

## Graduation Completion amongst IB and AP Students in Postsecondary Education

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Students in high school with advanced placement (AP) course credit and international baccalaureate (IB) exams receive special consideration when applying for admission to universities. How do these two groups of students compare in terms of graduation success? Propensity score matching was conducted to achieve an equal number of students in the IB and AP student groups because of the disproportionate number of AP students admitted to the university. This study compared IB and AP students who were incoming freshman at two southern universities to assess any difference in graduation completion using logistic regression. Results indicated comparable graduation completion amongst IB and AP students. The key indicator for graduation completion was whether entering freshman had a low grade point average their first year.

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**H**igh school graduates enroll in college to earn a degree, however, some students do not graduate. An institution fails to retain its students if the student does not graduate from where they started according to Seidman (2005), who defined student retention as the “ability of a particular college or university to successfully graduate the students that initially enroll at that institution” (p.3). The U.S. Department of Education’s Center for Educational Statistics reported that only 50% of those who enroll in college earn a degree (Siedman). Student graduation is therefore a very important indicator of academic performance and enrollment management by a university.

The key to effectively understanding this complex balance between enrollment and graduation is in the application of a predictive model. Admissions personnel and management must be able to predict future criteria for a student who graduates, or who does not graduate, and be able to help students who will not graduate. Having such accurate predictions will greatly aid in the ability of the administration of a university to keep this positive balance between growth, quality, retention, and graduation. Offices of institutional research at universities are keenly interested in researching characteristics of students who are not retained and fail to graduate.

A traditional indicator of college completion has been the advanced placement (AP) courses taken by high school students (DiYanni, 2008). Research has previously indicated that AP courses taken by high school students better prepared them for the challenging college curriculum (Hargrove, Godin, & Dodd, 2008). Moreover, students admitted to colleges and universities with AP credit completed their studies and graduated (Dougherty, Mellor, & Jian, 2006). International baccalaureate (IB) course credit, an alternative approach for preparing high school students, has also been studied as an indicator of college completion (Byrd, 2007). Universities are, therefore, interested in attracting high school students who have taken advanced placement courses, knowing that they are more successful in college and graduate.

As reported by Bergeron (2015), success in postsecondary education may be associated with participation in an IB program (Coca et al., 2012; Caspary & Bland, 2011; Shah, Dean, & Chen, 2010b).

Past research has examined the efficacy of AP students and IB students in pursuing a postsecondary degree, especially college completion. The International Baccalaureate Organization (IBO) (2012) published a summary of recent research on IB students, including standards alignment, program implementation, learner profile, and student performance. Past studies have compared AP to non-AP students, IB to non-IB students, and a few have compared AP and IB student performance. The comparisons were often difficult based on the types of courses taken and the relation between the AP

exams and the IB examination process. IBO provides SL and HL exams where HL exams are considered associated with higher level coursework, hence, more rigorous. No study was found that directly compared AP and IB students in terms of graduation completion. The current study, therefore, investigated graduation completion amongst AP and IB freshman students who were admitted to two universities with these status designations.

## Methods and Procedures

### *Participants*

The number of IB and AP freshman students at two southern universities were identified for the 2007 first semester freshman class. The data consisted of entering freshman status in 2007 (i.e., AP or IB), gender, race, graduation completion, and grade point averages for a six year period (i.e., from 2007 to 2012). The number of AP students were greater than the number of IB students at both universities. Specifically in 2007,  $n = 48$  IB freshmen students compared to  $n = 1,733$  AP freshmen students at one university, and  $n = 231$  IB freshmen students compared to  $n = 4,376$  AP freshmen students at the second university.

Propensity score analysis was conducted to select a matching group of AP freshman students to the IB freshman students at each university (Austin, 2011; Guo & Fraser, 2014; Holmes, 2014). Leite, Sandbach, Jin, MacInnes, and Jackman (2012) have shown that different longitudinal growth models worked well when using propensity score matched groups. However, May et al. (2014) felt that propensity score methods were futile when studying IB students. The rationale was that propensity score methods do not overcome selection bias that results from the voluntary participation of students in the IB program. The current study compared AP and IB students so selection bias was not deemed to be a confounding variable.

Schumacker (2009) pointed out that there are several practical issues to consider when conducting propensity score analysis, especially selection of covariate variables. The present study chose gender and race as covariates when selecting a matching group of AP freshman. These covariates were deemed sufficient for matching given the homogeneous student population of data and lack of other covariate variables.

*R* software was used with the *MatchIt* package using the "nearest neighbor" selection criteria with the covariates (<http://www.r-project.org>). The author wrote an *R* script to read in the SPSS data files from both universities, selected a matching group of students, then wrote-out the IDs to a file (see Appendix). The file of IDs was then used in SPSS to select the matching AP students. Afterwards, the two university SPSS data files were merged. The total number of freshman students were  $n = 558$  (IB = 279 students; AP = 279 students). A de-identified data set was used in the statistical analysis.

### *Research Questions*

The primary purpose of this study was to compare IB and AP students on graduation completion. Of specific interest, was an assessment of the propensity score matching on the covariate variables. The following research questions were addressed in the study:

1. Did propensity score matching achieve a similar number of AP students across gender and race?
2. Is there a statistically significant difference in graduation rates between IB and AP students?
3. Is probability of graduation completion predicted by knowledge of yearly grade point average?

### *Design and Analysis*

The student data were assumed to be accurate because the data were used for generating student academic reports and results at each university. Also, missing data were assumed to be missing completely at random. Data missing completely at random is explained as the probability that an observation that is missing does not depend on the value it would have assumed (Rubin, 1976), which means that the probability of the missing value in one of the variables is dissimilar to the values of any other variables. Some missingness in data was due to yearly attrition (i.e., leaving college), thus, 2011 and 2012 data were not useable.

The data analysis included descriptive, chi-square, logistic regression, and independent samples *t*-tests. The dependent variable was a binary variable, graduate. Graduation in this research study was defined as a first semester entering Freshmen student who may, or may not, have continued over the 2007

to 2010 academic years to graduation completion (i.e., coded as 0 = no; 1 = yes). The set of independent predictor variables were status (i.e., IB versus AP) and the yearly grade point averages (i.e., GPA07 to GPA10). The beginning 2007 grade point average is especially meaningful because research has shown that low first year grade point average was an indicator of not completing college (Raju, 2012).

Logistic regression (LR) used the logit model in analyzing the categorical dependent variable, graduate (Hosmer & Lemeshow, 2000). LR yields an association between the independent variables and the logarithm of the odds of a categorical response variable. Since the target variable graduate is a binary (i.e., yes/no) response, a binary logistic regression model was used. LR analysis applies maximum likelihood estimation after transforming the dependent variable (graduate) into a logit variable (i.e., the natural log of the odds of the dependent response occurring or not), therefore, LR will estimate the odds that an existing student completed, or did not complete, college. LR has proven to be a useful predictive modeling technique because it does not require the usual normal distribution assumptions (Fadlalla, 2005). A more in-depth explanation of the use of LR can be found in Hosmer and Lemeshow; Kleinbaum (1994); Schumacker, Anderson, and Ashby (1999).

## Results

### Propensity Score Matching

It is important to test for differences between groups on the covariate variables when matching subjects to groups in propensity score analysis. A chi-square statistic was used given the categorical nature of the covariate variables. A chi-square analysis of status by gender and status by race are presented below. Table 1 indicates that the cross tabulation of AP and IB students (status) with gender ( $\chi^2 = 1.54, p = 0.21$ ) was not statistically significant. Table 2 indicates that the cross tabulation of AP and IB students (status) with race ( $\chi^2 = 5.27, p = 0.15$ ) was also not statistically significant. The chi-square statistics for the propensity score analyses were non-significant, which indicated that the propensity score matching did provide a similar number of AP matching freshman students across the covariate variable categories.

### Logistic Regression

Logistic regression was conducted using graduate as the binary dependent variable with predictor variables: status and grade point averages for GPA07 to GPA10. The LR analysis indicated no statistically significant difference between AP and IP students ( $B = 0.16, SE = 0.32, p = 0.63, Nagelkerke R^2 = 0.001$ ). The yearly grade point averages, however, were statistically significant predictors of graduation. The Hosmer and Lemeshow test was not statistically significant ( $\chi^2 = 9.77, df = 8, p = 0.28$ ) with Nagelkerke  $R^2 = 0.18$ .

There were  $n = 558$  initial students, however, due to yearly attrition in the data, only 271 students had complete yearly GPA data for the LR analysis. The classification table indicated few non-graduates, and of these, none were correctly classified. The classification rate of 97 % was, therefore, due mainly to correct classification of graduates.

### Independent Samples t-Test

Given the LR results, it seemed prudent to determine mean differences in grade point averages for those students who did, and did not, graduate on a yearly basis from 2007 to 2010. The graduate variable (i.e., 0 = no; 1 = yes) was used as the independent categorical variable. The results are in Table 5. The grade point averages were statistically significantly lower for students who did not graduate in each year. The Cohen's  $d$  effect sizes for each year indicated a practical difference in the mean GPA.

**Table 1.** Cross Tabulation: Status by Gender

Group	Male	Female	Total
AP	91	188	279
IB	105	174	279

**Table 2.** Cross Tabulation: Status by Race

Group	White	Black	Asian	Other	Total
AP	163	19	41	56	279
IB	149	29	54	47	279

**Table 3.** Logistic Regression Predictor Variables

Variable	Efficiency Score	<i>p</i>
GPA07	6.49	0.010
GPA08	6.62	0.010
GPA09	6.96	0.008
GPA10	10.02	0.002

**Table 4.** Logistic Regression Classification Summary

Observed	Predicted	
	No	Yes
Graduate	0	7
No	0	264
Yes	0	264

**Table 5.** Independent Samples *t*-test Results

Variable	Graduate	N	Mean	SD	<i>t</i>	Cohen's <i>d</i>
GPA07	No	25	2.69	1.05	4.65	0.71
	Yes	278	3.29	0.57		
GPA08	No	33	2.91	0.64	3.99	0.65
	Yes	517	3.29	0.52		
GPA09	No	25	2.93	0.61	3.79	0.68
	Yes	514	3.30	0.47		
GPA10	No	13	2.86	0.47	3.61	0.99
	Yes	504	3.32	0.45		

Note.  $p < 0.0001$ ; See Soper (2014) for the online Cohen's *d* calculator

### Conclusions

Propensity score matching provided the basis for selecting the same number of AP students as IB students for the study. A chi-square test of independence indicated non-statistically significant differences between gender and race, thus, propensity score matching indicated a similar number of AP students were selected across the categories of the covariate variables.

Logistic regression analysis indicated that AP and IB students did not differ in graduation completion. The status variable (i.e., AP versus IB) being non-statistically significant in the LR model implied that AP and IB students were equally successful at graduation completion. Essentially, both groups achieved a similar graduation success rate. LR further indicated that yearly grade point averages were key predictor variables in whether students graduated. However, the classification results were more indicative of graduation completion than non-graduation completion.

The independent samples *t*-test results for graduate versus non-graduate mean differences in yearly grade point average were statistically significant. A low grade point average in each year was associated with non-graduates. Therefore, a key indicator of if a freshman would graduate was their freshman year grade point average.

Overall, the propensity score matching process worked to select the same number of AP students as IB students. This was a critical first step because the sample sizes of each group were markedly different. A comparison of AP and IB students indicated that they did not differ on graduation, rather both groups were predominantly successful completers of college. The few non-completers can be easily identified based on their entering freshman year grade point average. An entering freshman, who received a low grade point average, was a good indicator of whether the student would continue in college. Summarily, the variable status did not play a major role in the prediction of graduation, thus, both AP and IB students were well-prepared for success in college.

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**APPENDIX**

```
# Propensity score matching - nearest neighbor matching

install.packages("MatchIt")
library(MatchIt)

install.packages("Hmisc")
library(Hmisc)

# Data is from SPSS file of each university with only select variables
# status, gender and race
# Save SPSS dataset in transport format
# Use SAVE AS command in SPSS
# OR export outfile='c:\propensity.por'.

# Read in SPSS data set in R with value labels - last option converts value labels to R factors

mydata = spss.get("C:/propensity.por", use.value.labels=FALSE)
mydata

# Missing values corrected in SPSS file or finaldata = as.data.frame(na.omit(mydata))

# Matching is performed using propensity scores with covariate variables
# Data set must not have missing values and Y variable must be 0 or 1 coded

m.out = matchit(STATUS~GENDER+RACE, method="nearest", data=mydata, ratio = 1)

# Check the sample sizes for each group

m.out

# Final matched data saved as final_data

final_data = match.data(m.out)

# Set directory to save file

setwd("C:/")

# Write out the data file

write.table(final_data,file="match1",sep=" ",row.names=TRUE,col.names=TRUE,quote=FALSE)
```