Solutions to Homework #3

1. The following sensitivity reports from Solver are used to answer the questions in this and the next exercise:

Adjustable Cells

Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
Airtex Pounds	1000	0	7	2.333333333	1E+30
Extendex Pounds	533.3333333	0	7	1E+30	1.75
Resistex Pounds	400	0	6	8	1E+30

Constraints

Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
Polymer A	8000	2.3333333	8000	2000	100
Polymer B	4266.666667	0	6800	1E+30	2533.333333
Polymer C	7066.666667	0	10400	1E+30	3333.333333
Base	11600	0	17600	1E+30	6000
Airtex	1000	-2.3333333	1000	25	1000
Extendex	533.3333333	0	500	33.33333334	1E+30
Resistex	400	-8	400	16.66666667	375

(a) Only the Polymer A constraint is binding.

(b) The current production plan yields 533.333 pounds of Extendex, which meets an additional 5% of the demand of 500 pounds for Extendex.

(c) You should obtain more of Polymer A because that is the only one with a strictly positive shadow price.

(d) The coefficients of 7 for Extendex and 6 for Resistex could each double and remain within their respective sensitivity ranges of $[5.25, +\infty]$ and $[-\infty, 14]$. However, doubling the coefficient of 7 for Airtex would be outside the sensitivity range of $[-\infty, 9.333]$.

2. (a) The new coefficient for Extendex is 5.6. Because this is in the sensitivity range of $[5.25, +\infty]$, the current production plan remains optimal. The new profit, however, is 12386.6667.

(b) After the reduction, the right-hand side of the demand for Resistex is now 360. Because this value of 360 is in the sensitivity range of [25, 416.667] for the rhs of the Resistex demand constraint, the shadow price of −8 is applicable. Thus, the new optimal objective function value is $13133.33 - 8(360 - 400) = 13453.33$.

(c) To reach a profit of 18000, the current profit of 13133.33 must increase by 4866.67. The shadow price of 2.333 for Polymer A means that each additional ounce increases the profit by 2.333. Thus, to achieve an additional profit of 4866.67 requires 4866.67 / 2.333 = 2086.01 ounces of Polymer A. Unfortunately, an increase of 2086.01 ounces of Polymer A is more than the allowable increase of 2000. Thus, it is necessary to use trial-and-error to change the rhs of the Polymer A constraint until the optimal solution achieves a profit of 18000. This is accomplished with 2171.2 additional ounces of Polymer A.

(d) Because the rhs of the demand constraint for Airtex changes from 1000 to 1020, it is necessary to resolve the problem to obtain the new plan in which it is optimal to produce 1020 pounds of Airtex, 506.667 pounds of Extendex, and 400 pounds of Resistex.