

**Sensitivity Analysis in LP.**

Zales Jewelers uses rubies and sapphires to produce two types of rings. A type 1 ring requires 2 rubies, 3 sapphires, and 1 hour of jeweler's labor. A type 2 ring requires 3 rubies, 2 sapphires, and 2 hours of jeweler's labor. Each type 1 ring sells for \$400, and each type 2 ring sells for \$500. All rings produced by Zales can be sold. At present, Zales has 100 rubies, 120 sapphires, and 70 hours of jeweler's labor available. Extra rubies can be purchased at a cost of \$100 each. Market demand requires that the company produce at least 20 type 1 rings and at least 25 type 2 rings. To maximize profit, Zales should solve the following LP:

X1= type 1 rings produced.  
 X2= type 2 rings produced  
 R = number of rubies purchased.

$$\text{Maximize } z = 400X1 + 500X2 - 100R$$

subject to

$$2X1 + 3X2 \leq 100 + R$$

$$3X1 + 2X2 \leq 120$$

$$X1 + 2X2 \leq 70$$

$$X1 \geq 20$$

$$X2 \geq 25$$

$$X1 \geq 0, X2 \geq 0, R \geq 0$$

The LINDO output for this problem follows:

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MAX      400 X1 + 500 X2 - 100 R
SUBJECT TO
2)      2 X1 + 3 X2 - R <= 100
3)      3 X1 + 2 X2 <= 120
4)      X1 + 2 X2 <= 70
5)      X1 >= 20
6)      X2 >= 25

END

OBJECTIVE FUNCTION VALUE
1)      19000.00

VARIABLE      VALUE      REDUCED COST
X1            20.000000      .000000
X2            25.000000      .000000
R             15.000000      .000000

ROW  SLACK OR SURPLUS  DUAL PRICES
2)   .000000           100.000000
3)   10.000000         .000000
4)   .000000           200.000000
5)   .000000           .000000
6)   -.000000          -200.000000

RANGES IN WHICH THE BASIS IS UNCHANGED:

VARIABLE      CURRENT OBJ COEFFICIENT RANGES
                COEF      ALLOWABLE      ALLOWABLE
                INCREASE  DECREASE
X1            400.000000      INFINITY      100.000000
X2            500.000000      200.000000      INFINITY
R            -100.000000      100.000000      100.000000

                RIGHTHAND SIDE RANGES
ROW      CURRENT      ALLOWABLE      ALLOWABLE
                RHS      INCREASE      DECREASE
2         100.000000      15.000000      INFINITY
3         120.000000      INFINITY      10.000000
4          70.000000      3.333333      .000000
5          20.000000      .000000      INFINITY
6          25.000000      .000000      2.500000
    
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THE TABLEAU

ROW	X1	X2	R	SLK 2	SLK 3	SLK 4	SLK 5	SLK 6	RHS
1 ART	.00	.00	.00	100.00	.00	200.00	.00	200.00	19000.00
2 X2	.00	1.00	.00	.00	.00	.00	.00	-1.00	25.00
3 SLK 3	.00	.00	.00	.00	1.00	-3.00	.00	-4.00	10.00
4 R	.00	.00	1.00	-1.00	.00	2.00	.00	1.00	15.00
5 X1	1.00	.00	.00	.00	.00	1.00	.00	2.00	20.00
6 SLK 5	.00	.00	.00	.00	.00	1.00	1.00	2.00	.00

- Suppose that instead of \$100, each ruby costs \$150. Would Zales still purchase rubies?
  - Yes
  - No
  - Cannot be determined
- What is the most that Zales would be willing to pay for another hour of jeweler's time? Choose nearest answer:
  - nothing
  - \$50
  - \$100
  - \$150
  - \$200
  - Cannot be determined
- Your answer in (2) is valid for up to how many additional hours? Choose nearest answer:
  - zero
  - 1 hour
  - 2 hours
  - 3 hours
  - four hours
  - Cannot be determined
- Consider the labor availability constraint, after it is transformed by LINDO into equation form:
 
$$X1 + 2X2 (+ \text{ or } - ?) \text{ SLK 4} = 70$$
 What sign should SLK 4 have in this equation?
  - Plus
  - Minus
- If we wished to determine the effect on the above solution if 1 additional hour of jeweler's time were available, we would \_\_\_\_\_ the variable SLK 4 by 1 unit.
  - increase
  - decrease
- If the variable SLK 4 were to increase by 1 hour, then according to the substitution rates, the number of rubies purchased would
  - increase
  - decrease
  - remain the same
- If the variable SLK 4 were to increase by 1 hour, then according to the substitution rates, the number of type 2 rings made would
  - increase
  - decrease
  - remain the same
- If the variable SLK 4 were to decrease by 1 hour, then according to the substitution rates, the number of type 1 rings made would
  - increase
  - decrease
  - remain the same
- Suppose that instead of \$500, each type 2 ring were to have a profit of \$400 each. Would Zales reduce the number of such rings produced?
  - Yes
  - No
  - Cannot be determined
- Suppose that instead of \$500, each type 2 ring were to have a profit of \$600 each. Would Zales increase the number of such rings produced?
  - Yes
  - No
  - Cannot be determined