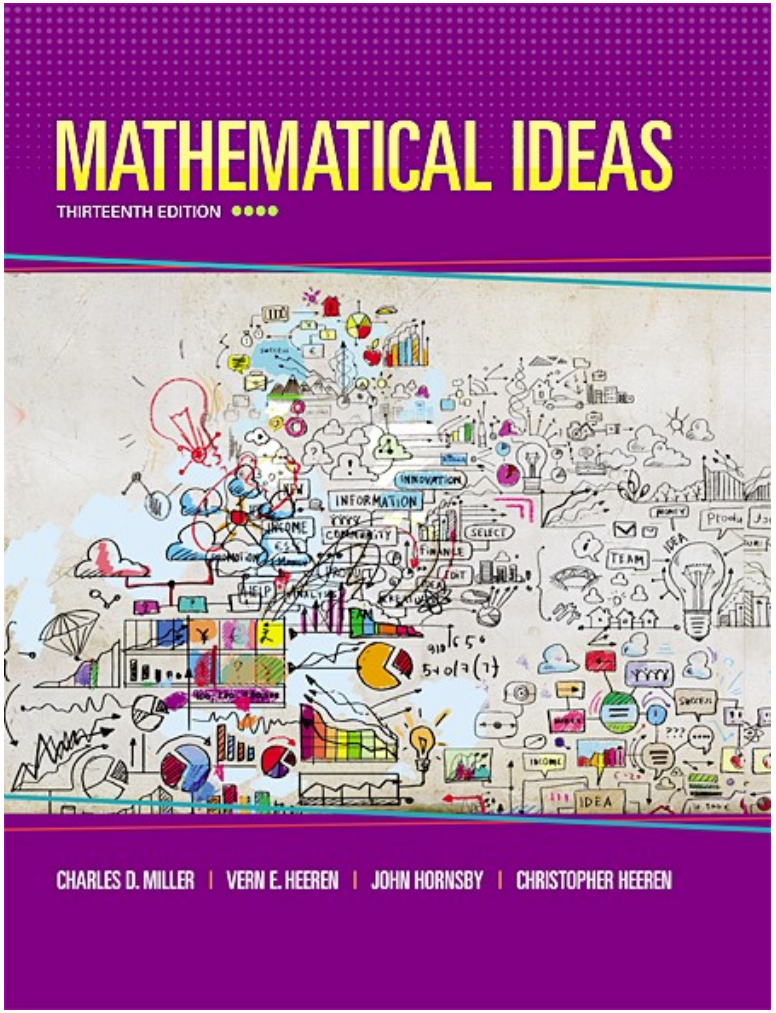
Chapter 12

Statistics



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Chapter 12: Statistics

12.1 Visual Displays of Data

12.2 Measures of Central Tendency

12.3 Measures of Dispersion

12.4 Measures of Position

12.5 The Normal Distribution

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Section 12-1

Visual Displays of Data

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Visual Displays of Data

- Understand the basic concepts of data displays.
- Work with frequency distributions.
- Work with grouped frequency distributions.
- Construct and interpret stem-and-leaf displays.
- Work with bar graphs, circle graphs, and line graphs.

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Basic Concepts

In statistics, a **population** includes *all* of the items of interest, and a **sample** includes *some* of the items in the population.

The study of statistics can be divided into two main areas. **Descriptive statistics** has to do with collecting, organizing, summarizing, and presenting data (information). **Inferential statistics** has to do with drawing inferences or conclusions about populations based on information from samples.

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Basic Concepts

Information that has been collected but not yet organized or processed is called **raw data**. It is often **quantitative** (or **numerical**), but can also be **qualitative** (or **nonnumerical**).

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Basic Concepts

Quantitative data: The number of siblings in ten different families: 3, 1, 2, 1, 5, 4, 3, 3, 8, 2

Qualitative data: The makes of five different automobiles: Toyota, Ford, Nissan, Chevrolet, Honda

Quantitative data can be **sorted** in mathematical order. The number of siblings can appear as: 1, 1, 2, 2, 3, 3, 3, 4, 5, 8

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Frequency Distributions

When a data set includes many repeated items, it can be organized into a **frequency distribution**, which lists the distinct values (x) along with their frequencies (f). It is also helpful to show the **relative frequency** of each distinct item. This is the fraction, or percentage, of the data set represented by each item.

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Example: Constructing Frequency and Relative Frequency Distributions

The ten students in a math class were polled as to the number of siblings in their individual families. Construct a frequency distribution and a relative frequency distribution for the responses below.

3, 2, 2, 1, 3, 4, 3, 3, 4, 2

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Example: Constructing Frequency and Relative Frequency Distributions

Solution

Number x	Frequency f	Relative Frequency f/n
1	1	1/10 = 10%
2	3	3/10 = 30%
3	4	4/10 = 40%
4	2	2/10 = 20%

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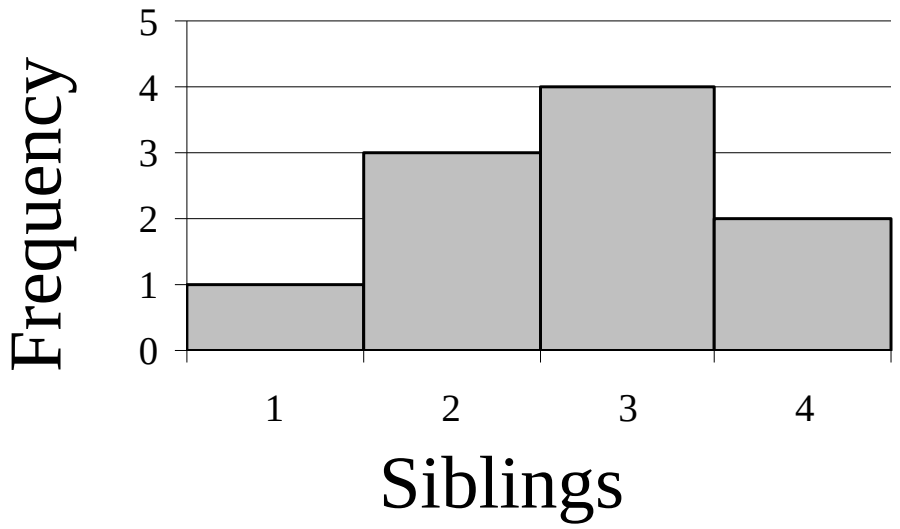
Histogram

The data from the previous example can be interpreted with the aid of a **histogram**. A series of rectangles, whose lengths represent the frequencies, are placed next to each other as shown below.



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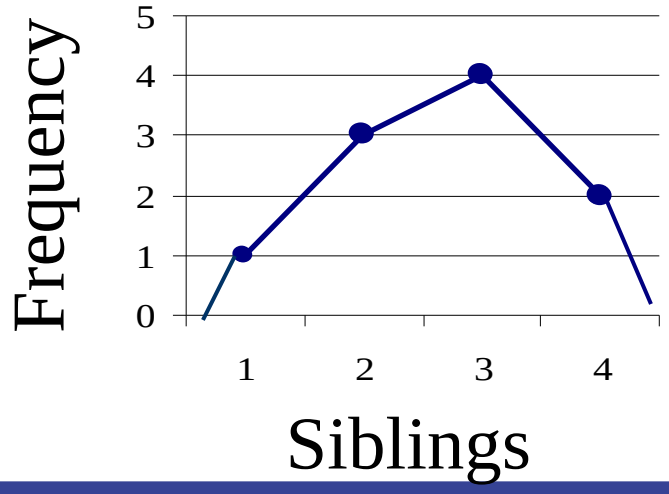
Frequency Polygon

The information can also be conveyed by a **frequency polygon**. Simply plot a single point at the appropriate height for each frequency, connect the points with a series of connected line segments and complete the polygon with segments that trail down to the axis.



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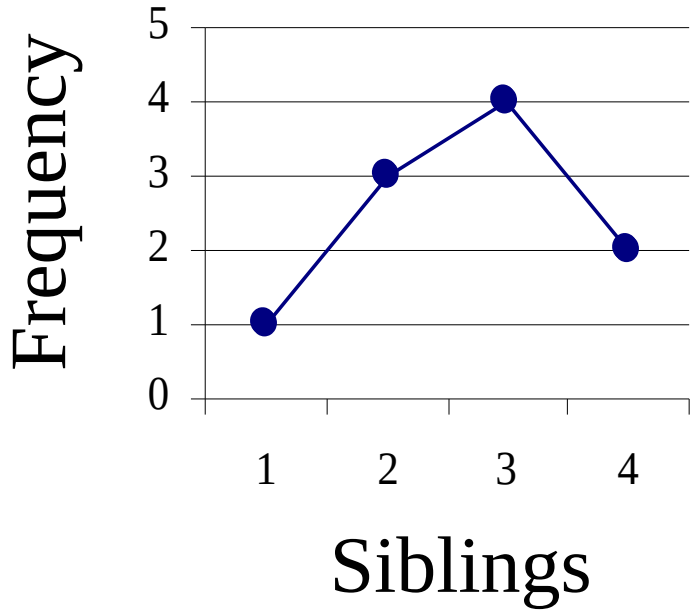
Line Graph

The frequency polygon is an instance of the more general *line graph*.



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Grouped Frequency Distributions

Data sets containing large numbers of items are often arranged into groups, or *classes*. All data items are assigned to their appropriate classes, and then a **grouped frequency distribution** can be set up and a graph displayed.

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Guidelines for the Classes of a Grouped Frequency Distribution

1. Make sure each data item will fit into one, and only one, class.
2. Try to make all the classes the same width.
3. Make sure that the classes do not overlap.
4. Use from 5 to 12 classes. Too few or too many classes can obscure the tendencies in the data.

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Example: Constructing a Histogram

Twenty students, selected randomly, were asked to estimate the number of hours that they had spent studying in the past week (in and out of class). The responses are recorded below.

15	58	37	42	20	27	36	57
29							
42	51	28	46	29	58	55	43
40							
56	36						

Tabulate a grouped frequency distribution and a relative frequency distribution and construct a histogram for the given data.

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Example: Constructing a Histogram

Solution

Hours	Frequency f	Relative Frequency f/n
10-19	1	5%
20-29	5	25%
30-39	3	15%
40-49	5	25%
50-59	6	30%

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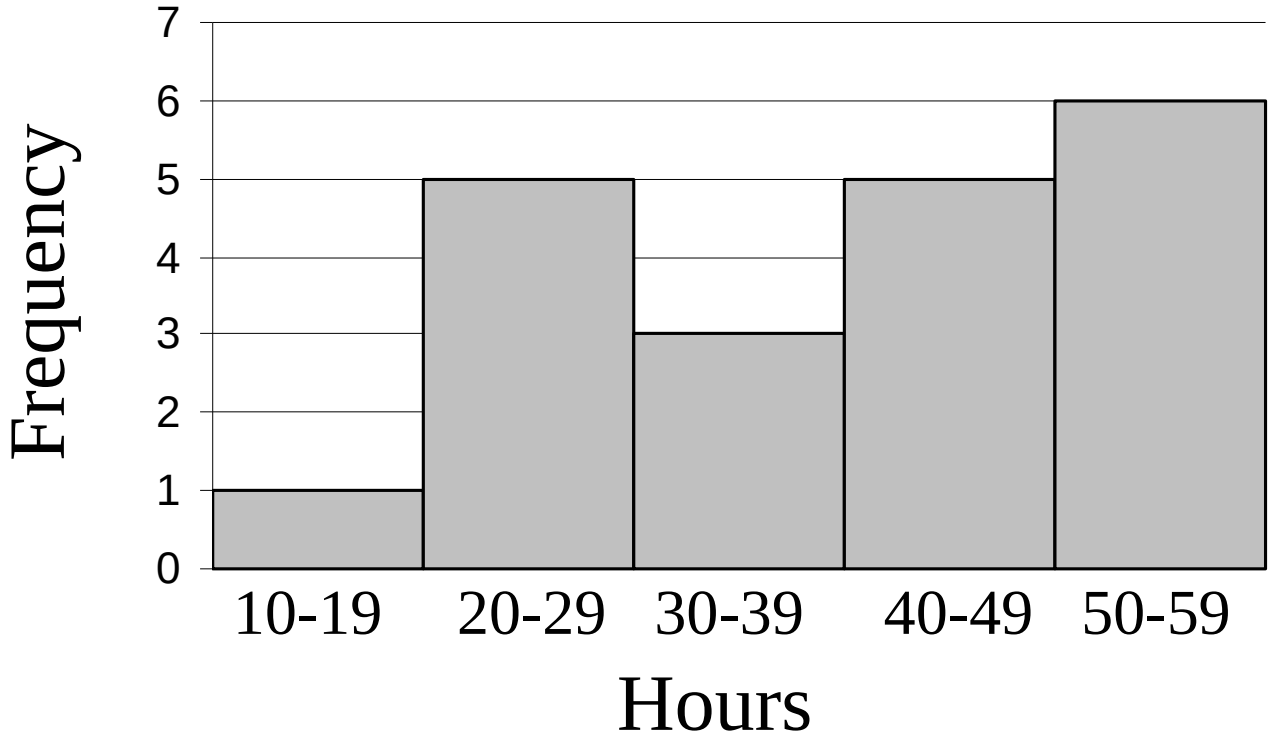
Example: Constructing a Histogram

Solution (continued)



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Frequency Distribution

In the table, the numbers 10, 20, 30, 40, and 50 are called the **lower class limits**. They are the smallest possible data values within their respective classes. The numbers 19, 29, 39, 49, and 59 are called the **upper class limits**.

The **class width** for the distribution is the difference of any two successive lower (or upper) class limits. In this case the class width is 10.

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Stem-and-Leaf Displays

The tens digits to the left of the vertical line, are the “stems,” while the corresponding ones digits are the “leaves.” The stem and leaf display conveys the impressions that a histogram would without a drawing. It also preserves the exact data values.

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Example: Constructing a Stem-and-Leaf Display

Below is a stem-and-leaf display of the data from the last example (15 58 37 42 20 27 36
57 29 42 51 28 46 29 58 55
43 40 56 1 5 36)

2	0 7 8 9 9
3	6 6 7
4	0 2 2 3 6
5	1 5 6 7 8 8

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Bar Graphs

A frequency distribution of nonnumerical observations can be presented in the form of a **bar graph**, which is similar to a histogram except that the rectangles (bars) usually are not touching one another and sometimes are arranged horizontally rather than vertically.

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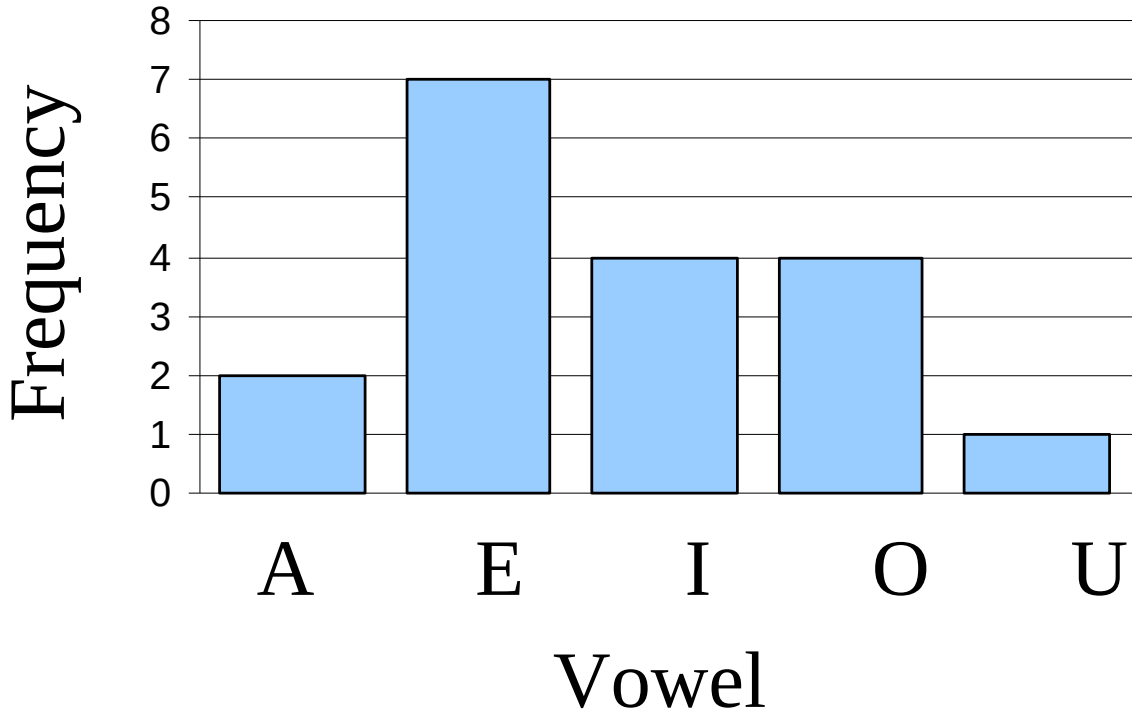
Example of a Bar Graph

This graph shown below displays the number of vowels in this sentence.



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Circle Graphs

A graphical alternative to the bar graph is the **circle graph**, or **pie chart**, which uses a circle to represent all the categories and divides the circle into sectors, or wedges (like pieces of pie), whose sizes show the relative magnitude of the categories. The angle around the entire circle measures 360°. For example, a category representing 20% of the whole should correspond to a sector whose central angle is 20% of 360° which is 72°.

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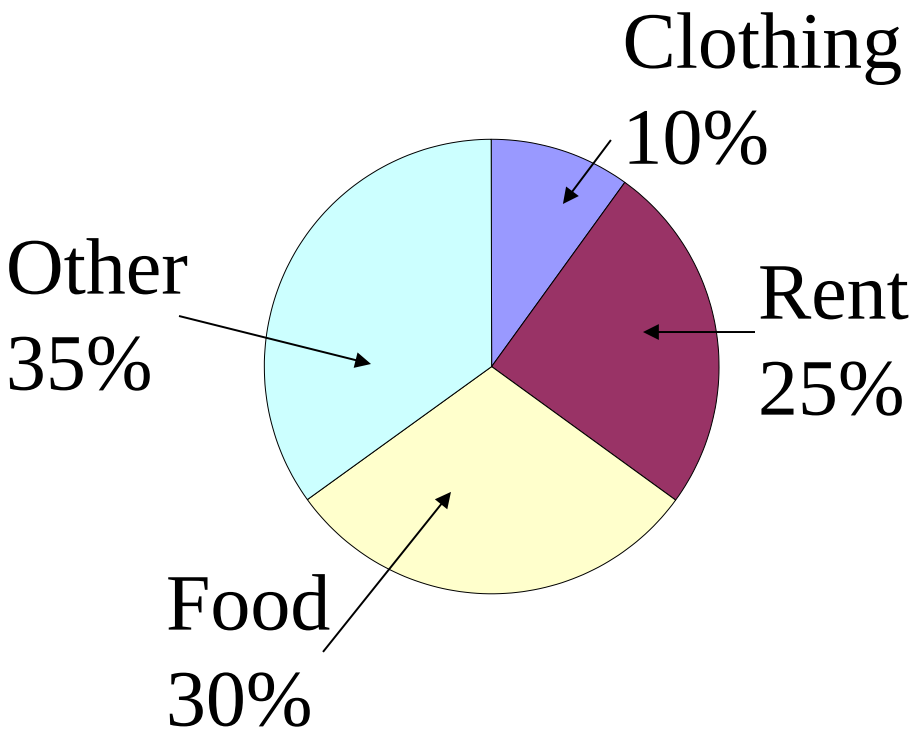
Example of a Circle Graph

A general estimate of Amy's monthly expenses are illustrated in the circle graph below.



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Line Graph

If we are interested in demonstrating how a quantity *changes*, say with respect to time, we use a **line graph**. We connect a series of segments that rise and fall with time, according to the magnitude of the quantity being illustrated.

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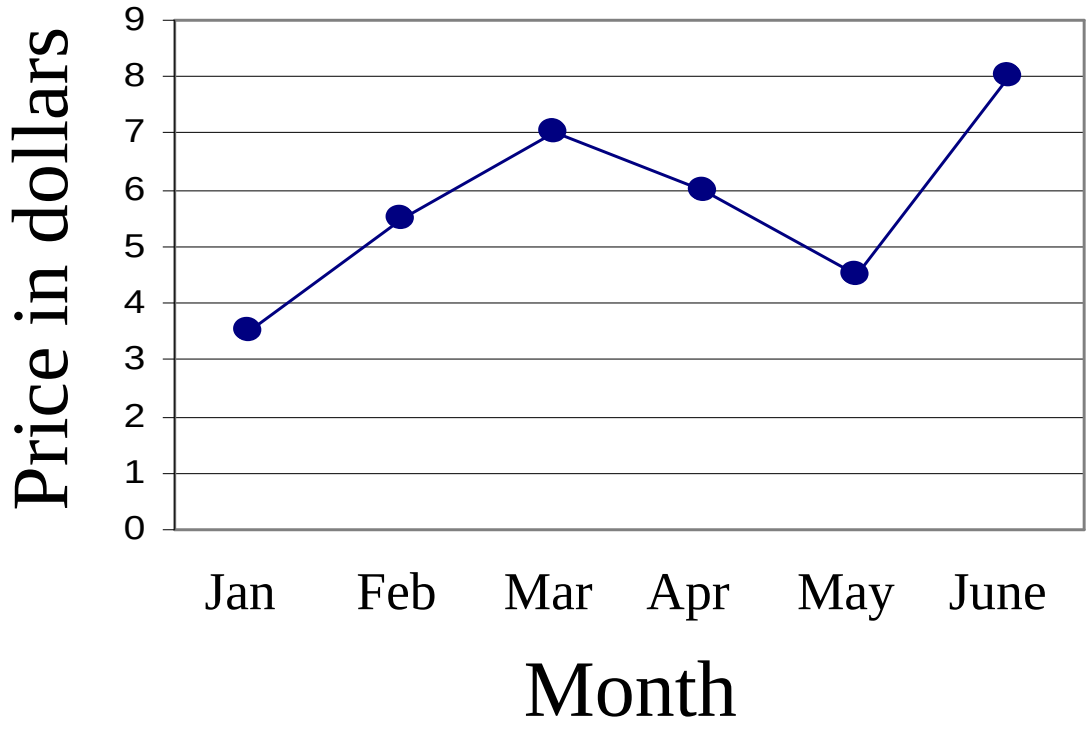
Example of a Line Graph

The line graph below shows the stock price of company PCWP over a 6-month span.



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