



The RBC (Royal Bank of Canada) uses online banking to market two new banking products. The first product is a home risk insurance that allows buyers to default for up to 6 months on their mortgage payments. The second is a guaranteed mortgage fund that buyers may purchase to leverage their funds without increasing their debt loads.

The RBC expects to make profit contributions of \$20 per unit on the home risk insurance instrument, and \$8 per unit on the guaranteed mortgage fund. The bank has a policy that no more than 50% of total sales of the two products are home risk insurance instruments. The bank is now determining sales quotas for its online offerings to maximize total expected contribution to profits based on the product resource requirements, as follows:

Resource Requirements per Product Offering (Hours per Unit)			
Bank Department	Home Risk Insurance (HRI)	Guaranteed Mortgage (GM)	Resource Availability (Hours)
Legal	6	4	4,800
Data Management	1	2	2,000
Policy Claims	3	0	1,800

A correct formulation for this problem is provided below:

Let *HRI* and *GM* denote the number of units of Home Risk Insurance instruments and Guaranteed Mortgage units to sell online, respectively.

$$\text{subject to,} \quad \text{MAX } z = 20 \text{ HRI} + 8 \text{ GM} \quad (\$)$$

- 1) Legal Hours $6 \text{ HRI} + 4 \text{ GM} \leq 4,800 \text{ hrs}$
- 2) Data Mgt Hours $1 \text{ HRI} + 2 \text{ GM} \leq 2,000 \text{ hrs}$
- 3) Policy Claims $3 \text{ HRI} \leq 1,800 \text{ hrs}$
- 4) Ratio Policy Limits $-0.5 \text{ HRI} + 0.5 \text{ GM} \geq 0$
- 5) Non-negativity $\text{HRI, GM} \geq 0$

RBC Problem Solution

Microsoft Excel 12.0 Answer Report

Target Cell (Max)

Cell	Name	Original Value	Final Value
\$F\$8	Variables Profits	0	A

Adjustable Cells

Cell	Name	Original Value	Final Value
\$C\$8	Variables HRI	0	480
\$D\$8	Variables GM	0	480

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
\$E\$11	Legal Hours LHS	4800	\$E\$11<=\$G\$11	Binding	0
\$E\$12	Data Mgmt LHS	B	\$E\$12<=\$G\$12	Not Binding	560
\$E\$13	Policy Claims LHS	1440	\$E\$13<=\$G\$13	Not Binding	C
\$E\$14	Ratio Policy Limits LHS	0	\$E\$14<=\$G\$14	Binding	0

Microsoft Excel 12.0 Sensitivity Report

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$8	Variables HRI	480	0	D	1E+30	8
\$D\$8	Variables GM	E	0	8	5.333333333	28

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$E\$11	Legal Hours LHS	4800	2.8	4800	1200	4800
\$E\$12	Data Mgmt LHS	B	0	2000	H	560
\$E\$13	Policy Claims LHS	1440	F	1800	I	J
\$E\$14	Ratio Policy Limits LHS	0	6.4	G	150	350

ANSWER REPORT

Target Cell - Final Value - Gives the maximized profit or minimized cost at the optimal solution. Sub Final values of adjustable cells into the Max/Min Function.

Adjustable Cells - Final Value - Gives the values for the decision variable at the optimal solution.

Cell Value - Shows how much of each constraint is being used up at the optimal solution. For a binding constraint this will be equal to the RHS. For a non-binding constraint the formula is RHS-Slack.

Status - Tells whether a constraint is binding or not. A binding constraint is one that has all of its resources used up. A non-binding constraint's resources are not all being used.

Slack - Shows how much excess resources we have for each constraint. A binding constraint will have slack of "0". Slack = RHS - Resources Used

SENSITIVITY REPORT

Adjustable Cells - Final Value - Same as above.

Reduced Cost - For any adjustable cell that has a final value that is NOT "0", the reduced cost will be "0". Otherwise Reduced Cost is equal to -(A. Increase).

Objective Coefficient - The coefficient attached to each variable in the optimization function.

Allowable Increase/Decrease - Shows the range in which the shadow price and opt. solution remain valid for the coefficients in the optimization function and the RHS of a constraint. For a non-binding constraint the allowable increase is infinity and the allowable decrease is equal to the slack.

Constraint - Final Value - Tells us how much of each constraint is being used up at the optimal solution.

Shadow Price - shows a how a 1 unit increase or decrease will affect the maximized profit or minimized cost. The shadow price for a non-binding constraint is "0".

SOLUTIONS

A) $\text{MAX } z = 20\text{HRI} + 8\text{GM}$
 $= 20(480) + 8(480)$
 $= \$13440$

B) $\text{Cell Value} = \text{RHS} - \text{Slack}$
 $= 2000 - 560 = 1440$

C) $\text{Slack} = \text{RHS} - \text{Cell Value}$
 $= 1800 - 1440 = 360$

D) $\text{Objective Coefficient} = 20$
From MAX formula.

E) $\text{Final Value} = 480$

From Answer Report.

F) $\text{Shadow Price} = 0$

Non-Binding Constraint

G) $\text{RHS} = 0$ See 4th Constraint

H) $\text{A. Increase} = \text{Infinity}$

Non - Binding Constraint

I) $\text{A. Increase} = \text{Infinity}$

Non - Binding Constraint

J) $\text{A. Decrease} = \text{Slack} = 360$