

# Shewhart Control Charts

## I Chart: Formula



**NHS**  
East London  
NHS Foundation Trust

# I Chart Formula

## Data

Month	Expenditure (I)	MR
1	5814.23	
2	5885.34	71.11
3	5803.66	81.68
4	5935.03	131.37
5	5583.37	351.66
6	5456.08	127.28
7	5386.95	69.14
8	5907.34	520.39
9	5537.06	370.28
10	5837.90	300.84
11	4356.85	1481.05
12	5563.29	1206.45
13	5638.69	75.39
14	5399.15	239.54
15	5877.60	478.46
16	5952.15	74.54
17	5367.89	584.25
18	5677.77	309.88
19	5145.06	532.71
20	5633.67	488.61
<b>Total (<math>\sum i</math>)</b>	<b>111759.07</b>	
<b><math>\sum mr</math></b>	<b>7494.64</b>	



## Calculation

$$\frac{\sum i}{k} = \frac{111759.07}{20} \quad CL = \bar{i} = \frac{\sum i}{k}$$

$$\bar{i} = \frac{\sum i}{k} = \frac{111759.07}{20} = 5587.9535$$

$$\frac{\sum mr}{k-1} = mrbar \quad \frac{7494.64}{20-1} = 394.455 \text{ (to 3. d. p)}$$

\* Remove any moving range bigger than the ULmr and recalculate the average moving range (mrbar), only do this process once.

$$ULmr = 3.27 * mrbar \quad ULmr = 3.27 * 394.455$$

$$ULmr = 1289.868 \text{ (to 3.d.p)} \quad * \text{ (Month 11: } 1481.05 > ULmr)$$

$$\text{New mrbar} = \frac{\sum mr - 1481.05}{k - (1 + \text{no. of values larger than ULmr})} = \frac{7494.64 - 1481.05}{20 - (2)}$$

$$\begin{aligned} UCL &= \bar{i} + (2.66 * \text{New mrbar}) \\ &= 5587.9535 + (2.66 * 334.088) \\ &= 5587.9535 + (888.67408) \\ &= 6476.62758 \text{ (6476.63 to 2.d.p)} \end{aligned}$$

$$\begin{aligned} LCL &= \bar{i} - (2.66 * \text{New mrbar}) \\ &= 5587.9535 - (2.66 * 334.088) \\ &= 5587.9535 - (888.67408) \\ &= 4699.27942 \text{ (4699.28 to 2.d.p)} \end{aligned}$$

$$CL = 5587.95 \text{ (to 2.d.p)}$$

Plot the expenditure, CL, UCL and LCL as seen on the chart

## Legend + Chart

I = expenditure per sub group (per row)

mr = difference between consecutive points (moving ranges)

ULmr = upper limit moving range

$\sum i$  = sum of incidents

$\sum mr$  = sum of moving ranges

k = number of sub groups

CL = center line (Mean)

UCL = upper control limit ( $\bar{i} + (2.66 * mrbar)$ )

LCL = lower control limit ( $\bar{i} - (2.66 * mrbar)$ )

