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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Fractal Analysis of Out-of-School Children of Primary School Age Worldwide

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ABSTRACT

This paper purported to describe the roughness of the data on Out-of-School children (OOSC) of primary school age around the world in the year 2000. A fractal analysis was conducted to determine a pattern of self-similarity, ruggedness and limitations on out-of-school children of primary school age of the different countries taken as subjects. The study covered official primary school age who are not enrolled in primary school and lower-secondary school, expressed as a percentage of the population of official primary school age in every country. The fractal dimension revealed that 7.2 percent of the countries obtained higher values of Out-of-school children of primary school age, and 92.8 percent attained lower values. This data was supported by hidden fractal dimensions where rich countries showed greater variability in out-of-school children (OOSC) of primary school age which is relatively small in thesaid year.

Keywords: fractal dimension, roughness, fractality, fractal analysis, Out-of-school children (OOSC)

Introduction

Fractal analysis is assessing fractal characteristics of data. Boeing (2016) stated that fractals exhibit similar patterns at increasingly small scales called self-similarity, also known as expanding symmetry or unfolding symmetry; if this replication is the same at every scale, Fractal geometry lies within the mathematical branch of topology. It consists of several methods to assign a fractal dimension and other fractal characteristics to a dataset which may be theoretical, or a pattern or signal extracted from phenomena including natural geometric objects, ecology and aquatic sciences, sound, market fluctuations, heart rates, frequency domain in electroencephalography signals, digital images, molecular motion, and data science. Fractal analysis is valuable in expanding our knowledge of the structure and function of various systems, and as a potential tool to mathematically assess novel areas of study.

UNESCO (2015) defined 'out-of-school' children and youth as the population between the ages of 3-25 years who do not attend schools or who have studied in schools but dropped out before completing their compulsory or basic education. This also includes handicapped children or children from families living in poverty who do not have the opportunity to attend schools. Furthermore, about 258 million children and youth are out of school, according to UIS data for the school year ending in 2018. The total includes 59 million children of primary school age, 62 million of lower secondary school age and 138 million of upper secondary age.

Albert (2012) states that the Philippines committed to Millennium Development Goals and Education for All (EFA) targets that include universal primary education. However, various data sources, including the Department of Education`s Basic Education Information System and household surveys conducted by the National Statistics Office, suggest that in 2008, a considerable magnitude of childrenwere not in school. The results of an econometric model suggest that socioeconomic characteristics as well as school resources (measured with the PTR) are determinants of nonparticipation in school. Children of poor families, with mothers that have little or no education are more likely to be OOSC. Boys are also at more at risk of nonparticipation in school (about 7 times more likely) than girls. Among primary aged children, younger children are more likely to be OOSC, while among secondary aged children, the older ones are less likely to be in school.

Vayachuta (2016) reveal that the problems of the 'out of school' children and youth include low quality of life, lack of life skills and social skills, and behavior problems. The causes are poverty, low achievement in school, and behavior issues which cause dismissal from school.

The 2013 Functional Literacy, Education and Mass Media Survey (FLEMMS) covered around 36 million population aged 6 to 24 years. According to the survey, one in every ten or about 4 million Filipino children and youth was out-of-school in 2013. Out-of-school children is defined in the FLEMMS as persons aged 6 to 14 years who are not attending school while out-of-school youth as persons aged 15 to 24 years who are not attending school, have not finished any college or post-secondary course, and are not working. The 2013 FLEMMS results also showed that of the nearly 4 million out-of-school children and youth, 22.9 percent have entered into union or marriage. Another 19.2 percent cited insufficient family income to send child to school as the reason for not attending school (this refers to all educational expenses other than tuition fee), while 19.1 percent lack the interest in attending school. Among females, 4 out of every 10 have already entered marriage while 3 in every 10 males have no interest in attending school. The proportion of out-of-school children and youth whose family income was not sufficient to send child to school was 22.7 percent and 17.0 percent, among males and females, respectively.

Methodology

This study utilized fractal statistics to measure fractal dimension which is a measure of the roughness of the data. Histograms ofthe Out-of-school children (OOSC) were determined and inspected if it is exponential and fractally distributed to establish a certain pattern or model for the phenomenal trend of Out-of-school children of primary school age worldwide.In this study, the researchers employed data from Worldbank. To determine the fractal dimension of the tabulated data set, the researcher first looked at the log x/θ, got the mean of the log x then assessed the entire ruggedness index lambda (ג) of the data. Furthermore, these formulas were used:

$$EXP\ (data/\theta) \qquad (1)$$

$$ג = 1 + 1=x \qquad (2)$$

Results and Discussion

The data presented in this section shows the exponential and fractal distribution of Out-of-school children of primary school age of the countries worldwide. Figure 1 illustrates the histogram or exponential distribution of the Out-of-school children per country in the year 2000.The graph illustrates the Out-of-school children of primary school age worldwide that appear most frequent within 0.03 to 9.48 which means that there were more countries having a lower percentage of Out-of-school children. It was observed that most of the countries had less percentage of Out-of-school children in the year 2000.The data indicates that most of the high-income countries has less percentage of Out-of-school children than those with low-income countries. High-income countries have more access to high quality basic education and resources that will somehow help to lessen the number of children to the risk of dropping out. As expected, wealthier countries and economies, and those spending more on their education systems, tend to provide better access to schooling – a key indicator of inclusion – as measured by the PISA.

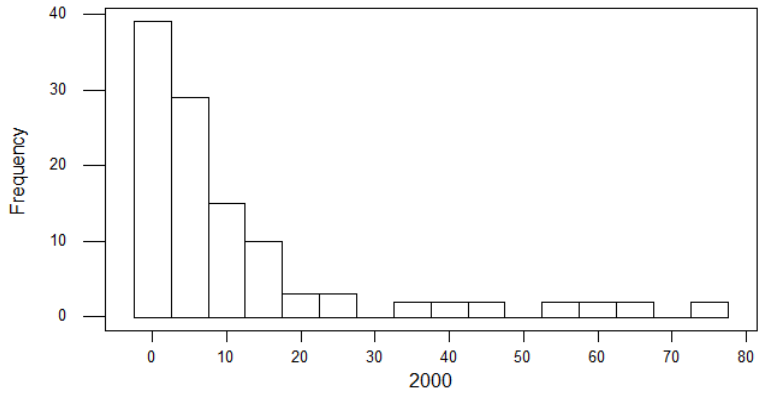

Figure 1.0 Exponential Distribution of the Out-of-school Children

Another set of data was utilized to observe the fractality in the year 2015. This figure illustrates the histogram of Out-of-school children in the year 2015 which is also exponential; therefore, the original data is fractal. The data shows the regularities in the pattern of the countries with OOSC in the year being studied. The year 2000 and 2015 was seen to havesimilarity in the distribution of OOSC in the countries identified as high-income countries like those in Europe and Northern America, but some countries in Asia were identified as higher percentage in OOSC in the year 2000 were moved to lower percentage where this country identified made some intervention for past one and half decade to lessen the number of children risk in dropping out. This was supported by UNESCO Institute for Statistics (UIS) (2018), the number of children who are excluded from education fell steadily in the decade following 2000, but UIS data show that this progress essentially stopped in recent years; the total number of out-of-schoolchildren and youth has declined by little more than 1 million per year since 2012.The decline in out-of-school rates and numbers over the past one and a half decades occurred with eduction in gender disparity at the global level.

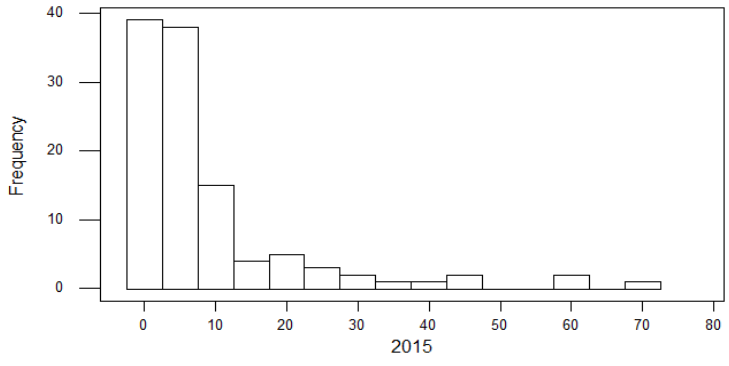

Figure 2: *2015 Out-of-school Children Worldwide*

Historically, girls and young women were more likely to be excluded from education. However globally, the gender gapamong children of primary school age dropped from more than five percentage points in 2000 to two percentage points in 2015.Evidently, this implies that OOSC is very common among the countries across the globe as demonstrated in both industrialized and less industrialized areas and further illustrates how influential and important economic advantage and some world group organizations intervention to decrease the percentage of OOSC. That the less economically advanced countries were catching up with the first-world" countries are the sign in regards to the predictability of the pattern. Therefore, the socio-economic status is the root for some other factors that affects OOSC.

The graph reveals that the data is fractal because of its one-spike graph. The histogram or fractal distribution indicates the fractal hidden dimensions of the out-of-school children of primary school age of the different countries worldwide.

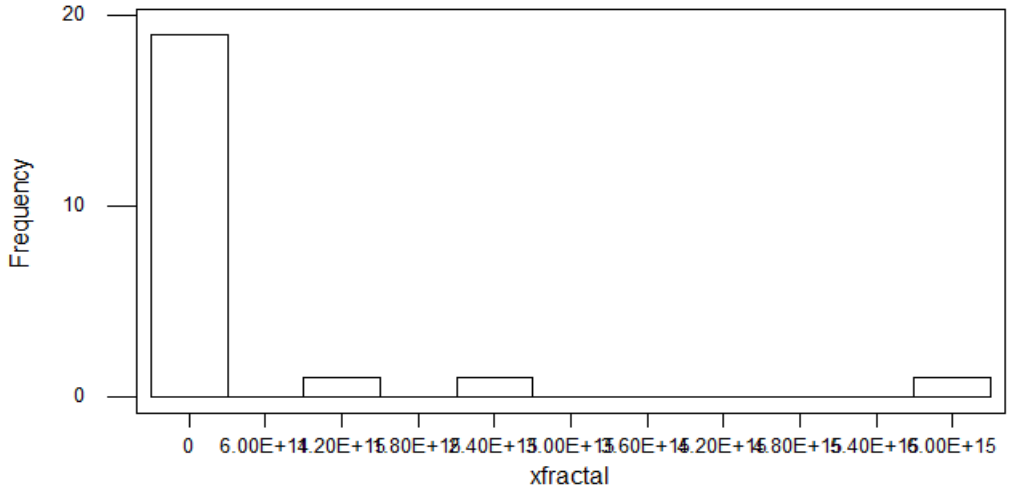

Figure 3: *shows the histogram or fractality of the data in the year 2000.*

Table 1 shows the computed values of the data set. As gleaned in the table, the OOSC in the year 2000 obtained a mean of 13.81with a minimum observation (θ) of 0.03.Moreover, the fractal dimension is1.07241which means that 7.2 percent of the countries obtained higher values of OOSC.As shown in Table 2, the values

Variable	**Mean**	**Minimum Observation (θ)**	**Lambda (ƛ)**
Out-of-school Children in the year 2000	13.81	0.03	`1.07241

Table 1: *Fractal Distributions of data (n=123)*

Table 2 shows the ranged from 0.03 to 0.25 where Japan attained the lowest rate while Ireland, Italy & Korea Republic got the highest rate of 0.25. These countries have been identified and known as high economic background. Because of their rich economies and high technologies, they very independent in dealing some of their major and minor problems in their country.

The socio-economic status of students and schools can have a powerful influence on learning outcomes. Because advantaged families are better able to enhance the effect of schooling, because students from advantaged families attend higher-quality schools, or because schools are simply better-equipped to nurture and develop young people from advantaged backgrounds, schools may sometimes reproduce existing patterns of socio-economic advantage. However, because schools are also environments that harmonize children's learning experiences, and because they can serve to channel resources towards disadvantaged children, schools can also help create a more equitable distribution of learning opportunities and outcomes (Downey and Condron, 2016). The degree to which reinforcing or compensatory mechanisms prevail depends both on the level of socio-economic inequality in a country/economy and on the characteristics of its school system.

Country	Percentage
Japan	0.03
Peru	0.05
United Kingdom	0.05
Canada	0.08
Germany	0.12
Spain	0.18
Ireland	0.25
Italy	0.25
Korea, Rep.	0.25

Table 2: *Countries with Lower Values of Out-of-school children of Primary School Age*

Table 3 shows the list of countries having high percentage values of Out-of-school children of primary school age of the different countries worldwide. As shown in Table 3, there are 9 countries or8.6 percent among 123 countries which obtained higher percentage values of OOSC.OOSC in these countries are very rampant due to financial problem and related incidence. There are a number of causes for this, including poverty (cannot afford to cover the basic needs, such as food and transportation),and unfavorable living and learning environment which interferes with their studies. The problem of children dropping out from school likely stems from economic and social reasons. These countries identified belong to sub-Saharan Africa as classified by UNESCO Institute for Statistics.

Country	Percentage
Chad	48.43
Guinea-Bissau	53.30
Guinea	55.02
Burundi	59.34
Ethiopia	59.84
Burkina Faso	63.25
Eritrea	63.74
Niger	72.62
Djibouti	74.11

Table 3: *Countries with High Values ofOut-of-school children of Primary School Age*

The countries with the highest out-of-school rates also tend to be among the poorest countries in the world. The World Bank assigns countries to four groups according to their gross national income (GNI) per capita. In low-income countries, out-of-school rates are systematically higher than in lower-middle-, upper-middle- and high-income countries. Household survey data from low- and middle-income countries consistently show that children from poor households, ethnic minorities or rural areas are significantly less likely to make the transition from primary to lower secondary school and from lower to upper secondary school, and are more likely to be delayed in their progression through the grade levels(UNESCO, 2015).In many regions, therefore, opportunities to participate in education remain unequally distributed, depending on students' socio-economic and family backgrounds.

Conclusion

UNESCOs strategies and initiative influenced the number of Out-of-school children of primary school age worldwide which also indicated and distinguished the socio-economic status of the countries tapped as respondents. UNESCOs strategies and initiative measures in both countries with lowest and highest valuesof Out-of-school children of primary school age were easily ascertained using fractal analysis. Moreover, fractal analysis, by all means is the best instrument for determining the roughness of data.

The problems that result from this are not only the problems of the dropped-out children, but they could lead to other bigger issues, such as crime and labor skills problems as well. It is to be noted, however, that this study is part of a need's analysis for the next part of the research. The information and

data collected will be carefully analyzed and then used to design a lifelong education model for the 'out-of-school' children of primary school age. This process will be done

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