

Profit Maximization and Level Curves:

**Applying Excel Data Tables, Conditional
Formatting, and the Solver**

by

J. M. Pogodzinski
Department of Economics
San Jose State University



Three Tools

- Excel Built-in Solver
- Data Tables
- Conditional Formatting

(Illustrated using profit maximization)



Profit Maximization Framework

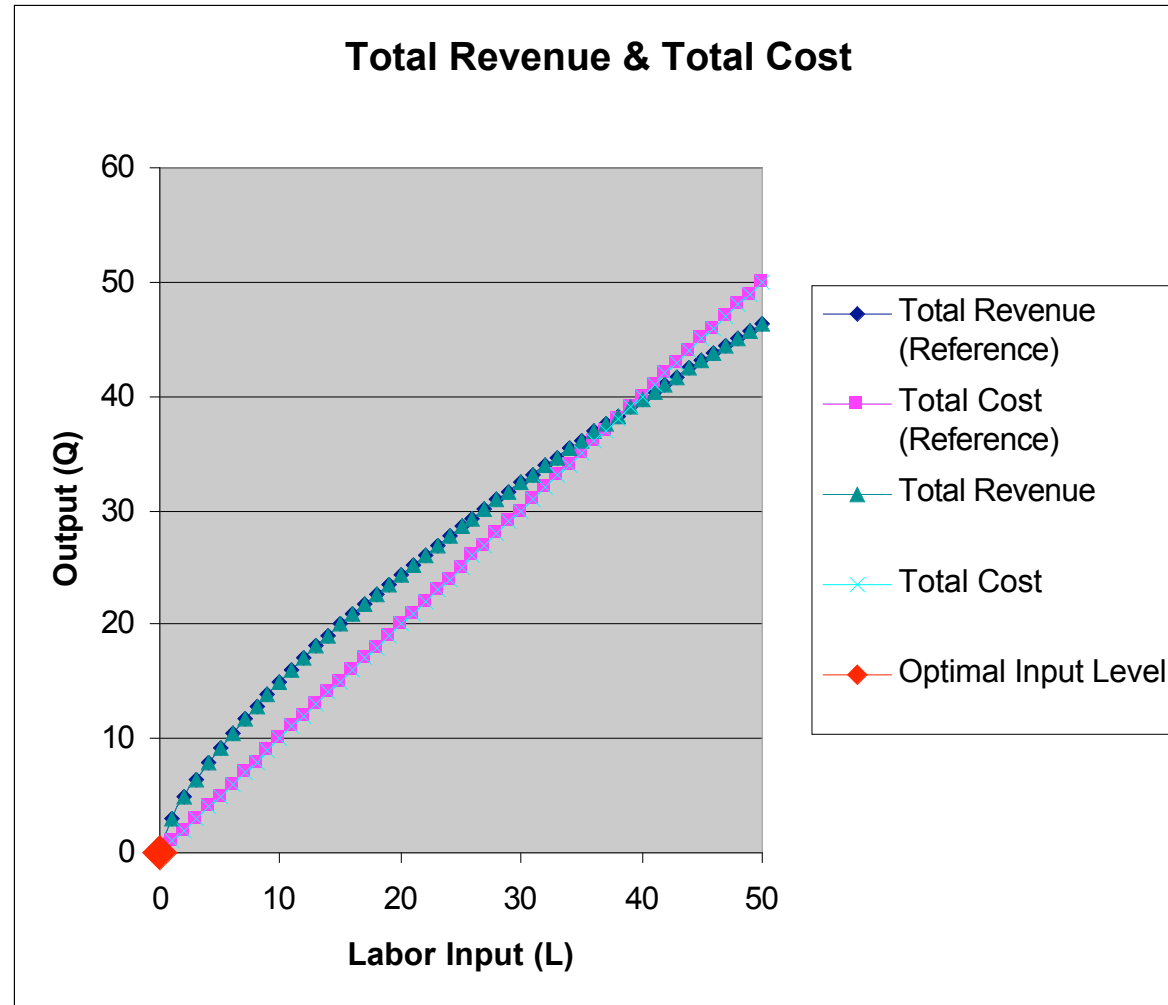
- Production Technology
 $Q = F(X_1, X_2, \dots, X_n)$
- Prices – Assumptions about market structure
- Total Revenue (TR), Total Cost (TC), and Profit (π)

Closed-Form Solution of the One-Input Profit-Maximization Problem

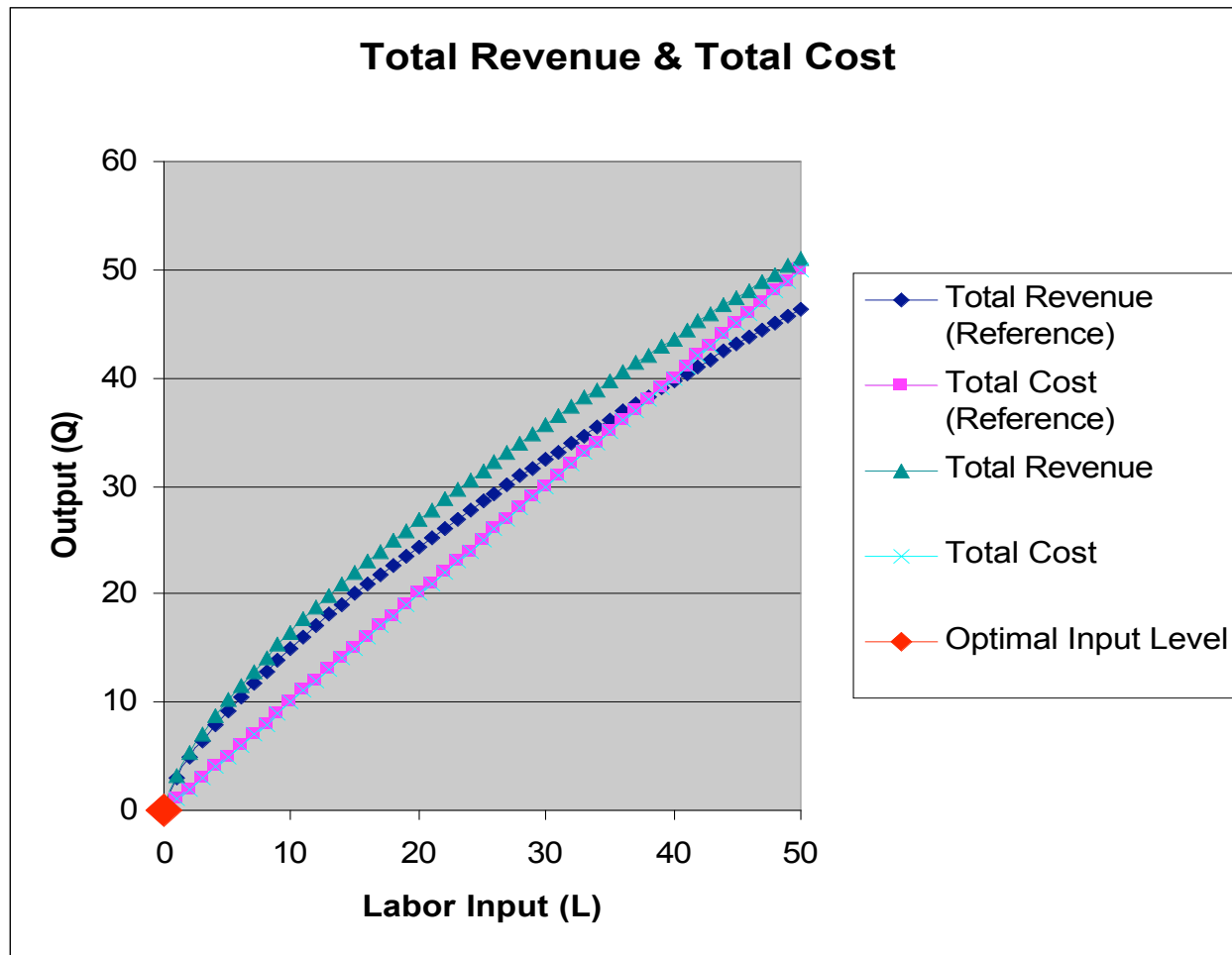
- Assume one input (labor) in production - $Q = A \cdot L^\alpha$
- Profit maximization –
 $\max_L \pi(L) = P \cdot A \cdot L^\alpha - w \cdot L$
- First- and second-order conditions yield optimal labor input

$$L^* = (w / P A \alpha)^{1/(\alpha-1)}$$

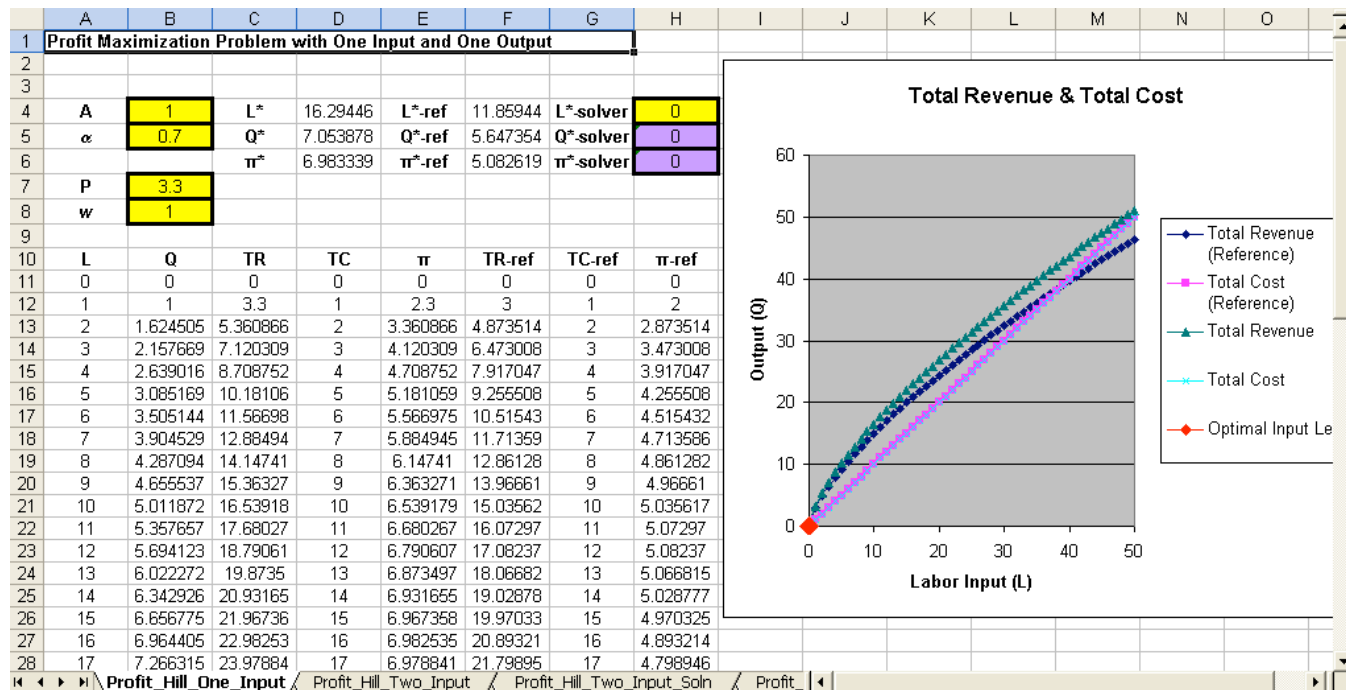
Profit Maximization Illustrated



Changes in the Optimal Solution



Using the Built-In Excel Solver – Set Up



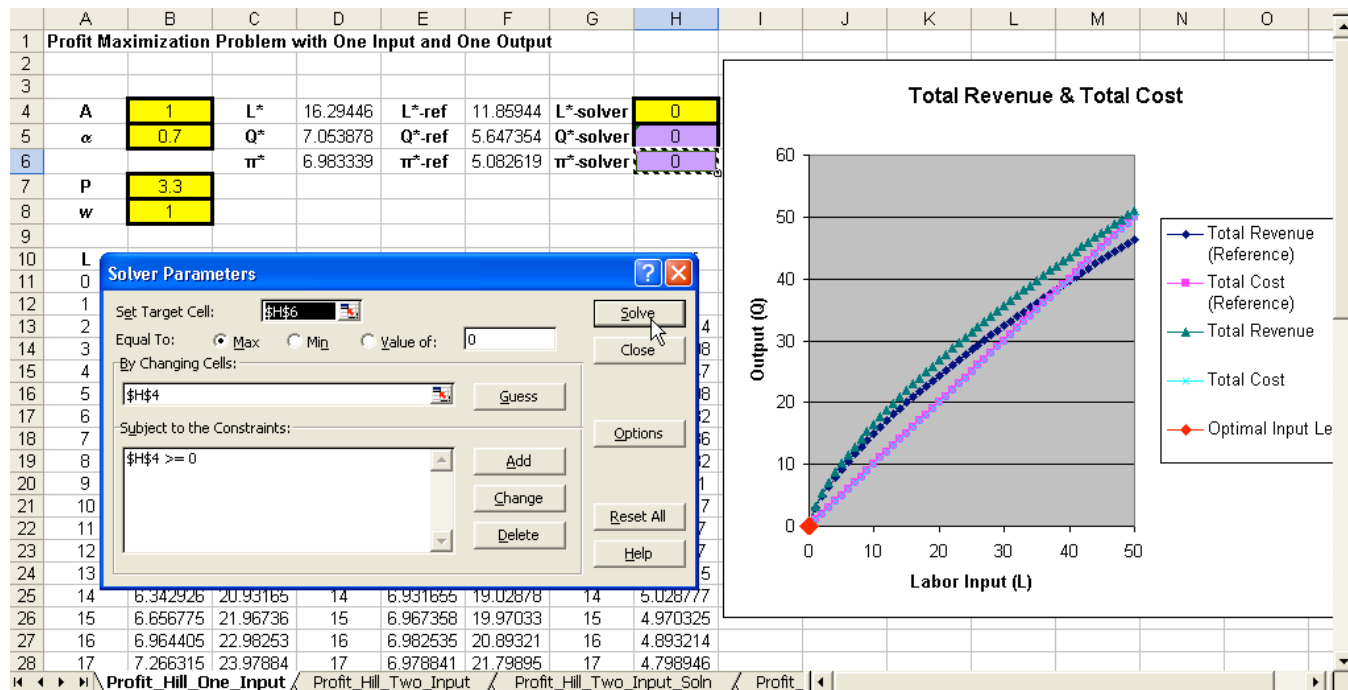
Using the Built-In Excel Solver - Launching

The screenshot shows the Microsoft Excel interface with the Solver tool being launched from the Data tab. The spreadsheet contains a profit maximization problem with variables A, α , P, w, L, Q, and TR. A line graph titled "Total Revenue & Total Cost" is visible on the right, plotting Output (Q) against Labor Input (L). The graph shows Total Revenue (Reference) and Total Cost (Reference) lines, along with Total Revenue and Total Cost lines, and an Optimal Input Le point.

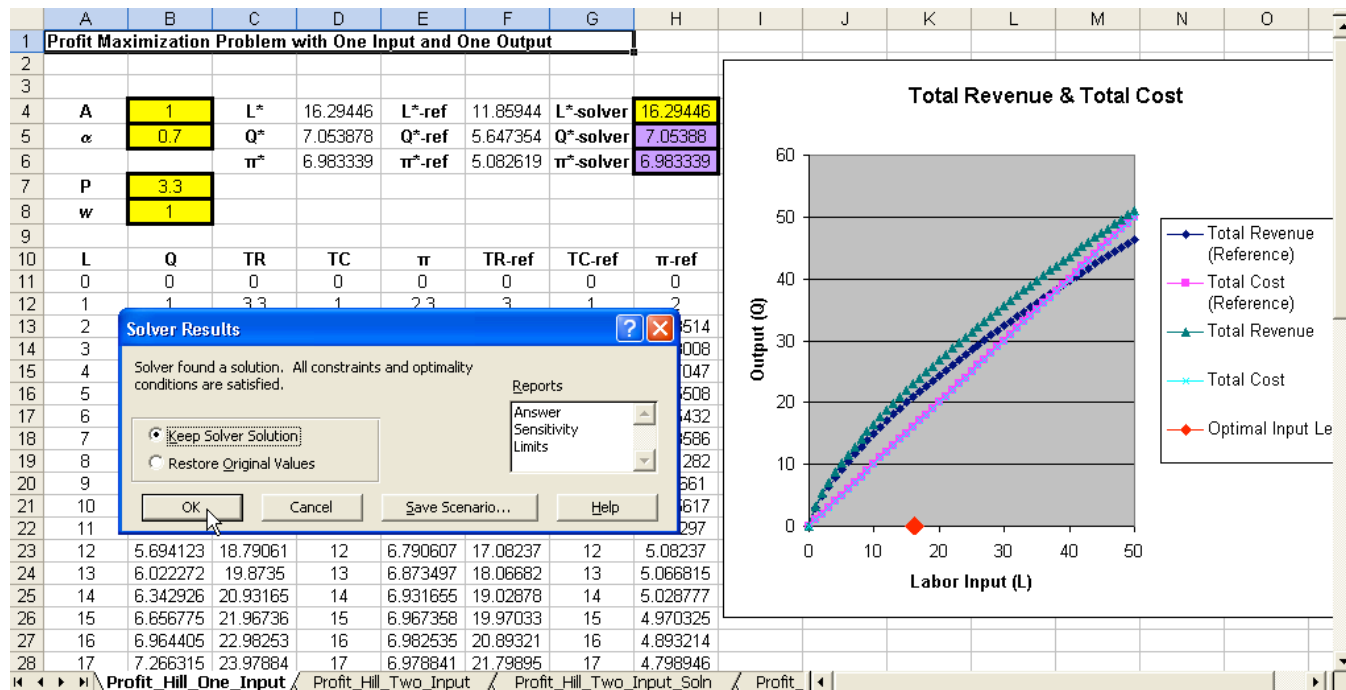
A	B	C	
1	Profit Maximization Problem w		
2			
3			
4	A	1	L*
5	α	0.7	Q*
6			π^*
7	P	3.3	
8	w	1	
9			
10	L	Q	TR
11	0	0	0
12	1	1	3.3
13	2	1.624505	5.360866
14	3	2.157669	7.120309
15	4	2.639016	8.708752
16	5	3.085169	10.18106
17	6	3.505144	11.56698
18	7	3.904529	12.88494
19	8	4.287094	14.14741
20	9	4.655537	15.36327
21	10	5.011872	16.53918
22	11	5.357657	17.68027
23	12	5.694123	18.79061
24	13	6.022272	19.8735
25	14	6.342926	20.93165
26	15	6.656775	21.96736
27	16	6.964405	22.98253
28	17	7.266315	23.97884

L	Q	TR	Total Revenue	Total Cost
0	0	0	0	0
1	1	3.3	3.3	1.624505
2	1.624505	5.360866	5.360866	2.157669
3	2.157669	7.120309	7.120309	2.639016
4	2.639016	8.708752	8.708752	3.085169
5	3.085169	10.18106	10.18106	3.505144
6	3.505144	11.56698	11.56698	3.904529
7	3.904529	12.88494	12.88494	4.287094
8	4.287094	14.14741	14.14741	4.655537
9	4.655537	15.36327	15.36327	5.011872
10	5.011872	16.53918	16.53918	5.357657
11	5.357657	17.68027	17.68027	5.694123
12	5.694123	18.79061	18.79061	6.022272
13	6.022272	19.8735	19.8735	6.342926
14	6.342926	20.93165	20.93165	6.656775
15	6.656775	21.96736	21.96736	6.964405
16	6.964405	22.98253	22.98253	7.266315
17	7.266315	23.97884	23.97884	

Using the Built-In Excel Solver – Implementation



Using the Built-In Excel Solver – Convergence



Data Tables - Implementation

The screenshot shows an Excel spreadsheet titled "Profit Maximization Problem with Two Inputs and One Output". The spreadsheet contains the following data:

Parameter	Value	Optimal Value	Reference
A	1	L*	3.814697
α	0.5	K*	3.051758
β	0.4	Q*	3.051758
P	2.5	π^*	0.762939
w	1		
r	1		

The "max-data table" is located in cell F8. The data table itself is a 11x11 grid with "Labor Input (L)" on the x-axis (0 to 10) and "Capital Input (K)" on the y-axis (0 to 10). The top row of the data table (row 14) is highlighted in green.

A "Table" dialog box is open, showing the following settings:

- Row input cell: $\$B\11
- Column input cell: $\$B\12

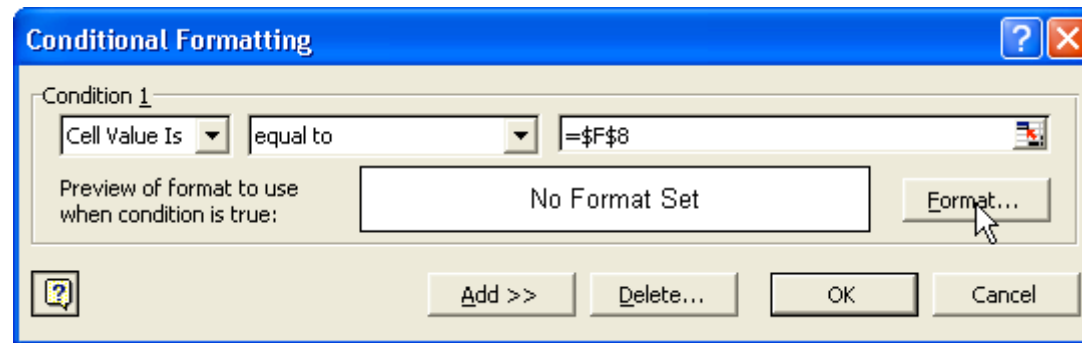
The dialog box has "OK" and "Cancel" buttons. A mouse cursor is pointing at the "OK" button.

Conditional Formatting - Launching

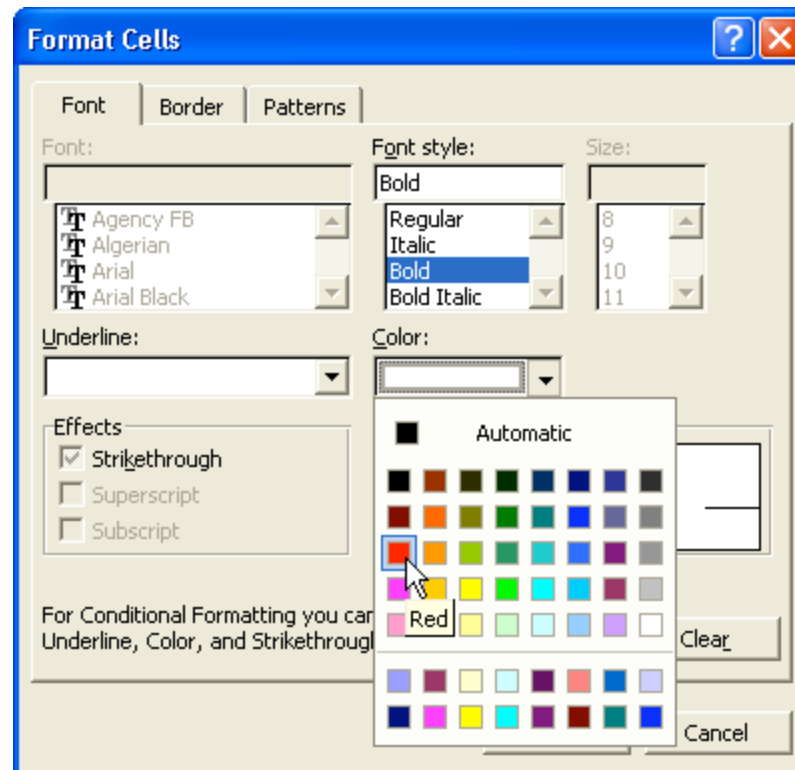
The screenshot shows the Microsoft Excel interface with the 'Format' menu open and 'Conditional Formatting...' selected. The spreadsheet below contains the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Profit Maximization Problem with Two Inputs and One Output														
2															
3	A	1	L*	3.814697	L*.ref	3.814697									
4	α	0.5	K*	3.051758	K*.ref	3.051758									
5	β	0.4	Q*	3.051758	Q*.ref	3.051758									
6			π^*	0.762939	$\pi^*.ref$	0.762939									
7	P	2.5													
8	w	1		max-data table		0.759228									
9	r	1													
10															
11	L*-solver	1													
12	K*-solver	1													
13	Q*-solver	1													
14	π^* -solver	0.5													
				Labor Input (L)											
				0	1	2	3	4	5	6	7	8	9	10	
15		0		0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	
16		1		-1	0.5	0.535534	0.330127	0	-0.40983	-0.87628	-1.38562	-1.92893	-2.5	-3.09431	
17		2		-2	0.29877	0.665165	0.713637	0.59754	0.376273	0.080303	-0.27228	-0.66967	-1.10369	-1.56837	
18		3		-3	-0.12039	0.486603	0.719688	0.759228	0.67508	0.503075	0.264494	-0.02679	-0.36116	-0.73158	
19		4		-4	-0.64725	0.155722	0.539189	0.705506	0.733051	0.662023	0.516301	0.311444	0.058258	-0.23539	
20		5		-5	-1.24087	-0.26957	0.243063	0.51827	0.641749	0.657452	0.591487	0.460866	0.277405	0.049706	
21		6		-6	-1.88082	-0.76038	-0.13332	0.238363	0.446837	0.539382	0.544081	0.479231	0.357544	0.188273	
22		7		-7	-2.55523	-1.29994	-0.56939	-0.11047	0.174867	0.336899	0.405497	0.400124	0.334298	0.217862	
23		8		-8	-3.25651	-1.87748	-1.05198	-0.51302	-0.15716	0.068624	0.195851	0.245048	0.230475	0.162516	
24		9		-9	-3.97944	-2.48564	-1.57208	-0.95888	-0.53761	-0.2527	-0.07109	0.02672	0.061685	0.038688	
25		10		-10	-4.72028	-3.11914	-2.12321	-1.44057	-0.95813	-0.6179	-0.38543	-0.23628	-0.16085	-0.14179	

Conditional Formatting – Setting Parameter Values 1



Conditional Formatting – Setting Parameter Values 2



Conditional Formatting Completed

Microsoft Excel - profit-maximization_ver1.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Reply with Changes... End Review...

Snagit Window

A1 Profit Maximization Problem with Two Inputs and One Output

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Profit Maximization Problem with Two Inputs and One Output														
2															
3	A	1	L*	3.814697	L*.ref	3.814697									
4	α	0.5	K*	3.051758	K*.ref	3.051758									
5	β	0.4	Q*	3.051758	Q*.ref	3.051758									
6			π^*	0.762939	$\pi^*.ref$	0.762939									
7	P	2.5													
8	w	1		max-data table		0.759228									
9	r	1													
10															
11	L*-solver	1													
12	K*-solver	1													
13	Q*-solver	1													
14	π^* -solver	0.5													
				Labor Input (L)											
15		0	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10		
16	1	-1	0.5	0.535534	0.330127	0	-0.40983	-0.87628	-1.38562	-1.92893	-2.5	-3.09431			
17	2	-2	0.29877	0.665165	0.713637	0.59754	0.376273	0.080303	-0.27228	-0.66967	-1.10369	-1.56837			
18	3	-3	-0.12039	0.486603	0.719688	0.759228	0.67508	0.503075	0.264494	-0.02679	-0.36116	-0.73158			
19	4	-4	-0.64725	0.155722	0.539189	0.705506	0.733051	0.662023	0.516301	0.311444	0.058258	-0.23539			
20	5	-5	-1.24087	-0.26957	0.243063	0.51827	0.641749	0.657452	0.591487	0.460866	0.277405	0.049706			
21	6	-6	-1.88082	-0.76038	-0.13332	0.238363	0.446837	0.539382	0.544081	0.479231	0.357544	0.188273			
22	7	-7	-2.55523	-1.29994	-0.56939	-0.11047	0.174867	0.336899	0.405497	0.400124	0.334298	0.217862			
23	8	-8	-3.25651	-1.87748	-1.05198	-0.51302	-0.15716	0.068624	0.195851	0.245048	0.230475	0.162516			
24	9	-9	-3.97944	-2.48564	-1.57208	-0.95888	-0.53761	-0.2527	-0.07109	0.02872	0.061685	0.038688			
25	10	-10	-4.72028	-3.11914	-2.12321	-1.44057	-0.95613	-0.6179	-0.38543	-0.23828	-0.16085	-0.14179			
26															
27															

Profit_Hill_One_Input Profit_Hill_Two_Input Profit_Hill_Two_Input_Soln Profit_

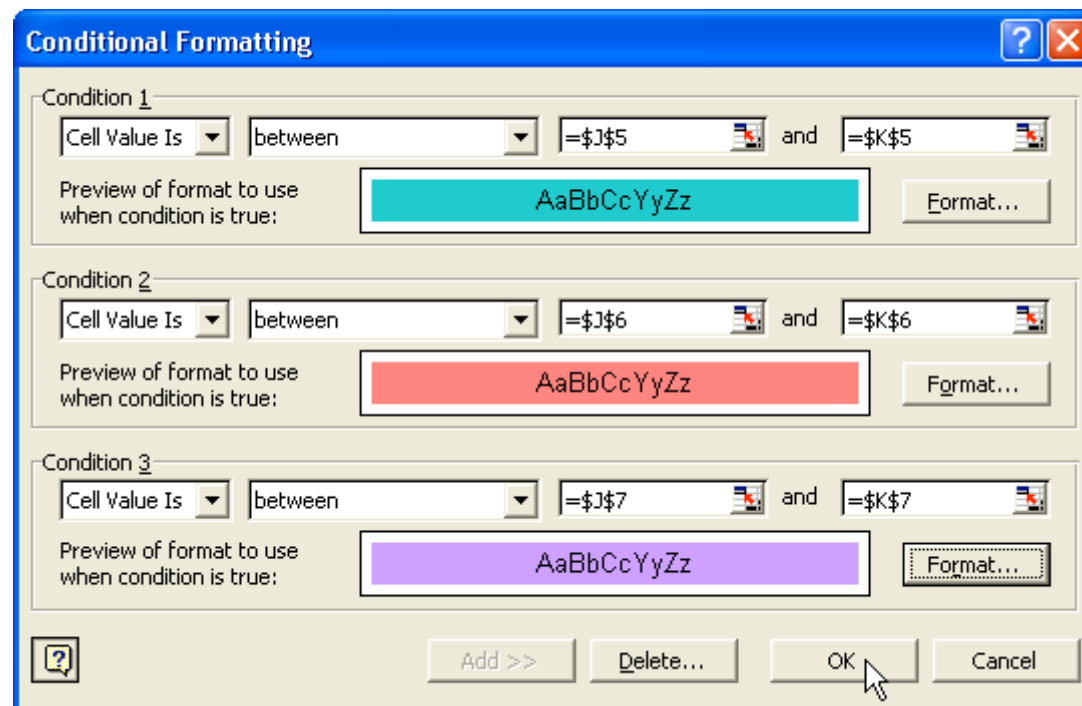
Ready

start 2 Microsof... 3 Microsof... 2 Microsof... Adobe Acro... CNN.com... 2 Window... Microsoft P... 8:09 AM

Conditional Formatting & Level Curves – the Levels

Level	from	to
1	-999	0.2
2	0.200001	0.5
3	0.500001	0.6
4	0.600001	0.7

Conditional Formatting & Level Curves - Details





Excel Books

Pogodzinski, J. M., *Using Microsoft® Excel in Introductory Macroeconomics*, Pearson Prentice-Hall, 2005 (accompanying Excel files can be downloaded from:

<http://www.prenhall.com/pogodzinski/>)

Pogodzinski, J. M., *Using Microsoft® Excel in Introductory Microeconomics*, Pearson Prentice-Hall, 2005 (accompanying Excel files can be downloaded from: <http://www.prenhall.com/pogodzinski/>)

Comments or Questions

J. M. Pogodzinski

Department of Economics (0114)

San Jose State University

1 Washington Square

San Jose, CA 95192-0114

USA

jmp@pogodzinski.net

excelbook@pogodzinski.com

paper and related materials available at

http://www.pogodzinski.net/MAA_AMS/maa_amsindex.html

(www.pogodzinski.net & click on “MAA-AMS”)