Using Regression Analysis to Forecast the Factors Affecting the Enrollment of a Tertiary School

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ABSTRACT

The development of the enrollment forecast was done using three models: the logit model (for demographic profile), the percentage, base and rate concepts (for price), and Markov analysis (for quality and convenience). The variables and the relationships among them were analyzed using the models. Enrollment forecast, based from the mathematical models, revealed that males are less likely to attend school by 23% than females. As they grow older the likelihood of attending school also decreases by 57.5%. With regards to age, results of the study shows that for every one year increase in the age, the likelihood of attending school decreases by 27.5%, and it even decreases further by 57 percent as they grow older. In terms of per capita income and remittance, as their values increases the probability/likelihood to pay tuition fee higher than the suggested tuition fee of the region (P29,579.00) increases.

Keywords: models, enrollment, forecast, Markov analysis, logit model

I. INTRODUCTION

Education plays a vital role in the development of an individual, especially in the developing country like the Philippines. Government measures are put up to cover education programs for the purpose of social mobility. To achieve a good socio economic standing in society, families aspire to send their children to college to finish a degree of their choice. The universities and colleges, on this part, establish policies and measures to cater to the needs of the government in producing well – rounded individual to face the challenge of the real world. In spite of these collaborative efforts of the government, families and universities, statistics show that not all students who started the primary schools reach college, studies show that out of the ten students who entered primary education, only six finished their high school and out of these six, only four goes to college.

This fact is not brought by the lack of the educational institution. Contrarily, according to National Statistics Office (NSO), there are an increasing number of schools in the country including in the tertiary level. However, school enrollment in tertiary education as reported by the Commission on Higher Education (CHED) has not been encouraging as it slowed down from 1999 to 2002, and then dropped gradually starting 2002 to 2003, with negative 0.8 percent growth in 2004-2005 for both public and private schools. Except for the big jump in 1998-1999, enrollment has been sliding down, thereafter. And, tertiary education enrollment even in public schools shows a decelerating trend, weakening to negative 1.2 percent growth in 2004-2005, despite the lower cost of public education. In the case of private schools, the decline started as early as 2002. [5]. It has been observed that the number of enrollees is not correlated with the number of schools. As the number of schools is constantly increasing, the enrollment in the country is unstable. There could be different factors that affect the enrolment of the tertiary level.

To understand these factors and predict the enrolment, it is but necessary to use appropriate method – mathematical form that will forecast the enrollment and serve as a guide for the tertiary schools. Forecasting is an effective tool in planning and making decision. It uses quantitative approach in mathematics.

Mathematics is often defined as the study of quantity, magnitude, and relations of numbers or symbols. It embraces the subjects of arithmetic, geometry, algebra, calculus, probability, statistics, and many other special areas of research. [2] In addition, mathematics is undeniably plays a vital role in the completion and success of any undertakings. From planning, implementation, evaluation and live operations and up to future planning of the project, mathematics is proven to be useful and visible (Dangelmayr, 2005).

Researches, experiments, innovations and the advances that people are experiencing at present are made possible with the aid of mathematics.

Mathematical models are of great help to clearly understand complicated things in mathematics. A mathematical model usually describes a system by a set of variables and a set of equations that establish relationships between the variables. The values of the variables can be practically anything; real or integer numbers, boolean values or strings, for example. The variables represent some properties of the system, for example, measured system outputs often in the form of signals, timing data, counters, event occurrence. The actual model is the set of functions that describe the relations between the different variables (Word IQ.com).

In addition, Abrams (2001), mathematical modeling is a representation of a particular phenomenon using structures such as graphs, equations and algorithms. It is develop through

a series of procedures and that one's knowledge, skills and expertise will be challenged. In addition, Abrams (2001), also mentioned that through this mathematical modeling one is exposed to the breadth, depth, utility and beauty of mathematics and train them to be able to use mathematics in a new and fruitful ways. Identifying variables, creating representations, working those abstractions to generate new information, and determining the significance of that information would lead them to develop a mathematical modeling (Abrams, 2010).

Manski and Wise study, found out that the financial aid can be an important determinant of postsecondary school attendance using a conditional logit model (Fuller & Manski, 2012).

A multivariate framework was also introduced in the archived presented in the MATHTHECH, INC. to examine the effect of each variable on the postsecondary education (PSE) attendance, holding all other factors constant. The probability that an individual attends postsecondary education (PSE) attendance is,

$$\Pr(PSE \mid x_t) = \frac{e^{B'X}}{1 + e^{B'X}}$$

Exponential Smoothing model in the book of Wilson, was written in the following manner:

$$F_{t+1} = \alpha X_t + (1- \alpha) F_t$$

Where: F_{t+1} - forecast value for period *t + 1*

In using this equation the forecaster does not need to deal with every actual past value at every step; only the exponentially smoothed value for the last period and the actual value for this period is necessary (Hilson & Keatng, 2007).

From the preceding discussions, various studies showed that there are several approaches in determining the factors affecting enrollment. In this study, the researcher focuses on the applications of mathematical concepts in developing a mathematical model related to it. Mathematical modeling is the process of constructing mathematical objects whose behaviors or properties correspond in some way to a particular real – world system. In this description, a mathematical object is a system of equations, an algebraic structure, an algorithm, or even a set of numbers. The term real–world system refers to a social system and other system whose behaviors can be observed (Edwards, 2000).

In the light of the foregoing, the researcher who has been teaching in the tertiary level as a Math Instructor for many years, gets inspired and attempted to study and explore the various mathematical concepts in developing a model to help others discover and utilize it in a more meaningful way.

The paper is considered to be necessary to increase the people's awareness on the use and applications of mathematical concepts particularly in the area of statistics. Moreover, it will be of great help in realizing the wider connections of mathematics to create and develop a useful tool in analyzing situations in mathematical form helpful in accomplishing one's mission.

In this equation, x_t is a vector of the characteristics of the person making of the choice (Projections of Education Statistics, 2012).

Another method utilized by the National Center for Education Statistics (NCES) was exponential smoothing to predict elementary and secondary enrollments, high school graduates, as well as the enrollments and degrees conferred at the post secondary level. Single exponential smoothing was used in developing projections of elementary and secondary enrollments. The rate at which students progress from one particular grade to the next (e.g., from grade 2 to grade 3) was projected using single exponential smoothing. Thus, this percentage was assumed to be constant over the forecast period.

In general, exponential smoothing places more weight on recent observations than on earlier ones. The weights for observations decrease exponentially as one moves further into the past. As a result, the older data have less influence on the projections. The rate at which the weights of older observations decrease is determined by the smoothing constant (MATHTECH, 2012).

α - smoothing constant ($0 < \alpha < 1$)
X_t - actual value now (in period t)
F_t - forecast (i.e., smoothed) value for a period t

The results of this research will be of great help to mathematics professors, instructors and teachers and particularly to the students. This could be a guide and a resource of instructions and motivations of instruction.

To clarify, the paper would like to target two issues: 1) To address one of the issues related to education that is to help administrators forecast enrollment particularly in the tertiary level and, 2) to show applications of regression analysis in forecasting to demonstrate rich application of mathematical concepts. It is not absolutely formulas and rigorous computations, there is beauty in it. Using regression analysis can be an effective tool to forecast the enrollment of a tertiary level. There is much more that mathematics could offer. And with that math phobia and math anxiety can be eliminated and it will be more appreciated.

II. OBJECTIVES OF THE STUDY

The research is limited to the development of the three models on enrollment forecast namely: the logit model (for demographic profile), the percentage, base and rate concepts (for price), and Markov analysis (for quality and convenience). However, it did not include the development of model that would encompass the said three models.

Specifically, the researcher aimed to present the variables to develop mathematical modeling; analyze relationship of variables related to enrollment in the tertiary level; develop mathematical models on the enrollment of the tertiary level in terms of percentage, base and rate concepts (for price), markov

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analysis (for quality and convenience), and logit model (for demographic profile); and synthesize the three developed mathematical models to forecast enrollment.

Research Framework

Process on How to Develop a Mathematical Modeling

Mathematical models are of great help to clearly understand complicated things in mathematics. A mathematical model usually describes a system by a set of variables and a set of equations that establish relationships between the variables. The values of the variables can be practically anything; real or integer numbers, boolean values or strings, for example. The variables represent some properties of the system, for example, measured system outputs often in the form of signals, timing data, counters, event occurrence. The actual model is the set of functions that describe the relations between the different variables (Word IQ.com, 2011).

In addition, Abrams (2001), mathematical modeling is a representation of a particular phenomenon using structures such as graphs, equations and algorithms. It is develop through a series of procedures and that one's knowledge, skills and expertise will be challenged. In addition, Abrams (2001), also mentioned that through this mathematical modeling one is exposed to the breadth, depth, utility and beauty of mathematics and train them to be able to use mathematics in a new and fruitful ways. Identifying variables, creating representations, working those abstractions to generate new information, and determining the significance of that information would lead them to develop a mathematical modeling.

The researcher used the Input-Process-Output diagram to develop mathematical models related to the enrollment in the tertiary level (Figure 1).

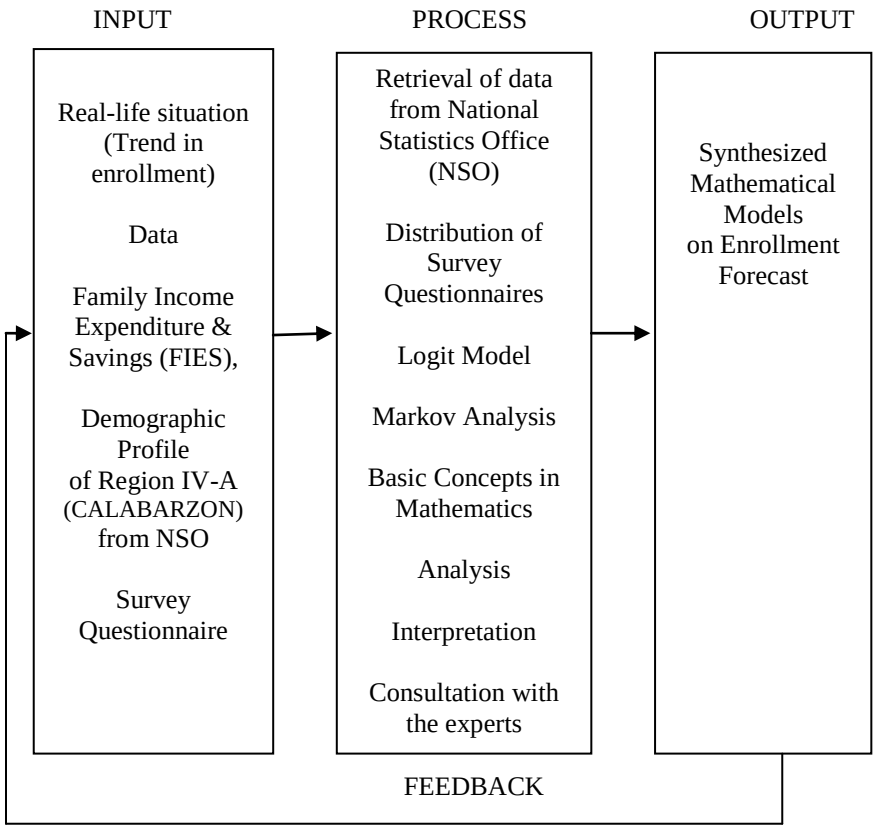

Figure 1. Mathematical Modeling Process

The researcher is interested on the trend of enrollment in the tertiary level. Data gathered/retrieved from National Statistics Office (NSO) particularly on the demographic profile of Region IV-A (CALABARZON) and survey questionnaires were the inputs of the model.

The process done was the analysis and interpretation of the gathered data related to enrollment using logit model, markov analysis and the fundamental concepts in mathematics. Consultation with the experts was also part in the process.

The output of the process was the synthesis of the three developed mathematical models in terms of the likelihood of

the demographic profile of Region IV-A (CALABARZON) to enrollment, suggested average amount of tuition fee in Region IV-A (CALABARZON) based on the average annual income of the Region and the probability contribution of the two features of tertiary schools (quality and convenience) to enrollment.

Feedback was done to address the real-life situation (trend on enrollment) based on the developed mathematical models.

III. Methodology

The paper utilized a combination of applied and expository research. It was done by applying concepts in statistics, economics and other field of mathematics in developing mathematical models related to enrollment. Stata was utilized to develop statistical results that determine the likelihood of increase / decrease of variables such as gender, age, per capita income, family size and remittance that of the enrollment. Analysis of data was done to determine the likelihood of those variables from the Poverty Indicators Survey 2007 in Region IV-A (CALABARZON). Thus, mathematical modeling was developed using logit model. Other computations using basic concepts in mathematics (percentage, base and rate) and markov analysis were utilized to show the relationship of tuition fee to enrollment, quality and convenience that the school could offer to enrollment. In order to clarify some concepts regarding the research study, experts in the fields of education, mathematics and economics were consulted. Electronic resources were also utilized aside from the books related to the topic.

IV. Results and Discussion

Variables Related to Enrollment in the Tertiary Level.

The average annual Family Income Expenditure and Savings (FIES) in Region IV-A (CALABARZON) is shown in Table 1.

Table 1
Average Annual Family Income Expenditure and Savings (FIES) in Region IV-A (CALABARZON)

Year	Income	Expenditure	Saving
2000	P179,000	P150,000	P29,000
2003	P184,000	P158,000	26,000
2006	P210,000	P186,000	23,000
2009	P249,000	P213,000	36,000

Source: National Statistics Office (NSO)

This study also considered the graphical presentation of Table 1, to clearly understand the figures presented. Figure 2 shows the distribution of Family Income Expenditure and Savings (FIES) in Region IV–A (CALABARZON).

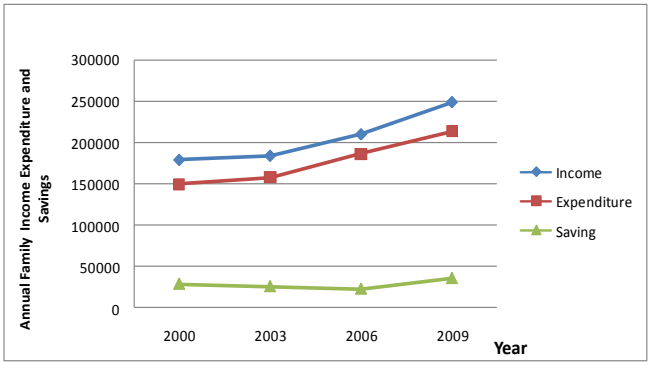

Figure 2. Distribution of Family Income Expenditure and Savings (FIES) in Region IV–A (CALABARZON)

The study was interested on the amount allocated for education. The following information presented the education expense.

Education Expense:

- Education accounts for 4.0% of family expenditures (National average)
- Regions with higher portions given to education:
  NCR – 23.8%
  Region IV-A (CALABARZON) – 17.1%
  Central Luzon – 12.3%

(Family Income and Expenditure Survey Final Results from NSO)

Based on the Theory on Investment in Human Capital by Gary Becker, one of the factors that affect enrollment is the average wages that can be represented by the annual family income from Table 1. It can be gleaned from Table 1 that the latest result of the family's annual income is P249,000; while the amount of expenditure is P213,000. Out of this amount, 17.1% allocated for education.

How much is the amount spent for education?
Using the percentage, base and rate concepts:

Let p – percentage amount spent for education
r - percent allocated for education
b – base or total annual income

Therefore, the equation that represents the amount spent for education will be: $p = b \cdot r$
Solving for p: given r = 17.1% b = P249,000

$p = b \cdot r$
$= 0.171$ (P249,000)
p = P42,579

Thus, the amount allocated per year is P42,579 given 17.1% allocated for education and with the average annual income of P249,000.

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The breakdown of 17.1% allocated for education is given in Figure 3 below.

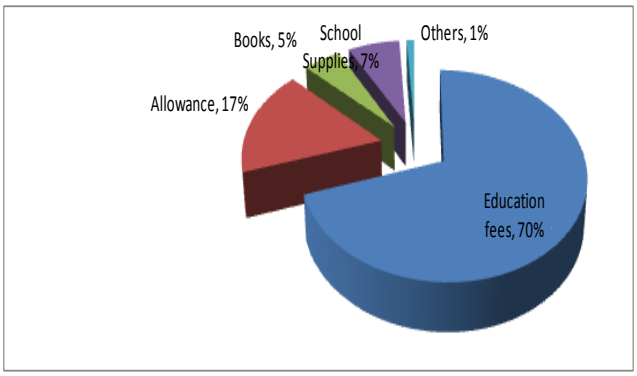

Figure 3. Distribution of Education Expenditure

Given, P42,579 allocated amount for education annually, how much should be the tuition fee (education fee in the Figure 3) of schools to meet the average income of the of the region to increase the enrollment?

Using the percentage, base and rate concept again:
Let p – suggested/affordable tuition fee of the region based from average family income
r – percent allocated for tuition fee
b – total amount spent for education
Solution:
Given: r = 70% b = P42,579
p = b • r
= P42,579 (0.70)
= P29,579.00

Thus, the affordable amount of tuition fee of the region per year is P29,579 based from the region's average annual income of P249,000. The expected number of population belongs to this income range has 46.59% based from Table 2 below.

Table 2
Number of Families by Income Class in Region IV–A (CALBARZON)

Income	Under P40,000	P40,000 to P59,999	P60,000 to P99,999	P100,000 to P249,999	P250,000 and above
No. of Families	1.41%	3.70%	15.37%	46.59%	32.92%

Source: National Statistics Office

Table 2 shows that majority of the Region's family income ranges from P100,000 to P249,999 with around 47%; followed by the income range of P250,000 and above with around 33%; and the least has only around 1% which has an income range of under P40,000.

Table 3 in the next page presents the six neighbor schools in Batangas and Laguna and the estimated amount of their tuition fee per school year and the required annual income of the family, to determine if their tuition fee fall within the computed affordable tuition fee per year (P29,579.00) of the Region.

Table 3
Six Neighbor Schools in Batangas and Laguna and the Estimated Amount of Their Tuition Fee per School Year and Required Annual Income of the Family

Six neighbor schools in Laguna and Batangas	Estimated Amount of Tuition Fee Per Year	Required Annual Income
A	P40,000	P334,169
B	P50,000	P417,711
C	P58,000	P484,545
D	P62,000	P517,962
E	P68,000	P568,087
F	P76,000	P634,921

Based from Table 3, no one among the six neighbor schools in Batangas and Laguna fall within the average annual income of the Region, P249,000. Therefore, the target market of the six neighbor schools are the families whose income is P250,000 and above which comprise the 33% of the total population of Region IV-A (CALABARZON) based from Table 2.

The graphical presentation of six neighbor schools in Batangas and Laguna and the estimated amount of their tuition fee per school year and required annual income of the family can be seen in Figure 4.

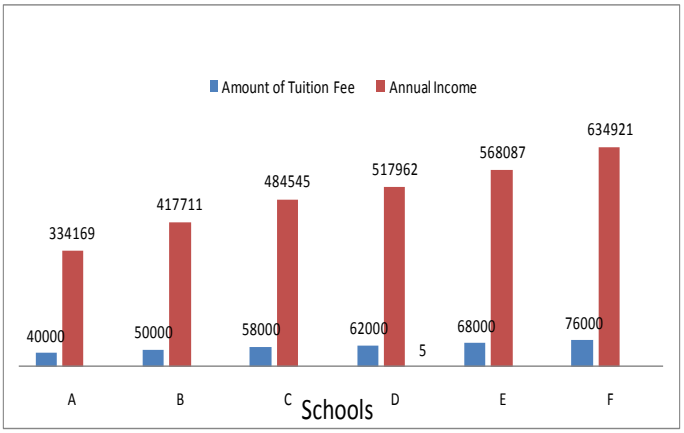

Figure 4. Distribution of Estimated Amount of Tuition Fee per Year and the Required Amount of Income Annually of the Six Neighbor Schools in Batangas and Laguna

Relationships of the Variables

How these six schools and other schools in Region IV-A (CALABARZON) offering higher tuition fee than the

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suggested tuition fee per year (P29,579) will compete in enrollment by considering other features of school?

Markov analysis is an effective tool/technique that deals with the probabilities of future occurrences by analyzing presently known variables. The techniques has numerous applications like in university predictions enrollment (Render, 2007).

Let us consider that a student will enroll based on two states.

State 1 – quality of the school

State 2 – convenience of the school is offering

Based from the result of the survey conducted to randomly selected 4th year high school students in Batangas, Laguna and Quezon, values of Pij were determined.

Let P_{ij} - conditional probability of being in state j in the future given the current state of i.

Let P - matrix of transition probabilities

$$P = \begin{vmatrix} P_{11} & P_{12} & P_{13} \dots P_{1n} \\ P_{21} & P_{22} & P_{23} \dots P_{2n} \\ P_{m1} & \dots. & P_{mn} \end{vmatrix}$$

The matrix of transition probabilities for enrollment by considering the quality and convenience of the school is shown below:

$$P = \begin{vmatrix} 0.94 & 0.06 \\ 0.12 & 0.88 \end{vmatrix}$$

Where:

P_{11} – 0.94 probability that a student will enroll by considering quality

P_{12} – 0.06 probability that a student will not enroll by considering quality

P_{21} – 0.12 probability that a student will not enroll by considering convenience

P_{22} – 0.88 probability that a student will enroll by considering convenience

After the states have been identified, the next step is to determine the probability that the system is in this state. Such information is then placed a vector of state of probabilities.

π (i) = vector of state of probabilities for period i

$= (\pi_1, \pi_2, \pi_3, \dots, \pi_n)$

In the study π_1 represents the probability that a potential student will enroll by considering the quality of the school and π_2, represents the probability that a potential student will enroll by considering the convenience the school is offering.

The tree diagram showing that a student would enroll by considering the two variables, quality and convenience of the school is shown below:

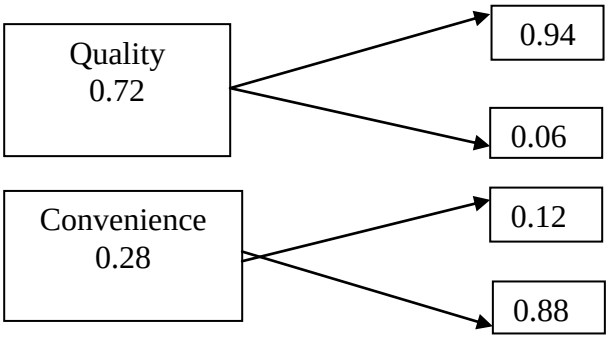

Figure 5. Tree Diagram for the Two School Features in Considering a School to Enroll

Thus, the probability matrix is shown below:

$$P = (0.72, 0.28)\begin{bmatrix} 0.94 & 0.06 \\ 0.12 & 0.88 \end{bmatrix}$$

$= [(0.72)(0.94)+(0.28)(0.12),\ (0.72)(0.06) + (0.28)(0.88)]$

$= (0.71, 0.29)$

This means that there is a probability of 0.71 or 71% that a student will enroll by considering the quality of the school and 0.29 or 29% chance that he will enroll by considering the convenience of school is offering.

Another model that considered the demographic profile, Region IV-A (CALABARZON) to enrollment is by using the logit model, a model described by (Wooldridge, 2002), for binary response where the response probability is the logit function evaluated at linear function of the explanatory variables. In addition, it is used to test the likelihood of a certain probabilistic observation with a possession of a characteristic (Wooldridge, 2002).

The estimated coefficients for the explanatory/independent variables are estimated using either the odds value or the logit value as the dependent measures. Each of these model formulations is shown below:

$$Odds = [[prob]_i event/(1 - \square prob\square_i event)] = e^{\dagger(''} 0 + (_i 1\, x_i 1 + \dots + k(_i k\, x_i k)$$
$$0 + (_1 x_1 + \dots + k(_k x_k$$

Both model formulations are equivalent, whichever is chosen affects how the coefficients are estimated. The present study used the logit model in a form:

$$P\ (\ y = 1 \mid x\ ) = (\beta_o + \beta_1 x_1 + \dots + \beta_k\, x_k\ )$$

Where, y is the dependent β_o is called the "intercept" and the β_1, β_2, β_3 , and so on, are called the "regression coefficients" of x_1, x_2, x_3, respectively. Each of the regression coefficients describes the size of the contribution of that risk factor. A positive regression coefficient means that the explanatory variable increases the probability of the outcome,

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while a negative coefficient means that the variable decreases the probability of that outcome; a large regression coefficient means that the risk factor strongly influences the probability of that outcome, while a near-zero regression coefficient means that risk factor has little influence on the probability of that outcome. [3].

Simple derivation:
By the definition of the "logit" as ln(odds),

$$where\ odds = \frac{p}{1-p} \quad , \qquad log[p(x)] = \ln\frac{p(x)}{1-p(x)}$$

$$p(x) = \frac{\frac{1}{1 + e-((o + (1x1)}}{\frac{e-((o + (1x1)}{1 + e-((o + (1x1)}} = \frac{1}{e-((o + (1x1)} =$$

$$y = \ln\frac{p}{1-p} = \ln(e\ (o + (1x1) = (o + (1x1$$

Then,

log y = logit [p(x)] = $\beta_o + \beta_1 x_1$, comes from $prob_{event} = e^{\beta o + \beta 1\ x1}$

In this study, the response probability (y) is "attend school" and the explanatory variables are: sex, age, per capita income, family size and remittance.

It can be gleaned from the Table 4 that a male within 5 to 25 year old bracket is 17 percent less likely than females to attend school, while adults in the 15 to 25 age bracket is 23 percent more likely to do so. This is because of the high likelihood of males to work than females as they grow older. In terms of age, for every one year increase in the age, the likelihood of attending school becomes lower by 27.5%, but for adults 15 to 25 decreases further by 57 percent. On the other hand, a one – peso increase in the person household income, household increases the likelihood by around 7.22e-06 (0.00000722), however, when they get older the probability increases further at 9.75e-06 (0.00000975). In terms of family size, for every one person in the family size the likelihood of attending school decreases by 5.54 percent regardless of the age range. Lastly, for remittance, if a household receives at least P1,000, the likelihood increase of attending school increases by around 35% up to around 58%.

Table 4
Result of the Likelihood of the Demographic Profile of Region IV-A CALABARZON – A using STATA.

Variables	G1 (Attend)	G2 (Attend)	G3 (Attend)	G4 (Attend)
Sex	-0.170*** (0.0204)	-0.170*** (0.0605)	-0.234** (0.0930)	-0.230** (0.0932)
Age	-0.274*** (0.00871)	-0.275*** (0.00873)	-0.572*** (0.0208)	-0.575*** (0.0210)
Per capita income	7.22e-06*** (1.10e-06)	7.21e-06*** (1.13e-06)	1.01e05*** (1.67e-06)	9.75e06*** (1.68e-06)
Family size	-0.0554*** (0.0153)	-0.0547*** (0.0154)	-0.0559** (0.0240)	-0.0576** (0.0241)
Remittance	0.343*** (0.0719)	0.353*** (0.0721)	0.588*** (0.110)	0.579*** (0.110)
Constant	4.808*** (0.180)	4.869*** (0.198)	10.05*** (0.413)	10.17*** (0.438)
Observations	7,657	7,657	3,604	3,604

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

G1& G2 (age range: 5 – 25 years old); G2 & G4 (age range: 15 – 25 years old)

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Mathematical Modeling Related to Tertiary Enrollment

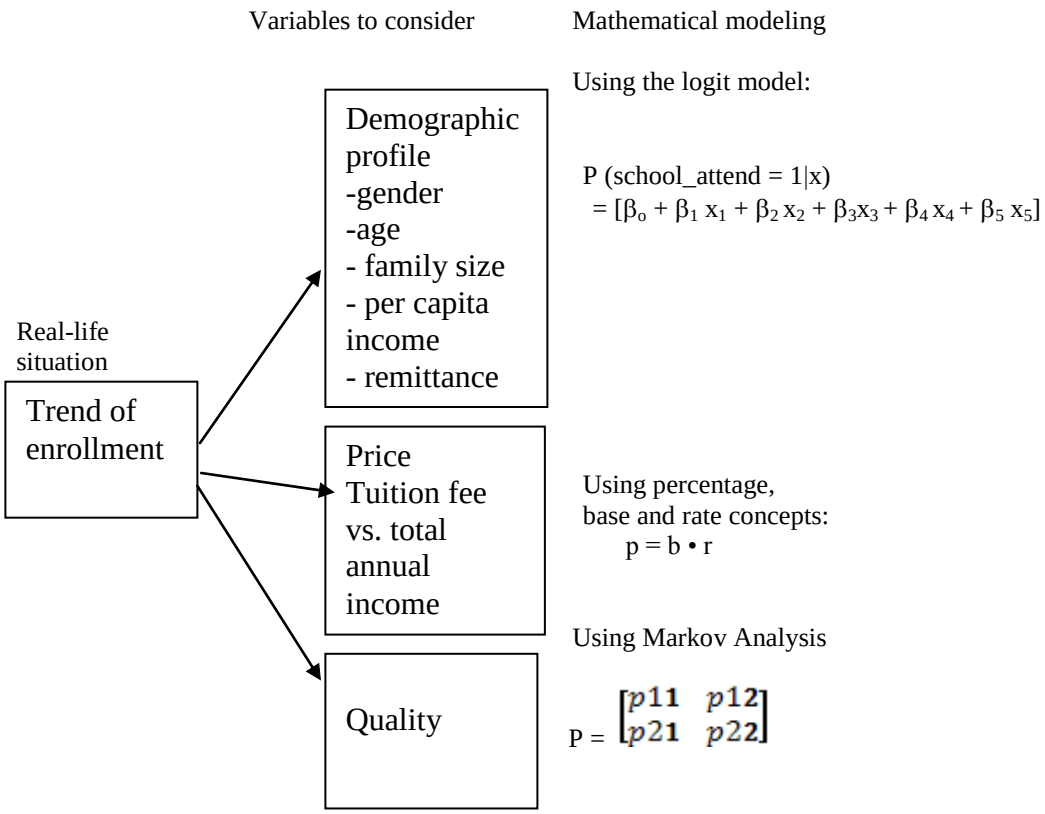

Figure 6. Diagram on How Mathematical Models were Developed

By applying the process of developing a mathematical model, the trend of enrollment represents the real – world situation. Different variables are to be considered such as the likelihood of the demographic profile to enrollment, affordable tuition fee based on the annual income of the region, and other features of school such as the quality and convenience in relation to enrollment. An application of the mathematical models to real-world situation was done to determine the likelihood of enrollment.

For demographic profile, logit model was utilized. The model is as follows:
Logit (school_attend = 1|x)
= [10.17 - 0.23x_1 - 0.575x_2 + 9.75e-06x_3 - 0.0576x_4 + 0.519x_5]

x_1 - likelihood that in terms of gender enrollment will increase/decrease
x_2 - likelihood that in terms of age enrollment will increase/decrease
x_3 - likelihood that in terms of per capita income enrollment will increase/decrease
x_4 - likelihood that in terms of family size enrollment will increase/decrease
x_5 - likelihood that in terms of remittance enrollment will increase/decrease

Price (tuition fee versus total annual income)
Using the percentage, base and rate concept:
Let p - amount spent for education
r - percent allocated for education
b - base total annual income

Then, for the suggested/affordable tuition fee of the region based from the amount spent for education of the Region
Let p - suggested/affordable tuition fee of the region based from the amount spent for education of the Region
r – percent allocated for tuition fee
b – total amount spent for education
Thus, the equation used was: p = b • r

Using the model the computed amount spent for education was P42,579.00; and out of this amount, P29,579.00 was allocated for tuition fee based on the Region IV-A (CALABARZON) annual income.

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Therefore, the affordable amount of tuition fee per year is P29,579 based on the total annual income of CALABARZON IV – A of P249,000.

For the other features of school (quality and convenience) and their probability contribution to enrollment, Markov analysis was utilized. P = (0.71, 0.29) 71% for the quality and 29% for convenience to the school.

Synthesis of the Developed Mathematical Models on Enrollment Forecast

As shown in Figure 6, this study illustrates how the three variables such as the demographic profile of the potential college students, the amount of tuition fee and the non-monetary features of the school (quality and convenience) can help in forecasting the enrollment in the tertiary level. This is in conformity with the theory of Gary Becker [14] which states that college enrollment's decision is based from the monetary and non-monetary factors. For mathematical modeling, the author used the three models namely: the logit model (for demographic profile); the percentage, base and rate concepts (for price); and the Markov analysis (for quality and convenience) to illustrate how these variables affect the trend of enrollment in the tertiary level.

Enrollment forecast, based from the mathematical models, revealed that males are less likely to attend school by 23% than females. As they grow older the likelihood of attending school also decreases by 57.5%. With regards to age, results of the study shows that for every one year increase in the age, the likelihood of attending school decreases by 27.5%, and it even decreases further by 57 percent as they grow older. In terms of per capita income and remittance, as their values increases the probability/likelihood to pay tuition fee higher than the suggested tuition fee of the region (P29,579.00) increases. Another important consideration for enrollment is the non-monetary features of school such as the quality and convenience. Based from the findings in this study, it shows that the quality of the school weighs higher rather than convenience. Results of the model reveal that there is 71% probability that a potential student would enroll by considering the quality of the school and only 29% probability considering the convenience of the school is offering.

IV. Conclusions and Directions for Future Use

Based from the findings of the study, the researcher concludes the following:

1. The process on how to develop mathematical model related to enrollment can be done using the Input-Process-Output concept;
2. Result shows that one can incorporate and apply basic concepts in mathematics, logit model and markov analysis to unveil one of the issues in the field of education which is the enrollment condition in Region IV-A (CALABARZON);
3. The researcher developed mathematical models in terms of:

3.1 likelihood of demographic profile to enrollment in Region IV-A (CALABARZON)

$$P(\text{school\_attend} = 1|x) = [\, 10.17 - 0.23x_1 - 0.575x_2 + 9.75e\text{-}06x_3 - 0.0576x_4 + 0.519x_5 \,]$$

Where:

x_1 - likelihood that in terms of gender enrollment will increase/decrease

x_2 - likelihood that in terms of age enrollment will increase/decrease

x_3 - likelihood that in terms of per capita income enrollment will increase/decrease

x_4 - likelihood that in terms of family size enrollment will increase/decrease

x_5 - likelihood that in terms of remittance enrollment will increase/decrease

3.2 Suggested/affordable average tuition fee of Region IV-A (CALABARZON) based on the average annual income of the region.

$p \leq$ P29,579

Where, p – suggested/affordable average tuition fee level of the Region

3.3 Features of school (quality and convenience) and their probability contribution to enrollment

Using Markov Analysis P = (0.71, 0.19) 71% probability by considering quality of school to enrollment and 29% probability for the convenience of the school; and

4. Enrollment forecast, based from the mathematical models, revealed that males are less likely to attend school by 23% than females. As they grow older the likelihood of attending school also decreases by 57.5%. With regards to age, results of the study shows that for every one year increase in the age, the likelihood of attending school decreases by 27.5%, and it even decreases further by 57 percent as they grow older. In terms of per capita income and remittance, as their values increases the probability/likelihood to pay tuition fee higher than the suggested tuition fee of the region (P29,579.00) increases. Another important consideration for enrollment is the non-monetary features of school such as the quality and convenience. Based on the findings in this study, quality of the school weighs higher rather than convenience. Results of the model reveal that there is 71% probability that a potential student would enroll by considering the quality of the school and only 29% probability that they will consider convenience in choosing a school.

The researcher strongly recommends to develop another mathematical model in other areas or related field, as needed based on the present condition of the society.

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