Dynamics of High School Certificate Examinations Demand: A Case Study of Kurdistan Region, Iraq

David Wafula Waswa[1] & Mowafaq Muhammed Al-Kassab[2] & Azhar Abdulrazak Alhasoo[3]

[1]Department of Mathematics Education, Faculty of Education, Tishk International University, Erbil, Iraq
[2]Department of Mathematics, College of Education, Mosul University, Mosul, Iraq
Correspondence: David Wafula Waswa, Tishk International University, Erbil, Iraq.
Email: david.wafula@tiu.edu.iq

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Abstract: College majors for high school students are mostly predicted by Grade Point Average (GPA) scores and standardized tests. Both predictors are applied by the regional government of Kurdistan, Iraq. The objectives of this research were to characterize dynamics that determine performance of high school students, in terms of both the standardized Wzary test and overall high school GPA, and the influence on their subsequent selection of college majors. Whether students who choose the same major could be assumed to have the similar cognitive abilities, on average, was also investigated by this paper. Data was collected via a questionnaire that was distributed to university students. The questionnaire sought to collect information on the academic performance in high school, socioeconomic status at the time, and parents' education status. It was established that biology major students had a distinct higher GPA compared to other departments in the faculty of Education, and through multiple linear regression, it was established that mother's education level, mode of transport to school, place of residence, and student's age are some of the predictors of high school GPA.

Keywords: Population, Demand, Grade Point Average, Analysis of Variance, Regression

1. Introduction

High school Grade Point Average (GPA) and standardized tests have been used for many years as criteria for college and or university admission. A lot of literature exists on various aspects of the relationship between high school grade point average and college educations. Some such aspects include use of GPA as a predictor of college performance (Kaissidis-Rodafinos & Sideridis, 1998; Hodara & Lewis, 2017; Allensworth & Clark, 2020; Shannon, 2020; Bansiong & Balagtey, 2020), use of high school GPA for college admission (Sawyer, 2013; Alwahibee, 2015), use of standardized tests for college admission (Syverson, 2007; Jiang, 2019; Cai, 2020), and the impact of college admission policies on high school performance (Grau, 2018). However, literature on high school GPA as a predictor of college majors dominantly use probability of success by students in the department and expected earnings of graduates from the department (Montmarquette, Cannings & Mahseredjian, 2002). Can the students' high school GPA be used as a predictor of the department selection in a faculty?

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In the Kurdistan region of Iraq, 12th grade students take a standardized test, the Wzary Examination, provided by the regional government between June and July every year. Students wait for about three weeks to get their results then apply for 6 different courses offered in various universities. The application is done online through a government run portal. The government then distributes students to the various universities based on their Wzary examination scores. Some universities, however, require students to take a direct entry examination and/or an interview by the department in which the student wants to join (Budur, Abdullah, & Poturak, 2018). Students with high marks from the Wzary exam get their first choices as those who did not perform well get last options available. Given the limited number of universities in the region, competition for courses that are deemed most important is stiff. Hence it can be assumed that most students admitted in the same faculty have, on average, the same cognitive abilities. Which then begs the question, how can high school performance, GPA or otherwise, predict college majors in the same faculty? Indeed, the question then becomes whether there is a statistically significant difference in the high school GPA among students admitted in different departments of the same faculty.

National standardized tests, such as the Wzary test breed gruesome competition among stake holders, especially among students, for the top slots. This must exert pressure on schools, teachers, and families as well to guide and produce students who can achieve high marks in the Wzary examinations. This paper looks at the various factors contributing to and predicting high GPA in high school with high mark on the Wzary examination. We look into a wide range of issues like families' socio-economic status, parents' educational level, family size and composition, students' status at school (work-study), average hours of daily studying and number of times the student took the Wzary examination. The multiple linear regression model was used to predict the factors affecting the average score of the students.

2. Data Collection

This quantitative research used a questionnaire to collect data from 140 students in the five departments of the faculty of education at Tishk International University. The sample size was randomly selected from this population. The final sample is shown in the table below.

Table 1: Summary of the population and sample sizes (N, n respectively)

Grade level /Department	1st Grade		2nd Grade		3rd Grade		4th Grade	
	N	n	N	n	N	n	N	n
Mathematics	11	6	17	6	20	6	17	6
Computer*	10	5	-----	-----	-----	-----	-----	-----
Physics	12	2	9	3	31	9	24	7
Biology	25	4	15	7	66	15	15	5
ELT	53	14	54	16	54	8	30	9
Total	111	31	95	32	171	38	86	27
Percentage	28%		34%		22%		31%	

*New department with 1st grade students only

Out of the questionnaires distributed, 12 were defective and therefore rejected, the remaining 128 were analyzed using frequency distributions and multiple linear regression model. The Multiple linear regression is a well-known method of analyzing the relationship between dependent variable and independent variables. The mathematical equation for this regression is:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + e_i \quad , i = 1, 2, \ldots, n$$

Where n is the number of observations. The matrix form of this equation is:

$$y = X\beta + e$$

Where y is $(n \times 1)$ vector of response variables, X is a matrix of $(n \times (p+1))$ known full column rank, e is the $(n \times 1)$ vector of errors with

$$E(e) = 0 \quad \text{and} \quad cov(e) = \sigma^2 I_n.$$

β is $((p+1) \times 1)$ vector of unknown regression parameters, and σ^2 is the unknown variance parameter. Minimizing the sum of squares of the error $e^T e$, the ordinary least squares estimators (OLS) are:

$$\hat{\beta}_{OLS} = (X^T X)^{-1} X^T Y$$

Where $\hat{\beta}_{OLS}$ is the unbiased estimate of β. The least squares estimator works with some assumptions such as linearly independent and identically distributed errors with mean zero and constant variance σ^2.

3. Results

We first checked whether there was significant difference in the average mean scores between the1st grade students of the five departments.

Table 2: Analysis of variance in the entry mean scores of 1st grade for all departments

Source of Variation	DF	SS	MS	F-Value	P-Value
Departments	4	592.0	148.0	4.65	0.005
Error	27	858.8	31.8		
Total	31	1450.8			

The table indicates a significant difference in the scores of 1st grade students in the departments, and biology department with an average mean score of 78 was the outlier, and therefore different from others. Similarly, we checked whether there were significant differences in the average mean scores between the 2nd, 3rd, and 4th grade students of the four departments.

Table 3: Analysis of variance in the entry mean scores of 2nd grade for all departments

Source of Variation	DF	SS	MS	F-Value	P-Value
Departments	3	507.8	169.3	2.21	0.109
Error	28	2141.9	76.5		
Total	31	2649.7			

Although the table indicates a non-significant difference in the scores of 2nd grade students in the departments, biology department has an average mean score of 77.714 which is still larger than the other departments (71.2, 70.133, 67.529).

Table 4: Analysis of variance in the entry mean scores of 3rd grade for all departments

Source of Variation	DF	SS	MS	F-Value	P-Value
Departments	3	1597.4	532.5	11.92	0.000
Error	34	1518.9	44.7		
Total	37	3116.3			

The table indicates a significant difference in the scores of 3rd grade students in the departments, and biology department with an average mean score of 79.976 was the outlier, and therefore different from others.

Table 5: Analysis of variance in the entry mean scores of 4th grade for all departments

Source of Variation	DF	SS	MS	F-Value	P-Value
Departments	3	125.4	41.8	0.80	0.506
Error	23	1200.0	52.2		
Total	26	1325.4			

The table indicates a non-significant difference in the scores of 4th grade students in the departments, biology department has an average mean score of 74.368 which is still larger than the other departments. We did another analysis for biology department to make sure that the average mean scores for the rest of the grades did not differ significantly to affect the validity of the results. Indeed, the analysis of variance for biology department showed no significant difference in the mean scores of the students at time of admission. The results are shown in table 6 below.

Table 6: Analysis of variance in the entry mean scores of all grades for biology department

Source of Variation	DF	SS	MS	F-Value	P-Value
Grades	3	122.3	40.8	0.64	0.599
Error	28	1797.2	64.2		
Total	31	1919.5			

The table indicates a non-significant difference in the entry mean scores of all grades for biology department.

4. Regression Analysis

Since biology department was found to have a statistically significant difference in the mean scores, regression analyses were performed separately. The first analysis was performed only for biology department to evaluate the fitness of the model. In the model, high school mean score was used as a dependent variable (y) and the rest of the scale items as independent variables ($x_1, x_2, \ldots, x_{21}$), excluding the department item.

The regression model.

$$\hat{y} = 67.7 + 5.07x_1 - 0.4x_2 + 7.31x_3 - 2.27x_4 + 1.64x_5 - 1.53x_6 + 1.99x_7 - 0.01x_8 - 3.11x_9 - 0.19x_{10} - 0.89x_{11} - 4.27x_{12} + 2.44x_{13} - 8.50x_{14} - 3.66x_{15} - 2.36x_{16} - 1.98x_{17} + 1.65x_{18} + 2.32x_{19} + 6.14x_{20} + 5.15x_{21}$$

Table 7: Predictor scale items for Biology department

Predictor Variable	SE Coef.	T-Value	P-Value
Average score in the high school certificate examination (y)	29.12	2.33	0.042
Type of Course (x_1)	4.636	1.09	0.299
Country of Certification (x_2)	12.56	-1.03	0.977
Age (x_3)	3.151	2.32*	0.043
Gender (x_4)	5.241	-0.43	0.673
Family monthly income in Iraqi Dinars (x_5)	1.387	1.18	0.265
The father's educational level (x_6)	2.015	-0.76	0.465
Father's job (x_7)	1.621	1.23	0.248
Mother's job (x_8)	2.610	-0.00	0.996

Table 8: Predictor scale items for Biology department (cont.)

Predictor Variable	SE Coef.	T-Value	P-Value
The mother's educational level (x_9)	1.310	-2.38*	0.039
Place of residence (x_{10})	1.031	-0.19	0.856
Does another family leave with your family? (x_{11})	4.099	-0.22	0.832
House ownership status (x_{12})	4.678	-0.91	0.382
Number of rooms in the house (x_{13})	3.306	0.74	0.477
Number of males in the family (x_{14})	3.582	-2.37*	0.039
Number of females in the family (x_{15})	2.608	-1.40	0.190
Ranking among the family (x_{16})	1.232	-1.92	0.084
Do you work beside the study? (x_{17})	3.495	-0.57	0.583
Number of hours for daily study at home (x_{18})	2.582	0.64	0.537
Did you take private lessons (x_{19})	5.522	0.42	0.683
Number of times high school certificate examination taken (x_{20})	3.859	1.59	0.143
Mode of transport to and from school (x_{21})	1.636	3.15*	0.010

Consequently, variables that were not significant were deleted from the model. Four items were found to be strong predictors of the model fitting 86.4% of the data.

$$\hat{y} = 75.9 + 5.22x_3 - 3.16x_9 - 4.53x_{14} + 3.16x_{21}$$

Table 9: Strong predictor scale items for Biology department

Variable	Predictor	SE Coef.	P-Value
y	Score in high school certificate examination	6.520	0.000
x_3	Age of the respondent	2.419	0.040
x_9	Mother's education level	0.8724	0.001
x_{14}	Number of males in the family	1.977	0.030
x_{21}	Mode of transportation to school	1.009	0.004

The second regression analysis was performed on all departments except biology. Again, high school mean scores were used as a dependent variable and the remaining scale items as independent variables in the multiple linear regression model below,

$$\hat{y} = 71.8 - 0.93x_1 + 3.19x_2 + 1.41x_3 + 1.58x_4 - 0.165x_5 - 0.347x_6 - 0.702x_7 - 0.19x_8 + 0.278x_9 - 1.55x_{10} + 3.97x_{11} + 1.91x_{12} - 1.01x_{13} - 0.81x_{14} - 0.091x_{15} - 0.077x_{16} - 3.04x_{17} + 0.19x_{18} + 0.91x_{19} - 3.04x_{20} + 0.061x_{21}$$

Table 10: Predictor scale items for all departments except biology department

Predictor Variable	SE Coef.	T-Value	P-Value
Average score in the high school certificate examination (y)	12.53	5.73	0.000
Type of Course (x_1)	1.189	-0.78	0.438
Country of Certification (x_2)	2.530	1.26	0.211
Age (x_3)	1.402	1.01	0.318

Table 11: Predictor scale items for all departments except biology department (cont.)

Predictor Variable	SE Coef.	T-Value	P-Value
Gender (x_4)	1.796	0.88	0.382
Family monthly income in Iraqi Dinars (x_5)	0.6279	-0.26	0.793
The father's educational level (x_6)	0.6826	-0.51	0.612
Father's job (x_7)	0.8135	-0.86	0.391
Mother's job (x_8)	1.218	-0.15	0.879
The mother's educational level (x_9)	0.6661	0.42	0.677
Place of residence (x_{10})	0.7090	-2.19*	0.032
Does another family leave with your family? (x_{11})	2.607	1.52	0.132
House ownership status (x_{12})	2.589	0.74	0.463
Number of rooms in the house (x_{13})	1.158	-0.88	0.384
Number of males in the family (x_{14})	1.173	-0.69	0.491
Number of females in the family (x_{15})	0.9261	-0.10	0.922
Ranking among the family (x_{16})	0.4350	-0.18	0.861
Do you work beside the study? (x_{17})	1.976	-1.54	0.128
Number of hours for daily study at home (x_{18})	1.268	0.15	0.881
Did you take private lessons (x_{19})	1.748	0.52	0.603
Number of times high school certificate examination taken (x_{20})	1.136	-2.68*	0.009
Mode of transport to and from school (x_{21})	0.6558	0.09	0.926

Consequently, from the analysis, variables that were found to be weak predictors or non-predictors were deleted, leaving only 2 items that were strong predictors of the model.

$$\hat{y} = 75.9 - 1.12x_{10} - 2.15x_{20}$$

Table 12: Strong predictor scale items for all departments except biology department

Code	Predictor	SE Coef.	P-Value
y	Score in high school certificate examination	2.783	0.000
x_{10}	Place of residence	0.9104	0.046
x_{20}	Number of times a student took the high school certificate exam	0.5540	0.020

A two samples t-test analysis done to see if there is a significant difference in the average high school scores between biology department students and students from other departments.

Table 13: 2-Samples t-test analysis between biology department and other departments

Department	Sample size	Mean	Std Deviation	t-value	P-Value
Biology	32	78.30	7.87	6.694**	0.000
Others	96	68.484	6.946		

From Table 13, it's clear that there is a high significant difference in the high school average scores between biology department students and students from other departments. This result therefore confirms our findings in table 2 and table 4 above, which led to biology department being analyzed separately from other departments.

5. Descriptive Analysis

Table 1 indicates that ELT department produced the highest number of students sampled, accounting for about 37% of the total sample size. Interestingly, half of the respondents' background is in the arts and other fields. This is a significant find given that all departments in the faculty, other than ELT, are science oriented. From the Minitab analysis, the average mean score for all students was 70.935 which is relatively low for science-based courses at university. Further analysis revealed that slightly more than half of the respondents (58%) have a high school mean score of 70, which is less than the average mean score. Only about 10% of the respondents have a high school mean score of 80 and above, with the highest being 95. The result also shows that 97% are Iraqi nationals and majority of them (52%) were female respondents.

Looking at the socioeconomic aspect, we found that a quarter of the responds' families do not have any form of income. This is a large population considering that Kurdistan is not very populous. It is important to note that about 70% of the respondents' families survive on a monthly income of less than $500 USD. This may partly be due to the large number of fathers (70%) with no steady or official employment, and mothers who are simply housewives (96%). The employment status may be linked directly to the level of education, especially for men, for instance, in this research 70% of the fathers have only secondary school level education and below, these men in most cases would not want to marry women who are more educated than them. Indeed, about 40% of the mothers do not have any formal education and more than 75% have only up to secondary level education, which explains why 86% of them do not have formal employment and are full time housewives.

Despite majority (91%) of them either staying in the dormitory or with their families, they share spaces in these places of domicile which affects how they study. For instance, almost a quarter of them live with other families in their homes, and most (88%) live in rented houses which are often small with 5 or less rooms (63%). The number of males in each household is more than that of females by about 7%. Being a patriarchal society, the difference implies more burdens to the girls in the family, which may explain the less daily number of hours of study, less than 3 hours per day for 64% of the respondents. This number of hours is quite less in a competitive environment where everyone takes a standardized test from the government. The alternative would be having private classes, but majority (72%) do not enjoy such luxury which may be a contributing factor to three-quarters of them taking the standardized test more than ones to pass. The other reason could be waste of time walking to and from school because slightly more than half of the respondents either walked to school or used public transport, which is not very convenient.

6. Discussion

Several conclusions can be drawn from this research. It's evident that biology major attracts students with higher GPA as compared to other departments in the faculty of education. The higher GPA for these students was influenced by 4 factors: their age, their mothers' educational level, the number of males in their families, and mode of transport to and from school. Higher educational levels for mothers could translate into a better GPA for children because such mothers pay attention to the children's education, this result was also obtained by Gormley, Pinho, Pollack, Puzino, Franklin, Busch & Anastopoulos, (2018) who were looking at parents' education level as a mediating factor in the relationship between study skills and GPA. Indeed, these mothers take children to school at a young age, hence the age factor as a predictor of high school GPA. Shaaban & Reda, (2021) on the other hand agree with this paper's finding that mode of transport is predicting factor for GPA, although their study was on college GPA. This research also supports Powell & Steelman, (1990) who first reported that the number of male siblings negatively affects the GPA of those in school.

The analysis for other departments showed two factors to be strong predictors of GPA; place of residence and the number of times a student took the high school certificate examination. The result on place of residence is consistent with Kamazima, (2020) who found that students residing in hostels (especially gender segregated hostels) had better academic performance, but Snyder, Kras, Bressel, & Reeve, (2011) found no significant difference between these 2 constraints. In this research, a possible explanation would be that many students stay in their family homes which expose them to conditions that are not conducive for academic growth.

7. Recommendations

Based on the findings of this study, the following recommendations are strongly put forward. First, the relevant stakeholders in the education industry should conduct civic education to sensitize mothers with low education level, on the importance of education for their children, especially the girl child. In the same vein, the government and civil societies to conduct mass education on the importance of sharing responsibilities in a family. This will ensure that the girl child is not overburdened in families where the number of males is higher. Alternatively, to build special, gender segregated dormitories for students. The government should make policies that force or strongly encourage parents to take their kids to school at early, but appropriate age. Lastly, schools in conjunction with other stakeholders should provide affordable and easily available means of transport for school going children.

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