OMIS 2010 – Assignment A1 – Fall 2017
Section __
Due Date:

Assignment Instructions (please read carefully)

1. Submit your assignment to the link posted on Moodle.
2. Make sure to upload it to the correct link by section.
3. Work can be done by group of 2-3 students. Groups can not consist of students from other sections of the course..
4. Only one person uploads the assignment, adding all names on the file.
   The files names should be of the form: "A1_LastName1_LastName2_LastName3.xlsx"
   LastName1 is the last name of student 1, LastName2 is the last name of student 2, etc.
5. You are free to discuss your approach with other individuals or pairs, but your write-up should be prepared independently by the person(s) submitting the assignment. It is a violation of the rules of academic honesty to copy someone else's assignment and present it as your own.
6. The assignment cover page is posted (see next page).
7. You should upload 3 files:
   a. A completed cover page.
   b. A Word or PDF file with the assignment answers. Each answer file should include screenshots of supporting work (Excel model & output) to accompany the relevant question.
   c. Excel file with your work [always submit the Excel work to support your answer]. Use different tabs to identify the answers to each individual question when needed.
8. Generally, answers should be typed on the computer (graphs can be generated manually and incorporated into the assignment document).
9. The assignments should be organized by question. That means every piece of information for that question is found in the same section of the report. Use labeling and titles to make sure all is clear. If I have to look for it, it is not organized. Don't forget to add the Excel outputs if you used them to analyze the case. You may use an appendix to give further details of your model or calculations if required.
10. Late work will not be accepted. (You will earn a grade of 0.)

OMIS 2010 – Assignment Cover Page
Fall 2017

Schulich School of Business

Assignment #:	A1

	Group Member 1	Group Member 2	Group Member 3
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Group can be minimum of 2 members and maximum of 3 members only from the same section.

Question	**Your Score**	**Max points**
1		**13**
2		**18**
3		**44**
Total		**75**

Question 1 [13 marks]:

The dean of a business school in Northern Carolina must plan the school's course offerings for the next term. Student demands make it necessary to offer at least 20 core courses (each of which counts for 3 credit hours) and 25 elective courses (each of which counts for 4 credit hours) in the term. Faculty contracts also dictate that a total of at least 50 core and elective courses and at least 185 total credit hours be offered. Each core course taught costs the college an average of $5850 in faculty wages, and each elective course costs $6000. How many core and elective courses should be taught so that total faculty salaries are kept to a minimum?

a) Formulate a linear program model. Clearly and completely define your variables.

x_1 = # of core courses x_2 = # of elective courses   Min $Z = 5850x_1 + 6000x_2$

b) Use the graphical method to find the optimal solution. Determine the profit at the optimal solution.

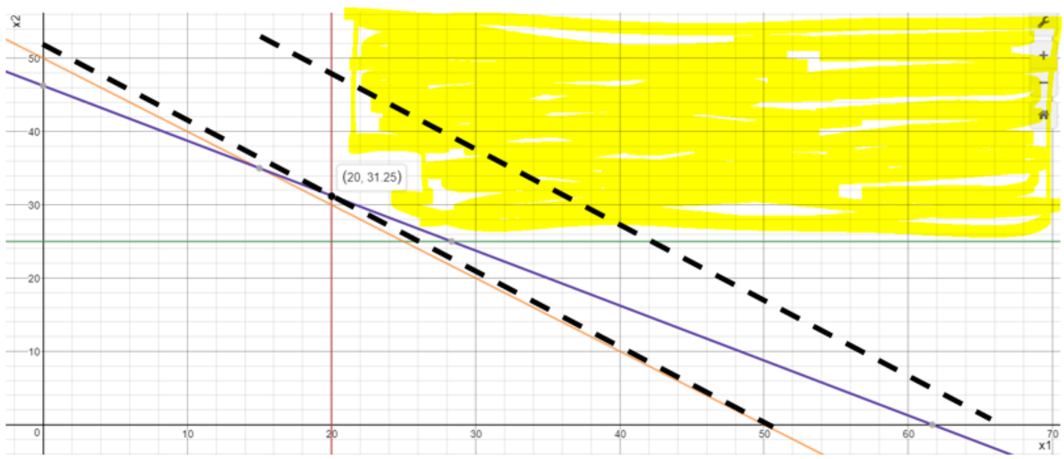
$x_1 \geq 20$

$x_2 \geq 25$

$x_1 + x_2 \geq 50$

$3x_1 + 4x_2 \geq 185$

$x_1, x_2 \geq 0$



$x_1=20$

$3x_1 + 4x_2 = 185$

$x_1 = {}^{185}/_{3} - {}^{4}/_{3}x_2$

$20 = {}^{185}/_{3} - {}^{4}/_{3}x_2$

${}^{4}/_{3}x_2 = {}^{185}/_{3} - 20$

$x_2 = 31.25$

Min $Z = 5850(20) + 6000(31.25) = \$304,500$

c) Compute manually the slack and surplus, if any, for all constraints. Define which are binding, non-binding and redundant constrains?

Binding: $x_1 = 20$ $3x_1 + 4x_2 = 185$

$20 = 20$ $3(20) + 4(31.25) = 185$

$60 + 125 = 185; 185 = 185$

Non-Binding: $x_2 = 25$

$20 = 25$

Surplus = 5

Redundant: $x_1 + x_2 = 50$

$20 + 31.25 = 50$

$51.25 = 50$

Surplus = 1.25

d) By how much can the Dean reduce the cost of the Core Course without affecting the result that you have obtained in part B? Show your work.

e) $-^{5850}/_{6000}$ = slope of objective line

undefined $\geq -^{c}/_{6000} \geq -^{3}/_{4}$

$-^{c}/_{6000} \geq -^{3}/_{4}$

$c \geq {}^{18000}/_{4} = 4500$

$c \geq 5850 - 4500 = 1350$

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$17	Decision Variables	20	0	5850	1E+30	1350
\$D\$17	X2	31.25	0	6000	1800	6000

This can also be seen in the allowable decrease for the variable.

f) Management is considering increasing the minimum number of elective courses that offered in the school. By how much this number can grow without affecting your solution to part B?

Minimum elective course provided = 25

Optimal solution = 31.25

Change: 31.25 – 25 = 6.25

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$B\$22	Constraints #1 Amount Used	20	1350	20	8.333333333	5
\$B\$23	Constraints #2 Amount Used	31.25	0	25	6.25	1E+30
\$B\$24	Constraints #3 Amount Used	51.25	0	50	1.25	1E+30
\$B\$25	Constraints #4 Amount Used	185	1500	185	1E+30	5

Question 2 [18 marks]:

Battery Technologies, a manufacturer of batteries for mobile phones, signed a contract with a large electronics manufacturer to produce 3 models of rechargeable battery packs for a new line of phones. The contract calls for the following:

Battery Pack	Production Quantity
BT-10	200,000
BT-20	100,000
BT-30	150,000

Battery Technologies can manufacture the battery packs at manufacturing plants located in India and Mexico. The unit cost of the battery packs differs at the 2 plants because of differences in production equipment and wage rates. The unit costs for each battery pack at each manufacturing plant are as follows:

Battery Pack	India ($)	Mexico ($)
BT-10	0.95	0.98
BT-20	0.98	1.06
BT-30	1.34	1.15

The BT-10 and BT-20 battery packs are produced using similar production equipment available at both plants. However, each plant has a limited capacity for the total number of BT-10 and BT-20 packs produced. The combined production capacities are 175,000 units in India and 160,000 in Mexico. The BT-30 production capacities are 75,000 units in India and 100,000 units in Mexico. The cost of shipping from India is $0.18 per unit, while the cost of shipping from Mexico is $0.10 per unit.

a) Formulate a linear program to solve this problem. Clearly define all variables.

Min $Z = (0.95+0.18)I_1 + (0.98+0.18)I_2 + (1.34+0.18)I_3 + (0.98+0.10)M_1 + (1.06+0.10)M_2 + (1.15+0.10)M_3$

I_1 = BT – 10 produced in India $\quad$ M_1 = BT – 10 produced in Mexico

I_2 = BT – 20 produced in India $\quad$ M_2 = BT – 20 produced in Mexico

I_3 = BT – 30 produced in India $\quad$ M_3 = BT – 30 produced in Mexico

$I_1 + M_1 >= 200,000$; required BT – 10 amount

$I_2 + M_2 >= 100,000$; required BT – 20 amount

$I_3 + M_3 >= 150,000$; required BT – 30 amount

$I_1 + I_2 <= 175,000$; combined capacity for BT – 10 and BT – 20 units in Mexico

$M_1 + M_2 <= 160,000$; combined capacity for BT – 10 and BT – 20 units in India

$I_3 <= 75,000$; production capacity for BT 30 units in India

$M_3 <= 100,000$; production capacity for BT 30 units in Mexico

b) Develop an Excel model. Solve the model to determine how many units of each battery pack to produce at each plant to minimize the total production and shipping cost associated with the new contract. What is the optimal production plan and associated cost?

Production entailments: $I_1 = 40{,}000$ $M_1 = 160{,}000$

$I_2 = 100{,}000$ $M_2 = 0$

$I_3 = 50{,}000$ $M_3 = 100{,}000$

Min Z = (0.95+0.18)40000 + (0.98+0.18)100000 + (1.34+0.18)50000 + (0.98+0.10)160000 + (1.06+0.10)0 + (1.15+0.10)100,000

Min Z = $535,000

	LHS coefficients						
constraint	**I1**	**I2**	**I3**	**M1**	**M2**	**M3**	**RHS**
1	1			1			200000
2		1			1		100000
3			1			1	150000
4	1	1					175000
5				1	1		160000
6			1				75000
7						1	100000
OBJ.FUNC.COEFF.	1.13	1.16	1.52	1.08	1.16	1.25	
	Decision Variables						
	40000	100000	50000	160000	0	100000	
	Min objective function				535000		
Contraints	Amount Used		Sign	Amount Available			
1		200000	>	200000			
2		100000	>	100000			
3		150000	>	150000			
4		140000	<	175000			
5		160000	<	160000			
6		50000	<	75000			
7		100000	<	100000			

c) Use sensitivity analysis to determine how much the production and/or shipping cost per unit would have to change to produce additional units of the BT-10 in India.

The cost of BT – 10 in India would have to reduce by at least $0.05 per unit, or the price of BT – 10 in Mexico must increase by $0.05, to produce additional units in India. This can be seen by the allowable increase / decrease in the sensitivity analysis.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	I1	40000	0	1.13	1E+30	0.05
$H$17	I2	100000	0	1.16	0.05	1.16
$I$17	I3	50000	0	1.52	1E+30	0.27
$J$17	M1	160000	0	1.08	0.05	1E+30
$K$17	M2	0	0.05	1.16	1E+30	0.05
$L$17	M3	100000	0	1.25	0.27	1E+30

d) Use sensitivity analysis to determine how much the production and/or shipping cost per unit would have to change to produce additional units of the BT-20 in Mexico.

The cost of BT – 20 in Mexico must decrease by at least $0.05, or the cost of BT – 20 in India must increase by at least $0.05, to change the solution and to produce more BT – 20 units in Mexico.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	I1	40000	0	1.13	1E+30	0.05
$H$17	I2	100000	0	1.16	0.05	1.16
$I$17	I3	50000	0	1.52	1E+30	0.27
$J$17	M1	160000	0	1.08	0.05	1E+30
$K$17	M2	0	0.05	1.16	1E+30	0.05
$L$17	M3	100000	0	1.25	0.27	1E+30

e) The plant manager of the Mexico plant has developed a plan to increase the combined capacity for BT-10 and BT-20 packs by 50,000 for this contract. While unit manufacturing costs and shipping costs will be unaffected, the plant will have to pay a $1000 fee to the Mexican government to obtain the necessary approvals to run the plant on Sundays for the duration of the contract. Should the plant manager pay the fee and increase capacity or not? Justify your recommendation using results from the sensitivity report.

Yes, he should pay the government fee. He will be able to minimize a net $1,100, **after** the government fee. The sensitivity report states that the constraint for BT – 10 and BT – 20 produced in Mexico has an allowable increase of 40,000 units, for which the price will drop by $0.05 per additional increase (shadow price). Mathematically speaking, the constraint can increase by 40,000 units and reduce the price by $2,000 (40,000*0.05) before there is a change in the solution.

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I2	200000	1.13	200000	35000	40000
$H$23	>= I2	100000	1.16	100000	35000	100000
$H$24	>= I2	150000	1.52	150000	25000	50000
$H$25	>= I2	140000	0	175000	1E+30	35000
$H$26	I2	160000	-0.05	160000	40000	35000
$H$27	I2	50000	0	75000	1E+30	25000
$H$28	I2	100000	-0.27	100000	50000	25000

prior to the new increase in the constraint

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I2	200000	1.09	200000	10000	90000
$H$23	>= I2	100000	1.16	100000	85000	90000
$H$24	>= I2	150000	1.52	150000	25000	50000
$H$25	>= I2	90000	0	175000	1E+30	85000
$H$26	I2	210000	-0.01	210000	90000	10000
$H$27	I2	50000	0	75000	1E+30	25000
$H$28	I2	100000	-0.27	100000	50000	25000

after the new increase in the constraint

For the rest of the 10,000 units increased, the shadow price of -0.01 will mean that the remaining decrease will only be $100(10,000*0.01). The collective decrease is $2,100, $1000 of which will be paid out to the government. We realize a $1,100 cost minimization if the we could take on the new constraint. In general terms, the increase in production capacity will allow the firm to omit the need to produce M_1 units at the Indian facility, which will open more space for the Indian facility to produce M_2 units. The Indian facility is more efficient at producing M_2 units, whereas the Mexican facility is more efficient at producing M_1 units. After the change, they will be producing at a new minimum cost of $532,900. This means that, after paying off the $1,000 fee to the government of Mexico, the plant manager will still save $1,100 on the production of all the units.

Question 3 [44 marks]

The Oakville Oats Company is planning its production for the coming week. It has available 1000 tonnes of oats that it can process in the coming week. (1 tonne, sometimes called a metric ton, is 1000kg.) Each tonne can be processed into:

- one tonne of quick-cooking, rolled instant (RI) oats, <u>or</u>
- one tonne of large flake, rolled slow cooking (RSC) oats, <u>or</u>
- 0.25 tonnes of oat bran (BR) and 0.75 tonnes of oat flour (FL).

Both types of rolled oats must pass through rolling machines. Rolled instant oats require 20 minutes per tonne while the slow cooking oats require 10 minutes per tonne. Bagging requires 13 minutes per tonne of bran, 15 minutes per tonne of flour, 11 minutes per tonne of rolled instant oats and 10 minutes per tonne of slow cooking oats. Bran and flour are separated in a separating machine that requires 20 minutes per tonne. The capacities of these types of machines are rolling: 7200 minutes, bagging: 14400 minutes, and separating, 16800 minutes. Oakville Oats must produce at least 200 tonnes of bran and 50 tonnes of each of rolled instant and rolled slow cooking oats. Instant oats cannot exceed 300 tonnes and slow cooking oats cannot exceed 200 tonnes. The profit margin per tonne of the products are $1,000 for bran, $120 for flour, $350 for rolled instant oats and $400 for slow cooking oats.

a) Formulate and solve. [20 marks]

Max Z = 340bf + 350i + 400s

bf = (1000*0.25)bran + (120*0.75) flour; i = rolled instant oats; s = slow cooking oats

bf + i + s <= 1000 ;	resource availability for oats
20i + 10s <= 7200 ;	rolling machine time
(13*0.25 + 15*0.75)bf + 11i + 10s <= 14400 ;	bagging time
20bf <= 16800;	separating time for bran and flour
4bf >= 200;	bran oat requirement
i >= 50; i <= 300;	rolled instant oats requirement
s >= 50; s <= 200;	slow cooked oats requirement

bf = 540, i = 260, s = 200

Max Z = 340(800) + 350(50) + 400(150) = $349,500

To maximize, the firm would produce 200 tonnes of bran oat (800*0.25), 600 tonnes of flour (800*0.75), 50 tonnes of rolled instant oats, and 150 tonnes of slow cooking oats

	LHS coefficients						
constraint	**BF**	**I**	**S**				**RHS**
1	1	1	1				1000
2		20	10				7200
3	14.5	11	10				14400
4	20						16800
5	1						800
6		1					50
7		1					300
8			1				50
9			1				200
10	1						500
OBJ.FUNC.COEFF.	340	350	400				
	Decision Variables						
	800	50	150				
	Max objective function				349500		
Contraints	Amount Used		Sign	Amount Available			
1		1000	<	1000			
2		2500	<	7200			
3		13650	<	14400			
4		16000	<	16800			
5		800	>	800			
6		50	>	50			
7		50	<	300			
8		150	>	50			
9		150	<	200			

b) What would Oakville Oats be willing to pay for additional machine time?

They wont be willing to pay for additional machine time as they do not need additional machine time. They use only 2500 hours of the 7200 hours available for rolling oats.

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	400	1000	50	100
$H$23	>= I	2500	0	7200	1E+30	4700
$H$24	>= I	13650	0	14400	1E+30	750
$H$25	>= I	16000	0	16800	1E+30	800
$H$26	I	800	-60	800	40	50
$H$27	I	50	-50	50	100	50
$H$28	I	50	0	300	1E+30	250
$H$29	I	150	0	50	100	1E+30
$H$30	I	150	0	200	1E+30	50

c) How do the statements, "Oakville Oats must produce 200 tonnes of bran and 50 tonnes of each of rolled instant and rolled slow cooking oats. Instant oats cannot exceed 300 tonnes and slow cooking oats cannot exceed 200 tonnes," affect the solution? Provide specific dollar values.

The firm would then omit the production of rolled instant oats, and focus on bran oats, flour, and slow cooked rolled oats. The new mix would be 70 tonnes of bran oats (280*0.25), 210 tonnes of flour (280*0.75), and 720 tonnes of slow cooked rolled oats. The new contribution margin will be $383,200, which will mean that they will be able to make $33,700 more if the constraints did not exist.

d) If Oakville Oats could produce 10 tonnes less oat bran, what would the firm's contribution margin be?

The new production would be 190 tonnes bran oat (760*0.25), 570 tonnes flour (760*0.75), 50 tonnes rolled instant oats, and 190 tonnes rolled slow cooked oats. The firm's contribution margin would be $351,900.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	760	0	340	60	1E+30
$H$17	I	50	0	350	50	1E+30
$I$17	S	190	0	400	1E+30	50

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	400	1000	10	140
$H$23	>= I	2900	0	7200	1E+30	4300
$H$24	>= I	13470	0	14400	1E+30	930
$H$25	>= I	15200	0	16800	1E+30	1600
$H$26	I	760	-60	760	80	10
$H$27	I	50	-50	50	140	10
$H$28	I	50	0	300	1E+30	250
$H$29	I	190	0	50	140	1E+30
$H$30	I	190	0	200	1E+30	10

e) If Oakville Oats could produce 20 tonnes less oat bran, what would the firm's contribution margin be?

The new production would be 180 tonnes of bran oat, 540 tonnes flour, 80 tonnes rolled instant oats, and 200 rolled slow cooked oats. The firm would have a contribution margin of $352,800.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	720	0	340	10	1E+30
$H$17	I	80	0	350	50	10
$I$17	S	200	0	400	1E+30	50

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	350	1000	98.18181818	30
$H$23	>= I	3600	0	7200	1E+30	3600
$H$24	>= I	13320	0	14400	1E+30	1080
$H$25	>= I	14400	0	16800	1E+30	2400
$H$26	I	720	-10	720	30	180
$H$27	I	80	0	50	30	1E+30
$H$28	I	80	0	300	1E+30	220
$H$29	I	200	0	50	150	1E+30
$H$30	I	200	50	200	30	150

f) Suppose that the price of rolled instant oats increases, so that the profit rises to $370/tonne, will the solution change? Explain.

No, it would not. The firm will still produce 200 tonnes of bran oat, 6000 tonnes of flour, 50 tonnes of rolled instant oats, and 150 tonnes of rolled slow cooked oats. This is because, relative to the production costs and constraints, the $20 increase per tonne of rolled instant oats is not enough to change the optimal solution. This can also be seen on the sensitivity report, where the shadow price for the rolled slow cooked oats changed from -50 to -30. This implies that the price per tonne of rolled instant oats must change by at least $50 per tonne to affect the solution.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	800	0	340	60	1E+30
$H$17	I	50	0	370	30	1E+30
$I$17	S	150	0	400	1E+30	30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	400	1000	50	100
$H$23	>= I	2500	0	7200	1E+30	4700
$H$24	>= I	13650	0	14400	1E+30	750
$H$25	>= I	16000	0	16800	1E+30	800
$H$26	I	800	-60	800	40	50
$H$27	I	50	-30	50	100	50
$H$28	I	50	0	300	1E+30	250
$H$29	I	150	0	50	100	1E+30
$H$30	I	150	0	200	1E+30	50

g) Suppose that the price of slow cooking oats falls, so that the profit falls to $380/tonne, will the solution change? Explain.

No, the solution will not change. The firm will produce at the same levels. Like the previous question, the shadow price of the slow cooking oats need to fall by $50 at least to affect the final solution.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	800	0	340	40	1E+30
$H$17	I	50	0	350	30	1E+30
$I$17	S	150	0	380	1E+30	30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	380	1000	50	100
$H$23	>= I	2500	0	7200	1E+30	4700
$H$24	>= I	13650	0	14400	1E+30	750
$H$25	>= I	16000	0	16800	1E+30	800
$H$26	I	800	-40	800	40	50
$H$27	I	50	-30	50	100	50
$H$28	I	50	0	300	1E+30	250
$H$29	I	150	0	50	100	1E+30
$H$30	I	150	0	200	1E+30	50

h) Suppose Bronte Bran Products was willing to pay an extra $250 per tonnes for oat bran. Would the solution change, and by how much?

Yes, the solution will change. The firm will produce 10 tonnes more of bran oats and 30 tonnes more of flour. The $250 per tonne of bran oats has a relative $62.50 increase compared to the other oats. This increase in price is larger than the shadow price indicated for the slow cooked oats and instant oats, which results in the change in the optimal solution.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	840	0	402.5	1E+30	2.5
$H$17	I	50	0	350	50	1E+30
$I$17	S	110	0	400	2.5	50

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1000	400	1000	57	60
$H$23	>= I	2100	0	7200	1E+30	5100
$H$24	>= I	13830	0	14400	1E+30	570
$H$25	>= I	16800	0.125	16800	1200	800
$H$26	I	840	0	800	40	1E+30
$H$27	I	50	-50	50	60	50
$H$28	I	50	0	300	1E+30	250
$H$29	I	110	0	50	60	1E+30
$H$30	I	110	0	200	1E+30	90

i) Suppose that Oakwinds Farms can deliver an additional 40 tonnes of oats to Oakville Oats, so that the total available oats changed to 1040 tonnes. Would the solution change, and by how much?

Yes, the solution will change. The firm will produce 40 tonnes more of rolled slow cooked oats because of the change in resource availability. This will not affect the optimal solution, however, as it is within the allowable increase for the binding constraint of the resource availability, which was +50.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	800	0	340	60	1E+30
$H$17	I	50	0	350	50	1E+30
$I$17	S	190	0	400	1E+30	50

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1040	400	1040	10	140
$H$23	>= I	2900	0	7200	1E+30	4300
$H$24	>= I	14050	0	14400	1E+30	350
$H$25	>= I	16000	0	16800	1E+30	800
$H$26	I	800	-60	800	40	10
$H$27	I	50	-50	50	140	10
$H$28	I	50	0	300	1E+30	250
$H$29	I	190	0	50	140	1E+30
$H$30	I	190	0	200	1E+30	10

j) Suppose that Oakwinds Farms can deliver an additional 60 tonnes of oats to Oakville Oats, so that the total available oats changed to 1060 tonnes. Would the solution change, and by how much?

The solution will change, Yes. This will cause the firm to now produce 200 tonnes of rolled slow cooked oats and 60 rolled instant oats; +50 tonnes and +10 tonnes, respectively. The optimal solution will change as well, since we surpassed the allowable increase for resource availability. The new optimal solution will be bound by the resource constraint, the minimum bran oat constraint, and the maximum rolled slow cooked oat constraint. This has changed over from the previous binding constraints, which was the resource constraint, the minimum bran oat constraint, and the minimum rolled instant oat constraint.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$G$17	Decision Variables	800	0	340	10	1E+30
$H$17	I	60	0	350	50	10
$I$17	S	200	0	400	1E+30	50

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$H$22	>= I	1060	350	1060	12.72727273	10
$H$23	>= I	3200	0	7200	1E+30	4000
$H$24	>= I	14260	0	14400	1E+30	140
$H$25	>= I	16000	0	16800	1E+30	800
$H$26	I	800	-10	800	10	200
$H$27	I	60	0	50	10	1E+30
$H$28	I	60	0	300	1E+30	240
$H$29	I	200	0	50	150	1E+30
$H$30	I	200	50	200	10	140

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$H$22	>= I	1000	$H$22<=$J$22	Binding	0
$H$23	>= I	2500	$H$23<=$J$23	Not Binding	4700
$H$24	>= I	13650	$H$24<=$J$24	Not Binding	750
$H$25	>= I	16000	$H$25<=$J$25	Not Binding	800
$H$26	I	800	$H$26>=$J$26	Binding	0
$H$27	I	50	$H$27>=$J$27	Binding	0
$H$28	I	50	$H$28<=$J$28	Not Binding	250
$H$29	I	150	$H$29>=$J$29	Not Binding	100
$H$30	I	150	$H$30<=$J$30	Not Binding	50

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$H$22	>= I	1060	$H$22<=$J$22	Binding	0
$H$23	>= I	3200	$H$23<=$J$23	Not Binding	4000
$H$24	>= I	14260	$H$24<=$J$24	Not Binding	140
$H$25	>= I	16000	$H$25<=$J$25	Not Binding	800
$H$26	I	800	$H$26>=$J$26	Binding	0
$H$27	I	60	$H$27>=$J$27	Not Binding	10
$H$28	I	60	$H$28<=$J$28	Not Binding	240
$H$29	I	200	$H$29>=$J$29	Not Binding	150
$H$30	I	200	$H$30<=$J$30	Binding	0