**Ag Ec 641, Spring 2021**

**Chapter XI, XII, XIII**

**Homework**

1. 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 |  | P1 = 18,000 + 1/2X1 |
| 2 |  | P2 = 40,000 + X2 |
| 3 |  | X3 = 0 |
| 4 |  | X4 = 0 |

where Xj 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 |  | P1F = 10,000 ‑ QF1 |  | P1Z = 1000 ‑ 1/2QZ1 |
| 2 |  | P2F = 8,000 ‑ 2QF2 |  | P2Z = 2000 ‑ QZ2 |
| 3 |  | P3F = 15,000 ‑ QF3 |  | P3Z = 1500 ‑ QZ3 |
| 4 |  | P4F = 12,000 ‑ QF4 |  | P4Z = 3000 ‑ QZ4 |

where PjF = price of fresh potatoes in quarter 1,

QFj = quantity of fresh potatoes demanded in quarter 1,

PjZ = price of frozen french fries in quarter 1,

QZj = quantity of frozen french fries demanded in quarter 1.

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

2. Take the simple goal program



a) Develop a weighted trade‑off type objective function without targets.

b) Make it quadratic, incorporating diminishing preferences for goals as more of the goal is attained. Explain your formulation.

3. Develop a general multi‑commodity spatial equilibrium problem in summation notation.

4. USDA wants to analyze some situations arising from the Geneva trade negotiations. Currently, they have information on 3 regions of the world and some data on grains trade costs.

The regions are: North America, South America and Europe. They have domestic demand and supply relationships.

North America Supply: 20 + .01Q

Demand: 100 ‑ Q

South America Supply: 23 + .5Q

Demand: 100 ‑ .25Q

Europe Supply: 41 + .2Q

Demand: 100 ‑ .35Q

Further, transportation rates between these countries are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | from: | | |
|  |  | North America | South America | Europe |
| to: | North America | 0 | 8 | 12 |
| South America | 8 | 0 | 11 |
| Europe | 12 | 11 | 0 |

The trade situations USDA wishes to analyze are:

1) Free trade.

2) No trade.

3) North American Export Quotas of Q = 10, 50, 200.

4) North American Export taxes of $1, $2, and 10% of value.

5) An outgoing transport limit of 50 to S. America from N. America.

a) Formulate the model to do these analyses. (You may wish to construct just the base model then portray additional features.)

b) Tell how you would find each country's prices.

5. Suppose you have been hired by an international development agency to do an analysis of the effects of new technology on farming conditions in Jalava. Suppose that you have chosen to use a mathematical program to do this and have the following data:

Farms grow 4 crops: rice, maize, cassava and legumes. The year is divided into two seasons. Rice may be grown in three versions: year‑long, wet sea­son, and dry season; maize in the dry season, cassava in the dry season or year‑long, and legumes in the dry season. The crops produce output, use land, labor, and miscellaneous outputs, and have prices as follows:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Crop | | Wet Rice | Dry Rice | Year Long Rice | Maize | Dry Casava | Year Long Casava | Legume |
| Yield (Kg.) | | 4000 | 3500 | 4500 | 2800 | 12000 | 22000 | 1000 |
| Labor Use (hours) | Wet Season | 50 | 0 | 30 | 0 | 0 | 15 | 0 |
| Dry Season | 0 | 50 | 25 | 30 | 20 | 10 | 18 |
| Land Use (Hectares) | Wet Season | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| Dry Season | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Miscellaneous Input Use (rp/hectare) | | 4000 | 3800 | 4100 | 2000 | 100 | 150 | 1000 |
| Price (rp/kg) | | 70 | 73 | 73 | 45 | 8 | 8 | 125 |
| Calories/kg | | 3360 | 3360 | 3360 | 3490 | 1050 | 1050 | 4520 |

Assume the farm has 2 hectares and 75 man‑days of labor in each period.

However, in addition to profits, the family is concerned about its diet. The family has 5 members. Assume that family members have a goal of consu­ming at least 1575 calories per day, with at least 210 from legumes, and no more than 400 calories from cassa­va. Further, assume the family would pre­fer to have at least 120 kg. annually of rice per member.

Formulate this as a multiple objective programming problem using a lexico­graphic for the diet and a profit max objective.

7. Give optimality conditions and tell whether (or how to find out whether) you have a maximum or a minimum, for the following problems:

a) Z = 3X2

b) Z = (4‑X)2 ‑ 4X

c) Z = 3X2 + 2Y2 ‑ 2XY

d) opt Z = 3X2 + 2Y2 ‑ 2XY

X + Y = 2

e) opt Z = 3X2 + 2Y2 ‑ 2XY

X + Y  10

X, Y  0

**8 T**ake your earlier GAMS formulation

1. Add multiple objectives and solve for a lexicographic and 3 different weights settings

* + 1. 2. Add in a demand and supply curve and solve under perfect and imperfect competition