

CHAPTER 3

The Distribution of Test Scores—The Perfect Body?

As we noted in Chapter 2, frequency distributions give you a bird's eye view of scores and allow you to make simple comparisons among the people who took your test. The problem with frequency distributions, however, is that they don't allow you to make really precise comparisons. To help you become slightly more sophisticated in your ability to compare test scores across people, we're going to teach you about *frequency curves*.

The first step in getting more meaning out of a frequency distribution is to graph it. This graph is called a frequency curve. A graph is created by two axes. Along the horizontal axis (x -axis), the score values are presented in ascending order. Along the vertical axis (y -axis), the frequency of people who could have gotten each score appears. Zero is the point where the y -axis intersects with the x -axis. For group frequency data, the possible intervals are listed on the x -axis. Although the midpoint score is typically used to represent the entire interval, in order not to confuse you, in our examples we will list the exact scores obtained within each interval.

Frequency curves can take on an unlimited number of shapes, but in measurement we most often assume that scores are distributed in a "bell-shaped" normal curve—the perfect body! This body is *symmetrical*. When you draw it, you can fold it in half and one side will be a reflection of the other.

Kurtosis

The normal curve also possesses a quality called kurtosis (no, that's not bad breath). *Kurtosis* is one aspect of how scores are distributed—how flat or how peaked. There are three forms of a normal curve depending on the distribution, or kurtosis, of scores. These forms are referred to as *mesokurtic*,

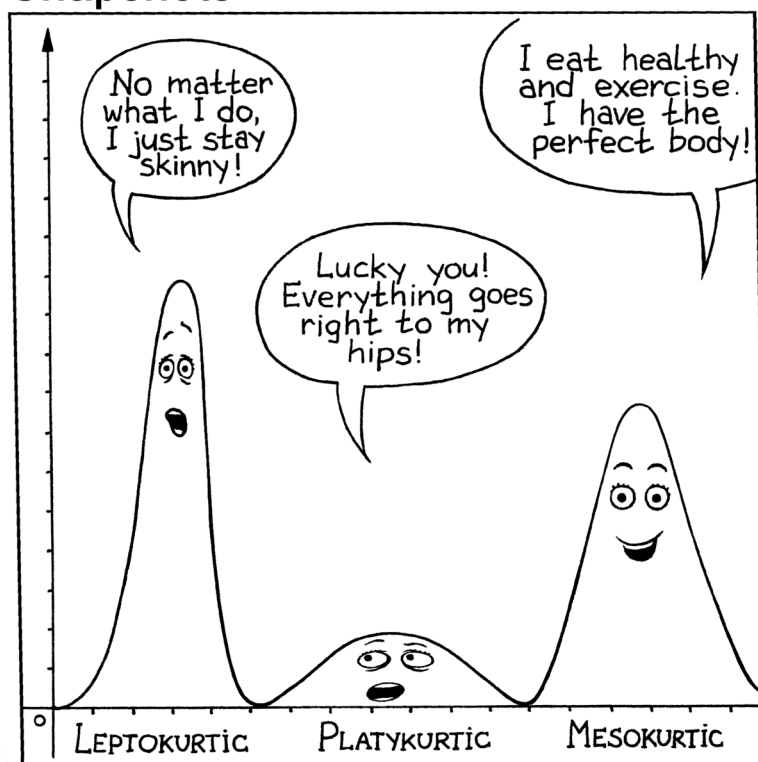
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leptokurtic, and *platykurtic* curves. Our friendly ghosts in Figure 3.1 illustrate these curves.

The first curve is the *mesokurtic curve*. While this is certainly not the perfect shape for the human body, it is the perfect body in measurement. It is what you typically think of as a normal, bell-shaped curve. Scores are nicely distributed around a clear central score. The majority of the scores fall in the center with fewer and fewer scores occurring as you move further from the center. The curve is just right—not too fat and not too skinny. We'll tell you a lot more about the normal curve when we discuss central tendencies and dispersion in the next chapter.

We all know, however, that it's rare to have a perfect body. A curve can be bell shaped and symmetrical, but be too skinny. This is called a *leptokurtic curve*. Almost everyone's scores cluster in the middle so that the bell-shaped curve is pointy and skinny. You can remember the name of this type of curve by thinking that the scores are leaping (lepto) up in the middle.

Snapshots



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Figure 3.1 Kurtosis

A curve can also be too fat. A curve that is too fat is called a *platykurtic curve*. Instead of scores leaping up in one cluster, they have spread themselves out like melting butter. There is still a slightly higher middle point and the curve is still symmetrical, but scores are spread out rather evenly from the lowest to highest points. To help you remember a platykurtic normal curve, you can remember that “plat” rhymes with flat and fat. Or, if you have a good visual imagination, you might think of the flat-billed platypus and compare its bill to the rather flat platykurtic curve.

Each one of these three curves is *symmetrical*. For each, the two halves match. This means that half of the scores are in one half of the curve and half of the scores are in the other half of the curve. (You’ll be glad we told you this when we start discussing percentiles.)



Let’s Check Your Understanding

1. Kurtosis is _____.
2. When a curve is bell shaped and symmetrical but all scores cluster tightly around one central point, the curve is _____.
3. When a curve is bell shaped and symmetrical but all scores are spread out across the score range, the curve is _____.
4. When a curve is perfectly bell shaped and symmetrical, the curve is _____.



Our Model Answers

1. Kurtosis is **one aspect of how scores are distributed.**
2. When a curve is bell shaped and symmetrical but all scores cluster tightly around one central point, the curve is **leptokurtic.**
3. When a curve is bell shaped and symmetrical but all scores are spread out across the score range, the curve is **platykurtic.**
4. When a curve is perfectly bell shaped and symmetrical, the curve is **mesokurtic.**

Skewness

When one side of a curve is longer than the other, we have a *skewed distribution* (see Figure 3.2). What this really means is that a few people’s scores

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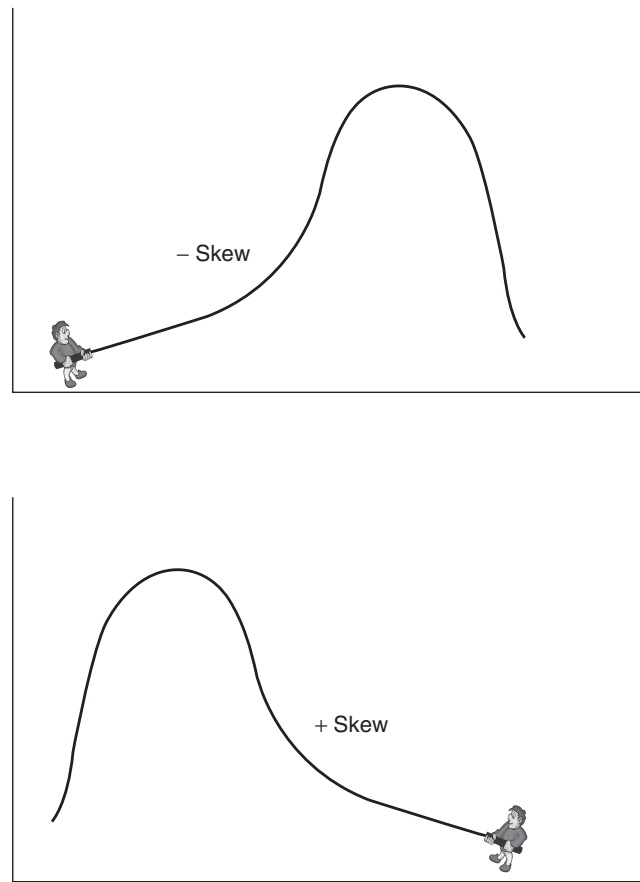


Figure 3.2 Skewness

did not fit neatly under the bell-shaped distribution and were either extremely high or extremely low. This makes one end of the curve longer than the other. The two ends of a curve are called its *tails*. All curves have two tails, whether they are long and flowing or stubby and cut off. On a symmetrical, normal curve, the two tails will fit on top of each other if you fold a drawing of the curve in half.

When a curve is skewed, one tail has run amok. When one or a few scores are much lower than all other scores, the tail is longer on the left side of the curve. This curve is called a *negatively skewed* curve. When one or a few scores are much higher than all other scores, the tail is longer on the right side of the curve. This curve is called a *positively skewed* curve. Since students often confuse what is negatively skewed and positively skewed, here's a memory hint: If the tail is long on the left, it's pointing to lower scores. On most tests, scoring low is not good—it's bad; it's negative! If the tail is long on the right, it is pointing to higher scores. Yea! Higher is usually

better; this is positive! Those of us who tend to score in the average range, though, think of these high scorers as “curve wreckers.” Figure 3.2 depicts both a negatively skewed curve and a positively skewed curve.

OK, let’s see if we can make all of this more concrete by looking at the frequency distribution from Table 2.1. From this frequency distribution we can create our own frequency curve. To make this easier, here is Table 3.1 (previously shown as Table 2.1).

Just by eyeballing these scores, what conclusions can you draw? Hmm. . . . Ask yourself, “Is there one score or a few scores clustered together that serve as a central point?” If you answered “No,” good for you! Then ask yourself, “Are the scores spread out rather evenly (like melted butter)?” If you answered “Yes” this time, you are right again!!! So far, so good! Now, based on the fact that there’s no real central point and the scores are spread out across the distribution, you wisely conclude that the curve is platykurtic.

Next, you need to determine if there might be distortions in the potential curve based on this frequency distribution. Ask yourself, “Are there any

Table 3.1 Frequency Distribution of Midterm Grades

Score X	f	Score X	f
100	1	77	
99		76	
98	1	75	1
97		74	
96		73	1
95	1	72	
94		71	1
93	2	70	
92		69	
91		68	
90	2	67	
89	1	66	
88		65	
87	2	64	
86	1	63	
85	3	62	
84		61	
83	1	60	
82		59	
81	2	58	
80	2	57	
79	1	56	1
78	1		

$N = 25$

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extreme scores that are much higher or lower than the rest of the scores?" The correct answer is . . . Yes! One person scored really low with a score of only 56. The tail of this curve is pulled to the left and is pointing to this low score. This means that the curve is skewed in the negative direction.

Just by looking at this frequency distribution, you can conclude that the students were very spread out in their midterm grades and one person scored very differently (much worse) than the rest of the class. You should arrive at these same conclusions if you examine the grouped frequency distribution of the same test scores in Table 2.3. All of the scores but one are somewhat evenly distributed across the intervals from 71–73 to 98–100. That one score in the 56–58 interval causes this platykurtic distribution to be negatively skewed.

Although eyeballing is a quick and dirty way of looking at your scores, a more accurate way is to graph the actual scores. As we told you at the beginning of this chapter, on the horizontal axis, typically called the *x-axis*, you list the possible scores in ascending order. If you are working with grouped frequency data, you list the intervals (see Figure 3.3). When you create a graph, however, let the midpoint of the interval represent the entire interval. On the vertical axis, typically called the *y-axis*, you list the frequencies in ascending order that represent the number of people who might have earned a score in each interval.

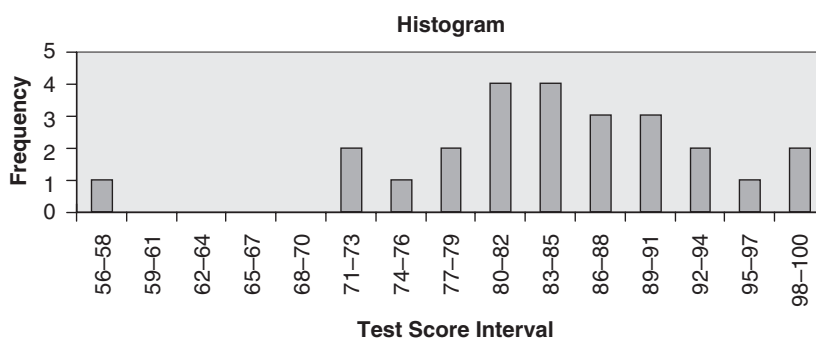


Figure 3.3 Graph of Grouped Midterm Scores



Let's Check Your Understanding

1. What are the ends of a curve called?

2. What causes a curve to be skewed?

3. When a curve is negatively skewed, what conclusion can you make about how people scored?



Our Model Answers

1. What are the ends of a curve called?
The ends of a curve are called its *tails*.
2. What causes a curve to be skewed?
When one or a few scores are much higher or lower than all other scores, the curve is skewed.
3. When a curve is negatively skewed, what conclusion can you make about how people scored?
We can conclude that one or a few people scored much lower than all the other people.

Some Final Thoughts About Distribution of Test Scores

Creating a frequency curve of your scores allows you to see how scores are distributed across the score range. You can see the shape of the distribution and tell whether it is skewed. It is possible to create a frequency distribution from single scores and from grouped scores.

Key Terms

Let's see how well you understand the concepts we've presented in this chapter. Test your understanding by explaining the following concepts. If you are not sure, look back and reread.

- Frequency curve
- Kurtosis
 - Mesokurtic
 - Leptokurtic
 - Platykurtic

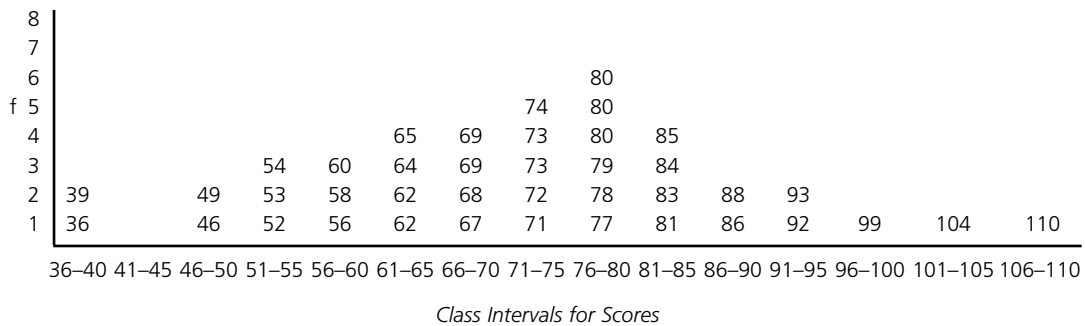
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- Skewness
 - Positively skewed
 - Negatively skewed
- Graphs
 - x -axis
 - y -axis

Models and Self-instructional Exercises

Our Model

We have created a frequency curve by graphing the College Stress Scale test scores originally presented in the tables on pages 28 and 30 [QQ].



1. What does the y -axis represent?

2. What does the x -axis represent?

3. What is the kurtosis of this frequency curve?

4. Is this frequency curve skewed?



Our Model Answers

1. What does the y -axis represent?
The frequency of people who could have gotten scores within each of the intervals appears next to the vertical axis. For our example, we used frequencies ranging from 0 to 8.
2. What does the x -axis represent?
On the horizontal axis, we listed all of the possible class intervals.
3. What is the kurtosis of this frequency curve?
Although not perfectly symmetrical, this distribution could be considered a normal, bell-shaped, mesokurtic curve.
4. Is this frequency curve skewed?
It is not skewed because no scores are extremely larger or extremely smaller than all of the other scores.

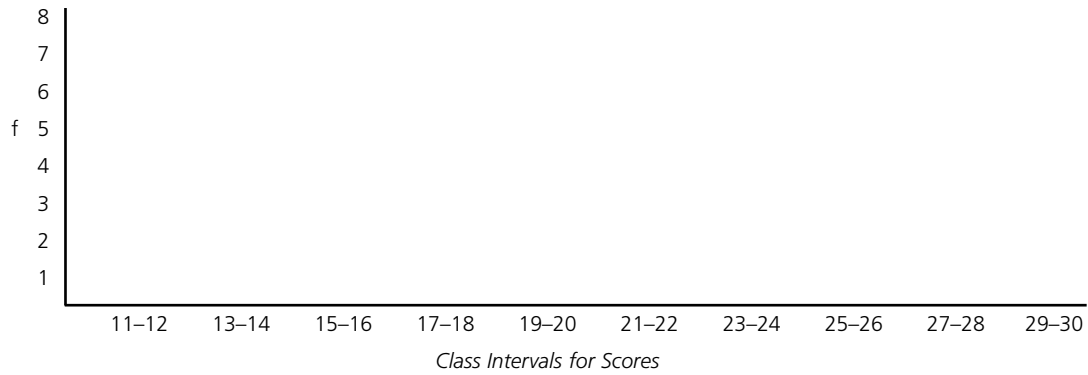


Now It's Your Turn

Now it's your turn to practice using what you have learned. Using the social support data for Ryan and 39 other freshmen presented in Chapter 2, create your own frequency curve in the graph we have started below. To help you, here is the grouped frequency distribution.

<i>Class Interval</i>	<i>f</i>	<i>cf</i>
29–30	3	40
27–28	4	37
25–26	4	32
23–24	6	28
21–22	7	23
19–20	6	16
17–18	4	10
15–16	4	6
13–14	1	2
11–12	1	1
$N = 40$	$i = 2$	

Remember that 40 freshmen took the social support inventory, so you should have 40 separate scores in your graph.

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Now that you've done this, you need to describe your frequency curve.

1. Is there one (or a few) score clustered together that serves as a central point?

2. Are the scores spread out rather evenly (like melted butter) across the distribution?

3. Based on your answers to these two questions, what can you conclude about kurtosis?

4. Are there any extreme scores that are much higher or lower than the rest of the scores?

5. Based on your answers to these questions, describe your frequency curve and what it tells you about how students scored on the social support inventory.



Our Model Answers



1. Is there one (or a few) score clustered together that serve as a central point?

Yes, scores are clustered around the interval 21–22.

2. Are the scores spread out rather evenly (like melted butter) across the distribution?

No, they resemble a bell-shaped curve.

3. Based on your answers to these two questions, what can you conclude about kurtosis?

The distribution is mesokurtic and is roughly symmetrical.

4. Are there any extreme scores that are much higher or lower than the rest of the scores?

No, there are no extreme scores. This means that the curve is not skewed.

5. Based on your answers to these questions, describe your frequency curve and what it tells you about how students scored on the social support inventory.

Scores on the social support inventory for this group of freshmen fell into a mesokurtic, bell-shaped curve. In addition, approximately half of them (19 students) scored between 19 and 24 on the inventory. No one had a really low score that was different from the rest of the group. Similarly, no one got a really high score. Forty points was the highest possible score on this 20-item inventory. (If you forgot the possible score range for this inventory, reread this section of Chapter 2.) We can conclude that Ryan and the other freshmen's scores are normally distributed in a mesokurtic, bell-shaped curve.

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Words of Encouragement

It's time for us to say thank you for hanging in there. We are really concerned about helping you become knowledgeable about measurement, and you have been following our lead quite nicely. From what we can tell, you are just where you should be. Good work!! ☺