Tools of Quality control

- HISTOGRAM
- PARETO CHART
- SCATTERD DIAGRAM
- CONTROL CHART
- FISHBONE OR CAUSE AND EFFECT DIAGRAM
- FLOW CHARTS
- CHECKSHEETS

Benefits of 7 QC Tools

- Improve management decision making skills
- Collect, present, Identify and analyses data
- Implement Six Sigma
- Control cost of poor quality
- Reduce variations and improve quality
- Reduce defects and improve production
- Reduce cycle time and improve efficiency
- Continuous quality improvement
- Encourages teamwork and confidence
- Enhances customer satisfaction through improved quality product

HISTOGRAMS

- A histogram is a bar chart or a bar diagram. It is a graphical depiction of a number of occurrences of an event.
- It is s powerful tool for elementary analyasis
- It can help to understand the total variation of a process, and quickly and easily understand the underlying distribution of a process
- The shape of the histogram will show process behavior

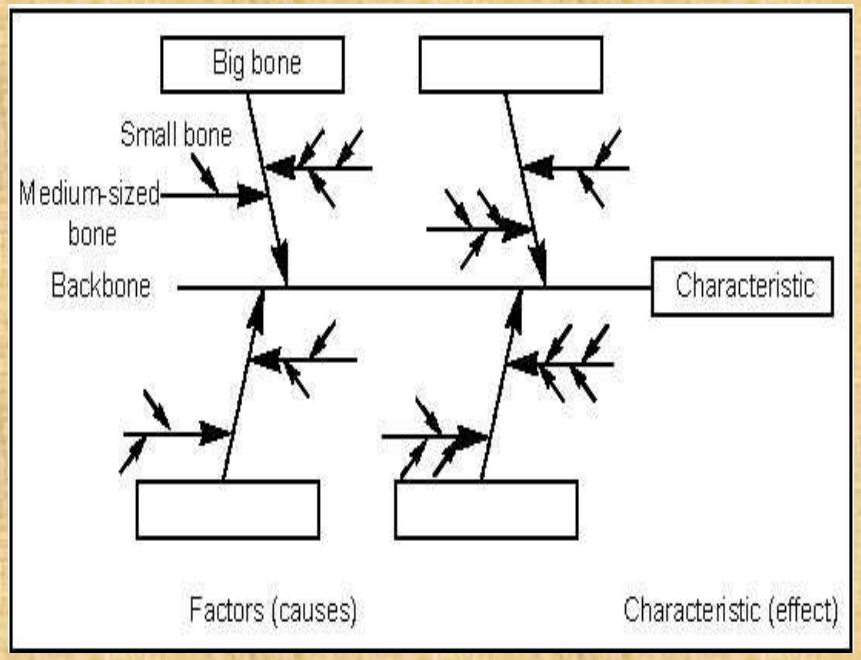
- It is used to communicate the distribution of data quickly and easily to others.
- Help in decision making
- Graphically summarize large data
- Compare performance to expectations or specification

Fishbone or Diagram Cause and Effect Diagram

- Graphical representation of the trail leading to the root cause of a problem
- It also known as fishbone diagram because it looks like skeleton of fish.
- This diagram is called Ishiwaka diagram, named after a Japanese quality expert who came up with this concept

How is it done?

- Decide which quality characteristic, outcome or effect you want to examine
- Backbone –draw straight line
- Ribs – categories
- Medium size bones –secondary causes
- Small bones – root causes



Cause & Effect Diagrams

Benefits:

- Breaks problems down into bite-size pieces to find root cause
- Fosters team work
- Common understanding of factors causing the problem
- Road map to verify picture of the process
- Follows brainstorming relationship

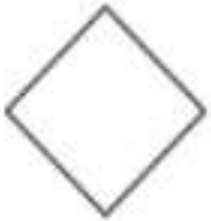
Flow Charts

- A flow chart is a schematic diagram of a process including all steps or operation in the sequence as they occur
- Visual illustration of the sequence of operations required to complete a task

Flow chart- Symbols

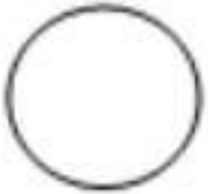
One step in the process

Direction of flow



Decision based on a question

Delay or wait



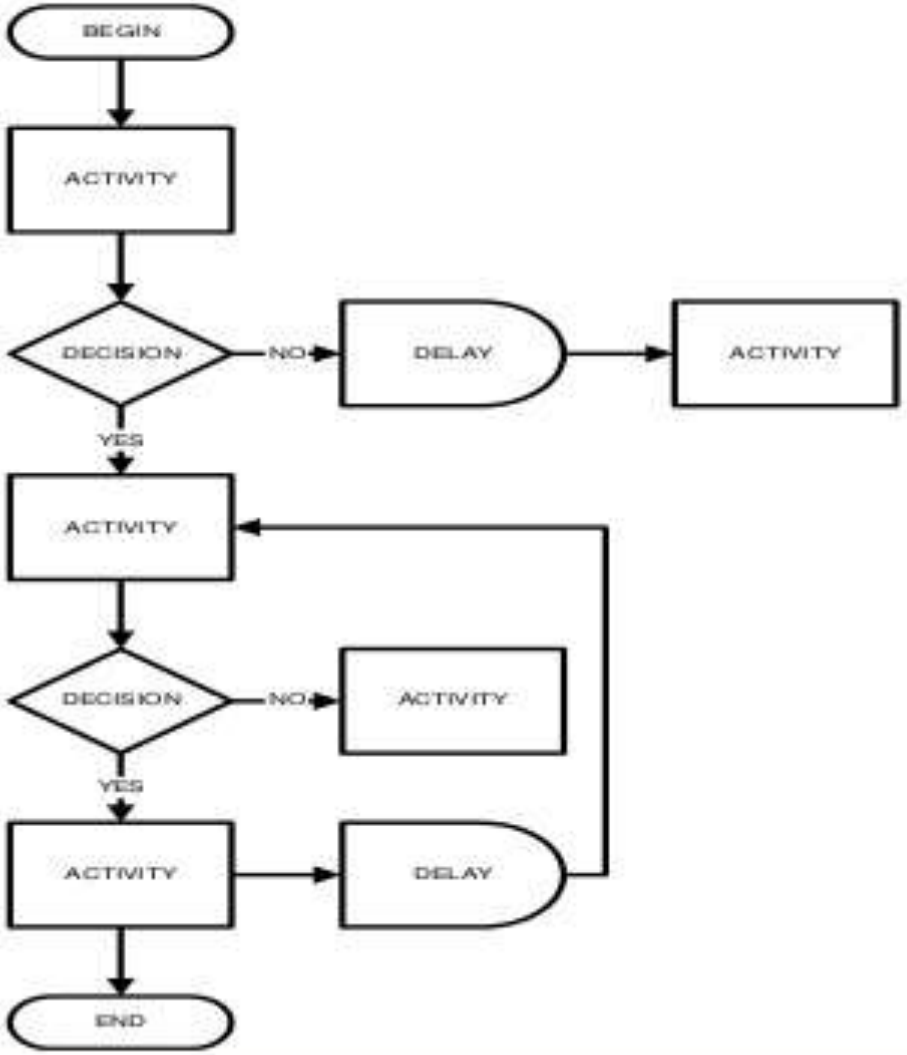
Link to another page or flowchart

Input or output

Document

Start and end points

The Process Flow Diagram (Flow Chart)



Used to understand the current process and identify opportunities for improvement. It shows the work flow through the process including all activities, decisions, delays, and measurement points.

Benefits

- Show what actually happens at each step in the process
- Show what happens when non-standard events occur
- Graphically display processes to identify redundancies and other wasted effort

How is it done?

- Write the process step inside each symbol
- Connect the Symbols with arrows showing the direction of flow

Check Sheet

- Defect concentration diagram
- 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
- A simple document used for collecting data in real time and at the location where the data is generated.

Checksheets

Purpose:

- Tool for collecting and organizing measured or counted data
- Data collected can be used as input data for other quality tools

Benefits:

- Collect data in a systematic and organized manner
- To determine source of problem
- To facilitate classification of data (stratification)

Product Number:
XXXXXX

Line Name:
ABC

Product Name:
XYZ

Process Name:
XYZ

Defective Item	2/5 (M)	2/6 (T)	2/7 (W)	2/8 (T)	2/9 (F)	TOTAL
Mold cracked	𝍸	///	𝍸 /	///	////	21
Fibers	//		𝍸	/		8
Grit	////	//	///	𝍸		14
Pinholes	/	𝍸		//	/	9
Cracks		/	/			2
Other	/	///			///	7
Total	13	14	15	11	8	61

Pareto Charts

Purpose:

Prioritize problems.

How is it done?

- Create a preliminary list of problem classifications.
- Tally the occurrences in each problem classification.
- Arrange each classification in order from highest to lowest
- Construct the bar chart

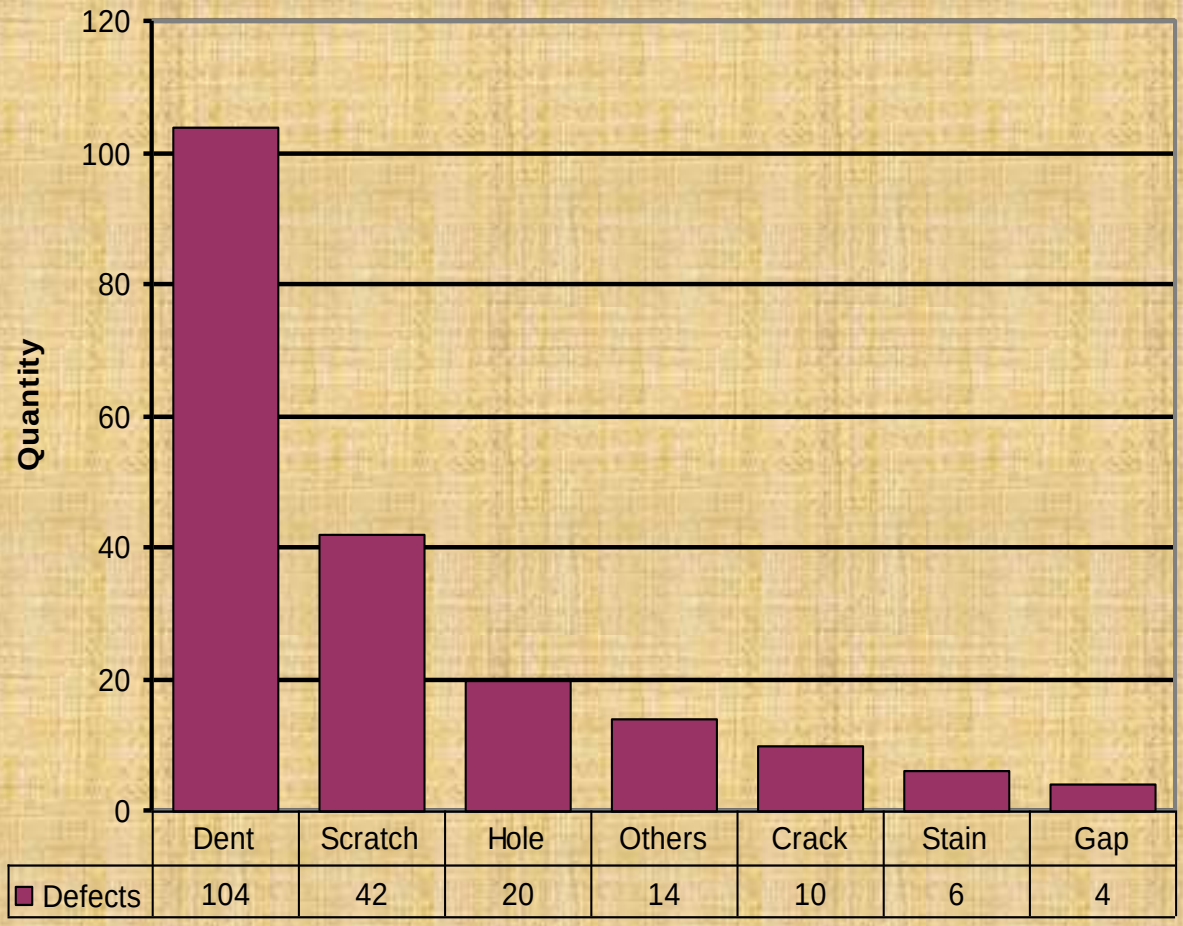
Type of Defect	Tally	Total
Crack	𝍸 𝍸	10
Scratch	𝍸 𝍸 𝍸 𝍸 ..... 𝍸 II	42
Stain	𝍸 I	6
Dent	𝍸 𝍸 𝍸 𝍸 ..... 𝍸 IIII	104
Gap	IIII	4
Hole	𝍸 𝍸 𝍸 𝍸	20
Others	𝍸 𝍸 IIII	14
Total		200

Example of a data tally sheet

Pareto Charts

Benefits:

- Pareto analysis helps graphically display results so the significant few problems emerge from the general background
- It tells you what to work on first

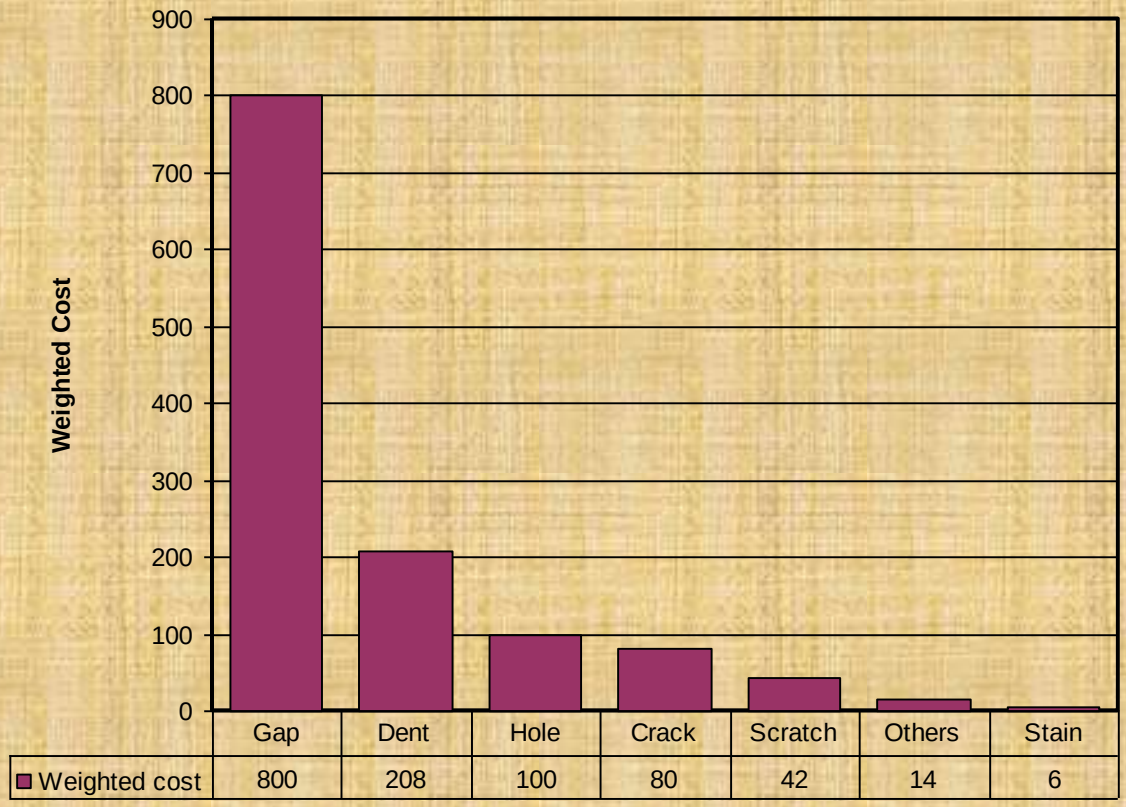


Pareto Charts

Weighted Pareto

- **Weighted Pareto charts use the quantity of defects multiplied by their cost to determine the order.**

Defect	Total	Cost	Weighted cost
Gap	4	200	800
Dent	104	2	208
Hole	20	5	100
Crack	10	8	80
Scratch	42	1	42
Others	14	1	14
Stain	6	1	6



Control Charts

Purpose:

The primary purpose of a control chart is to predict expected product outcome.

Benefits:

- Predict process out of control and out of specification limits
- Distinguish between specific, identifiable causes of variation
- Can be used for statistical process control

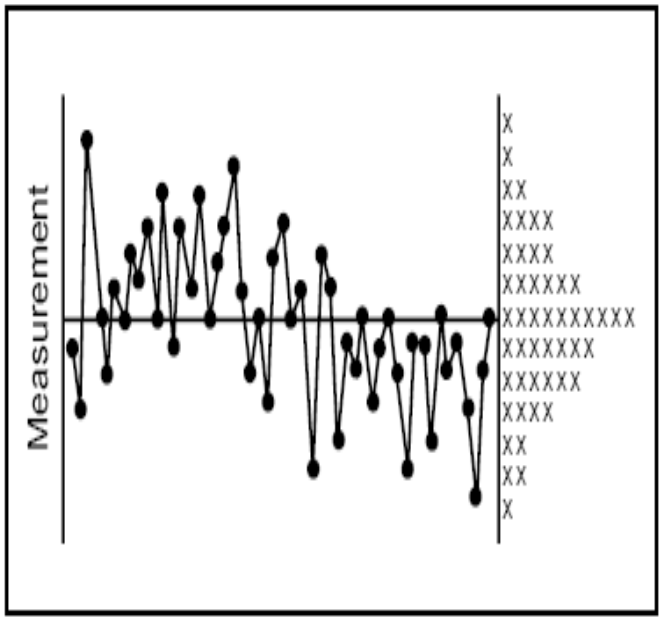
Control Charts

- **Strategy for eliminating assignable-cause variation:**
  - Get timely data so that you see the effect of the assignable cause soon after it occurs.
  - As soon as you see something that indicates that an assignable cause of variation has happened, search for the cause.
  - Change tools to compensate for the assignable cause.
- **Strategy for reducing common-cause variation:**
  - Do not attempt to explain the difference between any of the values or data points produced by a stable system in control.
  - Reducing common-cause variation usually requires making fundamental changes in your *process*

Control Charts

What does it look like?

- Adding the element of time will help clarify your understanding of the causes of variation in the processes.
- A run chart is a line graph of data points organized in time sequence and centered on the median data value.



Unusual variation can hide in a frequency plot

Control Charts

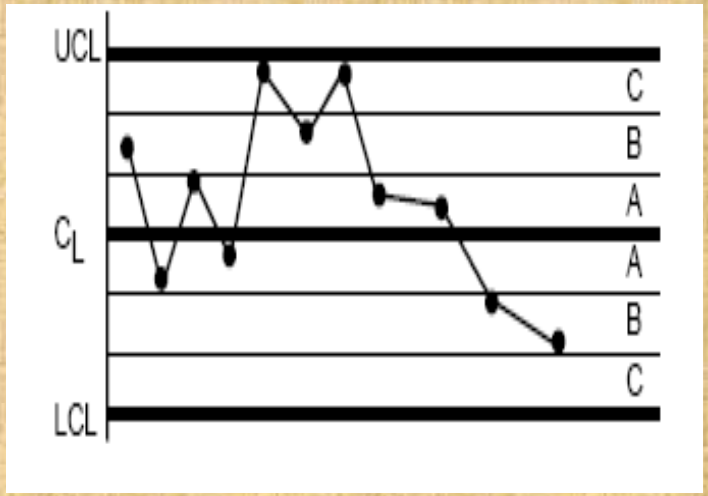
Individual X charts

How is it done?

- The data must have a normal distribution (bell curve).
- Have 20 or more data points. Fifteen is the absolute minimum.
- List the data points in time order. Determine the range between each of the consecutive data points.
- Find the mean or average of the data point values.
- Calculate the control limits (three standard deviations)
- Set up the scales for your control chart.
- Draw a solid line representing the data mean.
- Draw the upper and lower control limits.
- Plot the data points in time sequence.

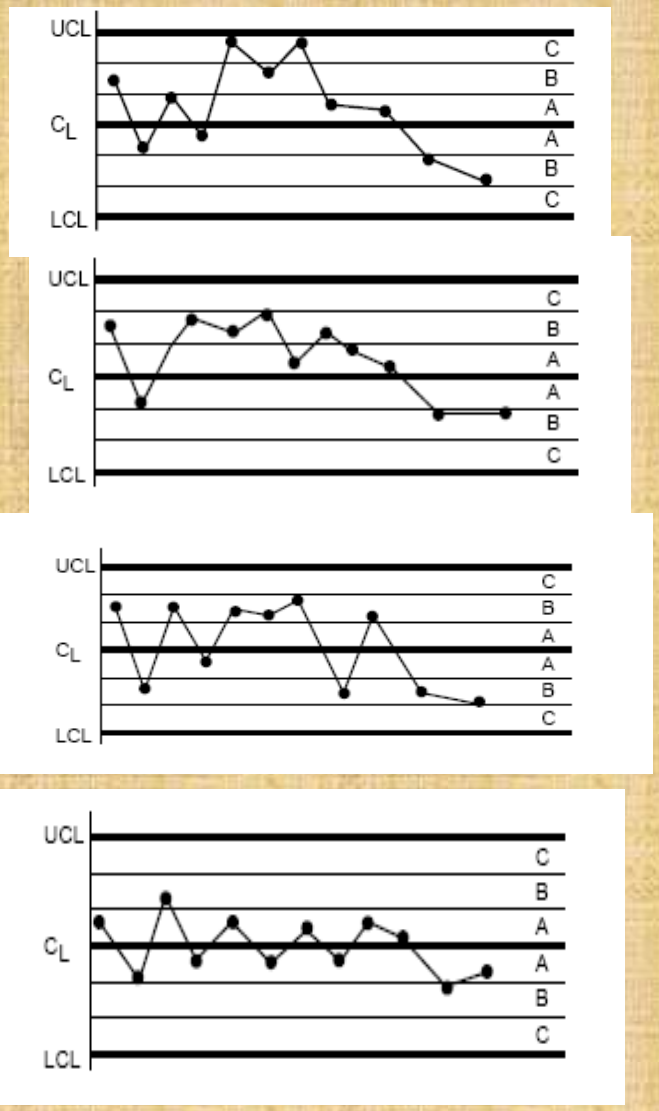
Control Charts

- Next, look at the upper and lower control limits. If your process is in control, 99.73% of all the data points will be inside those lines.
- The upper and lower control limits represent three standard deviations on either side of the mean.
- Divide the distance between the centerline and the upper control limit into three equal zones representing three standard deviations.



Control Charts

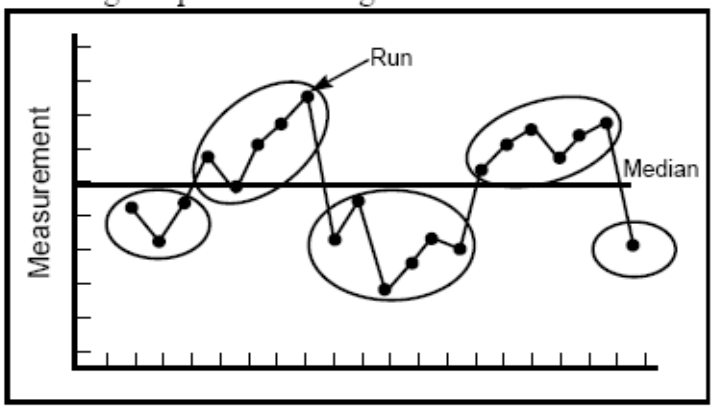
- Search for trends:
  - Two out of three consecutive points are in zone “C”
  - Four out of five consecutive points on the same side of the center line are on zone “B” or “C”
  - Only one of 10 consecutive points is in zone “A”



Control Charts

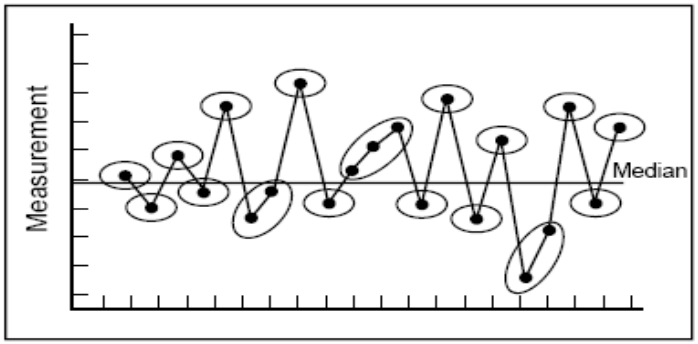
- **Basic Control Charts interpretation rules:**
  - Specials are any points above the UCL or below the LCL
  - A Run violation is seven or more consecutive points above or below the center (20-25 plot points)
  - A trend violation is any upward or downward movement of five or more consecutive points or drifts of seven or more points (10-20 plot points)
  - A 1-in-20 violation is more than one point in twenty consecutive points close to the center line

Too few runs (below the lower limit) generally indicates that something cyclic is systematically shifting the process average.



Example of too few run

Too many runs could point to a problem of consecutive, over-compensating process adjustments or indicate that the data points actually came from two sources with different process averages.



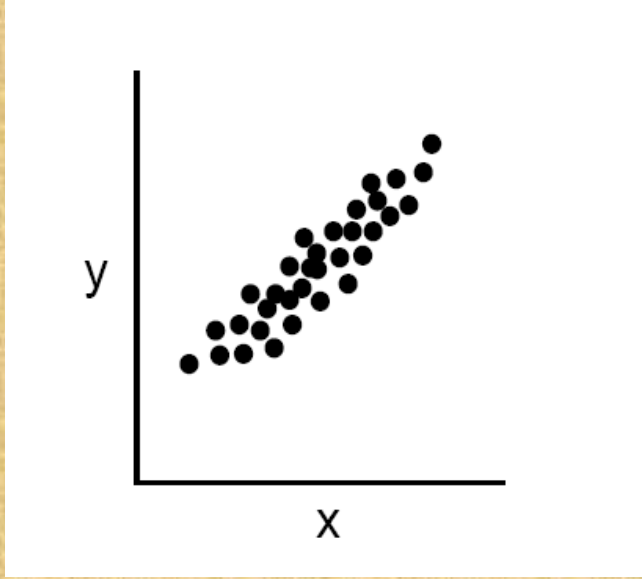
Example of too many runs

Scatter Diagrams

Purpose:

To identify the correlations that might exist between a quality characteristic and a factor that might be driving it

- A scatter diagram shows the correlation between two variables in a process.
  - These variables could be a Critical To Quality (CTQ) characteristic and a factor affecting it two factors affecting a CTQ or two related quality characteristics.
- Dots representing data points are *scattered* on the diagram.
  - The extent to which the dots cluster together in a line across the diagram shows the strength with which the two factors are related.



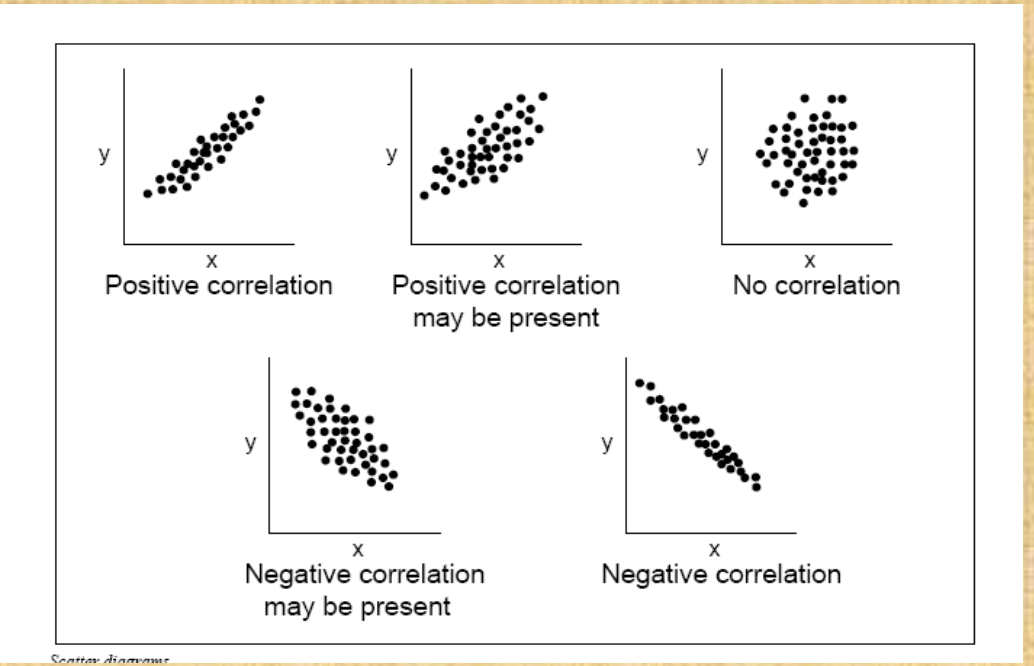
Scatter Diagrams

How is it done?:

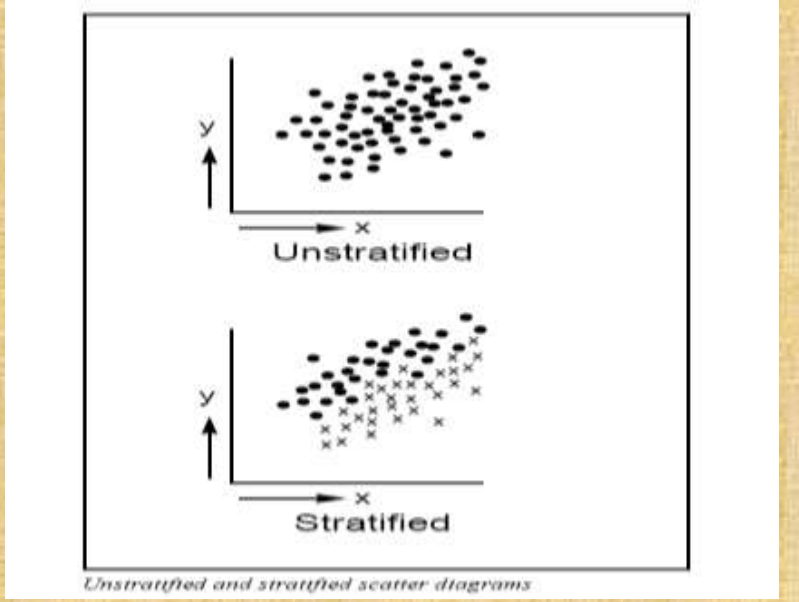
- Decide which paired factors you want to examine. Both factors must be measurable on some incremental linear scale.
- Collect 30 to 100 paired data points.
- Find the highest and lowest value for both variables.
- Draw the vertical (y) and horizontal (x) axes of a graph.
- Plot the data
- Title the diagram

The shape that the cluster of dots takes will tell you something about the relationship between the two variables that you tested.

- If the variables are correlated, when one changes the other probably also changes.
- Dots that look like they are trying to form a line are strongly correlated.
- Sometimes the scatter plot may show little correlation when all the data are considered at once.
  - ✓ Stratifying the data, that is, breaking it into two or more groups based on some difference such as the equipment used, the time of day, some variation in materials or differences in the people involved, may show surprising results



Scatter diagrams



Unstratified and stratified scatter diagrams

Scatter Diagrams

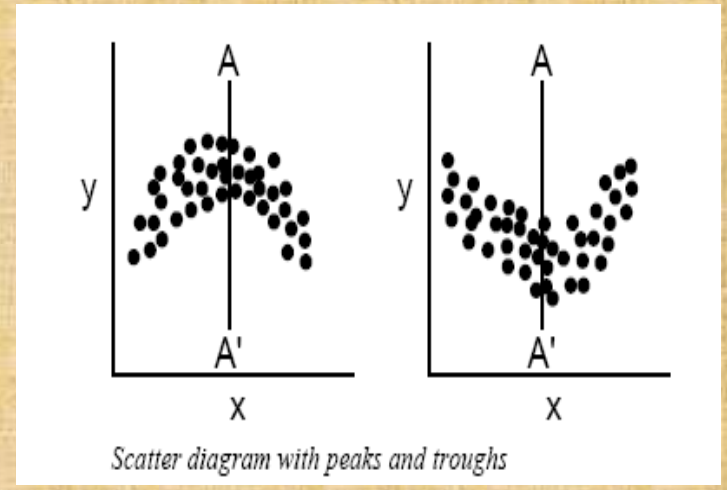
- You may occasionally get scatter diagrams that look *boomerang*- or *banana-shaped*.

  ✓To analyze the strength of the correlation, divide the scatter plot into two sections.

  ✓Treat each half separately in your analysis

Benefits:

- Helps identify and test probable causes.
- By knowing which elements of your process are related and how they are related, you will know what to control or what to vary to affect a quality characteristic.



Scatter diagram with peaks and troughs