Chapter 1

Getting Ready for Six Sigma: The Effects of Variation

In This Chapter

- Realizing that variation is everywhere
- Mastering the Six Sigma breakthrough equation
- Exploring the effect of variation on business performance

The characterization, measurement, analysis, and control of variation is the central theme of Six Sigma. Every process and every product is affected by variation. Variation — within limits — is okay, and is even desirable. However, you can actually have too much variation. If undesirable variation is out of control, failure is the result!

The key goals of Six Sigma are to fix undesirable variation, ignore variation that doesn't matter, and allow for variation that can't be fixed. Many of the tools and techniques in this workbook help you determine whether your variation is desirable or undesirable. These tools also show you how to fix the variation that can actually be fixed, so that your efforts are concentrated where you can make the most improvement impact.

Before you go any further in this workbook, however, you must accept two undeniable truths about variation: Every output varies and every input varies. Don't you feel better now that you've accepted the fact that variation happens? It's simply a fact of life. You can now focus on finding and correcting as much of that variation as possible — making your processes and products the best they can be. Please also check out `www.dummies.com/go/sixsigmaworkbook` for some useful forms you can print out.

Recognizing Variation around You

To get started recognizing the variation around you, use the variation journal in Figure 1-1 to chronicle the variation you encounter in a day of normal activities. Because you have accepted that everything has variation, your daily journal could exceed the size of the Library of Congress if you try to include everything that happens! Instead, try to concentrate on more significant events — events that, if impacted by unacceptable variation, could have a negative effect on your life or job. Figure 1-2 is an example of the entries you might make. Try to record at least 20 key items. As indicated on the worksheet, consider the type of failure that the variation could cause, and whether the variation can be controlled.

Variation Journal

Date: ________________

Activity	Undesirable Variation	Effect of Variation	Is Variation Controllable? Yes/No

Figure 1-1: The Six Sigma variation journal.

Variation Journal

Date: ________________

Activity	Undesirable Variation	Effect of Variation	Is Variation Controllable? Yes/No
Arriving at work	Arriving late	Loss of wages, lost business, lost job	Yes
Returning phone calls	Calls returned late	Lost business, irritation of boss	Yes
Accessing server computer	Server slow to respond or not available	Inefficiency, lost data	Maybe

Figure 1-2: Entry examples for the variation journal.

Evaluating Variation and Business Performance with $Y = f(X) + \varepsilon$

The word "breakthrough" is bandied about all the time, particularly when advertising some product — a breakthrough shaving system, breakthrough hair gel, a breakthrough mousetrap, and on and on. So, you have to be a bit cautious when claiming something is a breakthrough product. But, Six Sigma practitioners don't hesitate to call the basic equation, $Y = f(X) + \varepsilon$, a breakthrough equation. When you apply the concept that all outcomes (Ys) are the result of some number of inputs (Xs) that interact in some way — f, or the function — to produce that outcome, and that there are always some other factors, either known or unknown — ε, or epsilon — that will impact the outcome, then you are well on your way to breakthrough improvements.

REMEMBER

The elegance of the $Y = f(X) + \varepsilon$ equation is that it applies to anything and everything — from the simplest process, such as mixing a drink, to the most complex, such as building a space shuttle. After a process is broken down into primary elements, you can then identify the desired outcome, find the inputs that contribute to that outcome, identify those inputs that really matter, recognize where error and variation might occur, and plan improvements that will have a positive impact. This workbook gives you guidance in applying these concepts and conducting improvement activities.

Breaking down $Y = f(X) + \varepsilon$ to a simple process

Following is an example of a simple process with which almost everyone is familiar — cooking eggs. If you apply $Y = f(X) + \varepsilon$ to this process, the results look like this:

- Outcome (Y) — properly cooked eggs
- Inputs (Xs) — eggs, oil, heat, pan, timer
- Function (f) — shells are removed, oil is added to pan, eggs are placed in pan, heat is applied for a specific time, eggs are removed
- Epsilon (ε) — size of eggs, age of eggs, temperature of eggs, thickness of pan, amount of heat, timer accuracy, type of oil, altitude

TIP

Some of these factors can be quantified and controlled, but others can't. The trick is to determine which, if any, of these inputs have a significant impact on the outcome and can be controlled. One of the basic tenets of Six Sigma is focusing efforts only on those inputs that have a substantial impact and that are practical to address. Time and resources would be wasted if you tried to improve the egg-cooking process by changing the altitude!

Applying $Y = f(X) + \varepsilon$: A practice example

As practice, apply the $Y = f(X) + \varepsilon$ equation to a more complicated process, one much like many business processes. Think about the equation as you read the story about a house fire on Elm Street. Then use the worksheet in Figure 1-3 to match elements of the story to the components of the equation. Here's the story problem:

> A house catches fire on Elm Street and a neighbor calls 911 to report the fire and give the address. The 911 operator triggers an alarm in the nearest fire station and transmits the address. When the alarm sounds, the firefighters dress, load the truck, and leave the firehouse. Using a current map and an established route plan, they find and take the most direct route to Elm Street. Halfway to Elm Street, they encounter a major traffic jam, which is normal for that time of day, and have to detour. Shortly thereafter, a freak sleet storm forces the truck to slow to a crawl. When the truck finally arrives, the men hook up the hoses, but find that water pressure is low and that water flow to the fire is significantly less than normal. Eventually the flames are extinguished, but only after the house is a total loss. Fortunately, all the residents of the house escaped without injury.

From the perspective of the fire department, identify a primary Y, at least ten important Xs, and the elements of error.

$Y = f(X) + \varepsilon$ Worksheet

Output (Y)	Input (X)	Error

Figure 1-3: The $Y = f(X) + \varepsilon$ exercise worksheet.

Figure 1-4 is a solution to the practice house fire exercise. Even if your solution includes different items, it's okay. You have at least started thinking how the breakthrough equation applies to business processes.

Y = f(X)+ ε Worksheet		
Output (Y)	**Input (X)**	**Error**
Put out the fire quickly	911 call	Traffic
	Fire station alarm	Sleet storm
or: Prevent injuries or loss of life	Address of fire	Low water pressure
	Map	
	Route plan	
	Training	
	Firefighter	
	Fire truck	
	Water	
	Hoses	
	Traffic	

Figure 1-4: The solution to the practice house fire exercise.

Assessing the Impact of Variation on Business Performance

After you realize that variation is prevalent in all processes, you have to determine the effect variation has on your process, and then you have to assess if it's really a problem at all. After all, some variation is inevitable, and you can live with it, right? Well, maybe, or maybe not.

Suppose you're the general manager of Widgets International, the undisputed market leader. You're rightfully proud of your market position, and believe that producing the highest quality widgets has lead you to where you are today. So, you're taken aback when an upstart Six Sigma Yellow Belt dares ask you about the true reliability of your widget production process. "We produce the best darn widgets possible," you retort. "We just can't do much to improve that process. Our rigorous assessments have determined that each and every step in the process is 95 percent reliable. Therefore, the whole process is 95 percent reliable. How can we do better than that?"

The Yellow Belt persists, so you decide to humor her even though you're confident in your figures. "How many steps are there in the production process," she asks. Consulting your most recent production chart, you answer, "We have a total of 20 discrete steps." The Yellow Belt then says, "Let's do some calculations. If each of the first two steps is 95 percent reliable, the chance of a widget making it through both steps without a defect is 0.95 times 0.95, or 90.25 percent." "Uhhh," you respond eloquently, "90 percent is still pretty good, right?" "Well, sure," she says, "but we aren't done yet. The chance of a widget making it through the first three steps without a defect is 0.95 times 0.95 times 0.95, or 85.74 percent." You begin to get a sinking feeling in the pit of your stomach. Sweat begins to run down your face. You begin to see the big picture and stammer, "Are you telling me that this calculation should be made through all 20 steps? What is the bottom line here?" She whips out her calculator and pounds in a few numbers, and then she gives you the bad news: "Well, if each of the 20 steps is 95 percent reliable, the chance of a widget making it all the way through the process without defect is 36 percent."

You feel like you've been whacked with a 2 x 4. "How did you get so smart," you ask Miss Yellow Belt. "This type of analysis is called 'rolled throughput yield, or RTY,' and is part of any basic Six Sigma training," she replies. She again pounds her calculator briefly and says, "And another interesting calculation we can make from this data is Defects Per Unit, or DPU. In this case, the DPU is 1.02." Now you're really stunned. "So what you're telling me is that only about one-third of our widgets make it through the process without a defect, and we can expect, on average, more than one defect per widget? But I know from our latest production report that our final inspection is at 95 percent. Wouldn't that mean we have a tremendous amount of expense, rework, overhead, and excess inventory to make up the difference between the calculated 36 percent rolled throughput yield and our observed 95 percent final inspection?" The Yellow Belt smiled, "Now you know why I'm here."

Finally, you ask the Yellow Belt, "Can you give me a template that I can use to calculate these key ratios for other processes?" Figure 1-5 is a worksheet you can use to calculate the RTY and DPU for your own processes.

Process Step	Description	Yield or Reliability	RTY
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Instructions: Start with process step 1, whose RTY is the same as its yield for step 2, and enter the cumulative RTY. Continue for all process steps to calculate the RTY for the entire process.

Calculating DPU (From *Six Sigma For Dummies*, p. 138):
DPU = -1n(RTY)

Remember: 1n is the natural logarithm and can be obtained from any scientific calculator, as well as from math tables.

DPU

Figure 1-5: The worksheet for calculating RTY and DPU.