**Statistical Process Control**

**Knowledge Check**

**Weekly Learning Objectives**

* Define the quality of product or service
* Develop four types of control charts:$\overbar{x}$, R, p, and c
* Understanding the theoretical basis of statistical quality control
* Know whether process is in control

**Key Concepts Summary:**

Statistical process control is a major statistical tool of quality control. Control charts for SPC help operations managers distinguish between natural and assignable variations.

The $\overbar{X}$-chart and the R-chart are used for variable sampling, the p-chart, and the c-chart for attribute sampling. The c-chart for the attribute sampling. The Cpk index is a way to express process capability.

Operating characteristics curves facilitate acceptance sampling and provide the managers with tools to evaluate the quality of production run or shipment.

The process is said to be operating in statistical control when the only source of variation is common (natural) causes.

The process must first be brought into statistical control by detecting and eliminating special (assignable) causes of variation.

The objective of a process control system is to provide a statistical signal when assignable causes of variation are present.

When natural variations form a normal distribution, they are characterized by two parameters:

* Mean: the measure of central tendency
* Standard Deviation: the measure of dispersion

As long as the distribution (output measurements) remains within specified limits, the process is said to be “in control”, and natural variations are tolerated.

**Key Definitions:**

**1. Statistical process control:**

 uses statistical and probability tools to help control processes and produce consistent goods and services. A process used to monitor standards by taking measurements and corrective actions as a product or service is being produced.

**2. Quality and its definitions:**

* is the degree to which the product or service meets specifications.
* Is fitness for use
* Is defined by the consumer, consumer want products and services that, throughout their lives, meet customers’ needs and expectations at a cost that represents value.
* Even though quality cannot be defined, you know what it is

**3. Total Quality Management:** An emphasis on quality thatencompasses the whole organization

**4. Statistical Process Control**: helps set standards. It can also monitor, measure, and help correct quality problems.

**5. Control chart:** is a graphic way of presenting data over time. Control charts monitor a process as it currently operates, not necessarily how you would like it to operate. Thus, a process that is in control might still yield a higher number of problems than the managers would like.

**6. Natural variations:** are sources of variations in a process that is statistically in control. Are variabilities that affect almost very production process to some degree and are to be expected. Also known as common causes.

**7. Assignable variations:** in a process can be traced to a specific cause.

**8.** $\overbar{x} $**- charts:** measure central tendency of a process. A quality control chart for variables that indicates when changes occur in the central tendency of a production process.

**9. R - charts:** measure the range between the biggest (or heaviest) and smallest (or lightest) item in a random sample. Are process control charts that track the “range” within a sample, indicates that a gain or loss of uniformity has occurred in a production process.

**10. The Central Limit Theorem:** says that the distribution of sample means will follow a normal distribution as the sample size grows larger. It is a theoretical foundation of $\overbar{x}$ charts. It states that regardless of the distribution of the population of all parts or services, the distribution of $\overbar{x}$ will tend to follow a normal curve as the sample size grows.

**11. Dispersion or variability:** Control chart limits can be found using the range rather than the standard deviation. The central tendency can be under control, but ranges can be out of control.

**12. Sampling attributes:** differ from sampling variables.

**13. p - charts:** a quality control charts that is used to control attributes. p-charts limits are based on the binomial distribution.

**14. c - chart:** a quality control char that is used to control the number of defects per unit of output.

**15. Process capability:** the ability of the process to meet design specifications.

**16. Run test:** A test used to examine the points in a control chart to see if non- random variation is present.

**17. Cp ratio:** A ratio for determining whether a process meets design specifications; a ratio of the specifications to the process variation.

**18.CPk Ratio:** A proportion of variation (3σ) between the center of the process and the nearest specification limit.

**19. Acceptance sampling:** A method of measuring random samples of lots or batches of product against predetermined standards.

**20. Operating characteristic curve:** A graph that describes how well an acceptance plan discriminates between good and bad lots.

**21. Producer’s risk:** the mistake of having a producer’s good lot rejected through sampling.

**22. Consumer’s risk:** the mistake of a customer’s acceptance of a bad lot overlooked through sampling.

**23. Acceptable level of quality:** The quality level of a lot considered good.

**24. Type I error:** Statistically, the probability of rejecting a good lot.

**25. Type II error:** Statistically, the probability of accepting a bad lot.

**26. Total Process Variation:** Common Cause Variation + Special Cause Variation.

**27. Nominal Value:** A target for design specification.

**28. Tolerance:** An allowance above or below the nominal value.