

Part 2 of 6

Excel-Based Budgeting for Production

Creating Linked Production and Direct Costs Budgets

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Budgeting. The word reminds many accountants of hours of work for little reward. No matter how much time and effort they put into it, it seems that their budget is never comprehensive enough, the numbers never “right” enough, and the picture never clear enough. What begins as a potentially useful tool never truly realizes its full potential. To combat this, we’re offering a six-part series of articles describing an Excel-based Master Budget that we use to reduce the pitfalls of traditional paper-based budgets and that can become the allocation and planning tool that all accountants hope their budgets will be.

In Part 1 we discussed the basic mechanics of an Excel-based budget. More specifically, we walked through the most important element of this type of budget: the Data Input Sheet. By gathering all of our data and assumptions on one spreadsheet, we create a dynamic budget that can easily be modified to evaluate new assumptions, changing business conditions, or new options. In addition, department managers can easily update the entire budget each year by changing their assumptions on just that one page. Since the rest of the budget is linked to the information in the Data Input Sheet, the whole budget updates automatically every time information is added. Once you've created the spreadsheet-based budget template, updating the budget each year is a snap!

In addition to creating the Data Input Sheet, the first article discussed the creation of the Sales Budget and Cash Collections Schedule. This article continues the budgeting process by detailing the steps to create the Production Budget, the Direct Materials Budget, the Schedule of Cash Payments, and the Direct Labor Budget. When completed, these budgets will provide estimates of production throughout the period, the quantities and costs of materials that must be purchased, the timing of the payments for direct materials, and the total hours and costs of our direct labor employees. The information about direct input quantities will help the production, purchasing, and human resources departments as they plan for the coming period. The information about total costs will be essential for the accounting and finance departments as they calculate financing needs for the upcoming period.

Let's get started.

Creating the Production Budget

As in the Sales Budget and Cash Collections Schedule described in Part 1, all of the information used in the Production Budget is drawn from the Data Input Sheet. For Bob's Bicycles, our example company, the information needed for the Production Budget is in cells J9:J10 of Figure 1, highlighted in blue. The inventory and production departments estimated that 807 basic and 98 deluxe bicycles would be on hand at the end of 2009 and that the company will need to have 20% of its basic and 5% of its deluxe bicycle demand for 2011 on hand at the end of 2010 (see the estimates highlighted in purple in cells D27:D28). The equations using these numbers are straightforward. The production level for each quarter is budgeted sales for the quarter plus the desired ending inventory to be prepared for the following quarter minus

any inventory that's on hand at the beginning of the quarter.

When creating the Production Budget for 2010, inventory on hand at the end of 2009—807 for basic bicycles in this example—should be used as beginning inventory for Quarter 1 (Q1). Calculate ending inventory for Q1 by multiplying projected sales in Q2 by the desired ending inventory percentage from the Data Input Sheet—20% for basic bicycles—but be sure to use an equation to pick up the number from the Data Input Sheet. These links to the Data Input Sheet give the Excel-based budget its usefulness.

Changes made in your estimates or company policies are input on the Data Input Page and flow through to the rest of the spreadsheet without needing any additional work. You should even use a formula to pick up your date from the Data Input Sheet. When it's time to make next year's budget, you only have to change the date once, and it will flow through the rest of your budget as do all of your other changes. For example, using the original numbers, your budget should show that 4,009 regular bicycles are needed in Q1. Now go to the Data Input Sheet and change the policy so that desired ending inventory is 25% instead of 20%. If you've linked your equations to the Data Input Sheet properly, the estimated production of regular bicycles has automatically changed to 4,213. Simi-

As we move through this series of articles, we'll be creating the annual Master Budget for Bob's Bicycles as an example of the budgeting process. In creating this budget, we've decided to make quarterly estimates that add up to the annual estimates. This breakdown, of course, is entirely arbitrary. The same process described here can be used to create an annual budget with a monthly breakdown, a quarterly budget with a monthly breakdown, etc. This flexibility is one of the most useful traits of an Excel-based Master Budget.

Figure 1: Partial Data Input Sheet

Bob's Bicycles - Master Budget 2010 - Microsoft Excel												
	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3												
4												
5												
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larly, at the beginning of the next year, Bob's CFO will only have to ask the production manager to type in his or her 2011 estimates, and the budget will change itself.

To finish the Production Budget for 2010, use ending inventory from Quarter 1 as beginning inventory for Q2. Likewise, ending inventory from Q2 would be used as beginning inventory for Q3. Ending inventory for Q2

would be calculated as desired sales for Q3 times the 20% desired ending inventory estimate. Once you've completed the first two columns using permanent references to the Data Input Sheet, you can copy your equations through the rest of the budget. You'll need to make a slight adjustment in Q4, however, since copying your equations will create links to the yearly totals instead of

Figure 2: Production Budget

Bob's Bicycles - Master Budget 2010 - Microsoft Excel									
A	B	C	D	E	F	G	H	I	J
1		Production Budget							
2									
3			2010				2011		
4			Q1	Q2	Q3	Q4	Year	Q1	Q2
5	Basic Bicycles:								
6	Budgeted Sales		4,000	4,080	4,162	4,245	16,486	4,330	4,416
7	Desired Ending Inventory		816	832	849	866	866	883	
8	Total Units Needed		4,816	4,912	5,011	5,111	17,352	5,213	
9	Less: Beginning Inventory		807	816	832	849	807	866	
10	Required Normal Bike Production		4,009	4,096	4,178	4,262	16,545	4,347	
11									
12	Deluxe Bicycles:								
13	Budgeted Sales		2,000	2,100	2,205	2,315	8,620	2,431	2,553
14	Desired Ending Inventory		105	110	116	122	122	128	
15	Total Units Needed		2,105	2,210	2,321	2,437	8,742	2,559	
16	Less: Beginning Inventory		98	105	110	116	98	122	
17	Required Normal Bike Production		2,007	2,105	2,211	2,321	8,644	2,437	
18									
19									

Figure 3: Production Budget Formulas

Bob's Bicycles - Master Budget 2010 - Microsoft Excel									
A	B	C	D	E	F	G	H		
1		Production Budget							
2									
3			2010				2011		
4			Q1	Q2	Q3	Q4	Year	Q1	Q2
5	Basic Bicycles:								
6	Budgeted Sales								
7	Desired Ending Inventory								
8	Total Units Needed								
9	Less: Beginning Inventory								
10	Required Normal Bike Production								
11									
12	Deluxe Bicycles:								
13	Budgeted Sales								
14	Desired Ending Inventory								
15	Total Units Needed								
16	Less: Beginning Inventory								
17	Required Normal Bike Production								
18									
19									
20									

Q1 of 2011. You can adjust your references in Q4 by typing the correct column letter manually or by pressing F2 and clicking on the correct cell reference.

Once you have the quarterly numbers, you can easily create the annual summary numbers. To do this, use the same equations that you used in the quarterly estimates. Your desired production will link to the yearly totals in the Data Input Sheet. Your desired annual ending inventory will be the desired ending inventory for Q4, and your annual beginning inventory will be the beginning

inventory from Q1. Many people miss these important adjustments the first time through. Most people naturally assume that the annual numbers should be the sum of the quarterly numbers and try to add each row across for all of the quarterly totals, then become concerned that the math doesn't make sense because, if you do it incorrectly, the annual production from the year column won't match the sum of the four quarterly production estimates. Since January 1 is the beginning of both Quarter 1 and the year, the beginning inventory

Figure 4: **Direct Materials Budget—Rows 1 to 42**

Bob's Bicycles - Master Budget 2010 - Microsoft Excel										
	A	B	C	D	E	F	G	H	I	J
1	Direct Materials Budget									
2										
3				2010					2011	
4				Q1	Q2	Q3	Q4	Year		Q1
5	Required Production									
6		Basic		4,009	4,096	4,178	4,262	16,545		4,347
7		Deluxe		2,007	2,105	2,211	2,321	8,644		2,437
8										
9	Direct Materials Needed									
10		Basic								
11		Steel		8,018	8,193	8,356	8,524	33,091		8,694
12		Rubber Handles		8,018	8,193	8,356	8,524	33,091		8,694
13		Seat		4,009	4,096	4,178	4,262	16,545		4,347
14		Chain		4,009	4,096	4,178	4,262	16,545		4,347
15		Tires		8,018	8,193	8,356	8,524	33,091		8,694
16		Gear Shift		4,009	4,096	4,178	4,262	16,545		4,347
17		Brake Unit		4,009	4,096	4,178	4,262	16,545		4,347
18		Deluxe								
19		Steel		7,025	7,368	7,737	8,124	30,253		8,530
20		Special Handles		4,014	4,211	4,421	4,642	17,288		4,874
21		Specialty Seat		2,007	2,105	2,211	2,321	8,644		2,437
22		Chain		2,007	2,105	2,211	2,321	8,644		2,437
23		Tires		4,014	4,211	4,421	4,642	17,288		4,874
24		Expanded Shift		2,007	2,105	2,211	2,321	8,644		2,437
25		Brake Unit		2,007	2,105	2,211	2,321	8,644		2,437
26		Totals								
27		Steel		15,043	15,561	16,093	16,647	63,344		17,224
28		Rubber Handles		8,018	8,193	8,356	8,524	33,091		8,694
29		Seat		4,009	4,096	4,178	4,262	16,545		4,347
30		Chain		6,016	6,202	6,389	6,583	25,189		6,784
31		Tires		12,032	12,403	12,778	13,166	50,378		13,568
32		Gear Shift		4,009	4,096	4,178	4,262	16,545		4,347
33		Brake Unit		6,016	6,202	6,389	6,583	25,189		6,784
34		Special Handles		4,014	4,211	4,421	4,642	17,288		4,874
35		Specialty Seat		2,007	2,105	2,211	2,321	8,644		2,437
36		Expanded Shift		2,007	2,105	2,211	2,321	8,644		2,437
37										
38	Desired Ending Inventory									
39		Steel		2,334	2,414	2,497	2,584	2,584		
40		Rubber Handles		1,229	1,253	1,279	1,304	1,304		
41		Seat		614	627	639	652	652		
42		Chain		930	958	987	1,018	1,018		
H < > H Basic Information Sales Budget Production Budget DM Budget DL Budget OH Budget F										

value must be the same in both columns. Similarly, December 31 is the last day of both Quarter 4 and the year, so the ending inventory value must also be the same in both columns. Figure 2 presents Bob's Production Budget.

Again, keep in mind that you should link the sales estimates, ending inventory amounts, and desired ending inventory estimates to the Data Input Sheet rather than

typing them in by hand. Using formulas to pull the information into your budgets from the Data Input Sheet creates the greatest advantage of an Excel-based budget. You want your budgets to update automatically when you change the assumptions in your Data Input Sheet; you don't want to have to manually change every budget for every change. Figure 3 summarizes the Excel equations used in the Production Budget.

Figure 5: Direct Materials Budget Formulas

Bob's Bicycles - Master Budget 2010 - Microsoft Excel									
	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5	Required Production								
6	Basic								
7	Deluxe								
8									
9	Direct								
10	Basic								
11									
12									
13									
14									
15									
16									
17									
18	Deluxe								
19									
20									
21									
22									
23									
24									
25									
26	Totals								
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38	Desired Ending Inventory								
39									
40									
41									
42									

Creating the Direct Materials Budget and Schedule of Cash Payments

The information from the Production Budget becomes the basis for the Direct Materials and Direct Labor budgets. In most Master Budgets, the Direct Materials Budget appears immediately after the Production Budget, primarily because it's one of the most useful subsidiary budgets. The Direct Materials Budget and the accompanying Schedule of Cash Payments provide information about quantities needed throughout the year, total direct materials cost, and cash outflows for inventory. Because the Direct Materials Budget presents so much information, creating it can be challenging for Excel novices, so we'll walk through this budget in a little more detail than we have other budgets.

The first segment of the Direct Materials Budget presents the required quarterly production of each product produced by the company as reported in the Production Budget. The next segment reports the total amount of each component required by each product for the quarter. To do

this, we multiply the number of units to be produced by the quantity needed of each component used in that product (these quantities are found in cells C34:C49 on the Data Input Sheet in Figure 1). Using permanent row references to required production and permanent column references to the component list will allow you to easily copy your formulas from the first quarter to the other quarters in the budget. (Note: A permanent row reference will change columns but not rows when copied into new cells. These references in Excel will have a \$ in front of the row number but not in front of the column letter. You can either manually type in the \$, or you can hit F4 twice when you first create the reference link. A permanent column reference functions similarly. In this case, the column stays the same, but the row will change. The \$ appears in front of the column letter and not in front of the row number. Again, you can either type in the \$ manually or hit F4 three times when you create the reference link.)

Once you've done this for each product, a "totals" section is created that sums up the common components

**Figure 6: Direct Materials Budget—
Rows 38 to 79**

Bob's Bicycles - Master Budget 2010 - Microsoft Excel								
	A	B	C	D	E	F	G	H
38	Desired Ending Inventory							
39		Steel		2,334	2,414	2,497	2,584	2,584
40		Rubber Handles		1,229	1,263	1,279	1,304	1,304
41		Seat		614	627	639	662	662
42		Chain		930	968	987	1,018	1,018
43		Tires		1,860	1,917	1,975	2,035	2,035
44		Gear Shift		614	627	639	662	662
45		Brake Unit		930	968	987	1,018	1,018
46		Special Handles		632	663	696	731	731
47		Specialty Seat		316	332	348	366	366
48		Expanded Shift		316	332	348	366	366
49								
50	Total Needs							
51		Steel		17,377	17,976	18,590	19,231	65,928
52		Rubber Handles		9,247	9,446	9,635	9,828	34,395
53		Seat		4,623	4,723	4,818	4,914	17,197
54		Chain		6,946	7,160	7,376	7,600	26,207
55		Tires		13,892	14,320	14,752	15,201	52,414
56		Gear Shift		4,623	4,723	4,818	4,914	17,197
57		Brake Unit		6,946	7,160	7,376	7,600	26,207
58		Special Handles		4,646	4,874	5,117	5,373	18,019
59		Specialty Seat		2,323	2,437	2,559	2,687	9,009
60		Expanded Shift		2,323	2,437	2,559	2,687	9,009
61								
62	Less: Beginning Inventory							
63		Steel		(1,295)	(2,334)	(2,414)	(2,497)	(1,295)
64		Rubber Handles		(1,286)	(1,229)	(1,253)	(1,279)	(1,286)
65		Seat		(640)	(614)	(627)	(639)	(640)
66		Chain		(652)	(930)	(958)	(987)	(652)
67		Tires		(1,275)	(1,860)	(1,917)	(1,975)	(1,275)
68		Gear Shift		(609)	(614)	(627)	(639)	(609)
69		Brake Unit		(658)	(930)	(958)	(987)	(658)
70		Special Handles		(32)	(632)	(663)	(696)	(32)
71		Specialty Seat		(26)	(316)	(332)	(348)	(26)
72		Expanded Shift		(34)	(316)	(332)	(348)	(34)
73								
74	Direct Materials to be Purchased							
75		Steel		16,082	15,641	16,176	16,734	64,633
76		Rubber Handles		7,961	8,217	8,382	8,549	33,109
77		Seat		3,983	4,109	4,191	4,275	16,557
78		Chain		6,294	6,230	6,418	6,613	25,555
79		Tires		12,617	12,459	12,836	13,226	51,139
Navigation: Home, Insert, Page Layout, Formulas, Data, Review, View, Help								
Basic Information		Sales Budget		Production Budget		DM Budget		DL Budget

used in multiple products and lists the unique components. This “totals” section gives you a comprehensive list of the direct materials that will be needed to reach your production goals, making it much easier for the purchasing department to place its orders. Figure 4 provides an example of how this section should appear. Figure 5 shows a sample of what the formulas should look like when this section is linked correctly with the other budgets.

The next part of the Direct Materials Budget follows the same process used in the Production Budget. Desired ending inventory for Q1 will be the product of the desired percentage from the Data Input Sheet and the

total units needed for production in Q2. The sum of the total required for production and the desired ending inventory gives us the total direct material needed. For Q1, we then subtract the direct material quantities on hand at the end of 2009, reported in the Data Input Sheet, to get direct materials to be purchased. For Q2, desired ending inventory would be calculated using total units needed for production in Q3, and beginning inventory would be the Q1 ending inventory. The quarters would be calculated similarly. Again, make sure to adjust the Q4 equations to capture Q1 of 2011 rather than the 2010 yearly total. See Figure 6 for an example of this section of the Direct Materials Budget.

Finally, multiply the total amount of each component to be purchased by the purchase price per ingredient from the Data Input Sheet. The sum of the component totals is the total direct materials cost for the quarter, as shown in Figure 7. These totals are used to create the Schedule of Cash Payments, which is similar to the Schedule of Cash Collections that appears at the end of the Sales Budget. (See Part 1 for instructions on how to create a Schedule of Cash Collections.) In this case, use the accounts payable payment policy percentages listed in the Data Input

Sheet times the total direct materials cost per quarter to get the amount of cash paid each quarter. In the case of Bob's Bicycles, as you can see in Figure 8, the company pays for 75% of its purchases in the quarter they are made and 25% in the following quarter. This means that in Q1 of 2010 Bob's will pay 25% of the 2009 Q4 purchases and 75% of the Q1 purchases, and in Q2 of 2010 Bob's will pay the remaining 25% of the Q1 purchases and 75% of the Q2 purchases. (A simple adjustment for uncollectible accounts was made in the Schedule of Cash Collections, and a similar method can be used here to adjust for cash discounts.)

Creating the Direct Labor Budget

The final budget we'll discuss here is the Direct Labor Budget. This budget summarizes the labor hours and costs for the production estimates made in the Production Budget. Unlike the Direct Materials Budget, this process is relatively simple because labor hours can't be transferred from one quarter to the next. The first segment of the Direct Labor Budget again reports required production for each product. The next segment lists the standard number of hours required for each product as reported in the Data Input Sheet. The third section reports the total hours needed by multiplying the standard hours needed per product by the required production. The final section multiplies the total hours needed by the cost per direct labor hour—found in the Data Input Sheet—to get the total direct labor cost. Figure 9 provides an example of the Direct Labor Budget.

Unfortunately, not all Direct Labor Budgets are this straightforward. In many cases, different levels or types of employees are needed to complete production. In this case, the total direct labor cost would be the total hours needed from each classification of employee multiplied by the required production multiplied by the cost per direct labor hour for that employee classification. While this process requires a little more detail in the budget, the basic formulas and categories remain the same. If you use Excel-based budgeting and have multiple types of labor and labor rates, be sure to put the basic information on the Data Input Sheet and not on the Labor Budget. Again, this allows any changes to be made in one place and automatically flow through the rest of the budget instead of requiring step-by-step changes on each budget sheet.

A Helpful Process

The first article in this series discussed the importance of budgets, the usefulness of an Excel-based budget, and

Figure 7: Direct Materials Budget—
Rows 74 to 115

Bob's Bicycles - Master Budget 2010 - Microsoft Excel								
	A	B	C	D	E	F	G	H
74	Direct Materials to be Purchased							
75		Steel	16,082	15,641	16,175	16,734	64,633	
76		Rubber Handles	7,961	8,217	8,382	8,549	33,109	
77		Seat	3,983	4,109	4,191	4,275	16,557	
78		Chain	6,294	6,230	6,418	6,613	25,555	
79		Tires	12,617	12,459	12,836	13,226	51,139	
80		Gear Shift	4,014	4,109	4,191	4,275	16,588	
81		Brake Unit	6,288	6,230	6,418	6,613	25,549	
82		Special Handles	4,614	4,242	4,454	4,677	17,987	
83		Specialty Seat	2,297	2,121	2,227	2,338	8,983	
84		Expanded Shift	2,289	2,121	2,227	2,338	8,975	
85								
86	Cost per unit of Direct Materials							
87		Steel	\$15	\$15	\$15	\$15	\$15	
88		Rubber Handles	\$2	\$2	\$2	\$2	\$2	
89		Seat	\$4	\$4	\$4	\$4	\$4	
90		Chain	\$6	\$6	\$6	\$6	\$6	
91		Tires	\$10	\$10	\$10	\$10	\$10	
92		Gear Shift	\$8	\$8	\$8	\$8	\$8	
93		Brake Unit	\$6	\$6	\$6	\$6	\$6	
94		Special Handles	\$5	\$5	\$5	\$5	\$5	
95		Specialty Seat	\$14	\$14	\$14	\$14	\$14	
96		Expanded Shift	\$25	\$25	\$25	\$25	\$25	
97								
98	Cost of Direct Materials to be purchased							
99		Steel	\$241,225	\$234,613	\$242,646	\$261,006	\$969,490	
100		Rubber Handles	\$15,922	\$16,434	\$16,763	\$17,098	\$66,218	
101		Seat	\$15,934	\$16,434	\$16,763	\$17,098	\$66,230	
102		Chain	\$37,765	\$37,378	\$38,507	\$39,678	\$153,329	
103		Tires	\$126,175	\$124,593	\$128,357	\$132,261	\$511,386	
104		Gear Shift	\$32,116	\$32,869	\$33,526	\$34,197	\$132,707	
105		Brake Unit	\$37,729	\$37,378	\$38,507	\$39,678	\$153,293	
106		Special Handles	\$23,068	\$21,210	\$22,271	\$23,384	\$89,934	
107		Specialty Seat	\$32,155	\$29,695	\$31,179	\$32,738	\$125,767	
108		Expanded Shift	\$57,220	\$53,026	\$55,677	\$58,461	\$224,384	
109	Total Cost		\$619,308	\$603,630	\$624,198	\$645,601	\$2,492,737	
110								
111								
112	Schedule of Cash Payments							
113								
114								
115								
			Q1	Q2	Q3	Q4	Year	
	Basic Information	Sales Budget	Production Budget	DM Budget	DL Budget			

how to create the first two worksheets in the Master Budget. This article continued the process by discussing the creation of the Production, Direct Materials, and Direct Labor budgets. Future installments of this series will discuss the creation of a Manufacturing Overhead Budget, Ending Inventory Budget, Selling and Administrative Budget, Cash Budget, and Pro Forma Financial Statements. The final part will discuss ways to use this type of budget and some of the ethical issues that surround the budgeting process.

While creating an Excel-based budget can be challenging the first time through, the basic tools and format can be used for many years afterward. This powerful budget-

Figure 8: **Direct Materials Budget—Rows 112 to 121**

Bob's Bicycles - Master Budget 2010 - Microsoft Excel							
A	B	C	D	E	F	G	H
112		Schedule of Cash Payments					
113							
114			Quarter				
115			Q1	Q2	Q3	Q4	Year
116	Accounts Payable, Beginning		\$113,950	\$0	\$0	\$0	\$113,950
117	Q1		\$464,481	\$154,827	\$0	\$0	\$619,308
118	Q2		\$0	\$452,723	\$150,908	\$0	\$603,630
119	Q3		\$0	\$0	\$468,148	\$156,049	\$624,198
120	Q4		\$0	\$0	\$0	\$484,201	\$484,201
121		Total Cash Paid for Materials	\$578,431	\$607,550	\$619,056	\$640,250	\$2,445,287

Figure 9: **Direct Labor Budget**

Bob's Bicycles - Master Budget 2010 - Microsoft Excel							
A	B	C	D	E	F	G	H
1		Direct Labor Budget					
2							
3			2010				
4			Q1	Q2	Q3	Q4	Year
5	Required Production						
6	Basic		4,009	4,096	4,178	4,262	16,545
7	Deluxe		2,007	2,105	2,211	2,321	8,644
8							
9	DL hours per bicycle						
10	Basic		2	2	2	2	2
11	Deluxe		5	5	5	5	5
12							
13	Total DL hours needed						
14	Basic		8,018	8,193	8,356	8,524	33,091
15	Deluxe		10,035	10,526	11,053	11,605	43,219
16		Total DL hours needed	18,053	18,719	19,409	20,129	76,310
17							
18	Cost per DL Hour		\$14	\$14	\$14	\$14	\$14
19		Total DL Cost	\$252,742	\$262,064	\$271,727	\$281,803	\$1,068,337
20							

ing tool will greatly speed up the process in future years and allow you greater flexibility in using the budget for making decisions each year. This is what budgeting was really intended to be! In our next segment we'll discuss the creation of a Manufacturing Overhead Budget and how to use the Direct Materials, Direct Labor, Manufacturing Overhead, and Production budgets to estimate ending inventory and the cost per unit, essential pieces of information for any business. Until then, happy budgeting!

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Note: A copy of the example spreadsheet, including all the formulas, is available from either author.