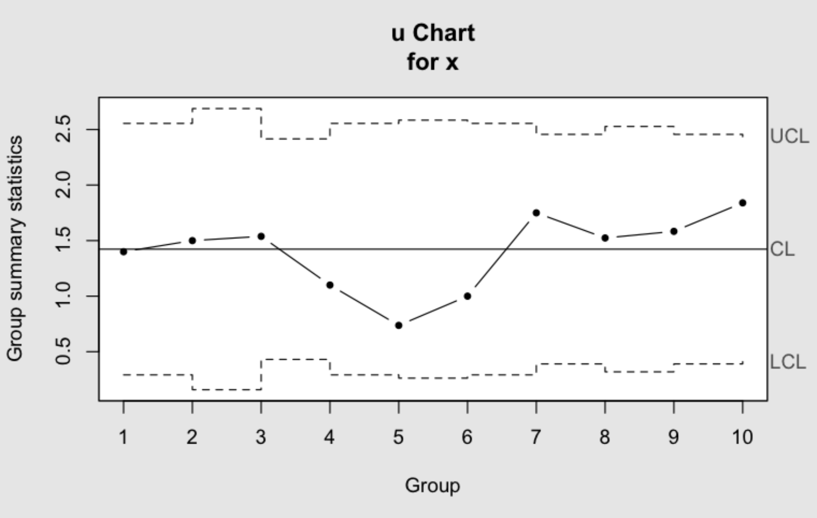
U-Charts

- A U chart plots the **number of defects** (also called nonconformities) per unit.
- It is possible for a unit to have one or more defects but still be acceptable in function and performance.
- For example, you can use a U chart to monitor the following: The number of tears and pulls per 50 running feet of carpet.


u Chart
for x
Group summary statistics
0.5
1.0
1.5
2.0
2.5
UCL
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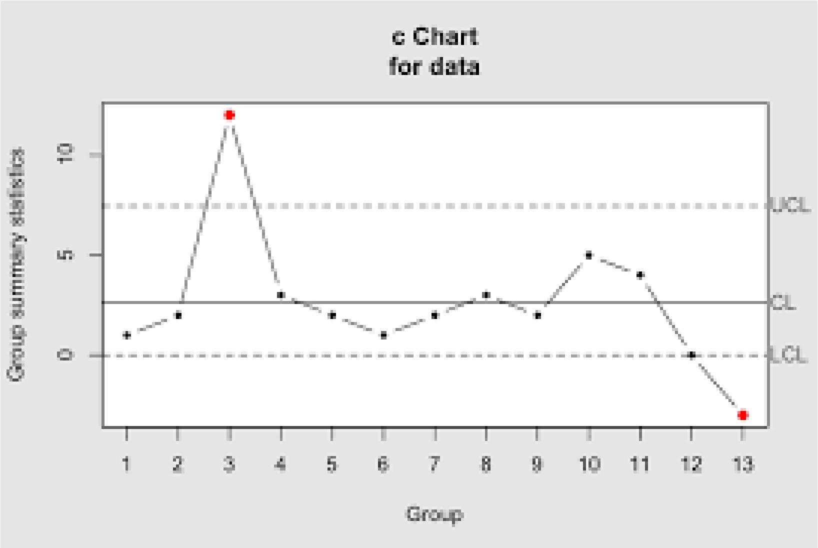
LCL
1
2
3
4
5
6
7
8
9
10
Group

U-Charts

- In statistical quality control, the c-chart is a type of control chart used to monitor "count"-type data, typically total number of nonconformities per unit.[1]
- It is also occasionally used to monitor the total number of events occurring in a given unit of time.

C-Charts



c Chart
for data
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Group

C-Charts

- The c-chart differs from the p-chart in that it accounts for the possibility of more than one nonconformity per inspection unit, and that (unlike the p-chart and u-chart) it requires a fixed sample size.
- The p-chart models "pass"/"fail"-type inspection only, while the c-chart (and u-chart) give the ability to distinguish between (for example) 2 items which fail inspection because of one fault each and the same two items failing inspection with 5 faults each; in the former case, the p-chart will show two non-conformant items, while the c-chart will show 10 faults.

C-Charts

Nonconformities may also be tracked by type or location which can prove helpful in tracking down assignable causes.
Examples of processes suitable for monitoring with a c-chart include:

* Monitoring the number of voids per inspection unit in injection molding or casting processes
* Monitoring the number of discrete components that must be re-soldered per printed circuit board
* Monitoring the number of product returns per day

C-Charts

The Poisson distribution is the basis for the chart and requires the following assumptions:

- The number of opportunities or potential locations for nonconformities is very large
- The probability of nonconformity at any location is small and constant
- The inspection procedure is same for each sample and is carried out consistently from sample to sample

C-Charts

The control limits for this chart type are

$$\bar{c} \pm 3\sqrt{\bar{c}}$$

where $\bar{c}$ is the estimate of the long-term process mean established during control-chart setup.

p-Charts

- In statistical quality control, the p-chart is a type of control chart used to monitor the proportion of nonconforming units in a sample, where the sample proportion nonconforming is defined as the ratio of the number of nonconforming units to the sample size, n.

p-Charts

- The p-chart only accommodates *"pass"*/*"fail"*-type inspection as determined by one or more go-no go gauges or tests, effectively applying the specifications to the data before they are plotted on the chart.
- Other types of control charts display the magnitude of the quality characteristic under study, making troubleshooting possible directly from those charts.

p-Charts

Assumptions The binomial distribution is the basis for the p-chart and requires the following assumptions:

- The probability of nonconformity p is the same for each unit; Each unit is independent of its predecessors or successors;
- The inspection procedure is same for each sample and is carried out consistently from sample to sample

p-Charts

Calculation and plotting

- The control limits for this chart type are

$$\bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

  where $\bar{p}$ is the estimate of the long-term process mean established during control-chart setup.
- Naturally, if the lower control limit is less than or equal to zero, process observations only need be plotted against the upper control limit.

p-Charts

Note that observations of proportion nonconforming below a positive lower control limit are cause for concern as they are more frequently evidence of improperly calibrated test and inspection equipment or inadequately trained inspectors than of sustained quality improvement.

p-Charts

- Some organizations may elect to provide a standard value for p, effectively making it a target value for the proportion nonconforming.
- This may be useful when simple process adjustments can consistently move the process mean, but in general, this makes it more challenging to judge whether a process is fully out of control or merely off-target (but otherwise in control).

p-Charts

Potential pitfalls

There are two circumstances that merit special attention:

- Ensuring enough observations are taken for each sample
- Accounting for differences in the number of observations from sample to sample