Quality Control

Presented by

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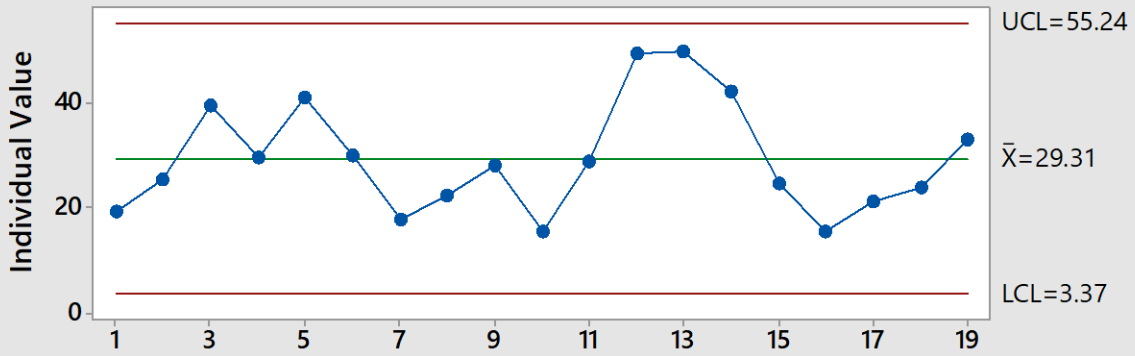
Reference book:
Six Sigma Handbook by Thomson & Paul

Quality

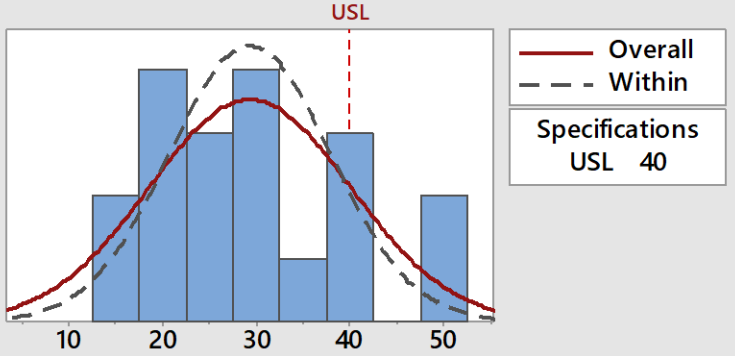
Quality is a measure of customer satisfaction with a product or a service

Process Capability Sixpack Report for Combined MPG

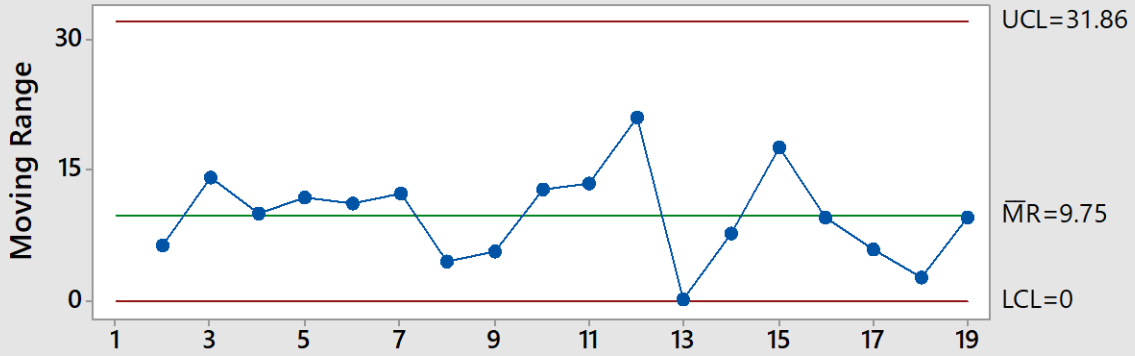
I Chart



Capability Histogram

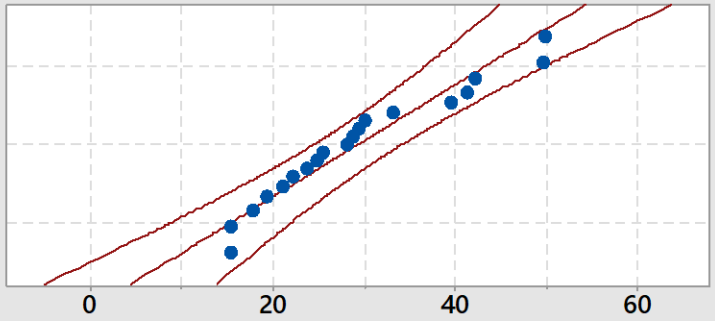


Moving Range Chart

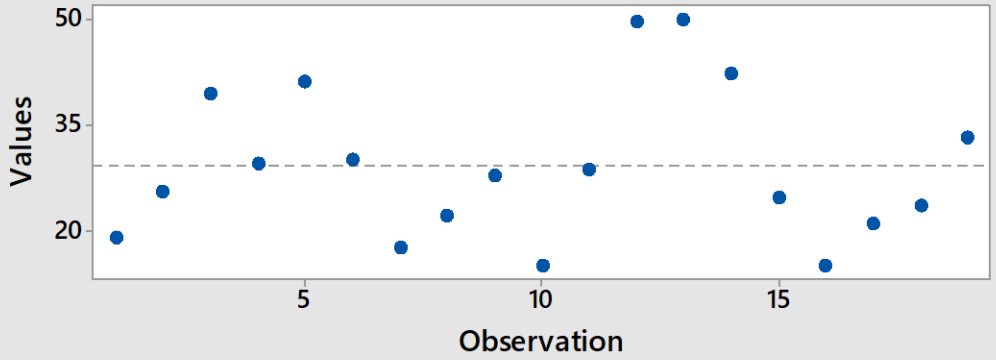


Normal Prob Plot

AD: 0.458, P: 0.234

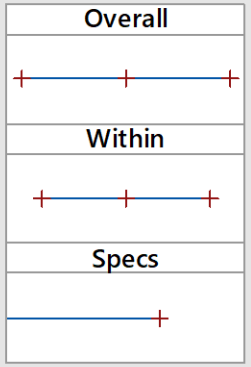


Last 19 Observations



Capability Plot

Within	
StDev	8.644
Cp	*
Cpk	0.41
PPM	107988.09



Overall	
StDev	10.75
Pp	*
Ppk	0.33
Cpm	*
PPM	159795.27

Management & Quality tools

Six Sigma

Six Sigma

Sigma Level	Defect per million Opportunity
1	690,000
2	308,000
3	66,800
4	6,210
5	320
6	3.4

- 3.4 defects per million opportunities
- **Six Sigma** is a data-driven approach and methodology for eliminating defects
- driving toward **six** standard deviations between the mean and the nearest specification limit in any process

Differing opinions on the definition of Six Sigma:

- **Philosophy**— The philosophical perspective views all work as processes that can be defined, measured, analyzed, improved and controlled. Processes require inputs (x) and produce outputs (y). If you control the **inputs**, you will control the **outputs**. This is generally expressed as y = f(x).
- **Set of tools**— The Six Sigma expert uses qualitative and quantitative techniques to drive process improvement. A few such tools include statistical process control (SPC), control charts, failure mode and effects analysis, and process mapping. Six Sigma professionals do not totally agree as to exactly which tools constitute the set.
- **Methodology**— This view of Six Sigma recognizes the underlying and rigorous approach known as DMAIC (define, measure, analyze, improve and control). DMAIC defines the steps a Six Sigma practitioner is expected to follow, starting with identifying the problem and ending with the implementation of long-lasting solutions. While DMAIC is not the only Six Sigma methodology in use, it is certainly the most widely adopted and recognized.
- **Metrics** – In simple terms, Six Sigma quality performance means 3.4 defects per million opportunities (accounting for a 1.5-sigma shift in the mean).

The calculation of a Sigma level, is based on the number of defects per million opportunities (DPMO).
In order to calculate the DPMO, three distinct pieces of information are required:

a) the number of units produced.
b) the number of defect opportunities per unit
c) the number of defects

The actual formula is:

$$DPMO = \frac{(\text{Number of Defects X } 1{,}000{,}000)}{((\text{Number of Defect Opportunities/Unit}) \times \text{Number of Units})}$$

Example:

A manufacturer of computer hard drives wants to measure their Six Sigma level.
Over a given period of time, the manufacturer creates 83,934 hard drives.
The manufacturer performs 8 individual checks to test quality of the drives.
During testing 3,432 are rejected.

Defects	3432	**DPMO**	**5111.159**
Opportunities	83934	**Sigma Level**	**4.1**
Defect Opportunities per unit	8		

DMAIC

- **D Define** the goals of the improvement activity, and incorporate into a Project Charter. Obtain sponsorship and assemble team.

Define1
–Project selection
–Scoping projects
–Developing a project plan
–Multigenerational projects
–Process identification (SIPOC)

DMAIC

- **M Measure** the existing system. Establish valid and reliable metrics to help monitor progress toward the goal(s) defined at the previous step. Establish current process baseline performance using metric.
- **Measure1**
  - –QFD
  - –Developing measurable CTQs
  - –Sampling (data quantity and data quality)
  - –Measurement system analysis (not just gage R&R)
  - –SPC Part I
  - –The concept of statistical control (process stability)
  - –The implications of instability on capability measures
  - –Capability analysis

DMAIC

- **A Analyze** the system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal. Use exploratory and descriptive data analysis to help you understand the data. Use statistical tools to guide the analysis.
- **Analyze2**
  - –Basic graphical improvement tools (“Magnificent 7”)
  - –Management and planning tools (Affinity, ID, etc.)
  - –Confidence intervals (emphasized)
  - –Hypothesis testing (de-emphasized)
  - –ANOVA (de-emphasized)
  - –Regression
  - –Developing conceptual designs in DFSS

DMAIC

- **I Improve** the system. Be creative in finding new ways to do things better, cheaper, or faster. Use project management and other planning and management tools to implement the new approach. Use statistical methods to validate the improvement.
- **Improve**

–DOE (focus on two-level factorials, screening designs, and RSM)
–Piloting (of DMAIC improvements)
–FMEA
–Mistake-proofing
–DFSS design tools
–CTQ flowdown
–Capability flowup
–Simulation

DMAIC

- **C Control** the new system. Institutionalize the improved system by modifying compensation and incentive systems, policies, procedures, MRP, budgets, operating instructions and other management systems. You may wish to utilize standardization such as ISO 9000 to ensure that documentation is correct. Use statistical tools to monitor stability of the new systems
- **Control**
  –Developing control plans
  –SPC
  –Control charts
  –Piloting new designs in DFSS

8D

The approach establishes a permanent corrective action based on statistical analysis of the problem and focuses on the origin of the problem by determining its root causes. Although it originally comprised eight stages, or disciplines, it was later augmented by an initial planning stage.

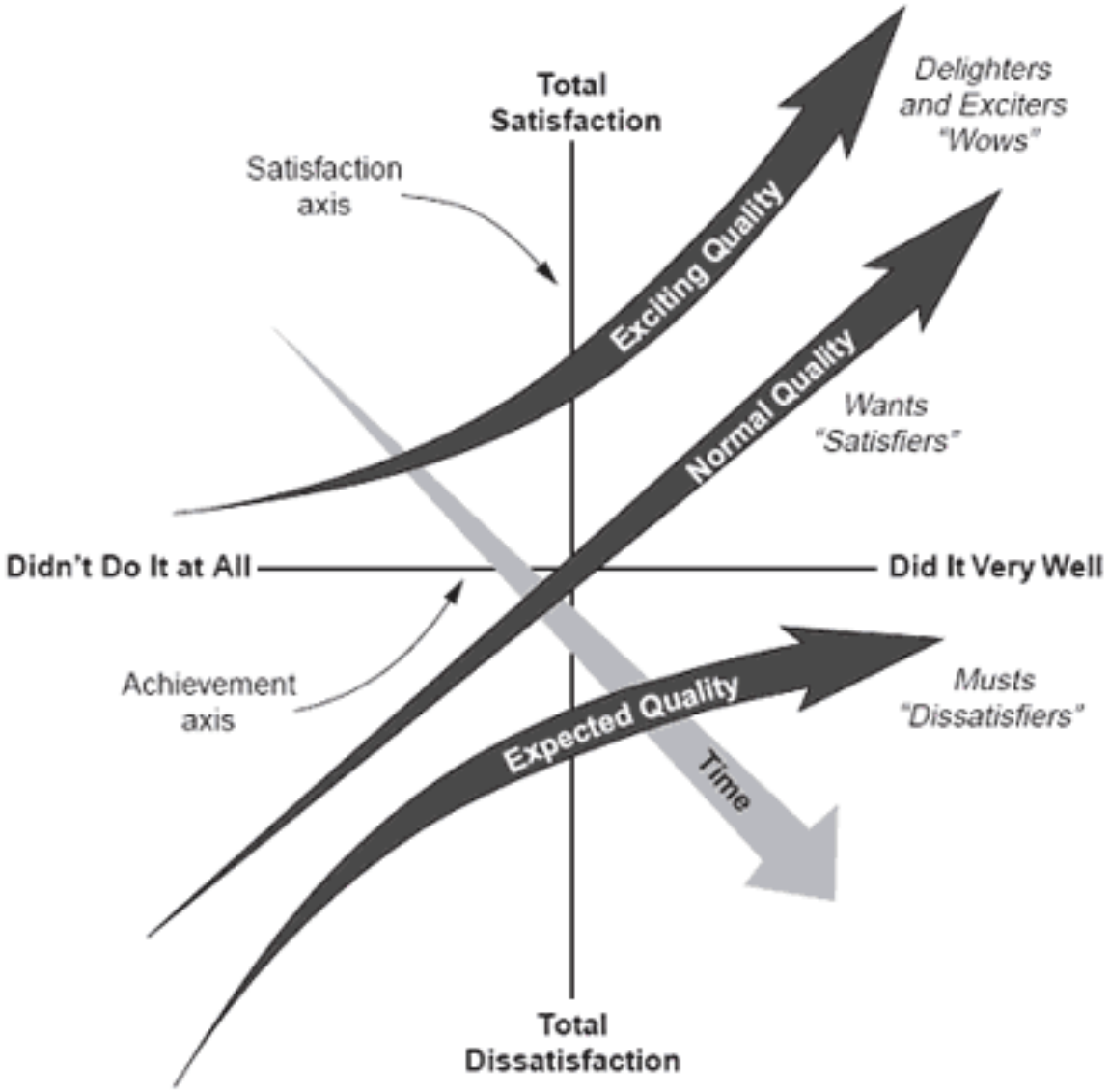
The disciplines are:

- **D0: Plan**—Plan for solving the problem and determine the prerequisites.
- **D1: Use a team**—Establish a team of people with product/process knowledge.
- **D2: Define and describe the problem**—Specify the problem by identifying in quantifiable terms the who, what, where, when, why, how, and how many (5W2H) for the problem.
- **D3: Develop interim containment plan; implement and verify interim actions**—Define and implement containment actions to isolate the problem from any customer.

8D

- **D4: Determine, identify, and verify root causes and escape points**—Identify all applicable causes that could explain why the problem occurred. Also identify why the problem was not noticed at the time it occurred. All causes shall be verified or proved, not determined by fuzzy brainstorming. One can use 5 Whys and cause and effect diagrams to map causes against the effect or problem identified.
- **D5: Choose and verify permanent corrections (PCs) for problem/nonconformity**—Through preproduction programs, quantitatively confirm that the selected correction will resolve the problem for the customer.
- **D6: Implement and validate corrective actions**—Define and implement the best corrective actions.
- **D7: Take preventive measures**—Modify the management systems, operation systems, practices, and procedures to prevent recurrence of this and all similar problems.
- **D8: Congratulate your team**—Recognize the collective efforts of the team. The team needs to be formally thanked by the organization.

Kano Model


Total
Satisfaction
Satisfaction
axis
Delighters
and Exciters
"Wows"
Exciting Quality
Normal Quality
Wants
"Satisfiers"
Didn't Do It at All
Did It Very Well
Achievement
axis
Expected Quality
Musts
"Dissatisfiers"
Time
Total
Dissatisfaction

Quality Plan

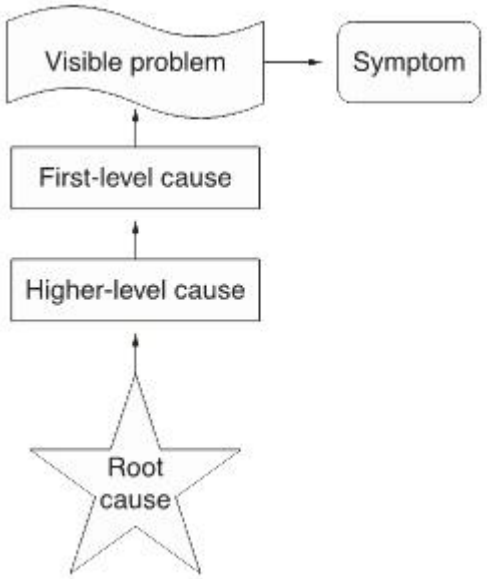
A quality plan is a document, or several documents, that together specify quality standards, practices, resources, specifications, and the sequence of activities relevant to a particular product, service, project, or contract. Quality plans should define:

- Objectives to be attained (for example, characteristics or specifications, uniformity, effectiveness, aesthetics, cycle time, cost, natural resources, utilization, yield, dependability, and so on)
- Steps in the processes that constitute the operating practice or procedures of the organization
- Allocation of responsibilities, authority, and resources during the different phases of the process or project
- Specific documented standards, practices, procedures, and instructions to be applied
- Suitable testing, inspection, examination, and audit programs at appropriate stages
- A documented procedure for changes and modifications to a quality plan as a process is improved
- A method for measuring the achievement of the quality objectives
- Other actions necessary to meet the objectives

Root cause

- A root cause is a factor that caused a nonconformance and should be permanently eliminated through process improvement.
- Root cause analysis is a collective term that describes a wide range of approaches, tools, and techniques used to uncover causes of problems.

The highest-level cause of a problem is called the root cause:



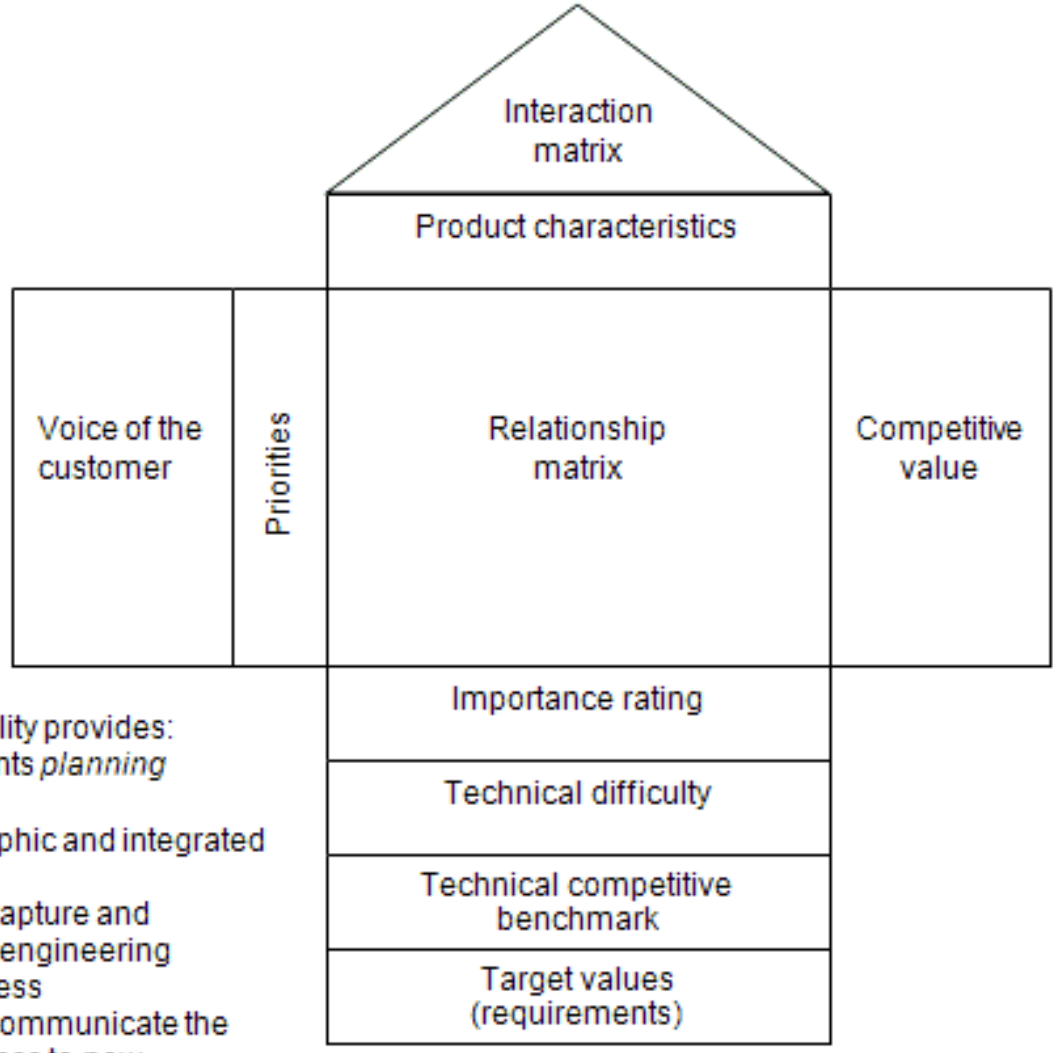
Root cause

- The root cause is “the evil at the bottom” that sets in motion the entire cause-and-effect chain causing the problem(s).
- Some root cause analysis approaches are geared more toward identifying true root causes than others; some are more general problem-solving techniques, while others simply offer support for the core activity of root cause analysis.
- By becoming acquainted with the root cause analysis toolbox, you’ll be able to apply the appropriate technique or tool to address a specific problem.

QFD

QFD is a focused methodology for carefully listening to the **voice** of the customer and then effectively **responding** to those needs and expectations.

Figure 1 — House of quality template and benefits



The house of quality provides:

- A requirements *planning* capability
- A tool for graphic and integrated thinking
- A means to capture and preserve the engineering thought process
- A means to communicate the thought process to new members of the QFD team
- A means to inform management regarding inconsistencies between requirements, risks, and needs of the customer

QFD

- QFD is a structured method that uses the seven management and planning tools to identify and prioritize customers' expectations quickly and effectively.
- Beginning with the initial matrix, commonly termed the **house of quality**, depicted in Figure 1, the QFD methodology focuses on the most important product or service attributes or qualities. These are composed of customer *wows*, *wants*, and *musts*. (See the Kano model of customer perception versus customer reality.)
- Once you have prioritized the attributes and qualities, QFD deploys them to the appropriate organizational function for action, as shown in Figure 2. Thus, QFD is the deployment of customer-driven qualities to the responsible functions of an organization.
- Many QFD practitioners claim that using QFD has enabled them to reduce their product and service development cycle times by as much as 75 percent with equally impressive improvements in measured customer satisfaction.

ISO

- International Organization for Standardization (ISO)

ISO 9001

- ISO 9001 is the international standard that specifies requirements for a quality management system (QMS).
- The ISO 9000 family addresses various aspects of quality management and contains some of ISO's best known standards. The standards provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer's requirements, and that quality is consistently improved.

What topics does ISO 9001:2015 cover?

ISO 9001 is based on the plan-do-check-act methodology and provides a process-oriented approach to documenting and reviewing the structure, responsibilities, and procedures required to achieve effective quality management in an organization. Specific sections of the standard contain information on topics such as:

- Requirements for a quality management system, including documented information, planning and determining process interactions
- Responsibilities of management
- Management of resources, including human resources and an organization's work environment
- Product realization, including the steps from design to delivery
- Measurement, analysis, and improvement of the QMS through activities like internal audits and corrective and preventive action

ISO 14001

- ISO 14001 is the international standard that specifies requirements for an effective environmental management system (EMS)
- **ISO 14000** is a family of standards related to environmental management that exists to help organizations (a) minimize how their operations (processes, etc.) negatively affect the environment

What topics does ISO 14001:2015 cover?

At the highest level, ISO 14001:2015 covers the following topics with regard to environmental management systems:

- Context of the organization
- Leadership
- Planning
- Support
- Operation
- Performance evaluation
- Improvement

FMEA

- http://asq.org/learn-about-quality/process-analysis-tools/overview/fmea.html

TQM

- http://asq.org/learn-about-quality/total-quality-management/overview/overview.html

Design of Experiments (DOE)

Design of Experiments (DOE)

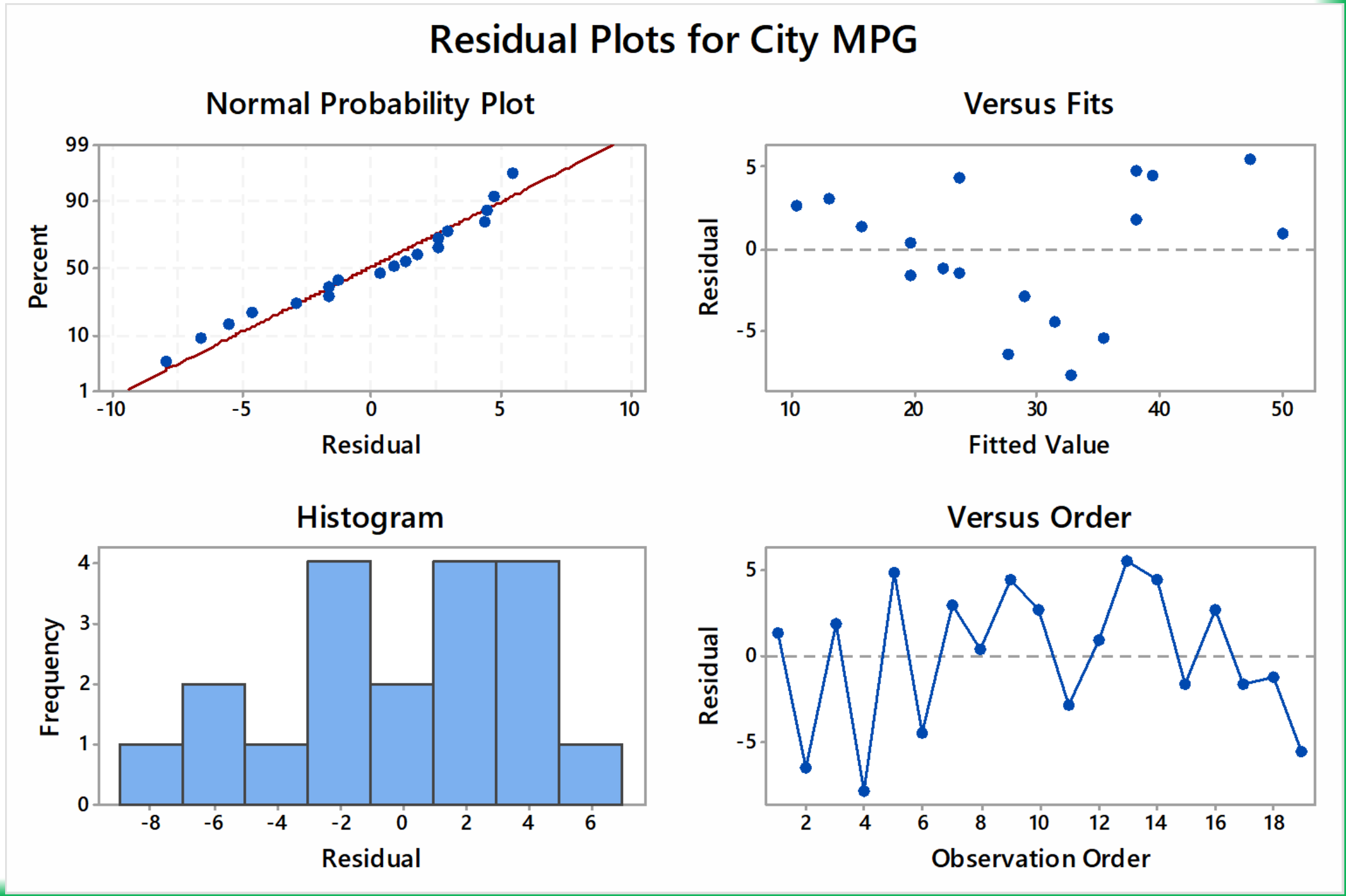
- **Experiment design**—The arrangement in which an experimental program is to be conducted, and the selection of the versions (levels) of one or more factors or factor combinations to be included in the experiment.
- **Factor**—An assignable cause which may affect the responses (test results) and of which different versions (levels) are included in the experiment.
- **Factorial experiments**—Experiments in which all possible treatment combinations formed from two or more factors, each being studied at two or more versions (levels), are examined so that interactions (differential effects) as well as main effects can be estimated.

Procedure for designing an experiment

1. Recognition and statement of the problem
2. Choice of factors and levels
3. Selection of the response variable
4. Choice of experimental design
5. Performing the experiment
6. Data analysis
7. Conclusions and recommendations

Page 554, Ch-13, Statistical Process Control by Montgomery

Residual


Residual Plots for City MPG
Normal Probability Plot
Percent
99
90
50
10
1
-10
-5
0
5
10
Residual
Versus Fits
Residual
5
0
-5
10
20
30
40
50
Fitted Value
Histogram
Frequency
4
3
2
1
0
-8
-6
-4
-2
0
2
4
6
Residual
Versus Order
Residual
5
0
-5
2
4
6
8
10
12
14
16
18
Observation Order

Reference materials for DOE

- Chapter 13, Introduction to Statistical Quality Control by Montgomery
- Page 352–369, Chapter 10, Six Sigma Handbook by Thomas & Paul
- Further Read: 13.4.3 Residual Analysis, Fig 13.13~13.16, Page 564, Montgomery

Data Mining, OLAP, Data Warehousing

How to assimilate Data Mining, OLAP and Data Warehousing with Six Sigma for quality engineering purposes?

Page 108-112, Chapter 3,
Six Sigma Handbook by Thomas & Paul

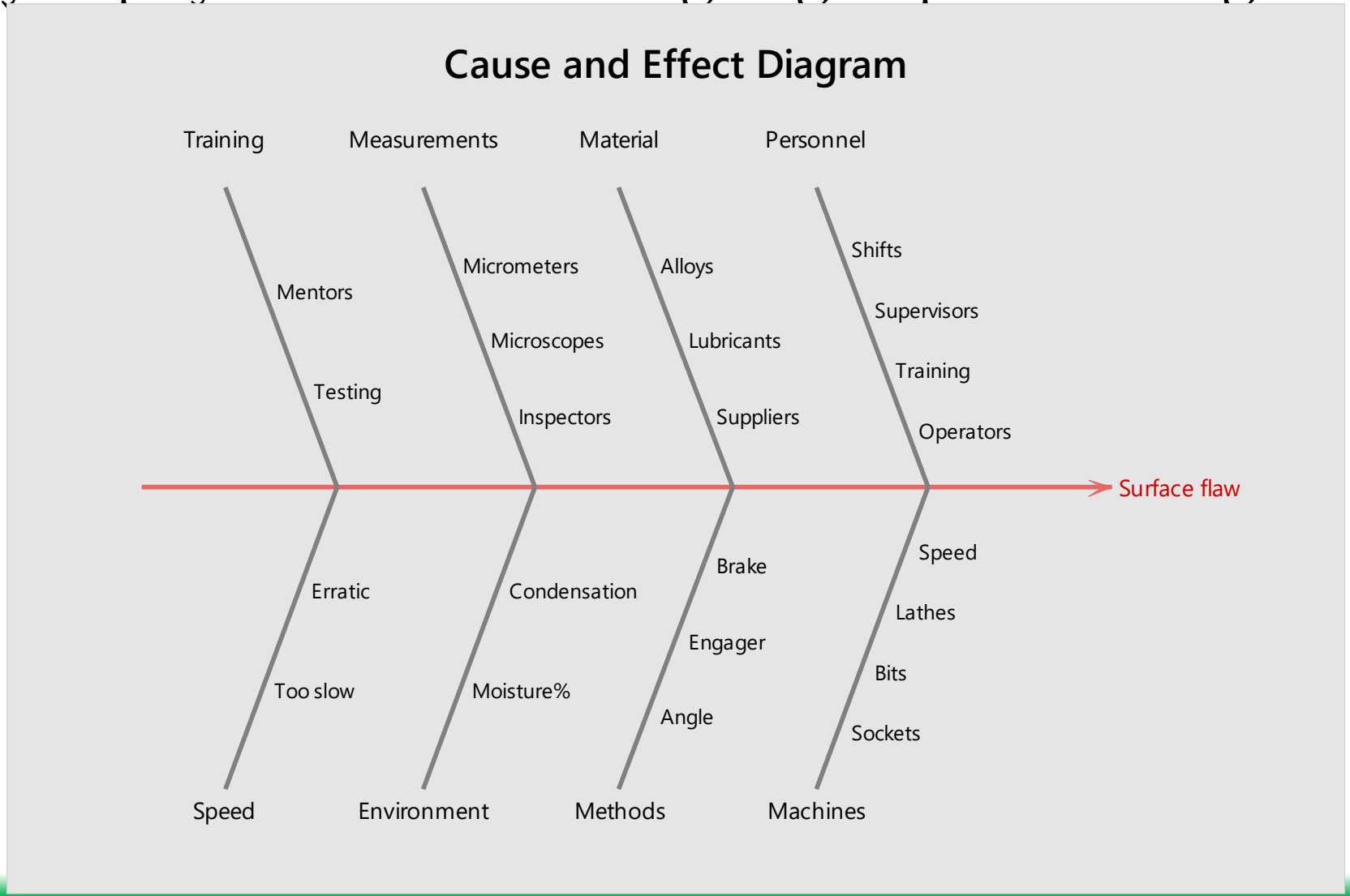
7 Tools of Quality

7 Tools of Quality

- Cause-and-effect diagram (also known as the "fishbone" or Ishikawa diagram)
- Check sheet.
- Control chart.
- Histogram.
- Pareto chart.
- Scatter diagram.
- Stratification (alternately, flow chart or run chart)

Cause & Effect Diagram

- Cause and effect diagrams are tools that are used to organize and graphically display all of the knowledge a group has relating to a particular problem



Check sheet

Pareto chart (Priority; 80-20 rules)

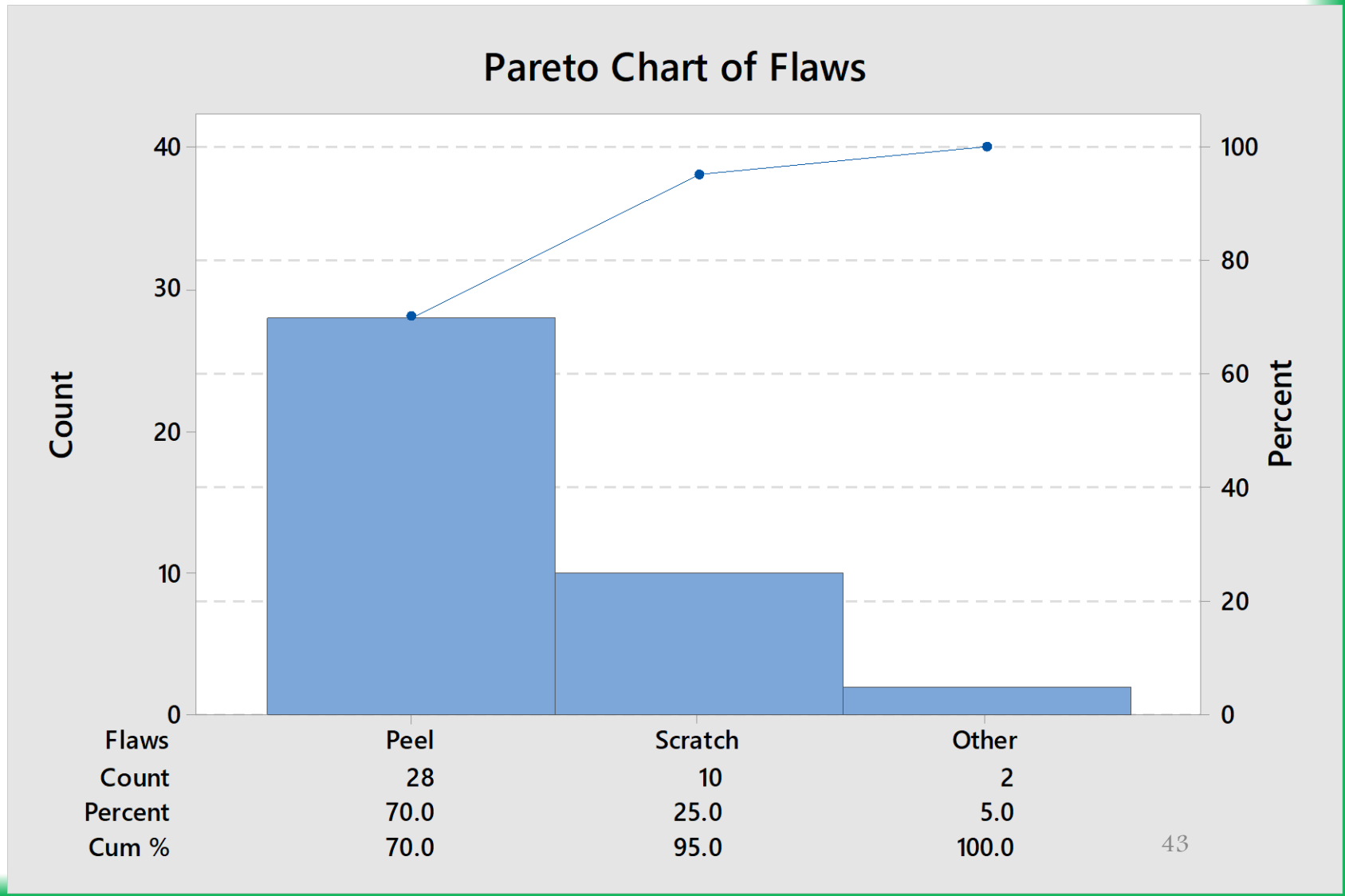
- *Pareto principle* refers to the fact that a small percentage of processes cause a large percentage of the problems.
- Pareto Priority Index, PPI

$$PPI = \frac{Saving \ * Probability\ of\ Success}{Cost \ * time\ to\ completion}$$

Pareto chart (Priority; 80-20 rules)

- *Pareto principle* refers to the fact that a small percentage of processes cause a large percentage of the problems.

Flaws	Shift
Scratch	Day
Scratch	Day
Peel	Day
Peel	Day
Peel	Day
Scratch	Day
Other	Day
Peel	Evening
Peel	Evening
Peel	Evening
Peel	Evening
Peel	Evening
Scratch	Evening
Scratch	Evening
Peel	Night
Scratch	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Scratch	Night
Peel	Night
Peel	Night
Peel	Night
Peel	Night
Scratch	Night
Other	Night
Scratch	Night
Scratch	Night
Peel	Weekend
Peel	Weekend
Peel	Weekend
Peel	Weekend
Peel	Weekend
Peel	Weekend
Peel	Weekend



Flow Chart

- A flowchart is a type of diagram that represents an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model to a given problem.

Run Chart

- A run chart, also known as a run-sequence plot is a graph that displays observed data in a time sequence. Often, the data displayed represent some aspect of the output or performance of a manufacturing or other business process. It is therefore a form of line chart

What is the House of Quality?

The House of Quality is a voice of customer analysis tool and a key component of the Quality Functional Deployment technique. It starts with the voice of the customer. It is a tool to translate what the customer wants into products or services that meet the customer wants in terms of engineering design values by way of creating a relationship matrix.

- Typically the first chart used in Quality Function Deployment
- Data intensive and is capable of capturing large amounts of information.
- Left side: has the customer's needs.
- Ceiling: has the design features and technical requirements.
- The Roof: a matrix describing the relationship between the design features. Used to show how the design requirements interact with each other.
- This can be an ordinal measurement scale.
- Competitive Section: based primarily on the customer's perspective.
- Lower level / Foundation: Benchmarking & target values used to rank the 'hows'. These are the actions your organization will take to satisfy your customers.

Highly frequent Glossary

Analysis of Variance (ANOVA)—A technique which subdivides the total variation of a set of data into meaningful component parts associated with specific sources of variation for the purpose of testing some hypothesis on the parameters of the model or estimating variance components.
Assignable cause—A factor which contributes to variation and which is feasible to detect and identify.
Average Outgoing Quality (AOQ)—The expected quality of outgoing product following the use of an acceptance sampling plan for a given value of incoming product quality.
Average Outgoing Quality Limit (AOQL)—For a given acceptance sampling plan, the maximum AOQ over all possible levels of incoming quality.
Chance causes—Factors, generally numerous and individually of relatively small importance, which contribute to variation, but which are not feasible to detect or identify.

Highly frequent Glossary

Coefficient of variation—A measure of relative dispersion that is the standard deviation divided by the mean and multiplied by 100 to give a percentage value. This measure cannot be used when the data take both negative and positive values or when it has been coded in such a way that the value $X = 0$ does not coincide with the origin.

Consumer's risk (β)—For a given sampling plan, the probability of acceptance of a lot, the quality of which has a designated numerical value representing a level which it is seldom desired to accept. Usually the designated value will be the Limiting Quality Level (LQL).

Defect—A departure of a quality characteristic from its intended level or state that occurs with a severity sufficient to cause an associated product or service not to satisfy intended normal, or reasonably foreseeable, usage requirements

Ref: Six Sigma Handbook by Thomas & Paul

Highly frequent Glossary

Experiment design—The arrangement in which an experimental program is to be conducted, and the selection of the versions (levels) of one or more factors or factor combinations to be included in the experiment.
Factor—An assignable cause which may affect the responses (test results) and of which different versions (levels) are included in the experiment.
Factorial experiments—Experiments in which all possible treatment combinations formed from two or more factors, each being studied at two or more versions (levels), are examined so that interactions (differential effects) as well as main effects can be estimated.

Quality—The totality of features and characteristics of a product or service that bear on its ability to satisfy given needs

Ref: Six Sigma Handbook by Thomas & Paul

Highly frequent Glossary

Producer's risk (α)—*For a given sampling plan, the probability of not accepting a lot the quality of which has a designated numerical value representing a level which it is generally desired to accept. Usually the designated value will be the Acceptable Quality Level (AQL)*

Statistic—A quantity calculated from a sample of observations, most often to form an estimate of some population parameter.

Type I error (acceptance control sense)—The incorrect decision that a process is unacceptable when, in fact, perfect information would reveal that it is located within the "zone of acceptable processes."

Type II error (acceptance control sense)—The incorrect decision that a process is acceptable when, in fact, perfect information would reveal that it is located within the "zone of rejectable processes."

Ref: Six Sigma Handbook by Thomas & Paul

Reliability

Reliability

If P_i is the probability that component i is functioning, a reliability function $R(P_1, P_2, \ldots, P_n)$ represents the probability that a system consisting of n components will work.
For n independent components connected in series,

$$R\ (P_1, P_2, \ldots\ P_n) = \prod_{i=1}^{n} P_i$$

For n independent components connected in parallel,

$$R\ (P_1, P_2, \ldots\ P_n) = \prod_{i=1}^{n} (1 - P_i)$$

Six Sigma Yellow Belt Exam questions and answers with explanation

Presented by

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Practice more questions from https://**github.com/tanmoyie/Quality-Control/**blob/master/Six%20Sigma%20Yellow%20Belt%20MCQ%20Q%26A.pdf

Question:

Quality and the Critical-to-Quality (CTQ's) are both subjective terms that are defined by the _____.

Management team
Line Supervisor
Customer
Design team

Answer: 3

Explanation:

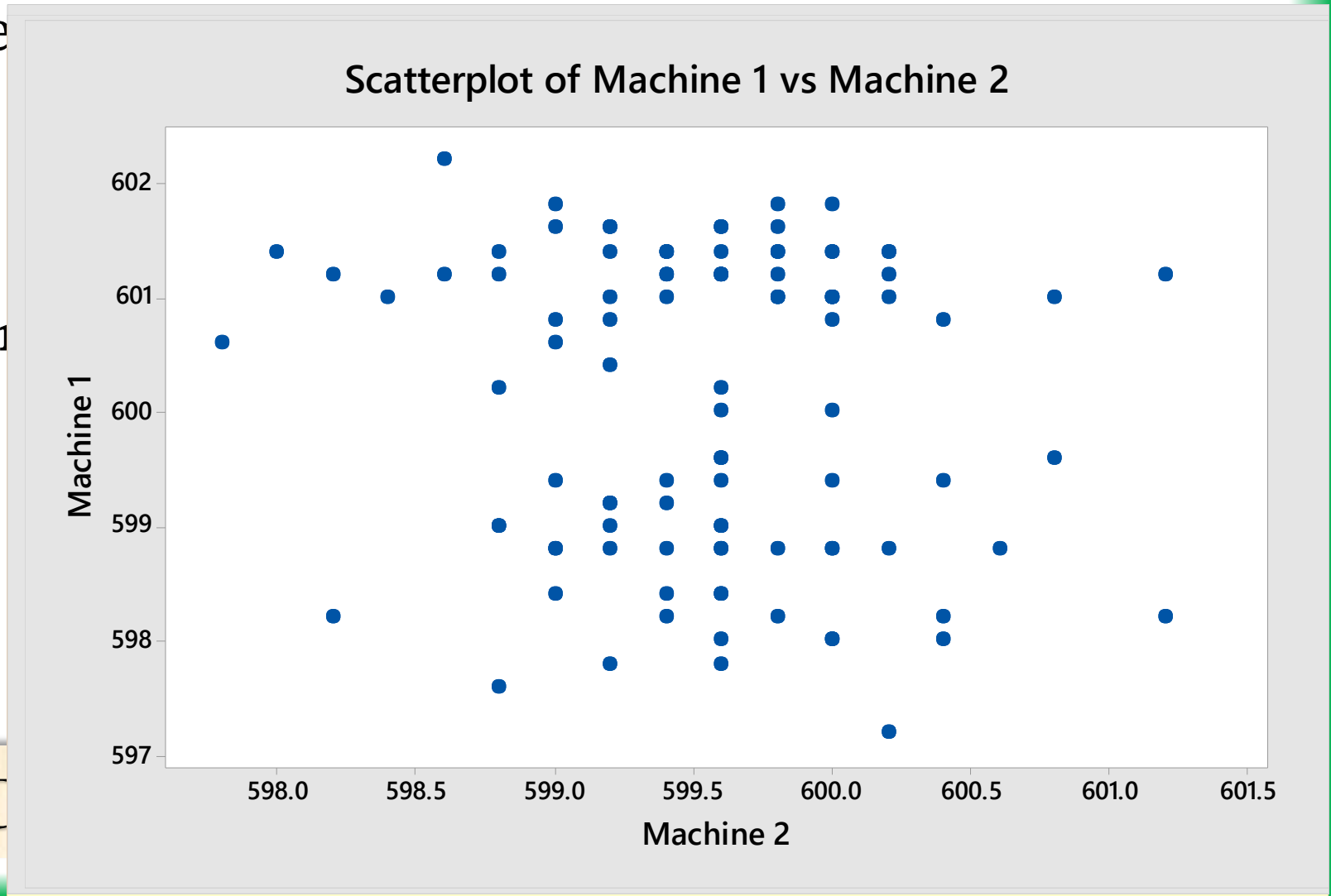
Question:

Which of the following tools indicates a relationship between X and Y variables, and provides a visual correlation coefficient.

Cause (X) and Effe
Pareto Chart
Scatter Diagram
Control Chart

Answer: Scatter Diagra

Explanation:



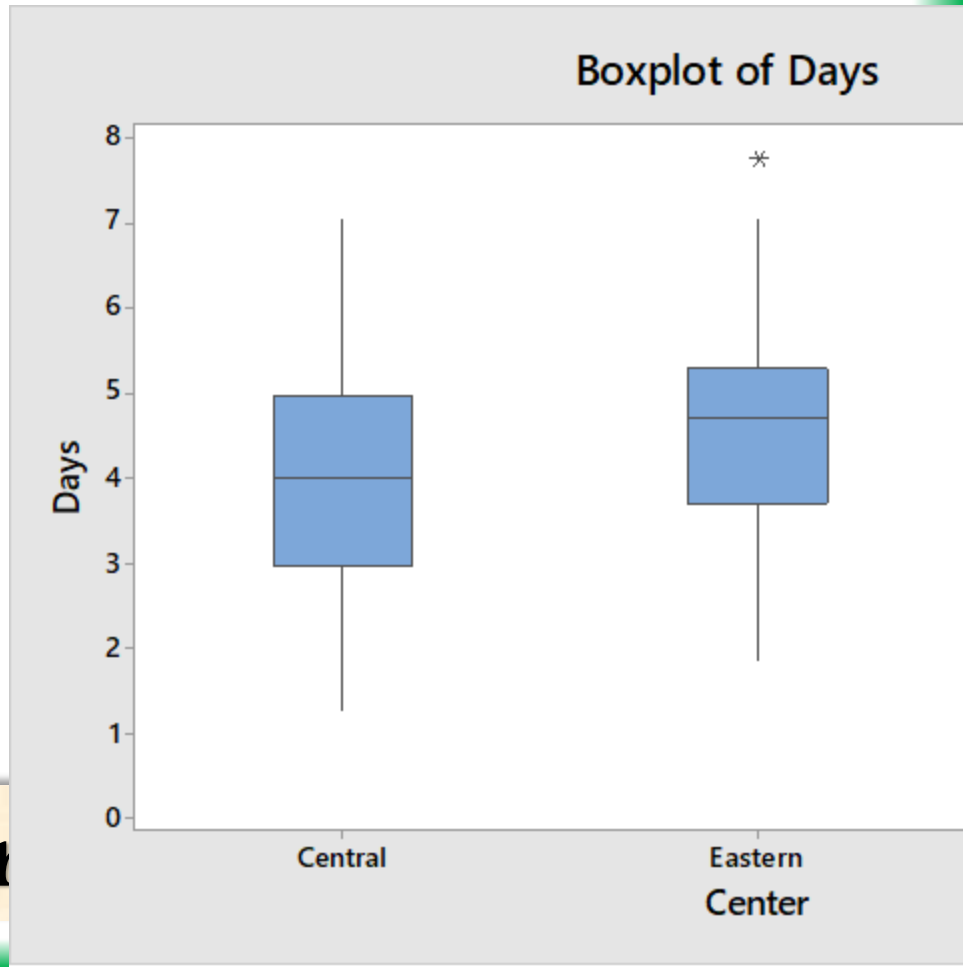
Question:

Box Plot Graph is used to_____ . [multiple choice]

1. Identify outliers
2. Differentiate before and after Improvements.
3. It is suited for time ordered data and parametric distribution.
4. B and C only

Answer: 1&2

Explanation:



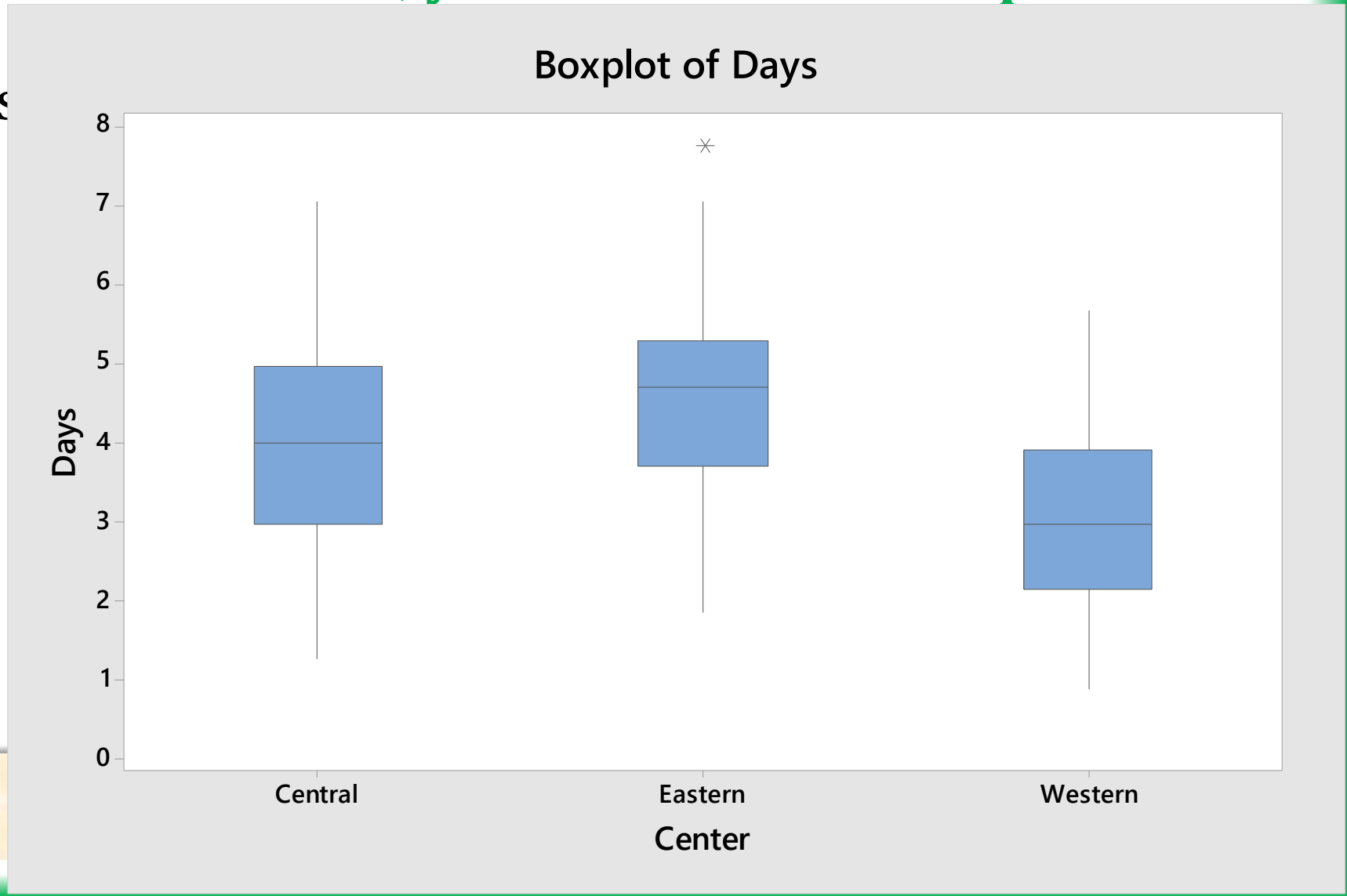
Question:

You are a Project Manager wanting to compare on time delivery (%) of Team Leads across 3 teams, your choice of technique would be?

Hypothesis Tes
Histograms
Pareto chart
Box Plots

Answer: 4

Explanation:



Question:

What kind of Graph would help us to analyze stability of non parametric (NO assumption) distribution of data points

P Chart
I-mR Chart
C Chart
Box Plot

Answer: Box Plot

Explanation: Assumption free/ distribution free data

Question:

The distance between Quartile1 (Q1) and Quartile3 (Q3) is called as _____ and it helps to understand _____ of process variation.

Inter Quartile Range and Width
Quartile Range and Height
Quartile 2 and Width
Median and Width

Answer: 1

Explanation:

Question:

The Pareto Graph is used to represent _____ scale of measurement.

Nominal
Ordinal
Ratio
Interval

Answer: Nominal

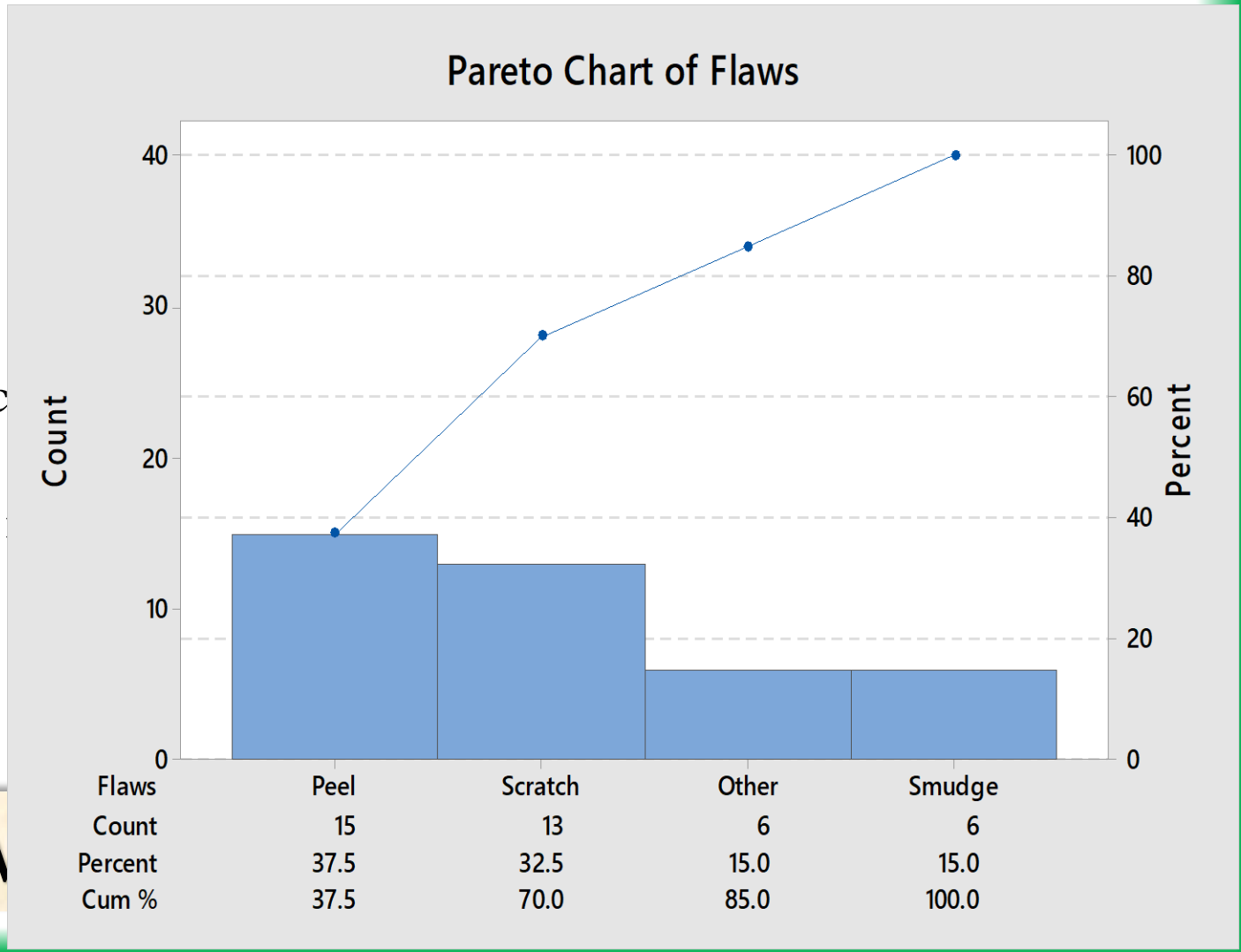
Explanation:

Nominal (e.g. **label**, Roll Number), least exac

Ordinal (e.g. **rank**, 1st / 2nd boy in the class)

Interval (e.g. **grading** in the exam(81 or 83

Ratio (e.g. **mark** in the exam), more exact



Data V

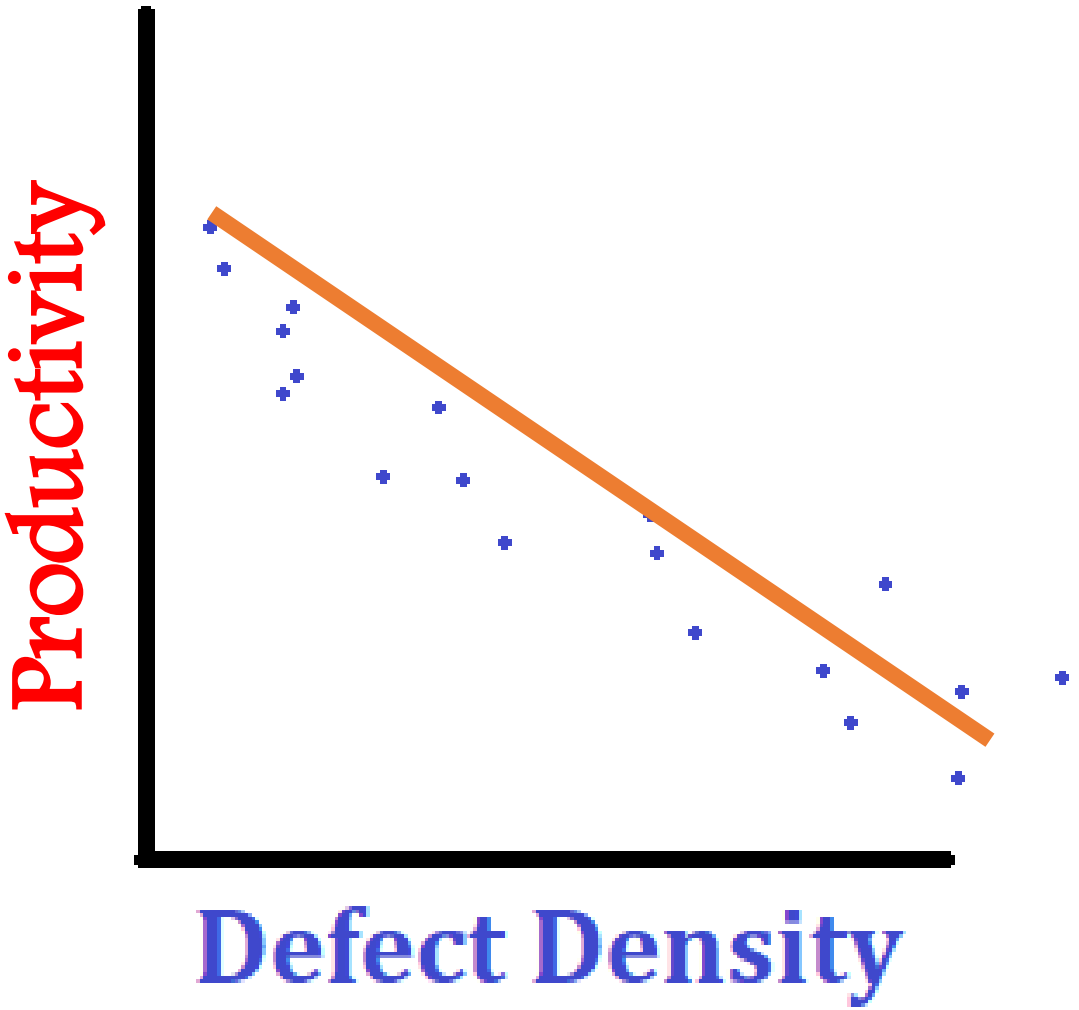
Question:

In a project, defect density increases and Productivity decreases in subsequent releases. Indicate what kind of relationship that you can interpret in this pair (x, y)?

Weak Positive Correlation
Strong Negative Correlation
No relation
Strong Positive Correlation

Answer: Strong Negative Correlation

Explanation:



Question:

Which of the following are characteristics of the inputs to a process?

[Multiple choice]

These are referred to as the x variables

These are the "causes" that create the effect

A process output is a function of its inputs

None of the above

Answer: 1,2,3

Explanation:

Question:

Six Sigma is a term used to indicate that there are 6 Standard Deviations below and above the process Mean and within upper and lower specification limits.

True
False

Answer: True

Explanation:

Question:

What is the percentage of perfection in a process operating at +/- 3 Sigma level

99.999660 %
99.999999. %
99.976700 %
3.4 DPMO

Answer: 99.976700 %

Explanation:

Question: **Which of the following is NOT an advantage of using a median?**

1. Extreme values do not affect the median as strongly as they affect Mean
2. A median can be calculated for qualitative descriptions
3. Median is easy to understand
4. Median can be calculated even for open-ended classes

Answer: 4

Explanation:

Question: **Which of the following is not a Measure of Central Tendency**

Geometric Mean
Median
Mode
Arithmetic Mean

Answer: Geometric Mean

Explanation:

Consider 1,2,3,5,-1,0

Question:

Ratio and Interval Scale of measurements are based on _____type of data

Discrete & Attribute

Discrete & Continuous

Variable & Continuous

Continuous & Attribute

Answer: variable & Continuous

Explanation:

Question:

The Graph which helps to identify and prioritize problems to be solved

Control Chart

Histogram Chart

Fish Bone Graph

Pareto Chart

Answer: Pareto Chart

Explanation:

Question:

The design and code review effort is high (process is effective) in a project, and it results in less number of defects injected in UAT phase. Identify the appropriate type of correlation between review effort and number of defects. (Assume that "r" value is good).

Positive Correlation
Strong Negative Correlation
Non linear Correlation
Strong Positive Correlation

Answer: Strong Negative Correlation

Explanation:

Question:

If the effort variance of your project shows a negatively skewed normal distribution curve, what will you infer from the following?

This means that the project is proactively finishing ahead of time

Project is in control

Project is influenced by lot of special causes

None of the above

Answer: 1, finish early

Explanation:

Question:

---------- helps to understand Process behavior for parametric distribution.

Median
Range
Mean
Variance

Answer: **Mean**

Explanation:

Question:

"If P value is >=0.5, then the process is said to be Normal" – Indicate what type of statistics is being used?

Descriptive
Inferential
Expression
None of the above

Answer: Inferential

Explanation:

Question:

Three Standard Deviations on left and right side of the mean would include what % of the total data points in Normal Distribution?

68 %
97 %
99 %
95 %

Answer:

Explanation:

Question:

In your project, Review effort (hrs, X) and defect rate (no. of defects per hour, Y) show a negative correlation. It means :

As Defect rate increases, Review effort also increases

Negative correlation does not infer any relationship between Review effort and defect Factors

As Defect Rate decreases, Review effort also decreases

As Defect Rate increases, Review Effort Hrs decreases

Answer: As Defect Rate increases, Review Effort Hrs decreases

Explanation:

Question:

If you are a Team Lead encountering a positively skewed normal distribution curve for Defect Leakage Rate, then what will you conclude from the following?

Process is stable
Process is within limits
Process needs Corrective action over Defects
Process is influenced by special cause variation

Answer: Process needs Corrective action over Defects

Explanation:

Question:

The measure which helps to understand the spread of variation is called as _____

Quartile 1
Cpk
Mode
Variance

Answer: Variance

Explanation:

Question:

One of the most popular measures of variability in a data set or population is _____.

Dispersion
Variation
Mean
Standard Deviation

Answer: SD

Explanation:

Question:

_____determines the nature of relationship which would help us to make predictions.

Correlation Analysis
Regression Analysis
Stability Analysis
Capability Analysis

Answer: Regression

Explanation:

Question:

A software development process has UAT Defect density as Y, percent review effectiveness as X1 and percent design phase effort as X2. Indicate the type of regression model Y= -0.1320 X1 + 0.16 X2 + 23.200

Single Linear Regression
Dummy Variable Regression
Multi Linear Regression
Logistic Regression

Answer: Multi Linear Regression

Explanation:

Question:

Which of the below statistical tests helps in decision making based on data inferences?

Mode
Hypothesis Test
Skewness
Stability Test

Answer: 2

Explanation:

Question:

What is the outcome of Hypothesis Testing, where P Value > = 0.05 ?

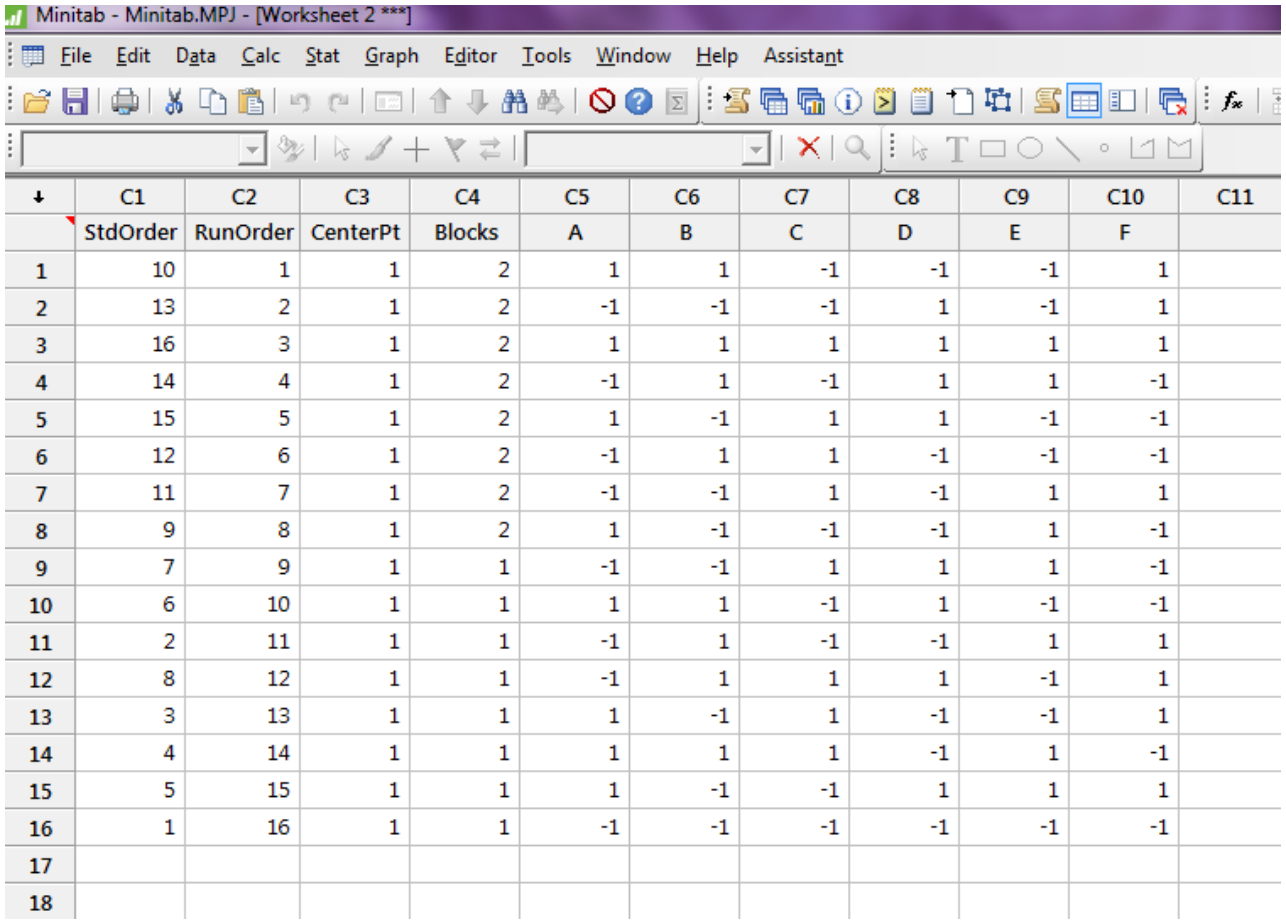
Accept Alternate Hypothesis
Reject Null
Accept Null Hypothesis
Data is normal

Answer:

Explanation:

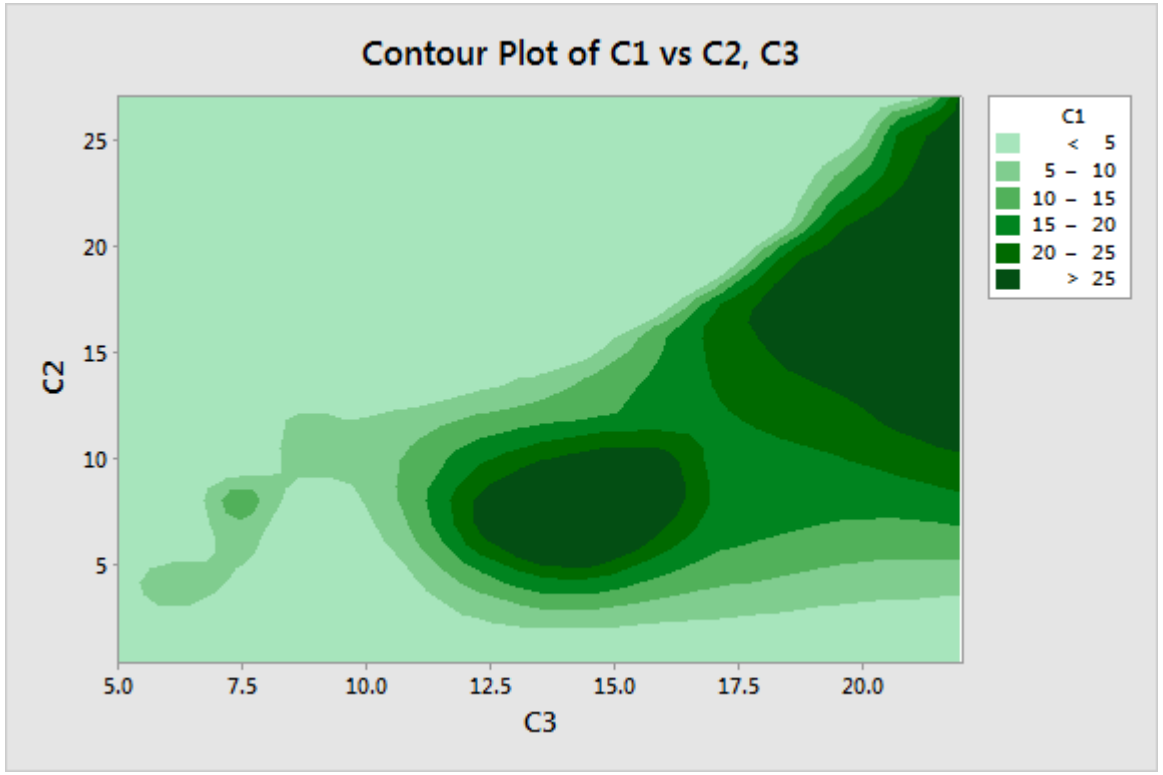
Exploratory Data Analysis in Quality Control

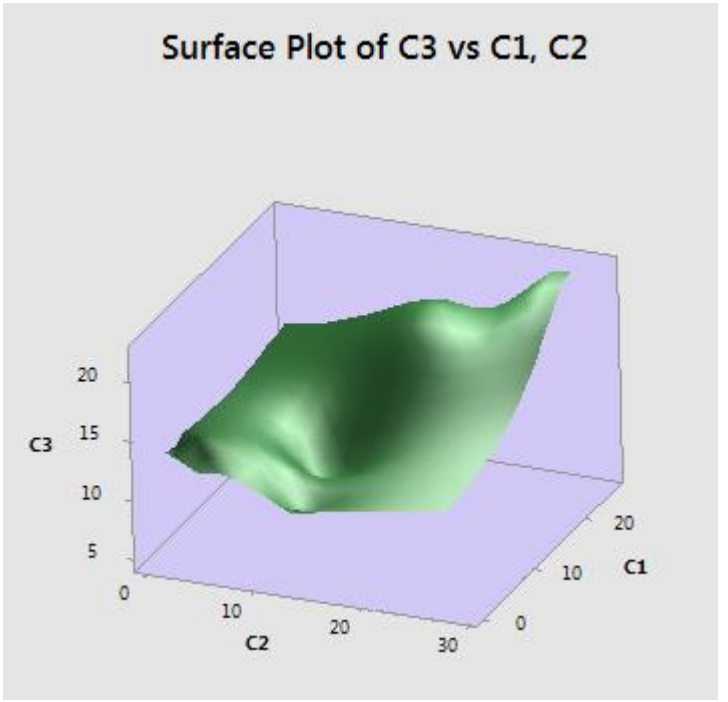
DOE



↓	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
	StdOrder	RunOrder	CenterPt	Blocks	A	B	C	D	E	F	
1	10	1	1	2	1	1	-1	-1	-1	1	
2	13	2	1	2	-1	-1	-1	1	-1	1	
3	16	3	1	2	1	1	1	1	1	1	
4	14	4	1	2	-1	1	-1	1	1	-1	
5	15	5	1	2	1	-1	1	1	-1	-1	
6	12	6	1	2	-1	1	1	-1	-1	-1	
7	11	7	1	2	-1	-1	1	-1	1	1	
8	9	8	1	2	1	-1	-1	-1	1	-1	
9	7	9	1	1	-1	-1	1	1	1	-1	
10	6	10	1	1	1	1	-1	1	-1	-1	
11	2	11	1	1	-1	1	-1	-1	1	1	
12	8	12	1	1	-1	1	1	1	-1	1	
13	3	13	1	1	1	-1	1	-1	-1	1	
14	4	14	1	1	1	1	1	-1	1	-1	
15	5	15	1	1	1	-1	-1	1	1	1	
16	1	16	1	1	-1	-1	-1	-1	-1	-1	
17											
18											

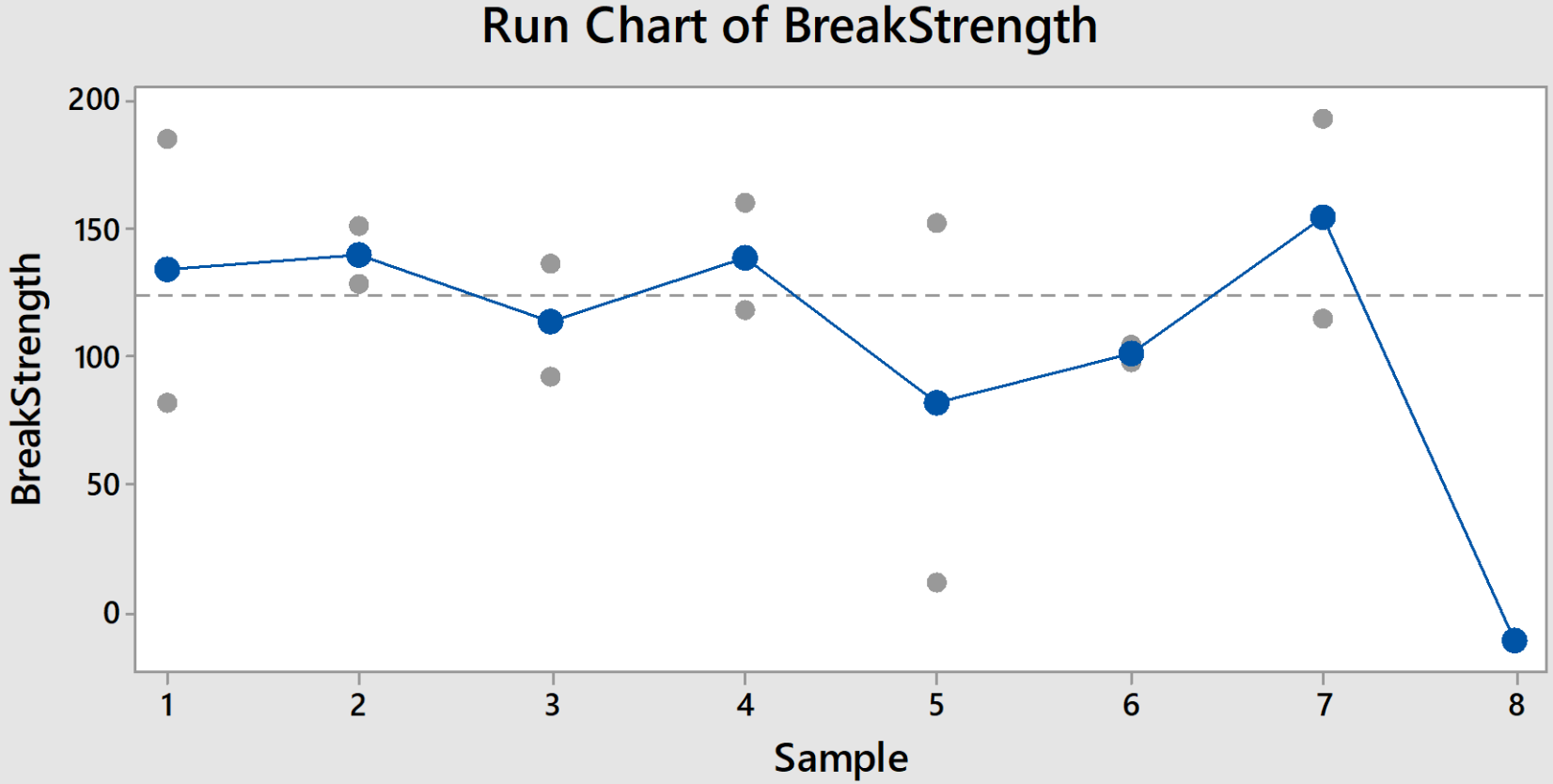
Response Surface





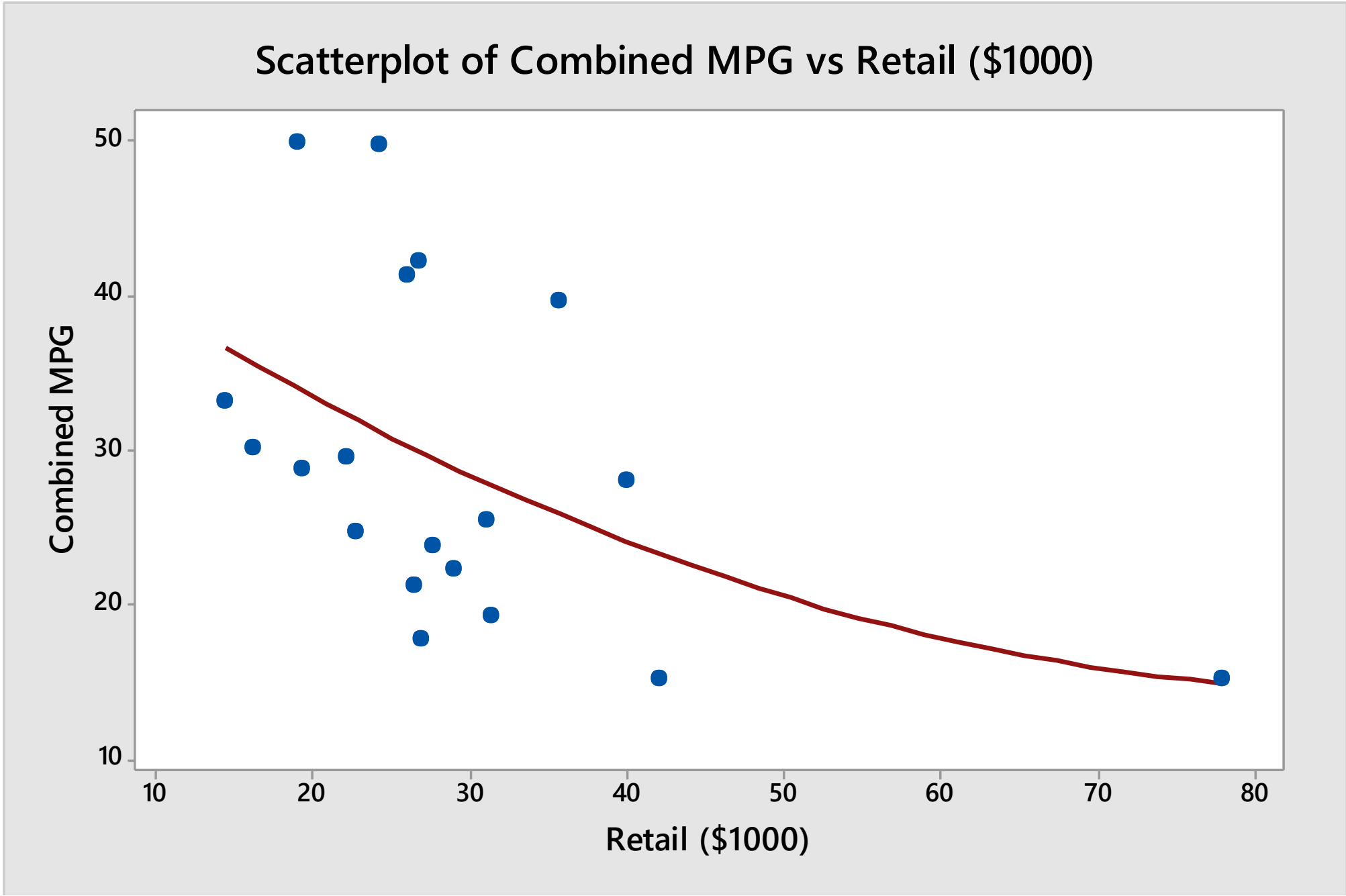
Run test

Filter	Membrane	Open Cup	Badge
26	45	36	21
21	33	34	23
16	26	33	27
28	46	29	29



Number of runs about median:	6
Expected number of runs:	5.0
Longest run about median:	2
Approx P-Value for Clustering:	0.777
Approx P-Value for Mixtures:	0.223

Number of runs up or down:	6
Expected number of runs:	5.0
Longest run up or down:	2
Approx P-Value for Trends:	0.830
Approx P-Value for Oscillation:	0.170


Scatterplot of Combined MPG vs Retail ($1000)
Combined MPG
50
40
30
20
10
10
20
30
40
50
60
70
80
Retail ($1000)

Regression Analysis: Combined MPG versus Retail ($1000)

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	415.6	415.64	4.25	0.055
Retail ($1000)	1	415.6	415.64	4.25	0.055
Error	17	1662.6	97.80		
Total	18	2078.3			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
9.88953	20.00%	15.29%	3.22%

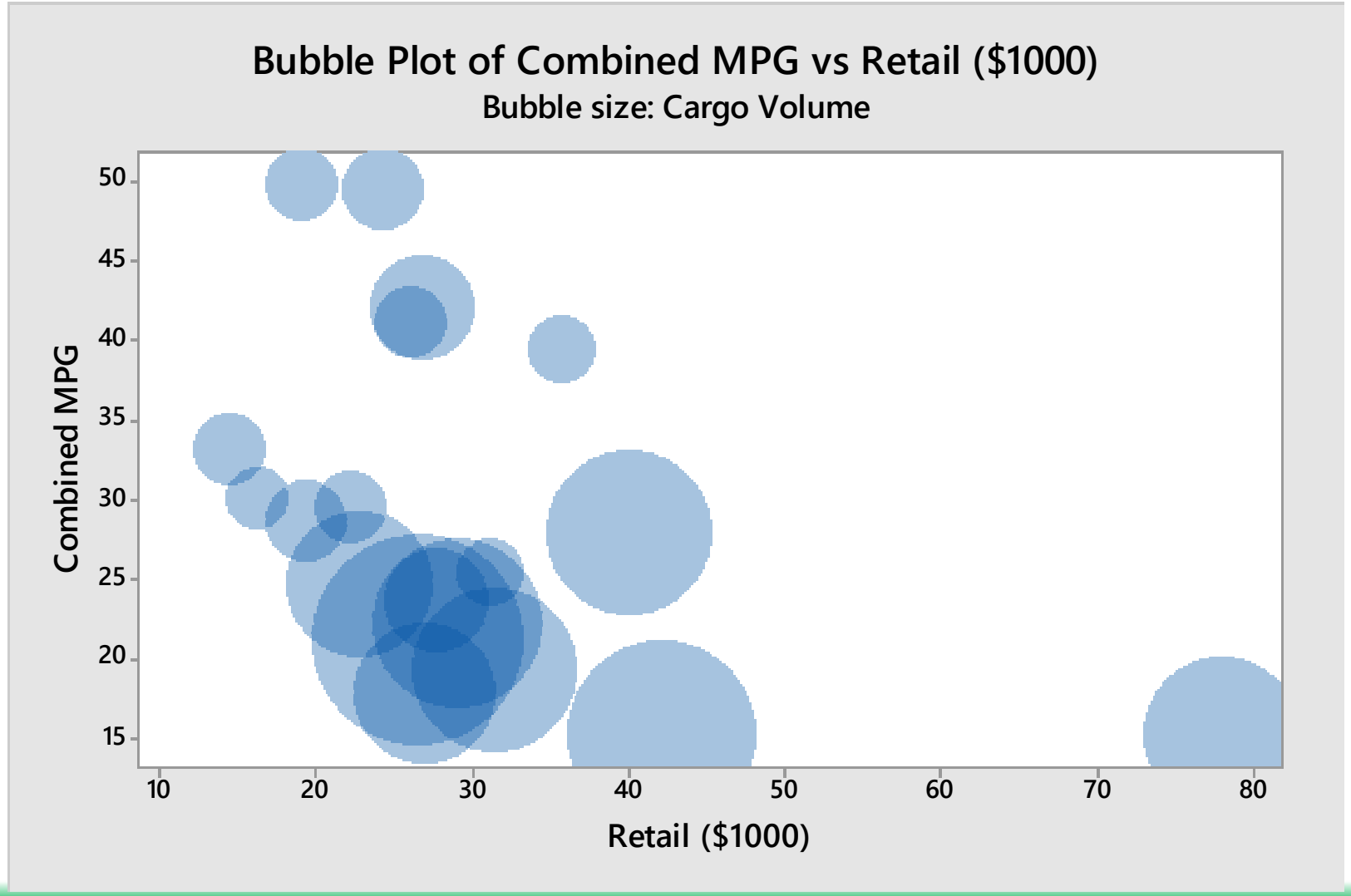
Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	39.51	5.44	7.26	0.000	
Retail ($1000)	-0.347	0.168	-2.06	0.055	1.00

Regression Equation

Combined MPG = 39.51 - 0.347 Retail ($1000)

Bubble plot


Bubble Plot of Combined MPG vs Retail ($1000)
Bubble size: Cargo Volume
Combined MPG
50
45
40
35
30
25
20
15
10
20
30
40
50
60
70
80
Retail ($1000)

Graphical Summary in Minitab