Quiz Sensitivity Analysis

1. The difference between the right-hand side (RHS) values of the constraints and the final (optimal) value assumed by the left-hand side (LHS) formula for each constraint is called the _____ and is found in the _____ column on the Answer Report.
   a. Slack, Status
   b. Cell Value, Slack
   c. Slack, Slack
   d. Cell Value, Status

2. A binding greater than or equal to (≥) constraint in a minimization problem means
   a. the variable is up against an upper limit.
   b. the minimum requirement for the constraint has just been met.
   c. another constraint is limiting the solution.
   d. the shadow price for the constraint will be positive.

3. A binding less than or equal to (≤) constraint in a maximization problem means
   a. that all of the resource is consumed in the optimal solution.
   b. it is not a constraint that the level curve contacts.
   c. another constraint is limiting the solution.
   d. the requirement for the constraint has been exceeded.

4. The allowable increase for a changing cell (decision variable) is
   a. how many more units to produce to maximize profits.
   b. the amount by which the objective function coefficient can increase without changing the optimal solution.
   c. how much to charge to get the optimal solution.
   d. the amount by which constraint coefficient can increase without changing the optimal solution.

5. The allowable decrease for a changing cell (decision variable) is
   a. the amount by which the constraint coefficient can decrease without changing final optimal solution.
   b. an indication of how many more units to produce to maximize profits.
   c. the amount by which objective function coefficient can decrease without changing the final optimal solution.
   d. an indication of how much to charge to get the optimal solution.

6. Which of the following statements is false concerning either of the Allowable Increase and Allowable Decrease columns in the Sensitivity Report?
   a. The values equate the decision variable profit to the cost of resources expended.
   b. The values give the range over which a shadow price is accurate.
   c. The values give the range over which an objective function coefficient can change without changing the optimal solution.
   d. The values provide a means to recognize when alternate optimal solution exist.

7. Given an objective function value of 150 and a shadow price for resource 1 of 5, if 10 more units of resource 1 are added (assuming the allowable increase is greater than 10) what is the impact on the objective function value?
   a. increase of 50
   b. increase of unknown amount
   c. decrease of 50
   d. increase of 10

8. If the allowable increase for a constraint is 100 and we add 110 units of the resource what happens to the objective function value?
   a. increase of 100
   b. increase of 110
   c. decrease of 100
   d. increases but by unknown amount

9. If the shadow price for a resource is 0 and 150 units of the resource are added what happens to the objective function value?
   a. increase of 150
   b. increases more than 0 but less than 150
   c. no increase
   d. increases but by an unknown amount

10. If the shadow price for a resource is 0 and 150 units of the resource are added what happens to the optimal solution?
   a. increases by an unknown amount
   b. increases more than 0 but less than 150
   c. no change
   d. decreases by an unknown amount

11. A change in the right hand side of a binding constraint may change all of the following except
   a. optimal value of the decision variables
   b. slack values
   c. other right hand sides
   d. objective function value

12. The absolute value of the shadow price indicates the amount by which the objective function will be
   a. improved if the corresponding constraint is loosened.
   b. improved if the corresponding constraint is tightened.
   c. made worse if the corresponding constraint is loosened.
   d. improved if the corresponding constraint is unchanged.

13. The reduced cost for a changing cell (decision variable) is
   a. the amount by which the objective function value changes if the variable is increased by one unit.
   b. how many more units to product to maximize profits.
   c. the per unit profits minus the per unit costs for that variable.
   d. equal to zero for variables at their optimal values.

14. All of the following are true about a variable with a negative reduced cost in a maximization problem except
   a. its objective function coefficient must increase by that amount in order to enter the basis.
   b. it is at its simple lower bound.
   c. it has surplus resources.
   d. the objective function value will decrease by that value if the variable is increased by one unit.

15. A variable with a final value equal to its simple lower or upper bound and a reduced cost of zero indicates
   a. an alternate optimal solution exists.
   b. an error in formulation has been made.
   c. the right hand sides should be increased.
   d. the objective function needs new coefficients.

16. What is the value of the objective function if X_1 is set to 0 in the following Limits Report?

Cell	Target Name	Value
$E$5	Unit profit: Total Profit:	3200

Cell	Adjustable Name	Value	Lower Limit	Target Result	Upper Limit	Target Result
$B$4	Number to make: X1	80	0	800	80	3200
$C$4	Number to make: X2	20	0	2400	20	3200

a. 80
b. 800
c. 2400
d. 3200

Questions 17 to 20 are based on the following problem.

Portable Ratio Systems makes radio products for two-way communications. The distribution channels for the new radio are as follows:

1). Marine distributors
2). Business equipment distributors
3). National chain of retail stores
4). Mail order

The table below shows the unit profit, advertising cost, and personal sales time data for the firm. Additional facts are that:

i. The advertising budget should be no more than $5000.
ii. There is a maximum of 1800 hours of sales force time available for allocation to the sales effort.
iii. Exactly 600 units for the current production period is scheduled.
iv. The national chain of retail stores requires at least 150 units be distributed through this distribution channel.

The firm would like to maximize its profit in distributing the radios. Decisions must be made as to how many units should be allocated to each of the four distribution channels, as well as how to allocate the advertising budget and sales force to each of the four distribution channels.

Profit, Advertising cost, and Personal sales time data			
Distribution Channel	Profit per Unit Sold	Advertising Cost per Unit Sold	Personal Sales Effort per Unit Sold
Marine distributors	$90	$10	2 hours
Business equipment distributors	$84	$8	3 hours
National chain of retail stores	$70	$9	3 hours
Mail order	$60	$15	None

The decision variables M, B, N, and P are defined as the number of units produced for the (M) Marine equipment distribution channel, for the (B) Business equipment distribution channel, for the (N) National chain retail stores distribution channel and for the (P) mail order distribution channel, respectively. The LP formulation for the problem is given as follows:

MAX 90 M + 84 B + 70 N + 60 P
Subject to:

10 M + 8 B + 9 N + 15 P	<= 5000	Amount of advertising expenditure
2 M + 3 B + 3 N	<= 1800	Sales times
1 M + 1 B + 1 N + 1 P	= 600	Units made during the current production period
1 N	>= 150	Units distributed by National chain retail stores
M, B, N, P	>= 0	

	A	B	C	D	E	F	G	H	I
1	Portable Radio Systems in Test 3 Fall 2008								
2			M Units for Marine	B Units for Business	N Units for National	P Units for Mail Order			
3			25	425	150	0			
4		Max	90	84	70	60	48450	OFV	
5		Subject To:							
6	Adv. Expenditure		10	8	9	15	5000	<=	5000
7	Sales Times		2	3	3	0	1775	<=	1800
8	Made in Current Period		1	1	1	1	600	=	600
9	Distributed by National Chain		0	0	1	0	150	>=	150

The Answer Report and Sensitivity Report are provided here for reference.

Answer Report

Target Cell (Max)

Cell	Name	Original Value	Final Value
$G$4	Max	0	48450

Adjustable Cells

Cell	Name	Original Value	Final Value
$C$3	M Units for Marine	0	25
$D$3	B Units for Business	0	425
$E$3	N Units for National	0	150
$F$3	P Units for Mail Order	0	0

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$G$6	Adv. Expenditure	5000	$G$6<=$I$6	Binding	0
$G$7	Sales Times	1775	$G$7<=$I$7	Not Binding	25
$G$8	Made in Current Period	600	$G$8=$I$8	Binding	0
$G$9	Distributed by National Chain	150	$G$9>=$I$9	Binding	0

Sensitivity Report

Target Cell (Max)

Cell	Name	Final Value
$G$4	Max	48450

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$C$3	M Units for Marine	25	0	90	1E+30	6
$D$3	B Units for Business	425	0	84	6	34
$E$3	N Units for National	150	0	70	17	1E+30
$F$3	P Units for Mail Order	0		60	45	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$G$6	Adv. Expenditure	5000	3	5000	850	50
$G$7	Sales Times	1775		1800	1E+30	25
$G$8	Made in Current Period	600	60	600	3.5714	85
$G$9	Distributed by National Chain	150	-17	150	50	150

5.1 For the Decision Variable "$F$3 P Units for Mail Order ":

17. What should be the value of its Reduced Cost? (Assume 0 as the value for any missing information in your computation)

a. 45 b. 60 c. -45 d. -60

18. How would you interpret the specific meaning of its Reduced Cost? (You should use your answer in the item a to answer this question b. No credit will be given for a general discussion of the meaning of Reduced Cost)
    a. Reduced cost for P "+amount" means negative contribution of each unit of P to the MIN objective function value.
    b. Reduced cost for P "+amount" means positive contribution of each unit of P to the MAX objective function value.
    c. Reduced cost for P of "-amount" means positive contribution of each unit of P to the MIN objective function value.
    d. Reduced cost for P of "-amount" means negative contribution of each unit of P to the MAX objective function value.

19. If its marginal profit increased from \$60 to \$110, is there any change to the Optimal Solution for the problem? If yes, why? If Not, why not?
    a. \$110 is outside of (- ∞, 105], the current optimal solution will not change. P will not be in the optimal solution.
    b. \$110 is outside of (- ∞, 105], the current optimal solution will change. P will not be in the optimal solution.
    c. \$110 is outside of (- ∞, 105], the current optimal solution will change. But we could not use Excel@ Solver to get the answer.
    d. \$110 is outside of (- ∞, 105], the current optimal solution will change. P will be in the optimal solution.

20. Suppose the profit margin for a Unit for Marine decreases from \$90 to \$85, if possible, determine the new total profit. If not, explain why not.

Type of ranging (Lower & Upper Limits): _____ Range: _____

The new total profit: _____

a. Type: RHSR, Range: [84, ∞), and New Total Profit: \$48,445
b. Type: OFCR, Range: [84, ∞), and New Total Profit: \$48,325
c. Type: RHSR, Range: [90, ∞), and New Total Profit: \$48,325
d. Type: OFCR, Range: [90, ∞), and New Total Profit: \$48,445

For the Constraint "\$G\$7 Sales Times":

21. What should be the value of the shadow price? (No credit will be given if the item b below is not answered correctly)
    a. Its shadow price is 5 because 1800 – 1775 = 5, thus no contribution to the OFV by the sales time.
    b. Its shadow price is 0 because 1800 – 1775 = 5, thus the contribution to the OFV by the sales time is 5.
    c. Its shadow price is 0 because 1800 – 1775 = 5, thus no contribution to the OFV by the sales time.
    d. Its shadow price is 5 because 1800 – 1775 = 5, thus the contribution to the OFV by the sales time is 5.

22. Suppose the Advertising Expenditure increases from \$5,000 to \$5,500. How this change will affect the current optimal solution? If possible, determine the new optimal net profit. If not, explain why not.

Type of ranging (Lower & Upper Limits): _____ Range: _____

New optimal net profit: _____

a. Type of ranging: RHSR, Range: [4950, 5850], New optimal net profit: \$49,950
b. Type of ranging: OFCR, Range: [850, 5850], New optimal net profit: \$48,450
c. Type of ranging: OFCR, Range: [4950, 5850], New optimal net profit: \$49,950
d. Type of ranging: RHSR, Range: [0, 850], New optimal net profit: \$48,450