

# Quality Tools in Management

A **quality tool** is an instrument or technique you can use to support and improve a process.

Organizations, team members and individuals can use basic quality tools to identify and analyze ways to better satisfy customers, reduce defects and improve the bottom line.

- Cause and effect diagram
- Pareto chart
- Scatter diagram
- Check sheet
- Histogram
- Control chart
- Process flow diagram

# Cause-and-effect diagram

Also called: Fishbone Diagram , Ishikawa diagram

The fishbone diagram identifies many possible causes for an effect or problem. It can be used to structure a brainstorming session. It immediately sorts ideas into useful categories.

## **When to use**

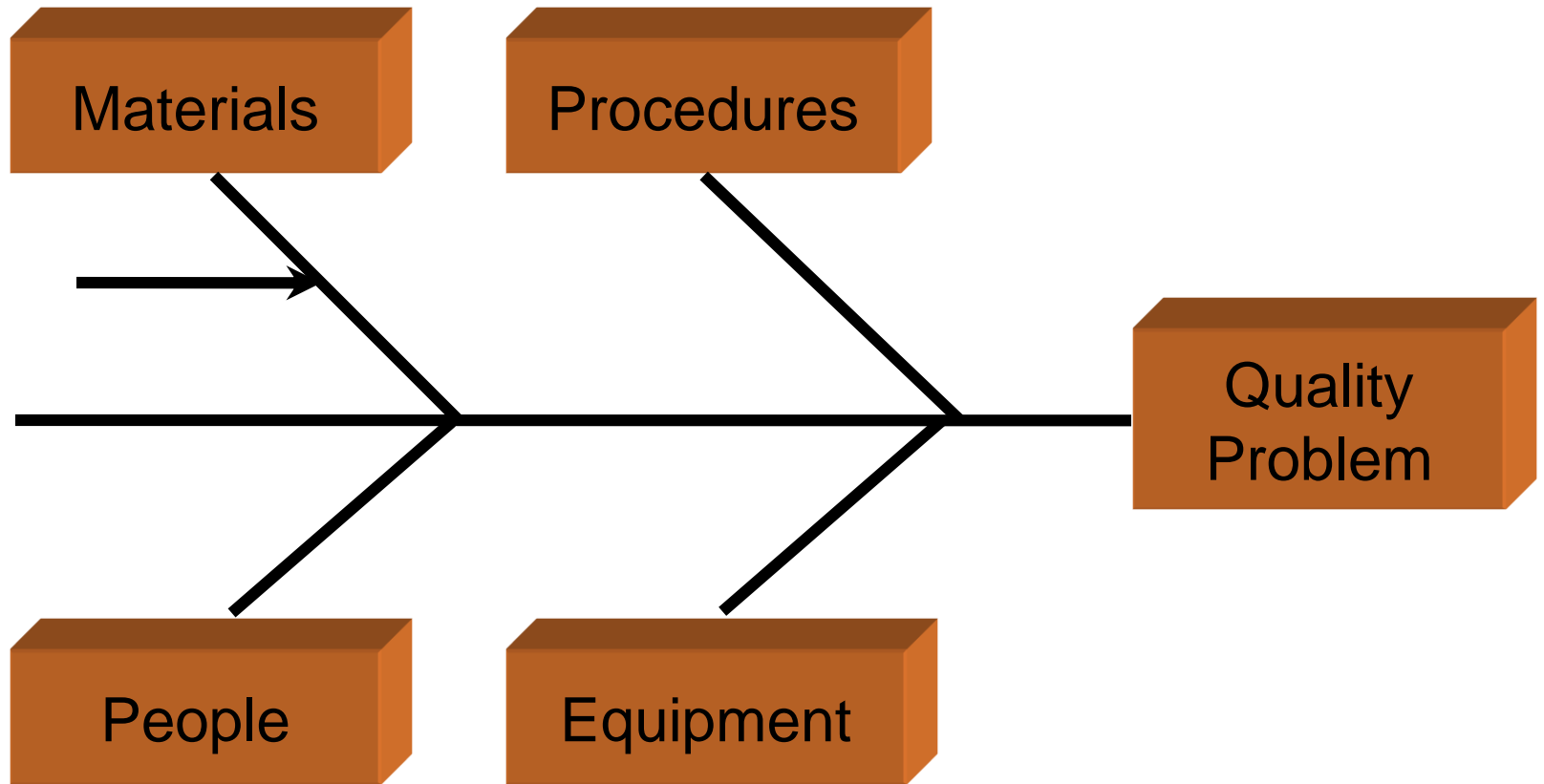
- a) When identifying possible causes for a problem.
- b) Especially when a team's thinking tends to fall into ruts.



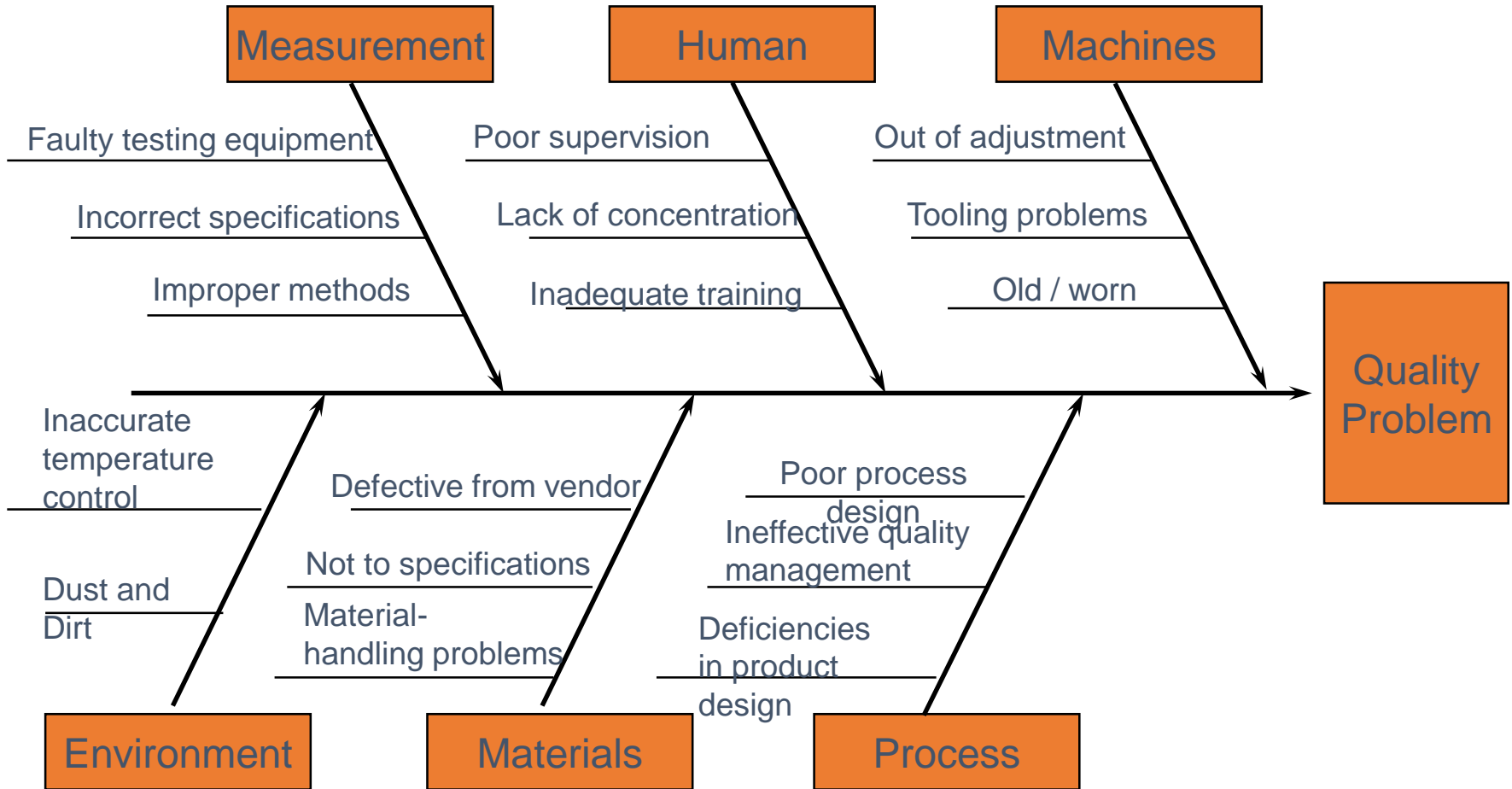
# Procedure

- a) Agree on a problem statement (effect). Write it at the center right of the flipchart or whiteboard. Draw a box around it and draw a horizontal arrow running to it.
- b) Brainstorm the major categories of causes of the problem. If this is difficult use generic headings:
  - Methods
  - Machines (equipment)
  - People (manpower)
  - Materials
  - Measurement
  - Environment
- c) Write the categories of causes as branches from the main arrow.
- d) Brainstorm all the possible causes of the problem. Ask: "Why does this happen?" As each idea is given, the facilitator writes it as a branch from the appropriate category. Causes can be written in several places if they relate to several categories.
- e) Again ask "why does this happen?" about each cause. Write sub-causes branching off the causes. Continue to ask "Why?" and generate deeper levels of causes. Layers of branches indicate causal relationships.
- f) When the group runs out of ideas, focus attention to places on the chart where ideas are few.

# Cause-effect Skeleton



# Fishbone Diagram



# Pareto Chart

A **Pareto chart** is a bar graph. The lengths of the bars represent frequency or cost (time or money), and are arranged with longest bars on the left and the shortest to the right. In this way the chart visually depicts which situations are more significant.

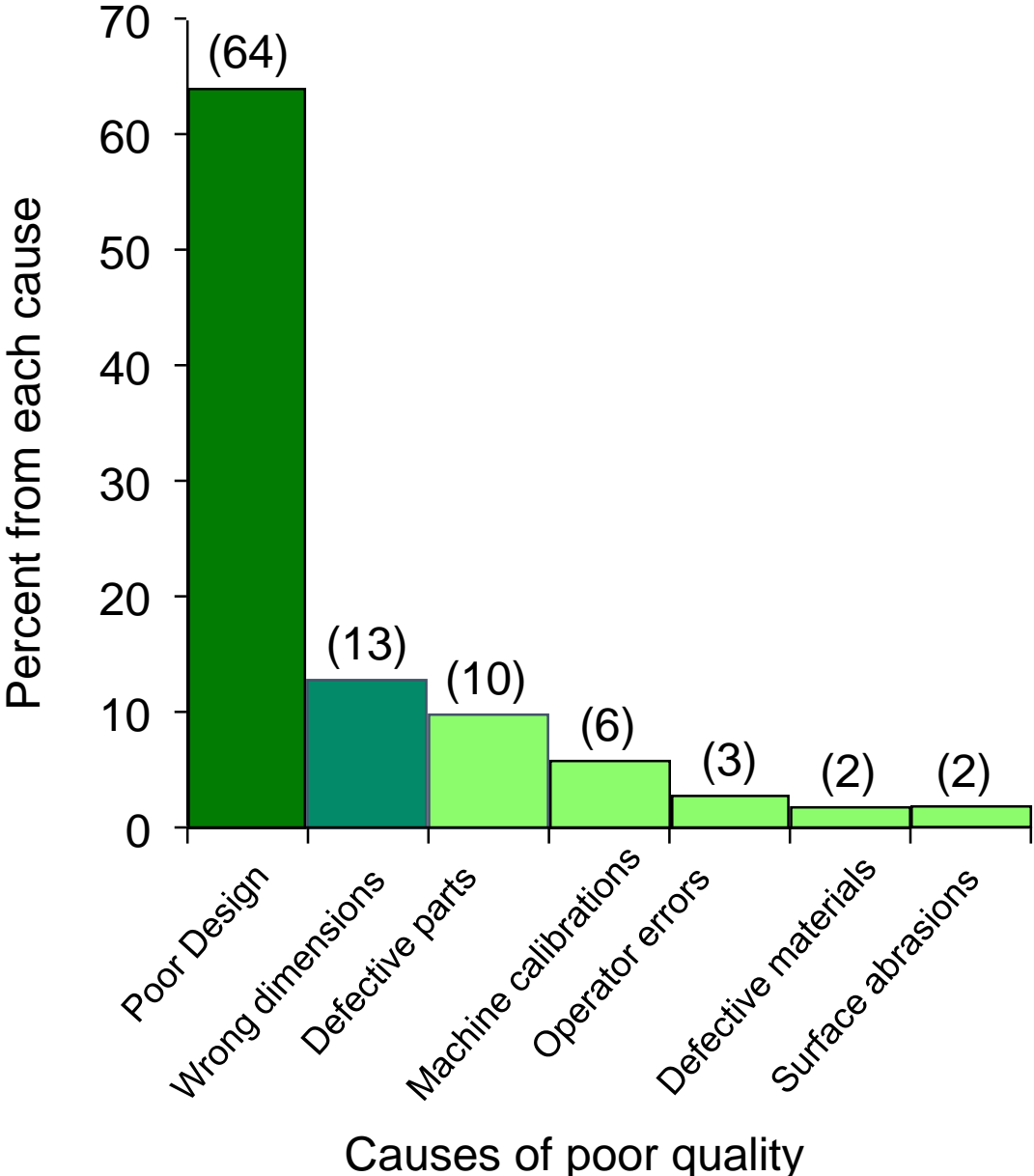
## **When to use**

- When analyzing data about the frequency of problems or causes in a process.
- When there are many problems or causes and you want to focus on the most significant.
- When analyzing broad causes by looking at their specific components.
- When communicating with others about your data.

# Procedure

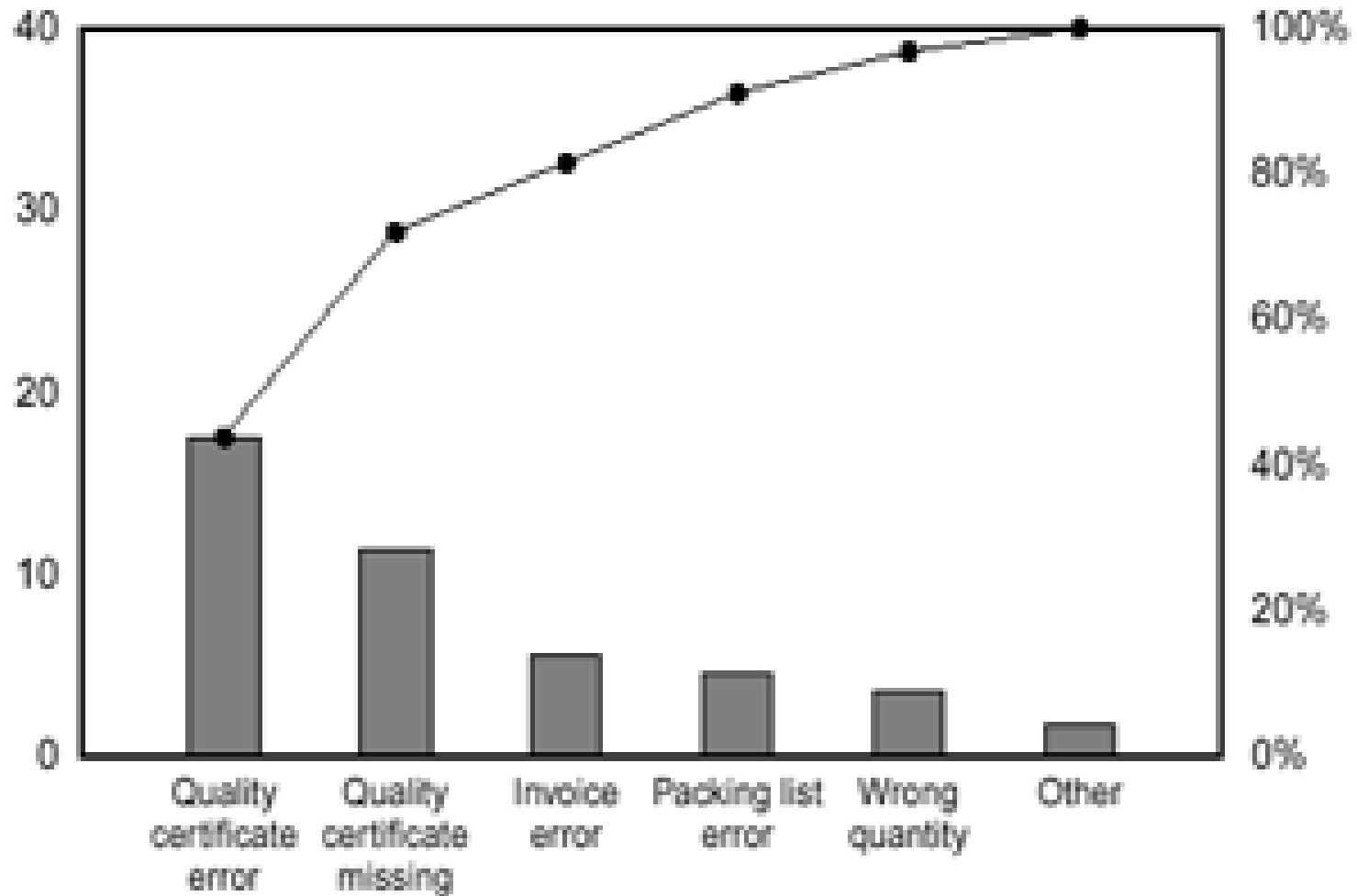
1. Decide what categories you will use to group items.
2. Decide what measurement is appropriate. Common measurements are frequency, quantity, cost and time.
3. Decide what period of time the chart will cover: One work cycle? One full day? A week?
4. Collect the data, recording the category each time.
5. Subtotal the measurements for each category.
6. Determine the appropriate scale for the measurements you have collected. The maximum value will be the largest subtotal from step 5. Mark the scale on the left side of the chart.
7. Construct and label bars for each category. Place the tallest at the far left, then the next tallest to its right and so on. If there are many categories with small measurements, they can be grouped as "other."
8. Calculate the percentage for each category: the subtotal for that category divided by the total for all categories. Draw a right vertical axis and label it with percentages. Be sure the two scales match: For example, the left measurement that corresponds to one-half should be exactly opposite 50% on the right scale.
9. Calculate and draw cumulative sums: Add the subtotals for the first and second categories, and place a dot above the second bar indicating that sum. To that sum add the subtotal for the third category, and place a dot above the third bar for that new sum. Continue the process for all the bars. Connect the dots, starting at the top of the first bar. The last dot should reach 100 percent on the right scale.

# Pareto Chart





Types of Document Complaints  
Second Quarter 2005



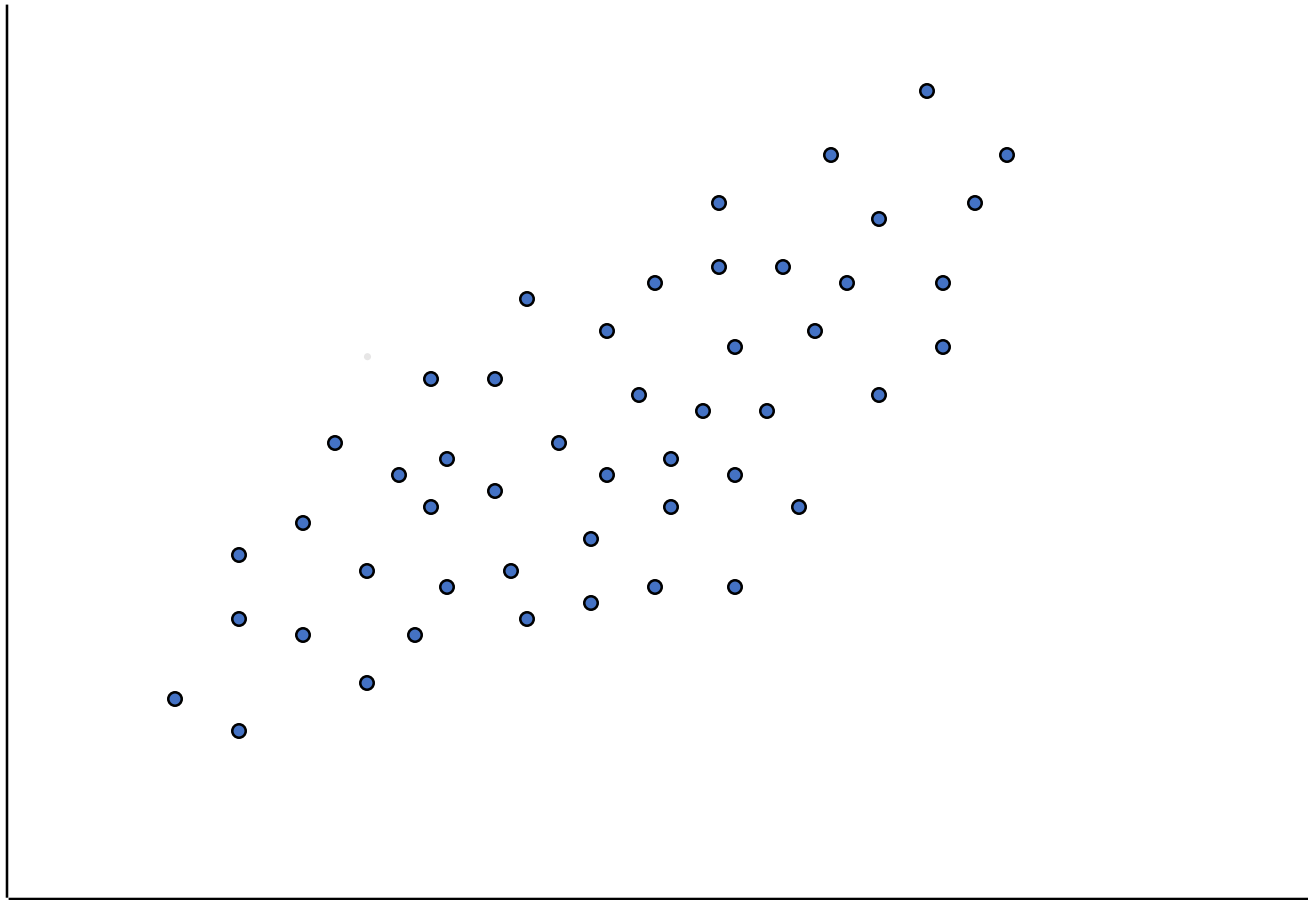
# Scatter Diagram

The scatter diagram graphs pairs of numerical data, with one variable on each axis, to look for a relationship between them. If the variables are correlated, the points will fall along a line or curve. The better the correlation, the tighter the points will hug the line.

## When to use

- When you have paired numerical data.
- When your dependent variable may have multiple values for each value of your independent variable.
- When trying to determine whether the two variables are related, such as when trying to identify potential root causes of problems.
- After brainstorming causes and effects using a fishbone diagram, to determine objectively whether a particular cause and effect are related.
- When determining whether two effects that appear to be related both occur with the same cause.
- When testing for autocorrelation before constructing a control chart.

# Scatter Diagram



# Check Sheet

A check sheet is a structured, prepared form for collecting and analyzing data. This is a generic tool that can be adapted for a wide variety of purposes.

## When to use

- When data can be observed and collected repeatedly by the same person or at the same location.
- When collecting data on the frequency or patterns of events, problems, defects, defect location, defect causes, etc.
- When collecting data from a production process.

# Procedure

1. Decide what event or problem will be observed. Develop operational definitions.
2. Decide when data will be collected and for how long.
3. Design the form. Set it up so that data can be recorded simply by making check marks or Xs or similar symbols and so that data do not have to be recopied for analysis.
4. Label all spaces on the form.
5. Test the check sheet for a short trial period to be sure it collects the appropriate data and is easy to use.
6. Each time the targeted event or problem occurs, record data on the check sheet.

# Check Sheet

		Shifts			
Defect Type		√ √ √	√ √ √ √	√	√ √ √
		√ √	√ √ √		
			√ √ √ √		√ √ √
			√ √	√	

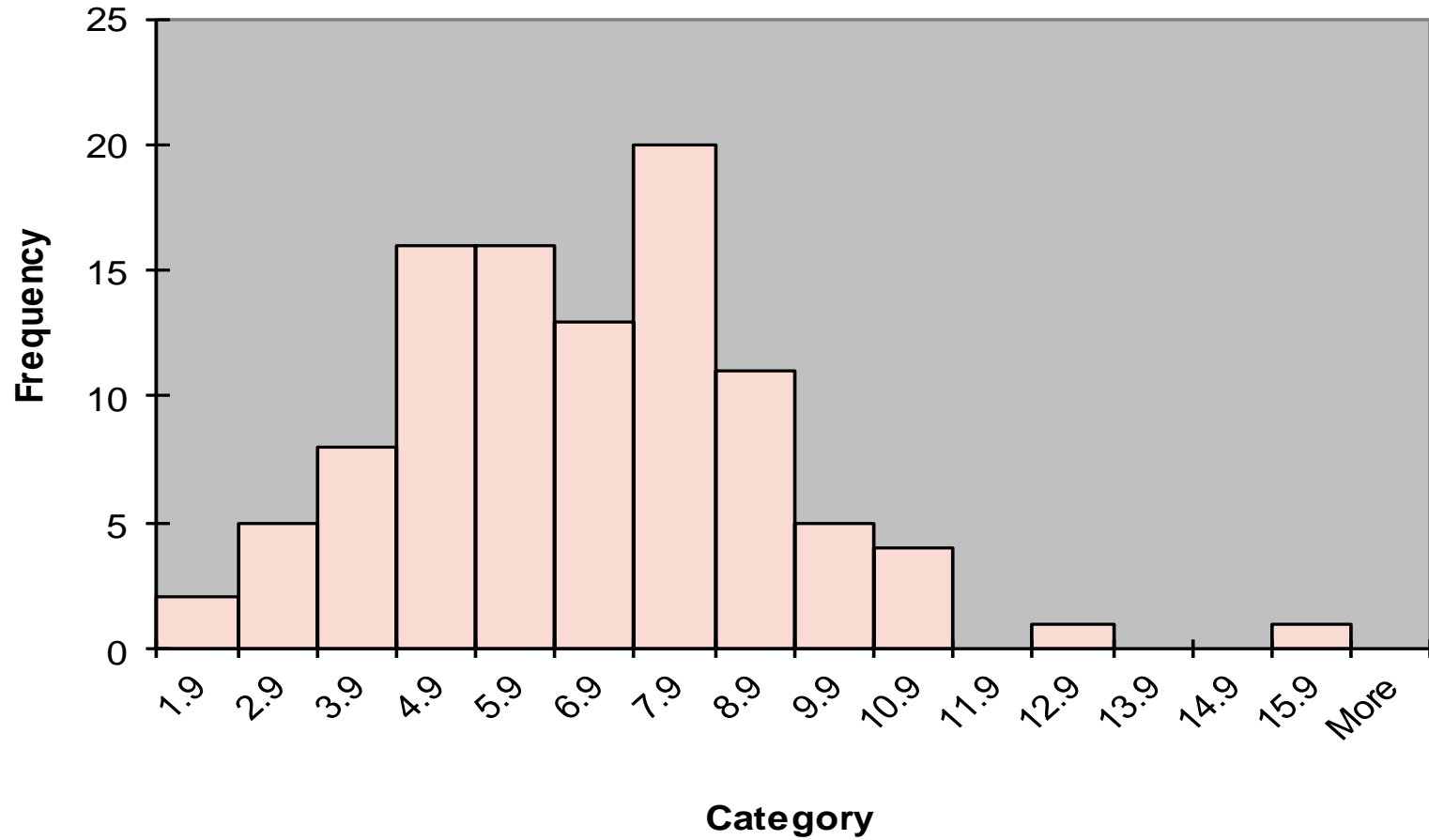
# Check Sheet

COMPONENTS REPLACED BY LAB  
TIME PERIOD: 22 Feb to 27 Feb 2010  
REPAIR TECHNICIAN: Kumar

TV SET MODEL 1013

Integrated Circuits	
Capacitors	/    /     /     /
Resistors	
Transformers	
CRT	

# Histogram





# Control Chart

**Variable data** are measured on a continuous scale. For example: time, weight, distance or temperature can be measured in fractions or decimals. The possibility of measuring to greater precision defines variable data.

## **Variables charts**

- X-bar and R chart (also called average and range chart)
- X-bar and s chart
- X-bar and MR chart

**Attribute data** are counted and cannot have fractions or decimals. Attribute data arise when you are determining only the presence or absence of something: success or failure, accept or reject, correct or not correct. For example, a report can have four errors or five errors, but it cannot have four and a half errors.

### **Attributes charts**

- p chart (also called proportion chart)
- np chart
- c chart (also called count chart)
- u chart

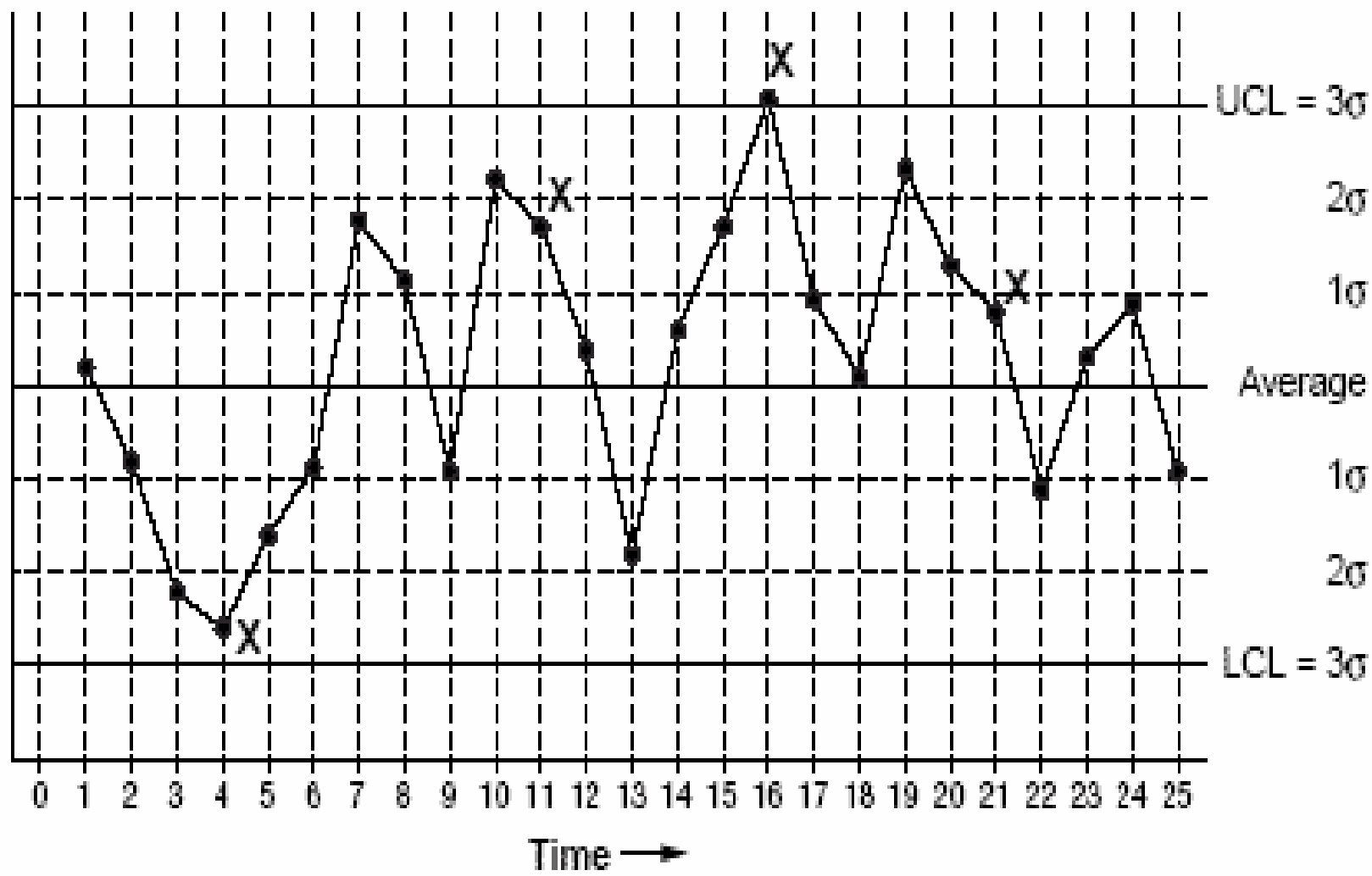


## **When to use**

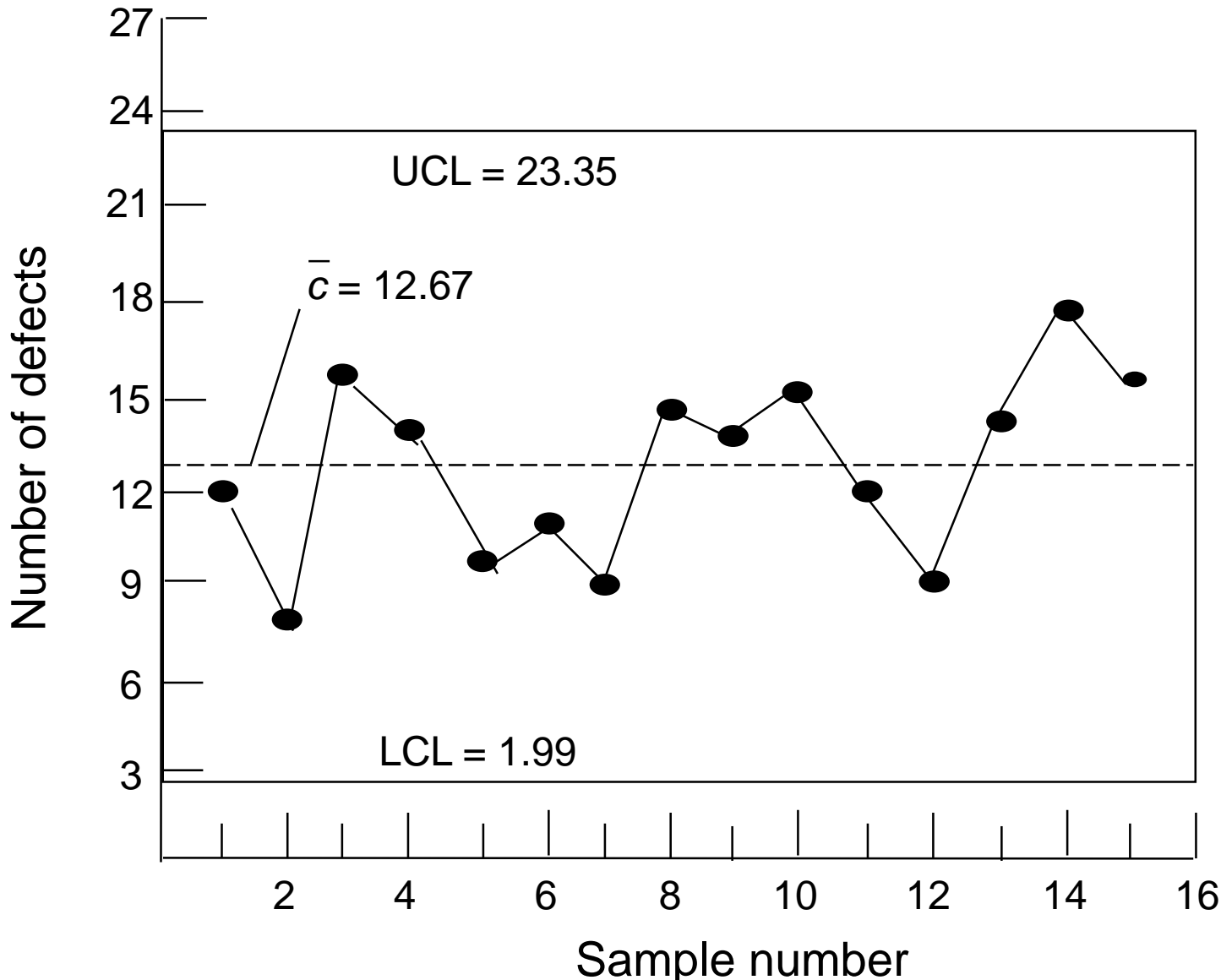
- ❖ When controlling ongoing processes by finding and correcting problems as they occur.
- ❖ When predicting the expected range of outcomes from a process.
- ❖ When determining whether a process is stable (in statistical control).
- ❖ When analyzing patterns of process variation from special causes (non-routine events) or common causes (built into the process).
- ❖ When determining whether your quality improvement project should aim to prevent specific problems or to make fundamental changes to the process.

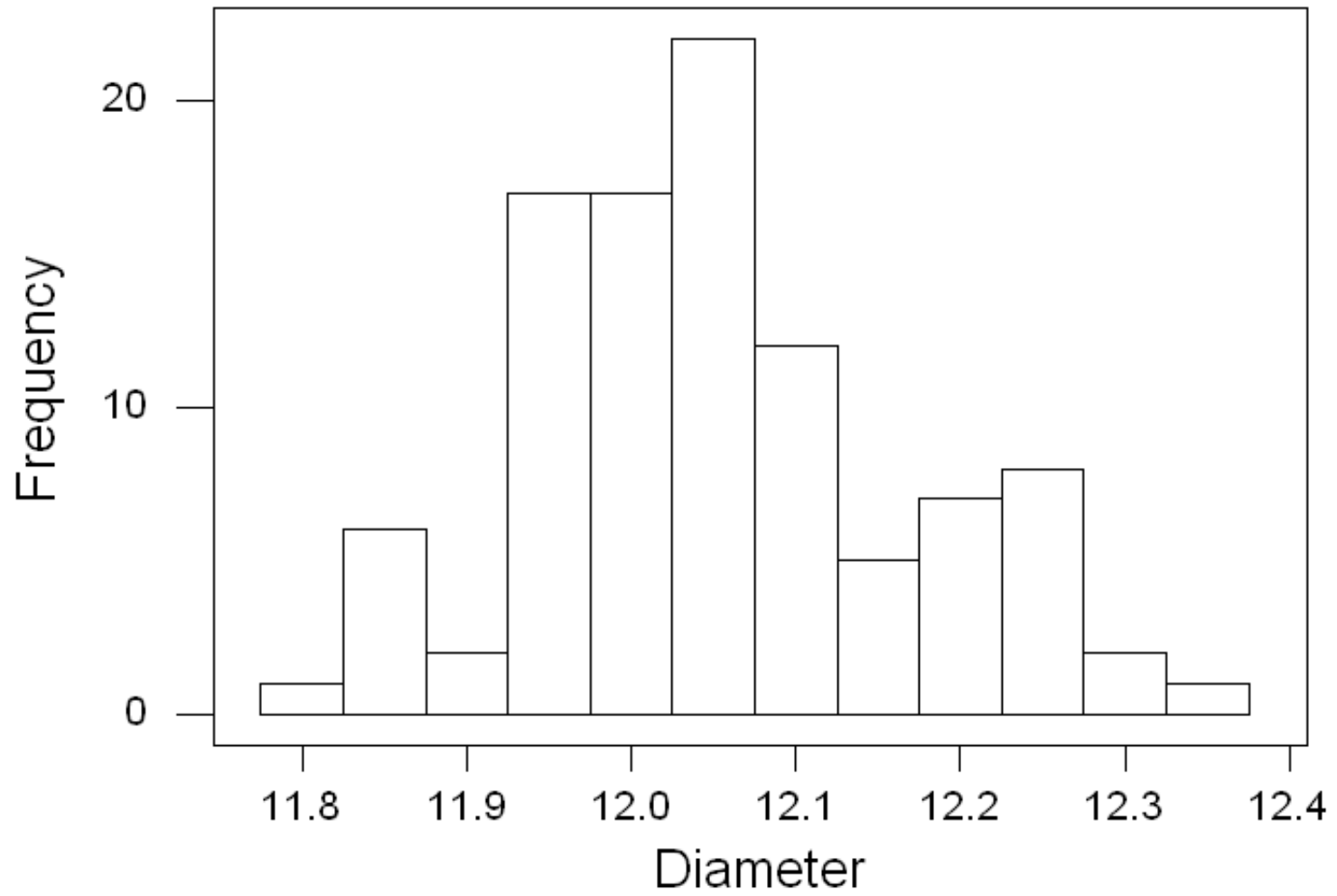
# Basic Procedure

1. Choose the appropriate control chart for your data.
2. Determine the appropriate time period for collecting and plotting data.
3. Collect data, construct your chart and analyze the data.
4. Look for “out-of-control signals” on the control chart. When one is identified, mark it on the chart and investigate the cause. Document how you investigated, what you learned, the cause and how it was corrected.
5. Continue to plot data as they are generated. As each new data point is plotted, check for new out-of-control signals.
6. When you start a new control chart, the process may be out of control. If so, the control limits calculated from the first 20 points are conditional limits. When you have at least 20 sequential points from a period when the process is operating in control, recalculate control limits.

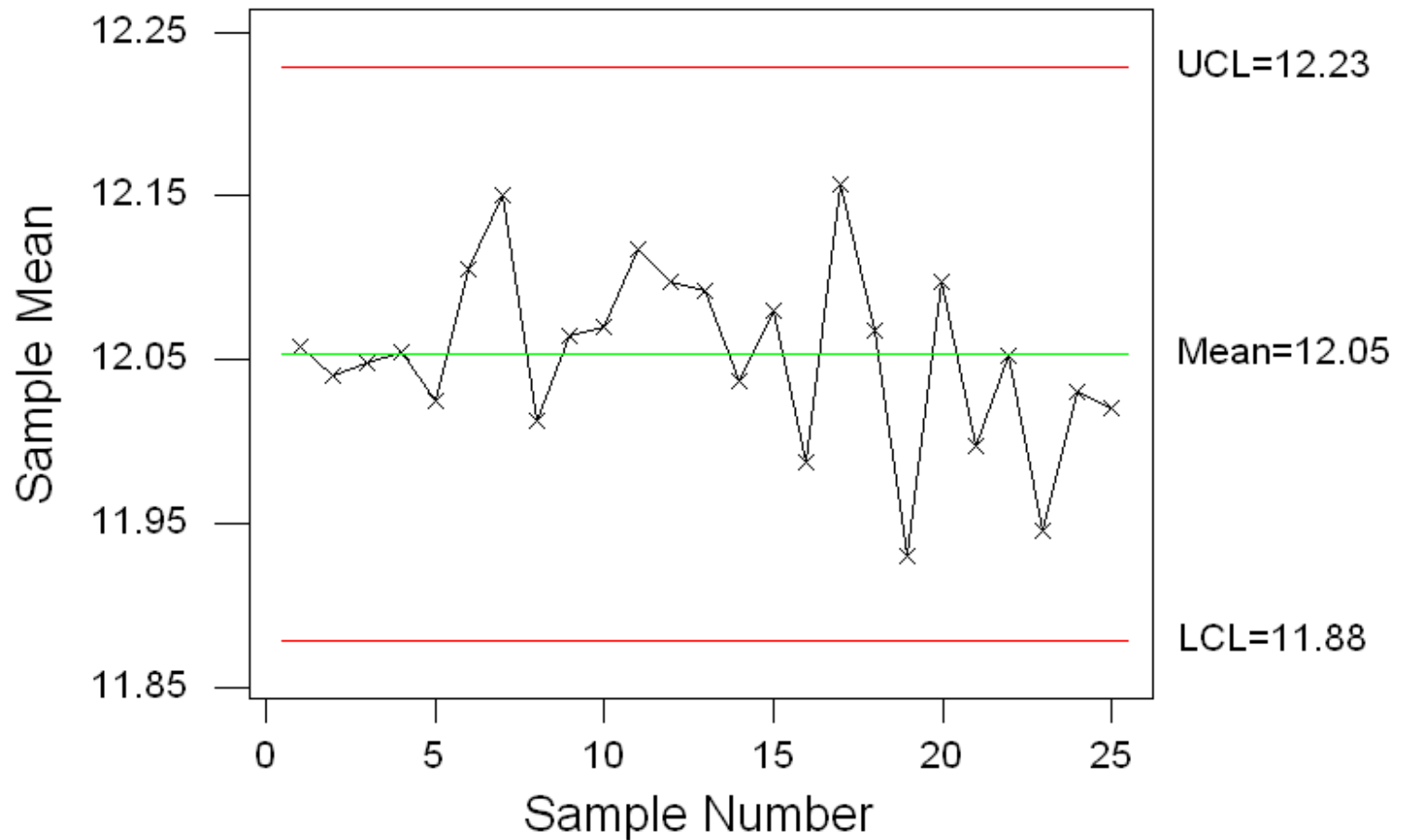


# Control Chart



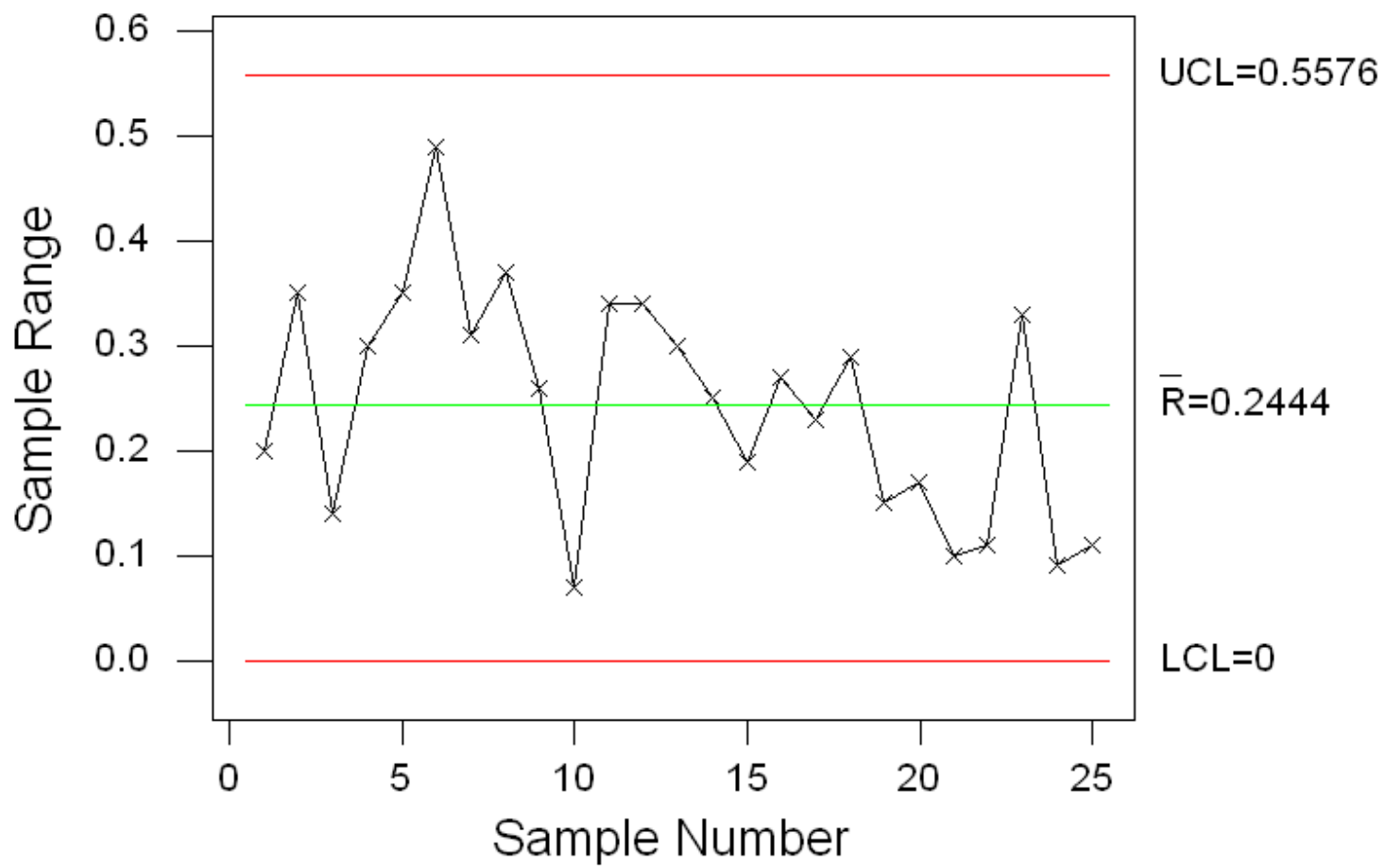


# X-bar Chart for Diameter





## R Chart for Diameter



# S Chart for Diameter

