GWT MEAN THEORY

William J. Grow
Gregg M. Wiersema
Dr. Elias O.A. Tembe
CIS Department
University of Dubuque
2000 University Ave.
Dubuque, IA 52001
wgrow@dbq.edu

Abstract

Knowledge is always evolving. New and innovate ideas are added into many fields of study. Deitel and Deitel (2005) cite Charles Sanders Pierce as follows: “All the evolutions we know of proceeds from the vague to the definite”. The evolution does not exclude the field of statistics. Statistics is a field of operational research (OR) technique which embraces the collection, observation, experimentation, analysis, interpretation, summarization, verification, validation, presentation of descriptive statistical data types: nominal, interval, and ratio, ordinal into inferential statistics (information) using parametric and non parametric testing techniques. The main purpose(s) of using statistics as an operational research (OR) tools are to the support of human beings in problem solving and decision making process.

This paper presents a new mathematical statistical theory known as “GWT mean theory” developed in 2005. The prefix GWT is derived and coined from the three authors of the last names. The brain children of this theory are William Joseph Grow, Gregg Matthew Wiersema and Elias O. A. Tembe at the University of Dubuque, Iowa, USA. The theory originated from the lectures and open comparative discussions in the Statistics Course: “BAC 336_ Knowledge Management: Planning, Research and Forecasting” taught be Dr. Elias O. A. Tembe. The investigation examines and compares all types of means techniques including the potential benefits and pitfalls of each mean in relation to the measurement of mathematical statistical central tendency.

The significant potential merits and demerits for GWT mean theory have been tested and modeled using software tools such as Visual programming languages and Visual Studio.NET packages. The measurement is based on feasibility study using cost benefit analysis approach with integration of using mathematical operational research techniques. The research associated with this new theory has yielded some interesting and attractive tangible and intangible preliminary results in real world application.

Introduction

In many situations to get ahead in business it is necessary to use different formulas to find common values. Doing this not only gives you a competitive advantage, but also sets you apart from your competition by letting employer know that you are a creative thinker. Using means such as the harmonic and geometric mean can give you central tendencies that are higher or lower than the average which simply takes the summation of the numbers and divides by n (n being the number of entities in the set). While this gives you an accurate measure of the center, it may not be appropriate depending on the situation.

Statement of problem

Not all types of means in statistics used in measuring central tendency have been included in mathematical statistics. The purpose of this study is to examine a new mean theory known as “GWT theory” (Coined from the Authors’ names William Joseph Grow, Gregg Matthew Wiersema and Elias O. A. Tembe) developed at the University of Dubuque in 2005.

Conceptual Framework

In computing the harmonic mean the reciprocal of the number is first taken. The next step is to find the summation of the set of numbers, and divide by n. Finally the reciprocal of this number is taken to establish slightly lower mean. This could be useful in business in many different situations. One example of the harmonic mean’s usefulness is in any sort of contracting bid; in these types of situations having the lowest numbers is essential to getting the contract, and thus you must have the lowest mean.

Another measure of central tendency is the geometric mean. This mean is slightly higher than the standard mean and is computed in a different way. A similar type of system is used to find the geometric mean; the process involves multiplying the numbers together, then taking the nth root of the product.

In learning about these different formulas for establishing these central tendencies from Dr. Elias Tembe, we noticed some similarities between the different methods. This lead us to establish our own method of calculating the mean of a set of numbers. The main tendency we noticed was that the steps involved followed a sort of ladder process (Figure: 1); doing and then undoing themselves. In doing the addition, you must do its opposite effect and divide, the reciprocal must be undone with another reciprocal, and the multiplication must be undone by the nth root of the product.

Graphical Representation of Normal Mean

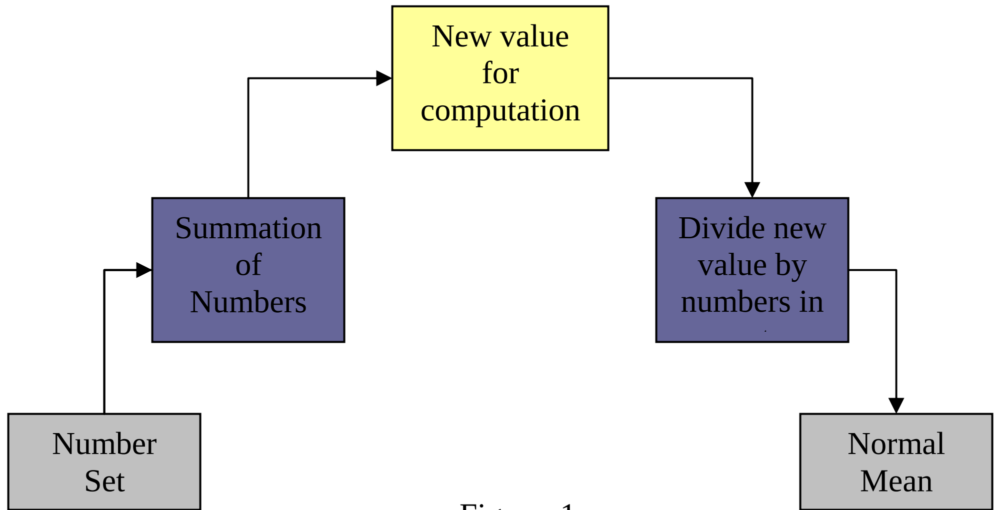

Figure: 1

In our new method of computing the mean, which we call the “GWT Mean” we incorporated different styles to establish a central tendency, while still following the ladder structure we realized was the blueprint behind the formulas.

With my programming background I felt a simple method to follow would be that of an encryption application. The idea behind encryption is basically this same ladder structure of “wrapping up” and undoing a piece of code. The idea behind encryption is to make the encapsulation side of the encryption difficult enough to hide the information well, but not so difficult that it cannot be undone. This task can become quite complicated, but if done right lead to very secure and accurate data. This accuracy was also the focus of our study.

Our hypothesis was if we followed the ladder structure above we would attain a mean accurate enough to use in a business and differing from any of the other three means we had previously discussed. There was a probability this would not be the case, and either the mean would not be close enough to the normal mean or it would be the same as one of the other three, rendering it useless. Our odds seemed to be one in three that we would get a new, accurate mean, and we set out to make our computations with some sample data.

Methodology

We decided a good place to start would be to square all of our numbers, and since no other formula had done this, we felt it would be our way of establishing a unique calculation. (Figure:2)

Sample Number	Sample Number Squared
5	25
10	100
8	64
7	49
6	36
5	25

(Figure: 2)

Our next step was to follow suit with the harmonic mean and take the reciprocal of these squared numbers. This step not only alters the numbers, but is easily undone, again following our encryption guidelines. (Figure: 3)

Sample Number Squared	Reciprocal of Sample Number Squared	Reciprocal Decimal
25	1/25	0.04
100	1/ 100	0.01
64	1/64	0.015625
49	1/49	0.020408163
36	1/36	0.027777778
25	1/25	0.04

(Figure: 3)

At the peak of our ladder we find the summation of the newly computed numbers, which starts the process of descending the ladder (Figure: 4). Upon examination, all the techniques for defining central tendency come to a climax by combining all of the data, and recess by doing the counter function to the compiled number.

Reciprocal Decimal
0.04
0.01
0.015625
0.020408163
0.027777778
0.04
0.153810941

(Figure: 4)

After reaching the peak of the formula the actions begin to be undone in reverse order. Starting with the summation, we then divide the “peak number” by n (n being the number of entities in the set). (fig 5) Doing this gets you closer to the central tendency by basically separating out the summation and undoing that action. Once you do this, and get your number in an “individual” state, you can then take the reciprocal if it and again undo another ascending action. (Figure: 6)

	Divide by n
Total =	0.153810941
n =	6
	0.025635157

(fig 5)

	Taking the reciprocal
	1
Divided Number =	0.025635157
	39.00892849

(Figure: 6)

The final step in the process is to take the square root of the last computation. (fig 7) This undoes the first step on the climbing side of the ladder. The final steps gives you an accurate mean that is slightly lower than the harmonic mean, but still close enough to the normal mean to be acceptable in business. This formula for computing the central tendency can have the same usefulness as the harmonic mean, computing a low mean, but it will give you a competitive advantage over the competition but having a slightly lower value. This could mean the statistician could get the contract he or she bid on, or had the lowest loss of profit for the year; there are many possibilities for using this form of the mean.

	Square Root of Reciprocal
Reciprocal =	39.00892849
N =	^(1/2)
	6.245712809

(Figure: 7)

Following the ladder structure the GWT mean accurately calculates the mean in a simple manner that also resembles an encryption type application. The variance in the normal mean and the GWT mean is small, displaying the accuracy of the method and verifying the formula. (Figure: 8)

Normal Mean	6.833333
GWT Mean	6.245713
Difference	0.587621

(Figure:8)

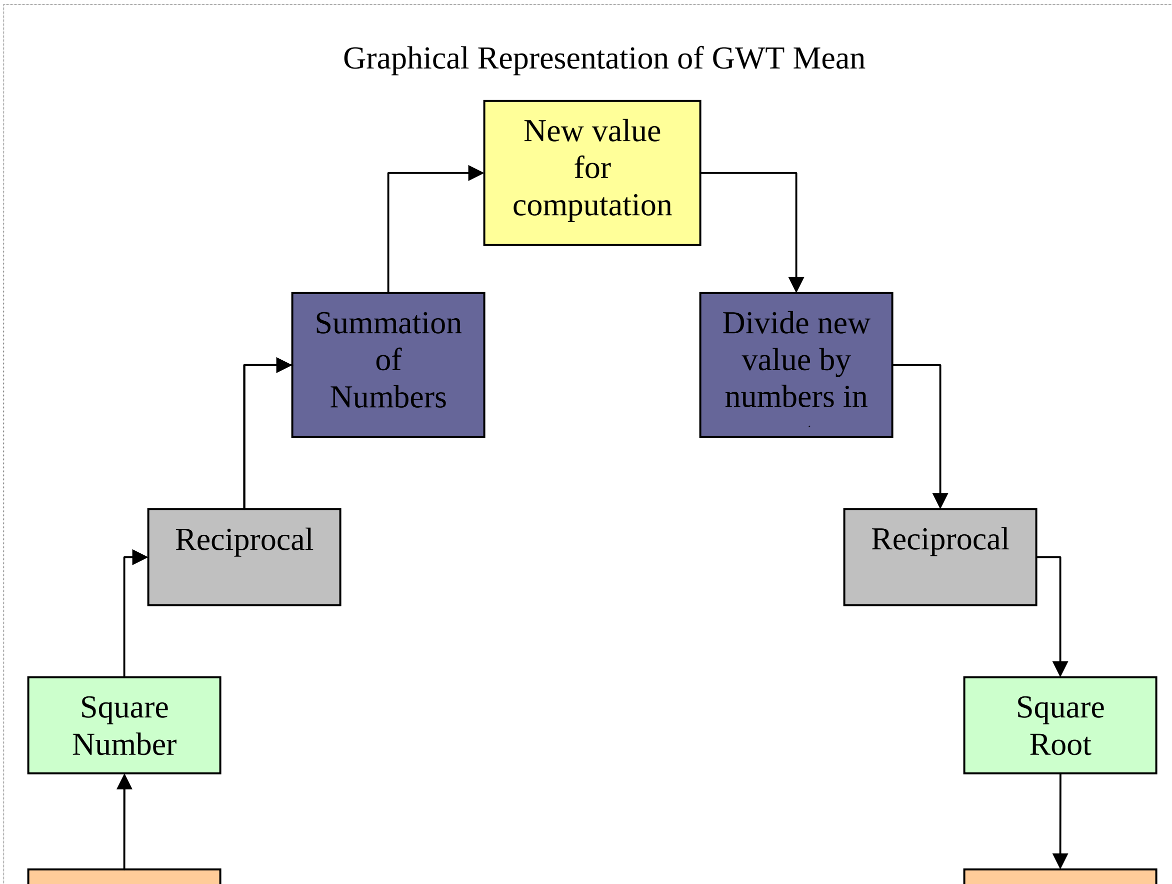

Figure: 9

Conclusion

As Figure: 9 shows, the ladder structure is an easy way to visualize the GWT mean, and will make it easier for clients of the customer to understand the meaning and equations behind the GWT means.

We have also included sample figures and statistics to show how the GWT mean can be used on an everyday basis to make businesses more money and show a favorable value in the computations of their choice. This data validates our findings and supports our hypothesis; the testing also shows the wide range of numbers the GWT mean works on. The limitations of our findings are the lack of real world testing, because we are not involved in any businesses that regularly have a need to compute a central tendency such as the GWT mean. Another limitation is the use of software, as it has not been tested in all languages. Our testing was done in Visual Studio.NET, and Excel with VBA code included. This new central tendency can be used as a conceptual framework in real world applications as a business decision making and problem solving process.

STATISTICAL DATA TO VERIFY HYPOTHESIS

GWT MEAN FORMULA:

Number	Number sqrd	Reciprocal	Reciprocal Decimal	Divide by n	Reciprocal	Sqr Root
5	25	1/25	0.04			
10	100	1/ 100	0.01			
8	64	1/64	0.015625			
7	49	1/49	0.020408163			
6	36	1/36	0.027777778			
5	25	1/25	0.04			GWT Mean
41			0.153810941	0.02563516	39.0089285	6.245712809

HARMONIC MEAN:

Number	Reciprocal	Divide by n	Reciprocal
5	0.2		
10	0.1		
8	0.125		
7	0.142857143		
6	0.166666667		
5	0.2		Harmonic Mean
41	0.93452381	0.15575397	6.420382166

DIFFERENCES:

Harmonic mean	Normal mean
GWT mean	GWT mean
6.420382166	6.833333333
6.245712809	6.245712809
0.174669357	0.587620525

NORMAL MEAN

5	Mean
10	
8	
7	
6	
5	
41	6.833333333

STATISTICAL DATA TO VERIFY HYPOTHESIS

RUNNING MEAN FORMULA:

Number	Number sqrd	Reciprocal	Reciprocal Decimal	Divide by n	Reciprocal	Sqr Root
85	7225	1/25	0.000138408			
79	6241	1/ 100	0.000160231			
75	5625	1/64	0.000177778			
57	3249	1/49	0.000307787			
67	4489	1/36	0.000222767			
88	7744	1/25	0.000129132			Running Mean
451			0.001136103	0.00018935	5281.21213	72.67194873

HARMONIC MEAN:

Number	Reciprocal	Divide by n	Reciprocal
85	0.011764706		
79	0.012658228		
75	0.013333333		
57	0.01754386		
67	0.014925373		
88	0.011363636		Harmonic Mean
451	0.081589136	0.01359819	73.53920238

DIFFERENCES:

Harmonic mean	Normal mean
Running mean	Running mean
73.53920238	75.16666667
72.67194873	72.67194873
0.867253647	2.494717932

NORMAL MEAN

85	Mean
79	
75	
57	
67	
88	
451	75.16666667

STATISTICAL DATA TO VERIFY HYPOTHESIS

RUNNING MEAN FORMULA:

Number	Number sqrd	Reciprocal	Reciprocal Decimal	Divide by n	Reciprocal	Sqr Root
199	39601	1/25	2.52519E-05			
178	31684	1/ 100	3.15617E-05			
197	38809	1/64	2.57672E-05			
167	27889	1/49	3.58564E-05			
135	18225	1/36	5.48697E-05			
99	9801	1/25	0.00010203			Running Mean
975			0.000275337	4.589E-05	21791.4537	147.6192865

HARMONIC MEAN:

Number	Reciprocal	Divide by n	Reciprocal
199	0.005025126		
178	0.005617978		
197	0.005076142		
167	0.005988024		
135	0.007407407		
99	0.01010101		Harmonic Mean
975	0.039215687	0.00653595	152.9999981

DIFFERENCES:

Harmonic mean	Normal mean
Running mean	Running mean
152.9999981	162.5
147.6192865	147.6192865
5.380711695	14.88071355

NORMAL MEAN

199	Mean
178	
197	
167	
135	
99	
975	162.5

References

Anderson, Sweeney, Williams. (2005) “An Introduction to Management Science”. Thomson Learning, Inc. USA

Black, Ken. “Business Statistics: Contemporary Decision Making 3rd Edition”. Thomson Learning, Inc Clear Lake.

Bowerman, O’connell, Orris. (2004) “Essentials of Business Statistics”. McGraw Hill. New York

Bronson, Gary J. (2002) “A first book of Java”. Thomson Learning, Inc. Pacific Grove, CA

Curwin, Slater. “Quantitative Methods for Business Decisions Fourth Edition”. Thompson Business Press. New York

Eldredge, David L.(2005) “A Microsoft Excel Companion for Business Statistics”. Thomson Learning, Inc. USA.

Farrell, Joyce.(2003) “Java Programming Second edition”. Thomson Learning, Inc Canada

Pohl, Ira. “C++ by Dissection”. Addison Wesley. Boston