

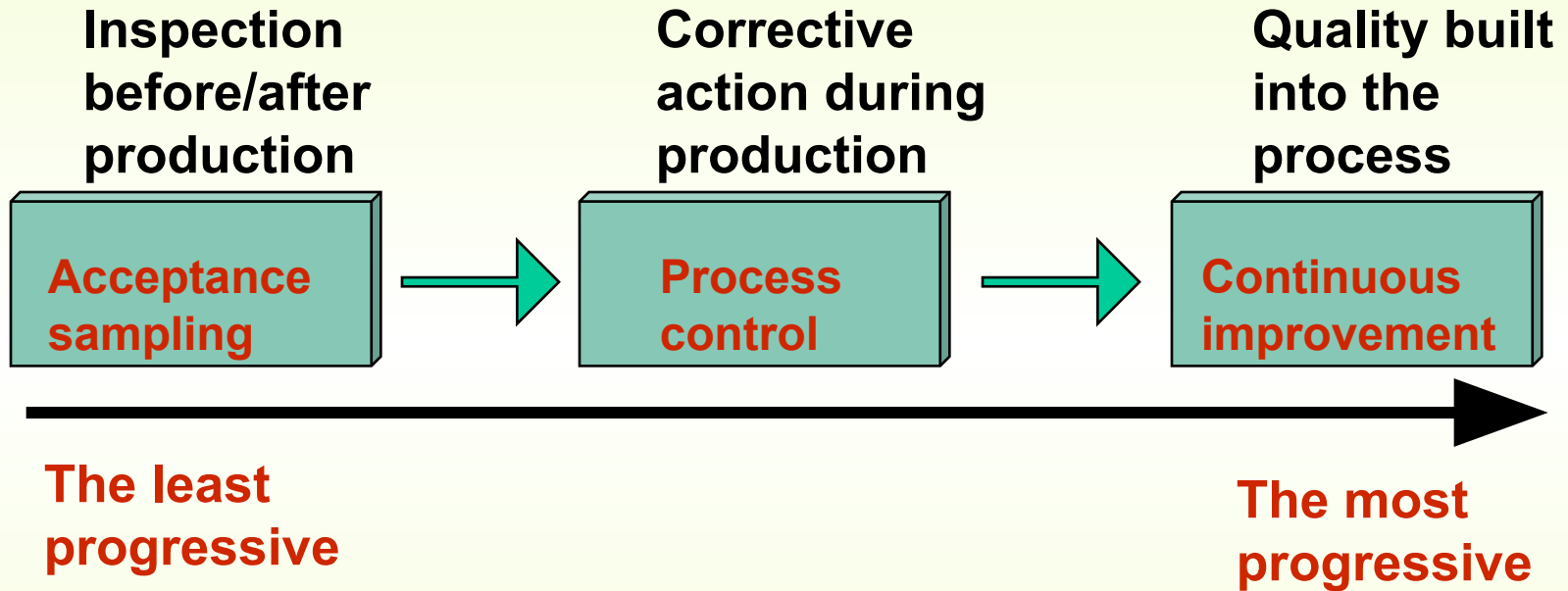


CHAPTER 10: Quality Management

Quality Control

- **What does the term quality control mean?**
 - Quality Control is an activity that evaluates quality characteristics relative to a standard, and takes corrective action when they do not meet standards
- **How is quality control accomplished?**
 - by monitoring and inspecting the product during process (but not preventing bad quality from happening)

Phases of Quality Assurance



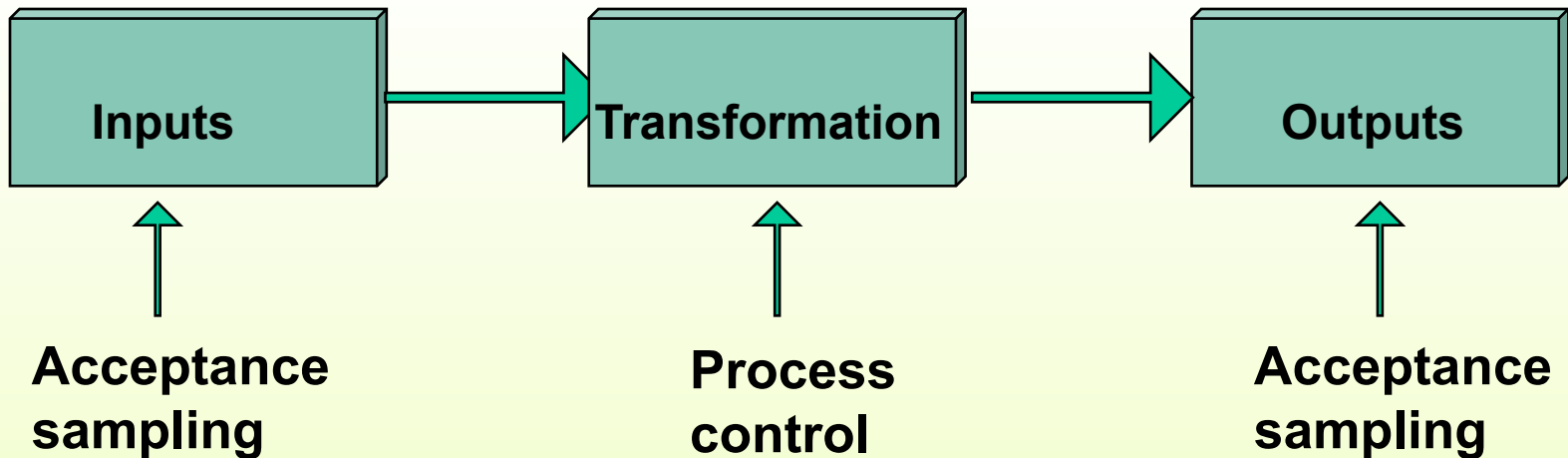
Quality Control focuses on quality during a process
(reactive)

Quality Assurance focuses on **proactive** actions to eliminate quality defects during processes

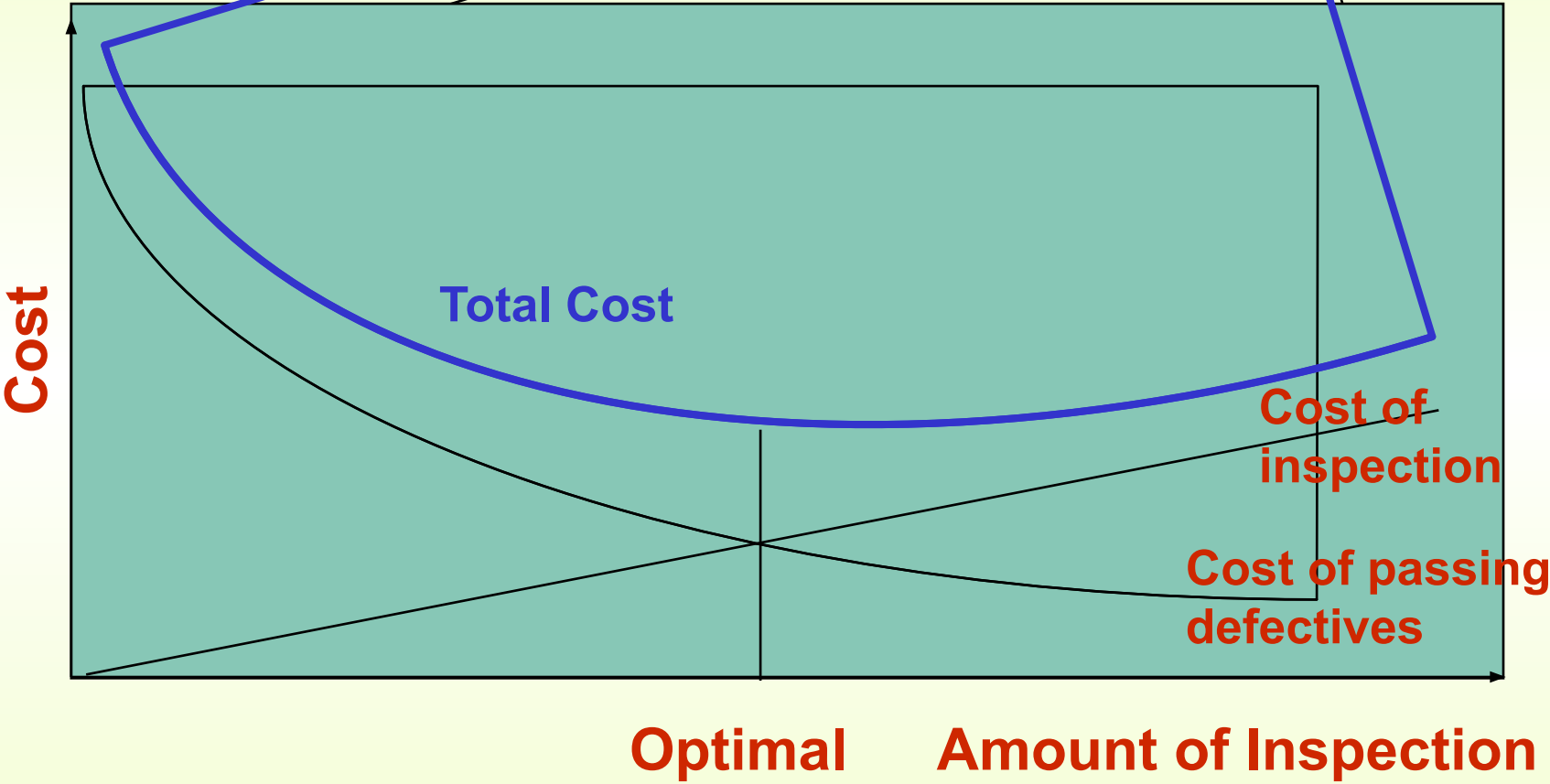
B. Inspection

Inspection: appraisal of goods or services against standards

- Inspection does NOT add value to the customer
- Only shows a picture of the existing situation
- We inspect because we expect to find defects
- We cannot trust the reliability of our process



How Much to Inspect and How Often?



What is the impact upon the customer (and Liability) if we do not inspect?

Where to Inspect in the Process

- Raw materials and purchased parts that arrive from suppliers- before we accept
- Finished products after final process step
- Finished product (packaged) before shipment to customer
- Before a costly operation
- Before an irreversible process (cannot undo once done)
- Before a covering process (painting)

Examples of Inspection Points

Type of business	Inspection points	Characteristics
Fast Food	Server Eating Area Kitchen	Appearance, friendliness Cleanliness Cleanliness, purity of food, food storage, health regulations, availability of ingredients, hygiene
Supermarket	Cashiers Aisles, stockrooms Shelf stock	Accuracy, courtesy, waiting time Uncluttered layout Ample supply, rotation of perishables, appearance

Statistical Process Control

Statistical Process Control: Statistical evaluation of the output of a process during production

1. Quality Control Steps
2. Type of Variations
3. Control Charts
4. Designing Control Charts
5. Individual Unit and Moving Range Charts
6. Control Charts for Attributes
7. Managerial Considerations

Quality Control Steps

1. Define the quality characteristics to monitor – ex. Product dimensions
1. Measure the characteristics – determine how often Ex. every 10th piece
1. Compare to a standard (engineering drawing or physical “perfect” sample) and evaluate
1. Take corrective action when necessary
1. Evaluate the effectiveness of the corrective action – should result in fewer defects going forward

Tolerances

Tolerances – allowable deviations from desired mean

Ex. Part length: **25mm+/- 3mm** means:

25 is the optimal desired

22 is the smallest we will allow

28 is the largest we will allow

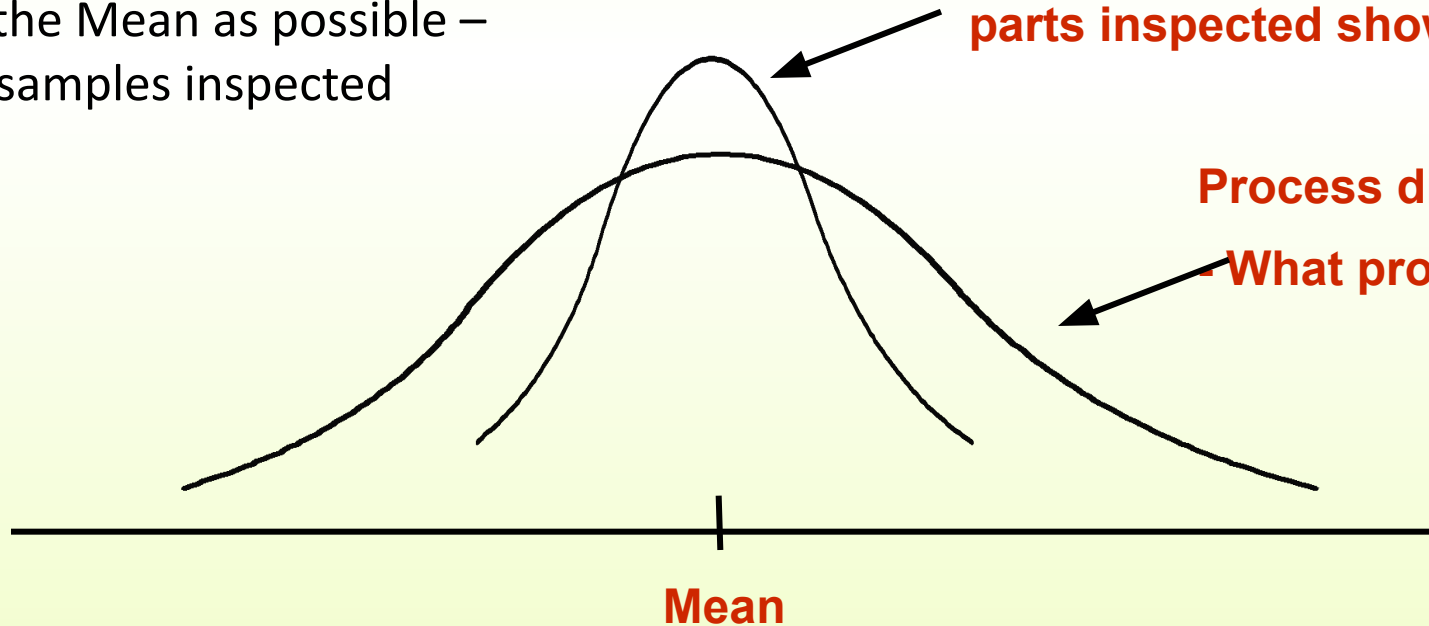
Any part whose measurement is higher or lower than these numbers are considered defective

The tighter the tolerance – the more difficult and costly it will be to meet that tolerance. Allow as great a tolerance without impacting product performance or appearance

Types of Variations

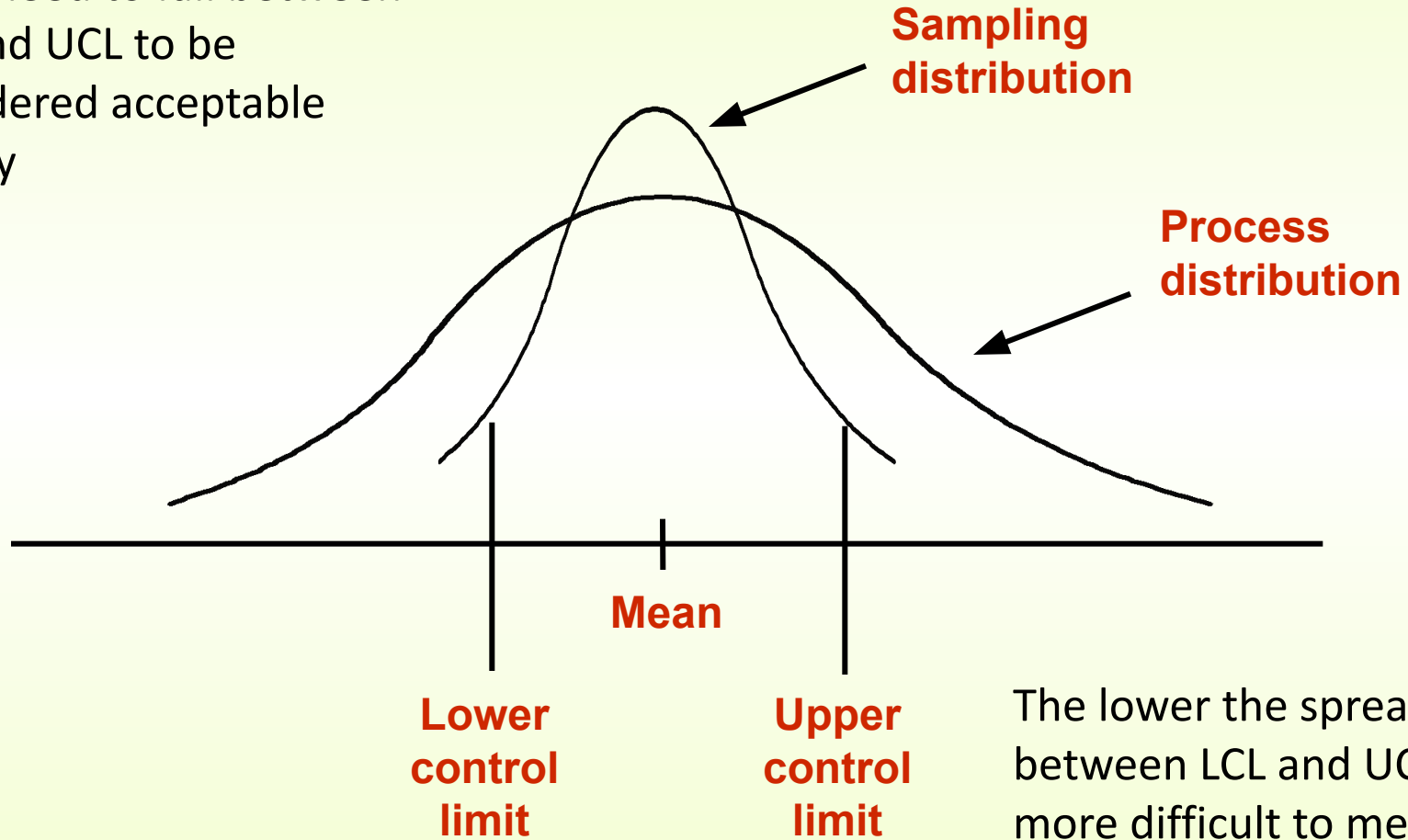
- **Random variation:** Natural variations in the output of process, created by countless minor factors
- **Assignable variation:** A variation whose source can be identified

Most desirable – closest to the Mean as possible – all samples inspected



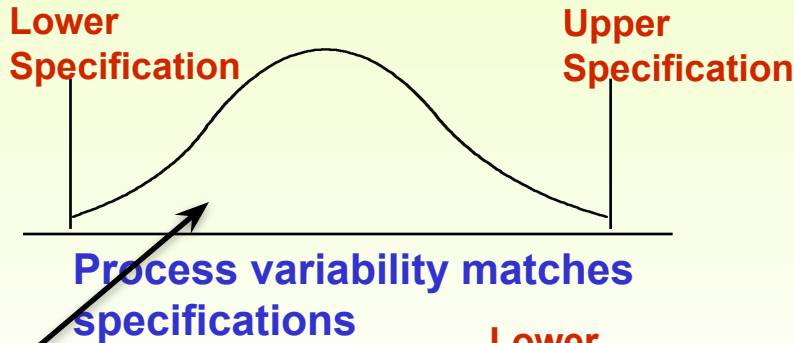
Control Limits

Parts need to fall between LCL and UCL to be considered acceptable quality

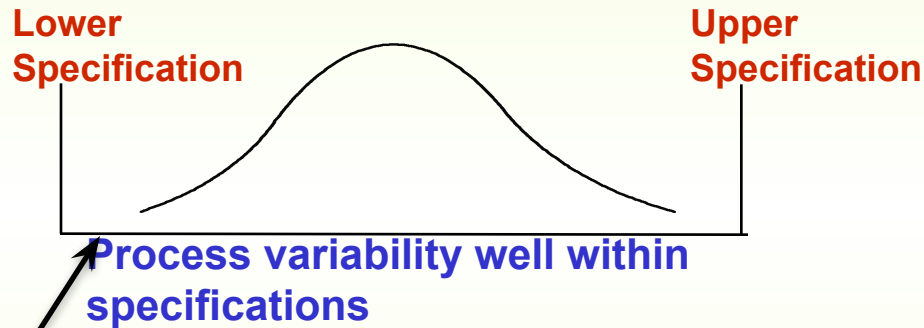


The lower the spread between LCL and UCL the more difficult to meet quality standards

Capability Analysis

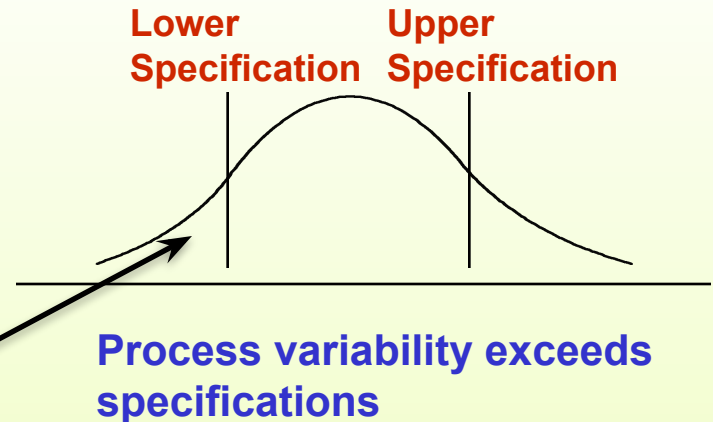


Good – samples within allowable range



BEST – samples well within allowable range

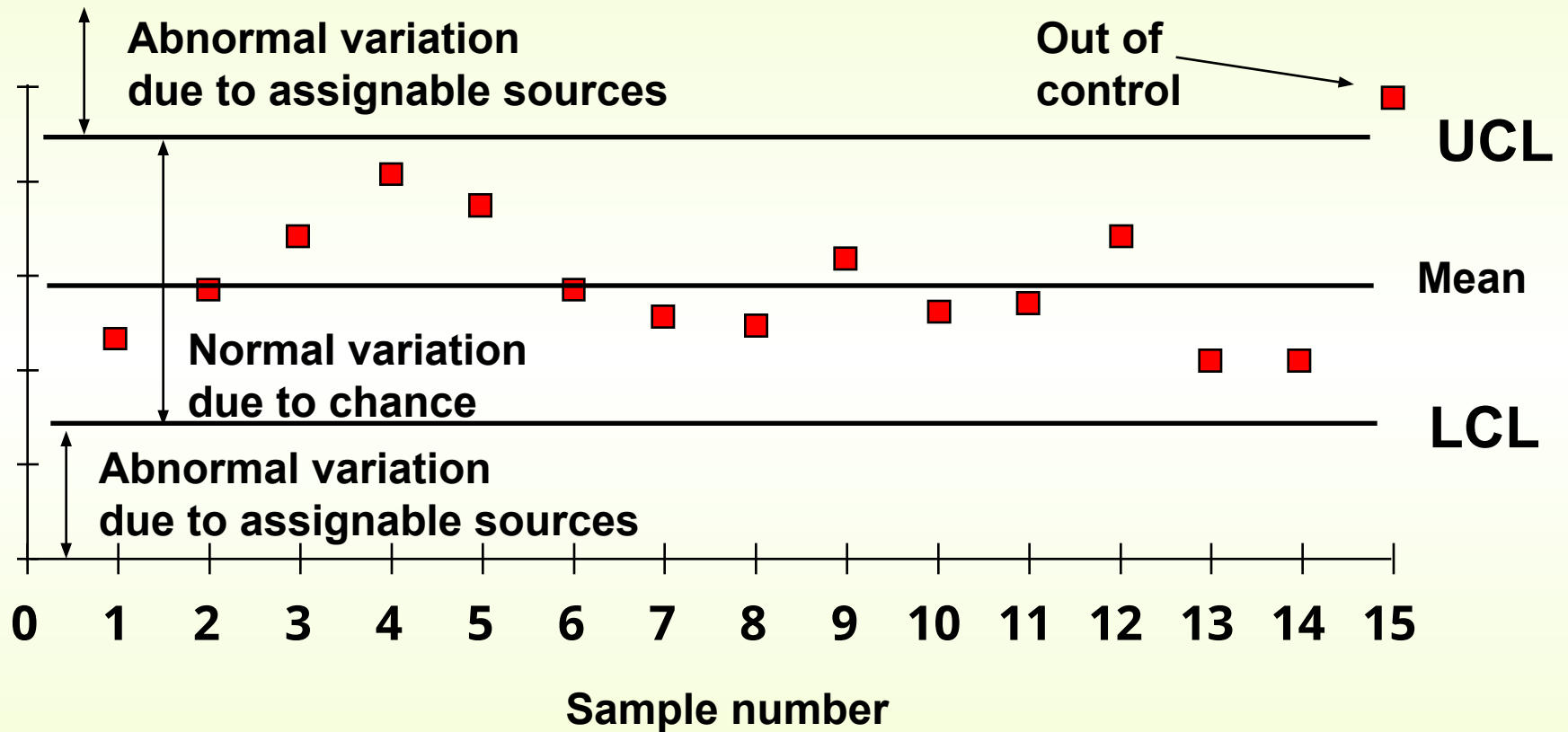
Bad – many samples outside allowable range



Control Charts

- **Control Chart:** A time ordered plot of sample statistics, used to distinguish between random and non random variability
- **Control Limits:** The dividing lines (upper and lower limits) from the desired mean of the sampling distribution
- Every x piece the operator measures and record on the Control Chart. Chart is kept beside the machine, visible to anyone

Control Chart



When to take action on variation trends?

Designing Control Charts

1. Determine how often to inspect a sample piece
2. Establish LCL and UCL control limits
3. Plot the inspected sample values on the control chart, and note whether any points fall outside control limits (CL)
4. If no points outside CL assume there is no assignable cause. If points are outside CL investigate and correct
5. Operators use control chart by recording the value of sample statistic which is periodically taken
6. Determine when to take action if a series of sample values trend in a certain direction (up or down)

Process Capability

- **Specifications**
 - A range of acceptable values established by engineering design or customer requirements
- **Control limits**
 - Statistical limits plotted against LCL and UCL
- **Process variability**
 - Natural or inherent variability in a process (process varies)
- **Process capability**
 - The inherent variability of process output relative to the variation allowed by the design specification

Acceptance Sampling

- **Acceptance sampling:**
 - Form of inspection applied to lots or batches of items before or after a process, to judge conformance with predetermined standards. Ex. Receive a box of 1000, randomly check 25, and based on results, infer to the entire amount
- **Conditions for Acceptance Sampling**
 - A large number of items must be processed in a short time
 - Destructive testing may be required Ex. Air tanks
 - Fatigue or boredom caused by inspecting large numbers of items leads to inspection errors

Sampling Plans

- **Sampling plans:**
 - Plans that specify lot size, sample size, number of samples, and acceptance/rejection criteria
- **Types:**
 - Single-sampling: one random sample is drawn from each lot
 - Double-sampling: a second sample could be taken
 - Multiple-sampling: more than two different samples may be required
- **Choose a plan in terms of cost and time for inspection**

Sampling Terms

- **Acceptance quality level (AQL):**
 - the percentage of defects at which consumers are willing to accept lots as “good”
- **Lot tolerance percent defective (LTPD):**
 - the upper limit on the percentage of defects that a consumer is willing to accept
- **Consumer’s risk:**
 - the probability that a lot containing defects equal to the LTPD will be accepted
- **Producer’s risk:**
 - the probability that a lot containing the acceptable quality level will be rejected