Chapter 15-16 Homework

2021

1. The Carluchi brothers own a dual purpose slaughter‑meat processing facility. A dual purpose plant can slaughter both cattle and hogs, but not both at the same time. Furthermore, there are costs associated with switching the kill line from one species to another.

You have been asked to formulate a production plan for the plant. The plant works on a weekly schedule; the kill line closes on the weekend for maintenance. The plant may choose to slaughter cattle only, hogs only, or both. It will not switch species more than once during the week. At the beginning of the week it incurs a fixed startup cost for whatever species it slaughters and if it switched to the other species it also incurs the startup cost. Killing capacity is 2000 animals per week. Other relevant data are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species | Start-up  costs ($) | Variable slaughter costs per head ($) | Purchase  price ($) | Meat yield  per head  (lb) |
| Cattle | 2000 | 65 | 500 | 600 |
| Hogs | 1500 | 45 | 100 | 150 |

The Carluchi brothers use beef and pork to produce country sausage, hot dogs, and spicy lunch meat. Data relevant to these products are

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Product | Beef (%) | Pork (%) | Selling  price ($/lb.) | Processing  cost ($/lb) |
| Sausage | 0 | 100 | .89 | .25 |
| Hot Dogs | 50 | 50 | 1.09 | .30 |
| Lunch Meat | 75 | 25 | 1.59 | .39 |

Formulate a mathematical programming model for the Carluchi brothers.

2. Suppose Ready Pack containers is trying to determine which consignment items to accept for shipping. Ready Pack has 10,000 cu. ft. of shipping space and can choose among the following 12 items:

|  |  |  |
| --- | --- | --- |
| Item | Shipping fee  collected | cu.. ft.  used |
| 1 | 700 | 700 |
| 2 | 1700 | 1500 |
| 3 | 1200 | 900 |
| 4 | 1500 | 1200 |
| 5 | 3500 | 2600 |
| 6 | 4000 | 3000 |
| 7 | 350 | 300 |
| 8 | 400 | 400 |
| 9 | 710 | 700 |
| 10 | 900 | 1100 |
| 11 | 5700 | 4200 |
| 12 | 1300 | 1200 |

Set up a model to maximize shipping fees subject to the restriction that you must take the whole item or nothing.

3. Set up a GAMS formulation with integer investment variables of your earlier model

4. Farmer Jones wishes to know what type of tractor to purchase among a choice of small and large tractors. Suppose he has 700 acres, works 40 hours/week during planting season (3 weeks long), and plants at 7 acres/hr. with the small tractor and 9 acres/hr. with the large. Yields are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Corn | Soybeans |
|  | 1 | 150 | 35 |
| Planting Week | 2 | 140 | 40 |
|  | 3 | 120 | 41 |

The corn price is $2.50, the soybean price is $6.00. The larger tractor costs $15,000 and the small tractor costs $12,000. Either tractor lasts 5 years and wears out an equal amount each year.

Formulate an integer program of this.

5. Suppose a firm is deciding how much to purchase Xs and resell Xd of the same good subject to the following:

Demand Price = 4 ‑ .6Xd

Marginal Cost = 3 ‑ .5Xs

Formulate the model explicitly including the downward sloping cost func­tion.