PROCESS CAPABILITY ANALYSIS

Semester IV   **STAT CC410**

Unit 2

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PROCESS CAPABILITY ANALYSIS

Definition:

- In product manufacturing industry, statistical techniques can be helpful throughout the product cycle, including development activities prior to manufacturing,

➢ in quantifying process variability,

➢ in analyzing this variability relative to product requirements or specifications, and

➢ in assisting development and manufacturing in eliminating or greatly reducing this variability. This general activity is called **process capability analysis**.

- In other words, **process capability** refers to the **uniformity of the process**. Obviously, the variability of the quality characteristics in the process is a measure of uniformity of output.

- There are two ways to think of this variability:

1. The natural or inherent variability in a quality characteristics at a specified time, that is, instantaneous variability.

2. The variability is a quality characteristic over time.

- Now, we present methods for investigating and assessing both aspect of process capability.

- Determining process capability is an important part of the DMAIC process. It is used primarily in the analyze step, but it also can be useful in other steps, such as improve.

- It is customary to take six-sigma spread in the distribution of the quality characteristic as a measure of process capability.

- Figure 1 shows a process for which a quality characteristics has a normal distribution with mean μ and standard deviation σ. The upper and lower natural tolerance limits of the process fall at $\mu + 3\sigma$ and $\mu - 3\sigma$ respectively, that is,

  UNTL (Upper Natural Tolerance Limit) = $\mu + 3\sigma$

  LNTL (Lower Natural Tolerance Limit) = $\mu - 3\sigma$
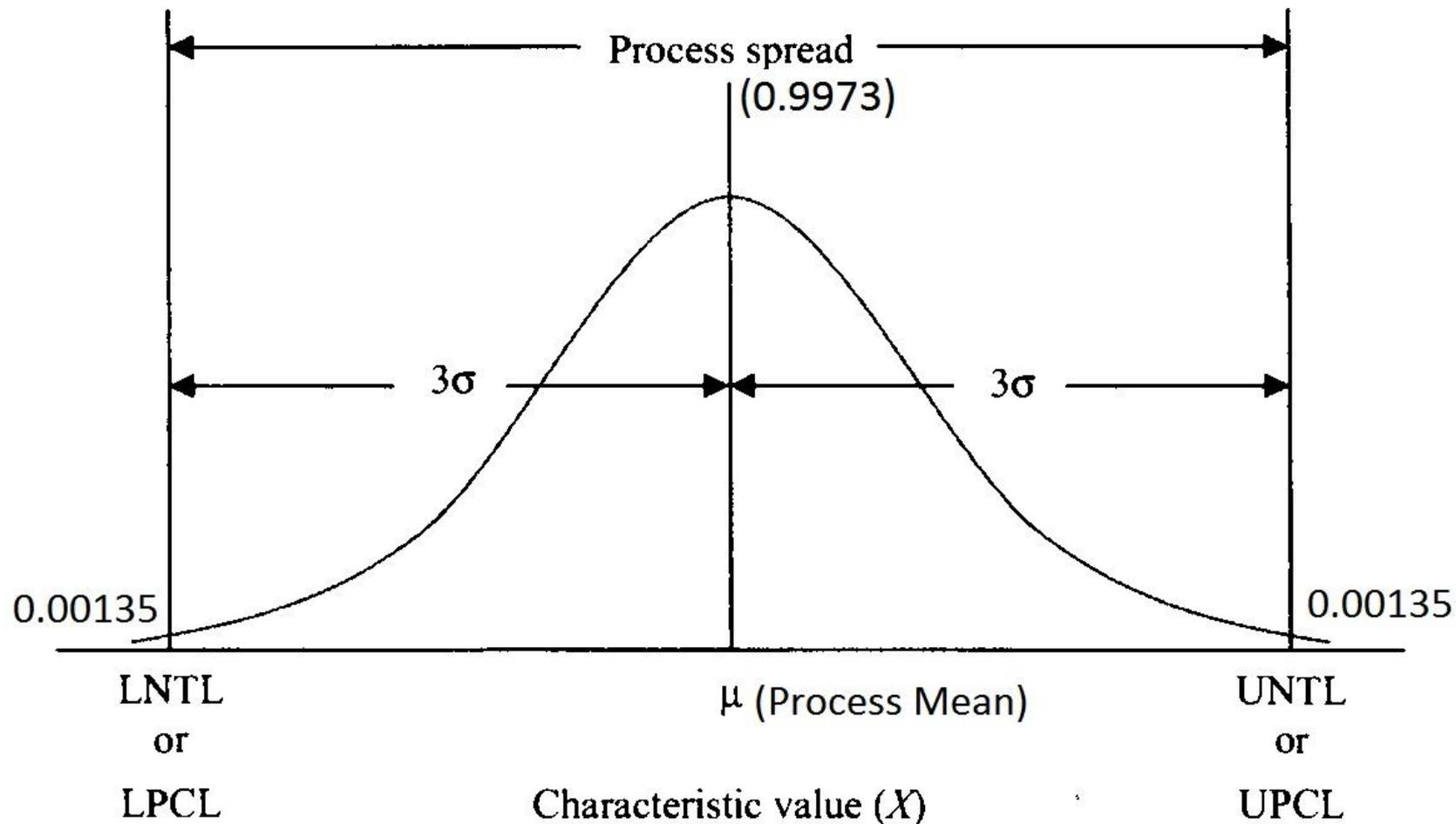
UNTL and LNTL in the Normal Distribution and Process Spread

Figure 1: Upper and Lower Natural Tolerance Limits in the Normal Distribution and Process Spread

- For a normal distribution, the natural tolerance limits include 99.73% of the variability, or put another way, only 0.27% of the process output will fall outside the natural tolerance limits.

- Here, two points should be remembered:

1. 0.27% outside the natural tolerance limits is actually small, but this corresponds to 2700 non-conforming per million (10,000)

2. If the distribution of the process is non-normal, then the percentage of output falling outside $\mu \pm 3\sigma$ may differ considerably from 0.27%.

Uses of Process Capability Analysis

- Process capability analysis is a vital part of an overall quality improvement program. Among the major uses of data from a process capability analysis are the following:

1) Predicting how will the process will hold the tolerance.
2) Assisting product developers/designers in selecting or modifying a program.
3) Assisting in establishing an interval between sampling for process monitoring.
4) Specifying process requirements for new equipment.
5) Selecting between competing suppliers and other aspects of supply chain management.
6) Planning the sequence of production processes when there is an interactive effect of processes on tolerances.
7) Reducing the variability in a process.
- Thus, process capability analysis is a technique that has application in many segments of the product cycle, including product and process design, supply chain management, production or manufacturing planning, and manufacturing.

Techniques of Process Capability Analysis

- There are three primary techniques that are used in process capability analysis which are as follows:

1) Histogram or probability plots,

2) Control Charts, and

3) Designed experiments.