HW Set 2

Old Edition:  27  23  19  21  24  25  33  42

6th Edition:  21  28  24  26  42  30  27  34

21. a. P*i* = proportion of compound *i* to include in the mix

MIN 5.00 P1 + 5.25 P2 + 5.50 P3

ST 0.20 P1 + 0.40 P2 + 0.10 P3 .20

0.60 P1 + 0.30 P2 + 0.40 P3 .30

0.20 P1 + 0.30 P2 + 0.50 P3 .30

0.20 P1 + 0.30 P2 + 0.50 P3 .45

P1 + P2 + P3 = 1.0

P*i*  0

b. See file: Prb3\_21.xlsm

c. P1=0.5714, P2=0.1429, P3=0.2857

Minimum cost per pound = $5.18

24. a. X*ij* = number of units of specimen *i* assigned to machine *j*

MIN 3 X1A + 4 X2A + 4 X3A + 5 X4A + 3 X5A

+ 5 X1B + 3 X2B + 5 X3B + 4 X4B + 5 X5B

+ 2 X1C + 5 X2C + 3 X3C + 3 X4C + 4 X5C

ST 3 X1A + 4 X2A + 4 X3A + 5 X4A + 3 X5A 480

5 X1B + 3 X2B + 5 X3B + 4 X4B + 5 X5B 480

2 X1C + 5 X2C + 3 X3C + 3 X4C + 4 X5C 480

X1A + X1B + X1C = 80

X2A + X2B + X2C = 75

X3A + X3B + X3C = 80

X4A + X4B + X4C = 120

X5A + X5B + X5C = 60

X*ij* 0

b. See file: Prb3\_24.xlsm

c. X1C = 80, X2B = 75, X3A = 75, X3C = 5, X4B = 18.33, X4C = 101.67, X5A = 60

Minimum processing time = 1258.33 minutes. (If an integer solution is needed the LP solution can be

rounded to yield the optimal integer solution.)

d. Machine A & C are used all 480 minutes, machine B is used 298.33 minutes

e. A solution exists where all machine are used for an equal amount of time (425.5 minutes each). This

increases the total time used to 1276.5 minutes.

26. a. X1 = number of workers starting at 12 am

X2 = number of workers starting at 4 am

X3 = number of workers starting at 8 am

X4 = number of workers starting at 12 pm

X5 = number of workers starting at 4 pm

X6 = number of workers starting at 8 pm

MIN X1+ X2 + X3+ X4 + X5+ X6

ST X6 + X1 90

X1 + X2 215

X2 + X3 250

X3 + X4 165

X4 + X5 300

X5 + X6 125

X*i* 0

b. See file: Prb3\_26.xlsm

c. X1=90, X2 =250, X3=0, X4 =175, X5=125, X6=0 (alternate optimal solutions exist)

Minimum number of employees = 640

27. a. A = amount to invest in bond A

B = amount to invest in bond B

C = amount to invest in bond C

D = amount to invest in bond D

E = amount to invest in bond E

MAX 0.095A + 0.08B + 0.09C + 0.09D + 0.09E

ST A + B + C + D + E = 100,000

B + E ≥ 50,000

A + D + E ≤ 50,000

A + B + D ≥ 30,000

0.095A + 0.08B + 0.09D ≥ 0.4\* (0.095A + 0.08B + 0.09C + 0.09D + 0.09E)

A, B, C, D, E ≥ 0

b. See file Prb3\_27.xlsm

c. A=20,339, B=20,339, C=29,661, D=0 , E=29,661

Maximum return = $8,898 (or 8.898%)

28. a. XiR = barrels of input *i* used to produce regular

XiS = barrels of input *i* used to produce supreme

MAX: (21-17.25)X1R+(21-15.75)X2R+(21-17.75)X3R+(25-17.25)X1S+(25-15.75)X2S+(25-17.75)X3S

ST: X1R + X1S ≤ 150

X2R + X2S ≤ 350

X3R + X3S ≤ 300

X1R + X2R + X3R  = 300

X1S + X2S + X3S = 450

(100X1R + 87X2R + 110X3R)/300 ≥ 90

(100X1S + 87X2S + 110X3S)/450 ≥ 97

Xij ≥ 0

b. See file Prb3\_28.xlsm

c. X1R=0, X2R=260.87, X3R=39.13, X1S=150, X2S=89.13, X3S=210.87 (alternate optimal exist)

Maximum Profit = $5,012.5 (in $1,000s)

30. a. B*i* = pounds of grade *i* fruit used in baskets

J*i* = pounds of grade *i* fruit used in juice

MAX: $2.50 (B1 + B2 + B*3* + B4 + B*5* ) + $1.75 (J1 + J2 + J*3* + J4 + J*5* )

S.T.: B1 + J1 ≤ 90

B2 + J2 ≤ 225

B3 + J3 ≤ 300

B4 + J4 ≤ 100

B5 + J5 ≤ 75

1 B1 + 2 B2 + 3 B3 + 4 B4 + 5 B5 ≥ 3.75 (B1 + B2 + B*3* + B4 + B*5* )

1 J1 + 2 J2 + 3 J3 + 4 J4 + 5 J5 ≥ 2.50 (J1 + J2 + J*3* + J4 + J*5* )

B*i*, J*i* ≥ 0

b. See file: Prb3\_30.xlsm

c. B1 = 0, B2 = 46.67, B3 =0, B4 = 100 B5= 45.33,

J1 = 90, J2 = 178.33, J3 =300, J4 = 0 J5= 29.67,

Profit = $1,526,500

34. a. X*ij* = number of bottles produced at vineyard *i* sold to restaurant *j*

MAX 39X11 + 36X12 + 34X13 + 34X14 + 32X21 + 36X22 + 37X23 + 34X24

ST X11 + X12 + X13 + X14 = 3,500

X21 + X22 + X23 + X24 = 3,100

X11 + X21 1800

X12 + X22 2300

X13 + X23 1250

X14 + X24 1750

X*ij* 0

b. See file: Prb3\_34.xlsm

c. X11 = 1,800, X12 = 1,700, X22 = 600, X23 = 1,250, X24 = 1,250, Maximum profit = $241,750

(Alternate optima exist.)

40. a. X1 = number of CD players to produce

X2 = number of tape decks to produce

X3 = number of stereo tuners to produce

MAX 75 X1 + 50 X2 + 40 X3

ST 3 X1 + 2 X2 + 1 X3 400,000

50,000 X1 150,000

50,000 X2 100,000

50,000 X3 90,000

b. See file: Prb3\_40.xlsm

c. X1= 70,000, X2 = 50,000, X3 = 90,000

Maximum profit = $11,350,000

42. a. T*i* = Number of people in group *i* surveyed by telephone

W*i* = Number of people in group *i* surveyed in “person” via web-cam

MIN: 18 T1 + 14T2 + 25T3 + 20T4 + 40W1 + 35W2 + 60W3 + 45W4

ST

2000 < T1 + T2 + W1 + W2 < 4000

1000 < W1 + W2 + W3 + W4 < 4000

1000 < W1 + W2 + W3 + W4 < 4000

-4000 < T1 – W1 < 0

0 < W2 + W4 + T2 + T4 < 1600

0 < 0.25W2 + 0.25W4 – 0.75T2 – 0.75T4 < 4000

400 < T*i* , W*i* < 2000

b. See file: Prb3\_42.xlsm

c. T1 = 1000, T2 = 1200, T3 = 400, T4 = 400, W1 = 1000, W2 =W3=W4= 0 ;

Minimum cost = $92,800