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The Legitimacy of Admission Criteria in Predicting the Achievement of the Students in the Medical Colleges at the University of Hafr Al-Batin

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Abstract. The purpose of this study is to show how the admission criteria can predict first-year college students' performance. The study uses the data of the students' high school GPA (HSGPA) and the scores of the Prerequirement standardized tests in the Kingdom of Saudi Arabia(achievement test score (ACT) and aptitude score (APT)), and the data of the first-year college GPA for correlations analysis and inferential statistics. As far as we are aware, no study has been conducted or has been made publicly accessible regarding the validity of admission criteria of the medical colleges at the University of Hafr Batin. The Bayesian Information Criterion and the Akaike Information Criterion are applied as model selection criteria in order to select the best model. Actual data is used to establish the legitimacy of the admission criteria.

1. Introduction

Making standardized tests a requirement for admission to universities has gained popularity in recent decades. The effectiveness of admission examinations in predicting students' chances of success and predicting their college GPA based on entrance exams - high school GPA (HSGPA), ACT score, and APT score - has been the subject of several studies undertaken across the world. A significant number of research have focused on analyzing student populations from various universities. When examining the validity of the entrance test results for various institutes, it might be challenging to get an overall mean connection between the admission test scores and HSGPA since the data must be integrated in an attentive manner. For instance, [1] separately determined the correlations for each institution, adjusted the correlations using the [2] correction technique, and then calculated the average correlation

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for numerous institutes. [1]'s report states that when comparing private and public organizations, the results of a thorough investigation into the validity of admissions exams were presented, and it was discovered that the correlation between the admission tests and HSGPA and (FYGPA) is a little bit lower for public schools.

[3]'s investigation of the numerous correlations between entrance test scores and FYGPA of student populations across a variety of universities was part of a study that concentrated on several correlations of various institutions. The correlation between admission exam scores and FYGPA of student populations in institutions with a greater range of extracurricular activities is less than that of those who stayed in the institutes' housing, according to the conclusions of their study. The study highlighted on several aspects of the report, such as the higher correlation between entrance test scores and FYGPA for liberal arts institutions than for the other universities included in the report. Additionally, small towns' institutes show a stronger correlation when compared to those in large cities [4] looked at student demographics across many University of California campuses for their research, and they got to the conclusion that there are differences between campuses in the correlation between entrance test scores and FYGPA.

Although research including many institutions are helpful, they do not directly address the degree to which entrance exams correspond to student performance across multiple institutes or the related factors that contribute to that variability. It can be difficult to extrapolate the results of studies on the accuracy of standardized tests and HSGPA in forecasting students' achievement across a variety of schools. Each institute has a multi-layered clustering of its student body that takes into account factors like HSGPA, programs, colleges, and a variety of other factors. The requirements and testing processes for admission to various colleges within the same university vary as well.

In order to give more comprehensive information on the greatest predictor of college students' GPAs, several institutes conducted regional research. Other studies have examined the relationships between certain departments and entrance test results, while others have examined the relationships between the GPAs of specific courses and the scores on those exams. The average achievement test score (ACH), high school class rank, and the SAT were determined to be the top predictors of student accomplishment at the University of Pennsylvania, according to [5] research on the best predictors of admission requirements.

At the University of California, San Diego, researchers examined the GPAs of more than 5,000 students [6]. The article came to the conclusion that both the HSGPA and SAT greatly improve student performance predictions. Using a sample of 521 students enrolled in a few classes of Principles of Economics courses, [7] investigated the extent to which the HSGPA and SAT may predict performance at the University of South Carolina.

Admission to Saudi universities was based on the HSGPA prior to the Saudi Ministry of Education turning toward the use of standardized exams as entry criteria for institutions. Saudi colleges employ high school grade point average and standardized examinations like the ACT and APT to assess admission. The ACT and APT exams are usually viewed by Saudi colleges as being better and more accurate indicators of success than the HSGPA since all students are examined using the same materials and under the same conditions [8]. While the APT test's outcome is focused on the verbal and quantitative components, the ACT test is a thorough review of High School courses in biology, chemistry, physics, mathematics, and English. For more details, see the following, [8].

Since there are so many secondary school graduates and there aren't enough slots in medical colleges (College of Medical Sciences and College of Pharmacy), Students competing for places at the University of Hafr Al-Batin are graded on standardized examinations and HSGPA, then the University of Hafr Al Batin will make a choice based on the FYGPA after initially admitting the students to the medical route for a year. Students with good GPAs have the option of enrolling in a department of one of the two schools of their choosing, while those with lower GPAs are offered the chance to improve their grades or transfer to another college.

To the best of our knowledge, no study nor results of research on the usefulness of the criteria for admission to medical colleges at the University of Hafr Batin have been published. The efficiency of standardized examinations and HSGPA in predicting FYGPA for students in the medical colleges at the University of Hafr Al-Batin is therefore examined for the first time in this study.

The rest of this article is divided into the following sections. The descriptive statistics for the actual data are shown in Section 2.The relationship between the inputs (HSGPA, APT, and ACT) and the outcome is demonstrated in Section 3 (FYGPA). The validity of the ACT, APT, and HSGPA in predicting FYGPA is discussed in Section 4 along with the results of the inferential statistics. Section 5 of this report presents the investigation's key conclusions.

2. Descriptive Statistics

This study was conducted at the University of Hafr Al-Batin, a public university with a predominance of female students. The study's data were given by the university's Decision support and performance control section. The sample consisted of 197 male and 422 female students who were accepted in the Fall of 2019. The University of Hafr Al-Batin used a 4.00 scale to determine the GPA. The `Rstudio` program was utilized for the data analysis.

2.1. **Dataset Distribution.** Descriptive statistics are used in this part to characterize a dataset that was utilized in the study's analysis in terms of its features and characteristics, Tables (1) - (3), for 422 female and 197 male students which represented graphically in Figure (1).

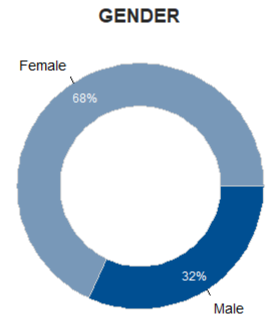

Figure 1. Pi-chart of the Distribution of the dataset

2.2. **Central Tendency.** Concentrating on the measures that characterize a variety of central measurements such as the mean and the median by looking at the usual central values within a dataset. The mean and median measures are clearly bigger for female students than male students for all scores. For instance, for female students, the median measurements for ACT, APT, HSGPA, and FYGPA are $M = 85$, $M = 82$, $M = 98$, and $M = 3.51$, while for male students are $M = 77$, $M = 79$, $M = 94$, and $M = 3.2$, respectively. Also, for female students, the mean measurements for ACT, APT, HSGPA, and FYGPA are $m = 84.1$, $m = 80.8$, $m = 97.03$, and $m = 3.45$, meanwhile for male students are $m = 77.8$, $m = 79.09$, $m = 93.9$, and $m = 3.2$, respectively. It is noticeable the mean of HSGPA is higher than the mean of FYGPA for both genders, which is an indication that the studies at the university are harder than the high schools.

2.3. **Variability.** The dispersion or variability of a dataset is described in this section. Considering that the term "variability" is used to describe a variety of metrics rather than just one single measure, such as standard deviation, range, kurtosis, skewness, minimum, and maximum values. The values of skewness and kurtosis of the ACT, APT and HSGPA do not exceed [-1, +1] and hence the distribution of the data is considered to be normal.

- **Standard deviation:** It is notable that for both genders, the amount of variation or dispersion for the standardized test is high while it is low for HSGPA which implies that most HSGPAs are close to the mean of HSGPA. Due to grading practices among high schools, high school grades are frequently seen as an unreliable criterion for college admissions, whereas standardized tests are seen as methodologically rigorous and offer a clear differentiation which is seen as more consistent and reliable for evaluating student ability and achievement.
- **Minimum and maximum values:** The minimum scores and GPAs for male students are lower than the minimum scores and GPAs for female students, moreover, the maximum values for male students are also lower than the maximum values for female students in most values.

Table 1. Descriptive Statistic of the Data for All Students

Descriptive Statistics	ACT	APT	HSGPA
nobs	619.000000	619.000000	619.000000
Minimum	64.000000	60.000000	81.000000
Maximum	98.000000	96.000000	100.000000
1. Quartile	76.000000	75.000000	94.000000
3. Quartile	89.000000	86.000000	99.000000
Mean	82.095315	80.261712	96.024233
Median	82.000000	80.000000	97.000000
SE Mean	0.300020	0.280580	0.132329
LCL Mean	81.506133	79.710707	95.764364
UCL Mean	82.684497	80.812718	96.284101
Variance	55.717438	48.730749	10.839218
Stdev	7.464411	6.980741	3.292297
Skewness	-0.000542	-0.134540	-1.153213
Kurtosis	-0.971225	-0.736097	1.380372

Table 2. Descriptive Statistic of the Data for Female Students

Descriptive Statistics	ACT	APT	HSGPA
nobs	422.000000	422.000000	422.000000
Minimum	65.000000	60.000000	88.000000
Maximum	98.000000	96.000000	100.000000
1. Quartile	78.000000	75.000000	96.000000
3. Quartile	90.000000	87.000000	99.000000
Mean	84.097156	80.810427	97.030806
Median	85.000000	82.000000	98.000000
SE Mean	0.346179	0.362663	0.121868
LCL Mean	83.416702	80.097572	96.791260
UCL Mean	84.777611	81.523281	97.270351
Variance	50.572486	55.503169	6.267457
Stdev	7.111433	7.450045	2.503489
Skewness	-0.183496	-0.199223	-1.052477
Kurtosis	-0.999609	-0.868899	0.953448

Table 3. Descriptive Statistic of the Data for Male Students

Descriptive Statistics	ACT	APT	HSGPA
nobs	197.000000	197.000000	197.000000
Minimum	64.000000	64.000000	81.000000
Maximum	92.000000	90.000000	100.000000
1. Quartile	73.000000	75.000000	92.000000
3. Quartile	82.000000	83.000000	97.000000
Mean	77.807107	79.086294	93.868020
Median	77.000000	79.000000	94.000000
SE Mean	0.450280	0.405518	0.265246
LCL Mean	76.919090	78.286556	93.344917
UCL Mean	78.695123	79.886032	94.391123
Variance	39.942194	32.395577	13.860044
Stdev	6.319984	5.691711	3.722908
Skewness	0.255537	-0.258531	-0.723645
Kurtosis	-0.672641	-0.609607	0.200854

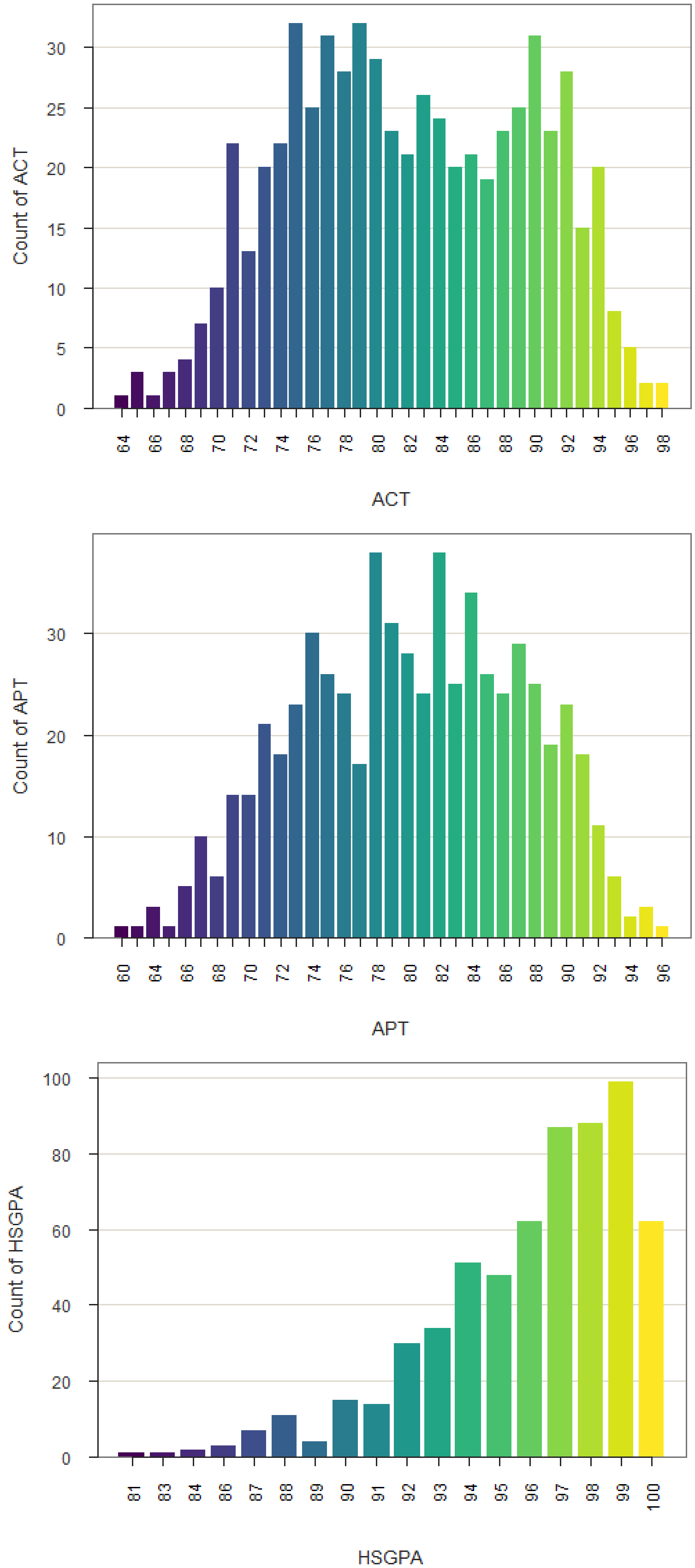

Figure 2. The plot of standardized tests and HSGPA for all Students

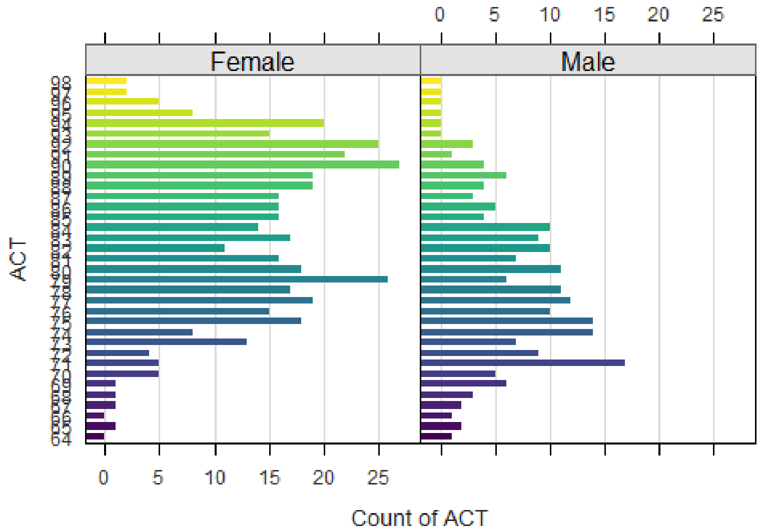

Figure 3. The plot of standardized test (ACT) for all Students by Gender

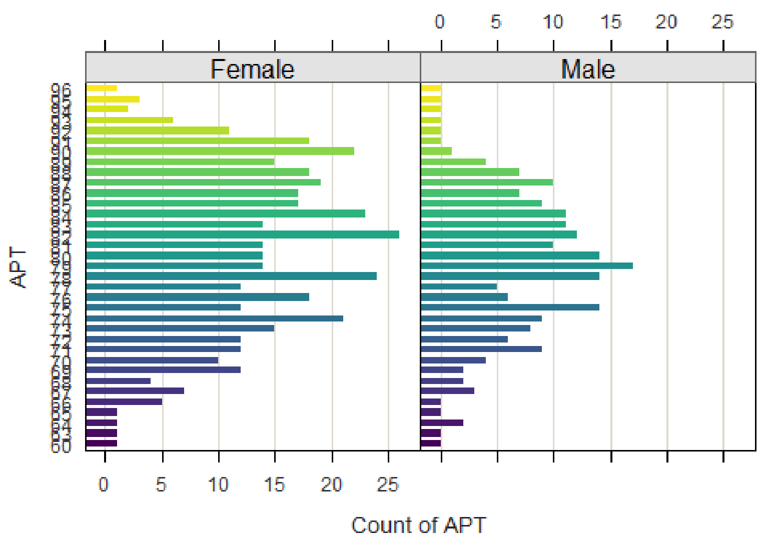

Figure 4. The plot of standardized test (APT) for all Students by Gender

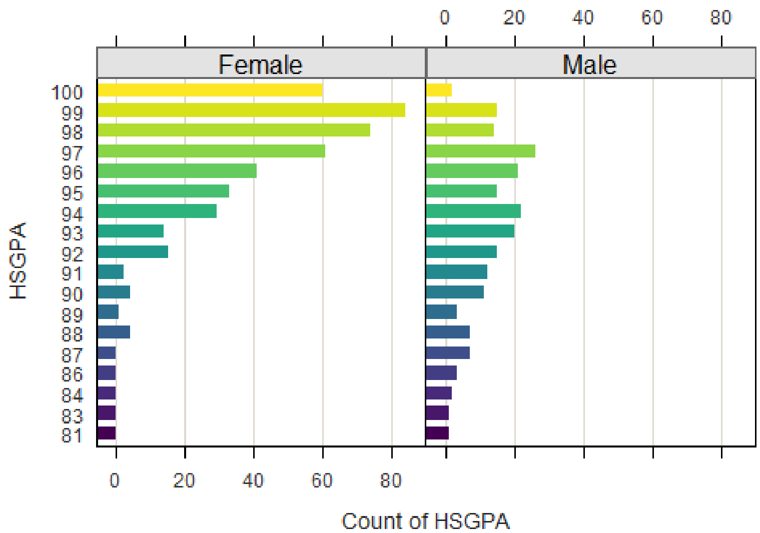

Figure 5. The plot HSGPA for all Students by Gender

3. Correlation

The effectiveness of the entrance requirements and FYGPA is evaluated quantitatively (via correlation) in this section. In general Table (4) shows a moderate correlation between each of ACT, APT, HSGPA, and FYGPA. At a glance, it can be seen that there is a correlation between each variable (ACT, APT, HSGPA) and FYGPA. As each value increases, FYGPA also tends to increase. Figure (6) demonstrates the relationship between each variable and FYGPA, each dot on the plots represents an individual student and her/his combination of each variable (say ACT) and FYGPA.

Things get interesting when analyzing the correlation by gender as shown in Tables (5) and (6). The correlation between each variable and FYGPA remains but is stronger for females than males for every single variable. In Table (5) $r = 0.65$ for ACT for females in compression to $r = 0.29$ for males. For APT and HSGPA $r = 0.56$ and $r = 0.51$, respectively, for female students, in contrast to $r = 0.15$ and $r = 0.25$. For both genders, the ACT is the best predictor for FYGPA, and this needs to be confirmed by inferential statistics as well.

Table 4. Correlation between the Inputs (ACT, APT, HSGPA) and the Outcome (FYGPA) for Male and Female students

Correlation	ACT	APT	HSGPA
FYGPA	0.5766857		
FYGPA		0.443804	
FYGPA			0.459829

Table 5. Correlation between the Inputs (ACT, APT, HSGPA) and the Outcome (FYGPA) for Female students

Correlation	ACT	APT	HSGPA
FYGPA	0.6504502		
FYGPA		0.5562798	
FYGPA			0.5073873

Table 6. Correlation between the Inputs (ACT, APT, HSGPA) and the Outcome (FYGPA) for Male students

Correlation	ACT	APT	HSGPA
FYGPA	0.2907015		
FYGPA		0.1590556	
FYGPA			0.2510924

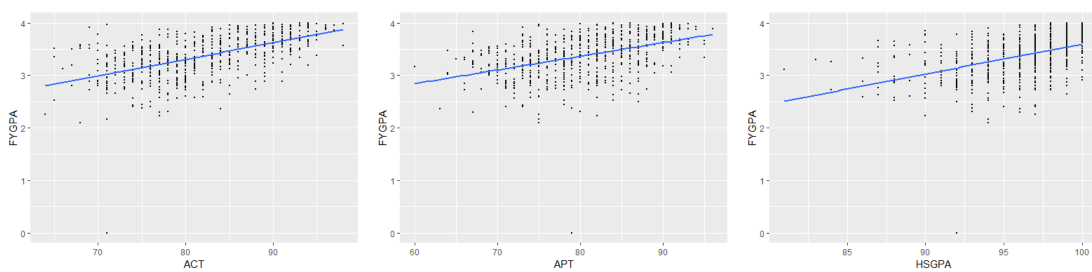

Figure 6. The plot of the correlations between (ACT, APT, HSGPA) and FYGPA for all Students

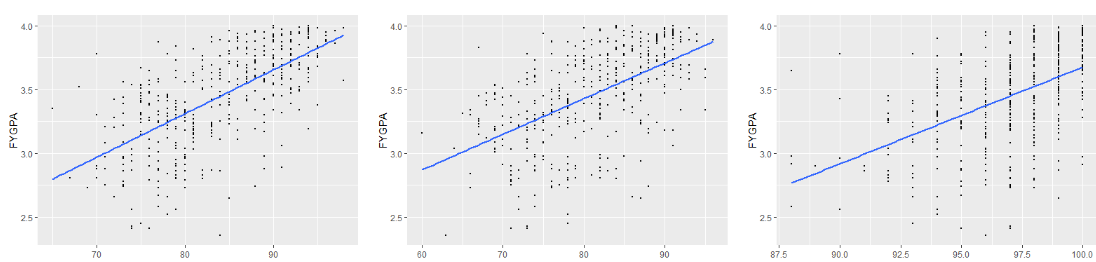

Figure 7. The plot of the correlations between (ACT, APT, HSGPA) and FYGPA for Females

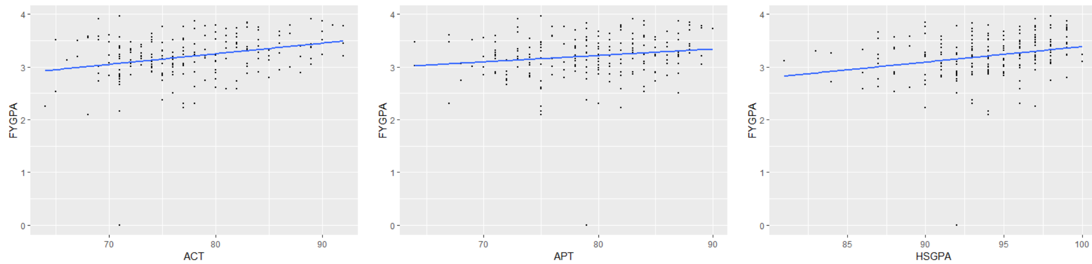

Figure 8. The plot of the correlations between (ACT, APT, HSGPA) and FYGPA for Males

4. Inferential statistics

Section (2) established the descriptive statistics and concentrated on describing the important aspects of the study's dataset. Moreover, section (3) demonstrated that there exists a positive correlation between each variable and FYGPA for both genders ranging from weak to relatively strong correlation, depending on the variable but ACT remains the best predictor for female and male students. Regression analysis, which is presented in this section, is also necessary to validate that. The regression analysis for the study's data is shown in table (7), and the analysis by gender is shown in table (8). Using the models below, Table (7) and Table (8) assess the impacts of the predictors (ACT, APT, and HSGPA) on the first-year college performance:

$$Y = \beta_0 + \beta_1 X_1 + \epsilon \tag{4.1}$$

where Y is the outcome (FYGPA), X_1 is the explanatory variable (ACT), and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \epsilon \tag{4.2}$$

where Y is the outcome (FYGPA), X_1 is the explanatory variable (APT), and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \epsilon \tag{4.3}$$

where Y is the outcome (FYGPA), X_1 is the explanatory variable (HSGPA), and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{4.4}$$

where Y is the outcome (FYGPA), ϵ is the random error, and X_1 and X_2 are the explanatory variables ACT and APT respectively.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \tag{4.5}$$

where Y is the outcome (FYGPA), ϵ is the random error, and X_1, X_2, and X_3 are the explanatory variables ACT, APT, and HSGPA, respectively.

When the entire percentile score for the predictors is zero, the intercepts indicate the average FYGPA. It is clear that no student has a score of zero, hence it is useless to evaluate the intercepts in these specific regression models (4.1) - (4.5). As a result, it is safe to leave them out. The slopes for single-variable models (i.e. (4.1) - (4.3)) show that, on average, the FYGPA tends to increase by 0.057, 0.032, and 0.026 for every increase of one in the ACT, APT, and HSGPA, respectively. Model (4.1) explains 33% of the variation of FYGPA which is the highest percentage among the single-variable models, moreover, (4.1) has the smallest value in compression to (4.2) and (4.3), but in compression to (4.1) and (4.5), clearly, the model that included all the variables (4.5) is the best.

Table 7. Regression Analysis for all Students

Coeff \ Model	Model 1	Model 2	Model 3	Model 4	Model 5
Num.Obs.	619	619	619	619	619
(Intercept)	0.767	1.277	-2.137	0.466	-2.340
ACT	0.057	-	-	0.027	0.020
APT	-	0.032	-	0.009	0.010
HSGPA	-	-	0.026	-	0.034
R2	0.333	0.211	0.197	0.347	0.410
R2 Adj.	0.331	0.196	0.210	0.345	0.407
AIC	410.3	524.8	513.5	398.7	338.1
BIC	423.6	538.1	526.8	416.4	360.3

In order to see how gender influences the variances in FYGPA, the following models will be used:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{4.6}$$

where Y is the outcome (FYGPA), X_1 and X_2 are the explanatory variable (ACT) and gender, and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{4.7}$$

where Y is the outcome (FYGPA), X_1 and X_2 are the explanatory variable (APT) and gender, and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{4.8}$$

where Y is the outcome (FYGPA), X_1 and X_2 are the explanatory variable (HSGPA) and gender, and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \tag{4.9}$$

where Y is the outcome (FYGPA), X_1, X_2 and X_3 are the variables ACT, APT and gender, respectively, and ϵ is the random error.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon \tag{4.10}$$

where Y is the outcome (FYGPA), X_1, X_2, X_3 and X_4 are the variables ACT, APT, HSGPA and gender, respectively, and ϵ is the random error.

The intercepts show the average FYGPA when all of the predictors' percentile scores are 0. No student has a score of zero, hence it serves no purpose to interpret the intercepts in these particular regression models (4.6)-(4.10). As a result, it is safe to neglect them.

When gender is taken into account. According to each model (4.6-4.8), an ACTscore change of one percentile correlates to a change in FYGPA of 0.052 points on average and males' FYGPAs drop on average by -0.055 points, while a one percentile change in the APT score correlates to a change in FYGPA of 0.030 and males' FYGPAs drop on average by -0.20 points, and finally, in the model (4.8), gender is taken into account, a one percentile change in HSGPA score is correlated with a 0.025 point change in FYGPA, on average, and males' FYGPAs drop on average by -0.081 points. Model (4.10) explains greater differences in FYGPA than models (4.6- 4.9), according to $R^2 Adj$ model comparisons. Additionally, model (4.10) is the best model, according to AIC and BIC model comparisons, as it has lower values than models (4.6- 4.9).

Table 8. Regression Analysis by Gender

Coeff \ Model	Model 6	Model 7	Model 8	Model 9	Model 10
Num.Obs.	619	619	619	619	619
(Intercept)	0.895	1.467	-1.620	0.610	-2.388
ACT	0.052	-	-	0.024	0.020
APT	-	0.030	-	0.010	0.009
HSGPA	-	-	0.025	-	0.035
GENDERMale	-0.055	-0.204	-0.081	-0.07	6 0.008
R2	0.336	0.250	0.218	0.353	0.410
R2 Adj.	0.334	0.247	0.216	0.350	0.406
AIC	409.2	484.8	510.2	394.9	340.0
BIC	427.0	502.5	527.9	417.0	366.6

5. Conclusion

This article found that ACT is a better predictor of first-year GPA for medical students than APT and HSGPA since they have different effects on FYGPA based on a student's gender. In order to better understand the connections between academic ability and academic success, this article examines the academic components typically utilized in college entrance applications and used by the university to assess admission. Future studies may take into account extracurricular aspects including family income, parents' educational backgrounds, and environmental influences. Investigating the relationship between the graduate GPA in compression and the FYGPA is another option.

Conflicts of Interest: The author declares that there are no conflicts of interest regarding the publication of this paper.

References

[1] J.L. Kobrin, B.F. Patterson, E.J. Shaw, et al. Validity of the Sat® for Predicting First-Year College Grade Point Average, Research Report no. 2008-5., College Board (2008).

[2] D. Lawley, IV.—A Note on Karl Pearson's Selection Formulæ, Proc. R. Soc. Edinburgh Sect. A: Math. 62 (1944), 28–30. https://doi.org/10.1017/S0080454100006385.

[3] L.L. Baird, Predicting Predictability: The Influence of Student and Institutional Characteristics on the Prediction of Grades, ETS Res. Rep. Ser. 1983 (1983), i–11. https://doi.org/10.1002/j.2330-8516.1983.tb00030.x.

[4] R. Zwick, T. Brown, J.C. Sklar, California and the Sat: A Reanalysis of University of California Admissions Data, Research & Occasional Paper Series: CSHE.8.04. University of California, Berkeley, (2004).

[5] J. Baron, M.F. Norman, Sats, Achievement Tests, and High-School Class Rank as Predictors of College Performance, Educ. Psychol. Measure. 52 (1992), 1047–1055. https://doi.org/10.1177/0013164492052004029.

[6] J.R. Betts, D. Morell, The Determinants of Undergraduate Grade Point Average: The Relative Importance of Family Background, High School Resources, and Peer Group Effects, J. Human Resources. 34 (1999), 268-293. https://doi.org/10.2307/146346.

[7] E. Cohn, S. Cohn, D.C. Balch, et al. Determinants of Undergraduate Gpas: Sat Scores, High-School Gpa and High-School Rank, Econ. Educ. Rev. 23 (2004), 577–586. https://doi.org/10.1016/j.econedurev.2004.01.001.

[8] National Center for Assessment in Higher Education, https://etec.gov.sa/en/Pages/default.aspx.