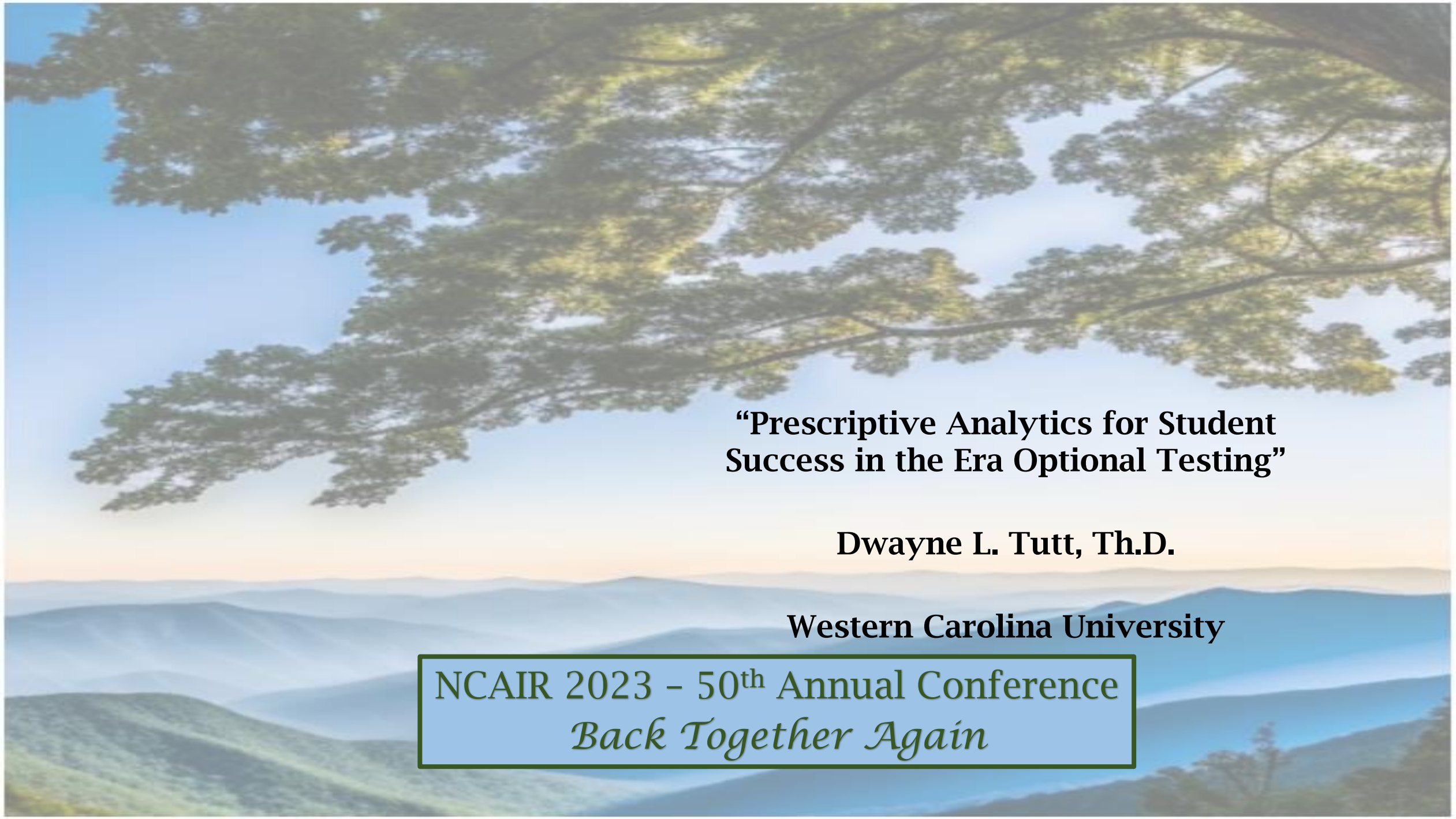

"Prescriptive Analytics for Student Success in the Era Optional Testing"

Dwayne L. Tutt, Th.D.

Western Carolina University

NCAIR 2023 – 50th Annual Conference
Back Together Again

Welcome

“Prescriptive Analytics for Student Success in the Era Optional Test

The Student Success Team

Lowell Davis (2013 – 2021), Associate Vice Chancellor of Student Success

Jeffery Lawson (2021 – 2022), Interim Associate Vice Chancellor of Student Success

William Moultrie, Associate Vice Chancellor of Student Success

Kristin Daiber, Director of Student Retention

Sibley Brian, Director Mathematics Tutoring Center

Caroline LeBoeuf, Assistant Director of Retention

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Welcome

“Prescriptive Analytics for Student Success in the Era Optional Test”

The Institutional Research Team

Timothy Metz, Associate Vice Chancellor, Institutional Planning & Effectiveness

William Hutchings, Social Research Specialist

Srisuda McCollough, Business Technical Applications Analyst

Trista Middleton, Social Research Specialist

Nathan Hodges, IT Business Intelligence Data Analyst II

Western Carolina University

2nd highest job satisfaction in the UNC system!

LOCATION

-Cullowhee, NC (1 hour west of Asheville, NC)

-3 hours from Charlotte, Atlanta and Knoxville

-Rural, regional, comprehensive, public

MISSION

As Western North Carolina's regional comprehensive university, Western Carolina University is dedicated to academic excellence, affordability, and access. WCU inspires student learning through innovative teaching, nationally recognized programs, exceptional support, and a robust connectedness with surrounding communities in Southern Appalachia, including the Eastern Band of Cherokee Indians. Through a broad range of scholarly activities, our faculty and students seek to better understand our region, state, nation, and world. With an emphasis on engaging students both inside and outside the classroom, WCU's bachelor's, master's, and professional doctoral programs in Cullowhee, Asheville, and online aim to improve lives and promote economic prosperity throughout Western North Carolina and beyond.

STUDENTS

~12,000 headcount

~10,000+ undergraduate

~9,500+ residential

~9,500+ full-time student

-87% NC residents

Welcome

"Prescriptive Analytics for Student Success in the Era of Optional Testing"

The Academic Challenge Without ACT and SAT Test Scores

I. How Do We Know Which Math Course A Student Should Be Placed?

II. How Do We Know If A Student Is Prepared For STEM Programs?

III. How Do We Know The "Overall" Preparedness For College?

IV. Does The High School GPA "Alone" Answer The Above Questions?

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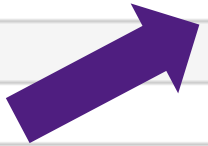
PROJECT BACKGROUND

HISTORICAL RETENTION

THE UNIVERSITY OF NORTH CAROLINA SYSTEM

Cohort Term	Demographic	Students in Cohort*	Fall-to-Spring (N)	Fall-to-Spring (%)	One-Year Retention (N)	One-Year Retention (%)
Fall 2009	All	1,554	1,370	88.2%	1,152	74.1%
Fall 2010	All	1,435	1,273	88.7%	1,030	71.8%
Fall 2011	All	1,520	1,328	87.4%	1,119	73.6%
Fall 2012	All	1,558	1,420	91.1%	1,225	78.6%
Fall 2013	All	1,621	1,459	90.0%	1,262	77.9%
Fall 2014	All	1,755	1,620	92.3%	1,405	80.1%
Fall 2015	All	1,638	1,488	90.8%	1,313	80.2%
Fall 2016	All	1,921	1,753	91.3%	1,516	78.9%
Fall 2017	All	1,997	1,819	91.1%	1,588	79.5%
Fall 2018	All	2,196	2,004	91.3%	1,715	78.1%
Fall 2019	All	2,106	1,917	91.0%	1,713	81.3%
Fall 2020	All	1,822	1,567	86.0%	1,348	74.0%
Fall 2021	All	1,729	1,495	86.5%	1,232	71.3%
Fall 2022	All	1,932				



*Adjusted cohort with allowable exclusions removed

Student Success

Defining A Student As “At Risk” For Modeling

WCU welcomed one of its largest freshmen classes in school history with 1,913 students.

Student Success

Project Description

- Develop a model to predict FTFTF who are **“At Risk”** to succeed
- Identify and develop interventions to promote student success
- “At Risk” is defined by their ability to maintain good academic standing
- The objective was to improve student success and **WAS NOT** about who to recruit

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Student Success

Defining “At Risk” For Modeling

All Types Of Students Arrive In The Fall

Some Are Prepared For Success

Some Are Not Prepared For Success

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Student Success

How Do We Make Success Happen For The “At Risk” Student?

Prescriptive analytics uses data analysis to offer the best possible course of action in any given scenario. It is also called the future of data analytics and is often referred to as business analytics when applied in business management and decision-making processes.

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Student Success

Defining “At Risk” For Modeling

Mathematically Thinking

STUDENT SUCCESS = FUNCTION (RISK)

RISK = FUNCTION (STATISTICAL VARIANCE)

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Student Success

Defining “At Risk” For Modeling

Mathematically Thinking

- **REVERENDJOHN VENN (1894 – 1923)**

  PHILOSOPHER, MATHEMATICIAN AND PRIEST

  HE THOUGHT IN TERMS OF FREQUENCY THEORY OF **PROBABILITY**

- **REVEREND THOMAS BAYES (1701 – 1761)**
  - PHILOSOPHER, STATISTICIAN AND MINISTER
  - HE THOUGHT IN TERMS OF **CONDITIONAL PROBABILITY**

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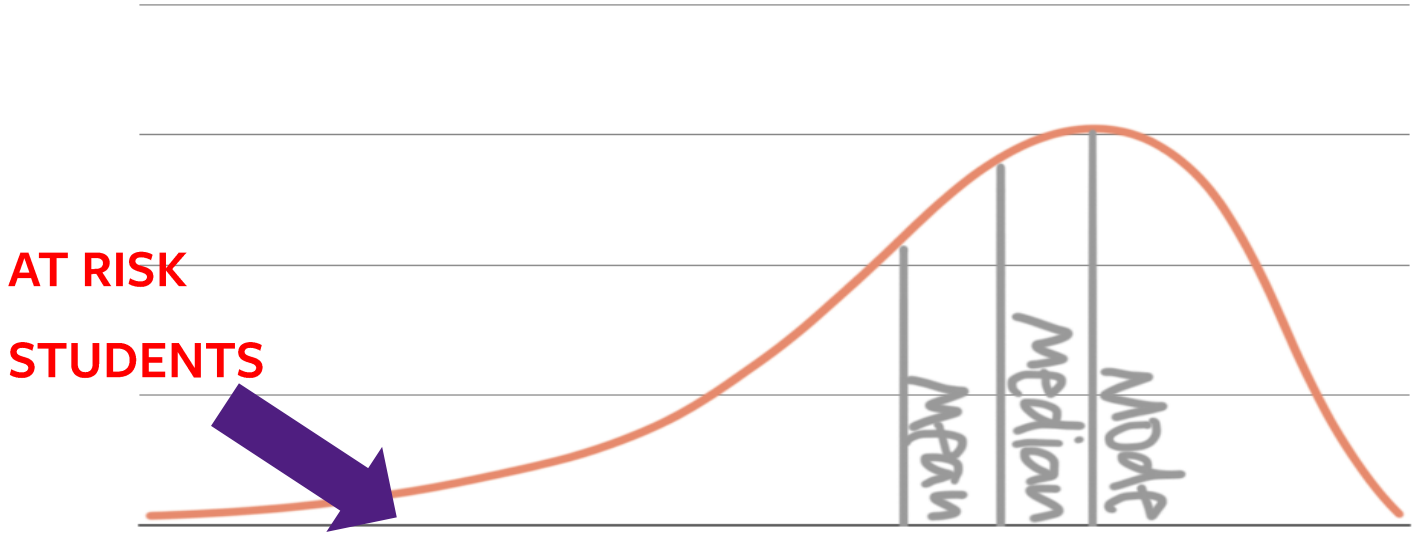
Student Success

Defining “At Risk” For Modeling

Mathematically Thinking – Skew Left (Lower HSGPAs)

In a left-skewed distribution, the “tail” is on the left. The median of a left-skewed distribution is still at the point that divides the area into two equal parts. The mean is further to the left than the median, more towards the tail on the left side, and the mode is where the data peaks:



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STUDENT SUCCESS

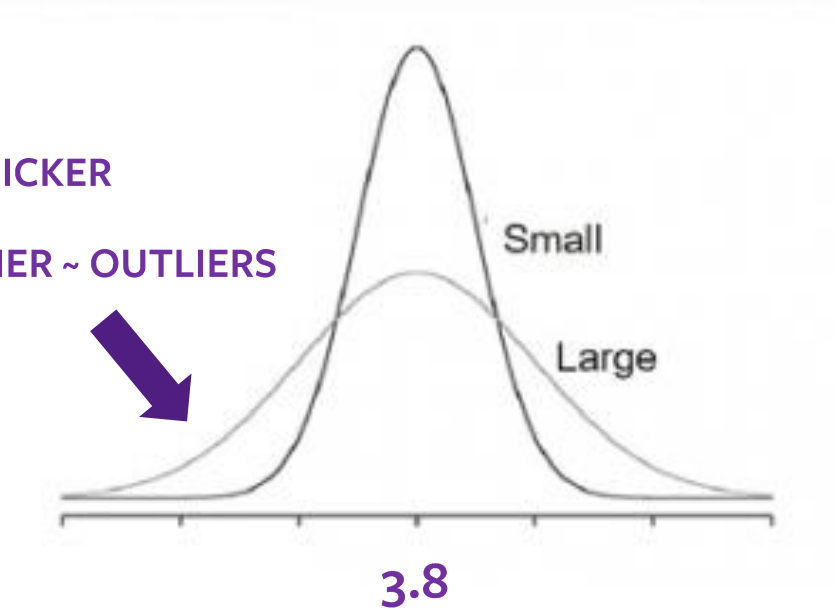
DEFINING "AT RISK" FOR MODELING THE DISPERSION ABOUT THE MEAN

MATHEMATICALLY THINKING

Student HSGPA 2010 Cohort	Student HSGPA 2011 Cohort
3.8	4.0
3.9	4.0
3.7	3.8
3.6	3.6
3.8	3.6
Mean = 3.76	Mean = 3.80
Standard Deviation = 11.40%	Standard Deviation = 20.00%
CV = 3.03	**CV = 5.26**
Where CV = (Mean / STD) * 100	

TAIL IS THICKER

KURTOSIS IS HEAVIER ~ OUTLIERS



STUDENT SUCCESS

DEFINING "AT RISK" FOR MODELING THE DISPERSION ABOUT THE MEAN

MATHEMATICALLY THINKING

The SAS System

Obs	Term_Code	ACT_Tests	AVG_ACT	STD_Composite	SAT_Tests	AVG_SAT	STD_SAT
1	201580	1102	21.8049	3.24017	1149	1080.35	110.305
2	201680	1388	21.7428	3.69621	1272	1064.36	123.298
3	201780	1449	21.7095	3.53150	1196	1083.82	118.914
4	201880	1583	22.2786	3.77748	1332	1103.75	118.662
5	201980	1481	21.9710	3.66980	1255	1100.05	115.413
6	202080	1319	22.3760	3.99919	1034	1102.02	127.346
7	202180	1045	21.8612	4.40338	498	1110.78	131.437
8	202280	1054	22.3435	4.65930	429	1117.74	142.579

Western Carolina University

Student Success

Defining “At Risk” For Modeling The Dispersion About The Mean

Mathematically Thinking

The SAS System

Obs	Term_Code	Students	HS_GPA	STD_HS_GPA	CV_HS_GPA
1	201580	1607	3.30482	0.36240	10.9658
2	201680	1898	3.28473	0.40489	12.3264
3	201780	1965	3.34159	0.37660	11.2701
4	201880	2165	3.39035	0.38113	11.2416
5	201980	2056	3.43286	0.37698	10.9815
6	202080	1765	3.45733	0.38297	11.0769
7	202180	1673	3.44239	0.42068	12.2205
8	202280	1887	3.40908	0.42379	12.4312

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Student Success

"Building The Analytical Dataset ~ Including Variables and Data Mining Counts"

- **Key Variables In Dataset:** FTFT Freshman From Fall 2015 to Spring 2019, Terms at WCU, Retention One Year Later, WCUFallGPA, WCUSpringGPA, Residency, NC Students, HS ACT Scores, HS SAT Scores, HS Unweighted GPA, DPI High School Rankings, DPI HS Average ACT, DPI HS SAT Average, Other DPI Data, Student Race, Gender, Age, Parent AGI, Student Loan Debt, Pell Grant Data, Financial Need, EFC, Number of Family Members In College, WCU Hours Taken, WCU GPA After First Semester, ASP Flag, Honors Student Flag, Military Flag, Plus many Other SDM Variables and I Created New Variables

- Analog FTFTF Cohort Years Fall2015 to Fall2016 Fall2016 to Fall2017 Fall2017 to Fall2018 Fall2018 to Fall2019
- Count of Distinct Students 7,635 (Filtered)
- Count of Distinct NC High Schools 225 (Filtered More For At Least 10 Students)
- AGI Average $88,105
- High School Unweighted GPA 3.32
- WCU Average Fall GPA 2.93

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Student Success

Data Mining

Simple Statistics By Filtered NC High Schools

(Note: Number High Schools = 225)

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
FallGPA1	225	2.90270	0.25378	653.10835	1.79889	3.51652
MissingProb	225	0.21931	0.11621	49.34565	0	0.69231
HSScoreAVG	215	73.84000	9.09904	15876	49.80000	99.40000
HS_GPA	225	3.31428	0.16584	745.71283	2.85538	3.80600
RankFallGPA1	225	48.69505	7.72860	10956	24.70000	69.91667
ACT	225	21.72361	1.34248	4888	17.33333	25.00000
SAT	224	1074	47.08073	240606	860.00000	1230
ParentRankAGI1	225	49.13771	10.85871	11056	18.70000	74.42857
AGI1	225	85726	26673	19288314	31684	210959
EFC1	225	16353	11289	3679521	1197	113057
FinNeed1	225	10361	2995	2331230	3842	26325
NumCollege1	225	1.31227	0.12317	295.26101	1.06538	1.69820

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Student Success

"Data Mining ~ Correlations"
By NC High Schools

TEST SCORES

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	FallGPA1	MissingProb	HSScoreAVG	HS_GPA	RankFallGPA1	ACT	SAT	ParentRankAGI1	AGI1	EFC1	FinNeed1	NumCollege1
FallGPA1	1.00000	-0.54952	0.25624	0.18115	0.94016	0.31133	0.32763	0.27466	0.24535	0.23292	-0.22427	0.07287
		<.0001	0.0001	0.0064	<.0001	<.0001	<.0001	<.0001	0.0002	0.0004	0.0007	0.2764
	225	225	215	225	225	225	224	225	225	225	225	225

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Student Success

Data Mining

- It Appears That High Schools Differ Regarding WCU Student Success
- Test Scores Are More Predictive Of WCU Success Than High School GPA
- Family Economics Is Correlated With WCU Student Success

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“CATIREAM”

(CATAMOUNT INSTITUTIONAL RESEARCH ENROLLMENT ADJUSTMENT MODEL)

- Predicts first semester GPA for each new FTFTF
- Assigns a risk score to each student (probability of retention)

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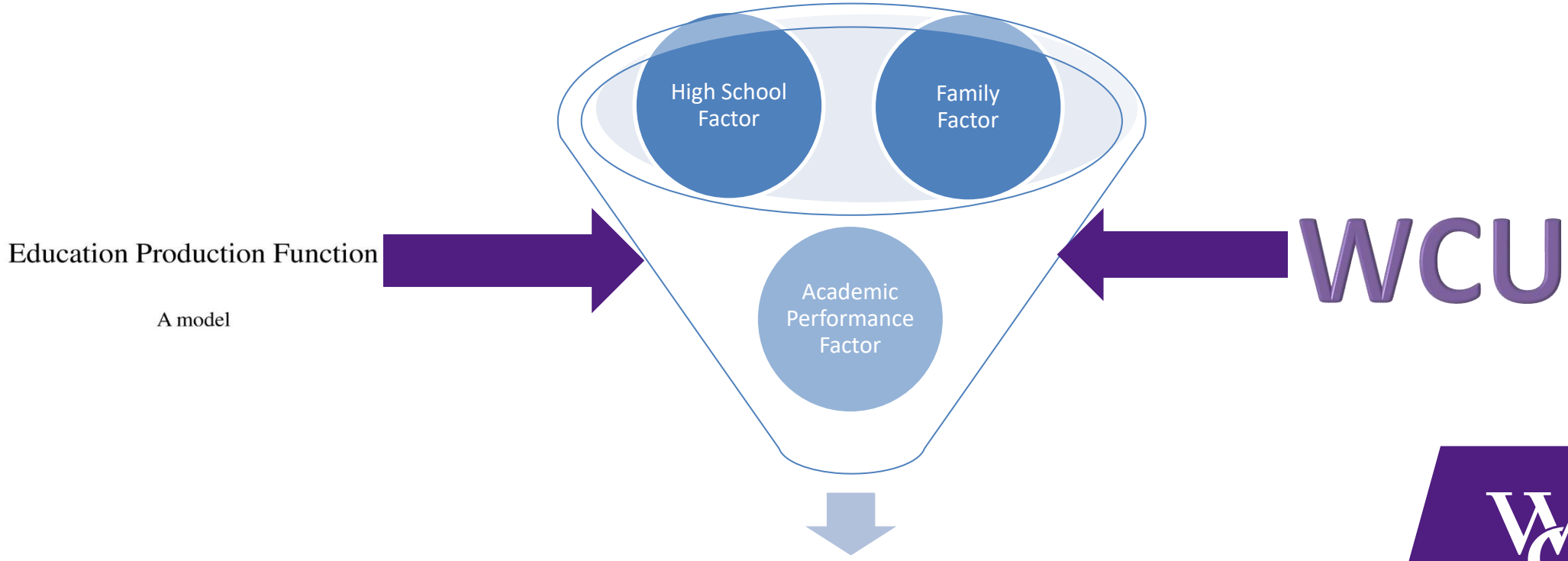
Student Success

CATIREAM

RETENTION HAS THREE INFLUENCERS (SDM RELATED)

FACTORS FOR RETENTION AND GRADUATION



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FACTORS SOURCE DATA

NOTE: STUDENT DATA MART (SDM) WAS USED BECAUSE IT IS SCRUBBED, CLEANED, VALIDATED AND FROZEN

Family Factor	High School Factor	Academic Performance Factor
NC DPI High Schools	NC DPI High Schools	SDM Test Scores
SDM Family AGI	SDM High School GPA	SDM High School GPA
WCU FTFTF Retention		

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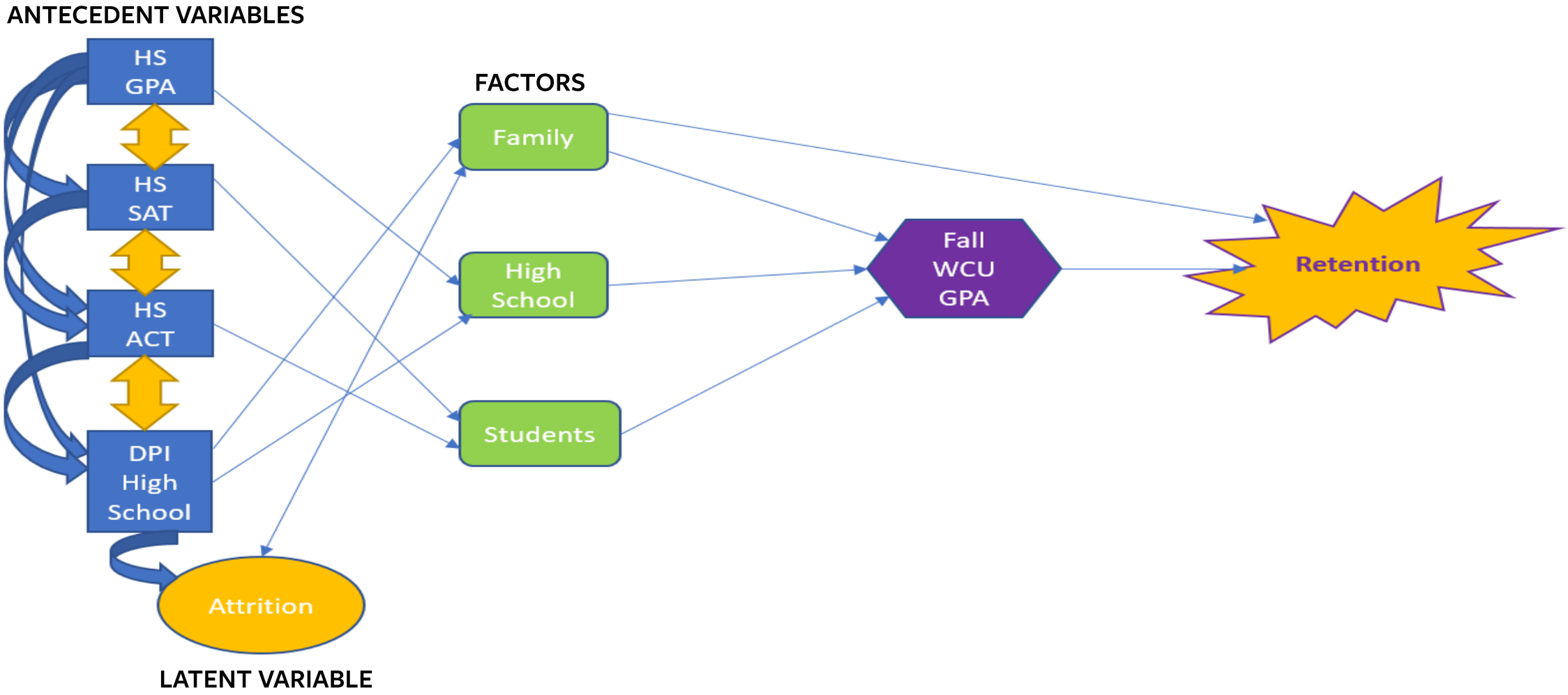
THE CATIREAM MODEL

"STUDENT SUCCESS USING FACTOR ANALYSIS AND PATH MODELING"



THE CATIREAM MODEL

MODEL TEST OF RANDOM SAMPLE OF FTFTF FALL 2018

MODEL FOUND 59 OF THE 91 STUDENTS

The SAS System

The FREQ Procedure

Frequency Percent Row Pct Col Pct	Table of Student_Missing by MissingChance		
	MissingChance		
Student_Missing	Attrition	Retained	Total
Attrition	59 16.03 64.84 36.65	32 8.70 35.16 15.46	91 24.73
Retained	102 27.72 36.82 63.35	175 47.55 63.18 84.54	277 75.27
Total	161 43.75	207 56.25	368 100.00

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THE CATIREAM MODEL

MODEL TEST OF RANDOM SAMPLE OF FTFTF FALL 2018

THERE IS A STATISTICAL SIGNIFICANCE

Statistics for Table of Student_Missing by MissingChance

Statistic	DF	Value	Prob
Chi-Square	1	21.8405	<.0001
Likelihood Ratio Chi-Square	1	21.8352	<.0001
Continuity Adj. Chi-Square	1	20.7171	<.0001
Mantel-Haenszel Chi-Square	1	21.7812	<.0001
Phi Coefficient		0.2436	
Contingency Coefficient		0.2367	
Cramer's V		0.2436	

Odds Ratio and Relative Risks			
Statistic	Value	95% Confidence Limits	
Odds Ratio	3.1633	1.9288	5.1880
Relative Risk (Column 1)	1.7607	1.4186	2.1854
Relative Risk (Column 2)	0.5566	0.4152	0.7462

Sample Size = 368

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CATIREAM MODEL

PHASE TWO:
SPRING 2022 SURVEY
RESPONSES 1,144

Successful Students Survey

Thinking back to when you were in high school, on A Scale of 1 to 10 with: "one meaning I strongly disagree **or not me at all**" and "10 meaning I strongly agree" please rate the following:

When I was in High School

1) I was confident in my ability do research a term paper?
2) I was confident in writing papers for my classes?
3) I was confident I would do well on exams?
4) I was confident in writing good class notes?
5) I was confident in my ability to understand my textbooks?
6) I was confident in my ability to pass my mathematics courses?
7) I was confident if I ran into difficulties in school, I could work harder to overcome them?
8) I was confident in setbacks, they didn't discourage me, I didn't give up easily?
9) I was confident that the harder I worked at something, the better I would become?
10) I was confident a college degree was necessary for me to reach my goals?
11) I was confident and motivated to complete a undergraduate degree?
12) I made lists and tried to focus on the most important things first?
13) I spent time each day planning?

CATIREAM MODEL

PHASE TWO:
SPRING 2022 SURVEY
RESPONSES 1,144

High School Interests, Hobbies, Activities and Goal Setting

23) I played on the local high school football team my junior and senior years?

24) I played on the local high school basketball team my junior and senior years?

25) I played on the local high school (any sport) other than football or basketball my junior and senior years?

26) I enjoyed playing golf in high school?

27) I enjoyed playing chess in high school?

28) I enjoyed playing video games in high school?

29) I was very active in **honors** societies and **honors** organizations in high school?

30) I was very active in social clubs and organizations in high school?

31) I was very active in the high school band?

32) I worked over 16 hours per week during high school?

33) I worked almost every summer (summer job) in high school?

34) I typically watched Fox News for information on current events?

35) I typically watched CNN News for information on current events?

36) I typically watched public broadcasting channels for information on current events?

37) I typically watched **NON-Cable Channels** for information on current events?

38) When I graduated high school, I had my own savings account at the bank?

39) When I graduated high school, I had my own vehicle **AND I HELPED BUY IT?**

40) My high school helped prepare me to succeed in college?

THE CATIREAM MODEL

PHASE TWO

SURVEY DATA (SPRING 2022 ~ SURVEY RESPONSES 1,144)

MOST SUCCESSFUL

WHILE IN HIGH SCHOOL THEY

1) Wrote Good Class Notes
2) Made Lists And Tried To Focus On The Most Important Things First
3) Planned Time Everyday
4) Planned The Steps Of A Project / Task Before Starting It
5) Completed Assignments Before They Were Due
6) Often Found Themselves Doing Work They Had Intended To Do Earlier

WCU PLANNERS

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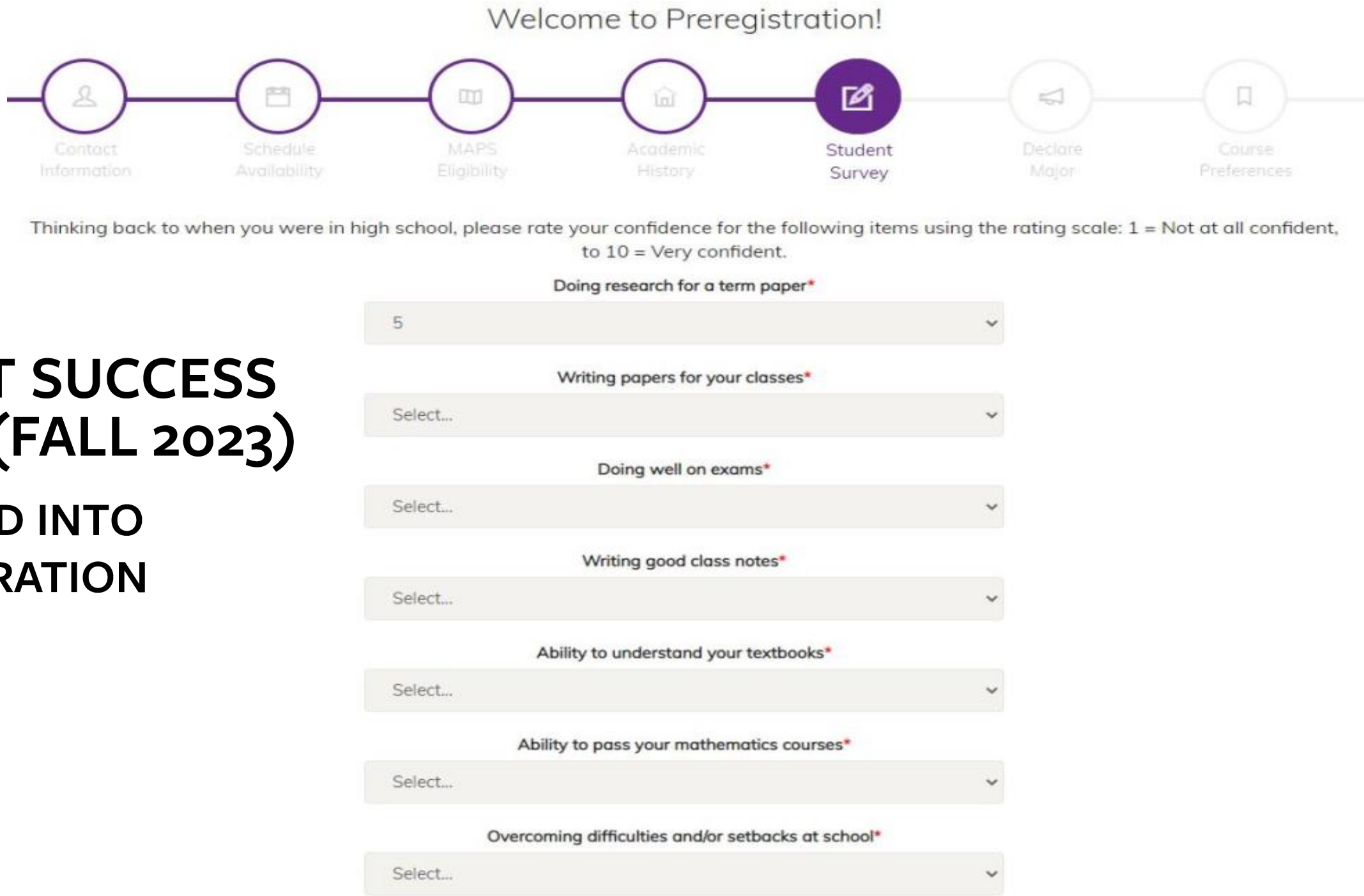
STUDENT SUCCESS SURVEY (FALL 2023)

INTEGRATED INTO PREREGISTRATION PROCESS



THE CATIREAM MODEL

PHASE TWO

IMPLEMENTED FOR FALL 2023

Thinking back to when you were in high school, please respond to the following statements using the rating scale: 1 = None of the time, to 10 = All of the time.

I made lists and tried to focus on the most important things first*

Select...

I planned my time every day*

Select...

I planned the steps of a project/task before starting it*

Select...

I kept track of my assignments and due dates*

Select...

I completed assignments before they were due*

Select...

I often found myself doing work I had intended to do earlier than I actually did*

Select...

How likely are you to complete your degree at WCU using the rating scale: 1 = Not likely, to 5 = Very likely?*

Select...

Was WCU the top choice of the colleges/universities you applied to?*

Select...

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THE CATIREAM MODEL

PHASE TWO

IMPLEMENTED FOR FALL 2023

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THE CATIREAM MODEL

PHASE THREE: ALEKS MATH PLACEMENT (SUMMER 2022)

ALEKS

ALEKS is a personalized, adaptive learning experience that supports students at all levels of preparation. Flexible enough to support a variety of course formats, ALEKS integrates assessment and learning to provide a truly optimal experience where students work on material they need, right when they need it.

Placement, Preparation, and Learning (PPL)

Students who are successful in their first math course are three times more likely to graduate. Empower students to be successful in this important course by ensuring they are properly placed and prepared. With a unique combination of adaptive assessment and personalized learning, ALEKS Placement, Preparation and Learning (PPL) accurately measures the student's math foundation and creates a personalized learning module to review and refresh lost knowledge. This allows the student to be placed and successful in the right course, expediting the student's path to complete their degree.

THE CATIREAM MODEL

PHASE THREE: ADDING ALEKS MATH RESULTS (SPRING 2023)

The SAS System

The FREQ Procedure

Frequency Expected Cell Chi-Square Percent	Table of ALEKS by Success		
	Success		
ALEKS	No	Yes	Total
No	172 152.15 2.5886 22.45	346 365.85 1.0766 45.17	518 67.62
Yes	53 72.846 5.4068 6.92	195 175.15 2.2487 25.46	248 32.38
Total	225 29.37	541 70.63	766 100.00

Statistics for Table of ALEKS by Success

Statistic	DF	Value	Prob
Chi-Square	1	11.3206	0.0008
Likelihood Ratio Chi-Square	1	11.7257	0.0006
Continuity Adj. Chi-Square	1	10.7574	0.0010
Mantel-Haenszel Chi-Square	1	11.3058	0.0008
Phi Coefficient		0.1216	
Contingency Coefficient		0.1207	
Cramer's V		0.1216	

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THE CATIREAM MODEL

PHASE THREE: ADDING ALEKS MATH RESULTS (SPRING 2023)

SUCCESS!!!

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THE CATIREAM MODEL

PHASE FOUR: MODELING WITHOUT TEST SCORES

NEW ALGORITHMS

- HIGH SCHOOL UNWEIGHTED GPA PER STUDENT
- FTFTF WCU GPA
- HIGH SCHOOL HISTORICAL GPA AVERAGE FOR ALL ENROLLED FTFTF
- HIGH SCHOOL SUCCESS AT WCU – WCU GPA HOW WELL DID THE STUDENTS PERFORM IN FIRST YEAR
- Z – SCORES FOR STUDENTS WITHIN THE HISTORICAL PERFORMANCE OF THEIR HIGH SCHOOL
- ALEKS OUTCOMES
- STUDENT SUCCESS SURVEY OUTCOME

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THE CATIREAM MODEL

CLOSING THOUGHTS

NEXT STEPS FOR WCU

- IMPLEMENT PILOT USI 130 STUDY TO INCLUDE MODULES FOR PLANNING SKILLS
- IMPLEMENT PLAN TO PILOT A NON - STEM ALEKS
- EVALUATE FALL 2023 FTFTF STUDENT SUCCESS SURVEY DATA
- REWORK CATIREAM MODELS SUBSTITUTING ALEK AND STUDENT SUCCESS DATA FOR TEST SCORES
- WORK WITH STUDENT SUCCESS AND I-T TO LEVERAGE LMS DATA

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Thank you for attending the 2023 NCAIR Annual Conference!

There's a QR code in your program for a conference evaluation form. You'll also get an e-mail following the conference with a link to the form, which will be available until 4/18.

Please take the opportunity at your earliest convenience to let the planning committee know your thoughts about this year's conference and where you would like to meet next year.