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Academic Performance of Computer Engineering Students on the K-12 Implementation

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ABSTRACT
Academic performance is the measurement of students' achievement across various academic subjects. Grades in Science and Mathematics subjects play an important role in finishing an engineering course on time. This study focused on demographic profile and the chosen strand in K-12 program as factors that may affect academic performance. The study is a quantitative research emphasizing the statistical and numerical analysis of data collected through questionnaires. Online approach using google form was used to disseminate the questionnaire in gathering responses as data needed in the study. The collected data was interpreted using analysis of variance or ANOVA. This statistical method was used to determine if there is a significant difference between the academic performance of Computer Engineering students, the demographic profile and the chosen strand in K-12 program. Result shows that there is no significant difference in the grade of students whatever their strands is. The weighted average of students in Science and Mathematics indicates a remarkable academic performance. There is no significant difference in the students' demographic profile, chosen strand in K-12 program and their academic performance in Science and Mathematics subjects.

Keywords: Academic performance, demographic profile, K-12 strands, computer engineering

INTRODUCTION

The Philippines in terms of its educational system is undergoing a big change since the implementation of K-12 program in the Department of Education [5]. The main interest and most important heritage to be passed on to learners is education. Quality education must be accessible to all Filipino. However, the latest Program for International Student Assessment (PISA) results in 2018 revealed that the Philippines ranked the second lowest in science and mathematics assessment conducted by the inter-government group Organization for Economic Co-operation and Development (OECD) [4].The College of Engineering of Bulacan State University offered Civil and Mechanical Engineering in 1970, Electrical Engineering in 1977, Electronics Engineering in 1994, Computer Engineering in 1995, Industrial Engineering in 1999, Mechatronics Engineering in 2003 and Manufacturing Engineering in 2007 [7]. These are 5 year programs following their respective CHED memorandum order. On the other hand, the students from K-12 programs who will pursue engineering courses will fall under the new curriculum of a 4-year program. The Computer Engineering students of Bulacan State University cater the most number of enrollees in engineering courses. The new curriculum started in academic year 2018-2019 with students who are a product of the K-12 program. The first batch consists of 3 sections, the second batch for consists of 4 sections and the third batch for academic year 2020-2021 consists of 3 sections. Academic performance is the measurement of students' achievement across various academic subjects [6]. Ideally engineering students must came from the STEM strand however the CHED released a memo that the strand chosen by the students during their senior year in the K-12 program should not be a hindrance for whatever course they want to pursue in college. As a result most of the students failed in some of their subjects particularly in math and science. In line with this, the researcher wants to conduct a correlation on the academic performance of the Computer Engineering students and focus on areas that may affect it.

Statement of the Problem

The general problem of the study is "What are the barriers that affect the academic performance of Computer Engineering students"?
Specifically, this study seeks answer to the following question:
1. How may the demographic profiles of the students be described in terms of:

1.1 age
1.2 sex
1.3 father's educational attainment
1.4 mother's educational attainment
1.5 relationship status of parents
1.6 daily allowance
1.7 family income
1.8 number of siblings
2. How may the chosen strand in K-12 program be related to their academic performance?
3. What is the academic performance of Computer Engineering students in Mathematics and Science subjects?
4. Is there any significant difference between the students' demographic profile, chosen strand in K-12 program and their academic performance in Mathematics and Science subjects?

METHODOLOGY

Methods and Techniques of the Study

This study used a quantitative approach. Quantitative research emphasizes objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon [1]. A descriptive survey research uses survey to gather data about varying subjects and aims to know the extent to which different conditions can be obtained among these subjects [8]. This approach was used to collect data from the population composing the 3rd year Computer Engineering students of Bulacan State University. In this study, the information was gathered through google form survey questionnaire and the link was given to the CpE students. The gathered raw data were tabulated to know which factor correlates the students' academic performance with the demographic profile and their chosen strand in K-12 program. The results of the survey was organized and consolidated and treated as an effective device in computing data.

Population and Sample of the Study

The process or selecting a portion of the population to represent the entire population is known as sampling [3].The population of the study are the Computer Engineering students under new curriculum. The sample or the respondents of the study came from the 3rd year CpE students of class 2020-2021. The Computer Engineering Department has a total population of 780 students. Focusing with the pioneer batch of students under the new curriculum and products of the K-12 program, there are 107 3rd year students.

Research Instrument

The questionnaire consists of two parts. The first was constructed to survey the demographic profile of the students in terms of age, sex, daily allowance, family income, mother and father's educational attainment, and number of siblings. The second part was constructed to determine the chosen strand of the students in the K-12 program and their grades in science and mathematics subjects in their first two years in the Computer Engineering program.

Data Gathering Procedure

The researcher prepared the survey questionnaire in google form and asked the 3rd year CpE students as the respondents to open the link and answer the survey questionnaire. Only those who finds time to answer it were considered as the actual respondents of the study.

Data Processing and Statistical Treatment

After the given allotted time for the students to answer the google form, the researcher consider the generated individual results and these raw data was processed. Statistical procedures were employed in analyzing the data gathered. A percentage frequency distribution is a very useful method of expressing the relative frequency of survey responses and other data [2]. Frequency and percentage was used in order to present and determine the profile of the CpE students. Correlation is used to measure how strong a relationship between variables [9]. It will be helpful in determining the relationship of students' performance with the demographic profile and their chosen strand in K-12 program. ANOVA is a statistical technique that assesses potential differences in a scale-level dependent variable by a nominal-level variable having 2 or more categories [10]. This method was used in analysis of the results.

RESULTS AND DISCUSSION

Demographic Profile

The following table shows the demographic profile of the sample of third year BS Computer Engineering students for academic year 2020-2021.

Table 1 shows the number of samples from each of the sections. Based on the number of samples, there will be 7.03% of error which is acceptable value of error. Also, Figure 1 shows the percent distribution of each section to the total number of responses.

Table 1. Sampling of Respondents

Section	Target	No. of Respondents	Percentage of the Sample from the Target
CpE 3A	38	18	47.37%
CpE 3B	37	26	70.27%
CpE 3C	32	26	81.25%
Total	107	70	65.42%

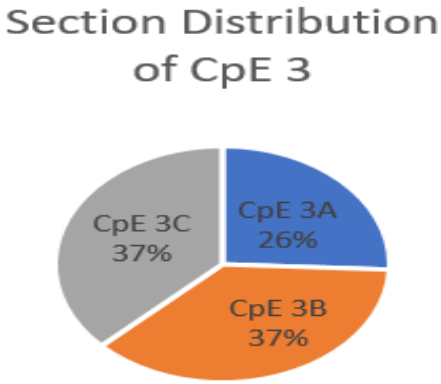


Figure 1. Section Relative Frequency n of CpE 3

Table 2 shows the age distribution of the respondents. Figure 2, shows the relative frequency of each age.

Table 2. Age Distribution

Age	Frequency
19 y.o.	1
20 y.o.	30
21 y.o.	37
22 y.o.	2
Total	70

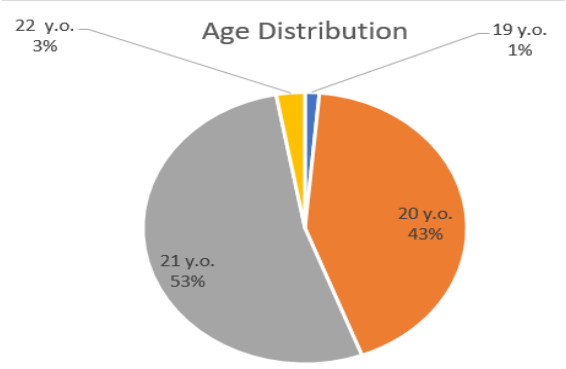


Figure 2. Age Relative Frequency

The distribution of sex of the respondents is given in Table 3 and the corresponding relative frequencies in Figure 3.

Table 3. Sex Distribution

Sex	Frequency
Male	43
Female	27
Total	70

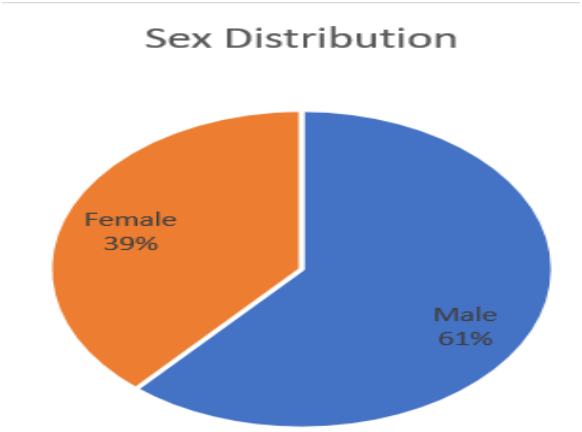


Figure 3. Sex Relative Frequency

Table 4 and Figure 4 show the father's educational attainment of the respondents.

Table 4. Father's Educational Attainment

Father's Educational Attainment	Frequency
Elementary Undergraduate	3
Elementary Graduate	5
High School Undergraduate	7
High School Graduate	15
College Undergraduate	18
College Graduate	22
Total	70

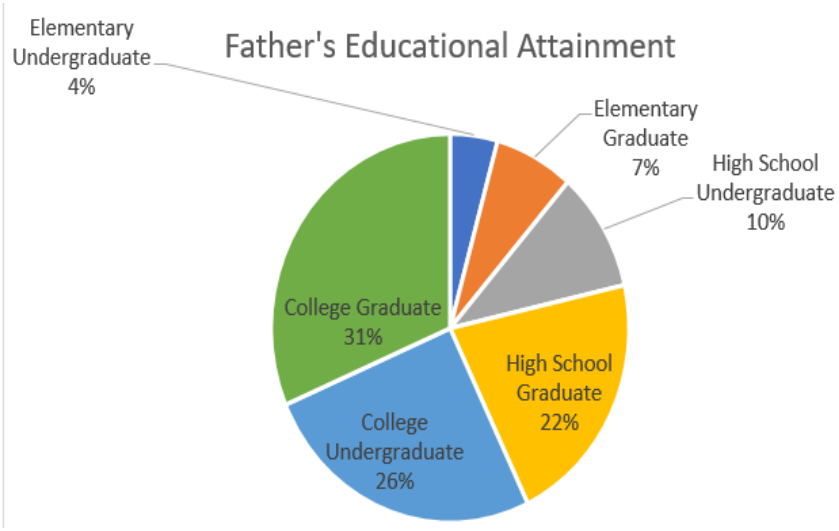


Figure 4: Relative Frequency of Father's Educational Attainment

Table 5 and Figure 5 show the mother's educational attainment of the respondents.

Table 5. Mother's Educational Attainment

Mother's Educational Attainment	Frequency
Elementary Undergraduate	3
Elementary Graduate	3
High School Undergraduate	5
High School Graduate	17
College Undergraduate	9
College Graduate	33
Total	70

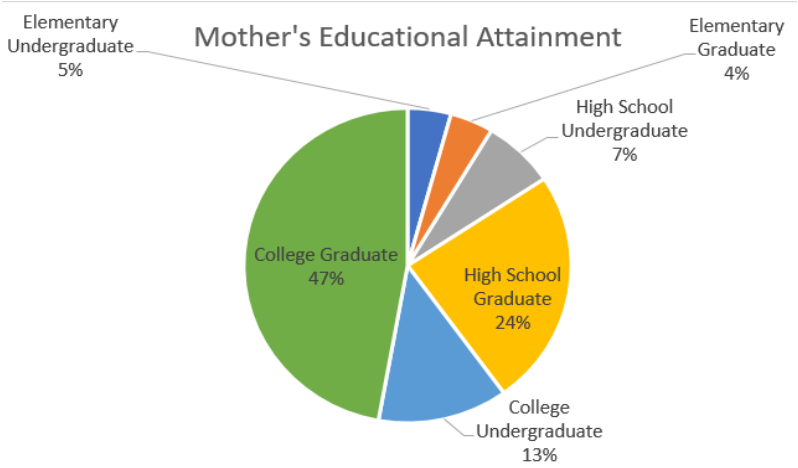


Figure 5. Relative Frequency of Mother's Educational Attainment

Table 6 and Figure 6 summarize the parents' relationship status of the respondents.

Table 6. Relationship Status of Parents

Parents' Relationship Status	Frequency
Single	2
Married	60
Separated	6
Widow/er	2
Total	70

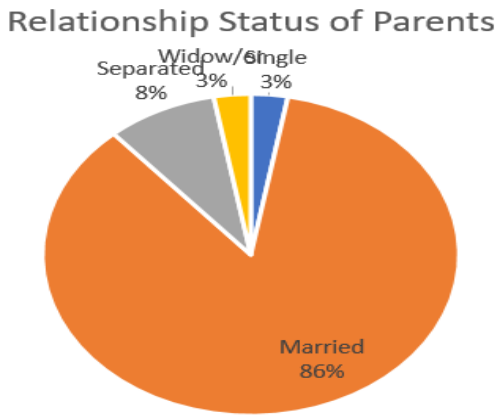


Figure 6. Relative Frequency of the Parents' Relationship Status

Table 7 and Figure 7 summarize the daily allowances of the respondents.

Table 7. Student's Daily Allowance

Daily Allowance	Frequency
0-50	11
51-100	14
101-150	22
151-200	13
Above 200	10
Total	70

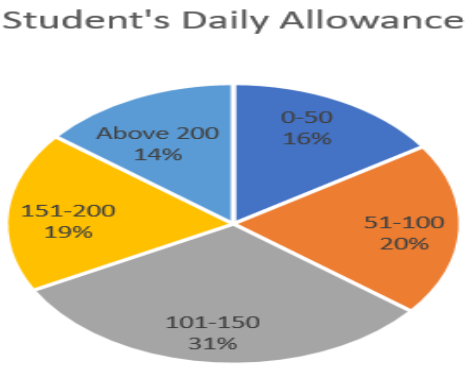


Figure 7. Relative Frequency of Student's

Daily Allowance

Table 8 and Figure 8 summarize the family' monthly income of the respondents.

Table 8. Family's Monthly Income

Monthly Family Income	Frequency
5000 and below	9
5100-10000	18
10100-15000	14
15100-20000	12
20100-25000	6
Above 25000	11
Total	70

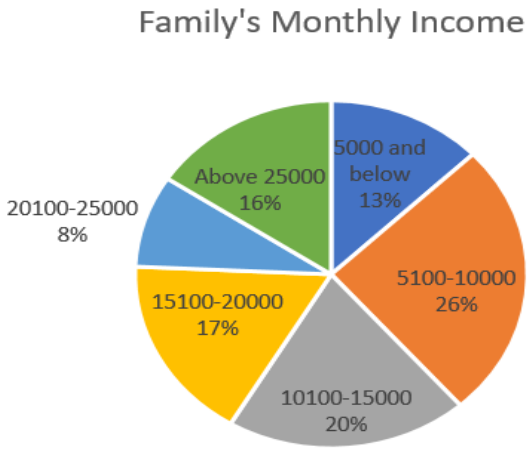


Figure 8.Relative Frequency of Family's

Monthly Income

Table 9 and Figure 9 presents the number of siblings of the respondents.

Table 9. Number of Siblings

Number of Siblings	Frequency
0 sibling	4
1 sibling	14
2 siblings	25
3 siblings	12
4 siblings	11
5 siblings	2
6 siblings	1
7 siblings	1
Total	70

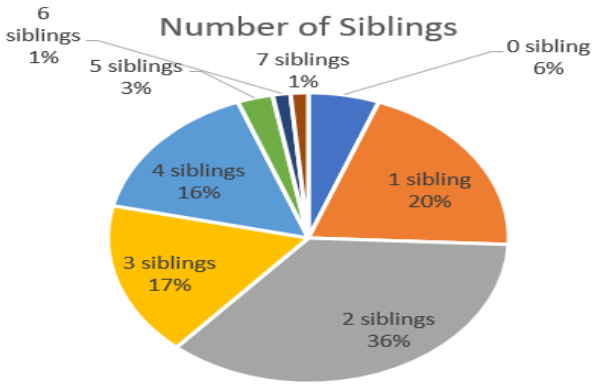


Figure 9. Relative Frequency of the Number of Siblings

Academic Performance in Mathematics and Science Courses

The following tables and figures present the academic profiling of the respondents. Table 10 and Figure 10 summarize the senior high school strands of the respondents.

Table 10. SHS Strands

SHS Strands	Frequency
STEM	47
HUMSS	1
ABM	0
GAS	0
TVL	7
ICT	15
Total	0
Total	70

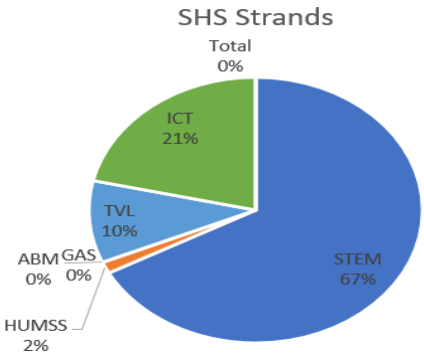


Figure 10. Relative Frequency of the SHS Strands

Table 11, Figure 11 and Figure 12 summarize the academic performance of the respondents in Math and Science courses.

Table 11. Student's Grades

Subjects	Numerical Grades										
	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	5.00	Weighted Average
Calculus 1	1	4	3	7	12	9	10	19	5	0	2.28
Chemistry for Engineers	0	2	2	5	11	19	10	13	7	1	2.37
Calculus 2	6	5	7	10	10	10	10	9	2	1	2.05
Physics for Engineer	0	0	2	2	10	10	18	18	10	0	2.48
Differential Equation	13	12	19	13	5	3	2	2	1	0	1.56
Engineering Data Analysis	0	3	6	9	18	6	5	11	11	1	2.27
Discrete Math	0	1	1	1	9	7	18	12	20	1	2.59
Numerical Method	18	1	0	0	1	0	1	0	36	13	2.81

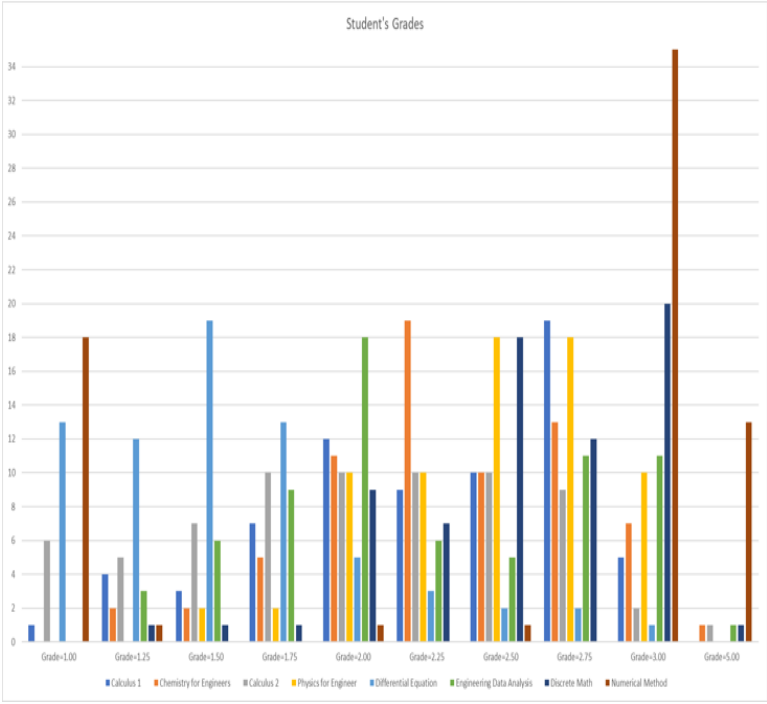


Figure 11. Student's Grades per Subject

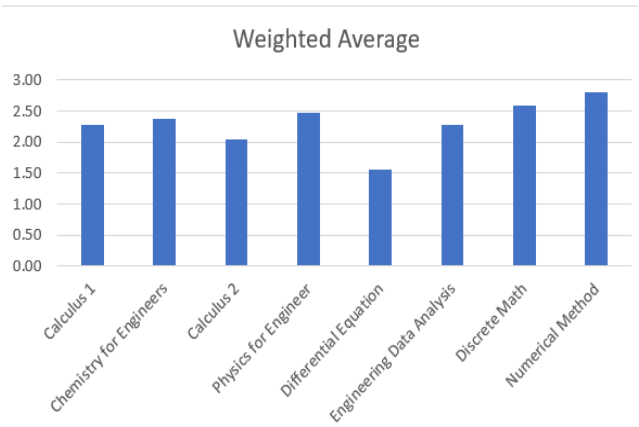


Figure 12. Student's Average per Subject

Analysis of Demographic Profile and Academic Performance

A. Average Grade

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	24	6.43342	66.84%	6.43342	0.26806	3.78	0.000
Age	1	1.01760	10.57%	0.96327	0.96327	13.58	0.001
No. of Siblings	1	0.01393	0.14%	0.01811	0.01811	0.26	0.616
Fathers Educational Attainment	5	0.30495	3.17%	0.97181	0.19436	2.74	0.030
Mothers Educational Attainment	5	0.55940	5.81%	0.54573	0.10915	1.54	0.197
Status of Parents	3	0.79661	8.28%	0.36965	0.12322	1.74	0.173
Monthly Family Income	5	3.35908	34.90%	3.61391	0.72278	10.19	0.000
Students Daily Allowance	4	0.38186	3.97%	0.38186	0.09546	1.35	0.268
Error	45	3.19184	33.16%	3.19184	0.07093		
Total	69	9.62526	100.00%				

Figure 13. ANOVA Table for the Demographic Profile and Average Grade

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.267893	68.68%	48.55%	*	*	79.99	101.70

Figure 14. Model Summary for the Demographic Profile and Average Grade

Figure 13 shows the Analysis of Variance (ANOVA) of the demographic profile and average grades of students while Figure 14 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 48.55%. Based on the ANOVA, the regression model is significant for at least one factor. The model is reduced so that factors that are not significant were removed from the model.

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	11	5.0332	52.29%	5.0332	0.45756	5.78	0.000
Age	1	1.0176	10.57%	1.0590	1.05899	13.38	0.001
Fathers Educational Attainment	5	0.3052	3.17%	0.9756	0.19513	2.46	0.043
Monthly Family Income	5	3.7103	38.55%	3.7103	0.74206	9.37	0.000
Error	58	4.5921	47.71%	4.5921	0.07917		
Lack-of-Fit	32	3.0889	32.09%	3.0889	0.09653	1.67	0.092
Pure Error	26	1.5032	15.62%	1.5032	0.05782		
Total	69	9.6253	100.00%				

Figure 15. ANOVA Table of the Reduced Model for the Demographic Profile and Average Grade

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.281379	52.29%	43.24%	6.72473	30.13%	40.46	63.19

Figure 16. Model Summary for the Reduced Model for the Demographic Profile and Average Grade

Figure 15 shows the ANOVA of the reduced model and Figure 16 shows the model summary. Based on the reduced model, the significant factors are age, father's educational attainment, and monthly family income. However, the coefficient of determination (R-sq (adj)) is 43.24% which is quite small. This means that though the factors are significant, the effect of changing at least one of the factors to the average grade of students is not strong. Only 43.24% of the variability in the average grades of students can be explained by at least one of the said factors.

B. Calculus I

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	11.2440	62.84%	11.2440	0.44976	2.98	0.001
Age	1	0.0000	0.00%	0.0196	0.01962	0.13	0.720
No. of Siblings	1	0.0185	0.10%	0.3074	0.30736	2.03	0.161
Gender	1	2.4142	13.49%	0.1855	0.18555	1.23	0.274
Fathers Educational Attainment	5	1.6093	8.99%	2.4927	0.49854	3.30	0.013
Mothers Educational Attainment	5	2.0666	11.55%	1.5328	0.30656	2.03	0.093
Status of Parents	3	0.6222	3.48%	0.5313	0.17709	1.17	0.331
Monthly Family Income	5	3.4649	19.36%	3.6671	0.73343	4.85	0.001
Students Daily Allowance	4	1.0482	5.86%	1.0482	0.26205	1.73	0.160
Error	44	6.6497	37.16%	6.6497	0.15113		
Total	69	17.8938	100.00%				

Figure 17. ANOVA Table for the Demographic Factors and Grade in Calculus I

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.388755	62.84%	41.72%	15.4150	13.85%	123.88	148.59

Figure 18. Model Summary for the Demographic factors and Grade in Calculus I

Figure 17 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Calculus I while Figure 18 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 41.72%. Based on the ANOVA, the regression model is significant for at least one factor. The model is reduced so that factors that are not significant were removed from the model.

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	15	9.080	50.74%	9.080	0.6053	3.71	0.000
Fathers Educational Attainment	5	2.381	13.31%	3.271	0.6542	4.01	0.004
Mothers Educational Attainment	5	2.777	15.52%	2.121	0.4243	2.60	0.035
Monthly Family Income	5	3.922	21.92%	3.922	0.7844	4.81	0.001
Error	54	8.814	49.26%	8.814	0.1632		
Lack-of-Fit	28	4.746	26.53%	4.746	0.1695	1.08	0.420
Pure Error	26	4.068	22.73%	4.068	0.1565		
Total	69	17.894	100.00%				

Figure 19. Reduced ANOVA Table for the Demographic Factors and Grade in Calculus I

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.404009	50.74%	37.06%	13.6528	23.70%	99.37	125.83

Figure 20. Model Summary for the Reduced Model for the Demographic Profile and Grade in Calculus I

Figure 19 shows the ANOVA of the reduced model and Figure 20 shows the model summary. Based on the reduced model, the significant factors are father's educational attainment, mother's educational attainment, and monthly family income. However, the coefficient of determination (R-sq (adj)) is 37.06% which is quite small. This means that though the factors are significant, the effect of changing at least one of the factors to the Calculus I grade of students is not strong. Only 37.06% of the variability in the Calculus I grade of students can be explained by at least one of the said factors.

C. Chemistry

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	9.0415	46.45%	9.0415	0.3617	1.53	0.108
Age	1	0.1791	0.92%	0.1803	0.1803	0.76	0.388
No. of Siblings	1	0.1247	0.64%	0.2179	0.2179	0.92	0.343
Gender	1	1.8639	9.58%	0.6186	0.6186	2.61	0.113
Fathers Educational Attainment	5	0.2045	1.05%	0.5469	0.1094	0.46	0.803
Mothers Educational Attainment	5	1.0996	5.65%	0.7477	0.1495	0.63	0.677
Status of Parents	3	0.5663	2.91%	0.3978	0.1326	0.56	0.644
Monthly Family Income	5	4.2628	21.90%	4.4830	0.8966	3.78	0.006
Students Daily Allowance	4	0.7406	3.80%	0.7406	0.1852	0.78	0.543
Error	44	10.4237	53.55%	10.4237	0.2369		
Total	69	19.4652	100.00%				

Figure 21. ANOVA Table for the Demographic Factors and Grade in Chemistry

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.486727	46.45%	16.02%	27.7606	0.00%	155.34	180.05

Figure 22. Model Summary for the Demographic Factors and Grade in Chemistry

Figure 21 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Chemistry while Figure 22 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 16.02%. Based on the ANOVA, the regression model is not significant. This means that none of the factors has significant effect to the Chemistry grade of students.

D. Calculus II

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	11.8165	39.13%	11.8165	0.47266	1.13	0.352
Age	1	0.8750	2.90%	1.7622	1.76224	4.22	0.046
No. of Siblings	1	0.0836	0.28%	0.0157	0.01569	0.04	0.847
Gender	1	0.9154	3.03%	0.0630	0.06296	0.15	0.700
Fathers Educational Attainment	5	1.6056	5.32%	3.6389	0.72777	1.74	0.145
Mothers Educational Attainment	5	0.8311	2.75%	2.0091	0.40182	0.96	0.452
Status of Parents	3	3.3384	11.05%	3.0478	1.01592	2.43	0.078
Monthly Family Income	5	2.5634	8.49%	2.6316	0.52632	1.26	0.298
Students Daily Allowance	4	1.6041	5.31%	1.6041	0.40101	0.96	0.439
Error	44	18.3835	60.87%	18.3835	0.41781		
Total	69	30.2000	100.00%				

Figure 23. ANOVA Table for the Demographic Factors and Grade in Calculus II

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.646379	39.13%	4.54%	44.0488	0.00%	195.06	219.77

Figure 24. Model Summary for the Demographic Factors and Grade in Calculus II

Figure 23 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Calculus II while Figure 24 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 4.54%. Based on the ANOVA, the regression model is not significant. This means that none of the factors has significant effect to the Calculus II grade of students.

E. Physics

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	4.9112	49.90%	4.91121	0.196448	1.75	0.051
Age	1	0.4870	4.95%	0.22889	0.228885	2.04	0.160
No. of Siblings	1	0.1022	1.04%	0.20183	0.201830	1.80	0.187
Gender	1	0.5026	5.11%	0.00154	0.001542	0.01	0.907
Fathers Educational Attainment	5	0.4081	4.15%	0.49719	0.099437	0.89	0.498
Mothers Educational Attainment	5	0.4678	4.75%	0.19792	0.039584	0.35	0.877
Status of Parents	3	0.4583	4.66%	0.55325	0.184417	1.65	0.193
Monthly Family Income	5	1.9397	19.71%	2.33335	0.466670	4.16	0.003
Students Daily Allowance	4	0.5455	5.54%	0.54552	0.136380	1.22	0.317
Error	44	4.9316	50.10%	4.93165	0.112083		
Total	69	9.8429	100.00%				

Figure 25. ANOVA Table for the Demographic Factors and Grade in Physics

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.334788	49.90%	21.43%	12.1201	0.00%	102.95	127.66

Figure 26. Model Summary for the Demographic Factors and Grade in Physics

Figure 25 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Physics while Figure 26 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 21.43%. Based on the ANOVA, the regression model is significant for at least one factor. The model is reduced so that factors that are not significant were removed from the model.

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	5	1.885	19.15%	1.885	0.3770	3.03	0.016
Monthly Family Income	5	1.885	19.15%	1.885	0.3770	3.03	0.016
Error	64	7.958	80.85%	7.958	0.1243		
Total	69	9.843	100.00%				

Figure 27. Reduced ANOVA Table for the Demographic Factors and Grade in Physics

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.352617	19.15%	12.84%	9.56217	2.85%	62.25	76.19

Figure 28. Model Summary for the Reduced Model for the Demographic Profile and Grade in Physics

Figure 27 shows the ANOVA of the reduced model and Figure 28 shows the model summary. Based on the reduced model, the significant factor is monthly family income. However, the coefficient of determination (R-sq (adj)) is 12.84% which is quite small. This means that though the factor is significant, the effect of changing it to the Physics grade of students is not strong. Only 12.84% of the variability in the Physics grade of students can be explained by the said factors.

F. Differential Equation

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	5.6779	38.27%	5.67787	0.227115	1.09	0.390
Age	1	0.3100	2.09%	0.42362	0.423621	2.04	0.161
No. of Siblings	1	0.0006	0.00%	0.00468	0.004680	0.02	0.881
Gender	1	0.2338	1.58%	0.01611	0.016113	0.08	0.782
Fathers Educational Attainment	5	0.4720	3.18%	1.66030	0.332061	1.60	0.181
Mothers Educational Attainment	5	1.0610	7.15%	0.66310	0.132621	0.64	0.672
Status of Parents	3	0.4415	2.98%	0.65929	0.219762	1.06	0.378
Monthly Family Income	5	2.0600	13.89%	2.43408	0.486817	2.34	0.057
Students Daily Allowance	4	1.0990	7.41%	1.09900	0.274749	1.32	0.277
Error	44	9.1578	61.73%	9.15784	0.208133		
Total	69	14.8357	100.00%				

Figure 29.ANOVA Table for the Demographic Factors and Grade in Differential Equations

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.456216	38.27%	3.20%	28.2352	0.00%	146.28	170.99

Figure 30. Model Summary for the Demographic Factors and Grade in Differential Equations

Figure 29 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Differential Equations while Figure 30 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 3.20%. Based on the ANOVA, the regression model is not significant. This means that none of the factors has significant effect to the Differential Equation grade of students.

G. Engineering Data Analysis

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	12.2344	46.10%	12.2344	0.48938	1.51	0.116
Age	1	1.3241	4.99%	0.7526	0.75263	2.31	0.135
No. of Siblings	1	0.0270	0.10%	0.0726	0.07256	0.22	0.639
Gender	1	0.6593	2.48%	0.0008	0.00079	0.00	0.961
Fathers Educational Attainment	5	2.0688	7.79%	1.4397	0.28794	0.89	0.499
Mothers Educational Attainment	5	0.8149	3.07%	1.2334	0.24669	0.76	0.584
Status of Parents	3	0.6963	2.62%	0.2379	0.07929	0.24	0.865
Monthly Family Income	5	5.9611	22.46%	5.9212	1.18424	3.64	0.008
Students Daily Allowance	4	0.6830	2.57%	0.6830	0.17074	0.53	0.718
Error	44	14.3057	53.90%	14.3057	0.32513		
Total	69	26.5402	100.00%				

Figure 31. ANOVA Table for the Demographic Factors and Grade in Engineering Data Analysis

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.570202	46.10%	15.47%	38.8881	0.00%	177.50	202.21

Figure 32. Model Summary for the Demographic Factors and Grade in Engineering Data Analysis

Figure 31 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Engineering Data Analysis while Figure 32 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 15.47%. Based on the ANOVA, the regression model is not significant. This means that none of the factors has significant effect to the Engineering Data Analysis grade of students.

H. Discrete Mathematics

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	7.3056	42.34%	7.30556	0.292222	1.29	0.224
Age	1	0.8474	4.91%	0.31176	0.311758	1.38	0.247
No. of Siblings	1	0.2594	1.50%	0.00177	0.001775	0.01	0.930
Gender	1	0.3592	2.08%	0.29486	0.294864	1.30	0.260
Fathers Educational Attainment	5	0.7485	4.34%	0.18293	0.036586	0.16	0.975
Mothers Educational Attainment	5	0.4250	2.46%	0.55097	0.110194	0.49	0.784
Status of Parents	3	0.0307	0.18%	0.06027	0.020091	0.09	0.966
Monthly Family Income	5	3.2102	18.61%	3.98606	0.797213	3.53	0.009
Students Daily Allowance	4	1.4252	8.26%	1.42516	0.356290	1.58	0.198
Error	44	9.9489	57.66%	9.94891	0.226112		
Total	69	17.2545	100.00%				

Figure 33. ANOVA Table for the Demographic Factors and Grade in Discrete Mathematics

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.475512	42.34%	9.58%	26.5286	0.00%	152.08	176.79

Figure 34. Model Summary for the Demographic Factors and Grade in Discrete Mathematics

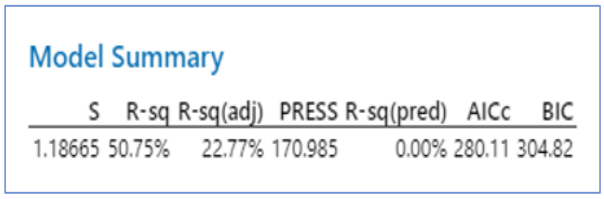
Figure 33 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Discrete Mathematics while Figure 34 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 9.58%. Based on the ANOVA, the regression model is not significant. This means that none of the factors has significant effect to the Discrete Mathematics grade of students.

I. Numerical Method

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	25	63.847	50.75%	63.8466	2.5539	1.81	0.041
Age	1	11.511	9.15%	12.2534	12.2534	8.70	0.005
No. of Siblings	1	1.201	0.96%	0.3375	0.3375	0.24	0.627
Gender	1	0.035	0.03%	0.1251	0.1251	0.09	0.767
Fathers Educational Attainment	5	9.794	7.79%	15.9464	3.1893	2.26	0.064
Mothers Educational Attainment	5	2.554	2.03%	6.7249	1.3450	0.96	0.455
Status of Parents	3	13.283	10.56%	7.3664	2.4555	1.74	0.172
Monthly Family Income	5	24.468	19.45%	21.9243	4.3849	3.11	0.017
Students Daily Allowance	4	0.999	0.79%	0.9989	0.2497	0.18	0.949
Error	44	61.958	49.25%	61.9579	1.4081		
Total	69	125.804	100.00%				

Figure 35. ANOVA Table for the Demographic Factors and Grade in Numerical Method

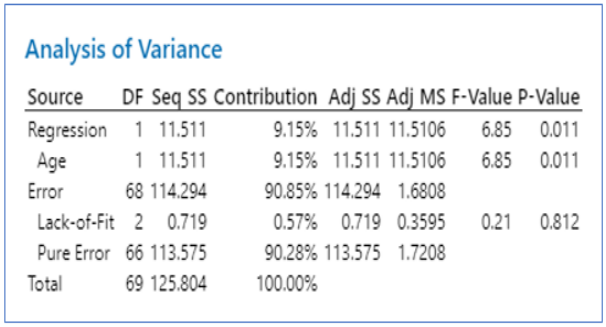


Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
1.18665	50.75%	22.77%	170.985	0.00%	280.11	304.82

Figure 36. Model Summary for the Demographic Factors and Grade in Numerical Method

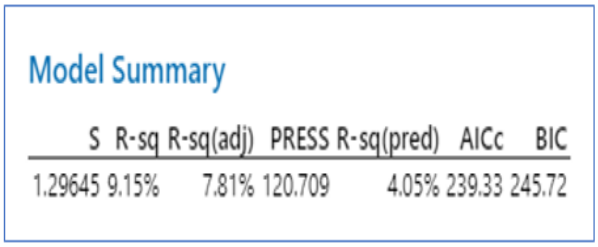
Figure 35 shows the Analysis of Variance (ANOVA) of the demographic profile and grade in Numerical Method while Figure 36 shows the model summary in which coefficient of determination (R-sq (adj)) is calculated with a value of 22.77%. Based on the ANOVA, the regression model is significant for at least one factor. The model is reduced so that factors that are not significant were removed from the model.



Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	1	11.511	9.15%	11.511	11.5106	6.85	0.011
Age	1	11.511	9.15%	11.511	11.5106	6.85	0.011
Error	68	114.294	90.85%	114.294	1.6808		
Lack-of-Fit	2	0.719	0.57%	0.719	0.3595	0.21	0.812
Pure Error	66	113.575	90.28%	113.575	1.7208		
Total	69	125.804	100.00%				

Figure 37. Reduced ANOVA Table for the Demographic Factors and Grade in Numerical Method



Model Summary

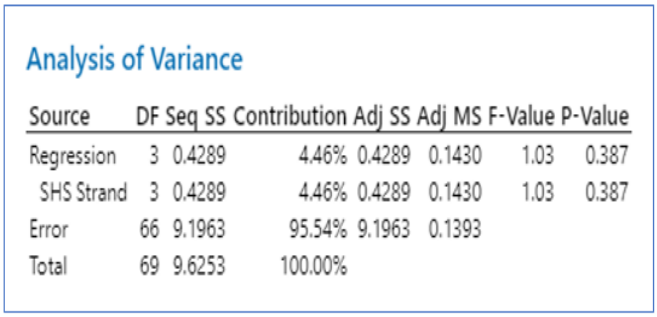
S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
1.29645	9.15%	7.81%	120.709	4.05%	239.33	245.72

Figure 38. Model Summary for the Reduced Model of Demographic Factors and Grade in Numerical Method

Figure 37 shows the ANOVA of the reduced model and Figure 38 shows the model summary. Based on the reduced model, the significant factor is age. However, the coefficient of determination (R-sq (adj)) is 7.81% which is quite small. This means that though the factor is significant, the effect of changing it to the Numerical Method grade of students is not strong. Only 7.81% of the variability in the Numerical Method grade of students can be explained by the said factors.

Analysis of Strands and Academic Performance

A. Average



Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	0.4289	4.46%	0.4289	0.1430	1.03	0.387
SHS Strand	3	0.4289	4.46%	0.4289	0.1430	1.03	0.387
Error	66	9.1963	95.54%	9.1963	0.1393		
Total	69	9.6253	100.00%				

Figure 39. ANOVA for SHS Stand and Average Grade

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.373280	4.46%	0.11%	*	*	67.51	77.82

Figure 40. Model Summary for SHS Stand and Average Grade

Figure 39 shows the ANOVA for SHS strand and average grades of CpE students while Figure 40 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 0.11%. Based on the ANOVA, the SHS strand of the students has no significant effect to their average grade.

B. Calculus I

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	2.303	12.87%	2.303	0.7676	3.25	0.027
SHS Strand	3	2.303	12.87%	2.303	0.7676	3.25	0.027
Error	66	15.591	87.13%	15.591	0.2362		
Total	69	17.894	100.00%				

Figure 41. ANOVA for SHS Stand and Grade in Calculus I

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.486030	12.87%	8.91%	*	*	104.46	114.77

Figure 42. Model Summary for SHS Stand and Grade in Calculus I

Figure 41 shows the ANOVA for SHS strand and Calculus I grade of CpE students while Figure 42 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 8.91%. Based on the ANOVA, the SHS strand of the students has significant effect to their Calculus I grade. However, the coefficient of determination (R-sq (adj)) is 8.91% which is quite small. This means that though the SHS strand is significant, the effect of changing it to the Calculus I grade of students is not strong. Only 8.91% of the variability in the Calculus I grade of students can be explained by their SHS strand.

C. Chemistry

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	0.3615	1.86%	0.3615	0.1205	0.42	0.742
SHS Strand	3	0.3615	1.86%	0.3615	0.1205	0.42	0.742
Error	66	19.1036	98.14%	19.1036	0.2894		
Total	69	19.4652	100.00%				

Figure 43. ANOVA for SHS Stand and Grade in Chemistry

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.538005	1.86%	0.00%	*	*	118.69	128.99

Figure 44. Model Summary for SHS Stand and Grade in Chemistry

Figure 43 shows the ANOVA for SHS strand and Chemistry grades of CpE students while Figure 44 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 0.00%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Chemistry grade.

D. Calculus II

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	0.9840	3.26%	0.9840	0.3280	0.74	0.531
SHS Strand	3	0.9840	3.26%	0.9840	0.3280	0.74	0.531
Error	66	29.2160	96.74%	29.2160	0.4427		
Total	69	30.2000	100.00%				

Figure 45. ANOVA for SHS Stand and Grade in Calculus II

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.665332	3.26%	0.00%	*	*	148.42	158.73

Figure 46. Model Summary for SHS Stand and Grade in Calculus II

Figure 45 shows the ANOVA for SHS strand and Calculus II grades of CpE students while Figure 46 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 0.00%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Calculus II grade.

E. Physics

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	1.141	11.60%	1.141	0.3805	2.89	0.042
SHS Strand	3	1.141	11.60%	1.141	0.3805	2.89	0.042
Error	66	8.701	88.40%	8.701	0.1318		
Total	69	9.843	100.00%				

Figure 47. ANOVA for SHS Stand and Grade in Physics

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.363097	11.60%	7.58%	*	*	63.64	73.94

Figure 48. Model Summary for SHS Stand and Grade in Physics

Figure 47 shows the ANOVA for SHS strand and Physics grades of CpE students while Figure 48 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 7.58%. Based on the ANOVA, the SHS strand of the students has significant effect to their Physics grades. However, the coefficient of determination (R-sq (adj)) is 7.58% which is quite small. This means that though the SHS strand is significant, the effect of changing it to the Physics grade of students is not strong. Only 7.58% of the variability in the Physics grade of students can be explained by their SHS strand.

F. Differential Equations

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	0.1044	0.70%	0.1044	0.03480	0.16	0.926
SHS Strand	3	0.1044	0.70%	0.1044	0.03480	0.16	0.926
Error	66	14.7313	99.30%	14.7313	0.22320		
Total	69	14.8357	100.00%				

Figure 49. ANOVA for SHS Stand and Grade in Differential Equations

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.472442	0.70%	0.00%	*	*	100.49	110.80

Figure 50. Model Summary for SHS Stand and Grade in Differential Equations

Figure 49 shows the ANOVA for SHS strand and Differential Equations grades of CpE students while Figure 50 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 0.00%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Differential Equations grade.

G. Engineering Data Analysis

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	1.405	5.29%	1.405	0.4684	1.23	0.306
SHS Strand	3	1.405	5.29%	1.405	0.4684	1.23	0.306
Error	66	25.135	94.71%	25.135	0.3808		
Total	69	26.540	100.00%				

Figure 51. ANOVA for SHS Stand and Grade in Engineering Data Analysis

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.617116	5.29%	0.99%	*	*	137.89	148.20

Figure 52. Model Summary for SHS Stand and Grade in Engineering Data Analysis

Figure 51 shows the ANOVA for SHS strand and Engineering Data Analysis grades of CpE students while Figure 52 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 0.99%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Engineering Data Analysis grade.

H. Discrete Mathematics

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	0.9220	5.34%	0.9220	0.3073	1.24	0.302
SHS Strand	3	0.9220	5.34%	0.9220	0.3073	1.24	0.302
Error	66	16.3325	94.66%	16.3325	0.2475		
Total	69	17.2545	100.00%				

Figure 53. ANOVA for SHS Stand and Grade in Discrete Mathematics

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
0.497456	5.34%	1.04%	*	*	107.72	118.02

Figure 54. Model Summary for SHS Stand and Grade in Discrete Mathematics

Figure 53 shows the ANOVA for SHS strand and Discrete Mathematics grades of CpE students while Figure 54 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 1.04%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Discrete Mathematics grade.

I. Numerical Method

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	3	7.534	5.99%	7.534	2.511	1.40	0.250
SHS Strand	3	7.534	5.99%	7.534	2.511	1.40	0.250
Error	66	118.270	94.01%	118.270	1.792		
Total	69	125.804	100.00%				

Figure 55. ANOVA for SHS Stand and Grade in Numerical Method

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)	AICc	BIC
1.33865	5.99%	1.72%	*	*	246.30	256.61

Figure 56. Model Summary for SHS Stand and Grade in Numerical Method

Figure 55 shows the ANOVA for SHS strand and Numerical Method grades of CpE students while Figure 56 shows the model summary in which the coefficient of determination (R-sq (adj)) is calculated with a value of 1.72%. Based on the ANOVA, the SHS strand of the students has no significant effect to their Numerical Method grade.

Summary of Results

The following tables present the summary of the statistical results. Based on the results, both the demographic factors and SHS strands have no significant effect to the grades of CpE students in the Mathematics and Science courses.

Table 12. Summary of Results for Demographic Profile

Subject	Significant Factors	Coefficient of Determination	Remarks
Calculus I	• Father's educational attainment • Mother's educational attainment • Monthly family income	37.06%	Inadequate coefficient of determination
Chemistry	• None	16.02%	No significance
Calculus II	• None	4.54%	No significance
Physics	• Monthly family income	12.84%	Inadequate coefficient of determination
Differential Equations	• None	3.20%	No significance
Engineering Data Analysis	• None	15.47%.	No significance
Discrete Mathematics	• None	9.58%	No significance
Numerical Method	• Age	7.81%	Inadequate coefficient of determination
Average Grade	• Age • Father's educational attainment • Monthly family income	43.24%	Inadequate coefficient of determination

Table 13. Summary of Results for SGS Strand

Subject	Significance of SHS Strands	Coefficient of Determination	Remarks
Calculus I	Yes	8.91%	Inadequate coefficient of determination
Chemistry	No	0.00%	No significance
Calculus II	No	0.00%	No significance
Physics	Yes	7.58%	Inadequate coefficient of determination
Differential Equations	No	0.00%	No significance
Engineering Data Analysis	No	0.99%	No significance
Discrete Mathematics	No	1.04%	No significance
Numerical Method	No	1.72%	No significance
Average Grade	No	0.11%	No significance

CONCLUSION AND RECOMMENDATION

The demographic profile of the student shows that most of the students' age is 20 years old (43%), most of the students are male (61%), most of their father's educational attainment was college graduate (31%), most of their mother's educational attainment was college graduate (47%), most of their parents' relational status was married (86%), most of the students; daily allowance ranges from 101-150 pesos (31%), most of their family's' monthly income ranges from 5,100-10000 pesos (20%), and most of the students were having 2 siblings (36%). There is no significant difference in the grades of students whatever their strand is. The academic performance of students in Mathematics and Science shows that the students' weighted average is 2.28 in Calculus 1, 2.37 in Chemistry for Engineers, 2.05 in Calculus 2, 2.48 in Physics for Engineers, 1.56 in Differential Equation, 2.27 in Engineering Data Analysis, 2.59 in Discrete Math, and 2.81 in Numerical Methods. This indicates a remarkable academic performance. There is no significant difference in students' demographic profile, chosen strand in K-12 program. and their academic performance in Mathematics and Science subjects.

It is recommended to have more sample size, make it per year level of the students. Consider also other factors that may affect the students' grades. Further analysis is highly recommended.

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