The Day the Sky Roared

Shortly after daybreak on April 3, 1974, thunder began to rumble through the dark skies that covered much of the midwestern United States. Lightning struck areas from the Gulf Coast states to the Canadian border. By the predawn hours of the next day, the affected region of around 490,000 acres was devastated by over 100 tornadoes. This "super outbreak" was responsible for the deaths of over 300 people in 11 states. More than 6100 people were injured by the storms, with approximately 27,500 families suffering some kind of loss. The total cost attributed to the disaster was more than $600 million. Amazingly, the storm resulted in six Category 5 tornadoes with wind speeds exceeding 261 miles per hour. To put this figure in perspective, the region endured about one decade's worth of Category 5 tornadoes in a single 24-hour period!

Fujita Wind Damage Scale

F-Scale	Wind Speed	Damage
F-0	Up to 72 mph	Light
F-1	73 to 112 mph	Moderate
F-2	113 to 157 mph	Considerable
F-3	158 to 206 mph	Severe
F-4	207 to 260 mph	Devastating
F-5	Above 260 mph	Incredible

Structural engineers and meteorologists are interested in understanding catastrophic events such as this tornado outbreak. Variables such as tornado intensity (as described by the F-Scale), tornado duration (time spent by the tornado in contact with the ground), and death demographics can provide insights into these events and their impact upon the human population. The following data list the duration time and F-Scale for each tornado in the April 1974 Super Outbreak:

Tornado Duration Times for Outbreak of April 3–4, 1974

| F-Scale	Tornado Duration (minutes)
F-0	1,1,5,1,1,6,4,10,5,4,1,1,1,1,1,1,1,1,1,1,30,1,9
F-1	16,13,9,8,13,10,15,1,17,23,10,8,12,5,20,31,12,5,30,13,7,1,5,13,1,2,5,10, 1,20,5
F-2	7,15,2,10,23,10,7,12,8,1,8,19,5,10,15,20,10,13,20,15,13,14,1,4,2,15,30, 91,11,5
F-3	9,20,8,16,26,36,10,20,50,17,26,31,21,30,23,28,23,18,35,35,15,25,30,15, 22,18,58,19,23,31,13,26,40,14,11
F-4	120,23,23,42,47,25,22,22,34,50,38,28,39,29,28,25,34,16,40,55,124,30, 30,31
F-5	37,69,23,52,61,122

The following tables present the number of deaths as a function of F-Scale and community size:

Deaths as a Function of F-Scale for April 3–4, 1974, Tornadoes	
F-Scale	**Deaths**
F-0	0
F-1	0
F-2	14
F-3	32
F-4	129
F-5	130

Deaths as a Function of Community Size for Tornado Super Outbreak of April 3–4, 1974	
Community Size	**Deaths**
Rural areas	99
Small communities	77
Small cities	63
Medium cities	56
Large cities	10

Create a report that graphically displays and discusses the tornado-related data. Your report should include the following:

1. A bar graph or pie chart (or both) that depicts the number of tornadoes by F-Scale. Generally, only a little more than 1 percent of all tornadoes exceed F-3 on the Fujita Wind Damage Scale. How does the frequency of the most severe tornadoes of the April 3–4, 1974, outbreak compare with normal tornado formation?

2. A single histogram that displays the distribution of tornado duration for all of the tornadoes.

3. Six histograms displaying tornado duration for each of the F-Scale categories. Does there appear to be a relationship between duration and intensity? If so, describe this relationship.

4. A bar chart that shows the relationship between the number of deaths and tornado intensity. Ordinarily, the most severe tornadoes (F-4 and F-5) account for more than 70 percent of deaths. Is the death distribution of this outbreak consistent with this observation?

5. A bar chart that shows the relationship between the number of deaths and community size. Include a discussion describing the number of deaths as a function of community size.

6. A general summary of your findings and conclusions.

Data Source: Abbey, Robert F. and T. Theodore Fujita. "Tornadoes: The Tornado Outbreak of 3–4 April 1974." In *The Thunderstorm in Human Affairs*, 2nd ed, edited by Edwin Kessler, 37–66. Norman, OK: University of Oklahoma Press, 1983. The death figures presented in this case study are based on approximations made from charts by Abbey and Fujita. Additional descriptions of events and normal tornado statistics are derived from Jack Williams's *The Weather Book*. (New York: Vintage Books, 1992.)
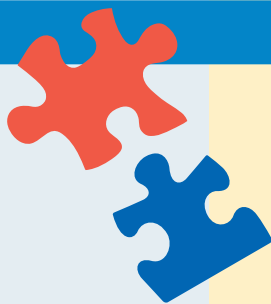
Tables or Graphs?

Suppose that you work for the school newspaper. Your editor approaches you with a special reporting assignment. Your task is to write an article that describes the "typical" student at your school, complete with supporting information. In order to write this article, you have to survey at least 40 students and ask them to respond to a questionnaire. The editor would like to have at least two qualitative and two quantitative variables that describe the typical student. The results of the survey will be presented in your article, but you are unsure whether you should present tabular or graphical summaries, so you decide to perform the following "experiment."

1. Develop a questionnaire that results in obtaining the values of 2 qualitative and 2 quantitative variables. Administer the questionnaire to at least 40 students on your campus.
2. Summarize the data in both tabular and graphical form.
3. Select 20 individuals. (They don't have to be students at your school.) Give the tabular summaries to 10 of the individuals and the graphical summaries to the other 10. Ask each individual to study each table or graph for 5 seconds. After 1 minute, give a questionnaire that asks various questions regarding the information contained in the table or graph. For example, if you had age data summarized, ask the individual which age group had the highest frequency. Record the number of correct answers for each individual. Which summary results in a higher percentage of correct answers, the tables or the graphs? Write a report that discusses your findings.
4. Now use the data collected from the questionnaire to create a couple of misleading graphs. Again, select 20 individuals. Give 10 of the individuals the misleading graphs and 10 of the individuals the correct graphs. Ask each of the individuals to study each graph for 5 seconds. After 1 minute has elapsed, give a questionnaire that asks various questions regarding the information contained in the graphs. Record the number of correct answers for each individual. Did the misleading graphs mislead? Write a report that discusses your findings.

DECISIONS

Consumer Reports

Consumer Reports Rates Treadmills

A study that compared exercisers who worked out equally hard for the same time on several different types of machines found that they generally burned the most calories on treadmills. Our own research has shown that treadmills are less likely than other machines to sit unused. So it should come as no surprise that treadmills are the best-selling home exercise machine in the U.S.

In a recent study by Consumer Reports (March 2002), we tested 11 best-selling brands of treadmills ranging in price from $500 to $3000. The treadmills were rated on ease of use, ergonomics, exercise factors, construction, and durability. Ease of use is based on how straightforward the treadmill is to use. Ergonomics, including safety factors, belt size, and handrail placement, indicates how well the treadmill fits people of different sizes. Exercise includes evaluations of the minimum incline level, speed control, and heart-rate monitoring. Construction covers factors like the motor's continuous-duty horsepower rating and weld quality.
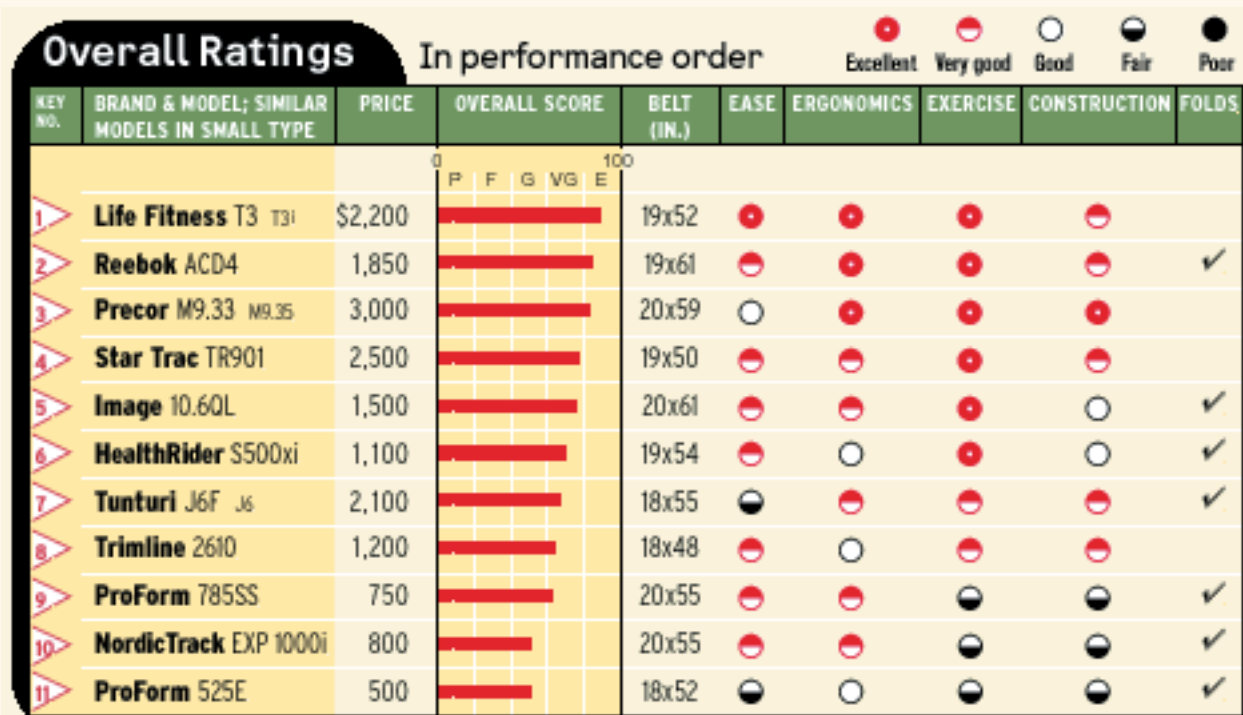
In order to help compare the treadmills, the individual attribute scores were combined into an overall score. The figure shown below is a ratings chart for the 11 treadmills based on our test results. In addition to the performance ratings, other useful information, such as the models' price and belt size, is included.

(a) What type of graph is illustrated to display overall score in the figure?

(b) Which model has the highest construction score? Which models have the lowest ease of use score?

(c) For ease of use, how many treadmills rated excellent? Very good? Good? Fair? Poor?

(d) Draw a frequency bar graph for each rating category. In other words, draw a bar graph for ease of use, ergonomics, and so on.

(e) Does there appear to be a relationship between price and overall score? Explain your opinion.

Note to Readers: In many cases, our test protocol and analytical methods are more complicated than described in these examples. The data and discussions have been modified to make the material more appropriate for the audience.

Ratings Chart for Treadmills

Rating	symbol
Excellent	● (red)
Very good	◖ (red)
Good	○
Fair	◖
Poor	●

KEY NO.	BRAND & MODEL; SIMILAR MODELS IN SMALL TYPE	PRICE	OVERALL SCORE	BELT (IN.)	EASE	ERGONOMICS	EXERCISE	CONSTRUCTION	FOLDS
1	**Life Fitness** T3 T3i	$2,200		19x52	●	●	●	◖	
2	**Reebok** ACD4	1,850		19x61	◖	●	●	◖	✔
3	**Precor** M9.33 M9.35	3,000		20x59	○	●	●	●	
4	**Star Trac** TR901	2,500		19x50	◖	◖	●	◖	
5	**Image** 10.6QL	1,500		20x61	◖	◖	●	○	✔
6	**HealthRider** S500xi	1,100		19x54	◖	○	●	○	✔
7	**Tunturi** J6F J6	2,100		18x55	◖	◖	◖	◖	✔
8	**Trimline** 2610	1,200		18x48	◖	○	◖	◖	
9	**ProForm** 785SS	750		20x55	◖	◖	◖	◖	✔
10	**NordicTrack** EXP 1000i	800		20x55	◖	◖	◖	◖	✔
11	**ProForm** 525E	500		18x52	◖	○	◖	◖	✔