# Box-and-Whisker Plots

A **box-and-whisker plot** is a convenient way to display the five-number summary. To draw a box-and-whisker plot:

a. Mark the minimum, maximum, median, Q_1, and Q_3 above the numbers on your number line.
b. Draw a box that represents the middle 50% of the data by drawing a box from Q_1 to Q_3. The length of the box represents the interquartile range (IQR).
c. Draw a vertical line segment inside the box to show the median.
d. Draw "whiskers" to represent the lowest 25% (by connecting Q_1 to the minimum value) and highest 25% (by connecting Q_3 to the maximum value) of the data.
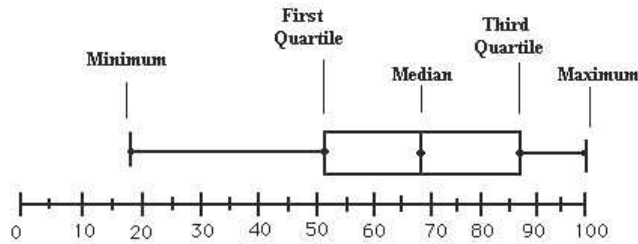

1. The data set on the right lists the high, average, and low temperatures in Farmington, CT from September 8 to September 23, 2011. Complete the table, using your calculator. (Suggestion: enter the data in L1, L2, and L3 and save for question 4.)

	Min	Q1	Med	Q2	Max	IQR	SD
High							
Avg.							
Low							

The statistics for the high temperatures are displayed in a box-and-whisker plot below.

September	High	Average	Low
8	78	67	57
9	77	68	55
10	71	62	52
11	63	59	55
12	69	64	60
13	82	72	64
14	78	68	57
15	81	68	57
16	70	63	55
17	63	56	50
18	75	60	48
19	71	60	51
20	73	58	43
21	77	60	46
22	75	64	53
23	81	74	66

2. Draw box-and-whisker plots below for the average and low temperatures.
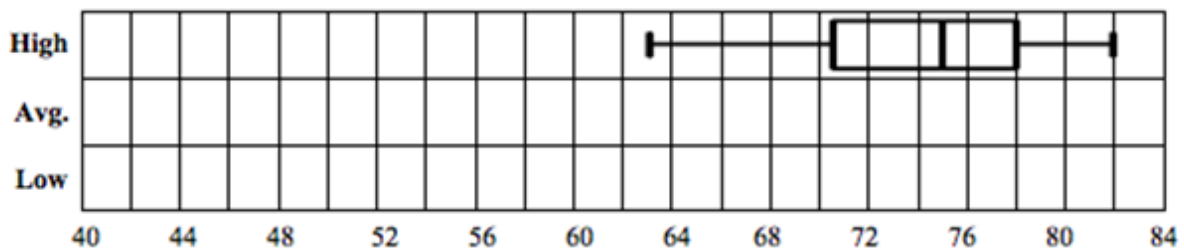
3. Match the box-and-whisker plots on the right to the descriptions they match.

a. Which plot has the greatest range?

b. Which plot has the greatest IQR?

c. Which plot has the greatest Q_1?

d. Which plot has the greatest median?

e. Which plot has the greatest Q_3?
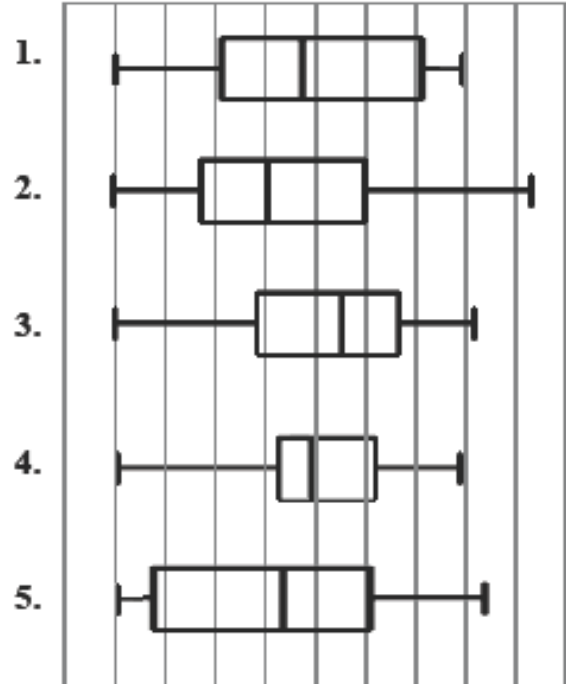
4. The following set of data lists the top 18 New York Yankees Salaries for 2011. Find the five-number summary, the range, and the interquartile range. Then make a box-and-whisker plot.

RK	Player	Salary (millions)
1	Alex Rodriguez	32.0
2	CC Sabathia	24.3
3	Mark Teixeira	23.1
4	A.J. Burnett	16.5
5	Mariano Rivera	14.9
6	Derek Jeter	14.7
7	Jorge Posada	13.1
8	Robinson Cano	10.0
9	Nick Swisher	9.1

RK	Player	Salary (millions)
10	Rafael Soriano	9.0
11	Curtis Granderson	8.3
12	Russell Martin	4.0
13	Phil Hughes	2.7
14	Eric Chavez	1.5
	Andruw Jones	1.5
	Freddy Garcia	1.5
17	Boone Logan	1.2
18	Bartolo Colon	0.9

(Source: *http://espn.go.com/mlb/team/salaries/_/name/nyy/new-york-yankees*)

Salary (millions)
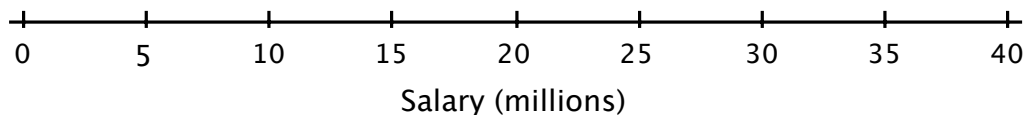
5. Michael Jackson's *Thriller* is the top-selling album of all time, with 110 million albums sold world-wide. The next 24 top-selling albums are below.

Album	Albums sold (millions)	Album	Albums sold (millions)
Thriller, Michael Jackson	110	*Sgt. Pepper,* The Beatles	32
Back in Black, AC/DC	49	*Falling Into You,* Celine Dion	32
The Dark Side of the Moon, Pink Floyd	45	*Music Box,* Mariah Carey	32
		Dangerous, Michael Jackson	32
The Bodyguard, Whitney Houston	44	*1,* The Beatles	31
Bat Out of Hell, Meatloaf	43	*Let's Talk About Love,* Celine Dion	31
Eagles: Their Greatest Hits, 1971–1975	42	*Goodbye Yellow Brick Road,* Elton John	31
Dirty Dancing, Various Artists	42	*Spirits Having Flown,* Bee Gees	30
Millennium, Back Street Boys	40		
Saturday Night Fever , Bee Gees	40	*Born in the U.S.A.,* Bruce Springsteen	30
Rumours, Fleetwood Mac	40	*Brothers in Arms,* Dire Straits	30
Come On Over, Shania Twain	40	*Immaculate Conception,* Madonna	30
Led Zeppelin IV	37	*Bad,* Michael Jackson	30
Jagged Little Pill, Alanis Morisette	33		

a. Find the five-number summary, the range, and the interquartile range of the albums sold data.

	min	Q₁	median	Q₃	max	range	IQR
Albums sold (millions)							

b. Apply the 1.5 times IQR rule to find the fences for this set of data.

Upper fence = _____ Lower fence = _____

c. According to the 1.5 times IQR rule, can *Thriller* be considered an outlier? Explain.

d. Find the five-number summary, the range, and the interquartile range of the albums sold data <u>without</u> *Thriller*.

	min	Q$_1$	median	Q$_3$	max	range	IQR
Albums sold (millions)							

e. Compare the charts made in parts (a) and (d).   Which statistics were most affected when the *Thriller's* albums sold was removed from the list?

f. Which statistics were least affected when *Thriller's* albums sold was removed from the list?

g. Statisticians often prefer a statistic that is not affected by outliers. Which measure of spread do you think they prefer? The range or the IQR? Explain.

h. Enter the data for all 25 albums in your calculator. (Suggestion: use L4 so you can keep the temperature data in L1, L2, and L3).   Now use the 1-Var Stats command to find the mean and standard deviation.

Mean = _____   Standard Deviation = _____

i. Remove the data value "110" for *Thriller* from your list and recalculate the mean and standard deviation for the remaining albums.

Mean = _____   Standard Deviation = _____

j. Describe the effect of an outlier on the mean and standard deviation of a data set.

Box-and-Whisker Plots on the Calculator

6. Use the calculator to make the three box &
   whisker plots for the temperature data from
   problem 1. You may display them side by side
   if you use L1 in StatPlot 1, L2 in StatPlot 2, and
   L3 in StatPlot 3 and turn all plots on. Select
   either of the two icons for Box & Whiskers shown
   to the right.

Box & Whiskers
Showing Outliers

Box & Whiskers
without Outliers
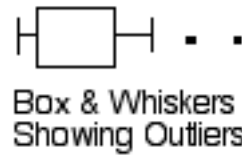
   Indicate what values you used in the Window menu:

   Xmin = _____   Xmax = _____   Xscl = _____

   Ymin = _____   Ymax = _____   Yscl = _____

7. Now change the values of Ymin and Ymax. Does this affect the way the box-and-whisker plots
   are displayed? Explain.

8. Now make a box & whiskers plot for the album data from problem 5. Turn off all plots except
   for one and use the data in L4. Adjust the values in the Window menu so that the entire plot
   shows.

   a. First select the icon "Box and Whiskers Showing Outliers." Make a sketch of what you see
      in the space below.

   b. Then select the icon "Box and Whiskers without Outliers." Make a sketch of what you see
      in the space below.

c. When there is an outlier, what is the effect of changing the box-and-whisker display on the length of the whiskers?

d. Now have the calculator make a histogram for the albums sold data. Make a sketch of what you see in the space below.

e. How can you tell from the histogram that there is an outlier in this set of data?

9. Make up a data set with ten values, listed in order, which could have the box-and-whisker plot shown below.
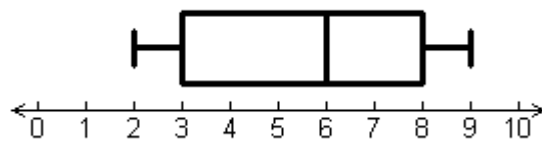
10. Write a story (context) to go along with your data in (9).