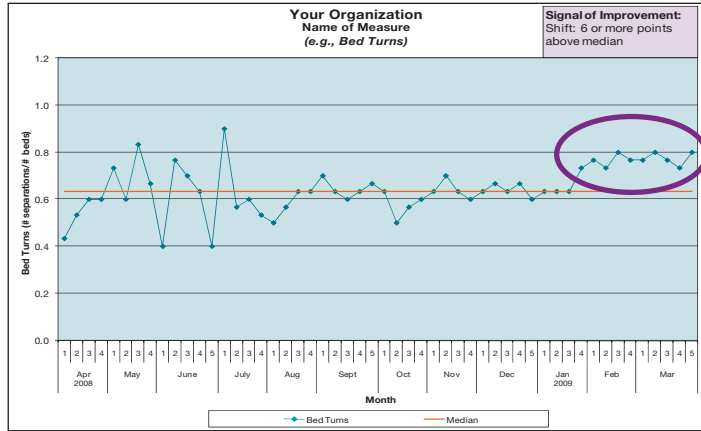# MEASUREMENT
Interpreting Run Charts

There are four rules for interpreting run charts. It is not necessary to find evidence of all four rules to determine that a change has occurred. The presence of any single rule is evidence of a non-random signal of change (there is less than 5% likelihood that the conditions of the rule will be met simply by chance).

Rule 1: Shift

- A shift (signaling change) is six or more consecutive points, either all above or all below the median
- Values that fall on the median neither add to nor break a shift — skip them and continue counting

Rule 2: Trend
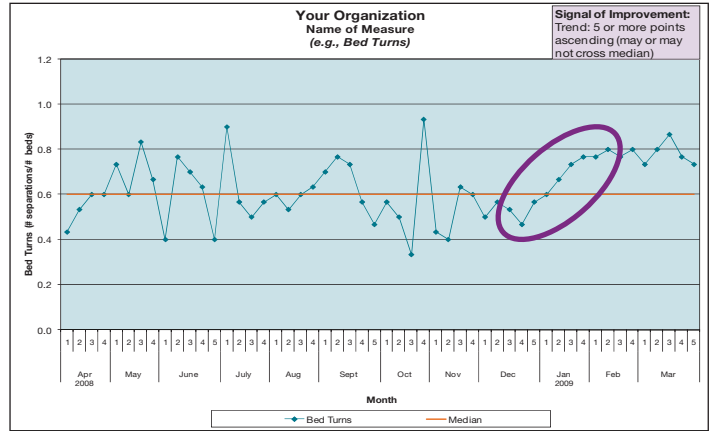
- A trend (signaling change) is five or more consecutive points all going up or all going down (Note: don't count the starting point)
- If the value of two or more consecutive points is the same, ignore one of the points and continue counting
- Note: Either there is a trend or there is not — there's no such thing as trending

Rule 3: Runs
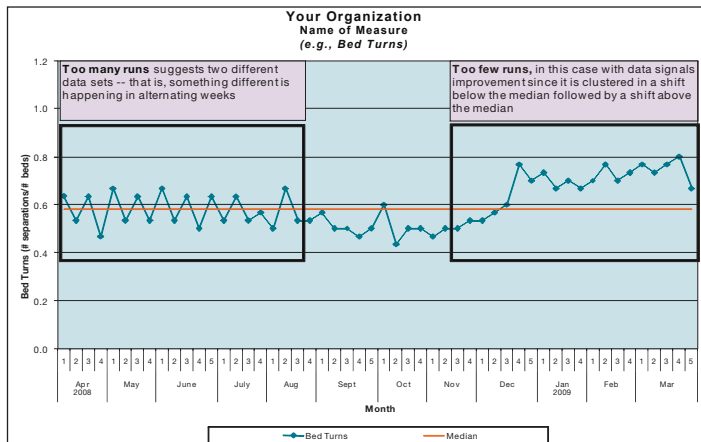
- A change is signaled by either too few or too many runs (crossings of the median line)
- Too many runs suggests two separate distributions of the data (e.g. Dr. X/Dr. Y; day shift/night shift), while too few runs signals that the data are clustered on one side of the median (may also include a trend or a shift if there are enough data points).
- To assess change:
  – Step 1: Count the number of data points that do not fall on the median. Look up using Column 1 of the table on reverse
  – Step 2: Count the number of times the line connecting the data point crosses the median and add one. Compare to columns 2 and 3 in table on reverse.

Rule 4: Astronomical Point
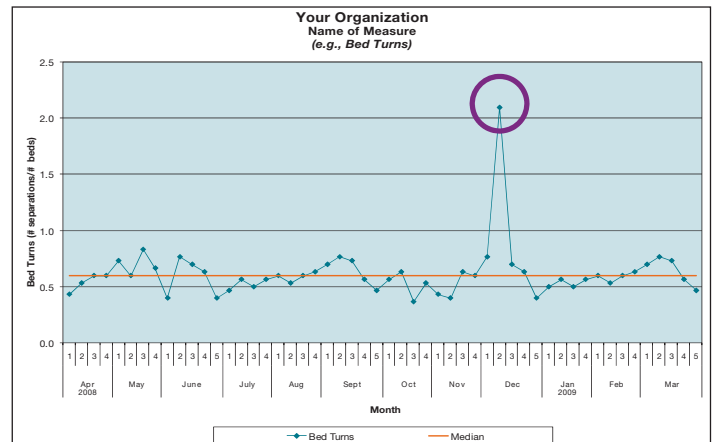
- An astronomical data point is one that is an obviously different value; anyone studying the chart would agree that it is unusual
- Every data set will have a highest point and a lowest point, but this does not necessarily make it "astronomical"
- It is worth understanding the cause of an astronomical point. This will allow you to emulate it if it is positive, or avoid/address it if it is negative.
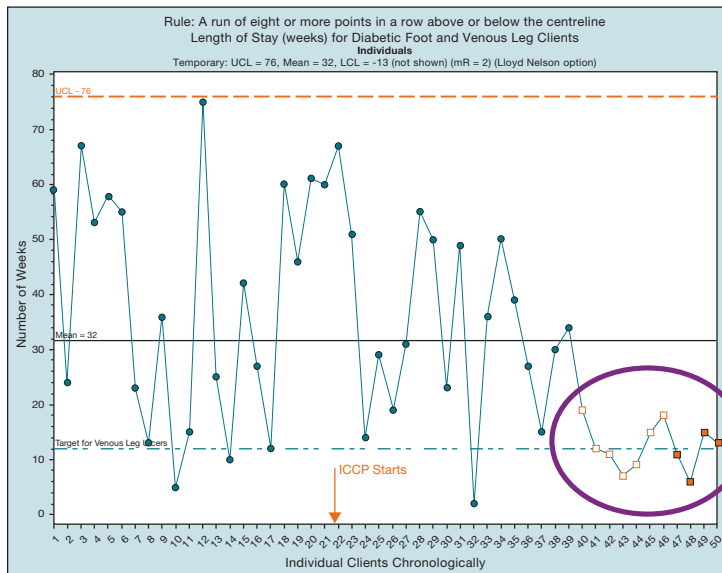
MEASUREMENT
Interpreting Run Charts

Rule 3: Runs

Table for checking for too many or too few runs

Based on about a 5% risk of failing the run test for random patterns of data. Adapted from Swed, Feda S. and Eisenhart, C. (1943). "Tables for Testing Randomness of Grouping in a Sequence of Alternatives. Annals of Mathematical Statistics. Vol. XIV, pp.66 and 87, Tables II and III. (Data Guide 3-18)

Column 1 # data points (not on median)	Column 2 Lower limit for # runs (fewer is too few)	Column 3 Upper limit for # runs (more is too many)	Column 1 # data points (not on median)	Column 2 Lower limit for # runs (fewer is too few)	Column 3 Upper limit for # runs (more is too many)
10	3	9	31	11	22
11	3	10	32	11	23
12	3	11	33	12	23
13	4	11	34	12	24
14	4	12	35	12	24
15	5	12	36	13	25
16	5	13	37	13	25
17	5	13	38	14	26
18	6	14	39	14	26
19	6	15	40	15	27
20	6	16	41	15	27
21	7	16	42	16	28
22	7	17	43	16	28
23	7	17	44	17	29
24	8	18	45	17	30
25	8	18	46	17	31
26	9	19	47	18	31
27	10	19	48	18	32
28	10	20	49	19	32
29	10	20	50	19	33
30	11	21	51	20	33

Rule: A run of eight or more points in a row above or below the centreline
Length of Stay (weeks) for Diabetic Foot and Venous Leg Clients
Individuals
Temporary: UCL = 76, Mean = 32, LCL = -13 (not shown) (mR = 2) (Lloyd Nelson option)

Shewhart (Control) Charts

Common Cause:
- Refers to random variation inherent in the process over time; affects everyone working in the process and affects all outcomes
- The process is stable if only common cause variation is noted

Special Causse:
- Arises because of specific circumstances — something was different in that particular case
- The process is unstable if there is special cause variation
- In improvement work, we are trying to create special cause

Rules for Determining Special Cause:
- A single point outside the control limits
- 8 or more points in a row on one side of the mean
- 6 consecutive points increasing or decreasing
- 2 of 3 points in the outside third of a control limit
- 15 consecutive points in the inner third (nearest the mean)