**Chapter VII Homework**

1. Dollar Hog Company is planning its weekly hog cutting operation. Dollar buys hogs and can either skin them or scald them and then cut them up via one of four patterns. Technical data follow.

|  |
| --- |
| Table 1. Technical Data by Processing Type |
|  | Hog Processing Type |
|  | Skin | Scald |
| Cost/Hog | 10 | 8 |
| skin yield/hog | 1 | 0 |
| labor/hog | 6 | 4 |
| meat yield /hog | 200 lbs | 210 lbs |

|  |
| --- |
| Table 2. Percent yield of product and labor use when cutting up the meat yield for four cutting patterns |
|  | Cutting Pattern |
| Product | 1 | 2 | 3 | 4 |
| Ham | .20 | .20 |  |  |
| Bacon | .10 |  | .15 |  |
| Sausage | .25 | .35 | .45 | .65 |
| By-product | .25 | .25 | .20 | .15 |
| Waste | .20 | .20 | .20 | .20 |
| Labor/hog | 0.5 | 0.2 | 0.2 | 0.1 |

Products sell for the following prices:

Skins: $18 Bacon: $2.45/lb. Ham: $2.90/lb.

Sausage: $2.00/lb. By product $0.50/lb

Hogs cost $80, weigh the amount specified above after the skinning or scalding operation. labor costs $6/hr. with 5000 man hours available. Waste costs $0.10/lb. to dispose of.

a) Formulate an LP

b) Discuss how to derive a demand curve for hogs.

c) Setup and interpret the dual equation for the major different types of variables.

2. Smears prepares prepackaged hardware for distribution through its chain of stores. Prepackaged hardware contains mixtures of various items or small packages of these items. Smears sells assorted packages of items containing#2, #4, and #6 bolts; #2, #4, and #6 nuts; #2, #4, and #6 washers; #6 and #10 wood screws; and #3 and #5 metal screws. The packages they sell are:

|  |  |  |  |
| --- | --- | --- | --- |
| Pack | Name | Composition by weight | Weight of Packaged Product |
| 1 | Handyman Set | Equal wt. of everything | 1 lb. |
| 2 | Screw, bolt, washer set | 10 of each size- | -- |
| 3 | Bolt Pack | 1 lb. of any of the bolts 1 size only | 1 lb. |
| 4 | Nut Pack | 1 lb. of any of the nuts 1 size only | 1 lb. |
| 5 | Washer Pack | 1 lb. of any of the washers 1 size only | 1 lb. |
| 6 | Bolt Mix 1 | 20% #2, 30% #4, 50% #6 | 1 lb. |
| 7 | Bolt Mix 2 | 40% #2, 20% #4, 40% #6 | 1 lb. |
| 8 | Washer Mix | 30% #2, 30% #4, 40% #6 | 1 lb. |
| 9 | Wood screw Mix | 40% #6, 60% #10 | 1 lb. |
| 10 | Metal screw Mix | 60% #3, 40% #5 | 1 lb. |
| 11 | Screw Mix | 50% wood screw mix, 50% metal screw mix | 1 lb. |
| 12 | Nut Mix | Equal weight of all types of nuts | 1 lb. |

In terms of raw materials:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Items/lb. | Inventory in lbs. | Cents/lbs. | Maximum available at this price |
| #2 bolt |  50 | 100 lbs | 50 | 1,000 |
| #4 bolt | 100 | 50  | 40 |  500 |
| #6 bolt | 150 | 75  | 30 | 7,000 |
| #2 nut | 300 | 90  | 20 | 1,000 |
| #4 nut | 325 | 110  | 30 |  700 |
| #6 nut | 350 | 10  | 40 | 1,000 |
| #2 washer | 500 | 3  | 10 |  600 |
| #4 washer | 550 | 25  | 10 | 1,500 |
| #6 washer | 600 | 200  | 10 | unlimited |
| #6 wood screw | 150 | 5  | 40 | 2,000 |
| #10 wood screw | 200 | 0  | 30 | 2,000 |
| #3 metal screw |  75 | 0  | 70 | 2,000 |
| #5 metal screw | 125 | 0  | 50 | 2,000 |

In terms of products...

|  |  |  |  |
| --- | --- | --- | --- |
| Product | Price/Unit | Minimum Sales | Maximum Sales |
| 1 | $1.00 | 100 |  500 |
| 2 |  .40 |  0 |  2,000 |
| 3 |  .75 |  0 |  -- |
| 4 |  .50 | 200 |  -- |
| 5 |  .70 |  0 |  1,000 |
| 6 |  .60 |  0 |  -- |
| 7 |  3.10 |  0 |  -- |
| 8 |  1.70 |  0 |  100 |
| 9 |  .85 |  50 |  -- |
| 10 |  2.05 |  0 |  -- |
| 11 |  .80 |  0 |  -- |
| 12 | .75 |  0 |  -- |

a) Formulate this as an LP including features which tell the number of bolts, nuts, washers and screws sold; the costs of purchases of bolts, nuts, washers and screws; and the total poundage sold.

b) How would you answer the question: "What items should Smears try to obtain more of?"

c) How would you answer the question: "What items should Smears try to sell more of?"

3. Louis Lots o' Turkey Co. wishes to find an optimum pattern for turning turkey into profits. LLOTC buys turkeys and produces several products: fresh turkeys, frozen turkeys, turkey hams, turkey roasts, lunch meat, turkey parts (legs, thighs, breasts) and ground turkey. To make these products, LLOTC has developed seven cutting patterns. These patterns are

a) Fresh turkey preparation e) Turkey parts (1, 2, and 3)

b) Frozen turkey preparation f) Lunchmeats

c) Turkey ham preparation g) Turkey grinding

d) Turkey pressing

All the patterns require 1 unit of kill capacity. In addition, the yield and input usage of the patterns are

|  |  |  |  |
| --- | --- | --- | --- |
| Pattern | Output | Cost Input | Labor Input |
| Fresh turkey | 1 fresh turkey | $0.50 | 1/3 hr. |
| Frozen turkey | 1 frozen turkey | $0.75 | 1/2 hr. |
| Turkey ham | 8 lbs. turkey hams | $1.50 | 3/4 hr. |
| Turkey pressing | 8 lbs. boneless turkey roast | $1.40 | 1/2 hr. |
| Turkey parts 1 | 4 lbs. breast, 5 lbs. quarters | $0.50 | 1/3 hr. |
| Turkey parts 2 | 9 lbs. quarters | $0.50 | 1/4 hr. |
| Turkey parts 3 | 4 lbs. breast, 3 lbs. thigh, 2 lbs. leg | $0.50 | 1/2 hr. |
| Lunchmeats | 8 lbs. lunch meats | $2.00  | 1 hr. |
| Turkey grinding | 10 lbs. ground meat | $0.25 | 3/4 hr. |

500 units of kill capacity and 1000 hrs. of labor are available. The product prices and maximum that can be sold are

Fresh turkey $12.00/turkey 100

Frozen turkey $11.00/turkey -‑‑‑

Turkey ham $ 2.50/lb. 75 lbs.

Turkey Roast $ 2.40/lb. 125 lbs.

Breast $ 1.30/lb. 50 lbs.

Leg $ 0.90/lb. 30 lbs.

Thigh $ 1.10/lb. 60 lbs.

Quarters $ 1.05/lb. 100 lbs.

Lunchmeats $ 1.75/lb. --‑‑

Ground Turkey $ 0.90/lb. --‑‑

Set up a profit maximizing model.

4. The Peck family is studying whether to make an offer on some property. Currently, the Peck's own two farms and a feedlot in Illinois. The option they are considering is the purchase of some land in Montana. The land in Montana would be used to raise cattle which would be in part fed to slaughter age in Montana and in part shipped to Illinois for feeding. Technical data follows:

|  |  |  |
| --- | --- | --- |
| Farm Data | Farm 1 | Farm 2 |
| Land Plowing |  |  |  |
|  | Acres/hour | 3 | 2.5 |
|  | Labor /hour plowing | 1 | 1 |
| Planting Corn |  |  |  |
|  | Acres/hour | 5 | 6 |
|  | Labor/hr of planting | 1 | 1 |
| Plant Soybeans |  |  |  |
|  | Acre/hour | 6 | 8 |
|  | Labor/hr of planting | 1 | 1 |
| Harvesting Corn |  |  |  |
|  | Acre/hour | 3 | 3 |
|  | Labor/hour | 1.5 | 1.5 |
| Harvest Soybeans |  |  |  |
|  | Acres/hour | 5 | 5.5 |
|  | Labor/hour | 1.5 | 1.5 |

Corn yields in bushels on Farm 1 are:

|  |  |  |
| --- | --- | --- |
|  |  | Planting Date |
|  |  | May | June |
| Harvest Date | October | 120 | 110 |
| November | 140 | 130 |

Corn yields on Farm 2 are 90% of those on Farm 1.

Soybean yields in bushels (bu) on Farm 1 are:

|  |  |  |
| --- | --- | --- |
|  |  | Planting Date |
|  |  | May | June |
| Harvest Date | September | 40 | 38 |
| October | 45 | 42 |

Soybean yields on Farm 2 are 110% of those on Farm 1. Plowing is done in December, March, April or May. Farm labor is shared between the farms and there are 60 hours in each month with 4 people working. Farm 1 has 300 acres, Farm 2 has 200 acres.

|  |  |
| --- | --- |
| Feed Lot Data | Characteristics of Alternative Feeding Systems per Feeder Animal |
| Method Number | 1 | 2 | 3 | 4 |
| Final Animal Weight/lbs. | 900 | 870 | 900 | 920 |
| Bushels of Corn | 40 | 45 | 30 | 42 |
| Bushels of Soybeans | 10 | 5 | 20 | 6 |
| Other Costs | 20 | 25 | 15 | 30 |

Market Data:

Purchase cost of feeder animals $125/head

Market price of corn (same to both farms) $3.00/bu

Market price of soybeans (same to both farms) $6.75/bu

Cost of purchasing feed 120% of market price

Price of fed beef applicable to final animal weight $50/100 lbs

Cost of raising corn $100/acre

 soybeans $ 60/acre

Transport Costs:

Farm 1 to Feedlot Corn $0.05/bu

Soybeans $0.12/bu

Farm 2 to Feedlot Corn $0.10/bu

Soybeans $0.05/bu

Assume purchased feed and crops sold to market have a zero transport cost.

Montana Proposal

Land/cow unit: 5 acres

Number of feed animals raised in year per cow unit: 0.7

Land utilized per feeder raised to sale: 5 acres

Cost/cow unit: $55/year

Cost/feed animal to ship to Illinois: $10/feeder

Weight of feeders raised to mature animals and slaughtered in Montana: 600 lbs.

Cost/feeder raised to maturity in Montana: $50

Annualized Land cost in Montana: $5/acre

Price feeders raised to sale weight in Montana: $.50/lb.

Maximum market potential in Montana: 500 head of feeders raised to maturity

a. Formulate a model for optimum firm size including both farms, the feed­lot, and the Montana option.

b. Discuss how you would use this model to determine whether to invest in Montana land.

c. What types of formulations are implicit in this solution relative to those in the chapter (resource allocation, etc.)?

5. Assume you are hired by a meat packing firm which has W warehouses and P plants. Assume each of the plants makes N products by M processes. The plants have R resources. The goods are shipped from the plants to the warehouses which each face fixed demand for all goods. Assume the firm has asked you to build a model for them to determine

 (a) Which plants produce which products via which processes

 (b) Where goods produced at plants should be shipped.

 Formulate this problem in a general summation notation fashion specifying the data you would need

6. Apply the homogeneity of units test to the improper model in figure 6.5 and discuss any problems you find.

7. Suppose you are in charge of the U.S. cheese depository and you have the problem of emptying your cheese by next year. Further, you know today:

a) Cheese can be sold for $1.00/lb. and you think the price will go up by 5 per lb. per month the next 8 months, then down by 10 for the subsequent four months.

b) It costs you 2/month/lb. to keep the cheese.

c) Six months from now 1/2 the cheese you have on hand must be committed to PL 480, for which you are not reimbursed. You must commit at least 500 lbs.

d) You have 10,000 lbs. of cheese on hand.

e) 1% of the cheese spoils each month.

Set up a profit maximizing LP.