Understanding Student Recommendations to Attend NIACC

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ABSTRACT

Successful organizations, both public and private, rely heavily on *"word-of-mouth recommendations"* for their products and services. Financial viability of any organization depends profoundly on formal and informal networks of customers who pass their assessments of an organization's performance to acquaintances, friends and families. This analysis attempts to explain students' recommendations to attend NIACC to families, friends and acquaintances. Information to help answer this question comes from the *Community College Survey of Student Engagement* (CCSSE). This analysis explores the relationship between students' responses to the CCSSE question, *"Would you recommend this college to a friend or family member,"* with other survey questions dealing with the quality of relationships with other students, faculty and administrative personnel. In addition, the analysis examines the relationship between student recommendations and how they evaluate their *"entire educational experience"* at NIACC. Logistic and multiple regression models identify important predictors of student recommendations and their response to the question, *"How would you evaluate your entire experience at this college?"* An increase in one unit on the Entire Experience scale increases the odds of making a positive recommendation by nearly 13 times, holding the environmental variable, student relationships with each other, constant. *"Quality relationships with faculty"* has the most important impact on students' entire experience responses. The key role of faculty for creating a positive experience at NIACC is highlighted by this finding.

EXECUTIVE SUMMARY

As *"enrollment management"* becomes more important for the fiscal heath of any higher education institution it is important to understand the dynamics and importance of '*word-of-mouth recommendations*' passed on by existing students to their friends and family members. What determines students' positive or negative recommendations?

One source of information to help answer this question is the *Community College Survey of Student Engagement* (CCSSE). The first stage of this analysis explores the relationship between students' responses to the CCSSE question, *"Would you recommend this college to a friend or family member?,"* with other survey questions dealing with the quality of relationships with other students, faculty and administrative personnel. Included in this stage of the analysis is an examination of the relationship between student recommendations and how they evaluate their *"entire educational experience"* at NIACC. In the final stage of the analysis the *"entire experience"* response was transformed from an explanatory variable utilized to understand student recommendations to a dependent variable to be explained by student responses to other CCSSE questions.

FINDINGS

STAGE ONE FINDINGS. In the first stage of the analysis logistics regression was utilized to assess the relative importance of variables dealing with the quality of student relationships with people, specifically administrative personnel, faculty and other students. Major findings for this first stage of the analysis include:

- Positive experiences (measured by a one unit change in student response) with administrative personnel, holding all other variables constant, improves the student's odds for providing a positive recommendation by 54%.

- Positive experiences with other students, holding all other variables constant, improve the student's odds for providing a positive recommendation by 49%.

- Positive experiences with faculty, holding all other variables constant, improve the student's odds for providing a positive recommendation by 21%.

There are many other CCSSE survey questions that add to our understanding and ability to predict student recommendations. In particular the CCSSE survey asks the question, *"How would you evaluate your entire experience at this college?"* If we add this response to the model will it improve our ability to understand and predict student recommendations?

Major findings associated with adding the *"Entire Experience"* response to the model include the following:

- Positive experiences with faculty and administrative personnel no longer are statistically significant and were therefore dropped from the explanatory model.

- Students' entire experiences at NIACC have a tremendous impact on their odds of making a positive recommendation for the college to family and friends.

    - An increase in one unit on the Entire Experience scale increases the odds of making a positive recommendation by nearly 13 times, holding the environmental variable, student relationships with each other, constant.

- Quality relationships with other students still demonstrate significant effects on "Recommendation". A one unit increase in student responses to relationships with other students increases the odds for a positive recommendation by 51%.

- Clearly both variables – students' "entire experiences" at NIACC and their "relationship with each other" – are important but students' total experiences at NIACC overwhelm all other variables in this analysis.

STAGE TWO FINDINGS. As students' entire experiences are so critical for determining their recommendations to attend NIACC a second stage analysis was undertaken to determine factors that account for the variance in *the "Entire Experience"* variable. In other words, "Entire Experience" was moved from an independent variable to a dependent variable to be explained.

Student responses on the CCSSE survey provide insights into many variables that could possibly impact students' responses to the "Entire Experience" question. Among the variables that were of immediate interest included the following:

VARIABLES FOR THE "ENTIRE EXPERIENCE" ANALYSIS	
Name	Description
ENVSTU	Quality of relationships with other students
ENVFAC	Quality of relationships with faculty
ENVADM	Quality of relationships with Administrative personnel and offices
GPA	College GPA
SATACAD	Satisfaction: academic advising/ planning
SATCACOU	Satisfaction: career counseling
SATCHLD	Satisfaction: child care
SATCOMLB	Satisfaction: computer lab
SATDISAB	Satisfaction: disability services
SATFAADV	Satisfaction: financial aid advising
SATJOBPL	Satisfaction: job placement services
SATLAB	Satisfaction: skill labs (writing, math, etc.
SATSTORG	Satisfaction: student organizations
SATTRCRD	Satisfaction: transfer credit assistance
SATTUTOR	Satisfaction: peer or other tutoring
ACCHALL_STD	Standardized academic challenge benchmark score
ACTCOLL_STD	Standardized active and collaborative benchmark score
STUEFF_STD	Standardized student effort benchmark score
STUFAC_STD	Standardized student-faculty interaction benchmark score
SUPPORT_STD	Standardized support for learners benchmark score

After several multiple regressions five of the above variables were determined to be statistically significant predictors of "Entire Experience" responses. The following table summarizes the significant predictors of "Entire Experience" and their relative importance ranking.

Ranking of the Impact of Each Significant Independent Variable on "Entire Experience, Holding All Other Variables Constant	
Rank	**Variable**
1	Quality relationships with faculty (ENVFAC)
2	Support for learners (SUPPORT_STD)
3	Grade point average (GPA)
4	Satisfaction in computer labs" (SATCOMB)
5	Academic challenge (ACCHALL_STD)

"Quality relationships with faculty" has the most important impact on students' entire experience responses. The key role of faculty for creating a positive experience at NIACC is highlighted by this finding.

The next most significant effect on "Entire Experience" is "*support for learners"* as measured by the standardized support for learners benchmark score[1]. This important finding regarding "support for learners" is enhanced by research findings that it is consistently correlated with measures of persistence (McClenney and Marti, 2006:7). As persistence is the key to graduation we can't help but be encouraged that students' overall assessment of their experience at NIACC is linked to their favorable evaluation of NIACC support services for learners.

The remaining three predictors of "Entire Experience" – "grade point average", *"satisfaction in computer labs" and "academic challenge benchmark[1]"* – share a direct relationship and approximately the same level of impact on "Entire Experience."

[1] See Appendix A for a description of the survey questions that comprise the '*support for learners'* and *'academic challenge benchmark scores'*.)

INTRODUCTION

Successful organizations, both public and private, rely heavily on *"word-of-mouth recommendations"* for their products and services. Financial viability of any organization depends profoundly on formal and informal networks of customers who pass their assessments of an organization's performance to acquaintances, friends and families.

As *"enrollment management"* becomes more important for the fiscal heath of any higher education institution it is important to understand the dynamics and importance of 'word-of-mouth recommendations' passed on by existing students to their friends and family members. What determines students' positive or negative recommendations?

One source of information to help answer this question is the *Community College Survey of Student Engagement* (CCSSE). This analysis explores the relationship between students' responses to the CCSSE question, *"Would you recommend this college to a friend or family member?,"* and other survey questions dealing with the quality of relationships with other students, faculty and administrative personnel. In addition, the analysis examines the relationship between student recommendations and how they evaluate their entire educational experience at NIACC. In the final stage of the analysis the *"entire experience"* response was transformed from an explanatory variable utilized to understand student recommendations to a dependent variable to be explained by student responses to other CCSSE questions.

DATA

The data for this analysis is from the CCSSE 2006 random sampling of 592 students enrolled at NIACC. The following is a descriptive summary of the sample:

- 84% began their postsecondary education at NIACC
- 87% are full-time students
- Credits earned at time of survey:

None	5.9%
1-14	25.6%
15-29	27.8%
30-44	14.2%
45-60	20.1%
Over 60	6.3%

- 48.8% are male; 51.2% are female

- 10.6% are married
- Highest academic credential at time of survey:

None	3.05%
High School Diploma	85.79%
Vocational Technical Certificate	5.08%
Associate Degree	4.74%
Bachelor's Degree	1.18%
Masters/Doctorate/Professional	0.17%

- 59.3% of students earned 0-29 credits
- 40.7% of students earned 30 or more credits
- 85.3% are traditional age students (24 and younger)
- 14.7% are 25 and older

VARIABLES IN THE ANALYSIS

Table 1 provides a summary of the variables in stage 1 of the analysis.

Table 1 Variables in Stage 1 of the Analysis

NAME	CCSSE QUESTION/INSTRUCTION	CODING
RECOMMEND "Recommendation"	Would you recommend this college to a friend or family member?	1 = Yes 0 = No
ENTIREXP "Entire Experience"	How would you evaluate your entire experience at this college?	1=Poor 2=Fair 3=Good 4=Excellent
VARIABLES DEALING WITH THE QUALITY OF RELATIONSHIPS WITH PEOPLE:		
ENVSTU "Environment Students"	Mark the box that best represents the quality of your relationship with people at this college. Your relationship with: Other students	Responses range from 1 to 7, with scale anchors described as (1) Unfriendly, unsupportive, sense of alienation (7) Friendly, supportive sense of belonging
ENVFAC "Environment Faculty"	Your relationship with: Instructors	Responses range from 1 to 7, with scale anchors described as (1) Unfriendly, unsupportive, sense of alienation (7) Friendly, supportive sense of belonging
ENVADM "Environment Admin"	Your relationship with: Administrative personnel and offices	Responses range from 1 to 7, with scale anchors described as (1) Unfriendly, unsupportive, sense of alienation (7) Friendly, supportive sense of belonging

RESEARCH HYPOTHESES

This analysis tests the following 'stage 1' hypotheses:

TABLE 2: RESEARCH HYPOTHESES: STAGE 1 OF THE ANALYSIS	
I. RECOMMENDATION AS THE DEPENDENT VARIABLE	
A.	BASIC MODEL
	H_o - RECOMMEND is not related to student ENVSTU, ENVFAC and ENVADM responses H_1 - RECOMMEND is directly related to student ENVSTU, ENVFAC and ENVADM responses
B.	EXPANDED MODEL
	H_0 - RECOMMEND is not related to student ENVSTU, ENVFAC, ENVADM and ENTIREXP responses H_1 - RECOMMEND is directly related to student ENVSTU, ENVFAC, ENVADM and ENTIREXP responses

STATISTICAL TOOL

LOGISTIC REGRESSION. As the dependent variable, RECOMMENDATION, is a binary categorical variable and because we are interested in controlling for an important variable that may impact the odds of making a positive recommendation the analytical tool of choice is logistic regression. Logistic regression is *"the most important model for categorical response data"* (Agresti, 2002:165).

Logistic regression applies maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent variable, positive recommendation, occurring or not). In this way, logistic regression estimates the probability of a positive recommendation occurring, controlling for other important predictor variables.

ANALYSIS

The first logistic model to be tested regresses "Recommendation" on the three quality relationship variables: "Environment Admin", "Environment Faculty" and "Environment Students." The regression is specified in the following form, Eq.1:

$$Eq.1: \quad \Pr ob\left(RECOMMENDATION = 1 \mid (x)\right) = \lambda\left(\alpha + \beta_1 ENVADM + \beta_2 ENVFAC + B_3 ENVSTU\right)$$

where $\lambda(\cdot)$ is the logit function, $\exp(x)/(1+\exp(x))$. The effects can be simply stated as the odds ratio.

Before we test this model we should perform a preliminary test on the three quality relationship variables - ENVSTU, ENVFAC and ENVADM. As these three predictors of "Recommendation" are ordinal variables an additional test is needed to determine if treating them as quantitative variable is permissible (Agresti, 2002). Such a test involves a two step process. First we run a more complex logistics regression having a separate parameter for each category of relationship. Recall responses range from 1 to 7, with scale anchors described as (1) Unfriendly, unsupportive, and a sense of alienation to (7) Friendly, supportive, and a sense of belonging.

This more complex model, let's call it "Model 2" in this context, is then compared to a simpler model (Model 1) where the quality relationship variable is treated as a single quantitative variable. The comparison tests a Chi-square difference with df equal to the degrees of freedom associated with the complex model minus the degrees of freedom of the simpler model.

Logistic regressions for all three "quality relationship" variables were run for both the simple and more complex models. Summary statistics needed to compute the Chi-square difference test are provided in Table 3. This statistic tests that the simpler model is adequate, given that model holds. In each case we conclude that treating the ordinal variable as a quantitative variable is permissible. Agresti indicates that, *"It is advantageous to treat ordinal predictors in a quantitative manner when such models fit well"* (Agresti, 2002: 191).

Table 3 Testing Permissiveness of Treating the Ordinal Quality Variables as Quantitative Variables

Likelihood Ratio Model 1	df Model 1	Likelihood Ratio Model 2	df Model 2	Difference	df	p^2
ENVADM						
39.663	1	47.982	6	8.319	5	0.140
ENVFAC						
29.069	1	32.189	6	3.12	5	0.681
ENVSTU						
29.232	1	35.531	6	6.299	5	0.278

Now that we have completed that preliminary test we can proceed to estimate the parameters of the logistics regression specified in Eq. 1.

[2] In contrast to traditional statistical procedures the researcher hopes *not* to reject H_0 in this case

Table 4 reports the estimated parameters for the "Recommendation" logistics regression, Eq. 1:

TABLE 4 LOGISTICS REGRESSION PARAMETER ESTIMATES FOR EQ. 1

Parameter	Estimate	Standard Error	Z	p-value	95 % Confidence Interval	
					Lower	Upper
1 CONSTANT	-2.573	0.704	-3.655	0.000	-3.953	-1.193
2 ENVADM	0.434	0.112	3.892	0.000	0.216	0.653
3 ENVFAC	0.190	0.092	2.050	0.049	0.008	0.372
4 ENVSTU	0.399	0.121	3.309	0.001	0.163	0.636
Likelihood Ratio = 57.361 with df = 3 and p = 0.000 Naglekerke's R-square = 0.204						

The logit model (Eq. 1) is statistically significant. The reported likelihood-ratio (LR) tests that "Recommendation" is jointly independent of the predictors simultaneously; H_o: $\beta_1 = \beta_2 = \beta_3 = 0$. The LR test statistic of 57.361 is chi-squared with 3 degrees of freedom and a p-value of 0.000. This demonstrates strong evidence that at least one predictor has an effect on Recommendation.

Nagelkerke's R-square is an attempt to imitate the interpretation of multiple OLS R-square based on the likelihood. Nagelkerke's R-square can vary from 0 to 1.

INTERPRETATION OF COEFFICIENTS

Table 4 indicates that all three predictors of "Recommendation" are significant at the .05 level of confidence or better. Nevertheless, it is known that logistic coefficients may be found to be significant when the corresponding correlation is found to be not significant, and vice versa. To make certain statements about the significance of an independent variable, both the correlation and the logit should be significant. This additional test was completed.

The predictor coefficients are large relative to their standard error and therefore appear to be an important predictor of "Recommendation." However, the interpretation of the logit coefficient is quite different from ordinary least squares The logit coefficient indicates how much the logit increases for a unit of change in the independent variable, but the probability of a 0 or 1 outcome is a nonlinear function of the logit. It is, therefore, more useful to turn to an evaluation of "odds ratio".

ODDS RATIO INTERPRETATION

Table 5 presents the odd ratios as well as standard errors and confidence intervals for the three predictors of "Recommendation."

Table 5 Odds Ratio Estimates				
			95 % Confidence Interval	
Parameter	Odds Ratio	Standard Error	Lower	Upper
2 ENVADM	1.544	0.172	1.241	1.922
3 ENVFAC	1.209	0.153	0.944	1.550
4 ENVSTU	1.491	0.180	1.177	1.888

The odds ratio table provides a more intuitive and meaningful understanding for the impact of the three predictors on "Recommendation."

The odds ratio is a multiplicative factor by which the odds change when the independent variable increases by one unit, holding all other independent variables constant. The odds ratio for "Environment Admin" is 1.544[3].

A one unit increase in "Environment Admin", holding all other variables constant, improves the student's odds for providing a positive recommendation by 54%. We may say that when "Environment Admin" increases one unit, the odds that Recommendation = 1 (yes) increases by a factor of 54%, when all other variables are controlled.

The odds ratio for "Environment Faculty" is 1.209. A one unit increase in "Environment Faculty", holding all other variables constant, improves the student's odds for providing a positive recommendation by 21%. We may say that when "Environment Faculty" increases one unit, the odds that Recommendation = 1 (yes) increases by a factor of 21%, when all other variables are controlled.

The odds ratio for "Environment Student" is 1.491. A one unit increase in "Environment Student", holding all other variables constant, improves the student's odds for providing a positive recommendation by 49%. We may say that when "Environment Student" increases one unit, the odds that Recommendation = 1 (yes) increases by a factor of 49%, when all other variables are controlled.

[3] Given a logit coefficient, β_i, the odds ratio can be calculated $\exp(\beta_i)$. For example, the logit coefficient for "Environmental Admin" equals 0.434. The odds ratio equals exp(0.434) = 1.544.

Each odds ratio has a reported 95% confidence interval. For the variable "Environment Student" the lower boundary odds for a positive recommendation is nearly 18% with an upper boundary of 89%, holding all other variables constant. The reader is encouraged to inspect the confidence intervals for the other two predictors of "Recommendation."

Given the known parameter estimates for the logistics regression, Eq. 1:

$$Eq.1: \quad \Pr ob\left(RECOMMENDATION = 1 \mid (x)\right) = \lambda\left(\alpha + \beta_1 ENVADM + \beta_2 ENVFAC + B_3 ENVSTU\right)$$

in Table 3 we can predict the logit for any given student with known or with assumed three predictor inputs. For example, what would be the logit and odds ratio for "Recommendation" for students with the following CCSSE responses to the environmental questions?

For example: Student "A" responds to the following three quality questions in the following manner:

Quality relationship with administration:	Student response is 4
Quality relationship with faculty:	Student response is 5
Quality relationship with students:	Student response is 6

Substituting the student's inputs into the estimated logit model (Eq.1 and coefficients found in Table 3) produces this predicted logit:

$$Eq.1: \quad \Pr ob\left(RECOMMENDATION = 1 \mid (x)\right) = \lambda\left(\alpha + \beta_1 ENVADM + \beta_2 ENVFAC + B_3 ENVSTU\right)$$

= 2.573 + (.0.434)(4) + (0.190)(5) + (0.399 (6) = 7.653

This student's probability for making a positive recommendation can be calculated using the following method:

1. Calculate the odds ratio:

exp(logit) = odds ratio = exp(7.653) = 2106.95

2. Calculate probability:

$$\Pr obability = \frac{Odd\ Ratio}{(1 + Odd\ Ratio)} = \frac{2106.957}{(1 + 2106.957)} = .999$$

The estimated positive recommendation probability for this student is .999. She has an estimated 99% probability of making a positive recommendation to family and friends, given her responses to the CCSSE survey. Checking the database we find that this student did respond favorably to the "recommendation" question.

EXPANDED MODEL

We now know that student responses to CCSSE environmental quality of relationship questions are highly predictive for making positive college recommendations. There are many other CCSSE survey questions that may add to our understanding and ability to predict student recommendations. In particular the CCSSE survey asks the question, *"How would you evaluate your entire experience at this college?"* If we add this response to the model will it improve our ability to understand and predict student recommendations?

To answer this question we add ENTIREXP ("Entire Experience") variable to Eq. 1 to produce the following expanded logistics model:

$$Eq.\,2: \quad \Pr ob\left(RECOMMENDATION = 1 \mid (x)\right) = \lambda\left(\begin{array}{l}\alpha + \beta_1 ENVADM + \beta_2 ENVFAC + B_3 ENVSTU + \\ B_4 ENTIREXP\end{array}\right)$$

where $\lambda(\cdot)$ is the logit function, $\exp(x)/(1+\exp(x))$. The effects can be simply stated as the odds ratio.

Before we test this model we should perform a preliminary test on "Entire Experience". As "Entire Experience" is an ordinal variable an additional test is needed to determine if treating "Entire Experience" as a continuous variable is permissible. Such a test involves a two step process. First we run a more complex logistics regression having a separate parameter for each category of "Entire Experience" (Poor, Fair, Good and Excellent) minus 1. This logistics regression takes the following form:

$$Eq.\,3: \quad \Pr ob\left(RECOMMENDATION = 1 \mid (x)\right) = \lambda\left(\alpha + \beta_1 Poor + \beta_2 Fair + \beta_3 Good\right)$$

where "Excellent" equals the reference category. This logistics regression produces a LR test statistic of 112.701 which is chi-squared with 3 degrees of freedom and a p value =0.000.

This more complex model (Eq. 3) is then compared to a simpler model where "Entire Experience" was treated as a single quantitative

variable. Estimated parameters for this logistic regression are reported in Table 6:

TABLE 6 LOGISTICS REGRESSION PARAMETER ESTIMATES FOR TESTING "ENTIRE EXPERIENCE" AS A QUANTITATIVE VARIABLE

Parameter	Estimate	Standard Error	Z	p-value	95 % Confidence Interval	
					Lower	Upper
1 CONSTANT	-4.782	0.766	-6.243	0.000	-6.283	-3.281
2 ENTIREXP	2.682	0.318	8.428	0.000	2.058	3.306
Likelihood-ratio (LR) = 110.80; df = 1; p = .000 Naglekerke's R-square = 0.376						

A chi-squared difference test between the more complex and simpler model revealed a χ^2_{diff} equal to 1.901 (112.701 – 110.80) with 2 df and p = 0.387. This statistic tests that the simpler model is adequate, given that model holds. This simplification (from an ordinal to a quantitative variable) seems permissible (p=0.387[4]). Agresti indicates that, *"It is advantageous to treat ordinal predictors in a quantitative manner when such models fit well"* (Agresti, 2002: 191).

Having confirmed the legitimacy of treating the ordinal variable "Entire Experience" as a quantitative variable we proceed with estimating the parameters for Eq. 2. The estimated parameters for Eq. 2 are found below in Table 7.

TABLE 7 PARAMETER ESTIMATES FOR LOGISTICS MODEL, EQ. 2

Parameter	Estimate	Standard Error	Z	p-value	95 % Confidence Interval	
					Lower	Upper
1 CONSTANT	-6.621	0.999	-6.626	0.000	-8.580	-4.663
2 ENV_ADM	0.246	0.126	1.958	0.050	0.000	0.493
3 ENV_FAC	-0.175	0.144	-1.217	0.224	-0.458	0.107
4 ENV_STU	0.430	0.137	3.148	0.002	0.162	0.698
5 ENTIREXP	2.488	0.353	7.051	0.000	1.797	3.180
Likelihood Ratio = 125.702 with df = 4 and p = 0.000 Naglekerke's R-square = 0.423						

The model is significant, p = 0.000. However, the coefficient for "Environment Faculty" is not significant (p = 0.224) while all the other predictors remain significant. As such, we must drop "Environment Faculty" from the model and recast Eq.2 to the following logistics model, Eq. 3:

[4] In contrast to traditional statistical procedures the researcher hopes *not* to reject H_0 in this case.

$$Eq.3: \quad \Pr ob(RECOMMENDATION = 1 | (x)) = \lambda(\alpha + \beta_1 ENVADM + B_2 ENVSTU + B_3 ENTIREXP)$$

where $\lambda(\cdot)$ is the logit function, $\exp(x)/(1+\exp(x))$. The effects can be simply stated as the odds ratio.

This revised model produced the following parameter estimates, depicted in Table 8 and odds ratios in Table 9.

TABLE 8 PARAMETER ESTIMATES FOR LOGISTIC REGRESSION EQ. 3

Parameter	Estimate	Standard Error	Z	p-value	95 % Confidence Interval	
					Lower	Upper
1 CONSTANT	-6.734	0.995	-6.770	0.000	-8.684	-4.784
2 ENV_ADM	0.208	0.122	1.700	0.089	-0.032	0.447
3 ENV_STU	0.373	0.129	2.897	0.004	0.121	0.626
4 ENTIREXP	2.370	0.336	7.054	0.000	1.711	3.028
Likelihood Ratio = 124.201 with df = 3 and p = 0.000 Naglekerke's R-square = 0.418						

TABLE 9 ODDS RATIO ESTIMATES FOR LOGISTICS REGRESSION EQ. 3

Parameter	Odds Ratio	Standard Error	95 % Confidence Interval	
			Lower	Upper
2 ENV_ADM	1.231	0.150	0.969	1.563
3 ENV_STU	1.453	0.187	1.128	1.870
4 ENTIREXP	10.693	3.592	5.535	20.657

Table 8 reveals that the revised model is statistically significant (p = 0.000) but "Environment Admin" is now beyond our alpha of .05. As such, we must drop "Environment Admin" and recast another more parsimonious model without "Environment Admin", Eq. 4:

$$Eq.4: \quad \Pr ob(RECOMMENDATION = 1 | (x)) = \lambda(\alpha + B_1 ENVSTU + B_2 ENTIREXP)$$

where $\lambda(\cdot)$ is the logit function, $\exp(x)/(1+\exp(x))$. The effects can be simply stated as the odds ratio. Table 10 reveals the estimated parameters associated with Eq. 4.

TABLE 10 PARAMETER ESTIMATES FOR LOGISTICS REGRESSION EQ. 4

Parameter	Estimate	Standard Error	Z	p-value	95 % Confidence Interval	
					Lower	Upper
1 CONSTANT	-6.498	0.973	-6.677	0.000	-8.405	-4.591
2 ENV_STU	0.413	0.126	3.283	0.001	0.166	0.659
3 ENTIREXP	2.550	0.323	7.885	0.000	1.916	3.184
Likelihood Ratio = 121.312 with df = 2 and p = 0.000 **Hosmer-Lemeshow = 4.168 with 8 df and p = 0.842** **Naglekerke's R-square = 0.409**						

Table 11 reports the corresponding odds ratios.

TABLE 11 ODDS RATIO ESTIMATES FOR LOGISTICS REGRESSION EQ. 4				
			95 % Confidence Interval	
Parameter	Odds Ratio	Standard Error	Lower	Upper
2 ENV_STU	1.511	0.190	1.181	1.933
3 ENTIREXP	12.806	4.141	6.794	24.137

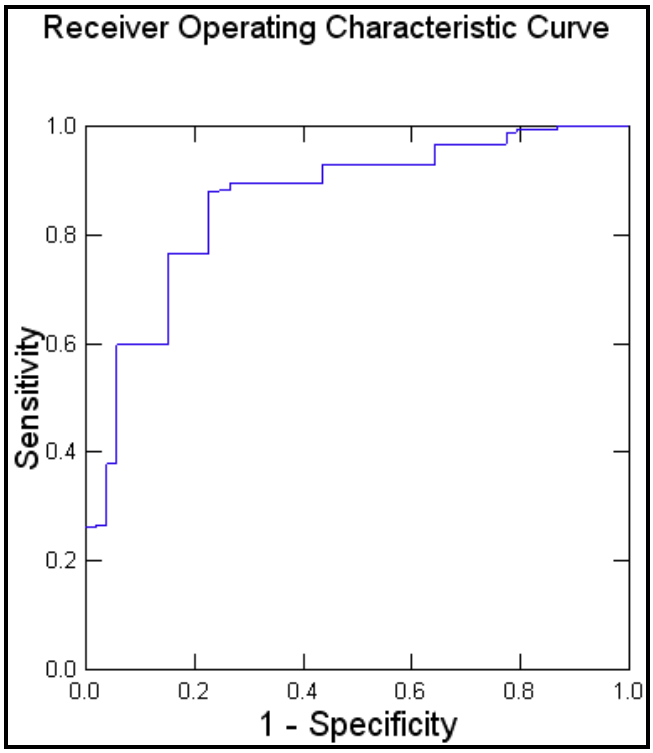
This model is statistically significant as well as all the predictors! We note that Naglekerke's R-square = 0.409, which is regarded as very satisfactory in the literature (Hensher and Johnson, 1981). In addition, the Hosmer-Lemeshow statistic (4.17 with p = 0.842) indicates a good fit of the model to the data.

The odds ratio table reveals that a student's "Entire Experience" at NIACC has a tremendous impact on his/her odds of making a positive recommendation for the college to family and friends. An increase in one unit on the Entire Experience scale increases the odds of making a positive recommendation by nearly 13 times, holding constant "Environment Student."

Students' quality relationships with other students still demonstrate significant effects on "Recommendation". Holding constant "Entire Experience", a one unit increase in student responses to "Environment Student" increases the odds for a positive recommendation by 51%. Clearly both variables are important but students' total experiences at NIACC overwhelm all other variables in this analysis.

Given one of the primary purposes of logistic regression is to generate an equation that can reliably classify observations into one or two outcomes (positive recommendation versus a negative recommendation) we can check the model's predictive ability through a graphical means, the ROC (Receiver Operating Characteristic) curve. The ROC curve is presented below.

The larger the area below the curve the better the model; that is, the better the predictions (Agresti, 2002). The area under the ROC curve is 0.885, which is identical to another measure of predictive power, the *concordance index, c*. The concordance index estimates the probability that the predictions and outcomes are concordant. A value of 0.5 means predictions are no better than random guessing. A concordance index equal to .885 is considered quite satisfactory.



ACCOUNTING FOR "ENTIRE EXPERIENCE" RESPONSES

Now that we know that NIACC students' entire experiences significantly and in a huge manner impact their recommendation for a friend or family member to enroll at NIACC the next logical question is what determines students' responses to "Entire Experience." What variables are most highly and significantly related to how a student judges their entire experience at NIACC?

Student responses on the CCSSE survey provide insights into many variables that could possibly impact students' responses to the "Entire Experience" response. Among the variables that appear to be of immediate interest are summarized in Table 12.

TABLE 12 VARIABLES FOR THE "ENTIRE EXPERIENCE" ANALYSIS	
Name	Description
ENVSTU	Quality of relationships with other students
ENVFAC	Quality of relationships with faculty
ENVADM	Quality of relationships with Administrative personnel and offices
GPA	College GPA
SATACAD	Satisfaction: academic advising/ planning
SATCACOU	Satisfaction: career counseling
SATCHLD	Satisfaction: child care
SATCOMLB	Satisfaction: computer lab
SATDISAB	Satisfaction: disability services
SATFAADV	Satisfaction: financial aid advising
SATJOBPL	Satisfaction: job placement services
SATLAB	Satisfaction: skill labs (writing, math, etc.
SATSTORG	Satisfaction: student organizations
SATTRCRD	Satisfaction: transfer credit assistance
SATTUTOR	Satisfaction: peer or other tutoring
ACCHALL_STD	Standardized academic challenge benchmark score
ACTCOLL_STD	Standardized active and collaborative benchmark score
STUEFF_STD	Standardized student effort benchmark score
STUFAC_STD	Standardized student-faculty interaction benchmark score
SUPPORT_STD	Standardized support for learners benchmark score
The "satisfaction" measures were coded 0=NA, 1=Not at all, 2=Somewhat and 3=Very. Responses 1, 2 and 3 can be treated as ordinal responses. "0" responses were treated as missing data.	

In order to determine if these variables significantly account for the variance in "Entire Experience" OLS (Ordinary Least Squares regression) was utilized as the statistical tool of choice. The specified OLS model for accounting for the variance in "Entire Experience" is found in Eq. 5.

$$Eq.\,5: \quad ENTIREXP = a + B_1\text{SATACAD} + B_2\text{SATCACOU} + B_3\text{SATCHLD} + B_4\text{SATCOMLB} + B_5\text{SATDISAB} + B_6\text{SATFAADV} + B_7\text{SATJOBPL} + B_8\text{SATLAB} + B_9\text{SATSTORG} + B_{10}\text{SATTRCRD} + B_{11}\text{SATTUTOR} + B_{12}\text{ACCHALL\_STD} + B_{13}\text{ACTCOLL\_STD} + B_{14}\text{STUEFF\_STD} + B_{15}\text{STUFAC\_STD} + B_{16}\text{SUPPORT\_STD} + B_{17}GPA + B_{18}ENVSTU + B_{19}ENVFAC + B_{20}ENVADM + e$$

The OLS regression of "Entire Experience" on the specified independent variables produced the results reported in Table 13.

Table 13 Regression Coefficients, Eq. 5						
Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-value
ACCHALL_STD	0.003	0.001	0.108	0.637	2.652	0.008
ACTCOLL_STD	-0.001	0.001	-0.033	0.537	-0.733	0.464
ENV_ADM	0.029	0.020	0.066	0.512	1.444	0.149
ENV_FAC	0.139	0.023	0.266	0.555	6.086	0.000
ENV_STU	0.016	0.022	0.031	0.641	0.751	0.453
GPA	0.068	0.018	0.133	0.870	3.791	0.000
SATACAD	0.077	0.047	0.077	0.480	1.642	0.101
SATACOU	-0.063	0.051	-0.064	0.405	-1.240	0.216
SATCHLD	0.031	0.043	0.035	0.442	0.723	0.470
SATCOMLB	0.090	0.045	0.077	0.729	2.022	0.044
SATDISAB	-0.009	0.042	-0.009	0.524	-0.210	0.834
SATFAADV	0.039	0.039	0.042	0.598	0.996	0.319
SATJOBPL	0.039	0.046	0.039	0.476	0.828	0.408
SATLAB	0.020	0.044	0.020	0.596	0.465	0.642
SATSTORG	-0.041	0.041	-0.041	0.617	-1.000	0.318
SATTRCRD	0.077	0.043	0.078	0.560	1.800	0.072
SATTUTOR	0.019	0.039	0.020	0.580	0.470	0.639
STUEFF_STD	0.000	0.001	0.012	0.549	0.280	0.780
STUFAC_STD	0.000	0.001	-0.002	0.468	-0.032	0.975
SUPPORT_STD	0.006	0.001	0.185	0.440	3.760	0.000
Multiple R = 0.627; Squared Multiple R = 0.393 F-ratio = 18.480; p = 0.000						

It's clear that while the entire model is significant (p =0.000) a number of predictors of "Entire Experience" are not significant at the .05 level of confidence. Only five predictors are significant:

ACCHALL_STD	Standardized academic challenge benchmark score
ENVFAC	Quality of relationships with faculty
GPA	College GPA
SUPPORT_STD	Standardized support for learners benchmark score
SATCOMLB	Satisfaction: computer lab

It is noted that satisfaction with transfer credit assistance approaches significance (p = 0.072) but doesn't make the cut point at .05.

Given the above results the non-significant variables were deleted from the original "Entire Experience" model and a revised model was specified with the statistically significant variables. The revised model is specified in Eq. 6:

$$Eq.\,6: \quad ENTIREXP = a + B_1\text{ENVFAC} + B_2\text{GPA} + B_3\text{SATCOMLB} + B_4\text{ACCHALL\_STD} + B_5\text{SUPPORT\_STD} + e$$

This model produced the following regression coefficients in Table 14 and the associated Analysis of Variance in Table 15.

Table 14 Regression Coefficients, Eq. 5

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-value
ACCHALL_STD	0.003	0.001	0.100	0.846	2.788	0.005
ENVFAC	0.166	0.019	0.318	0.788	8.575	0.000
GPA	0.065	0.017	0.128	0.944	3.778	0.000
SUPPORT_STD	0.134	0.040	0.115	0.932	3.361	0.001
SATCOMLB	0.008	0.001	0.267	0.754	7.061	0.000

Multiple R = 0.605; Squared Multiple R = 0.366
'Condition indices' for the independent variables range between 1.0 and 1.88, providing confidence that multicollinearity is not a problem (Belsley, Kuh and Welsh, 1980)

Table 15 Analysis of Variance "Entire Experience"

Source	SS	df	Mean Squares	F-ratio	p-value
Regression	94.921	5	18.984	67.552	0.000
Residual	164.683	586	0.281		

The revised "Entire Experience" model (Eq.5) is significant with an F-ratio of 67.55 and a p = 0.000. In addition, each predictor of "Entire Experience" is statistically significant at p = 0.005 or better. The model explains 36.6% of the variance in "Entire Experience." This is a satisfactory level of explained variance in educational research.

The standardized coefficients (beta weights) in Table 14 provide a means to assess the relative impacts of the predictors of "Entire Experience". Standardized coefficients have the advantage of being scale-free indices and therefore can be compared across different variables[5] (Pedhazur, 1982: 247). The beta weights indicate the expected change in "Entire Experience", expressed in standard scores, associated with a one standard deviation change in an independent variable, holding the remaining variables constant.

Table 16 provides a ranking summary of the impact of each independent variable on "Entire Experience, holding all other variables constant.

[5] The disadvantage of using beta weights is that they are sample-specific and can not be used for the purpose of generalization across settings and populations (Pedhazur, 1982: 247). This is not an issue for this analysis as the research purpose is to understand the dynamics of *"Recommendation"* and *"Entire Experience"* and apply that knowledge to advance the mission of NIACC.

Table 16 Ranking of the Impact of Each Independent Variable on "Entire Experience, Holding All Other Variables Constant	
Rank	**Variable**
1	Quality relationships with faculty (ENVFAC)
2	Support for learners (SUPPORT_STD)
3	Grade point average (GPA)
4	Satisfaction in computer labs" (SATCOMB)
5	Academic challenge (ACCHALL_STD)

Quality relationships with faculty (ENVFAC) has the most important impact on students' entire experience response. The key role of faculty for creating a positive experience at NIACC is highlighted by this finding.

The next most significant effect on "Entire Experience" is *support for learners (*SUPPORT_STD), as measured by the standardized support for learners benchmark score. (See Appendix A for a description of the survey questions that comprise this benchmark.)

This important finding regarding support for learners is enhanced by research findings that "support for learners" is consistently correlated with measures of persistence (McClenney and Marti, 2006:7). As persistence is the key to graduation we can't help but be encouraged that students' overall assessment of their experience at NIACC is linked to their favorable evaluation of NIACC support services for learners.

The remaining three predictors of "Entire Experience" are nearly equal in impact. *GPA* and "Entire Experience" are directly related. A one unit increase in GPA standard deviation is associated with a .13 standard deviation in "Entire Experience." A similar relationship exists between *"satisfaction in computer labs"* (SATCOMB) and "Entire Experience" with a beta weight equal to .11. Finally, *"academic challenge benchmark"* (ACCHALL_STD) shares a direct relationship with "Entire Experience" at about the same level of impact (.10).

Conclusion and Discussion

Recommendations that existing NIACC students pass on to their acquaintances, friends and families to attend NIACC are vital to NIACC's important mission and its fiscal health. Quality of student relationships with people, specifically administrative personnel, faculty and other students have been found to be significant predictors of student recommendations to attend NIACC.

STAGE ONE FINDINGS. In the first stage of the analysis logistics regression was utilized to assess the relative importance of variables dealing with the quality of student relationships with people, specifically administrative personnel, faculty and other students. Major findings for this first stage of the analysis include:

- Positive experiences (measured by a one unit change in student response) with administrative personnel, holding all other variables constant, improves the student's odds for providing a positive recommendation by 54%.

- Positive experiences with other students, holding all other variables constant, improve the student's odds for providing a positive recommendation by 49%.

- Positive experiences with faculty, holding all other variables constant, improve the student's odds for providing a positive recommendation by 21%.

There are many other CCSSE survey questions that add to our understanding and ability to predict student recommendations. In particular the CCSSE survey asks the question, *"How would you evaluate your entire experience at this college?"* If we add this response to the model will it improve our ability to understand and predict student recommendations?

Major findings associated with adding the *"Entire Experience"* response to the model include the following:

- Positive experiences with faculty and administrative personnel no longer are statistically significant and were therefore dropped from the explanatory model.

- Students' entire experiences at NIACC have a tremendous impact on their odds of making a positive recommendation for the college to family and friends.

    - An increase in one unit on the Entire Experience scale increases the odds of making a positive recommendation by nearly 13 times, holding the environmental variable, student relationships with each other, constant.

- Quality relationships with other students still demonstrate significant effects on "Recommendation". A one unit increase in

student responses to relationships with other students increases the odds for a positive recommendation by 51%.

- Clearly both variables – students' "entire experiences" at NIACC and their "relationship with each other" – are important but students' total experiences at NIACC overwhelm all other variables in this analysis.

STAGE TWO FINDINGS. As students' entire experiences are so critical for determining their recommendations to attend NIACC a second stage analysis was undertaken to determine factors that account for the variance in *the "Entire Experience"* variable. In other words, "Entire Experience" was moved from an independent variable to a dependent variable to be explained.

Student responses on the CCSSE survey provide insights into many variables that could possibly impact students' responses to the "Entire Experience" question. Among the variables that were of immediate interest included the following:

VARIABLES FOR THE "ENTIRE EXPERIENCE" ANALYSIS	
Name	Description
ENVSTU	Quality of relationships with other students
ENVFAC	Quality of relationships with faculty
ENVADM	Quality of relationships with Administrative personnel and offices
GPA	College GPA
SATACAD	Satisfaction: academic advising/ planning
SATCACOU	Satisfaction: career counseling
SATCHLD	Satisfaction: child care
SATCOMLB	Satisfaction: computer lab
SATDISAB	Satisfaction: disability services
SATFAADV	Satisfaction: financial aid advising
SATJOBPL	Satisfaction: job placement services
SATLAB	Satisfaction: skill labs (writing, math, etc.
SATSTORG	Satisfaction: student organizations
SATTRCRD	Satisfaction: transfer credit assistance
SATTUTOR	Satisfaction: peer or other tutoring
ACCHALL_STD	Standardized academic challenge benchmark score
ACTCOLL_STD	Standardized active and collaborative benchmark score
STUEFF_STD	Standardized student effort benchmark score
STUFAC_STD	Standardized student-faculty interaction benchmark score
SUPPORT_STD	Standardized support for learners benchmark score

After several multiple regressions five of the above variables were determined to be statistically significant predictors of "Entire Experience" responses. The following table summarizes the significant predictors of "Entire Experience" and their relative importance ranking.

Ranking of the Impact of Each Significant Independent Variable on "Entire Experience, Holding All Other Variables Constant

Rank	Variable
1	Quality relationships with faculty (ENVFAC)
2	Support for learners (SUPPORT_STD)
3	Grade point average (GPA)
4	Satisfaction in computer labs" (SATCOMB)
5	Academic challenge (ACCHALL_STD)

"Quality relationships with faculty" has the most important impact on students' entire experience responses. The key role of faculty for creating a positive experience at NIACC is highlighted by this finding.

The next most significant effect on "Entire Experience" is "*support for learners"* as measured by the standardized support for learners' benchmark score[1]. This important finding regarding "support for learners" is enhanced by research findings that it is consistently correlated with measures of persistence (McClenney and Marti, 2006:7). As persistence is the key to graduation we can't help but be encouraged that students' overall assessment of their experience at NIACC is linked to their favorable evaluation of NIACC support services for learners.

The remaining three predictors of "Entire Experience" – "grade point average", *"satisfaction in computer labs" and "academic challenge benchmark*[6]*"* – share a direct relationship and approximately the same level of impact on "Entire Experience."

The importances of these findings now need to be examined within a context of continuous quality improvement. Specifically, how can NIACC maximize the positive findings to optimize enrollments? Second, why aren't some of the CCSSE variables significantly related to student recommendations or to their entire experience responses?

[6] See Appendix A for a description of the survey questions that comprise the '*support for learners'* and *'academic challenge benchmark scores'*.)

APPENDIX A
CCSSE BENCHMARKS

ACADEMIC CHALLENGE BENCHMARK:

Benchmark composed of ten survey items. A four-item response scale (*Never, Sometimes, Often, Very often)* is used for the following Academic Challenge related college activity:

- Worked harder than you thought you could to meet an instructor's standards or expectations

A four-item response scale (*Very little, Some, Quite a bit, Very much)* is used for the following mental activity items:

- Analyzing the basic elements of an idea, experience, or theory
- Synthesizing and organizing ideas, information, or experiences in new ways
- Making judgments about the value or soundness of information, arguments, or methods
- Applying theories or concepts to practical problems or in new situations
- Using information you have read or heard to perform a new skill

A five-item response scale (*None, Between 1 and 4, Between 5 and 10, Between 11 and 20, More than 20)* is used for the following academic preparation items:

- Number of assigned textbooks, manuals, books, or book-length packs of course readings
- Number of written papers or reports of any length

A seven-item response scale (*Ranging from 1 to 7, with scale anchors described: (1) Extremely easy (7) Extremely challenging)* is used for the following exam item:

- Mark the box that best represents the extent to which your examinations during the current school year have challenged you to do your best work at this college

A four-item response scale (*Very little, Some, Quite a bit, Very much)* is used for the following college opinion item:

- Encouraging you to spend significant amounts of time studying

SUPPORT FOR LEARNERS BENCHMARK

This support benchmark is composed of seven survey items. A four item response scale (*Very little, Some, Quite a bit, Very much)* was used by CCSSE to construct the benchmark from the following college survey questions:

- Providing the support you need to help you succeed at this college
- Encouraging contact among students from different economic, social, and racial or ethnic backgrounds
- Helping you cope with your non-academic responsibilities (work, family, etc.)
- Providing the support you need to thrive socially
- Providing the financial support you need to afford your education

In addition, a four-item response scale (*Don't know/N.A.*, *Rarely/ never*, *Sometimes*, *Often)* was used for the following student services items:

- Frequency: Academic advising/planning
- Frequency: Career counseling

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