

	Decision Variables		
	Face Cream	Body Cream	Hand Cream
Shift 1	0	1000	13200
Shift 2	0	0	4800
Outsourced	12000	7000	
Total Produced	12000	8000	18000

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Demand	12000	8000	18000
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Total Produced In-house		
0	1000	18000

Outsource Cost/Cart.		
\$40.00	\$55.00	

	Material Needed (lb/cart.)			Tot. Used	Tot. Av.	Cost/lb
Water	8.0	6.0	7.0	132000	<= 200000	\$1.00
Oil	1.0	3.0	2.0	39000	<= 50000	\$1.50
Scents	0.5	0.3	0.4	7500	<= 7500	\$3.00
Emuls	0.5	0.7	0.6	11500	<= 15000	\$2.00

Labor Needed (hrs/cart.)				Shift 1		Shift 2	
<i>*Shift 2 Diff Factors</i>	0.9	1.1		Tot. Used	Tot. Av. Cost/hr	Tot. Av.	Cost/hr
Stage 1	1.5	1.8	1.0	15000	<= 15000 \$8.50 ; 4800	<= 13500	\$9.35
Stage 2	0.8	1.0	0.5	7600	<= 10000 \$9.25 ; 2400	<= 9000	\$10.18

Cost Calculations	
Materials	\$236,000
Shift 1 Labor	\$197,800
Shift 2 Labor	\$69,300
Outsourcing	\$865,000

Total Cost per Product:			
Face Cream	Body Cream	Hand Cream	
Shift 1	\$32.15	\$37.35	\$25.53 per carton
Shift 2	\$34.17	\$39.81	\$26.84 per carton

Total Cost	
---->	\$1,368,100.00 <----
Minimization Objective	

**Microsoft Excel 16.0 Answer Report****Worksheet: [3b\_CaseStudy\_Rougir.xlsx]Rougir Cosmetics****Report Created: 8/12/2018 5:43:12 PM****Result: Solver found a solution. All Constraints and optimality conditions are satisfied.****Solver Engine**

Engine: Simplex LP

Solution Time: 0.047 Seconds.

Iterations: 8 Subproblems: 0

**Solver Options**

Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling

Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

**Objective Cell (Min)**

Cell	Name	Original Value	Final Value
\$C\$36	Total Cost	\$0.00	\$1,368,100.00

**Variable Cells**

Cell	Name	Original Value	Final Value	Integer
\$C\$5	Shift 1 Face Cream	0	0	Contin
\$D\$5	Shift 1 Body Cream	0	1000	Contin
\$E\$5	Shift 1 Hand Cream	0	13200	Contin
\$C\$6	Shift 2 Face Cream	0	0	Contin
\$D\$6	Shift 2 Body Cream	0	0	Contin
\$E\$6	Shift 2 Hand Cream	0	4800	Contin
\$C\$7	Outsourced Face Cream	0	12000	Contin
\$D\$7	Outsourced Body Cream	0	7000	Contin
\$E\$7	Outsourced Hand Cream	0	0	Contin

**Constraints**

Cell	Name	Cell Value	Formula	Status	Slack
\$C\$8	Total Produced Face Cream	12000	\$C\$8=\$C\$10	Binding	0
\$D\$8	Total Produced Body Cream	8000	\$D\$8=\$D\$10	Binding	0
\$E\$8	Total Produced Hand Cream	18000	\$E\$8=\$E\$10	Binding	0
\$F\$19	Water Tot. Used	132000	\$F\$19<=\$H\$19	Not Binding	68000
\$F\$20	Oil Tot. Used	39000	\$F\$20<=\$H\$20	Not Binding	11000
\$F\$21	Scents Tot. Used	7500	\$F\$21<=\$H\$21	Binding	0
\$F\$22	Emuls Tot. Used	11500	\$F\$22<=\$H\$22	Not Binding	3500
\$F\$26	Stage 1 Tot. Used	15000	\$F\$26<=\$H\$26	Binding	0
\$F\$27	Stage 2 Tot. Used	7600	\$F\$27<=\$H\$27	Not Binding	2400
\$K\$26	;	4800	\$K\$26<=\$M\$26	Not Binding	8700
\$K\$27	;	2400	\$K\$27<=\$M\$27	Not Binding	6600
\$E\$7	Outsourced Hand Cream	0	\$E\$7=\$E\$16	Binding	0

**Microsoft Excel 16.0 Sensitivity Report****Worksheet: [3b\_CaseStudy\_Rougir.xlsx]Rougir Cosmetics****Report Created: 8/12/2018 5:43:13 PM**

## Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$5	Shift 1 Face Cream	0	19.59791667	32.15	1E+30	19.59791667
\$D\$5	Shift 1 Body Cream	1000	0	37.35	0.0925	35.415625
\$E\$5	Shift 1 Hand Cream	13200	0	25.525	1.3125	0.051388889
\$C\$6	Shift 2 Face Cream	0	19.64416667	34.165	1E+30	19.64416667
\$D\$6	Shift 2 Body Cream	0	0.0925	39.805	1E+30	0.0925
\$E\$6	Shift 2 Hand Cream	4800	0	26.8375	0.051388889	1.3125
\$C\$7	Outsourced Face Cream	12000	0	40	19.59791667	1E+30
\$D\$7	Outsourced Body Cream	7000	0	55	35.415625	11.75875
\$E\$7	Outsourced Hand Cream	0	-47.22083333	0	1E+30	47.22083333

## Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$C\$8	Total Produced Face Cream	12000	40	12000	1E+30	12000
\$D\$8	Total Produced Body Cream	8000	55	8000	1E+30	7000
\$E\$8	Total Produced Hand Cream	18000	47.22083333	18000	750	5250
\$F\$19	Water Tot. Used	132000	0	200000	1E+30	68000
\$F\$20	Oil Tot. Used	39000	0	50000	1E+30	11000
\$F\$21	Scents Tot. Used	7500	-50.95833333	7500	1100	300
\$F\$22	Emuls Tot. Used	11500	0	15000	1E+30	3500
\$F\$26	Stage 1 Tot. Used	15000	-1.3125	15000	4800	8700
\$F\$27	Stage 2 Tot. Used	7600	0	10000	1E+30	2400
\$K\$26	;	4800	0	13500	1E+30	8700
\$K\$27	;	2400	0	9000	1E+30	6600

	Decision Variables		
	Face Cream	Body Cream	Hand Cream
Shift 1	0	4667	6600
Shift 2	0	0	11400
Outsourced	12000	3333	
Total Produced	12000	8000	18000

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Demand	12000	8000	18000
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Total Produced In-house		
0	4667	18000

Outsource Cost/Cart.		
\$40.00	\$55.00	

	Material Needed (lb/cart.)			Tot. Used	Tot. Av.	Cost/lb
Water	8.0	6.0	7.0	154000	<= 200000	\$1.00
Oil	1.0	3.0	2.0	50000	<= 50000	\$1.50
Scents	0.5	0.3	0.4	8600	<= 8600	\$3.00
Emuls	0.5	0.7	0.6	14066.67	<= 15000	\$2.00

Labor Needed (hrs/cart.)				Shift 1			Shift 2	
*Shift 2 Diff Factors	0.9	1.1		Tot. Used	Tot. Av.	Cost/hr	Tot. Av. Cost/hr	
Stage 1	1.5	1.8	1.0	15000	<= 15000	\$8.50 ; ####	<= 13500	\$9.35
Stage 2	0.8	1.0	0.5	7966.67	<= 10000	\$9.25 ; 5700	<= 9000	\$10.18

Cost Calculations	
Materials	\$282,933
Shift 1 Labor	\$201,192
Shift 2 Labor	\$164,587
Outsourcing	\$663,333

Total Cost per Product:			
Face Cream	Body Cream	Hand Cream	
Shift 1	\$32.15	\$37.35	\$25.53 per carton
Shift 2	\$34.17	\$39.81	\$26.84 per carton

Total Cost	
---->	\$1,312,045.83 <----
Minimization Objective	