The Fractal Dimension of the Levels of Depression

[1]Sandy Valmores, [2]Kristine June D. Uy, [3]Virgilio Lumayno and [4]Helmae N. Etulle

Abstract

Depression lurks in people's lives.The intensity of the feelings, causes and reactions vary from person to person.It is within this nature of depression that the study would explore the fractality of the phenomenon. The data were obtained by conducting the Goldberg Depression Inventory among a hundred young adults enrolled from each of the six colleges of the university. Findings show that most of the data do not obey normal distribution as evident in this histogram and normality tests. Hence, they were subjected to a fractal statistical analysis. Fractal dimensions and scales for each college depression scores were determined. It was found out that the level of depression among the young adults of the different colleges were leaning towards the mild level of depression. In view of the fractal dimensions, it is evident that young adults had varied coping mechanisms against depression.

Keywords: depression, levels of depression, Goldberg depression inventory, fractal approach, fractal dimensions, scales

1.0 Introduction

The world is filled with mysteries that are yet to be unfolded. Nature everything around us, the vastness of the sky, the sweet-touching breeze—the host of golden daffodils, down to the intricate lushes of the human body. Nevertheless, it remains unobtrusive simply because what is obvious is seemingly unattractive. Men get so engrossed with what is on the surface that they fail to appreciate what lies beneath. Conventional thinking stagnates us to centuries of old assumptions on various form that nature takes. However, a bold challenge comes to break the barriers, making the invisible visible. The eminent rising of a neophyte science of fractals ultimately leads us to think not of what we see but what it takes to produce what we see. To the eye everything is finite. Amazingly, fractals enlighten us that a part or piece is similar to the character as the whole. The part creates beauty to the whole. It takes endless repetition forming patterns amidst randomness, pointing similarities despite differences and investigating smoothness behind roughness. Behind all seeming abnormalities, as commonly perceived by our senses, the reality of what is normal.

It is universally established that people experience feelings of sadness and moments of lows generally characterized as episodes of depression. However, the intensity of the feelings, causes, and reactions vary from person to person. Confusion as to the nature and definition of depression is a dilemma at hand, for the fact that the term "depression" may often be used to describe moods that do not satisfy its generally accepted diagnostic. It is in this perspective that directed the paper to look at depression on a different manner through concentration on its fractal dimension. Fractal analysis can be a better tool to view depression since the varying degrees of depression are possible manifestation of the "ruggedness" of depression levels.

[1,3]College of Arts and Sciences
[2] College of commerce
[4] College of Education
University of San Jose-Recoletos

Depression is more than just a low mood. World Health Organization (WHO) defines, (as cited in Grover, 2013) depression as a common mental disorder characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness and poor concentration. At some stage in life, one may get depressed. Although the exact cause of depression may be unknown, multiple factors contribute to its development such as frustrating life events, personal factors such as family history and personality, serious medical illness and drug and alcohol use. Generally, depression stems not from a single event but from a series of untoward life experiences.

On one hand, Beck (2009) contends that depression cannot be defined only by reference to mood. Change in mood may only be one element of depression and may not, in any event always be present (Allen, 2009). Key attributes such as: (1) specific alteration in mood, whether sadness, apathy or loneliness (2) a negative self-image involving self-blame, (3) desire for self-punishment, (4) physically expressed changes such as anorexia, or insomnia and (5) changes in level of activity whether increased hyperactivity or withdrawal and inaction are specified to describe depression. Beck believed, that central to depression are the negative thoughts and not just simply hormonal changes or low rates of reinforcement as postulated by other theorists. In other words, the more negative thoughts you experience, the more depressed you will become. In validation to Beck's theory, Moilanen (1995) studied adolescent depression and found out that students' depression was often associated with dysfunctional beliefs and negative future attitudes. Gonca and Savasir (2001) posit that negative way of thinking guides one's perceptions thereby resulting to negatively based worldview leading to depression. An interesting study conducted by Lewinson, Steinmetz, Larson, and Franklin (1981) comparing Beck's theory against hopelessness theory in depression found out that under conditions of stress, a risk factor of dysfunctional attitudes prompts adolescents major depressive disorder. According to the Diagnostic and Statistical Manual of Mental Disorders, (2003), studies on major depressive disorder have reported a wide range of values for the proportion of adult population with the disorder. The point prevalence of major depressive disorder in adult community samples has varied from 5% to 9% for women and from 2% to 3% for men. These studies corroborate Beck's theory indicating that the theory has shown its usefulness in explaining and treating depression. A study conducted by Tartakovsky (2008) showed that depression and anxiety are prevalent problems in colleges across the countries. In the past 15 years, depression has doubled and suicide tripled said Jerald Kay, M.D (2006), Professor at the Wright University School of Medicine. Furthermore, Courtney Knowles (2013) of The JED Foundation, a charitable organization that aims to reduce suicide and improve mental health for college students, held that the average age of onset for many mental health conditions is the typical college age range from 18 to 24 years.

Evident in the studies are the views of depression grounded on negative thoughts and feelings affecting humanity as a whole such that it is statistically seen as a normally distributed phenomenon. Its prevalence is irrefutable among all walks of life. However, the possibility of a statistically non-normal distribution of depression is overlooked. Hence, the use of fractal statistics as a tool of measurement to ascertain the ruggedness of the phenomenon through looking into its fractal dimension is hereby explored.

Taking into account the limited existing studies in fractals, this paper will contribute to knowledge by launching in the fundamental nature of the fractal dimensions of the level of depression among young adults in universities.

2.0 Conceptual Framework

Fractals are infinitely complex patterns that are self-similar, irregular, and having several existing dimensions. It forms geometric patterns that are repeated smaller scales out of bigger scales producing irregular shapes and surfaces and creating ruggedness in a fractional dimension (Padua, 2013). Depression as a seen phenomenon in social sciences is apparently self-similar as all people experience being depressed at one point in life. Intensity of depression varies among people from highs to lows, could be high of highs and lows of lows. It is within this nature of depression that the study would explore the fractality of the phenomenon.

Owing to fractals' presence in nature, this study looks into the level of depression among six hundred young adults of the different colleges of the University of San Jose-Recoletos. The Goldberg Depression Inventory (Goldberg,1983) was utilized as an instrument to determine the level of depression. Fractal statistics is applied to determine the ruggedness of the data (Padua, 2013). The decision of the researchers to utilize fractal statistics is anchored on the premise that fractals is the science and language of nature. Depression, being a mood disorder examined in this paper in the context of human beings, is then believed to be best scrutinized under the lens of fractals.

The similarity established from the data gathered in the study will attest that fractals exist in the field of social sciences. This study is guided with the examination of depression scores from the different colleges of the university with the aim of applying fractal statistics in its analysis. Based on the results of fractal statistics, fractal segmentation is then performed. This will eventually lead the researchers to the comparative analysis of the fractal dimensions of depression.

3.0 Fractal Model and Analysis on the Fractal Dimension of Level of Depression

The data sets were subjected to fractal statistics by primarily establishing their fractal distribution. As such, histograms were made to determine the type of distribution. See Figures 1-6.

HISTOGRAM OF DEPRESSION SCORE AMONG YOUNG ADULTS OF DIFEERENT COLLEGES

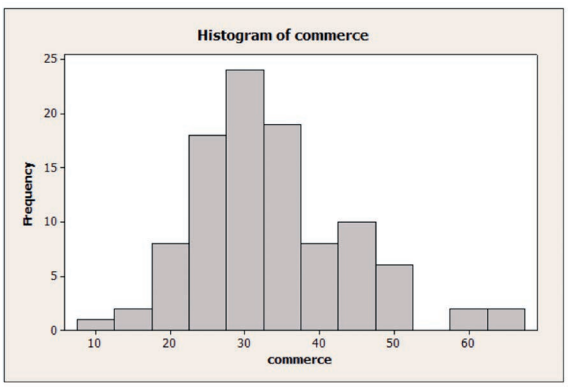

Figure 1: Histogram, Commerce

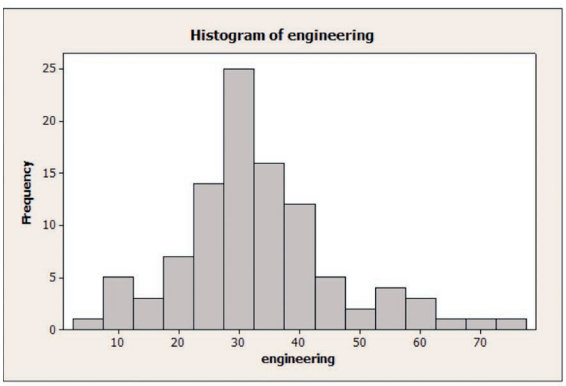

Figure 2: Histogram, Engineering

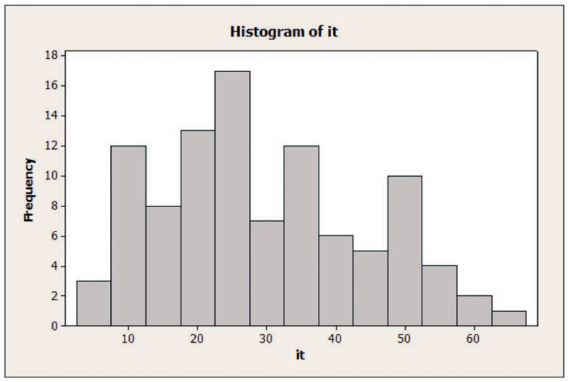

Figure 3: Histogram, IT

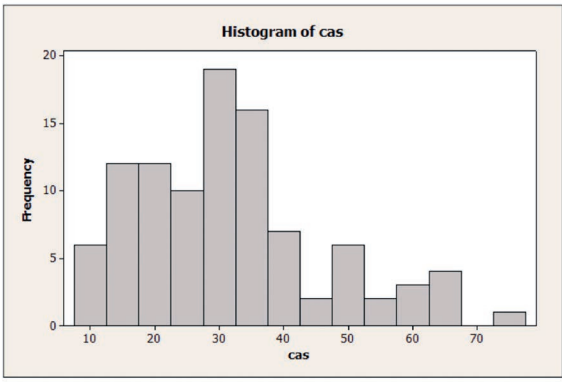

Figure 4: Histogram, CAS

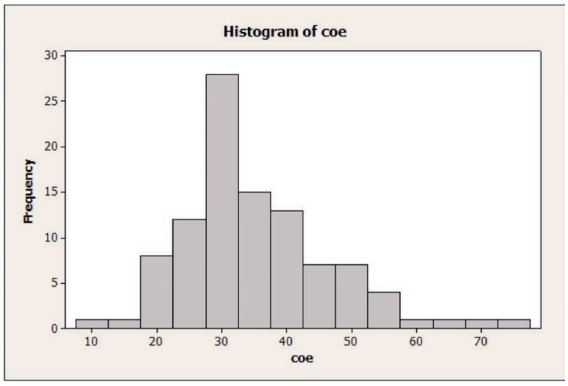

Figure 5: Histogram, COE

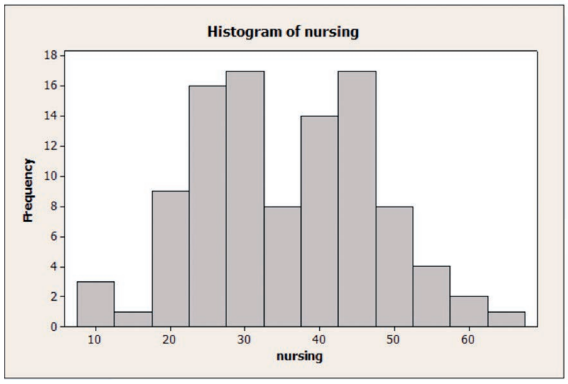

Figure 6: Histogram, Nursing

The ocular inspection of the histograms is performed in order to establish whether the data follows a normal distribution. It is to be noted that should normal distribution be exhibited, it would be appropriate to apply normal statistics rather than fractal statistics. Thus, it is critical that the researchers establish the non-normality of the depression scores. As such, on top of the generation of the histograms in Figures 1 to 6, the data were subjected to a normality test using Kolmogorov-Smirnov to formally establish non-normal distribution of data sets.

NORMALITY TEST OF DEPRESSION LEVEL

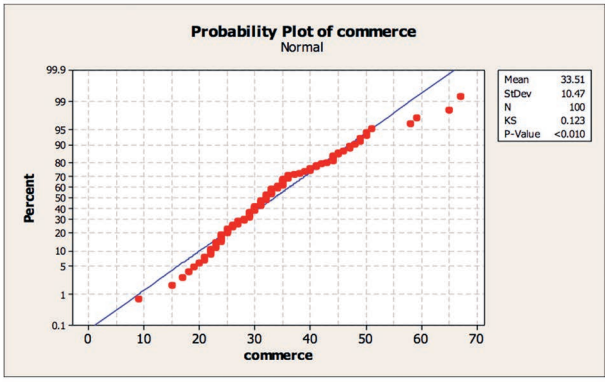

Figure 7: Normality Test, Commerce

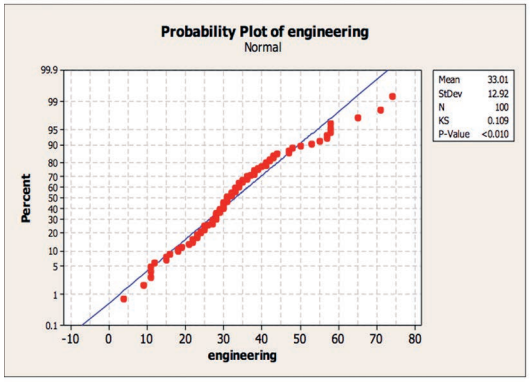

Figure 8: Normality Test, Engineering

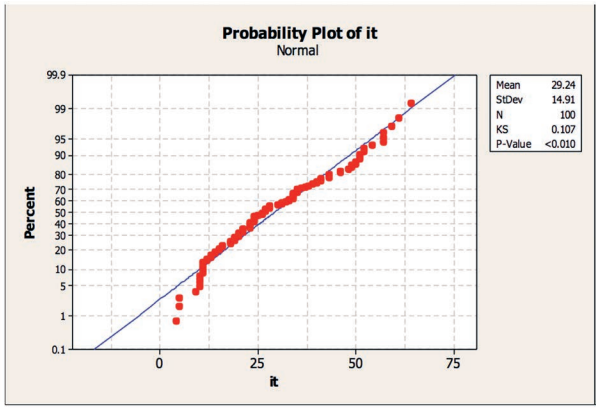

Figure 7: Normality Test, Commerce

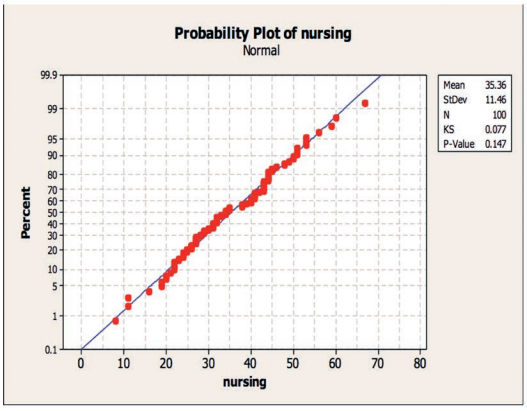

Figure 8: Normality Test, Engineering

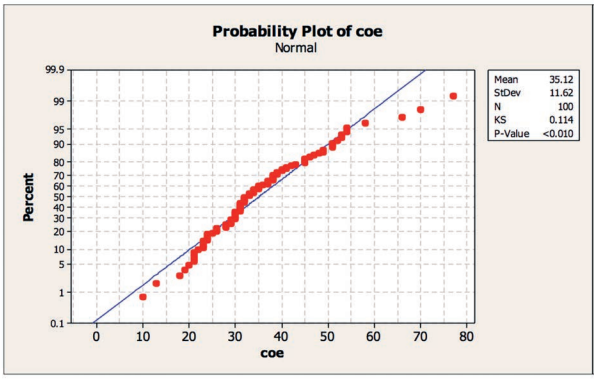

Figure 11: Normality Test, COE

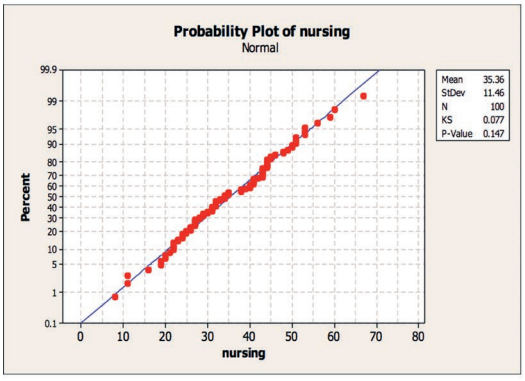

Figure 12: Normality Test, Nursing

As revealed in the histograms (see Figures 1-6) and normality test results (see Figures 7-12), it has been noted that only the data sets from the College of Nursing (see Figure 6 and Figure 12) displayed a normal distribution while the rest of the data sets from the five colleges (see Figures 1-5 and Figures 7-11) reflected significant deviations from the 45-degree lines denoting deviations from normality. These indicators then, lead the researchers to apply fractal analysis.

To proceed, with the analysis all data sets were tabulated and ranked using fractal statistics proposed by Padua (2013).

The fractal dimension (λ)was computed by means of the following formula:

$$\lambda = 1 - \frac{\log(1-\alpha)}{\log(\frac{x_i}{\theta})}$$

where: $\alpha = \frac{rank\,(x_i)}{n}$

and: $\theta = min\ \{x_1, x_2, \ldots, x_n\}$.

The computed fractal dimension (λ) is the determinant of the fractal spectrum or that which displays the variability of the different fractal dimensions within the data set. It represents the

roughness of data which means to say, that fractal dimension measures how erratic the depression levels are in a particular college. Barabat, Borres, and Salazar (2013) proposed to utilize the minimum value in the data set (λ) to serve as a powerful "microscope" that enhances the detailed picture of the observed data; thus, the value of (λ) may either be increased or decreased depending on the need to sharpen the focus on the features of the data sets.

After determining the ruggedness of data, the scale which is needed to arrive with a fractal spectrum is computed using the formula:

$$S = \frac{1}{\log(\frac{x}{\theta})}$$

Having established the fractal dimensions and scale measures, the fractal spectrum is plotted as shown in figures 13-17. The spectrum has reflected that the higher the fractal dimensions, the higher the variations from one depression level to another. This fractal spectrum allows the researchers to examine the behavior of the depression scores among the different colleges. This spectrum shall be the spring board for the fractal segmentation.

FRACTAL SPECTRUM OF DEPRESSION AMONG COLLEGES

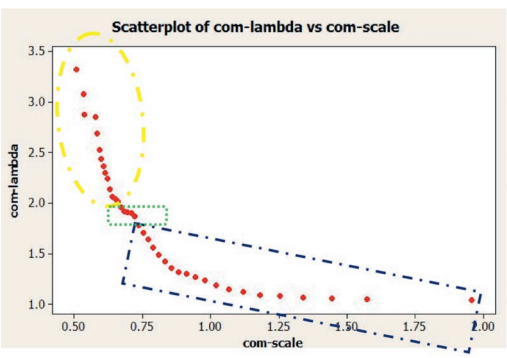

Figure 13: Commerce

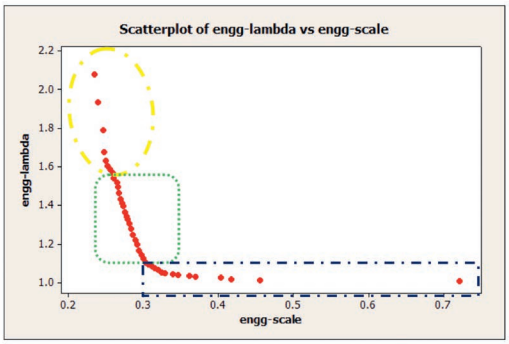

Figure 14: Engineering

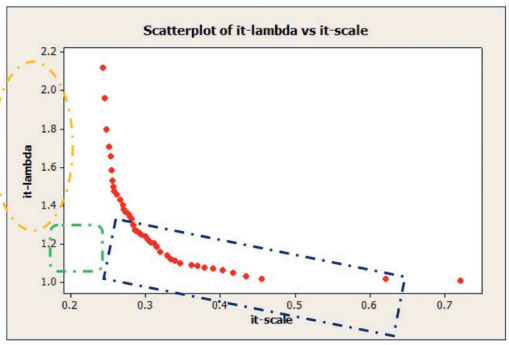

Figure 15: IT

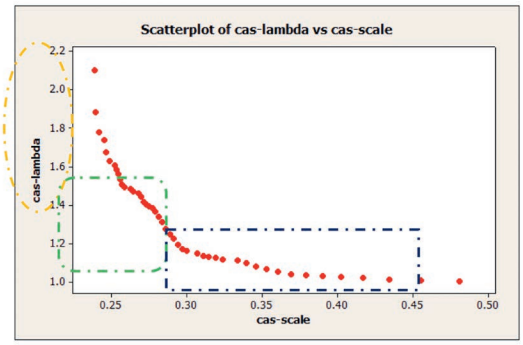

Figure 16: CAS

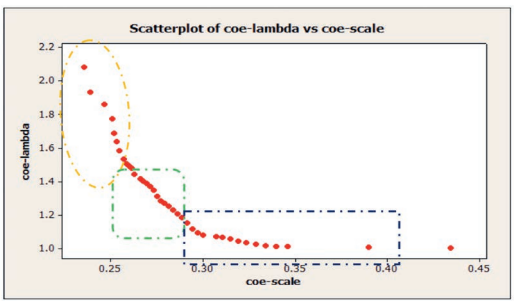

Figure 17: COE

The figures (Figure 13-17) indicated multiple fractal dimensions at the lower scale and a pattern of mono-fractality on the higher scale. Thus, there is a need to supplement this information with data segmentation. This process is performed in order to identify distinct behaviors within the each college's fractal depression behavior. Considering that one of the characteristics of a fractal is self-similarity, the segmentation of the fractal spectrum will yield to a more detailed understanding of the disparity among depression scores in the different colleges.

The data sets were divided into three scales, low, medium and high to have a closer examination of the ruggedness of data. The average value of the low and high scales was then raised to the power of the lambda in the respective scales presenting the fractal disparity within the two scales. The results of the average lambda segmentation are shown in Table 1.

Table 1: Summary of fractal segmentation

Colleges	Low		Medium		High		Disparity Value
	$\bar{x}$	λ	$\bar{x}$	λ	$\bar{x}$	λ	$\bar{x}$ ^ λ
Commerce	27.29	1.14	38	1.36	48.65	1.62	496.58
Engineering	18.81	1.05	33.57	1.26	57	1.71	984.10
CICCT	11.22	1.05	25.16	1.19	46.97	1.53	348.65
CAS	17.82	1.08	32.75	1.27	53.75	1.62	615.31
COE	21.68	1.04	33.79	1.22	52.81	1.63	618.21

The data revealed that the young adults from the College of Engineering manifested the highest disparity within the data sets. This means, then, that the College of Engineering exhibited the most varied levels of depression. There were respondents who had extremely high depression levels, but there were also respondents with extremely low depression levels. One contributing factor to this apparent observation is the customary culture of the College of Engineering. Being stereotyped as tough and loud, it is possible for students belonging to this college to repress emotions that are considered weak, thus leading them to more serious levels of depression. On the other hand, others may choose to live up to the stereotyping thus becoming more carefree and choosing not to linger on their worries.

Furthermore, the young adults from the College of Information, Communication and Computer Technology (CICCT) have the lowest disparity value. This means, then, that there is no extreme fluctuation of depression levels among CICCT students. The learners cope almost similarly to the assigned and given tasks which their specific academic requirements demand. The College of Education and the College of Arts and Sciences exhibited an almost similar disparity, suggesting that students in these colleges have similarly the same variations in the degrees of their depression scores. The College of Commerce ranked second to the CICCT in terms of disparity. The suggested lack of extreme fluctuations may be due to the fact that majority of the students in this college are enrolled in the same course (i.e. Bachelor of Science in Accountancy) and, are such, existed in more or less the same academic environment.

Based on the results, it is found out that the level of depression among the young adults of the different colleges, are leaning towards the mild level of depression. During college, students deal with a unique amount of stressors owing to significant

transition, adjustment to a bulk of requirements and projects, and exposure to a new culture. Hence, a significant change in coping must also be addressed. While coping has not been measured in this study, the researchers propose to further explore this variable in future studies.

With this seemingly obtrusive result, it can be inferred that looking into the ruggedness of data through their fractal dimensions, young adults have varied coping mechanism against stressors that results to depression. Adherent to Beck's key attributes of describing depression, these students experienced negative beliefs which affected physical, emotional and mental functioning. Feelings of worthlessness and of being a failure were the most invoked emotions of depressed people. These variables, however, are not part of this existing study and may be made the subject of further research.

4.0 Conclusion

Depression lurks into people's lives. If all individuals experience depression, the varied reactions can be investigated through fractal dimensions. Regardless of the level of depression that people go through, people's evaluation of their vulnerability to negative life events establish the difference amidst the similarities in the course of going through depression. Varied experiences in life beget different modes of depressions. Thus, behavior is more or less directly influenced by the force of environment. One's culture also enhances the modes of vulnerability to depressing events. One responds differently in a given situation. It simply entails that how abstruse the experiences of every individual, there lies beneath and behind the normality of life.

5.0 Reference

Allen, J. P. (2009). An overview of Beck's Theory of Depression in Contemporary Literature.

Barabat, E. O., Borres, M., & Salazar, R. (2013).Some Results on Multifractal Spectral Analysis.The Recoletos Journal of Higher Education, 78- 89.

Beck, A.T (2009).Depression: Clinical, experimental, and theoretical Aspect. New York: Harper and Row

Better Health Channel (2013). State Government of Victoria

Goldberg, I. K.(1993). The Goldberg Depression Inventory

Gonca; Savaşir, Işik (2001).The relationship between interpersonal schemas and depressive Symptomatology.Journal of Counseling Psychology, Vol 48(3), Jul 2001, 359-364

Grover, M. (2013).Depression Definition – What is the definition of depression? Too Depressed.Com. Depression Help Strategies

Kay, J. (2006). Essentials of Psychiatry.Chichester, John R. Wiley and Sons.

Knowles, C. (2013). The Emotional Health and Violence Connection.Stylus Publishing, Virginia.

Lewinson, P. M., Steinmetz, J. L., Larson, D. W., & Franklin, J.(1981). Depression-related cognitions: Antecedent or consequence?Journal of Abnormal Psychology, 90, 213-219.

Moilanen, D. L. (1995).Validity of Beck's cognitive theory of depression with nonreferred adolescents. Journal of Counseling & Development, 73, 438-442.

Padua, R. N. (2013, March). Data Roughness and Fractal Statistics.Cebu Normal University Journal of Higher Education. Cebu, Cebu, Philippines: Cebu Normal Press.

Tartakovsky, M. (2008). Depression and Anxiety Among College Students.Psych Central.