

# Using Logistic Regression to Predict Retention at a Technical College

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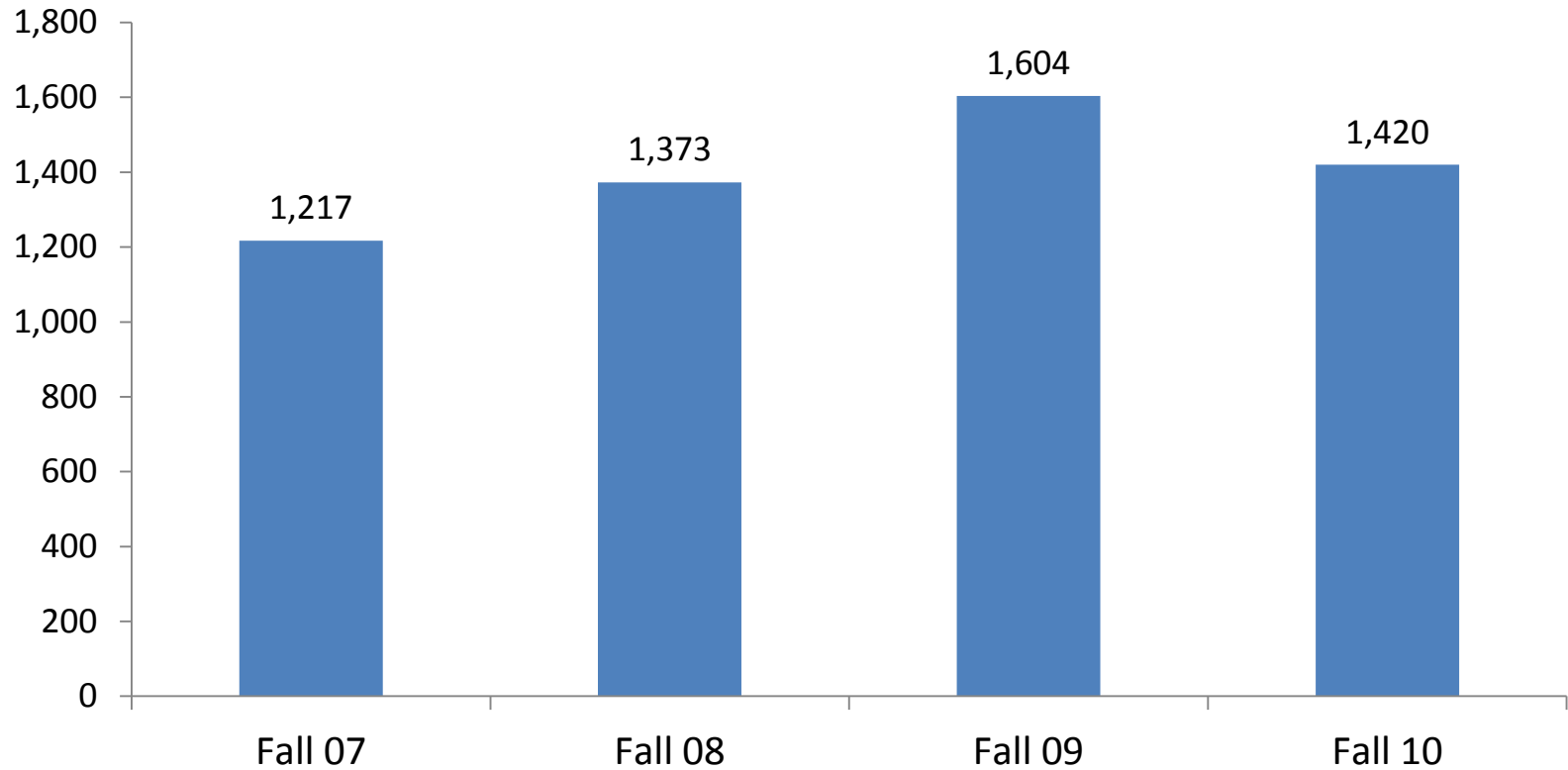
# About Northwest Technical College (NTC)

- Northwest Technical College grew very quickly since 2004 – but now has stabilized.
  - Fall 2004 Headcount = 794
  - Fall 2010 Headcount = 1,420
- NTC and Bemidji State University (BSU) share our president and some offices and services such as Resident Housing, Finance Division, Student Services, Institutional Research, etc.
- NTC has an open enrollment policy.



# Fall Semester Headcount

## Headcount



Source: ISRS ST\_TERM\_DATA 30th day



# New\* / Returning Student Headcount

	Fall 07		Fall 08		Fall 09		Fall 10	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
New*	626	51.4%	689	50.2%	866	54.0%	665	46.8%
Return	591	48.6%	684	49.8%	738	46.0%	755	53.2%
Total	1,217		1,373		1,604		1,420	

Source: ISRS ST\_TERM\_DATA 30th day

Note: \* New students in Summer or Fall semester



# Full-time vs. Part-time Student Headcount

	Fall 07		Fall 08		Fall 09		Fall 10	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Full-time	582	48%	508	37%	590	37%	568	40%
Part-time	635	52%	865	63%	1,014	63%	852	60%
Total	1,217		1,373		1,604		1,420	

Source: ISRS ST\_TERM\_DATA 30th day



# Student FTE vs. Course Location

	Fall 07		Fall 08		Fall 09		Fall 10	
	FTE	Percent	Count	Percent	Count	Percent	Count	Percent
On-campus	655.3	84.1%	573.4	77.1%	662.6	77.2%	584.2	71.4%
Off-campus	123.8	15.9%	170.4	22.9%	196.0	22.8%	234.4	28.6%
Total	779.1		743.8		858.6		818.6	

- Note: FTE = Undergraduate Semester Hours / 15.



# The Purpose of this Study

- Using student's "**Success Status**" (to be explained later) in stead of retention status
- Including "**transfer students**" in the study
- Introducing student's "**College Ready**" status by using the Accuplacer tests results
  - Sentence Skills ( $\geq 86$ )
  - Reading Comprehension ( $\geq 78$ )
  - Arithmetic Test ( $\geq 65$ )
- Considering when students registered on their first courses
  - Registered after August 1<sup>st</sup>: **Late Registration**



# DATA

- Fall 2009 **first-year, full-time, degree seeking** students data
- In this study, we included **first-time regular students** and **transfer students** whose attempted transferred credits  $\leq 6$ .
  - # regular students = 168
  - # transfer students = 112
  - # total students = 280





# Target Variable

- Target Variable: Second Fall Success
  - Define “Second Fall Success = Success” if

At the beginning of 2<sup>nd</sup> Fall

- Students came back to NTC (**retained**) or
  - Students transferred out to another institution (**transferred**) or
  - Students completed the program (**graduated**)
- In our data,

- # students came back = 122
- # students transferred out = 12
- # students graduated = 46



Success Rate = 64.3%

# The Reasons to Use Success Status

- In standard retention study,
  - the students who went to another institution
  - the students who graduated were excluded.



Retention Rate = 55%

- NTC offers 19 one-year certificate programs (19/55 total programs).
- If we conduct a standard retention study, we need to throw away 58 samples (21% of the data).

# The Reasons to Include Transfer Students

# Attempted Transfer Credits to NTC vs. # Transfer Students

# Credits	0 credit	1 credit	2 credits	3 credits	6 credits
# Students	98	7	1	4	2

- Were they well experienced college students?
  - Were they **already at risk**?
- There was no difference in the student's **success** status for “Regular” students and “Transfer” students.
- About 50% of “Transfer” students were categorized as **underprepared**.
- About 30% of “Transfer” students registered after Aug. 1<sup>st</sup> (**Late Registration**).

# Logistic Regression – Initial Predictors

1. Age
2. Gender (Female/Male)
3. College Ready Status (Ready/Underprepared)
  - if a student needed to take **at least one** college readiness course, then he/she was categorized as “Underprepared” student.
4. Pell Status (Yes/No)
5. Enrolled Semester GPA
6. Enrolled Semester Credit Completion Rate
7. Late Registration Status (before or after August 1st)



# Descriptive Statistics for Numerical Predictors

	SECOND FALL SUCCESS			
	Not Successful		Successful	
	Mean	SEM	Mean	SEM
Age	24.54	0.90	26.40	0.81
<b>GPA ***</b>	2.49	0.11	3.27	0.50
<b>Completion ***</b>	41.47	3.99	93.07	1.19

Note: \*\*\*  $p < 0.001$ , t-test; SEM = Standard Error of Mean

- Effect Size
  - GPA: Eta-squared = 0.19, large effect
  - Completion: Eta-squared = 0.46, large effect
- “Age” was excluded from the predictor list.

# Descriptive Statistics for Categorical Predictors

		SECOND FALL SUCCESS			
		Not Successful		Successful	
		Count	Row N %	Count	Row N %
Gender	Female	48	37.2%	82	62.8%
	Male	52	34.7%	98	65.3%
<b>College Ready</b> **	Ready	30	26.3%	84	73.7%
	Not Ready	70	42.2%	96	57.8%
<b>PELL</b> *	No	24	26.7%	66	73.3%
	Yes	76	40.0%	114	60.0%
<b>Late Registration</b> ***	No	60	29.7%	142	70.3%
	Yes	40	51.3%	38	48.7%

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ , Chi-square Test & Fisher's Exact Test.

# Descriptive Statistics for Categorical Predictors

## ■ Interpretations

- College Ready: Underprepared students were **less likely** to succeed than college ready students (Odds Ratio = 0.49).
- PELL Status: The students with PELL status were **less likely** to succeed than the students without PELL status (Odds Ratio = 0.55).
- Late Registration: The students whose first registration happened after Aug. 1<sup>st</sup> were **less likely** to succeed than the students who first registered after Aug. 1<sup>st</sup> (Odds Ratio = 0.40).
- Note:
  - “Odds Ratio” is the ratio of the odds of an event occurring.
  - “Gender” was excluded from the predictor list.



# Final Predictors

1. College Ready Status (Ready/Underprepared)
2. Pell Status (Yes/No)
3. Enrolled Semester GPA
4. Enrolled Semester Credit Completion Rate
5. Late Registration Status (before or after August 1st)





# Stepwise Logistic Regression

- We entered all the predictor variables into the model and found the most important predictors using a stepwise logistic regression with forward selection method.

		95% Confidence Interval		
	Odds Ratio	Lower	Upper	P-value
GPA	2.24	1.35	3.71	< 0.0001
Credit Comp. Rate	1.04	1.03	1.06	< 0.0001

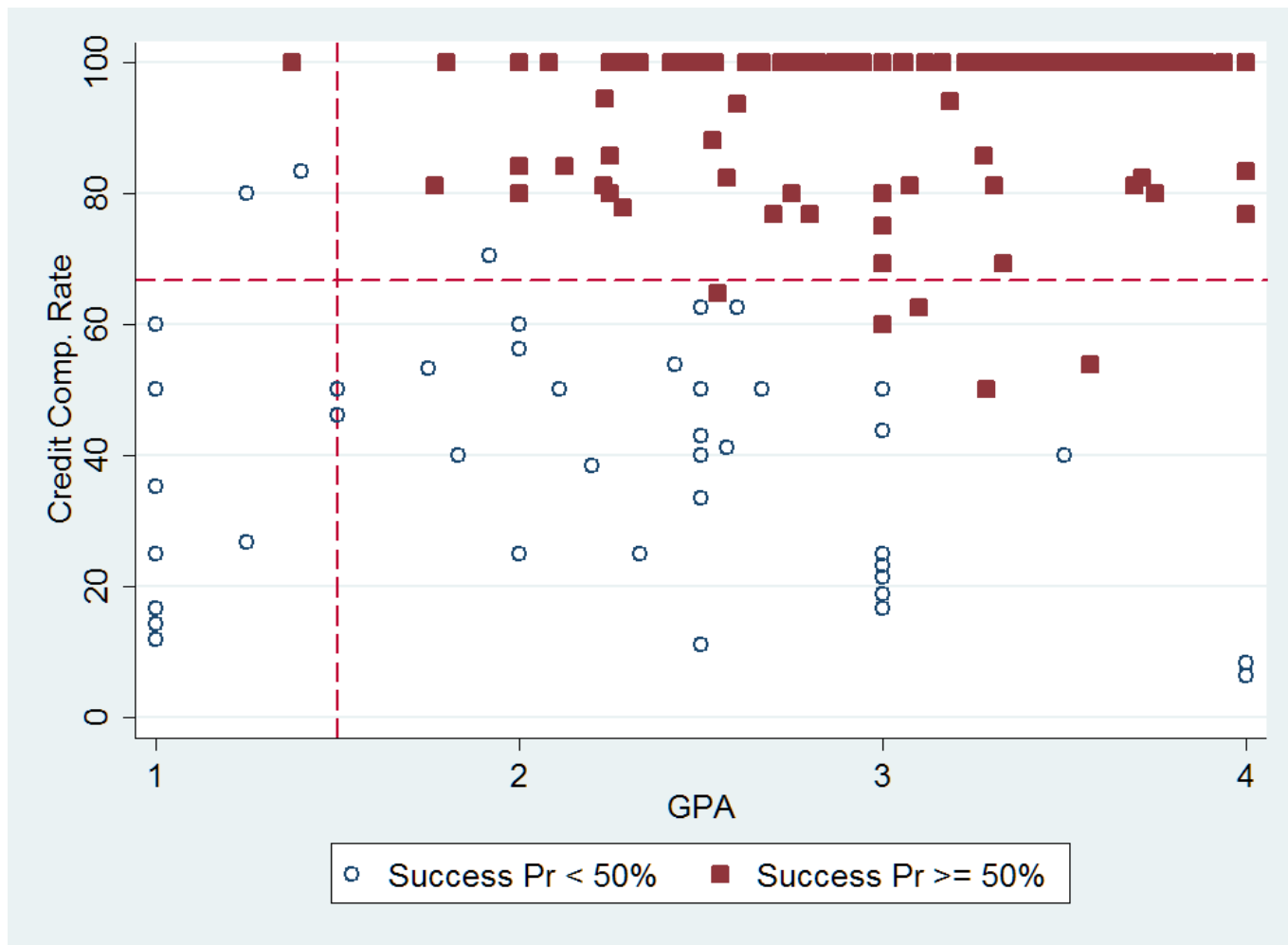
- Sample Interpretation
  - GPA: The students were 2.24 times **more likely** to be successful as their 1<sup>st</sup> semester college GPA increased by 1 point.

# Final Model with GPA and Credit Comp. Rate

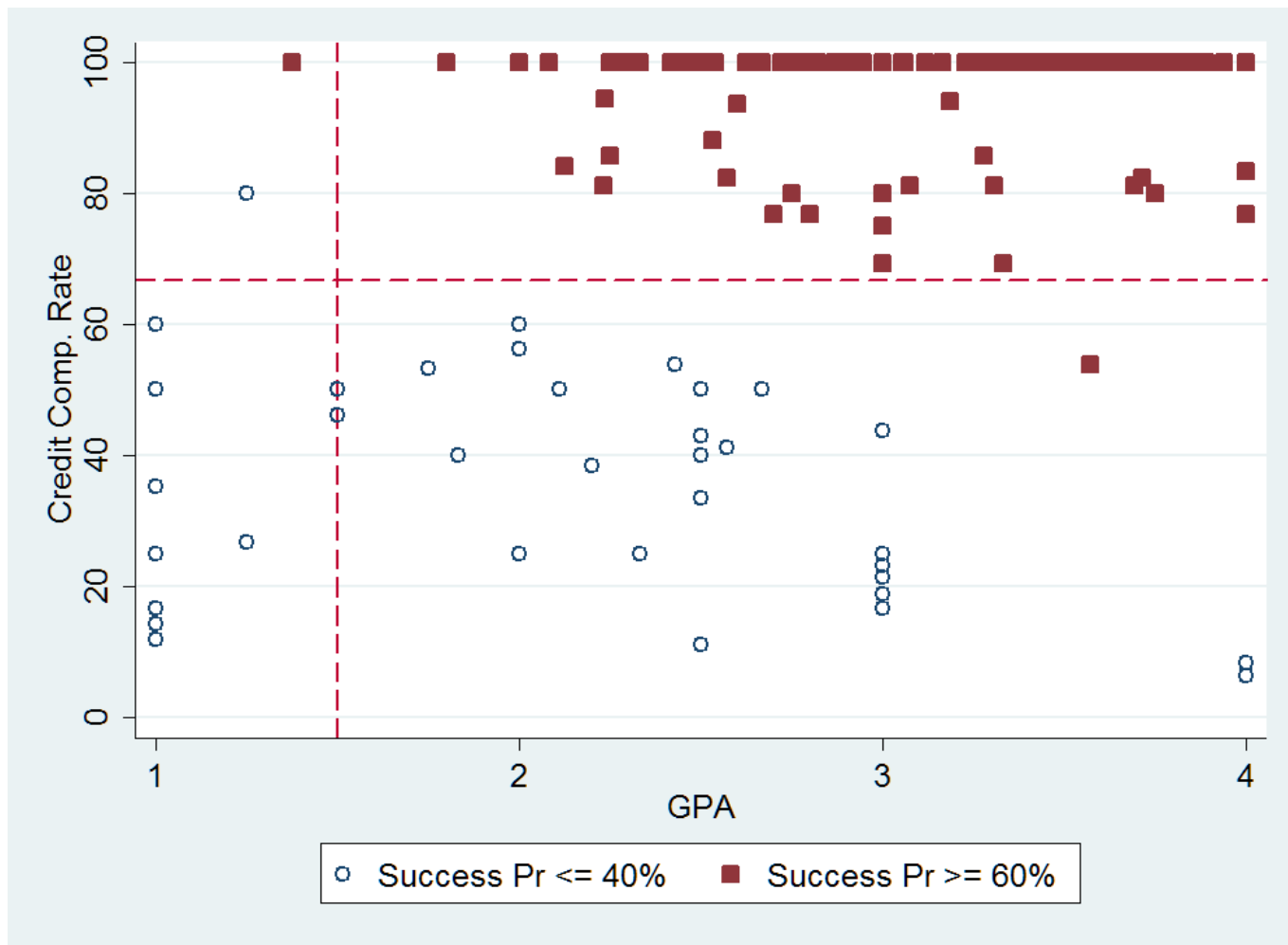
- The final logistic model with GPA and Credit Completion Rate correctly predicted 84% of the sample data.
- Sensitivity: 94%
  - Prob. that the model classified as “Successful” when given to a group of students who were “Successful”
- Specificity: 55%
  - Prob. that the model classified as “not Successful” when given to a group of students who were not “Successful”
- The Area Under an ROC Curve: 0.82
  - ROC = Receiver operating characteristic
  - The value of 0.82 indicated this is a good model.



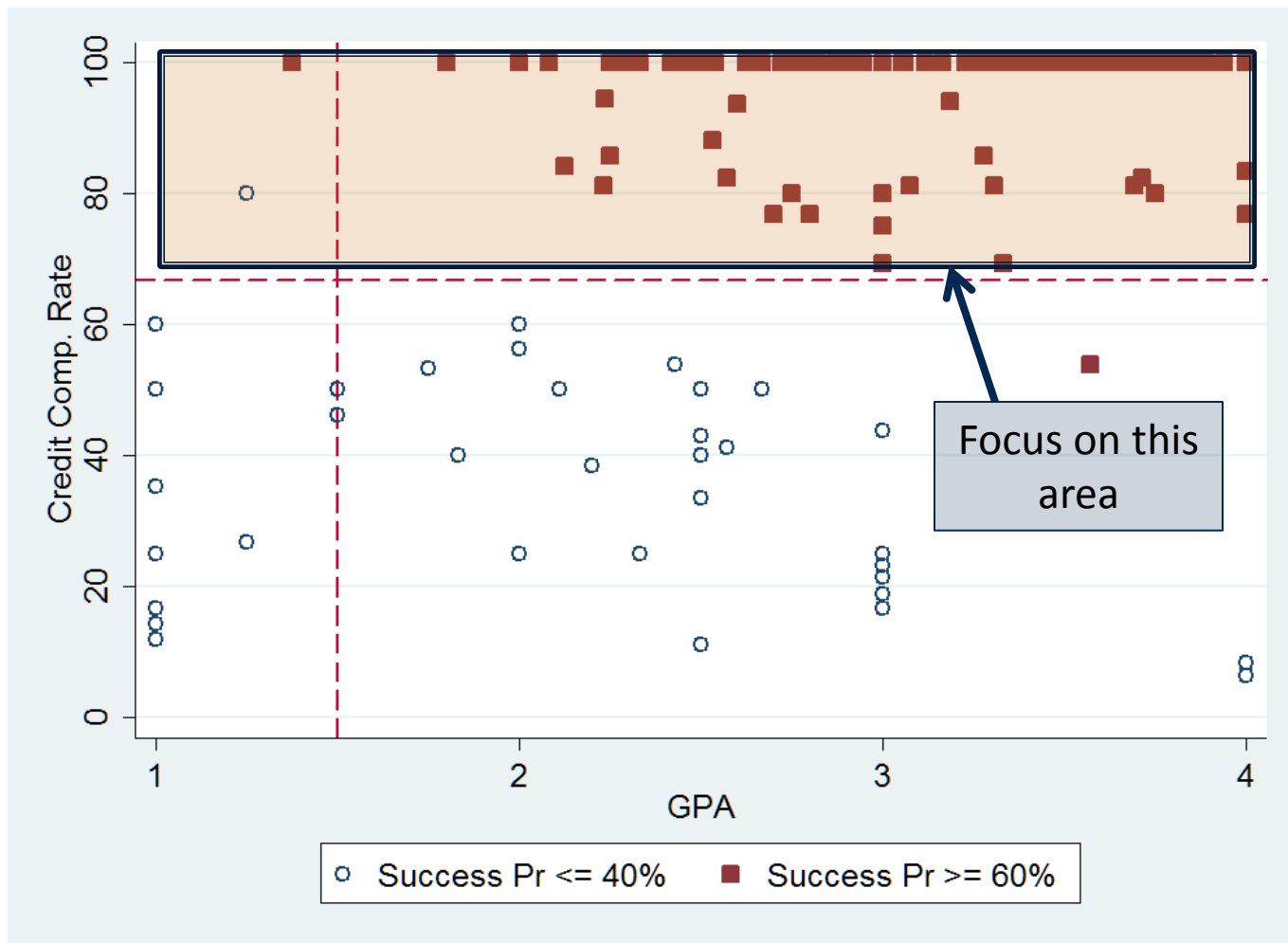
# Model Prediction: Success Prob. $\geq 50\%$



# Model Prediction: Success Prob. $\geq 60\%$



# Model Prediction: Success Prob. $\geq 60\%$



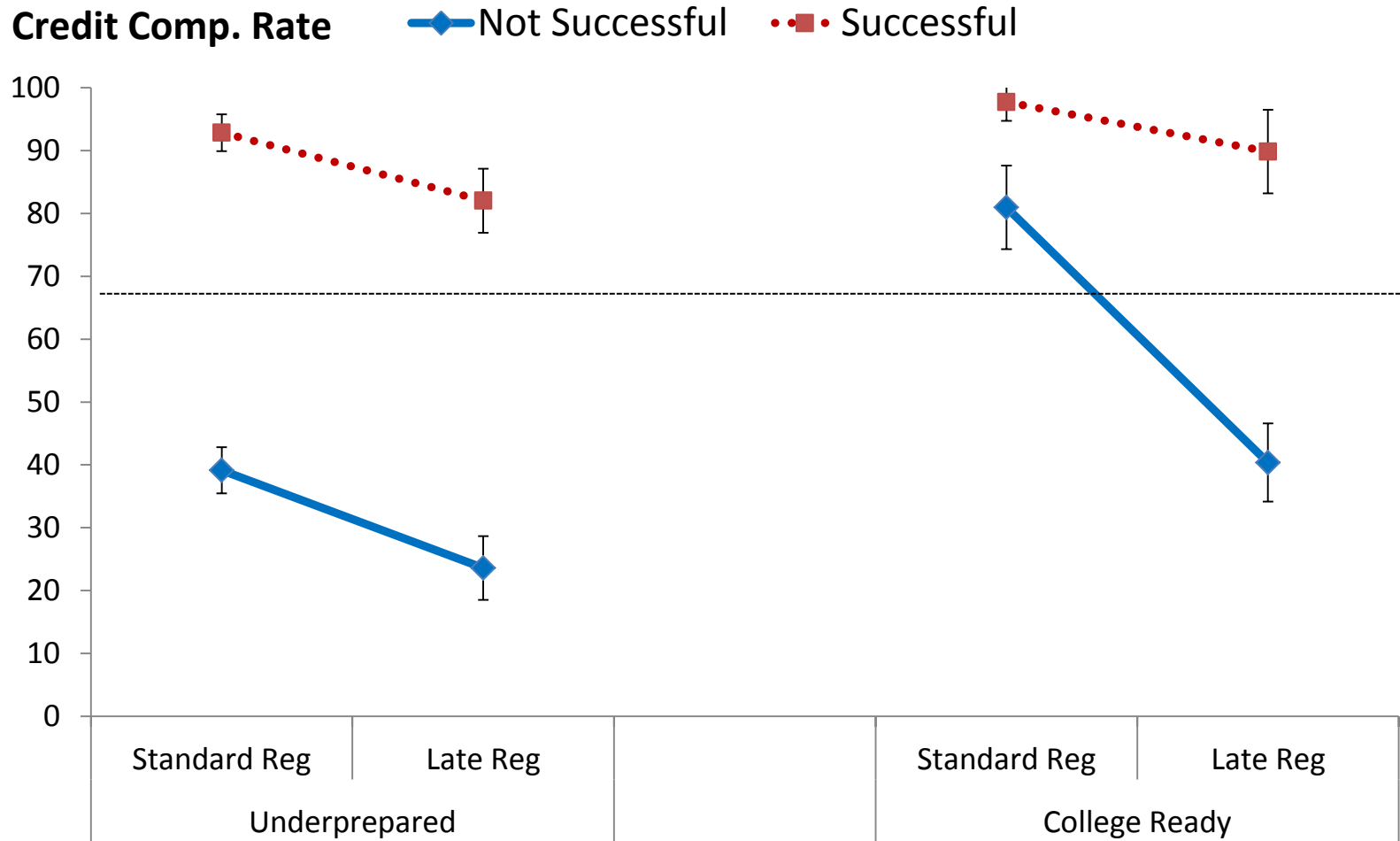
# Model for Credit Comp. Rate

- The student's 1<sup>st</sup> semester credit completion rate was analyzed using a
  - 2 (success status: successful vs. not successful) ×
  - 2 (college ready status: ready vs. underprepared) ×
  - 2 (late registration status: regular vs. late)

ANOVA.



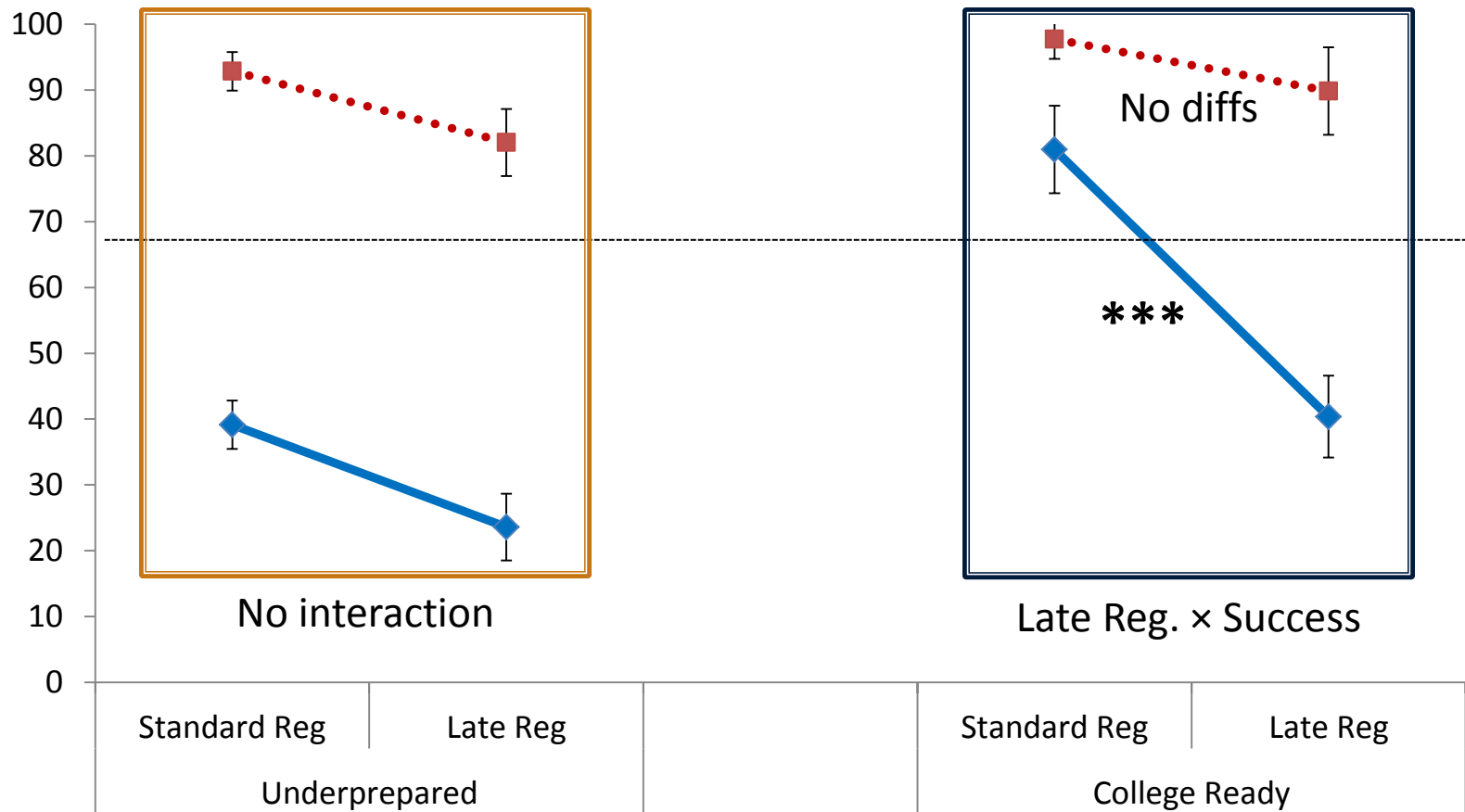
# 3-way Interaction ( $F(1, 272) = 3.73, p = 0.054$ )



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**Credit Comp. Rate**

◆ Not Successful    ■ Successful

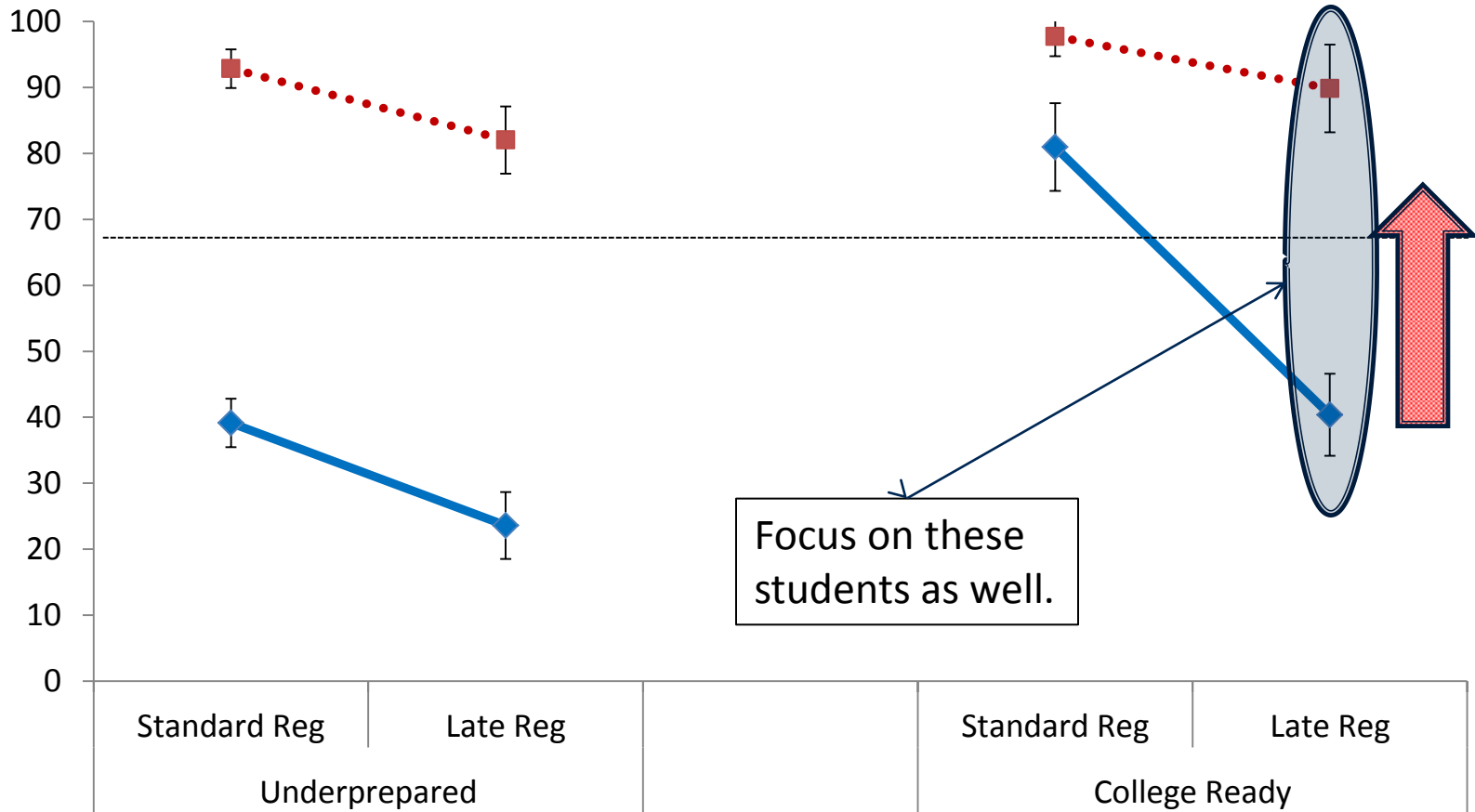




# 3-way Interaction ( $F(1, 272) = 3.73, p = 0.054$ )

Credit Comp. Rate

◆ Not Successful    ■ Successful



# Results

- 3-way Interaction
- 2-way Interactions
  - Success × Late Registration
    - In “not successful” group, Standard Reg. > Late Reg. But, no diff. in “Successful” group.
  - Success × College Ready
    - In “not successful” group, Ready > Underprepared. But, no diff. in “Successful” group.
- Main Effects
  - Success: Successful > Not Successful
  - Late Registration: Standard > Late
  - College Ready: Ready > Underprepared

# Summary and Conclusion

- In this study, we included **transfer students** because we believed some of them were **already at risk** when they transferred to NTC.
- We also used the student's **success status** instead of retention status because we wanted to use the information from the students who completed the program and the students who transferred out.
- A stepwise regression revealed that **1<sup>st</sup> semester credit completion rate** and its **GPA** were the factors for student's success status.



## Conclusions (contd.)

- The final model (based on the graphics) suggested that the **credit completion rate** might influence student's success status.
- We assessed a 3-way ANOVA for the credit completion rate and found that student's **late registration status** might be the factor.



# Future Research

- The most updated data will be available next month.
- We will get the similar data from our sister institutions.
  - Mixed Model?
- Use different cut-off date for “Late Registration”
  - June 1st

