Sqc – statistical quality control

Statistical quality control (SQC) The application of statistical techniques to measure and evaluate the quality of a product, service, or process. Two basic categories: I. Statistical process control (SPC): - the application of statistical techniques to determine whether a process is functioning as desired II. Acceptance Sampling: - the application of statistical techniques to determine whether a population of items should be accepted or rejected based on inspection of a sample of those items. Quality Measurement: Attributes vs Variables Attributes:

Characteristics that are measured as either " acceptable" or " not acceptable", thus have only discrete, binary, or integer values. Variables: Characteristics that are measured on a continuous scale. Statistical Process Control (SPC) Methods Statistical process control (SPC) monitors specified quality characteristics of a product or service so as: To detect whether the process has changed in a way that will affect product quality and To measure the current quality of products or services. Control is maintained through the use of control charts. The charts have upper and lower ontrol limits and the process is in control if sample measurements are between the limits. Control Charts for Attributes P Charts - measures proportion defective. C Charts - measures the number of defects/unit. Control Charts for Variables X bar and R charts are used together - control a process by ensuring that the sample average and range remain within limits for both. Basic Procedure 1. An upper control limit (UCL) and a lower control limit (LCL) are set for the process. 2. A random sample of the product or service is taken, and the specified quality characteristic is measured. . If the average of the sample of the quality characteristic is higher than the upper control limit or lower than the lower control limit, the process is considered to be " out of control". CONTROL CHARTS FOR ATTRIBUTES p-Charts for Proportion Defective p-chart: a statistical control chart that plots movement in the sample proportion defective (p) over time Procedure: 1. take a random sample and inspect each item 2. determine the sample proportion defective by dividing the number of defective items by the sample size 3. lot the sample proportion defective on the control chart and compare with UCL and LCL to determine if process is out of control The underlying statistical sampling distribution is the binomial distribution, but can be approximated by the normal distribution with: mean = u = np (Note - add the bars above the means used in all the equations in this section) standard deviation of p: sigmap = square root of (p(1 -p) / n) where p = historical population proportion defective and n = sample size Control Limits: UCL = u + z sigmap LCL = u - z sigma p is the number of standard deviations from the mean. It is set based how certain you wish to be that when a limit is exceeded it is due to a change in the process proportion defective rather than due to sample variability. For example: If z = 1 if p has not changed you will still exceed the limits in 32% of the samples (68% confident that mean has changed if the limits are exceeded. z = 2 - limits will be exceeded in 4. 5 (95. 5 % confidence that mean has changed) z = 3 - limits will be exceeded in . 03 (99. % confidence) c-Charts for Number of Defects Per Unit c-chart: a statistical control chart that plots movement in the number of defects per unit. Procedure: 1. randomly select one item and count the number of defects in that item 2. plot the number of defects on a control chart 3. compare with UCL and LCL to determine if process is out of control The underlying sampling distribution is the Poisson distribution, but can be approximated by the normal distribution with: mean = c standard deviation = square root of c here c is the historical average number of defects/unit Control Limits: UCL = c + z c LCL = c - z c Control Charts for Variables Two charts are used together: R-chart (" range chart") and X barchart (" average chart") Both the process variability (measured by the R-chart) and the process average (measured by the X bar chart) must be in control before the process can be said to be in control. Process variability must be in control before the X bar chart can be developed because a measure of process variability is required to determine the -chart control limits.

R-Chart for Process Variability: UCLR = D4(R) LCLR = D3(R) where is the average of past R values, and D3 and D4 are constants based on the sample size -Chart for Process Average: UCLR = X bar + A2(R) LCL = X bar - A2(R) where X bar is the average of several past values, and A2 is a constant based on the sample size Other Types of Attribute-Sampling Plans Double-Sampling Plan: Specifies two sample sizes (n1 and n2) and two acceptance levels (c1 and c2) 1. f the first sample passes (actual defects c1), the lot is accepted 2. if the first sample fails and actual defects > c2, the lot is rejected 3. if first sample fails but c1 < actual defects c2, the second sample is taken and judged on the combined number of defectives found. Sequential-Sampling Plan: Each time an item is inspected, a decision is made whether to accept the lot, reject it, or continue sampling. Acceptance Sampling Goal: To accept or reject a batch of items.

Frequently used to test incoming materials from suppliers or other parts of the organization prior to entry into the production process. Used to determine whether to accept or reject a batch of products. Measures number of defects in a sample. Based on the number of defects in the sample the batch is either accepted or rejected. An acceptance level c is specified. If the number of defects in the sample is c the atch is accepted, otherwise it is rejected and subjected to 100% inspection.