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CS325 – HW6

Problem 1:

a) shortest path from g to c = 16

```
max dc
st
    dg = 0
    da – df <= 5
    da – dh <= 4
    db – da <= 8
    db – df <= 7
    db – dh <= 9
    dc – db <= 4
    dc – df <= 3
    dd – dc <= 3
    dd – de <= 9
    dd – dg <= 2
    de – db <= 10
    de – dd <= 25
    de – df <= 2
    df – da <= 10
    df – dd <= 18
    dg – de <= 7
    dh – dg <= 3
END
```

b) shortest path to each:

DA	**7.000000**
DB	**12.000000**
DC	**16.000000**
DD	**2.000000**
DE	**19.000000**
DF	**17.000000**
DH	**3.000000**

max da + db + dc + dd + de + df + dg+ dh

ST

dg = 0
da – df <= 5
da – dh <= 4
db – da <= 8
db – df <= 7
db – dh <= 9
dc – db <= 4
dc – df <= 3
dd – dc <= 3
dd – de <= 9
dd – dg <= 2
de – db <= 10
de – dd <= 25
de – df <= 2
df – da <= 10
df – dd <= 18
dg – de <= 7
dh – dg <= 3

END

Problem 2:

OBJECTIVE FUNCTION VALUE

120196.0

VARIABLE	VALUE	
X1	**7000.000000**	**Silk**
X2	**13625.000000**	**Polyester**
X3	**13100.000000**	**Blend 1**
X4	**8500.000000**	**Blend 2**

Max (6.70 – .75 – (20*.125 +6 * 0 + 9*0))x1 + (3.55 - .75 – (20*0 +6* .08 +9*0))x2 + (4.31 - .75 – (20*0 + 6*.05 +9* .05))x3 + (4.81 - .75 – (20*0 + 6*.03 +9*.07))x4

Simplified:
Max 3.45x1 + 2.32x2 + 2.81x3 + 3.25x4

ST

.125x1 <= 1000
.08 x2 + .05 x3 + .03x4 <= 2000
.05x3 + .07x4 <= 1250
x1 <= 7000
x1 >= 6000

$x2 <= 14000$
$x2 >= 10000$
$x3 <= 16000$
$x3 >= 13000$
$x4 <= 8500$
$x4 >= 6000$
$x1 >= 0$
$x2 >= 0$
$x3 >= 0$
$x4 >= 0$

END

Max $\sum^n_{i=1} (si - li - (\sum^n_{j=1} cij * aij))xi$ (sum of the selling price of product i minus the labor cost of i minus the sum of the cost of material j in i times amount of material i in j all times the amount of product i

S.T.

$bi <= xi <= ci$ (amount between min b of product i and max c of product i)

$\sum^n_{i=1} aij <= dj$ (sum of material j in each product i less than or equal to amount of material j available)

$xi >= 0$

Problem 3:

i = plant number
j= warehouse number
k = retailer number
xij = amount shipped from plant i to warehouse j
yjk = amount shipped from warehouse j to retailer k
n = number of i
m = number of j available to i
c = cost, cij = cost plant i to warehouse j, cjk = cost warehouse to retailer
l = number of k available to j
bi = supply of i
bk = demand of k

max $\sum^n_{i=1}(\sum^m_{j=1}(c_{ij}x_{ij}) + \sum^l_{i=1}(c_{jk}*y_{jk}))$ (the sum of all the plant's sum of costs of shipping to each warehouse added together with the sum of the shipping costs of the corresponding warehouses to each corresponding available retailer.)

S.T.

$\sum^{m}_{j=1}(x_{ij}) = b_i$ (the sum of items shipped out of each plant must be equal to it's supply)

$\sum^{m}_{j=1} (y_{jk}) <= b_k$ (the sum of all products arriving at a retailer must be greater than or equal to demand)

$x_{ij}, y_{jk} >= 0$ (non-negativity constraints)

a)

min 10X11 + 15X12 + 11X21 + 8X22 + 13X31 + 8X32 + 9X33 + 14X42 + 8X43 + 5Y11 + 6Y12 + 7Y13 + 10Y14 + 12Y23 + 8Y24 + 10Y25 + 14Y26 + 14Y34 + 12Y35 + 12Y36 + 6Y37

ST

X11 + X12 = 150

X21 + X22 = 450

X31 + X32 + X33 = 250

X42 + X43 = 150

Y11 >= 100

Y12 >= 150

Y13 + Y23 >= 100

Y14 + Y24 + Y34 >= 200

Y25 + Y35 >= 200

Y26 + Y36 >=150

Y37 >= 100

X11 >= 0

X12 >= 0

X21 >= 0

X22 >= 0

X31 >= 0

X32 >= 0

X33 >= 0

X42 >= 0

X43 >= 0

Y11 >= 0

Y12 >= 0

Y13 >= 0

Y14 >= 0

Y23 >= 0

Y24 >= 0

Y25 >= 0

Y26 >= 0

Y34 >= 0

Y35 >= 0

Y36 >= 0

Y37 >= 0

END

OBJECTIVE FUNCTION VALUE

1) 16400.00

VARIABLE	VALUE	REDUCED COST
X11	150.000000	0.000000
X12	0.000000	5.000000
X21	0.000000	3.000000
X22	450.000000	0.000000
X31	0.000000	5.000000
X32	250.000000	0.000000
X33	0.000000	1.000000
X42	0.000000	6.000000
X43	150.000000	0.000000
Y11	100.000000	0.000000

Y12	150.000000	0.000000
Y13	100.000000	0.000000
Y14	0.000000	2.000000
Y23	0.000000	5.000000
Y24	200.000000	0.000000
Y25	200.000000	0.000000
Y26	0.000000	2.000000
Y34	0.000000	6.000000
Y35	0.000000	2.000000
Y36	150.000000	0.000000
Y37	100.000000	0.000000

b)
It is still possible because both warehouse 1 and 3 are able to receive from all the plants and able to ship to all the retailers.

min 10X11 + 11X21 + 13X31 + 9X33 + 8X43 + 5Y11 + 6Y12 + 7Y13 + 10Y14 + 14Y34 + 12Y35 + 12Y36 + 6Y37

ST

X11 = 150

X21 = 450

X31 + X33 = 250

X43 = 150

Y11 >= 100

Y12 >= 150

Y13 >= 100

Y14 + Y34 >= 200

Y35 >= 200

Y36 >=150

Y37 >= 100

X11 >= 0

X21 >= 0

X31 >= 0

X33 >= 0

X43 >= 0

Y11 >= 0

Y12 >= 0

Y13 >= 0

Y14 >= 0

Y34 >= 0

Y35 >= 0

Y36 >= 0

Y37 >= 0

END

OBJECTIVE FUNCTION VALUE

1) 18800.00

VARIABLE	VALUE	REDUCED COST
X11	150.000000	
X21	450.000000	
X31	0.000000	
X33	250.000000	
X43	150.000000	

Y11	100.000000
Y12	150.000000
Y13	100.000000
Y14	200.000000
Y34	0.000000
Y35	200.000000
Y36	150.000000
Y37	100.000000

c)

min 10X11 + 15X12 + 11X21 + 8X22 + 13X31 + 8X32 + 9X33 + 14X42 + 8X43 + 5Y11 + 6Y12 + 7Y13 + 10Y14 + 12Y23 + 8Y24 + 10Y25 + 14Y26 + 14Y34 + 12Y35 + 12Y36 + 6Y37

ST

X11 + X12 = 150

X21 + X22 = 450

X31 + X32 + X33 = 250

X42 + X43 = 150

X12 + X22 + X32 + X42 = 100

Y11 >= 100

Y12 >= 150

Y13 + Y23 >= 100

Y14 + Y24 + Y34 >= 200

Y25 + Y35 >= 200

Y26 + Y36 >=150

Y37 >= 100

X11 >= 0

X12 >= 0

X21 >= 0

X22 >= 0

X31 >= 0

X32 >= 0

X33 >= 0

X42 >= 0

X43 >= 0

Y11 >= 0

Y12 >= 0

Y13 >= 0

Y14 >= 0

Y23 >= 0

Y24 >= 0

Y25 >= 0

Y26 >= 0

Y34 >= 0

Y35 >= 0

Y36 >= 0

Y37 >= 0

END

OBJECTIVE FUNCTION VALUE

1) 17700.00

VARIABLE	VALUE	REDUCED COST
X11	150.000000	
X12	0.000000	
X21	350.000000	
X22	100.000000	
X31	0.000000	

X32	0.000000
X33	250.000000
X42	0.000000
X43	150.000000
Y11	100.000000
Y12	150.000000
Y13	100.000000
Y14	0.000000
Y23	0.000000
Y24	200.000000
Y25	200.000000
Y26	0.000000
Y34	0.000000
Y35	0.000000
Y36	150.000000
Y37	100.000000

Problem 4:

max $\sum^{n}_{i-1} x_i$

ST

$\sum^{n}_{i=1} c_i x_i = d$

$x_i >= 0$

$x_i \in \mathbb{Z}$

Minimize: A + B + C + D + E + F

ST

1.00A+.50B+.25C+.10D+.05E+.01F = Desired Change

A,B,C,D,E,F >= 0

A,B,C,D,E,F = Integers

xi = amount of currency i

ci = value of currency i
Z = set of integers
A = Amount for which to find change

$\min \sum_{i=1}^{n} x_i$

ST

$\sum_{i=1}^{n} c_i x_i = A$

$x_i >= 0$

$x_i \in \mathbb{Z}$

a)
min a + b + c + d

ST

1a + 5b + 10c + 25d = 202

a >= 0

b >= 0

c >= 0

d >= 0

END

GIN a

GIN b

GIN c

GIN d

OBJECTIVE FUNCTION VALUE

1) 10.00000

VARIABLE	VALUE
A	2.000000
B	0.000000
C	0.000000

D 8.000000

b)

min a + b + c + d + e

ST

1a + 3b + 7c + 12d + 27e= 293

a >= 0

b >= 0

c >= 0

d >= 0

END

GIN a

GIN b

GIN c

GIN d

GIN e

OBJECTIVE FUNCTION VALUE

1) 14.00000

VARIABLE	VALUE
A	0.000000
B	0.000000
C	2.000000
D	3.000000
E	9.000000