**Boxplots**

There are two boxplots on the calculator: the **Modified Boxplot** and the **Standard Boxplot**. The modified boxplot is the fourth symbol in **Type** (located in **STAT PLOT**) and the standard boxplot is the fifth symbol in **Type**.

The Standard Boxplot represents the Five-Number Summary: Min, Q₁, Median, Q₂, Max. The Modified Boxplot is more informative as it identifies possible outliers. Instead of extending the whiskers to the minimum and maximum value it extends the whiskers to the smallest data value and the largest data value in the interval \((\text{lower fence}, \text{upper fence}) = (Q_1 - 1.5 \times IQR, Q_3 + 1.5 \times IQR)\), where \(IQR\) is the interquartile range \((Q_3 - Q_1)\). Generally, values outside this range are considered outliers.

**Example 1**  Generate a Standard Boxplot and a Modified Boxplot for the values:

\[
1, 2, 3, 3, 4, 5, 5, 5, 6, 7, 8, 9, 25
\]

1. Enter the data values into **L1**.
2. Press **2nd Y=** (to select **STAT PLOT**), then press **ENTER**.
3. Set the window for **Plot1** as shown.
4. Press **ZOOM 9**.
5. Press **TRACE** and press ▶ twice.

Here the maximum value is shown to be 25. The Modified Boxplot for the same data shows the right whisker now only extends to the value of 9; the value
of 25 is shown separate from the boxplot. This is because 25 lies outside the interval \((-3.75, 14.25)\). The data value of 9 is the largest that lies inside this interval. So we have identified 25 as an outlier.

Comparing Two or More Boxplots

Boxplots make it easy to compare samples from the same or different populations. Multiple boxplots may be put on the same axes and thus make comparisons easier than multiple histograms, each of which require a separate graph.

Example 2 The following data represent the number of cold cranking amps of group size 24 and group size 35 batteries. The cold cranking amps number measures the amps produced by the battery at 0 ° Fahrenheit. Which type of battery would you prefer?

<table>
<thead>
<tr>
<th>Group Size 24 Batteries</th>
<th>Group Size 35 Batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 600 675 525 620 550</td>
<td>525 620 550 560 675 550</td>
</tr>
<tr>
<td>600 525 700</td>
<td>560 675 550</td>
</tr>
<tr>
<td>500 660 550</td>
<td>530 570 640</td>
</tr>
<tr>
<td>585 675</td>
<td>525 640 640</td>
</tr>
</tbody>
</table>

1. Enter the data values into \(L1\) and \(L2\).
2. Set \(\text{Plot1}\) for a standard or modified boxplot, and set \(\text{XList}\) to \(L1\).
3. Set \(\text{Plot2}\) for the same type of boxplot, and set \(\text{XList}\) to \(L2\).
This shows modified boxplots, which is the same as a standard boxplot if there are no outliers. Press the up and down arrows to move between the boxplots.

There are no outliers for either type battery. A group size 24 battery (the upper boxplot, Plot1) is preferable.