How do I Choose the Appropriate Type of Control Chart?

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Proper control chart selection is critical to realizing the benefits of Statistical Process Control. Many factors should be considered when choosing a control chart for a given application. These include:

- The type of data being charted (continuous or attribute)
- The required sensitivity (size of the change to be detected) of the chart
- Whether the chart includes data from multiple locations or not
- The ease and cost of sampling
- Production volumes

For variable data, X-Bar and R (or Xbar and S) charts are very common, however there are cases when they are not appropriate. For example, charts for multiple locations within the subgroup are utilized when a subgroup consists of measurements that may come from different distributions. Examples include:

- Multiple measurements on the same unit (e.g. diameter in 3 places)
- Units produced during the same cycle from different cavities, machining locations, filling heads etc.

When sampling is costly, within-sample variation is negligible, or it is not required to detect “small” process changes, charts of individual measurements are often utilized. EWMA and CUSUM charts are useful when charting individual measurements but the traditional Individuals/Moving Range charts do not provide adequate sensitivity (ability to detect process changes when they occur).

The following table may be utilized to help select an appropriate control chart for each application. The charts are segregated by data type. Charts for variable data are listed first, followed by charts for attribute data.

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Data Type	Chart	Monitors	Applications
Variable	X-Bar and S	Process average and standard deviation	High volume, single characteristic Sample size 2 or larger
Variable	X-Bar and R	Process average and range	High volume, single characteristic Sample size between 2 and 6
Variable	X and MR	Process average and moving range	Sensitivity not required Sampling is costly Long Cycle Time Note: Normality of data must be considered
Variable	Deviation from Nominal	Process average and range (or standard deviation)	Short Production Runs (Multiple parts) All parts have similar standard deviation
Variable	Standardized X-Bar and R Standardized X-Bar and S	Process average and range Process average and std dev	Short Production Runs (Multiple parts) Part standard deviations differ
Variable	X-Bar, Rb, d	Process average, range between and difference between extreme locations	Multiple locations within subgroup Location averages are statistically different
Variable	X-Bar, Rb, Rw X-Bar, Rb, S	Process average, range (or std dev) within and range between subgroup	Multiple locations within subgroup Variation within and between subgroups different Location averages are not statistically different
Variable	CUSUM	Cumulative deviations from mean	Charts for individuals when X and MR are not sensitive enough
Variable	EWMA	Weighted moving average	Charts for individuals when X and MR are not sensitive enough
Attribute	np	Number of Defectives	Pass/Fail Data Constant Sample Size n > 3/p
Attribute	p	Proportion Defective	Pass/Fail Data Constant or Variable Sample Size n > 3/p
Attribute	standardized p	Standardized Proportion Defective	Pass/Fail Data Variable Sample Size n > 3/p can be used for short production runs
Attribute	c	Number of Defects	Multiple types of defects on unit Constant Sample Size n such that c > 7
Attribute	u	Number of Defects per unit	Multiple types of defects on unit Constant or Variable Sample Size n such that c > 7
Attribute	standardized u	Standardized Number of Defects per unit	Multiple types of defects on unit Variable Sample Size n such that c > 7 can be used for short production runs

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