Operations Research Project Report

Topic: Linear Programming Models

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Problem 1

X_1 = Number of 20-inch girls bicycles produced this week
X_2 = Number of 20-inch boys bicycles produced this week
X_3 = Number of 26-inch girls bicycles produced this week
X_4 = Number of 26-inch boys bicycles produced this week

MAX $27X_1 + 32X_2 + 38X_3 + 51X_4$
S.T.

$X_1 + X_3 \geq 200$	(Min girls models)
$X_2 + X_4 \geq 200$	(Min boys models)
$12X_1 + 12X_2 + 9X_3 + 9X_4 \leq 4800$	(Production minutes)
$6X_1 + 9X_2 + 12X_3 + 18X_4 \leq 4800$	(Assembly minutes)
$2X_1 + 2X_2 \leq 500$	(20-inch tires)
$2X_3 + 2X_4 \leq 800$	(26-inch tires)

All X's ≥ 0

Solution:

x1 = 150.0 Reduced Cost = -0.0

x2 = 100.0 Reduced Cost = -0.0

x3 = 100.0 Reduced Cost = -0.0

x4 = 100.0 Reduced Cost = -0.0

Optimal Value: 16150.0

Interpretation of Results:

The optimal Value of this problem is 16150.0. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won't be reduced per unit decrease the value of the decision variable.

Problem 2

a) X_1 = Number of stoves produced weekly
X_2 = Number of washers produced weekly
X_3 = Number of electric dryers produced weekly
X_4 = Number of gas dryers produced weekly
X_5 = Number of refrigerators produced weekly

MAX $110X_1 + 90X_2 + 75X_3 + 80X_4 + 130X_5$
S.T.

$$
\begin{array}{lll}
5.5X_1 + 5.2X_2 + 5.0X_3 + 5.1X_4 + 7.5X_5 & \leq 4800 & \text{(Molding/pressing)} \\
4.5X_1 & \leq 1200 & \text{(Stove assembly)} \\
4.5X_2 + 4.0X_3 + 3.0X_4 & \leq 2400 & \text{(Washer/dryer assembly)} \\
9.0X_5 & \leq 1200 & \text{(Refrigerator assembly)} \\
4.0X_1 + 3.0X_2 + 2.5X_3 + 2.0X_4 + 4.0X_5 & \leq 3000 & \text{(Packaging)} \\
\text{All X's} \geq 0 & &
\end{array}
$$

b) Add the following constraints:

$$
\begin{array}{lll}
X_2 - X_3 - X_4 & = 0 & \text{(Washers = Dryers)} \\
X_3 - X_4 & \leq 100 & \text{(E. Dryers} \leq \text{G. Dryers + 100)} \\
-X_3 + X_4 & \leq 100 & \text{(G. Dryers} \leq \text{E. Dryers + 100)}
\end{array}
$$

Solution:

x1 = 266.667 Reduced Cost = 0.0

x2 = 448.718 Reduced Cost = 0.0

x3 = 0.0 Reduced Cost = -11.538

x4 = 0.0 Reduced Cost = -8.269

x5 = 133.333 Reduced Cost = 0.0

Optimal Value: 87051.2821

Interpretation of Results:

The optimal Value of this problem is 87051.2821. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 3

X_1 = the number of standard Z345's produced weekly
X_2 = the number of industrial Z345's produced weekly
X_3 = the number of standard W250's produced weekly
X_4 = the number of industrial W250's produced weekly
X_5 = the total number of products produced weekly

$$
\begin{array}{llllllll}
\text{MAX} & 400X_1 + 560X_2 + 560X_3 + 700X_4 & & & & & & \\
\text{S.T.} & 25X_1 + & 46X_2 + & 16X_3 + & 34X_4 & & \leq 2500 & \text{(zinc)} \\
& 50X_1 + & 30X_2 + & 28X_3 + & 12X_4 & & \leq 2800 & \text{(iron)} \\
& X_1 + & X_2 & & & & \geq \quad 20 & \text{(Min Z345's)} \\
& X_1 + & X_2 + & X_3 + & X_4 \; - & X_5 & = \quad 0 & \text{(X5 definition)} \\
& & X_2 + & & X_4 - & .50X_5 & \geq \quad 0 & \text{(Industrial min.)} \\
& X_1 + & X_2 & & - & .75X_5 & \leq \quad 0 & \text{(Max Z345's)} \\
& & & X_3 + & X_4 - & .75X_5 & \leq \quad 0 & \text{(Max W250's)} \\
& & X_1, X_2, X_3, X_4, X_5 \geq 0 & & & & &
\end{array}
$$

Solution:

x1 = 22.936 Reduced Cost = -0.0

x2 = 0.0 Reduced Cost = -44.954

x3 = 22.936 Reduced Cost = -0.0

x4 = 45.872 Reduced Cost = -0.0

x5 = 91.743 Reduced Cost = -0.0

Optimal Value: 54128.4408

Interpretation of Results:

The optimal Value of this problem is 54128.4408. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 4

X_1 = amount invested in EAL stock
X_2 = amount invested in BRU stock
X_3 = amount invested in TAT stock
X_4 = amount invested in long term bonds
X_5 = amount invested in short term bonds
X_6 = amount invested in the tax deferred annuity
X_7 = the total amount invested in stocks only

MAX $.15X_1 + .12\ X_2 + .09X_3 + .11X_4 + .085X_5 + .06X_6$
S.T.

$$
\begin{array}{llllllll}
X_1 + & X_2 + & X_3 + & X_4 + & X_5 + & X_6 & & = 50{,}000 \text{ (Total)} \\
 & & & & & X_6 & & \geq 10{,}000 \text{ (TDA)} \\
X_1 + & X_2 + & X_3 & & & & -\ X_7 & = 0 \text{ (Stocks)} \\
 & & X_3 & & & & -.25X_7 & \geq 0 \text{ (Min TAT)} \\
 & & & X_4 + & X_5 & & -\ X_7 & \geq 0 \text{(Bond} \geq \text{stock)} \\
 & & X_3 + & & X_5 + & X_6 & & \leq 12{,}500 \text{ (Low \%)}
\end{array}
$$

All X's ≥ 0

Solution:

x1 = 7500.0 Reduced Cost = 0.0

x2 = 0.0 Reduced Cost = -0.03

x3 = 2500.0 Reduced Cost = 0.0

x4 = 30000.0 Reduced Cost = 0.0

x5 = 0.0 Reduced Cost = -0.125

x6 = 10000.0 Reduced Cost = 0.0

x7 = 10000.0 Reduced Cost = 0.0

Optimal Value: 5250.0

Interpretation of Results:

The optimal Value of this problem is 5250.0. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 5

	Unit Profit
X_1 = Number of full comforters produced daily	19-3(.50)-55(.20) = 6.50
X_2 = Number of queen comforters produced daily	26-4(.50)-75(.20) = 9.00
X_3 = Number of king comforters produced daily	32-6(.50)-95(.20) = 10.00

MAX $6.50X_1 + 9.00X_2 + 10.00X_3$

S.T.

$$3X_1 + 4X_2 + 6X_3 \leq 2{,}700 \text{ (Stuffing)}$$
$$55X_1 + 75X_2 + 95X_3 \leq 48{,}000 \text{ (Fabric)}$$
$$3X_1 + 5X_2 + 6X_3 \leq 3{,}000 \text{ (Cutting minutes)}$$
$$5X_1 + 6X_2 + 8X_3 \leq 12{,}000 \text{ (Sewing minutes)}$$

All X's ≥ **<u>120</u>**

Solution:

x1 = 240.0 Reduced Cost = 0.0

x2 = 312.0 Reduced Cost = 0.0

x3 = 120.0 Reduced Cost = -1.35

Optimal Value: 5568.0

Interpretation of Results:

The optimal Value of this problem is 5568.0. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 6

X_1 = number of 8-oz. portions of steak in the diet
X_2 = number of ounces of cheese in the diet
X_3 = number of apples in the diet
X_4 = number of 8-oz. portion of milk in the diet

$$\begin{array}{ll} \text{MIN} & 51X_1 + 9X_2 + 1X_3 + 8X_4 \\ \text{S.T.} & \\ & 692X_1 + 110X_2 + 81X_3 + 150X_4 \geq 1410 \quad (=1800\text{-}390 \text{ minimum calories}) \\ & 692X_1 + 110X_2 + 81X_3 + 150X_4 \leq 1610 \quad (=2000\text{-}390 \text{ maximum calories}) \\ & 57X_1 + 6X_2 + 1X_3 + 8X_4 \geq 85 \quad (=100\text{-}15 \text{ grams of protein}) \\ & 1X_2 + 22X_3 + 12X_4 \geq 25 \quad (= 45\text{-}20 \text{ grams of carbs.}) \\ & \text{All X's} \geq 0 \end{array}$$

Solution:

x1 = 1.395   Reduced Cost = 0.0

x2 = 0.0   Reduced Cost = 3.575

x3 = 5.49   Reduced Cost = 0.0

x4 = 0.0   Reduced Cost = 0.761

Optimal Value: 76.6306

Interpretation of Results:

The optimal Value of this problem is 76.6306. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 7

X_1 = Number of Student models produced each week
X_2 = Number of Plus models produced each week
X_3 = Number of Net models produced each week
X_4 = Number of Pro models produced each week

MAX $70X_1 + 80X_2 + 130X_3 + 150X_4$
S.T.

		X_3		$\geq$	100	(Contract)
$.4X_1 +$	$.5X_2 +$	$.6X_3 +$	$.8X_4$	$\leq$	750	(Production Hours)
$X_1 +$	$+$	X_3		$\leq$	700	(Celeron)
	$X_2 +$		X_4	$\leq$	550	(Pentium)
$X_1 +$	$X_2 +$	$X_3 +$		$\leq$	800	(20gb Hard Drives)
			X_4	$\leq$	950	(30gb Hard Drives)
$X_1 +$	$X_2 +$	$2X_3 +$	X_4	$\leq$	1600	(Floppy Drives)
$X_1 +$	$X_2 +$		X_4	$\leq$	1000	(Zip Drives)
$X_1 +$		$X_3 +$	X_4	$\leq$	1600	(CD R/W's)
	$X_2 +$	$X_3 +$	X_4	$\leq$	900	(DVD's)
$X_1 +$	X_2			$\leq$	850	(15-in. monitors)
		$X_3 +$	X_4	$\leq$	800	(17-in. monitors)
	$X_2 +$	X_3		$\leq$	1250	(Mini-tower cases)
$X_1 +$			X_4	$\leq$	750	(Tower cases)

All X's ≥ 0

Solution:

x1 = 325.0   Reduced Cost = 0.0

x2 = 100.0   Reduced Cost = 0.0

x3 = 375.0   Reduced Cost = 0.0

x4 = 425.0   Reduced Cost = 0.0

Optimal Value: 143250.0

Interpretation of Results:

The optimal Value of this problem is 143250.0. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won’t be reduced per unit decrease the value of the decision variable.

Problem 8

X_1 = the number of Delta assemblies produced daily
X_2 = the number of Omega assemblies produced daily
X_3 = the number of Theta assemblies produced daily

$$
\begin{array}{llllll}
\text{MAX} & 800X_1 + 900X_2 + 600X_3 & & & \\
\text{S.T.} & X_1 + \quad X_2 + \quad X_3 & \leq & 7 & \text{(X70686 chips)} \\
 & 2X_1 + \quad X_2 + \quad X_3 & \leq & 8 & \text{(Production hours)} \\
 & 80X_1 + 160X_2 + \quad 80X_3 & \leq & 480 & \text{(Quality minutes)} \\
 & \text{All X's } \geq 0 & & &
\end{array}
$$

Solution:

x1 = 2.0 Reduced Cost = -0.0

x2 = 0.0 Reduced Cost = -100.0

x3 = 4.0 Reduced Cost = -0.0

Optimal Value: 4000.0

Interpretation of Results:

The optimal Value of this problem is 4000.0. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 9

X_1 = the number in group I contacted by telephone
X_2 = the number in group II contacted by telephone
X_3 = the number in group III contacted by telephone
X_4 = the number in group IV contacted by telephone
X_5 = the number in group I contacted in person
X_6 = the number in group II contacted in person
X_7 = the number in group III contacted in person
X_8 = the number in group IV contacted in person

$$
\begin{array}{ll}
\text{MIN} & 15X_1 + 12X_2 + 20X_3 + 18X_4 + 35X_5 + 30X_6 + 50X_7 + 40X_8 \\
\text{S.T.} & X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 = 2000 \text{ (Total)} \\
 & X_1 + X_2 + X_5 + X_6 \geq 1000 \text{ (W\&R)} \\
 & X_5 + X_6 + X_7 + X_8 \geq 500 \text{ (In person)} \\
 & -.5X_1 + .5X_5 \geq 0 \text{ (W\&R,ip)} \\
 & X_2 + X_4 + X_6 + X_8 \leq 800 \text{(Small)} \\
 & -.25X_2 - .25X_4 + .75X_6 + .75X_8 \leq 0 \text{ (Small,ip)} \\
 & X_1 + X_5 \geq 200 \text{ (Min I)} \\
 & X_2 + X_6 \geq 200 \text{ (Min II)} \\
 & X_3 + X_7 \geq 200 \text{ (Min III)} \\
 & X_4 + X_8 \geq 200 \text{ (Min IV)} \\
 & X_1 + X_5 \leq 1000 \text{ (Max I)} \\
 & X_2 + X_6 \leq 1000 \text{ (Max II)} \\
 & X_3 + X_7 \leq 1000 \text{ (Max III)} \\
 & X_4 + X_8 \leq 1000 \text{ (Max IV)} \\
 & \text{All X's} \geq 0
\end{array}
$$

Solution:

x1 = 500.0 Reduced Cost = 0.0

x2 = 600.0 Reduced Cost = 0.0

x3 = 200.0 Reduced Cost = 0.0

x4 = 200.0 Reduced Cost = 0.0

x5 = 500.0 Reduced Cost = 0.0

x6 = 0.0 Reduced Cost = 8.0

x7 = 0.0 Reduced Cost = 20.0

x8 = 0.0   Reduced Cost = 12.0

Optimal Value: 39800.0

Interpretation of Results:

The optimal Value of this problem is 39800.0. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 10

X_1 = the number of ounces of Multigrain Cheerios in the mixture
X_2 = the number of ounces of Grape Nuts in the mixture
X_3 = the number of ounces of Product 19 in the mixture
X_4 = the number of ounces of Frosted Bran in the mixture
X_5 = the total number of ounces in the mixture

$$
\begin{array}{llll}
\text{MIN} & 12X_1 + 9X_2 + 9X_3 + 15X_4 & & \\
\text{S.T.} & 30X_1 + 30X_2 + 20X_3 + 20X_4 & \geq 50 & \text{(Vitamin A)} \\
 & 25X_1 + 2X_2 + 100X_3 + 25X_4 & \geq 50 & \text{(Vitamin C)} \\
 & 25X_1 + 25X_2 + 25X_3 + 25X_4 & \geq 50 & \text{(Vitamin D)} \\
 & 25X_1 + 25X_2 + 100X_3 + 25X_4 & \geq 50 & \text{(Vitamin B6)} \\
 & 45X_1 + 45X_2 + 100X_3 + 25X_4 & \geq 50 & \text{(Iron)} \\
 & X_1 + X_2 + X_3 + X_4 - X_5 & = 0 & \text{(Total)} \\
 & X_1 - .1X_5 & \geq 0 & (\geq 10\% \text{ M/G Cheerios}) \\
 & X_2 - .1X_5 & \geq 0 & (\geq 10\% \text{ Grape Nuts}) \\
 & X_3 - .1X_5 & \geq 0 & (\geq 10\% \text{ Product 19}) \\
 & X_4 - .1X_5 & \geq 0 & (\geq 10\% \text{ Frosted Bran}) \\
 & \text{All X's} \geq 0 & &
\end{array}
$$

Solution:

x1 = 0.2 Reduced Cost = 0.0

x2 = 1.224 Reduced Cost = 0.0

x3 = 0.376 Reduced Cost = 0.0

x4 = 0.2 Reduced Cost = 0.0

x5 = 2.0 Reduced Cost = 0.0

Optimal Value: 19.8

Interpretation of Results:

The optimal Value of this problem is 19.8. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won’t be reduced per unit decrease the value of the decision variable.

Problem 11

X_1 = Number of refrigerator/ovens produced
X_2 = Number of French fry makers produced
X_3 = Number of French toast makers produced

MIN $140X_1 + 50X_2 + 36X_3$
S.T.

$100X_1 + 35X_2 + 27X_3$	$\geq$	2,000,000	(Min Profit)
X_1	$\geq$	5,000	(Min Refrig/oven)
X_2	$\geq$	4,000	(Min French fry maker)
X_3	$\geq$	2,300	(Min French toast maker)
X_1	$\leq$	15,000	(Max Refrig/oven)
X_2	$\leq$	15,000	(Max French fry maker)
X_3	$\leq$	15,000	(Max French toast maker)

Solution:

x1 = 14550.0 Reduced Cost = 0.0

x2 = 4000.0 Reduced Cost = -0.0

x3 = 15000.0 Reduced Cost = 0.0

Optimal Value: 2777000.0

Interpretation of Results:

The optimal Value of this problem is 2777000.0. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won't be reduced per unit decrease the value of the decision variable.

Problem 12

a) X_1 = Number of plates made per day
X_2 = Number of mugs made per day
X_3 = Number of steins made per day
X_4 = Total daily production

MAX $2.50X_1 + 3.25X_2 + 3.90X_3$
S.T.

$2X_1 + 3X_2 + 6X_3$	≤ 1920	((4)(8)(60) Molding min.)
$8X_1 + 12X_2 + 14X_3$	≤ 3840	((8)(8)(60) Finishing min.)
X_2	≥ 150	(Minimum mugs)
$-2X_1 - 2X_2 + X_3$	≤ 0	(Steins ≤ 2(Plates + Mugs)
$X_1 + X_2 + X_3 - X_4$	$= 0$	(Total Definition)
$X_1 - .3X_4$	≤ 0	(Plates ≤ 30% Total Produced)

All X's ≥ 0

b) Combine the first two constraints into one:
$$10X_1 + 15X_2 + 20X_3 \leq 5760$$

Solution:

x1 = 101.803 Reduced Cost = -0.0

x2 = 150.0 Reduced Cost = -0.0

x3 = 87.541 Reduced Cost = -0.0

x4 = 339.344 Reduced Cost = 0.0

Optimal Value: 1083.418

Interpretation of Results:

The optimal Value of this problem is 1083.418. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won't be reduced per unit decrease the value of the decision variable.

Problem 13

X_1 = $ invested in first trust deeds
X_2 = $ invested in second trust deeds
X_3 = $ invested in third trust deeds
X_4 = $ invested in commercial trust deeds
X_5 = $ invested in a savings account
X_6 = Total $ invested in residential trust deeds
X_7 = Total $ invested in all trust deeds

MAX $.0775X_1 + .1125X_2 + .1425X_3 + .9875X_4 + .0445X_5$
S.T.

$$\begin{array}{lllllllll}
X_1 + & X_2 + & X_3 + & X_4 + & X_5 & & & = 68{,}000{,}000 & \text{(Total)} \\
& & & & X_5 & & & \geq 5{,}000{,}000 & \text{(Save)} \\
X_1 + & X_2 + & X_3 + & & & -X_6 & & = 0 & \text{(Res Tr.)} \\
X_1 + & X_2 + & X_3 + & X_4 & & & -X_7 & = 0 & \text{(Total Tr)} \\
& & & & & X_6 & -.8X_7 & \geq 0 & \text{(80\% Res.)} \\
X_1 & & & & & -.6X_6 & & \geq 0 & \text{(60\% First)} \\
4X_1 + & 6X_2 + & 9X_3 + & 3X_4 & & & & \leq 340{,}000{,}000 & (*)
\end{array}$$

All X's ≥ 0

*Average Risk Factor is found by:

$$4\frac{X_1}{68{,}000{,}000} + 6\frac{X_2}{68{,}000{,}000} + 9\frac{X_3}{68{,}000{,}000} + 3\frac{X_4}{68{,}000{,}000} + 0\frac{X_5}{68{,}000{,}000}$$

This expression must be ≤ 5. Multiplying both sides by 68,000,000 gives the above constraint.

Solution:

x1 = 30240000.0 Reduced Cost = -0.0

x2 = 66666.667 Reduced Cost = 0.0

x3 = 20093333.0 Reduced Cost = 0.0

x4 = 12600000.0 Reduced Cost = -0.0

x5 = 5000000.0 Reduced Cost = 0.0

x6 = 50400000.0 Reduced Cost = -0.0

x7 = 63000000.0 Reduced Cost = 0.0

Optimal Value: 17879399.9525

Interpretation of Results:

The optimal Value of this problem is 17879399.9525. Furthermore, the cost reduced per unit of decision variable is 0.0. This means that the cost won't be reduced per unit decrease the value of the decision variable.

Problem 14

X_{JR} = Motor home cabinets produced in regular time in July
X_{JO} = Motor home cabinets produced in overtime in July
X_{AR} = Motor home cabinets produced in regular time in August
X_{AO} = Motor home cabinets produced in overtime in August
X_{JS} = Motor home cabinets produced in regular time in September
X_{JS} = Motor home cabinets produced in overtime in September
Y_{JR} = Mobile home cabinets produced in regular time in July
Y_{JO} = Mobile home cabinets produced in overtime in July
Y_{AR} = Mobile home cabinets produced in regular time in August
Y_{AO} = Mobile home cabinets produced in overtime in August
Y_{JS} = Mobile home cabinets produced in regular time in September
Y_{JS} = Mobile home cabinets produced in overtime in September
S_J = Motor home cabinets stored in July
S_A = Motor home cabinets stored in August
S_S = Motor home cabinets stored in September
T_J = Mobile home cabinets stored in July
T_A = Mobile home cabinets stored in August
T_S = Mobile home cabinets stored in September

Solution:

Mobile_home_cabinets_produced_in_overtime_in_August = 131.0 Reduced Cost = 0.0

Mobile_home_cabinets_produced_in_overtime_in_July = 95.0 Reduced Cost = 0.0

Mobile_home_cabinets_produced_in_overtime_in_September = 0.0 Reduced Cost = 6.0

Mobile_home_cabinets_produced_in_regular_time_in_August = 150.0 Reduced Cost = 0.0

Mobile_home_cabinets_produced_in_regular_time_in_July = 285.0 Reduced Cost = 0.0

Mobile_home_cabinets_produced_in_regular_time_in_September = 144.0 Reduced Cost = 0.0

Mobile_home_cabinets_stored_in_August = 281.0 Reduced Cost = 0.0

Mobile_home_cabinets_stored_in_July = 300.0 Reduced Cost = 0.0

Mobile_home_cabinets_stored_in_September = 25.0 Reduced Cost = 0.0

Motor_home_cabinets_stored_in_August = 0.0 Reduced Cost = 0.6

Motor_home_cabinets_stored_in_July = 0.0 Reduced Cost = 3.0

Motor_home_cabinets_stored_in_September = 10.0 Reduced Cost = 0.0

cabinets_produced_in_overtime_in_August = 0.0 Reduced Cost = 0.0

cabinets_produced_in_overtime_in_July = 0.0 Reduced Cost = 0.0

cabinets_produced_in_overtime_in_September = 0.0 Reduced Cost = 3.6

cabinets_produced_in_regular_in_July = 225.0 Reduced Cost = 0.0

cabinets_produced_in_regular_time_in_August = 250.0 Reduced Cost = 0.0

cabinets_produced_in_regular_time_in_September = 160.0 Reduced Cost = -0.0

Optimal Value: 367969.0

Interpretation of Results:

The optimal Value of this problem is 367969.0. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.

Problem 15

X_1 = the number of acres of wheat planted
X_2 = the number of acres of corn planted
X_3 = the number of acres of oats planted
X_4 = the number of acres of soybeans planted

Profit coefficients are 210($3.20) - $50 = $622, 300($2.55) - $75 = $690, 180($1.45) - $30 = $231, and 240($3.10) - $60 = $684 respectively.

$$
\begin{array}{llllll}
\text{MAX} & 622X_1 + 690X_2 + 231X_3 + 684X_4 & & & & \\
\text{S.T.} & 4X_1 + 5X_2 + 3X_3 + 10X_4 & \le & 1{,}800 & & \text{(Labor hours)} \\
 & 50X_1 + 75X_2 + 30X_3 + 60X_4 & \le & 25{,}000 & & \text{(Expenses)} \\
 & 2X_1 + 6X_2 + X_3 + 4X_4 & \le & 1{,}200 & & \text{(Water)} \\
 & 210X_1 & \ge & 30{,}000 & & \text{(Min. Wheat)} \\
 & 300X_2 & \ge & 30{,}000 & & \text{(Min. Corn)} \\
 & 180X_3 & \le & 25{,}000 & & \text{(Max Oats)} \\
 & X_1 + X_2 + X_3 + X_4 & \le & 300 & & \text{(Total acres)} \\
 & \text{All X's} \ge 0 & & & &
\end{array}
$$

Solution:

x1 = 142.857 Reduced Cost = 0.0

x2 = 142.857 Reduced Cost = -0.0

x3 = 0.0 Reduced Cost = -444.0

x4 = 14.286 Reduced Cost = -0.0

Optimal Value: 197199.9961

Interpretation of Results:

The optimal Value of this problem is 197199.9961. Furthermore, the cost reduced per unit of some decision variables is non-zero. This means that the cost will be reduced per unit decrease the value of the decision variable.