FIT3158 Note - W4 Scheduling problem

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An Employee Scheduling Problem: Air-Express

- An express shipping company – guarantees o/night delivery

- Various hubs across the country – shipments go to hubs, then on to their destination

- Manager of Baltimore hub is concerned about labour costs and wants to investigate the most effective way of scheduling of workers

- Hub open 7 days per week

- # packages varies from 1 day to the next

- An estimate of the number of workers needed on each day of the week has been calculated using historical data

Day of Week	Workers Needed
Sunday	18
Monday	27
Tuesday	22
Wednesday	26
Thursday	25
Friday	21
Saturday	19

Shift	Days Off	Wage
1	Sun & Mon	$680
2	Mon & Tue	$705
3	Tue & Wed	$705
4	Wed & Thr	$705
5	Thr & Fri	$705
6	Fri & Sat	$680
7	Sat & Sun	$655

Step 1: Defining the Decision Variables

X_1 = the number of workers assigned to shift 1

X_2 = the number of workers assigned to shift 2

X_3 = the number of workers assigned to shift 3

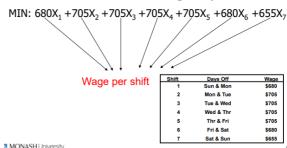X_4 = the number of workers assigned to shift 4

X_5 = the number of workers assigned to shift 5

X_6 = the number of workers assigned to shift 6

X_7 = the number of workers assigned to shift 7

Step 2:Defining the Objective Function

Minimize the total wage expense.

$$\text{MIN: } 680X_1 + 705X_2 + 705X_3 + 705X_4 + 705X_5 + 680X_6 + 655X_7$$

Wage per shift

Shift	Days Off	Wage
1	Sun & Mon	$680
2	Mon & Tue	$705
3	Tue & Wed	$705
4	Wed & Thr	$705
5	Thr & Fri	$705
6	Fri & Sat	$680
7	Sat & Sun	$655

MONASH University

Step 3: Defining the Constraints

Step 4: Implementing the Model

- Workers required each day

$0X_1 + 1X_2 + 1X_3 + 1X_4 + 1X_5 + 1X_6 + 0X_7 >= 18$ } Sunday

$0X_1 + 0X_2 + 1X_3 + 1X_4 + 1X_5 + 1X_6 + 1X_7 >= 27$ } Monday

$1X_1 + 0X_2 + 0X_3 + 1X_4 + 1X_5 + 1X_6 + 1X_7 >= 22$ } Tuesday

$1X_1 + 1X_2 + 0X_3 + 0X_4 + 1X_5 + 1X_6 + 1X_7 >= 26$ } Wednesday

$1X_1 + 1X_2 + 1X_3 + 0X_4 + 0X_5 + 1X_6 + 1X_7 >= 25$ } Thursday

$1X_1 + 1X_2 + 1X_3 + 1X_4 + 0X_5 + 0X_6 + 1X_7 >= 21$ } Friday

$1X_1 + 1X_2 + 1X_3 + 1X_4 + 1X_5 + 0X_6 + 0X_7 >= 19$ } Saturday

- Non-negativity & integrality conditions

$X_i >= 0$ and integer for all i

Implementing the Model

See file Lecture 4.xlsm (*AirExpress*)

	A	B	C	D	E	F	G	H	I	J
1				Air-Express						
2										
3			Days On=1, Days Off=0						Workers	Wages per
4	Shift	Sun	Mon	Tues	Wed	Thur	Fri	Sat	Scheduled	Worker
5	1	0	0	1	1	1	1	1	6	$680
6	2	1	0	0	1	1	1	1	0	$705
7	3	1	1	0	0	1	1	1	5	$705
8	4	1	1	1	0	0	1	1	1	$705
9	5	1	1	1	1	0	0	1	7	$705
10	6	1	1	1	1	1	0	0	5	$680
11	7	0	1	1	1	1	1	0	9	$655
12	Available	18	27	28	27	25	21	19	Total	$22,540
13	Required	18	27	22	26	25	21	19		
14										

At least as many as required