Beginning Excel What-If Data Analysis Tools

Getting Started with Goal Seek, Data Tables, Scenarios, and Solver

Paul Cornell

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CHAPTER 5

Case Study: Using Excel What-If Tools

The preceding chapters have introduced four Excel what-if data analysis tools: Goal Seek, data tables, scenarios, and Solver. This chapter presents a case study demonstrating how a fictional running club, called the Ridge Running Cooperative, might use each of these what-if tools to produce reports and tools to assist runners. In the exercises in this chapter, you will use Goal Seek to forecast membership dues, data tables to forecast race paces, scenarios to forecast race-day cash flow, and Solver to forecast race-day finish times as well as pair up race relay teams.

About the Ridge Running Cooperative

Four years ago, residents of Red Hills Ridge, a city in the western part of the United States, formed a local running club named the Ridge Running Cooperative. Members of this not-for-profit cooperative volunteer their time at local running events in exchange for receiving special discounts on running apparel and nutritional supplements at several local athletic supply retail stores. Some of the club's members also serve as board members to oversee the cooperative's activities. At the end of every year after the club's operating expenses are paid, the board members distribute any remaining profits to track and field organizations in the local public school systems.

At the board's annual meeting toward the end of this year, board members have traditionally provided the following reports to all attending club members:

- A forecast of next year's annual membership dues income
- A forecast of next year's incoming cash flow from registrants for the annual Red Hills Ridge Labor Day race event

In addition, club members have asked the board's activities director to supply some special computer-based tools to assist runners. They would like tools to do the following:

- Forecast race paces
- Forecast race-day finish times
- Pair up relay race teams

The board's activities director has committed to producing these tools on compact disc (CD), which will be distributed to attending club members at the annual meeting.

The board's treasurer and activities director have decided to use the Excel what-if tools to produce these reports and tools. The following sections present a series of exercises to allow you to practice producing these reports and tools.

Use Goal Seek to Forecast Membership Dues

In this section, you will use Goal Seek to forecast next year's total club membership dues. This section's exercises are available in the Excel workbook named Ridge Running Exercises.xls, which is available for download from the Source Code area of the Apress web site (`http://www.apress.com`). These exercises' data is on the workbook's Membership Dues worksheet, as shown in Figure 5-1.

	A	B	C
1	New Individual Member Annual Dues	$30.00	
2	Renewing Individual Member Annual Dues	$25.00	
3	New Individual Member Lifetime Membership	$275.00	
4	New Family Annual Dues	$55.00	
5	Renewing Family Annual Dues	$45.00	
6	New Family Lifetime Membership	$400.00	
7			
8	New Individual Annual Members	95	$2,850.00
9	Renewing Individual Annual Members	135	$3,375.00
10	New Lifetime Individual Members	35	$9,625.00
11	New Annual Families	40	$2,200.00
12	Renewing Annual Families	65	$2,925.00
13	New Lifetime Families	20	$8,000.00
14			
15	Totals	390	$28,975.00

Figure 5-1. *The Membership Dues worksheet*

This worksheet contains the following information:

- New individual membership dues at a rate of $30.00 per year (cell B1, defined name NIMAD)
- Renewing individual membership dues at a rate of $25.00 per year (cell B2, defined name RIMAD)
- New individual lifetime membership dues at a one-time rate of $275.00 (cell B3, defined name NIMLM)
- New family membership dues at a rate of $55.00 per year (cell B4, defined name NFAD)
- Renewing family membership dues at a rate of $45.00 per year (cell B5, defined name RFAD)

- New family lifetime membership dues at a one-time rate of $400.00 (cell B6, defined name NFLM)
- The number of new annual individual memberships (cell B8, defined name NIAM)
- The number of renewing annual individual memberships (cell B9, defined name RIAM)
- The number of new individual lifetime memberships (cell B10, defined name NLIM)
- The number of new annual family memberships (cell B11, defined name NAF)
- The number of renewing annual family memberships (cell B12, defined name RAF)
- The number of new family lifetime memberships (cell B13, defined name NLM)
- The products of each dues level multiplied by the number of memberships at that level (cells C8 through C13)
- The total number of memberships (cell B15)
- The total membership dues (cell C15)

New Lifetime Family Club Membership Dues

Use Goal Seek to forecast how many new lifetime family club memberships are needed to achieve an overall club membership dues total of $30,000, assuming that all other club membership levels are constant.

1. Type the following values in the following cells:

   B8: **95**

   B9: **135**

   B10: **35**

   B11: **40**

   B12: **65**

2. Click Tools ➤ Goal Seek.
3. Click the Set Cell box, and then click or type cell **C15**.
4. Click the To Value box, and then type **30000**.
5. Click the By Changing Cell box, and then click or type cell **B13**.
6. Click OK, and then click OK again.

Compare your results to Figure 5-2. Note that the values are approximate due to the formatting and subsequent rounding of member and financial totals.

	A	B	C
1	New Individual Member Annual Dues	$30.00	
2	Renewing Individual Member Annual Dues	$25.00	
3	New Individual Member Lifetime Membership	$275.00	
4	New Family Annual Dues	$55.00	
5	Renewing Family Annual Dues	$45.00	
6	New Family Lifetime Membership	$400.00	
7			
8	New Individual Annual Members	95	$2,850.00
9	Renewing Individual Annual Members	135	$3,375.00
10	New Lifetime Individual Members	35	$9,625.00
11	New Annual Families	40	$2,200.00
12	Renewing Annual Families	65	$2,925.00
13	New Lifetime Families	23	$9,025.00
14			
15	Totals	393	$30,000.00

Figure 5-2. *Results of goal seeking for new lifetime family club memberships*

New Annual Family Club Memberships

Use Goal Seek to forecast how many new annual family club memberships are needed to achieve a new annual family club membership total of $3,000, assuming that all other club membership levels from the previous exercise are constant.

1. Using the results from the previous exercise, click Tools ➤ Goal Seek.
2. Click the Set Cell box, and then click or type cell **C11**.
3. Click the To Value box, and then type **3000**.
4. Click the By Changing Cell box, and then click or type cell **B11**.
5. Click OK, and then click OK again.

Compare your results to Figure 5-3.

	A	B	C
1	New Individual Member Annual Dues	$30.00	
2	Renewing Individual Member Annual Dues	$25.00	
3	New Individual Member Lifetime Membership	$275.00	
4	New Family Annual Dues	$55.00	
5	Renewing Family Annual Dues	$45.00	
6	New Family Lifetime Membership	$400.00	
7			
8	New Individual Annual Members	95	$2,850.00
9	Renewing Individual Annual Members	135	$3,375.00
10	New Lifetime Individual Members	35	$9,625.00
11	New Annual Families	55	$3,000.00
12	Renewing Annual Families	65	$2,925.00
13	New Lifetime Families	23	$9,025.00
14			
15	Totals	407	$30,800.00

Figure 5-3. *Results of goal seeking for new annual family club memberships*

Use Data Tables to Forecast Race Paces

In this section, you will use one-variable and two-variable data tables to forecast various race paces. Simply defined, a *race pace* is the average time for a given distance between two points. Paces are usually expressed as the average number of minutes it takes to run an average kilometer or mile. So, if you run a 10-minute-per-mile pace, this means it takes you an average of 10 minutes to run an average mile.

Time for a Single Race Pace

The first exercise in this section uses a one-variable data table to forecast the average amount of time it would take to run various distances at a single race pace. This exercise's data is on the Ridge Running Exercises.xls workbook's Race Paces 1 worksheet, as shown in Figure 5-4.

This worksheet contains the following information:

- Column A (cells A4 through A17) displays the number of miles, 1 through 13.1 (the length of a half-marathon race is 13.1 miles).
- Column B (cells B4 through B17) will display the average number of minutes to run the various distances at the race pace in cell B3.

Use a one-variable data table to calculate the average amount of time it would take to run from 1 through 13.1 miles at an 8.5-minute-per-mile pace.

	A	B
1		1
2		8.5
3		8.5
4	1	
5	2	
6	3	
7	4	
8	5	
9	6	
10	7	
11	8	
12	9	
13	10	
14	11	
15	12	
16	13	
17	13.1	

Figure 5-4. *The blank one-variable race paces worksheet*

1. Select cells A3 through B17.
2. Click Data ➤ Table.
3. Click Column Input Cell.
4. Click cell B1.
5. Click OK.

Compare your results to Figure 5-5.

Tip You can change the race pace variable (in cell B2) in one location and have those changes immediately reflected in the times for each distance. For example, try changing the value of cell B2 to the number 9 and see how the values in cells B4 to B17 change accordingly.

	A	B
1		1
2		8.5
3		8.5
4	1	8.5
5	2	17
6	3	25.5
7	4	34
8	5	42.5
9	6	51
10	7	59.5
11	8	68
12	9	76.5
13	10	85
14	11	93.5
15	12	102
16	13	110.5
17	13.1	111.35

Figure 5-5. *Results of calculating race times using a one-variable data table*

Time for Multiple Race Paces

The second exercise in this section uses a two-variable data table to forecast the average amount of time it would take to run various distances at several race paces. This exercise's data is on the Ridge Running Exercises.xls workbook's Race Paces 2 worksheet, as shown in Figure 5-6.

	A	B	C	D	E	F	G	H	I	J
1	1									
2	5									
3	5	5	5.5	6	6.5	7	7.5	8	8.5	9
4	1									
5	2									
6	3									
7	4									
8	5									
9	6									
10	7									
11	8									
12	9									
13	10									
14	11									
15	12									
16	13									
17	13.1									

Figure 5-6. *The blank two-variable race paces worksheet*

This worksheet contains the following information:

- Column A (cells A4 through A17) is the same as the Race Paces 1 worksheet, displaying the number of miles, 1 through 13.1.
- Columns B through J (cells B4 through J17) will display the average number of minutes to run the various distances at the race paces in cells B3 through J3.

Use a two-variable data table to calculate the average amount of time it would take to run from 1 through 13.1 miles at 5-minute-per-mile through 9-minute-per-mile paces, in half-minute increments.

1. Select cells A3 through J17.
2. Click Data ➤ Table.
3. Click Row Input Cell.
4. Click cell A2.
5. Click Column Input Cell.
6. Click cell A1.
7. Click OK.

Compare your results to Figure 5-7.

	A	B	C	D	E	F	G	H	I	J
1	1									
2	5									
3	5	5	5.5	6	6.5	7	7.5	8	8.5	9
4	1	5	5.5	6	6.5	7	7.5	8	8.5	9
5	2	10	11	12	13	14	15	16	17	18
6	3	15	16.5	18	19.5	21	22.5	24	25.5	27
7	4	20	22	24	26	28	30	32	34	36
8	5	25	27.5	30	32.5	35	37.5	40	42.5	45
9	6	30	33	36	39	42	45	48	51	54
10	7	35	38.5	42	45.5	49	52.5	56	59.5	63
11	8	40	44	48	52	56	60	64	68	72
12	9	45	49.5	54	58.5	63	67.5	72	76.5	81
13	10	50	55	60	65	70	75	80	85	90
14	11	55	60.5	66	71.5	77	82.5	88	93.5	99
15	12	60	66	72	78	84	90	96	102	108
16	13	65	71.5	78	84.5	91	97.5	104	110.5	117
17	13.1	65.5	72.05	78.6	85.15	91.7	98.25	104.8	111.35	117.9

Figure 5-7. *Results of calculating race times using a two-variable data table*

Tip You can use a Visual Basic for Applications (VBA) macro included in this workbook to quickly convert minutes in decimal format to hour/minute/second (hh:mm:ss) format. To do this, click a single cell containing the number of minutes (for example, 111.35), press Ctrl+Shift+M, and look at the status bar (for example, 111.35 minutes = 1:51:21). You can use another VBA macro included in this workbook to reset the value from the status bar. To do this, press Ctrl+Shift+R. To examine the macros' code, click Tools ➤ Macro ➤ Macros, click ThisWorkbook.ConvertMinutesToHHMMSS or ThisWorkbook.ResetStatusBar, and then click the Edit button.

Use Scenarios to Forecast Race-Day Cash Flow

In this section, you will use scenarios to forecast next year's projected incoming cash flow from registrants for the annual Red Hills Ridge Labor Day Race event.

The data for this set of exercises is on the Ridge Running Exercises.xls workbook's Race Day Cash Flow worksheet, as shown in Figure 5-8.

	A	B	C	D	E	F
1		2K Kids Dash	5K Run/Walk	10K Run/Walk	Half Marathon Run/Walk	Marathon Run/Walk
2	Early Bird Registration Fee	$8.00	$15.00	$20.00	$60.00	$80.00
3	Regular Registration Fee	$10.00	$18.00	$25.00	$70.00	$90.00
4	Day-Of-Race Registration Fee	$15.00	$20.00	$30.00	$85.00	$115.00
5						
6	Early Bird Registrants	1	1	1	1	1
7	Regular Registrants	1	1	1	1	1
8	Day-Of-Race Registrants	1	1	1	1	1
9						
10	Subtotals	$33.00	$53.00	$75.00	$215.00	$285.00
11	Grand Total	$661.00				

Figure 5-8. *The incoming cash flow worksheet for Red Hills Ridge Half Marathon event registrants*

This worksheet contains the following information:

- The early bird registration fee for the 2-kilometer kids dash (cell B2, defined name EBRF2K)
- The early bird registration fee for the 5-kilometer run/walk race (cell C2, defined name EBRF5K)
- The early bird registration fee for the 10-kilometer run/walk race (cell D2, defined name EBRF10K)
- The early bird registration fee for the half marathon run/walk race (cell E2, defined name EBRFHM)

- The early bird registration fee for the marathon run/walk race (cell F2, defined name EBRFM)
- The regular registration fee for the 2-kilometer kids dash (cell B3, defined name RRF2K)
- The regular registration fee for the 5-kilometer run/walk race (cell C3, defined name RRF5K)
- The regular registration fee for the 10-kilometer run/walk race (cell D3, defined name RRF10K)
- The regular registration fee for the half marathon run/walk race (cell E3, defined name RRFHM)
- The regular registration fee for the marathon run/walk race (cell F3, defined name RRFM)
- The day-of-race registration fee for the 2-kilometer kids dash (cell B4, defined name DORF2K)
- The day-of-race registration fee for the 5-kilometer run/walk race (cell C4, defined name DORF5K)
- The day-of-race registration fee for the 10-kilometer run/walk race (cell D4, defined name DORF10K)
- The day-of-race registration fee for the half marathon run/walk race (cell E4, defined name DORFHM)
- The day-of-race registration fee for the marathon run/walk race (cell F4, defined name DORFM)
- The number of early bird registrants for the 2-kilometer kids dash (cell B6, defined name EB2K)
- The number of early bird registrants for the 5-kilometer run/walk race (cell C6, defined name EB5K)
- The number of early bird registrants for the 10-kilometer run/walk race (cell D6, defined name EB10K)
- The number of early bird registrants for the half marathon run/walk race (cell E6, defined name EBHM)
- The number of early bird registrants for the marathon run/walk race (cell F6, defined name EBM)
- The number of regular registrants for the 2-kilometer kids dash (cell B7, defined name RR2K)
- The number of regular registrants for the 5-kilometer run/walk race (cell C7, defined name RR5K)
- The number of regular registrants for the 10-kilometer run/walk race (cell D7, defined name RR10K)

- The number of regular registrants for the half marathon run/walk race (cell E7, defined name RRHM)
- The number of regular registrants for the marathon run/walk race (cell F7, defined name RRM)
- The number of day-of-race registrants for the 2-kilometer kids dash (cell B8, defined name DOR2K)
- The number of day-of-race registrants for the 5-kilometer run/walk race (cell C8, defined name DOR5K)
- The number of day-of-race registrants for the 10-kilometer run/walk race (cell D8, defined name DOR10K)
- The number of day-of-race registrants for the half marathon run/walk race (cell E8, defined name DORHM)
- The number of day-of-race registrants for the marathon run/walk race (cell F8, defined name DORM)
- Subtotals for 2-kilometer, 5-kilometer, 10-kilometer, half marathon, and marathon registration fees (cells B10 through F10)
- The grand total for all registration fees (cell B11)

Cash Flow for a Rainy Weather Race Day

Create a scenario to forecast next year's projected incoming cash flow from registrants based on rainy weather the day of the race.

1. Select cells B6 through F8.
2. Click Tools ➤ Scenarios.
3. Click Add.
4. In the Scenario Name box, type **Rainy Weather Race Day Scenario**.
5. Click OK.
6. Type these values in the following cells:

   EB2K: **55**

   EB5K: **125**

   EB10K: **110**

   EBHM: **90**

   EBM: **50**

   RR2K: **95**

   RR5K: **200**

RR10K: **180**

RRHM: **120**

RRM: **75**

DOR2K: **50**

DOR5K: **100**

DOR10K: **95**

DORHM: **75**

DORM: **40**

7. Click OK.
8. Click Show.
9. Click Close.

Compare your results to Figure 5-9.

	A	B	C	D	E	F
1		2K Kids Dash	5K Run/Walk	10K Run/Walk	Half Marathon Run/Walk	Marathon Run/Walk
2	Early Bird Registration Fee	$8.00	$15.00	$20.00	$60.00	$80.00
3	Regular Registration Fee	$10.00	$18.00	$25.00	$70.00	$90.00
4	Day-Of-Race Registration Fee	$15.00	$20.00	$30.00	$85.00	$115.00
5						
6	Early Bird Registrants	55	125	110	90	50
7	Regular Registrants	95	200	180	120	75
8	Day-Of-Race Registrants	50	100	95	75	40
9						
10	Subtotals	$2,140.00	$7,475.00	$9,550.00	$20,175.00	$15,350.00
11	Grand Total	$54,690.00				

Figure 5-9. *Results of using scenarios to forecast cash flow for a rainy weather race day*

Cash Flow for a Normal Weather Race Day

Create a scenario to forecast next year's projected incoming cash flow from registrants based on normal weather the day of the race. Note that the only change between this scenario and the previous scenario is the number of day-of-race registrants, which is expected to be higher for normal race-day weather than for rainy race-day weather.

1. Select cells B6 through F8.
2. Click Tools ➤ Scenarios.
3. Click Add.

4. In the Scenario Name box, type **Normal Weather Race Day Scenario**.
5. Click OK.
6. Change the values in only the following cells:

   DOR2K: **75**

   DOR5K: **130**

   DOR10K: **120**

   DORHM: **100**

   DORM: **55**
7. Click OK.
8. Click Show.
9. Click Close.

Compare your results to Figure 5-10.

	A	B	C	D	E	F
1		2K Kids Dash	5K Run/Walk	10K Run/Walk	Half Marathon Run/Walk	Marathon Run/Walk
2	Early Bird Registration Fee	$8.00	$15.00	$20.00	$60.00	$80.00
3	Regular Registration Fee	$10.00	$18.00	$25.00	$70.00	$90.00
4	Day-Of-Race Registration Fee	$15.00	$20.00	$30.00	$85.00	$115.00
5						
6	Early Bird Registrants	55	125	110	90	50
7	Regular Registrants	95	200	180	120	75
8	Day-Of-Race Registrants	75	130	120	100	55
9						
10	Subtotals	$2,515.00	$8,075.00	$10,300.00	$22,300.00	$17,075.00
11	Grand Total	$60,265.00				

Figure 5-10. *Results of using scenarios to forecast cash flow for a normal weather race day*

Cash Flow for a Perfect Weather Race Day

Create a scenario to forecast next year's projected incoming cash flow from registrants based on perfect weather the day of the race. Note that the only change between this scenario and the previous two scenarios is the number of day-of-race registrants, which is expected to be higher for perfect race-day weather than for rainy and normal race-day weather.

1. Select cells B6 through F8.
2. Click Tools ➤ Scenarios.
3. Click Add.

4. In the Scenario Name box, type **Perfect Weather Race Day Scenario**.
5. Click OK.
6. Change the values in only the following cells:

   DOR2K: **110**

   DOR5K: **170**

   DOR10K: **150**

   DORHM: **110**

   DORM: **70**
7. Click OK.
8. Click Show.
9. Click Close.

Compare your results to Figure 5-11.

	A	B	C	D	E	F
1		2K Kids Dash	5K Run/Walk	10K Run/Walk	Half Marathon Run/Walk	Marathon Run/Walk
2	Early Bird Registration Fee	$8.00	$15.00	$20.00	$60.00	$80.00
3	Regular Registration Fee	$10.00	$18.00	$25.00	$70.00	$90.00
4	Day-Of-Race Registration Fee	$15.00	$20.00	$30.00	$85.00	$115.00
5						
6	Early Bird Registrants	55	125	110	90	50
7	Regular Registrants	95	200	180	120	75
8	Day-Of-Race Registrants	110	170	150	110	70
9						
10	Subtotals	$3,040.00	$8,875.00	$11,200.00	$23,150.00	$18,800.00
11	Grand Total	$65,065.00				

Figure 5-11. *Results of using scenarios to forecast cash flow for a perfect weather race day*

Report to Display Race-Day Cash-Flow Forecasts Side by Side

Create a scenario summary report to display the previous three race-day cash-flow forecasts next to each other on a new worksheet.

1. Click Tools ➤ Scenarios.
2. Click Summary.
3. Click the Scenario Summary option.
4. Click the Result Cells box, and then select cells B10 through F10 and cell B11.
5. Click OK.

Compare your results to Figure 5-12.

	B	C	D	G	H
2	**Scenario Summary**				
3			Current Values:	Perfect Weather Race Day Scenario	Normal Weather Race Day Scenario
5	**Changing Cells:**				
6		**EB2K**	55	55	55
7		**EB5K**	125	125	125
19		**DORHM**	110	110	100
20		**DORM**	70	70	55
21	**Result Cells:**				
22		**Fees2K**	$3,040.00	$3,040.00	$2,515.00
23		**Fees5K**	$8,875.00	$8,875.00	$8,075.00
24		**Fees10K**	$11,200.00	$11,200.00	$10,300.00
25		**FeesHalfM**	$23,150.00	$23,150.00	$22,300.00
26		**FeesM**	$18,800.00	$18,800.00	$17,075.00
27		**TotalFees**	$65,065.00	$65,065.00	$60,265.00

Figure 5-12. *Results of creating a scenario summary report to display several race-day cash-flow forecasts side by side*

Report to Display Race-Day Cash-Flow Forecasts in PivotTable Format

Create a scenario PivotTable report to display the previous three race-day cash-flow forecasts in a PivotTable. To begin, click the Race Day Cash Flow worksheet tab.

1. Click Tools ➤ Scenarios.
2. Click Summary.
3. Click the Scenario PivotTable Report option.
4. Click the Result Cells box, and then select cells B10 through F10 and cell B11.
5. Click OK.

Compare your results to Figure 5-13.

	A	B	C	D	E	F	G
1	$B$6:$F$8 by	(All)					
2							
3		Result Cells					
4	$B$6:$F$8	Fees2K	Fees5K	Fees10K	FeesHalfM	FeesM	TotalFees
5	Normal Weather Race Day Scenario	2515	8075	10300	22300	17075	60265
6	Original Values	33	53	75	215	285	661
7	Perfect Weather Race Day Scenario	3040	8875	11200	23150	18800	65065
8	Rainy Weather Race Day Scenario	2140	7475	9550	20175	15350	54690

Figure 5-13. *Results of creating a scenario PivotTable report to display several race-day cash-flow forecasts in PivotTable format*

Now, clean up the PivotTable's appearance and display format.

1. Right-click cell A1 (the cell containing `$B$6:$F$8 by`) and click Hide.
2. Right-click cell A4 (the cell containing `$B$6:$F$8`) and click Field Settings.
3. Click the Name box, type **Scenario**, and click OK.
4. Right-click cell B5 (2K Kids Dash Fees) and click Field Settings.
5. Click Number.
6. Click Currency.
7. Click OK, and then click OK again.
8. Repeat steps 4 through 7 for cells C5, D5, E5, F5, and G5.

Compare your results to Figure 5-14.

	A	B	C	D	E	F	G
1							
2							
3		Result Cells					
4	Scenario	Fees2K	Fees5K	Fees10K	FeesHalfM	FeesM	TotalFees
5	Normal Weather Race Day Scenario	$2,515.00	$8,075.00	$10,300.00	$22,300.00	$17,075.00	$60,265.00
6	Original Values	$33.00	$53.00	$75.00	$215.00	$285.00	$661.00
7	Perfect Weather Race Day Scenario	$3,040.00	$8,875.00	$11,200.00	$23,150.00	$18,800.00	$65,065.00
8	Rainy Weather Race Day Scenario	$2,140.00	$7,475.00	$9,550.00	$20,175.00	$15,350.00	$54,690.00

Figure 5-14. *Results of cleaning up the PivotTable's appearance and display format*

Use Solver to Forecast Race-Day Finish Times

In this section, you will use Solver to forecast race-day finish times using three primary timing methods:

- Given a distance in kilometers or miles and a target pace per kilometer or mile in minutes, you can forecast how many minutes it will take to cover that distance.
- Given a distance in kilometers or miles and how long it took for a runner to cover that distance in minutes, you can forecast a target pace per kilometer or mile in minutes.
- Given a distance in kilometers or miles, your target pace per kilometer or mile in minutes, and a pacer's total number of minutes to cover that distance, you can forecast how many total minutes faster or slower a runner will be from the pacer's time, as well a how many minutes faster or slower a runner will be from the pacer's target pace per kilometer or mile in minutes.

■ **Note** A *pacer* is someone who runs in a race at a set number of minutes per kilometer or mile. Theoretically, if you run alongside this person, you should be able to finish the race in the exact amount of time as set by the pacer. A pacer is typically a race volunteer who has a sign pinned to his back that reads something like "Run with me to finish in 2 hours and 30 minutes" or simply "Pace 2:30:00." In bigger races, there are usually several pacers at various speeds running throughout the race course.

The data for this set of exercises is on the Ridge Running Exercises.xls workbook's Finish Times worksheet, as shown in Figure 5-15.

	A	B
1	***Using Distance and Target Pace***	
2	Total Distance (km/Miles)	13.1
3	Target Minutes Per Km/Mile	8.65
4	Target Finish Time (Minutes)	113.315
5		
6	***Using Distance and Elapsed Time***	
7	Total Distance (km/Miles)	13.1
8	Total Elapsed Time (Minutes)	126
9	Average Minutes Per Km/Mile	9.618321
10		
11	***Using a Pacer***	
12	Total Distance (km/Miles)	13.1
13	Your Minutes Per Km/Mile	10
14	Pacer's Target Finish Time (Minutes)	120
15	Difference From Pacer's Time (Minutes)	11
16	Difference From Pacer's Time (Minutes Per Km/Mile)	0.839695

Figure 5-15. *The race-day finish times forecasting worksheet*

This worksheet contains the following information:

- For forecasting elapsed time given total distance and target pace, the total distance is specified in cell B2, the target pace is specified in cell B3, and the elapsed time is displayed in cell B4.
- For forecasting target pace given total distance and elapsed time, the total distance is specified in cell B7, the elapsed time is specified in cell B8, and the target pace is displayed in cell B9.
- For forecasting the difference in elapsed time and target pace from a pacer, the total distance is specified in cell B12, your target pace is specified in cell B13, the pacer's elapsed time is specified in cell B14, your difference in elapsed time from the pacer is displayed in cell B15, and your difference in target pace from the pacer is displayed in cell B16.

Race-Day Finish Times with Distance and Target Pace

Use Solver along with cells B2 through B4 to forecast the maximum number of miles you could run in two hours given a target pace of 9.5 minutes per mile.

1. Click Tools ➤ Solver.
2. Click Reset All, and then click OK.
3. Click the Set Target Cell box, and then click cell B4.
4. Click the Value Of option, and then type **120** in the Value Of box.
5. Click the By Changing Cells box, and then select cells B2 and B3.
6. Click Add.
7. Click the Cell Reference box, and then click cell B3.
8. In the operator list, click =.
9. Click the Constraint box, and then type **9.5**.
10. Click OK.
11. Click Solve, and then click OK.

Compare your results to Figure 5-16.

	A	B
1	***Using Distance and Target Pace***	
2	Total Distance (km/Miles)	12.63158
3	Target Minutes Per Km/Mile	9.5
4	Target Finish Time (Minutes)	120

Figure 5-16. *Using Solver to forecast the maximum number of miles you could run in two hours given a target pace of 9.5 minutes per mile*

Now, save this problem as a model.

1. Click Tools ➤ Solver.
2. You will see that the Solver Parameters dialog box retained the settings from the previous exercise. Click Options.
3. Click Save Model.
4. Click cell D19, and then click OK.
5. Click OK to return to the Solver Parameters dialog box, and then click Close.

Finally, load the previously saved model.

1. Change the values in cells B2 and B3, so that you can see the numbers change when you load a saved model (for example, type **10** in cell B2 and **9** in cell B3).
2. Click Tools ➤ Solver.
3. Click Reset All, and then click OK.
4. Click Options.
5. Click Load Model.
6. Select cells D19 through D22, and then click OK.
7. Click OK to return to the Solver Parameters dialog box.
8. Click Solve, and then click OK.

Compare your results to Figure 5-16 again.

Race-Day Finish Times with Distance and Elapsed Time

Use Solver along with cells B7 through B9 to forecast the time it would take to complete a marathon (26.2 miles) at a pace of 10.5 minutes per mile.

1. Click Tools ➤ Solver.
2. Click Reset All, and then click OK.
3. Click the Set Target Cell box, and then click cell B9.
4. Click the Value Of option, and then type **10.5** in the Value Of box.
5. Click the By Changing Cells box, and then select cells B7 and B8.
6. Click Add.
7. Click the Cell Reference box, and then click cell B7.
8. In the operator list, click =.
9. Click the Constraint box, and then type **26.2**.
10. Click OK.
11. Click Solve, and then click OK.

Compare your results to Figure 5-17.

6	***Using Distance and Elapsed Time***	
7	Total Distance (km/Miles)	26.2
8	Total Elapsed Time (Minutes)	275.1
9	Average Minutes Per Km/Mile	10.5

Figure 5-17. *Using Solver to forecast the time it would take to complete a marathon at a pace of 10.5 minutes per mile*

Race-Day Finish Times with a Pacer

Use Solver along with cells B12 through B16 to forecast your target pace per mile given a distance of 6.2 miles (10 kilometers), a pacer's target finish time of 52 minutes, and a desired target pace per mile of 15 seconds faster than the pacer.

1. Click Tools ➤ Solver.
2. Click Reset All, and then click OK.
3. Click the Set Target Cell box, and then click cell B16.
4. Click the Value Of option, and then type **0.25** in the Value Of box.
5. Click the By Changing Cells box, and then select cells B12 through B14.
6. Click Add.
7. Click the Cell Reference box, and then click cell B12.
8. In the operator list, click =.
9. Click the Constraint box, and then type **6.2**.
10. Click Add.
11. Click the Cell Reference box, and then click cell B14.
12. In the operator list, click =.
13. Click the Constraint box, and then type **52**.
14. Click OK.
15. Click Solve, and then click OK.

Compare your results to Figure 5-18.

11	***Using a Pacer***	
12	Total Distance (km/Miles)	6.2
13	Your Minutes Per Km/Mile	8.637097
14	Pacer's Target Finish Time (Minutes)	52
15	Difference From Pacer's Time (Minutes)	1.55
16	Difference From Pacer's Time (Minutes Per Km/Mile)	0.25

Figure 5-18. *Using Solver to forecast your target pace per mile given a distance of 10 kilometers, a pacer's target finish time of 52 minutes, and a desired target pace per mile of 15 seconds (0.25 minute) faster than the pacer*

Use Solver to Pair Up Race Relay Teams

In this section, you will use Solver to determine whether a particular runner would be a good candidate for a race relay team, given factors such as total race distance, number of runners on the relay team, the target elapsed finish time, and so on.

This exercise's data is on the Ridge Running Exercises.xls workbook's Relay Teams worksheet, as shown in Figure 5-19.

	A	B
1		
2	Total Distance (km/Miles)	26.2
3	Total Number of Racers	3
4	Target Total Finish Time (Minutes)	240
5	Total Distance (km/Miles) Per Racer	8.733333
6	Average Minutes Per Km/Mile	9.160305
7	Total Minutes Per Racer	80
8		
9	Your Average Minutes Per Km/Mile	9
10	Qualify for This Relay Team?	Yes

Figure 5-19. *The relay teams pairing worksheet*

This worksheet contains the following information:

- The race's total distance, in kilometers or miles, is provided in cell B2.
- The number of racers on the race relay team is provided in cell B3.
- The target elapsed race finish time, in minutes, is provided in cell B4.
- The distance, in kilometers or miles, that each race relay team member will run is provided in cell B5.
- The pace in minutes per kilometer or mile that each race relay team member needs to run to meet or beat the target elapsed race finish for the given distance is provided in cell B6.
- The elapsed time per race relay team member is provided in cell B7.
- You enter your projected pace in minutes per kilometer or mile in cell B9.
- Cell B10 displays whether you are a good candidate for this particular relay team.

Use Solver to determine whether you are a good candidate for a five-person race relay team running a distance of 62 miles (100 kilometers), with no team member running for more than 1.5 hours, assuming your average pace per mile is 8.75 minutes.

1. Click Tools ➤ Solver.
2. Click Reset All, and then click OK.
3. Click the Set Target Cell box, and then click cell B7.

4. Click the Value Of option, and then type **90** in the Value Of box.
5. Click the By Changing Cells box, and then select cells B2, B3, B4, and B9.
6. Click Add.
7. Click the Cell Reference box, and then click cell B2.
8. In the operator list, click =.
9. Click the Constraint box, and then type **62**.
10. Click Add.
11. Click the Cell Reference box, and then click cell B3.
12. In the operator list, click =.
13. Click the Constraint box, and then type **5**.
14. Click Add.
15. Click the Cell Reference box, and then click cell B9.
16. In the operator list, click =.
17. Click the Constraint box, and then type **8.75**.
18. Click OK.
19. Click Solve, and then click OK.

Compare your results to Figure 5-20.

	A	B
1		
2	Total Distance (km/Miles)	62
3	Total Number of Racers	5
4	Target Total Finish Time (Minutes)	450
5	Total Distance (km/Miles) Per Racer	12.4
6	Average Minutes Per Km/Mile	7.258065
7	Total Minutes Per Racer	90
8		
9	Your Average Minutes Per Km/Mile	8.75
10	Qualify for This Relay Team?	No

Figure 5-20. *Using Solver to determine whether you are a good candidate for a five-person race relay team running a distance of 62 miles, with no team member running for more than 1.5 hours, assuming your average pace per mile is 8.75 minutes*

Summary

In this chapter, you completed several exercises that demonstrated in case-study format how to do the following:

- Use Goal Seek to forecast a running club's membership dues.
- Use one-variable and two-variable data tables to forecast race paces.
- Use scenarios to forecast race-day cash flow.
- Use Solver to forecast race-day finish times and pair up race relay teams.