Shewhart Control Charts
T Chart: Formula

NHS
East London
NHS Foundation Trust

T Chart Formula

East London NHS Foundation Trust

Data

Date of Fall	Days Between Falls (t)	Transformed Days Between Falls (y)	Moving Range of y ($\text{MR} = y_i - y_{(i+1)}$)
02/03/2014			
06/03/2014	4	1.5	
07/03/2014	1	1.0	0.5
15/03/2014	8	1.8	0.8
22/03/2014	7	1.7	0.1
01/04/2014	10	1.9	0.2
11/04/2014	10	1.9	0.0
14/04/2014	3	1.4	0.5
26/04/2014	12	2.0	0.6
03/05/2014	7	1.7	0.3
04/05/2014	1	1.0	0.7
13/05/2014	9	1.8	0.8
28/05/2014	15	2.1	0.3
04/06/2014	7	1.7	0.4
10/06/2014	6	1.6	0.1
14/06/2014	4	1.5	0.2
21/06/2014	7	1.7	0.2
30/06/2014	9	1.8	0.1

$\sum y$	28.2	$\sum \text{MR}$	5.8

n = total number of falls
t = time between falls
($t \neq 0$, more specific measurement required e.g. hours, minutes.)
$y = t^{0.2777}$
$\bar{Y}$ = average of y's
MR = moving range of y's
$\overline{\text{MR}}$ = average moving range of y's

Calculation

$n = 18$

Calculate $\bar{Y}$. This will be used to calculate the CL, UCL and LCL

$$\bar{Y} = \frac{\sum y}{n-1} = \frac{28.2}{17} = 1.7\ (1.d.p)$$

Calculate $\overline{\text{MR}}$ and $3.27\overline{\text{MR}}$. Remove any y values where $y > 3.27\overline{\text{MR}}$. This is necessary to ensure the limits aren't affected by special cause variation.

$$\overline{\text{MR}} = \frac{\sum \text{MR}}{n-2} = \frac{\sum (y_i - y_{(i+1)})}{n-2} = \frac{5.8}{16} = 0.4\ (1.d.p)$$

$$3.27\ \overline{\text{MR}} = 3.27 \times 0.4 = 1.2\ (1.d.p)$$

Use the remaining MR values to calculate $\overline{\text{MR}}'$. In this instance, none of the MR values are greater than 1.2 therefore $\overline{\text{MR}}' = \overline{\text{MR}} = 0.4$

Calculate the UL and LL. These will be used to calculate the UCL and LCL

$$\text{UL} = \bar{Y} + 2.66 \times \overline{\text{MR}}' = 1.7 + 2.66 \times 0.4 = 2.6\ (1.d.p)$$

$$\text{LL} = \bar{Y} - 2.66 \times \overline{\text{MR}}' = 1.7 - 2.66 \times 0.4 = 0.7\ (1.d.p)$$

Perform the following transformations to calculate the CL, UCL and LCL. When LL < 0, then there is no LCL (as per this example).

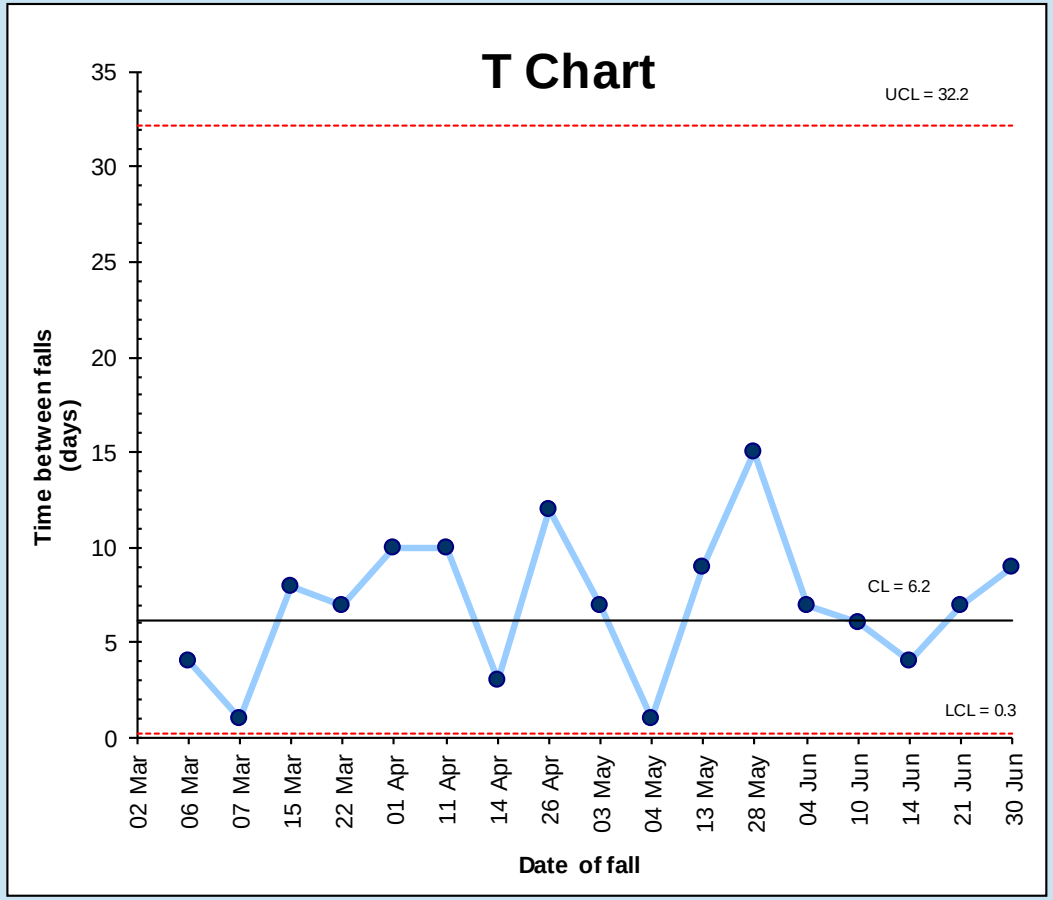
$$\text{UCL} = \text{UL}^{3.6} = 2.6^{3.6} = 32.2$$

$$\text{LCL} = \text{LL}^{3.6} = 0.7^{3.6} = 0.3$$

$$\text{CL} = \bar{Y}^{3.6} = 1.7^{3.6} = 6.2$$

Legend + Chart

n = total number of events
t = time between events
y = transformed time between events ($y = t^{0.2777}$)
UCL = upper control limit
LCL = lower control limit
CL = centre line



The T Chart is sometimes also displayed on a **logarithmic ($\log_{10}$) scale** axis to make the limits appear more symmetrical and creating more visual sensitivity around the LCL