

SPC Chart Lab - Instructions

Learning Objective

- Build DAX measures and DAX calculated tables.
- Become familiar with useful DAX table functions.
- Consolidate understanding of how filter context applies in a visual.
- Apply dynamic visualisation techniques – what-if using numeric parameters, dynamic formats, reference lines.

Background

The objective of this exercise is to build a SPC (Statistical Process Control) chart. This is a common chart in healthcare and in manufacturing processes but is not an out-of-the-box standard visualisation in Power BI. An SPC chart is based on a line chart. It records observations of a particular value at regular intervals - typically hourly, daily or monthly. The chart has three reference lines

- A central line
- A lower control line
- An upper control line

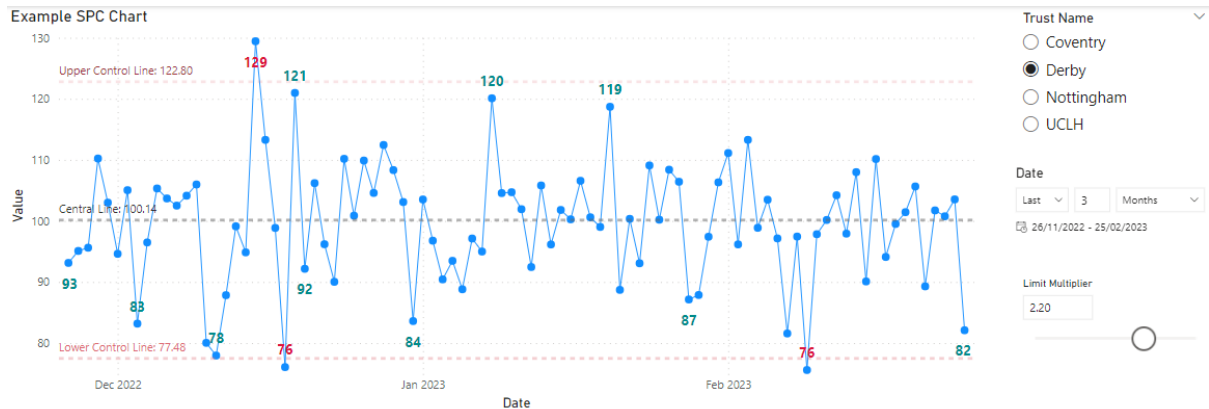
The value of the central line is often the average of the values. The lower and upper control lines are typically set to the average value plus or minus three standard deviations. Often these the average and standard deviations are calculated on data in a historic period, for example before a planned change to the process was introduced. An SPC Chart may look something like the example below.

The purpose of an SPC chart is to monitor a process to determine if it continues to operate normally – usually defined as observations staying within the upper and lower control lines. If points occur outside these line, this may suggest that the process is not operating normally and should be investigated.

Instructions

All the data for this lab is generated using DAX functions. We do not need to load any data into Power BI.

At the end of the exercise, our chart should look finally something like this



Part 1: Build a Dates table with DAX

Name the table Dates.

The dates should cover all of 2022 and 2023 years.

The columns should include at least the following:

- Date,
- Year,
- Quarter,
- Month,
- Month Key (hide this and use it to order the Month column).

The Dates table should look something like the snapshot below.

Date	Year	Month	MonthKey	Quarter
01/01/2022 00:00:00	2022	Jan	1	Q1
02/01/2022 00:00:00	2022	Jan	1	Q1
03/01/2022 00:00:00	2022	Jan	1	Q1
04/01/2022 00:00:00	2022	Jan	1	Q1
05/01/2022 00:00:00	2022	Jan	1	Q1
06/01/2022 00:00:00	2022	Jan	1	Q1
07/01/2022 00:00:00	2022	Jan	1	Q1
08/01/2022 00:00:00	2022	Jan	1	Q1
09/01/2022 00:00:00	2022	Jan	1	Q1
10/01/2022 00:00:00	2022	Jan	1	Q1
11/01/2022 00:00:00	2022	Jan	1	Q1

Part 2: Build a DAX calculated table to hold the sample data for the SPC chart.

Create a table named Trust with one column 'Trust Name'. This table has four rows with values: Coventry, Derby, Nottingham, UCLH. It should look like this.

Trust Name
Derby
Coventry
Nottingham
UCLH

Create a table named Sample Data. This table has three columns: Trust Name, Recorded Date and Value.

The table has a row for every possible combination of Date and Trust Name values.

The Value of each row is a random variable based on a normal distribution with mean 100 and standard deviation of 10.

The Sample Data table should look something like the snapshot below.

Date	Trust Name	Value
01/01/2022 00:00:00	Nottingham	75.0650912042514
01/01/2022 00:00:00	Derby	92.5398744514638
01/01/2022 00:00:00	Coventry	92.7887424709999
01/01/2022 00:00:00	UCLH	92.0699649176547
02/01/2022 00:00:00	Nottingham	93.36998197563
02/01/2022 00:00:00	Derby	104.336664858372
02/01/2022 00:00:00	Coventry	99.2144581023031
02/01/2022 00:00:00	UCLH	89.1092680197868
03/01/2022 00:00:00	Derby	89.7759301195215
03/01/2022 00:00:00	Coventry	105.509087647849
03/01/2022 00:00:00	Nottingham	108.1738717372
03/01/2022 00:00:00	UCLH	94.8643344959953

Create a relationship between the Dates, Trust and Sample Data tables. Hide fields as appropriate.

Part 3: Build a SPC Chart

Use a new page.

Add a single-select slicer on the category field.

Add a line chart to the page. Configure with [Value] field on the Values well and Dates[Date] filed on the Axis well.

Add a relative date slicer to the page

Create these measures:

- [Central Value] as the average of all the Values
- [Lower Control Limit] as the [Central Value] – 3 standard deviations
- [Upper Control Limit] as the [Central Value] + 3 standard deviations

Add three reference line, based on each measure above. Show the name and the value on the reference line.

Create a measure [Marker Colour] that returns two colour names: “DarkCyan” if a [Value] is within the control limits or “Crimson” if not. Add data label to the chart and set the colour of these labels to the [Marker Colour].

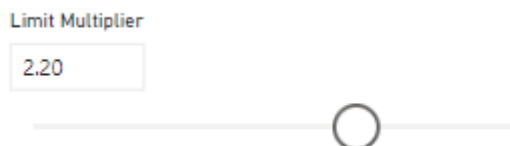
This may not give the expected results. If so, investigate by adding the [Central Value], [Lower Control Limit] and [Upper Control Limit] to the tooltips and view the values on each point. Fix these measures by using DAX to change the filter context.

Question: why did these measures work on the reference lines but not at the points?

Part 4 – Add What-If capabilities

The purpose of this is to be able to set the values if the upper and lower control limits so that the report user can set these to calculate a value between 1 and 3 standard deviations (SD) above / below the central line rather than being fixed at 3 SD.

Add a numeric parameter that varies between 1 and 3 with a step size of 0.2. name this ‘Limit Multiplier’ This will also put a slicer on the page. It should look like this.



Understand how the numeric parameter works. Review the DAX generated to create the table and the measure. Add a card to hold the [Limit Multiplier Measure].

Use the [Limit Multiplier Measure] to edit the [Lower Control Limit] and [Upper Control Limit] measures so that they reflect the value set on the numeric range slicer.

Hints

You may find these DAX functions of use during the lab:

- CALENDAR()
- FORMAT()
- TODAY()
- ADDCOLUMNS()
- SELECTCOLUMNS()

- GENERATE() or CROSSJOIN()
- GENERATESERIES()
- SELECTEDVALUE()
- NORM.INV()
- RAND()
- AVERAGE()
- ST.DEV()
- IF()
- And of course CALCULATE() and some CALCULATE modifiers

Power BI understand the names of a set of colours known as CSS colours. These are listed at https://www.w3schools.com/cssref/css_colors.php

Optional Additional Exercises

Change the calculation of the three control measures so that they use data from the first six months of 2022 only.

Extend the calculation of the random variables so that they slowly diverge from the central line over time.