of the demand equations for X
Y is a vector of production alternatives
d is the vector of per unit costs of producing Y
E is the matrix of per unit yields of Y
A is a matrix of resource usages by Y
b is a vector of resource endowments

Do the following

a. State the conditions under which a global optimal solution would arise.
b. Explain the Kuhn Tucker conditions.
c. Explain the significance of the 0.5 term which pre multiplies X'QX.

2. The potato growers have come to you with the following situation. Potatoes are produced during the first two quarters of a year. The following supply functions have been estimated:

Quarter	Function
1	$P_1 = 18{,}000 + 1/2X_1$
2	$P_2 = 40{,}000 + X_2$
3	$X_3 = 0$
4	$X_4 = 0$

where X_j is the quantity of potatoes supplied in quarter j in pounds.

After potatoes are harvested, they may be sold as fresh potatoes processed into frozen french fries. It takes 2 pounds of potatoes to produce 1 pound of frozen french fries, and the conversion costs are $.10 per pound of frozen french fries produced. Processing may take place only during the harvest season (Quarters 1 and 2).
Fresh potatoes may be stored for sale in the future at a cost of $.03 per pound for each quarter stored. Storage costs for frozen french fries are $.05 per pound for each quarter stored.
The demand for fresh potatoes and frozen french fries is:

Quarter	Fresh Potato Demand	Frozen French Fry Demand
1	$P_{1F} = 10{,}000 - QF_1$	$P_{1Z} = 1000 - 1/2QZ_1$
2	$P_{2F} = 8{,}000 - 2QF_2$	$P_{2Z} = 2000 - QZ_2$
3	$P_{3F} = 15{,}000 - QF_3$	$P_{3Z} = 1500 - QZ_3$
4	$P_{4F} = 12{,}000 - QF_4$	$P_{4Z} = 3000 - QZ_4$

where P_{jF} = price of fresh potatoes in quarter 1,
Q_{Fj} = quantity of fresh potatoes demanded in quarter 1,
P_{jZ} = price of frozen french fries in quarter 1,
Q_{Zj} = quantity of frozen french fries demanded in quarter 1.

a) Formulate a mathematical model which determines the competitive allocation of potatoes to the fresh and frozen markets and the optimal level of storage.

3. Given the following data for a marketing firm, develop, using simple calculus:

a) perfectly competitive optimum
b) monopolistic optimum
c) monopsonistic optimum
d) monopolistic monopsonistic optimum
e) optimum when $\alpha = ½$ for all curves but the fourth where $\alpha = 1$
f) explain your results

Inverse demand curve for exports of the good $P = 15 - .5q_1$
Inverse demand curve for domestic consumption of the good $P = 18 - q_2$
Inverse supply curve for imports of the good $P = 6 + q_3$
Inverse supply curve for domestic production of the good $P = 3 + .5q_4$

4. Choose a problem for which you have a GAMS formulation from an earlier homework, add price endogenous to one demand condition and one supply, then solve it with GAMS.