A Novice Approach for The Beginners of The Professional Researchers in Automobile Engineering

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Abstract. Globalising the Research by the Transformation of the Research Practices using the latest Research Tools (Roots of the Educational Research –Redefined) is the motto of the present today and in this regard a review show-casing the six sigmas as an add-on for the combined studies of the service – quality with the Living –Standards with the Descriptive statistics in mind had been considered through this research practice and the approach.

Keywords: Descriptive statistics, FOSS, Inter-Disciplinary Research, Six Sigma, Service Quality

1. Introduction

This is to introduce the modern methods of the research practices using the latest tools and the techniques of the research. This paper is going to run through the roots of the research for the better understanding for the professional researchers to themselves carry-out the primary type of the research work and to lead towards the secondary type of the research work as well with-out too much of the researching efforts. The motto is to introduce the beginner with the fundamentals of the research, research types and the methodology to carry –out the research practice using the free and the open sources (FOSS). This also provides the data updated till date considered as factual for the better understanding for the upcoming professionals of the fields of inter-disciplinary research [1]. The data collected for this kind of the research is of primary research type and then calls for conversion to the secondary type.

All the organizations, individuals or businesses use the soft wares as a form to communicate with the whole world of the research in the form of the apps or the free and the open source software [2]. Six sigmas had been proved to the best for producing the results for the outsourced projects with the increased validity, reliability and reduction in the all the other science, technical, engineering and mathematical aspects.

But there still lies some gaps in the areas of the academic research and developments in terms of the successful stories count [3]. The reason could be due to the misconceptions and the disbeliefs that six sigmas when as an add-on could not produce the desired results for the applications, theories, policies, practices and the administrative implications.

A software development frame needs to be used to develop very high-quality service engineering processes using the different methodologies of the six sigma which means that conducting the studies on the current arts and calibers of the six sigmas in the services sector had been neglected due to certain reasons or the defects. The ultimate goal of the day for any organization lies in the six-sigma philosophy as an add-on for the zero-defect services and customer delight.

Misconceptions associated with the six sigmas are hereby tabulated as a ready reckoner for the future researchers.

The below mentioned are some of the mis-conceptions about the six sigmas,

Table 1: Mis-conceptions on Six –Sigma

Misconception1- The whole company is supposed to adopt the six sigma.
Misconception2-Six sigma is only applicable to the manufacturing sector.
Misconception3-six sigma is all about the statistics only.
Misconception4-any other not cited.

Customer orientation is the basis for the organization learning that results in the superior value attributions and greater customer satisfactions (Sinkula , Bakar& Noordwier , 1997 ; Slater & Narven , 1995).But the question and the equation here is to check the implemented strategies for the development that could lead to the orientation of the six sigma for the service industries as well Further, there is also a need to develop some of the new and advanced optimization tools for the intermediaries perspective as well [4]. There is a need to continuously measure the service quality gaps using the monitoring tools.

1.1 Six sigma for the service processes

The ultimate power of the six sigma lies in the fact that this is a disciplined approach to improve the products/processes/services/activities in the service sector and the service industries as well [5]. Six sigmas is much beyond the quality initiatives like TQM for the industries also.

Hoerl & Snee (2002) explained the below mentioned rudimentary principles of the statistical thinking, namely,

1. Variability is almost in all the processes.
2. Creation of the data is an essential in almost all the situations.
3. Strategies are to be developed for the reduction / elimination in all the aspects of variations

The above mentioned were based upon the service-oriented companies. And the following were the below mentioned benefits for the service-oriented organizations:

Table 2: The benefits of Six Sigma for the Service Industries.

Organization	Benefits
Citi-Bank Group	Reduced call backs by the eighty percent.
	External call backs by eighty five percent.
	Reduced credit processing time by fifty percent.
	Reduced credit decision cycle time from three days to one day.
	Reduced statement processing time by from twenty-eight days to fifteen days.
Morgan Chase	Reduced flaws in the customers facings.
	Increased customer satisfaction.
	Improved efficiency.

British Telecom	Improved cycle times. Increased levels of the customer satisfaction. More robust and effective processes. Creation of the common languages for the businesses. Reduced capital expenditure. Significant fault reduction. Improved repairs management.

1.2 Inputs for any DMAIC process

a) Integration of the human and the process issues of the processes improvement.
b) Data driven decision and measurement.
c) Management leadership commitment.
d) Statistical thinking and application of the quality tolls and the techniques.
e) Linking six sigmas with the businesses strategies.
f) Influence of the bottom-line and customers satisfactions.
g) Common Six Sigma performance indicators (KPI's):
h) Cost of the poor quality.
i) DPMO.
j) Process Capability.
k) Time to respond to the customer complaints.
l) Processing Times.
m) Delivery times and the speed of the delivery.
n) Waiting time to obtain the services.
o) Services reliability.
p) Accuracy of the information provided to the customers.

1.3 Key success factors (KSF's)

a) Strong Leadership.
b) Management Commitment.
c) Organisatioon Culture change.
d) Aligning the six sigma projects to the corporate business objectives.
e) Selection of the team members and the team work
f) Six sigma trainings.
g) Key Ingredients:
h) Uncompromised support.
i) Commitment from the top management.
j) Well-designed education.
k) Training programmes .
l) Cooperative environment.
m) Back-up from the facilitators.
n) Availability of the resources.
o) Rigourous project management approach.
p) Development of the framework to indicate which tool or technique to use & when, etc.

1.4 Benefits of successful completion of the six sigmas

a) Improved customer satisfaction.
b) Reduced defects rate in the service processes.
c) Reduced variability of key success processes.
d) Improved culture with the attitude of the continuous improvement of the service process performances.
e) Reduced process cycle times.
f) Achievement of faster service deliveries.
g) Reduced service operational costs.
h) Increased market share.
i) Critical success factors:
j) Linking six sigmas with the business strategies.
k) Customer focus.
l) Project management skills.
m) Management commitment and involvement.
n) Organisation infrastructure.
o) Understanding of the six-sigma methodology.
p) Project selection and the prioritization.
q) Integration of six sigma with the financial accountability.
r) Management of the culture change.
s) Trainings and educations.
t) Project trackings and the reviews.
u) Incentive programs.
v) Companywide commitments.

1.5 Types of the validity for the six sigma

a) Known groups validity
b) Longitudinal validity.
c) Concurrent validity.
d) Construct validity.
e) Content validity.
f) Criterion validity.
g) Descriminant validity.

Reliability: Test –Retest, gold standards, internal consistency, sensitivity, specificity , floor effect, intra-class correlation coefficient and cronbach's alpha.

1.6 Qualified Levels of Six Sigma

Table 3: Six Sigma Roles and Qualification Levels

Levels	Qualified for
Champions	Fully trained business leaders responsible for the promotion and the direction of the six sigma strategies, selection of the critical projects and deployments.
Master Black Belts	Fully trained quality leaders responsible for the six sigma implementation, trainings , monitoring and the results .
Black Belts	Fully trained experts who are experienced in leading the improvement teams

Green Belts	Fully trained experts in six sigma tools and the methodologies deployed in the six sigma projects.
Team Members	Individuals supporting the specific projects working teams in their areas.

1.7 GAPS in Six Sigma

1 Difference between the consumer expectations and quality determinants, management perceptions of such consumer expectations.
2 Difference between the management's perceived quality determinants and service specifications.
3 Difference between the quality specifications and the actual service deliverables.
4 Difference between the actual service delivery and the company's external communications about the service deliveries.
5 Difference between the expected service and the perceived services.
6 The dimensions of the service quality depend upon the Brand Image, Past Experiences, Industry Standards, Expected Services, Perceived Services.

1.8 Process Mapping Techniques for the mapping of Six Sigma and the Service Quality

A process mapping shows and displays the sequential steps that are involved in converting the specific format into the required output [6] , With the below mentioned features ; namely , Waste of Correction , Waste of Processing , Waste of Conveyance , Waste of Motions , Waste of Waiting , Waste of Over-Production , Waste of Waiting .

The process is to be mapped as the same happens actually and the process should be taken across the organizations. The intentions with all the people involved in the process is to be carried out. The beginning and the end of the process is to be defined. The process mapping should be done at the highest level. Questioning is to be carried-out at all the levels.

1.9 FMEA –An Introduction

Identify the potential failures and the failure modes. Rate the severity of the effects. Identify the potential causes. Evaluate objectively the probability of occurrence

2. Literature Review

By the definition, research is a crtical examination or careful examination for seeking the facts or the principles with the universal reliability and validity [7].

According to B. W. Tuckman (1978), research is characterized by the below mentioned keywords:

Keywords: Replacability, Systems, Logic, Reductibility, Empiricalness, Transmittability

Research in simplification is as mentioned below:

Table 4: Systematic Stages in Research Problem Solving and Thesis Development.

Sl No.	Stages
1	Selection of a Problem
2	Formulation of a Problem
3	Definition of the Problem

4	Attack on the Problem
5	Collection of What is Known (Available Data)
6	Collection of What is Un-known (Un-available Data)
7	Findings Collection
8	Interpretation of the Findings
9	Formulation of the Conclusions / Results / Discussions
10	Recommendations
11	Framing of the Thesis
12	Emergence of Thesis

2.1 Sources of the Problems

Conflicts, Contradictions, Incongruities, Points of Controversy, Contested Conclusions, Suggestions, Completed Research works, Uncompleted Research works, Gaps, Deficiencies in the explanations, Past theories, Consultations, Schools, Colleges, Class-Rooms, Technological Ranges, Social Disputes, Social Discussions, Social Developments, Lectures, Seminars, Conferences, Colloquiums, Symposiums, Colleagues, etc.

2.2 Areas of the Research Problems

Curriculums, Text-Books, Syllabii, Administration, Development, Skills, Guidances, Counselling, Measurements, Aids, Equipments, Methods, Teacher's Notes, History, Philosophy, Psychology, Socio-Economics, Comparative Techniques, etc.

Any scientific approach of the Research involves seven elements as quoted by Downing in his research, namely.

Table 5: Steps and the Keywords.

Steps	Keywords
1	Purposeful Observation
2	Analysis & Synthesis
3	Selective Research
4	Hypothesis
5	Verification by Inference
6	Verification by Experimentation
7	Verification by Reasoning

Table 6: The reasoning of any research process is done by the below mentioned methods.

Method of Agreement	Method of Disagreement	Method of Concomitant variation	Method of Residues	Joint Method of Agreement

2.3 Meta –Analysis

Statistical analysis which combines or integrates the results of several independent studies considered by the analyst and which are to be combinable for the below mentioned:

1. Avoid the time and the expense of conducting the studies repeatedly.
2. Make the interventions more objective and accurate.
3. Identify the areas of the insufficient research.
4. Increases the power of the statistics.
5. Obtains more information from the available data.
6. One or more of the statistical techniques could be applied.
7. Multi – Directional studies provides more answers for the similar kinds of the studies.

2.4 Difference between the Primary Research and the Secondary Research

1. The primary research is based upon the Questions / Hypothesis whereas the Secondary Research is based upon the Questions / Objectives.
2. The primary research requires a criterion for the selection of the subjects whereas the Secondary research requires a criterion for the selection of the studies.
3. The primary research is based upon the study population whereas the Secondary research is based upon the study programmers.
4. The primary research is based upon the Sampling whereas the Secondary research is based upon the Data Extraction

The narrative reviews are the functions of the broad questions, unspecified resources, unspecified selections, variable appraisals, qualitative synthesis and sometimes evidence-based inferences.

The systematic reviews are the functions of the focused questions, specified resources, uniformly applied selections, critical appraisals, quantitative synthesis and fully evidence-based interferences.

Any research work should move across the IMRADT i.e. continuous rotation of the questions across the 6 W's & 2H's (what, when, where, who, why, how & how much)

The paper includes a comprehensive set of tables supporting the analysis and discussion of Six Sigma, research methodologies, and service quality. Table 1 presents common misconceptions about Six Sigma. Table 2 details the benefits of Six Sigma in various service industries. Table 3 outlines the Six Sigma Roles and Qualification Levels. Table 4 illustrates the Systematic Stages in Research Problem Solving and Thesis Development. Table 5 lists Steps and Keywords in research methodology. Table 6 elaborates on reasoning methods used in research. Table 7 explains the IMRADT structure. Table 8 describes the DMAIC phases. Table 9 shows the outcomes of hypothesis testing. Table 10 provides a Hypothesis Test Procedure. Table 11 contains correlation-related survey data. Table 12 explains the Interpretation of Correlation Coefficient and Relationship Types. Tables 13 to 17 include analysis of maximum ratings, survey data, and device-wise insights, and Table 18 presents Service Quality Questionnaire Results. These tables collectively enrich the research framework and validate the analytical approach adopted throughout the study.

Table 7: Imradt-Details.

Introduction	Why was this work undertaken?
Methods	How was that done?
Results	What did you find?
Abstract	Summary of the complete work
Title	Mixture of the keywords

2.5 Different types of the Analysis

1. Sub-Group Analysis
2. Quality Assessment
3. Cumulative meta-analysis
4. Meta-Regression results
5. Sensitivity Analysis
6. Cross Design Synthesis
7. Publication Bias

The same could be used for the areas of consumer technology, arts, healthcare, media, social entrepreneurship, finance, industry, retail, entertainment, sports and e-commerce. Some of the pioneers in the fields of six sigma are Bill Smith, Bob Galvin and Jack Germaine

The six sigmas has got the roots of the Business Strategy, Measurement System, Problem Solving Approach, Disciplined Change Process, Measure of the consistency and also the 18th letter of the alphabet. Basically, sigma is the spread about the mean or the average of any process or the procedures.

The six sigma is a problem-solving approach which includes the journey through the practical problems, ststistical problems, statistical solution and the practical solutions. The generally accepted phases of the Six Sigma include the DMAIC- Define, Measure, Analyze, Improve and the Control phases.

Table 8: DMAIC

Define	Measure	Analyze	Improve	Control
Customer's impression on the service provider.	Improvements essential for the achievement. Best practices for the measurement Trust on the out-put data.	Position possessed by the service provider. Other area Improvements essential for the achievement. The factors that make the difference.	Identifying the roots of the problem. The essential steps to predict the output. The necessary controlling measures.	The trust on the in-process data. The goal reached so far. The procedures required to sustain the improvements.

3. Research Methodology

Table 9: Outcomes of the hypothesis test

Decision	True	False
Fail to reject the null hypothesis	Correct Decision	Type II error
Reject the null hypothesis	Type I Error	Correct Decision

a. Two sample t-test using the Excel

When the means of the two groups are too compared (i.e. when the two samples of each of the groups consists of the subjects that are not related), then the excel two sample t-test procedure is to be adopted to perform the suitable calculations.

H0: M1 equals to M2 (mean scores are the same)

HA:M1 is not equal to M2 (mean scores are not the same)

b. Tabulation for the Hypothesis Test

Table 10: Hypothesis Test Procedure

Group-1		Group-2	
Group	Scores	Group	Scores

c. Procedure in Excel

Tools Menu

1. Data Analysis
2. T-Test
3. Highlight the input range of the Variables -1
4. Highlight the input range of the Variables-2
5. Click OK.

If the P-value is lesser than 0.05, then this provides the evidence to reject the null hypothesis.

If the P-value is greater than 0.05, then this provides the evidence to accept the null hypothesis.

d. Steps for transforming the gaps for the improvement

1. Prioritization of the opportunities for the improvement of the processes.
2. Generating the alternatives and then evaluating and selecting the best solutions.
3. Identification of the potential problems and the obstacles that are to be encountered for the implementation of the solutions [12].
4. After mapping out the 7M's ie. Manpower, Machinery, Materials, Methods, Measurement, Money, Management.
5. Then the translation of the improvements opportunities into the quantitative and the qualitative aspects.

e. Analyze the Deliverables

a) Project Plan

b) Transformation and Translation of the Practical Theory
c) Statement of the Practical theories
d) Analysis plan for proving / disproving the Hypothesis
e) Hypothesis tests for the X's Root Causes.

f. Conclusion on the Hypothesis Test.

Regression Analysis is used to construct the relationship between a dependant variable (X's) and the independent variable (Y's) and one / more independent or the predictor variables (X's).

The ultimate goal is to deliver the values of the parameters for a function that could cause the functions to best fit the set of the data observations [7]. Finally, a mathematical model or a formula is obtained. The linear or the curvilinear relationship is obtained to showcase the relationship. https://admin.typeform.com/form/1038251/fields/

The correlation is the measure of the strength of the association between the two qualitative or the two quantitative variables [8].
The correlation is measured by the PEARSON Correlation coefficient (r) i.e. product-moment correlation [13].

Table 11: Tabulation for the Measure of the Correlation

R No.	Research Statement	Average Rating	How Many Have Answered	Maximum Answers Attempt Count
1	He / she should believe that "Teaching is a profession which teaches all the other professions.	3.95	22	22 Out of 73
2	He / she should believe that ROME was not built in one day but was built day by day.	4.38	21	22 Out of 73
3	He / she should believe that "winner never quit and the quitters never win ".	4.19	21	22 Out of 73
4	He / she should remember that the "the ends justify the means " is still relevant for today.	3.71	21	22 Out of 73

5	He / she should believe that winning the competition is not always necessary, rather he / she should enjoy the same also.	4.05	21	22 Out of 73
6	He / she would like to possess very rare and he antique things than others.	3.52	21	22 Out of 73
7	He / she should believe that the progress of his / her depends upon the others as well	3.71	21	22 Out of 73
8	He / she would wish to be recognized for his / her own consignments.	3.86	21	22 Out of 73
9	He / she would like to possess their own transport.	3.25	20	22 Out of 73
10	He / she should believe that maintain good relations with the others is very very important.	3.90	21	22 Out of 73
11	He / she should keep in mind that sharing things with the others is not wise.	3.05	21	22 Out of 73
12	He / she should believe that doing socially useful productive work is better than outstanding work.	3.76	21	22 Out of 73
13	He / she should forgo one's own interests for the	3.33	13	22 Out of 73

	society as a thing of the past.			
14	He / she should undergo immediate gratification of the senses.	3.35	14	22 Out of 73
15	He / she should work on an assignment just before it is due.	3.24	21	22 Out of 73
16	He / she should first serve one's own ends rather than the service to the same society.	2.95	21	22 Out of 73
17	He / she should like the routine tasks rather than the challenging and the innovative one's.	2.86	21	22 Out of 73
18	He / she should never think that hard-work is the way to achieve one's goals.	2.70	20	22 Out of 73
19	He / she should not pay attention to the ideas put forward by the people who are not trustworthy.	3.10	21	22 Out of 73
20	He / she should wish the betterment of their family and do the resourceful all the time.	3.71	21	22 Out of 73
21	He / she should should wish for their stand easily.	3.85	21	22 Out of 73
22	He / she should not give up their stand easily.	3.38	21	22 Out of 73

23	He / she gets the dedication and the determination for achieving the goals from the hurdles.	4.10	21	22 Out of 73
24	The worldly comforts are made for enjoying, so he / she should enjoy the same upto the maximum extent possible.	3.67	21	22 Out of 73
25	In the present day world, only the fittest survives.	4.24	21	22 Out of 73
26	He / she feels happy when the others follow his / her instructions.	3.86	21	22 Out of 73

Table 12: Interpretation of Correlation Coefficient and Relationship Types

Sl No.	Correlation Coefficient (r)	Type of the Relationship	Objective
1	Equal to (-1)	Negative	
2	Equal to (0)	Lack of the Correlation	
3	Equal to (+1)	Positive	Y = f(X) X- Variable
4	Greater than 80	Significant Correlation	
5	Less than 20	Insignificant Correlation	

4. Research Methodology

Figure 1: Analysis for the first thirteen questions.

Mean is 3.601; Median is 3.71; Mode is 3.71; Minimum Value is 2.7; Maximum Value is 4.36; Range is 1.68; Variance is 0.202; Standard Deviation is 0.450; Standard Error is 0.088[14].

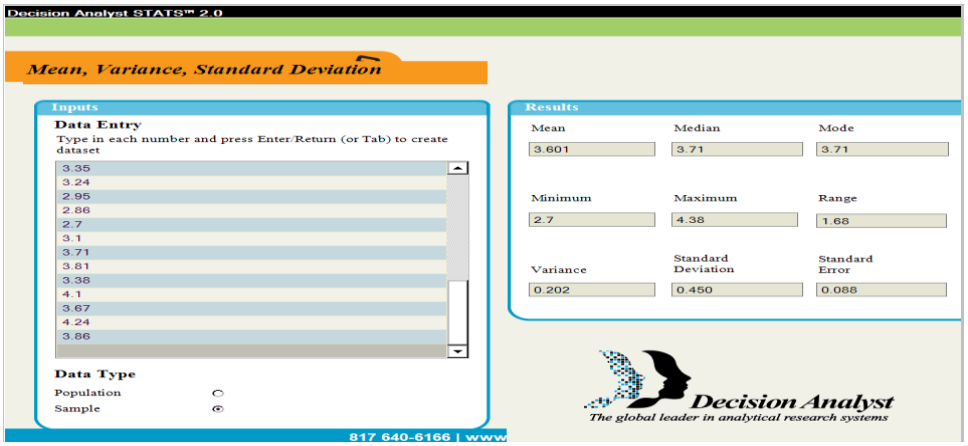

Figure 2: Analysis for the second thirteen questions.

Mean is 3.601; Median is 3.71; Mode is 3.71; Minimum Value is 2.7; Maximum Value is 4.36; Range is 1.68; Variance is 0.195; Standard Deviation is 0.442; Standard Error is Not Applicable [15].

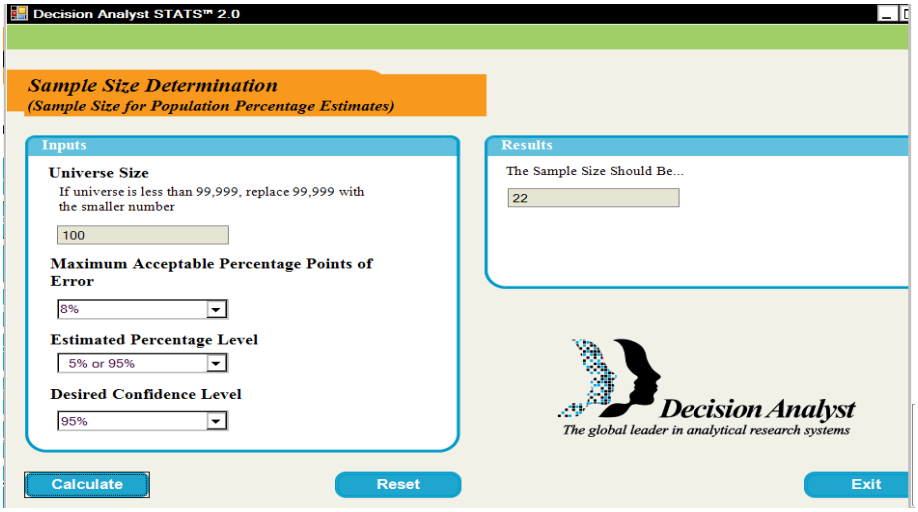

Figure 3: Sample Size Determination.

The Universe=100; Maximum error percentage points of Error = 8%; Estimated percentage level = 5%, Desired Confidence Level= 95% and [16] the sample size for the same = 22.

And the other relevant results are as mentioned below:

Figure 4: Dependant Proportion Test.

5. Analysis

Table 13: Maximum Number of Ratings on a Scale Of 1-5.

Research Statement Number	Maximum Ratings Count	Research Statement Number	Maximum Ratings Count
1	7	14	2
2	6	15	3
3	4	16	2
4	2	17	2
5	4	18	2
6	2	19	4
7	2	20	4
8	4	21	3
9	1	22	2
10	5	23	2
11	3	24	2
12	3	25	4
13	3	26	5

Table 14: Survey Analysis.

Total Visits	Responses	Completion Rate	Devices Used	Remarks
73	22	30 Percent	Pc's & Laptops , Smart phones Tablets	Pc's & Laptops Were Used Most

Table 15: Devise –Wise Analysis.

Device Name	Total Visits	Responses	Average Time of Completion	Remarks
Pc's & Laptops	41	16	03:53	56 Percent
Smartphones	31	06	02:23	01 Percent
Tablets	01	00	00:00	42 Percent

Table 16: Steps Involved.

Build-Design-Configure-Distribute-Analyze

BUILD				
Short-Text	Multiple Choice	Long-Text	Picture Choice	Statement
Question Group	Drop Down	Yes/No	E-Mail	**Rating**
Date	Opinion Scale	Legal	Number	Website
DESIGN				
Colours	Fonts	Background Image		
CONFIGURE				
General	Integrations	Self-Notifications		
Respondent –Notifications	Progress Widget	Messages		
DISTRIBUTE				
Share your Typeform	Launch in a pop-up	Embed in a Webpage		
URL	FaceBook	Twitter		
Google	Linkedin	Bufferapp		
ANALYZE				
Metrices	Results	Google Analytics	Reports	

Table 17: Maximum Number of Ratings on A Scale Of 1-5.

Research Statement Number	Maximum Ratings Count	Research Statement Number	Maximum Ratings Count
1	7	14	2
2	6	15	3
3	4	16	2
4	2	17	2
5	4	18	2
6	2	19	4
7	2	20	4
8	4	21	3
9	1	22	2
10	5	23	2
11	3	24	2
12	3	25	4
13	3	26	5

Table 18: Service Quality Questionnaire -Results.

Sno.	Exp	Maximum Ratings Count	Sno.	Per	Maximum Ratings Count
1	E1	5	1	P1	5
2	E2	5	2	P2	5
3	E3	5	3	P3	4
4	E4	5	4	P4	5
5	E5	5	5	P5	5
6	E6	5	6	P6	5
7	E7	5	7	P7	5
8	E8	5	8	P8	5
9	E9	5	9	P9	5
10	E10	5	10	P10	1

11	E11	1	11	P11	1
12	E12	1	12	P12	1
13	E13	1	13	P13	1
14	E14	5	14	P14	5
15	E15	5	15	P15	5
16	E16	5	16	P16	5
17	E17	5	17	P17	5
18	E18	5	18	P18	3
19	E19	5	19	P19	3
20	E20	1	20	P20	1
21	E21	1	21	P21	1
22	E22	1	22	P22	1

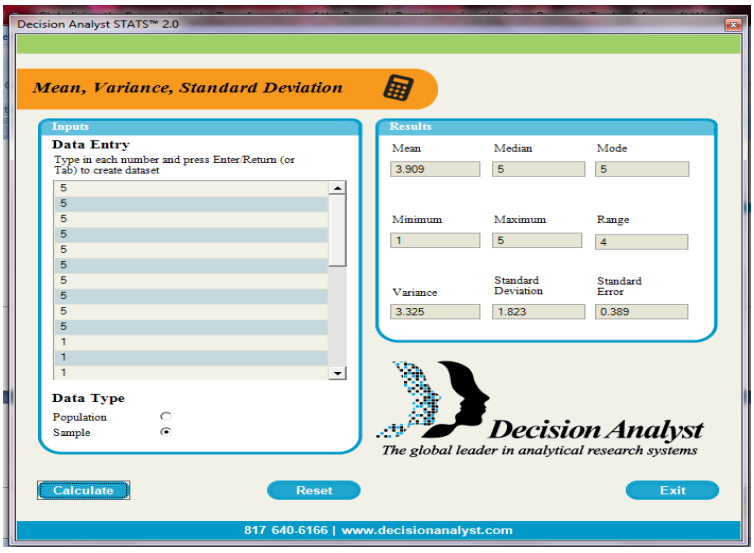

Figure 5: Mean, Variance & Standard Deviation.

Mean is 3.909; Median is 6; Mode is 8; Minimum Value is 1; Maximum Value is 5; Range is 4; Variance is 3.325; Standard Deviation is 1.823; Standard Error =0.389[9].

Figure 6: Mean, Variance & Standard Deviation.

The analysis of the study is represented through several key figures, each providing critical insights into various aspects of the research. Figure 1 presents the analysis for the first thirteen questions, while Figure 2 focuses on the analysis for the second set of thirteen questions. Figure 3 illustrates the sample size determination, and Figure 4 depicts the dependent proportion test conducted. Figures 5 and 6 provide a detailed comparison of the mean, variance, and standard deviation, offering a statistical summary of the data. Figure 7 revisits the sample size determination process, and Figure 8 explores the difference between two independent proportions. Finally, Figure 9 presents the difference between two independent proportions under mutually exclusive conditions. These figures collectively support the methodology and findings of the research.

Mean is 3.909; Median is 6; Mode is 8; Minimum Value is 1; Maximum Value is 5; Range is 4; Variance is 3.325; Standard Deviation is 1.823; Standard Error =0.389[10].

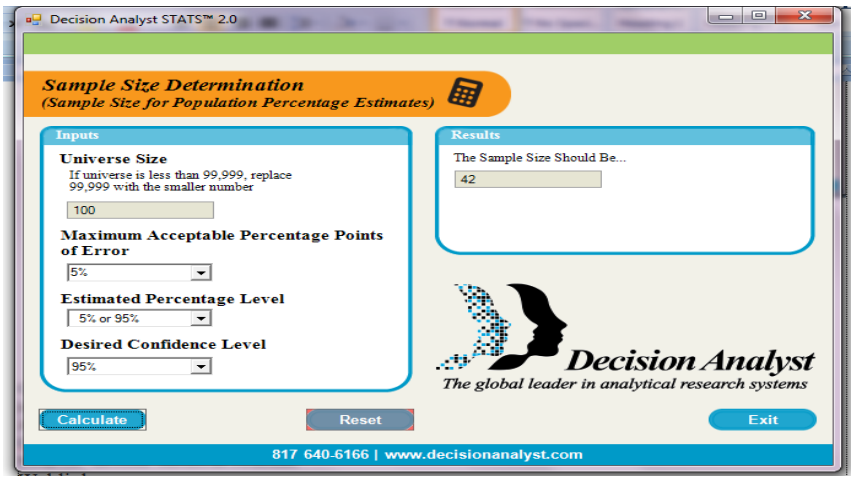

Figure 7: Sample Size Determination.

The Universe=100; Maximum error percentage points of Error = 5%; Estimated percentage level = 5%, Desired Confidence Level= 95% and the sample size for the same = 42[17].

6. Comparative Analysis

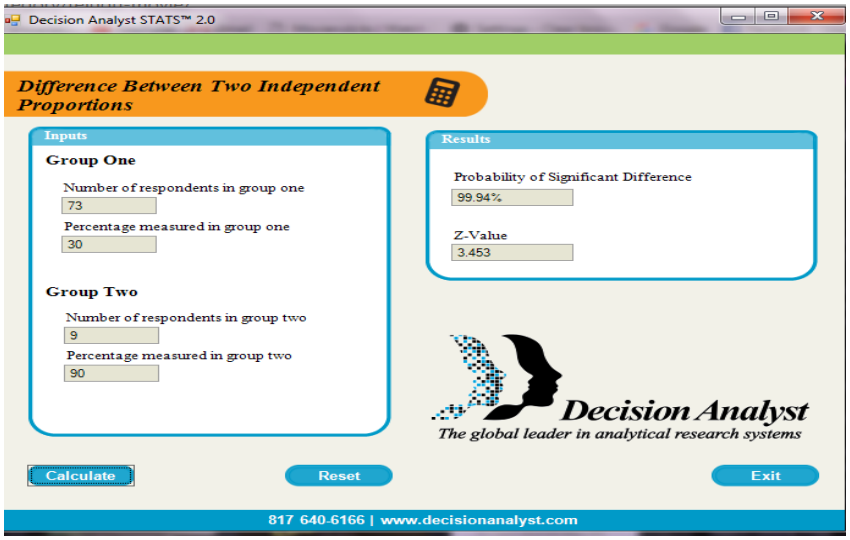

Figure 8: Difference between two independent proportions.

The z-score is 3.453.

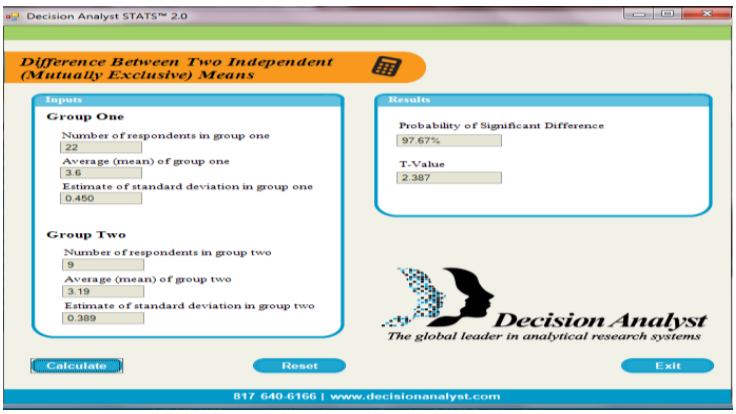

Figure 9: Difference between two independent proportions (Mutually Exclusive).

The t-score is 2.387.

The greater the magnitude of T (it can be either positive or negative), the greater the evidence *against* the null hypothesis that there is no significant difference. The closer T is to 0, the more likely there isn't a significant difference. A z-score and a t score are both used in hypothesis testing. If the sample size is above 30 [11], use the z-score provided the standard deviation is known and if not, use the t-score where there is no need to obtain the standard deviation [18].

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