Using daily data in Tableau to calculate a seven-day moving average and moving range control chart pair, with control limits shown on each.

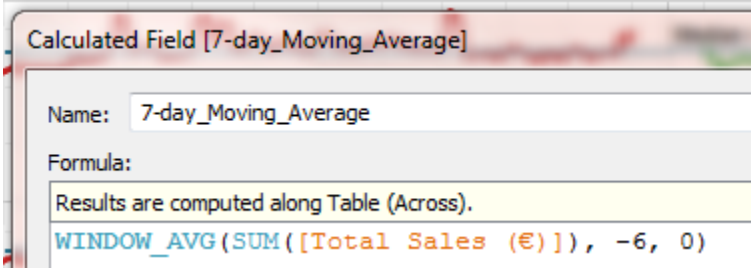Written by Ken Black

This chart pair is typically called an x-bar and R chart. Descriptions of this chart an be found at: (http://en.wikipedia.org/wiki/Xbar_and_R_chart)

Step 1: Example data

Shown below is a sample of the data, with turnover being the total sales for a station per day. In Tableau, the turnover field is renamed Total Sales (€). This field is what is shown in the control charts. The database as 565 stations, about 500,000 rows of data from 2011-current, and is blended with another file to access geographical information for the stations.
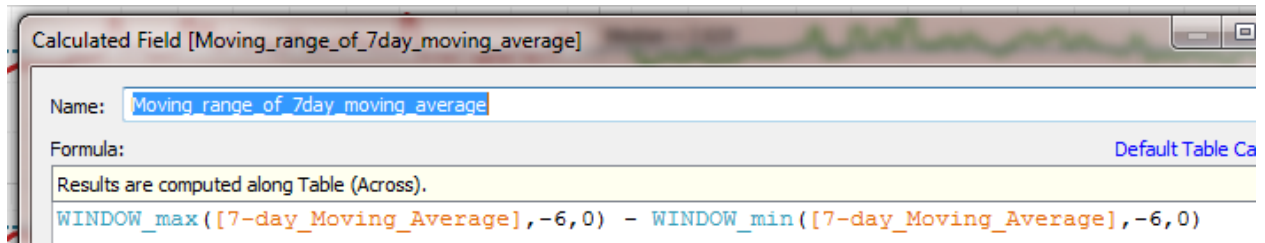
	A	B	C	Site type	District	Sales Off.	Sales Grp	Pricing dt	turnover
	Ship-to	party	Date						
2	XJ00004	MUENCHEN	01.01.2011	002		0003	006	1/1/2011	1,868.18
3	XJ00004	MUENCHEN	02.01.2011	002		0003	006	1/2/2011	2,797.67
4	XJ00004	MUENCHEN	03.01.2011	002		0003	006	1/3/2011	1,870.65
5	XJ00004	MUENCHEN	04.01.2011	002		0003	006	1/4/2011	1,697.22
6	XJ00004	MUENCHEN	05.01.2011	002		0003	006	1/5/2011	2,081.51
7	XJ00004	MUENCHEN	06.01.2011	002		0003	006	1/6/2011	2,397.09
8	XJ00004	MUENCHEN	07.01.2011	002		0003	006	1/7/2011	2,257.90
9	XJ00004	MUENCHEN	08.01.2011	002		0003	006	1/8/2011	2,112.48
10	XJ00004	MUENCHEN	09.01.2011	002		0003	006	1/9/2011	2,763.97
11	XJ00004	MUENCHEN	10.01.2011	002		0003	006	1/10/2011	2,440.65

Step 2: Calculate the 7-day moving average

Calculated Field [7-day_Moving_Average]

Name: 7-day_Moving_Average

Formula:

Results are computed along Table (Across).

```
WINDOW_AVG(SUM([Total Sales (€)]), -6, 0)
```
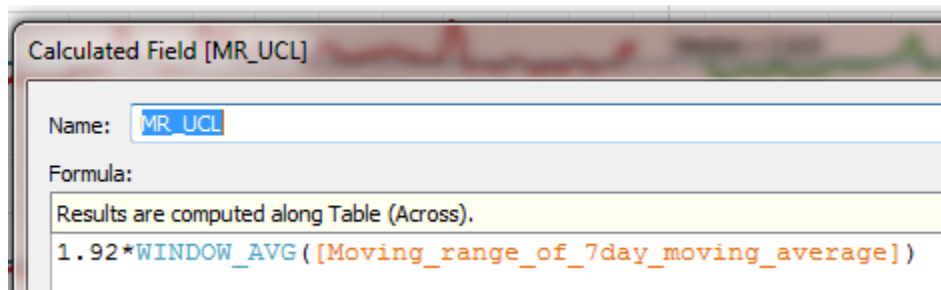
Note that the seven day moving average includes the previous six days (-6) and the current day (0), which are the optional parameters in the window_avg function.

Step 3: Calculate the 7-day moving range , using the 7-day moving average field

Calculated Field [Moving_range_of_7day_moving_average]

Name: Moving_range_of_7day_moving_average

Formula: Default Table Ca

Results are computed along Table (Across).

```
WINDOW_max([7-day_Moving_Average],-6,0) - WINDOW_min([7-day_Moving_Average],-6,0)
```
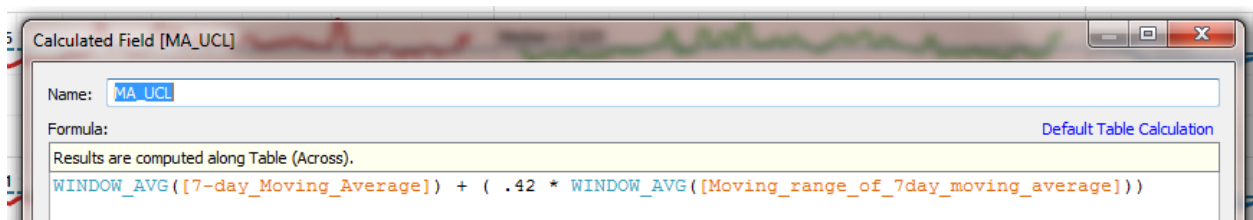
Note that the same approach is used for the moving range as was used for the moving average in which the six previous days and the current day were used to find the maximum and minimum values for each seven day period, to calculate the ranges for those periods.

Step 4: Calculate the Moving Range Upper Control Limit = UCL (for n=7, D_4 = 1.92)

Calculated Field [MR_UCL]

Name: MR_UCL

Formula:

Results are computed along Table (Across).

```
1.92*WINDOW_AVG([Moving_range_of_7day_moving_average])
```

Step 5: Calculate the Moving Average UCL (for n=7, A_2 = .42)

Calculated Field [MA_UCL]

Name: MA_UCL

Formula: Default Table Calculation

Results are computed along Table (Across).

```
WINDOW_AVG([7-day_Moving_Average]) + ( .42 * WINDOW_AVG([Moving_range_of_7day_moving_average]))
```

Step 6: Calculate the Moving Average Lower Control Limit = LCL
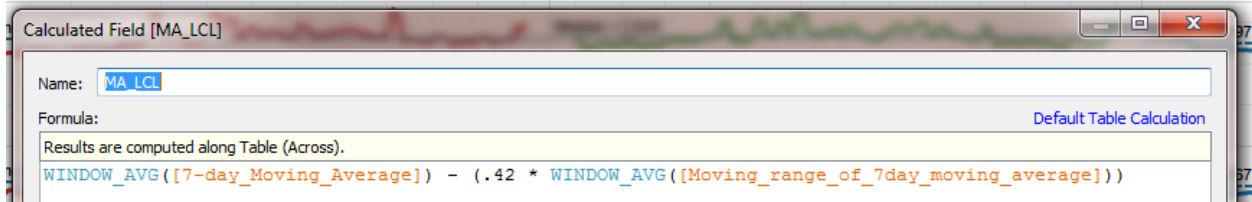
Step 7: Example Chart Produced for all Stations
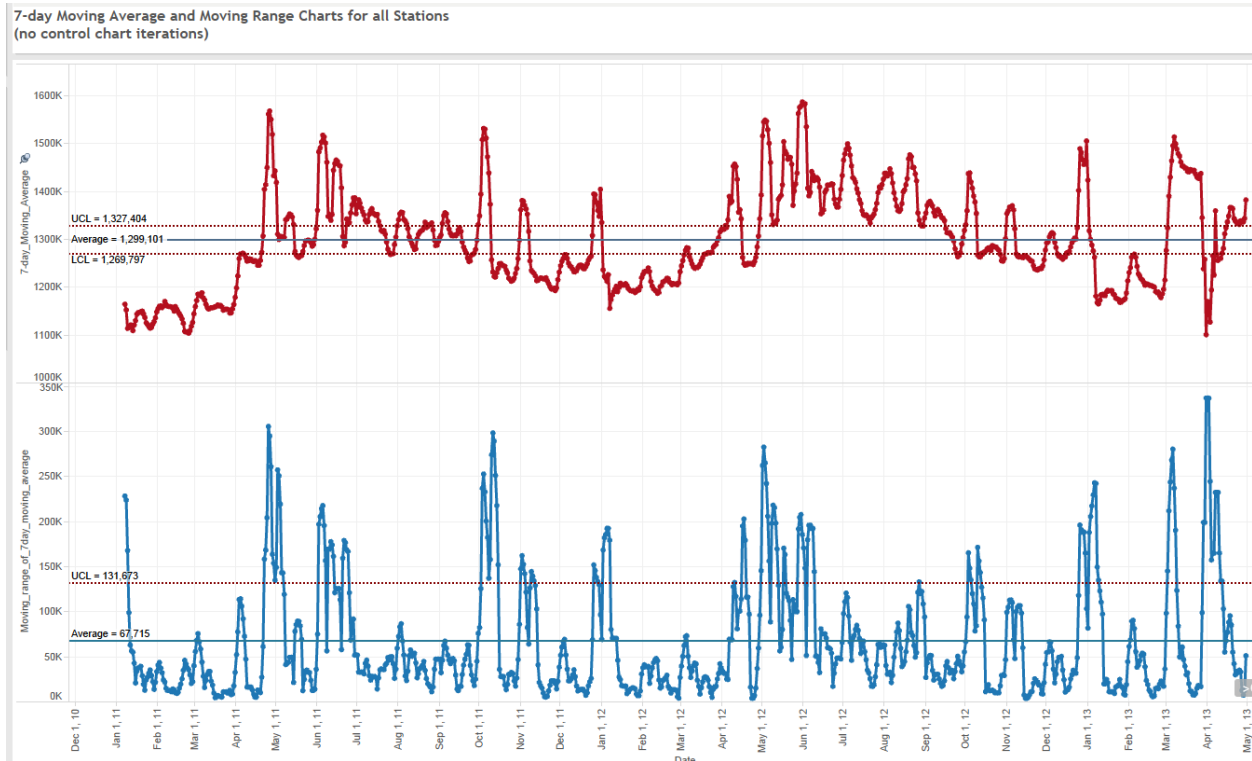
Note that this control chart shows a lot of points being out of control. This dataset has a lot of seasonality to it, which makes it a poor candidate for control charting. This example was made to document the process of creating the moving average/moving range charts rather than being used for system evaluation. Normally an iterative approach to removing outliers would be used in this type of chart set, but in this case, the seasonality was too great to allow the creation of a well-behaved control chart.

Step 8: Known issues

First Issue is the date used for the start of the moving range calculation

The moving range should start 7-days after the first moving average, which occurs 7 days after the start of the data (see table below, in which the moving range starts on Jan 13, 2011). This lag should occur in the chart above, but the moving range chart does not show this. Even with the checkbox "Null if there are not enough values" checked (see menu below), the moving range is calculated starting at the second data point (Jan 2, 2011) because Tableau has no knowledge that there should be a time delay in this measure and that essentially 13 days are required to begin the calculation. This will produce an erroneous average moving range, which is used to calculate the control limits for the moving average plot. The true moving range average is = 67,198.7 whereas the Tableau calculated value of 67,715 as shown on the lower chart above. This occurs because the inflated moving range values of Jan 7 to Jan 12 are included in the average calculation (see second table below). The numbers highlighted in red should not be included in the overall average of the moving range.

Day of US Date	Total Sales (€)	7day_avg_test along Year of US Date, Day of US Date	Moving_range_of_7day_moving_average along Table (Down)
January 1, 2011	1,148,228		
January 2, 2011	1,605,022		
January 3, 2011	1,093,367		
January 4, 2011	1,006,687		
January 5, 2011	1,034,121		
January 6, 2011	1,136,824		
January 7, 2011	1,128,810	1,164,723	
January 8, 2011	1,063,209	1,152,577	
January 9, 2011	1,336,001	1,114,145	
January 10, 2011	1,107,988	1,116,234	
January 11, 2011	1,038,736	1,120,813	
January 12, 2011	1,035,505	1,121,010	
January 13, 2011	1,056,464	1,109,530	55,192
January 14, 2011	1,209,639	1,121,077	43,047
January 15, 2011	1,129,468	1,130,543	21,013
January 16, 2011	1,428,700	1,143,786	34,255

Table Calculation [Moving_range_of_7day_moving_average]

Calculated Field:: Moving_range_of_7day_movi ▼

Calculation Definition

Compute using: **Table (Across)** ▼

At the level: ▼

Restarting every: ▼

☑ Null if there are not enough values

Description

Results are computed along Day of US Date for each Year of US Date.

Formula

WINDOW_max([7-day_Moving_Average],-6,0) - WINDOW_min([7-day_Moving_Average],-6,0)

Edit Formula...   OK   Cancel   Apply

Day of US Date	Total Sales (€)	Moving_range_of_7day_moving_average along Table (Down)	Moving Average based on starting point	
January 1, 2011	1,148,228	0	68,580	
January 2, 2011	1,605,022	228,397	68,660	
January 3, 2011	1,093,367	228,397	68,472	
January 4, 2011	1,006,687	228,397	68,284	
January 5, 2011	1,034,121	228,397	68,095	
January 6, 2011	1,136,824	228,397	67,905	
January 7, 2011	1,128,810	228,397	67,715	Tableau Value
January 8, 2011	1,063,209	224,048	67,525	
January 9, 2011	1,336,001	168,060	67,339	
January 10, 2011	1,107,988	99,181	67,219	
January 11, 2011	1,038,736	63,340	67,181	
January 12, 2011	1,035,505	56,563	67,186	
January 13, 2011	1,056,464	55,192	67,199	Actual Value

Second issue – be careful on using dates to set colors for continuous data

The same control chart is shown below as was used shown in step 7. However, in this version, the year was used to set the color in both charts. When this is done, notice that there are breaks between the red and green and the green and blue lines. These breaks will translate into "lost data". Note that in the lower chart, the Average is shown as 65,295, which is less than the true average value of 67,199. This difference occurs because of the lost data that occurs at the end of a year.