CMOR 360 HW1

Hubert King

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Problem 1

Let x_1 be the number of product 1 to produce and x_2 be the number of product 2 to produce.

$$\max(x_1 + 2x_2)$$
$$\text{s.t.} \quad x_2 \leq 60$$
$$x_1 + 3x_2 \leq 200$$
$$2x_1 + 2x_2 \leq 300$$
$$x_2 \leq 60$$
$$x_i \geq 0, \forall i = 1, 2$$

Problem 2

Let s be the units of special risk insurance and m units of mortgages.

$$\max(5s + 2m)$$
$$\text{s.t.} \quad 3s + 2m \leq 2400$$
$$m \leq 800$$
$$2s \leq 1200$$
$$s, m \geq 0$$

Problem 3

Let h be the number of hot dogs and b be the number of buns.

$$\max(0.88h + 0.33b)$$
$$\text{s.t.} 3h + 2b \leq 5 * 40 * 60$$
$$\frac{b}{10} \leq 200$$
$$\frac{h}{4} \leq 800$$
$$b, h \geq 0$$

Problem 4

We will use cups for all the measurements. Let x_1 be the cups of chicken breast, x_2 the cups of tomatoes, x_3 the cups of dried cherries, x_4 the cups of walnuts, and x_5 the cups of avocado.

$$\min(2.5x_1 + 0.23x_2 + 1.5x_3 + 1.6x_4 + 2.1x_5)$$
$$\text{s.t} \quad 350 \leq 231x_1 + 36x_2 + 77x_3 + 523x_4 + 240x_5 \leq 700$$
$$30 \leq 5x_1 + 0.4x_2 + 0.5x_3 + 52x_4 + 22x_5 \leq 40$$
$$100 \leq 119x_1 + 7.8x_2 + 19x_3 + 11x_4 + 13x_5 \leq 200$$
$$27.4x_2 + 20x_3 + x_4 + 15x_5 \geq 50$$
$$43x_1 + 1.8x_2 + 1.6x_3 + 12x_4 + 3x_5 \geq 16$$
$$x_1 \geq 1$$
$$x_i \geq 0, \forall i = 1, 2, 3, 4, 5$$

Problem 5

We reformulate the shifts as follows: 8AM to noon is shift 1, noon to 4pm is shift 2, 4pm to 8pm is shift 3, and 8pm to midnight is shift 4. Let $x_{i,i+1}$ be the number of full time consultants starting in shift i and ending with shift $i + 1$, $\forall i = 1, 2, 3$. Let y_j be the number of part time consultants working shift j, $\forall j = 1, 2, 3, 4$.

$$\min(40(x_{12} + x_{23} + x_{34}) + 30(y_1 + y_2 + y_3 + y_4))$$
$$\text{s.t.} \quad x_{12} + y_1 \leq 4$$
$$x_{12} + x_{23} + y_2 \leq 8$$
$$x_{23} + x_{34} + y_3 \leq 10$$
$$x_{34} + y_4 \leq 6$$
$$x_{12} \geq 2y_1$$
$$x_{12} + x_{23} \geq 2y_2$$
$$x_{23} + x_{34} \geq 2y_3$$
$$x_{34} \geq 2y_4$$
$$x_{i,i+1}, y_j \geq 0, \forall i = 1, 2, 3, j = 1, 2, 3, 4$$