Academic performance in freshman courses and major switching patterns of CNSM students

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Introduction and Goals

Across most of CSU campuses and in many other four-year universities, a large fraction of STEM entering freshman graduate with non-STEM degrees. Moreover, persistent racial, gender, and first generation status opportunity gaps in retention and graduation rates persist despite more than 40 years of concerted efforts to improve inclusivity of STEM fields. These trends are illustrated in Figure 1.

Figure 1. Six-year graduation data for CNSM native freshman cohorts 2009-11.
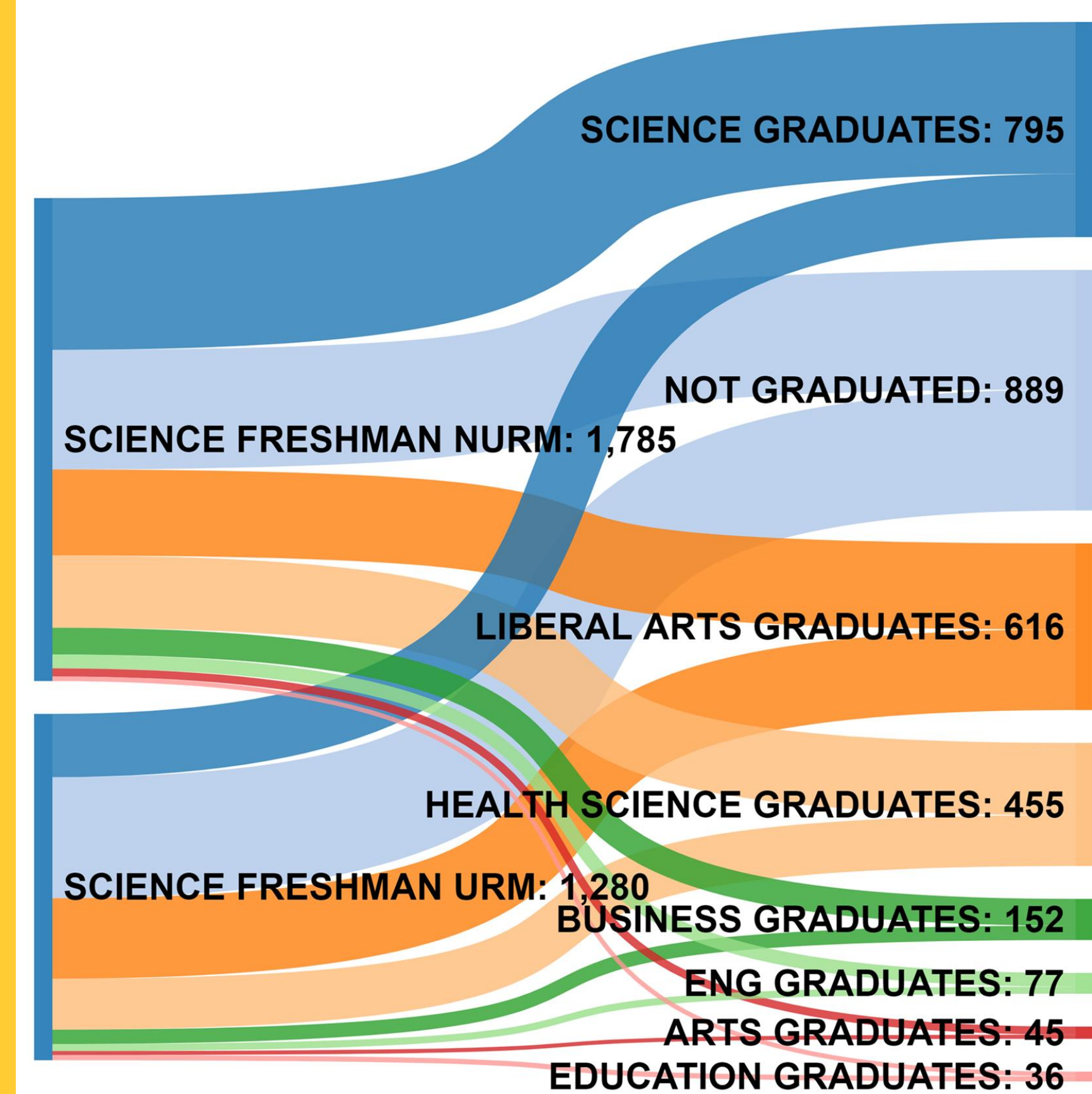
Methods

The major migration patterns (admissions/graduation) were obtained via CSULB Tableau for first time freshman.

Course grade patterns and retention in the major were calculated based student-level SSC data.

The CSU-wide major switching for BIOL majors is based on the CSUCO Dashboard

(calstate.edu/dashboard)

From among the CNSM 2009-11 entering freshman, only about 36% of students who graduated, actually completed their degrees in science or mathematics. Therefore the CNSM student success efforts are focused on retaining and graduating science majors while providing appropriate advising and support to students who transfer to other colleges. Unfortunately, while six-year science and math graduation rates correlate strongly with both HS GPA and MATH SAT, much weaker correlation is observed for two-year "within science" retention.

Figure 2. CNSM 2Y retention and 6Y graduation rates vs. HS GPA (data for the combined 2008-11 FTF cohorts)
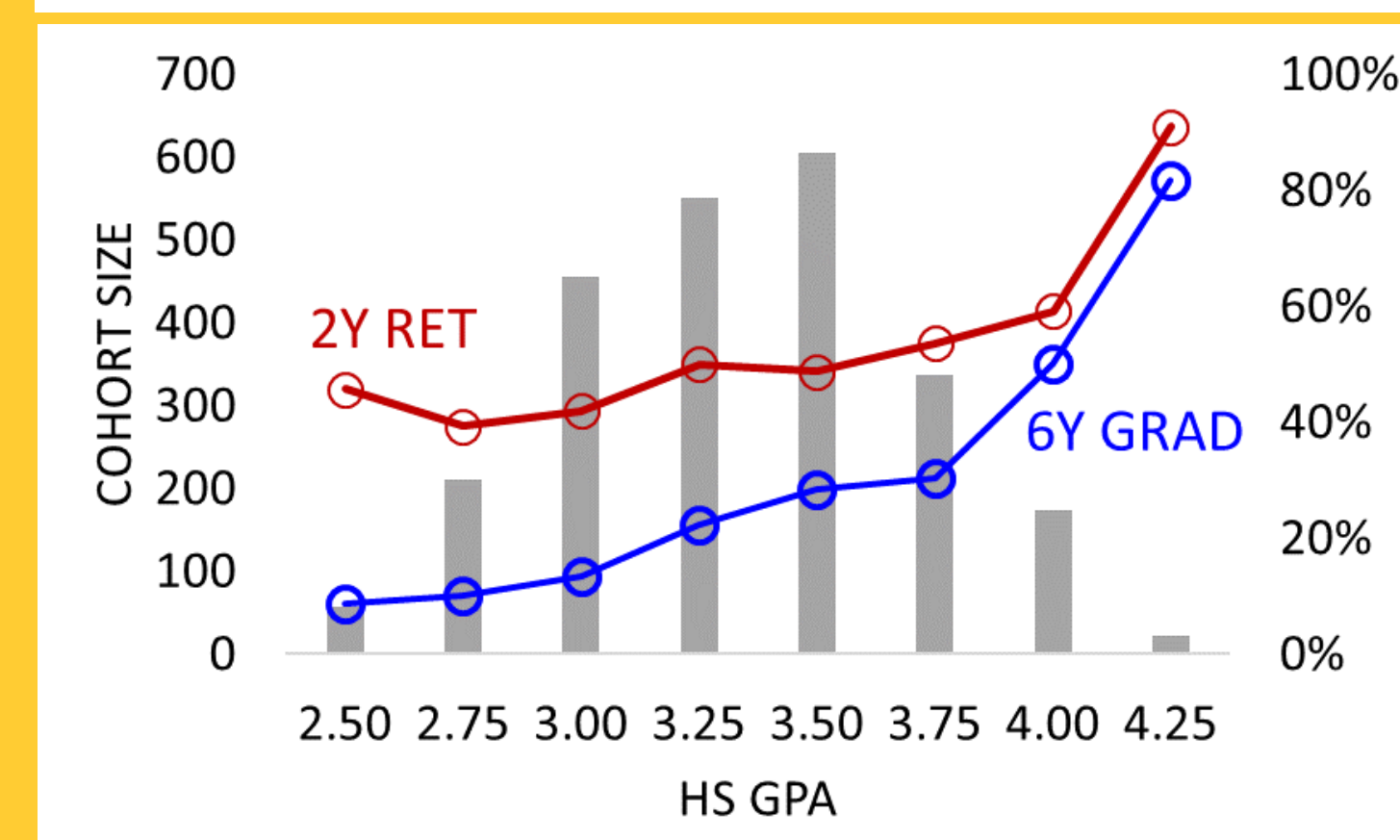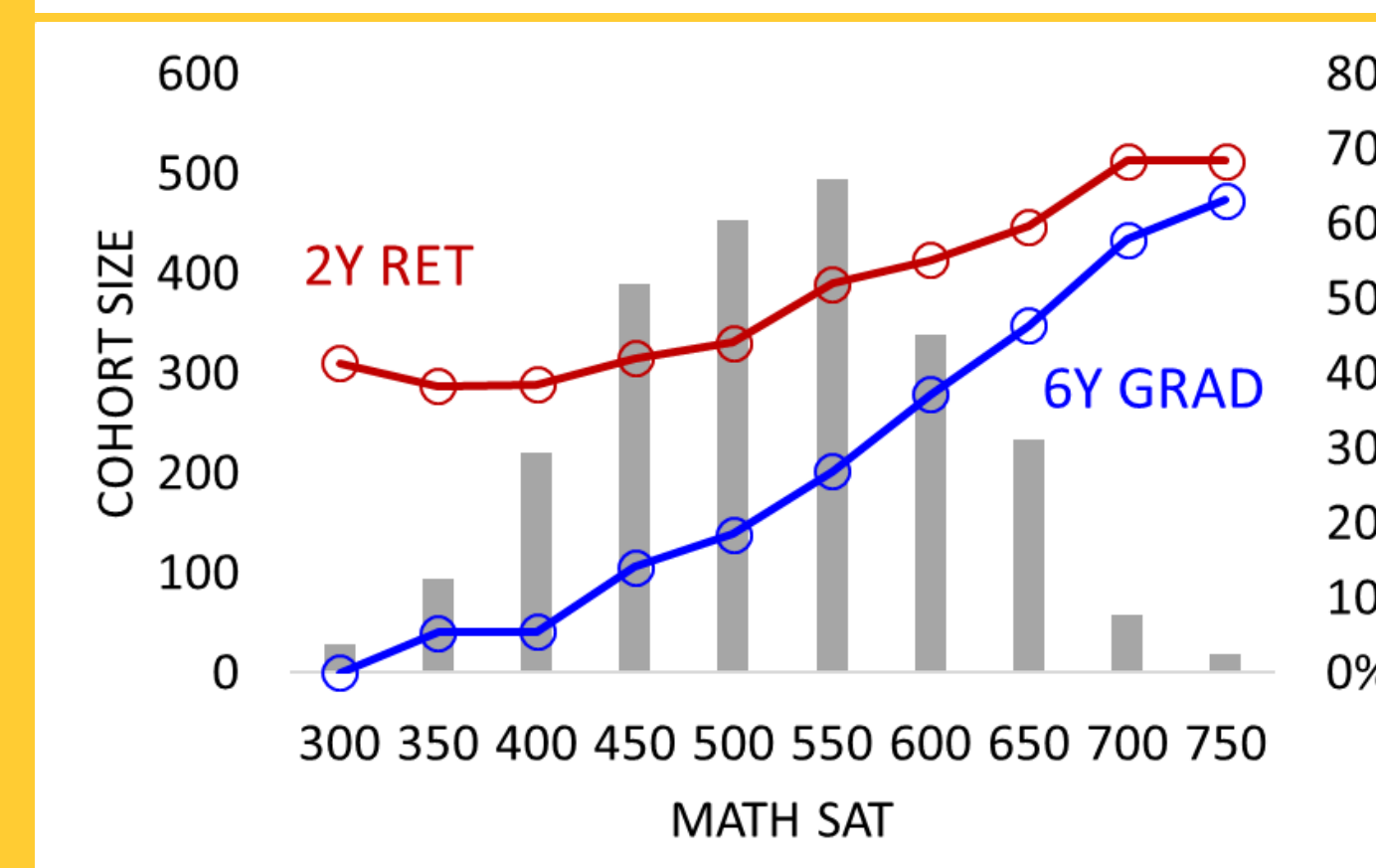

Figure 3. CNSM 2Y retention and 6Y graduation rates vs. MATH SAT (data for the combined 2008-11 FTF cohorts)

Moreover, both HS GPA and, particularly MATH SAT, correlate with socioeconomic status*, thus we are interested in finding non-admission data (both quantitative and qualitative) that could be useful in our efforts to improve success of students interested in pursuing STEM degrees. The goal of this study is to determine **if course talking patterns and academic performance in major freshman courses offer additional insight that might inform admission, advising, and curricular policies. These results are complementary to our qualitative study aimed at determining perceptions of students leaving STEM at CSULB.**

*Disentangling the Role of High School Grades, SAT® Scores, and SES in Predicting College Achievement, ETS RR-13-09, 2013

Research Questions and Results

RQ 1. Given that CNSM's largest major, BIOL, is also the one with largest fraction of native freshman migrating to other colleges, are the migration patterns for BIOL native freshman similar across the CSU system?

TABLE 1. Migration of students originally admitted as BIOL freshman.

|	CSULB	CHICO	FRESNO	FULLERTON	LA	NORTHRIDGE	POMONA	SAC	SDSU	SFSU	SJSU	SLO
TOP GRADUATION MAJORS FOR FRESHMAN WHO STARTED IN BIOLOGY	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL	BIOL
	HDEV	PSY	HEALTH SC	HEALTH SC	BUS ADM	PUB HEALTH	BIOTECH	CHILD DEV	KIN	KIN	PUB HEALTH	KIN
	KIN	EXC PHYS	PSY	KIN	PSY	PSY	LIBERAL ST	KIN	PSY	COMM	NURS	MARINE
	PSY	HEALTH SC	LIBERAL ST	PSY	SOC	CHILD DEV	BUSIN ADM	CRJ	INTERDISC	PSY	BUS ADM	BIOCHM
% OF BIOL FTF ADMITS GRADUATING IN BIOL	27%	24%	23%	37%	51%	24%	49%	28%	44%	41%	23%	64%

Clearly, different admissions and advising strategies result in large variation of major-switching out of BIOL within the CSU. Further research is needed to determine causes of these differences.

RQ 2: How does student performance in math and chemistry courses taken during theirs first freshman semester correlate with CNSM retention?

FIRST SEMESTER COURSE	2Y CNSM RET %
CHEM 111A "A"	81%
CHEM 111A "B"	81%
CHEM 111A "C"	66%
CHEM 111A "DFW"	25%
CHEM 90 "CR"	43%
CHEM 90 "NC"	24%
MATH 113 "A"	72%
MATH 113 "B"	41%
MATH 113 "C"	35%
MATH 113 "DFW"	15%
CALCULUS 1 "ABC"	75%
CALCULUS 2 "DFW"	54%
MAPB 1 OR 11	14%

Figure 4. Two-year CNSM retention for Fall 2016 freshman cohort vs. performance in the first math or chemistry course (based on SSC analysis of individual student records as of Jan 2019). CHEM 90 (Preparatory Chemistry, CHEM 111A (General Chemistry I), MATH 113 (College Algebra), MAPB (Pre-baccalaureate Mathematics). The analysis does not include students with math or science AP credit.

Figure 5. Typical requisite course sequence for intro math and science
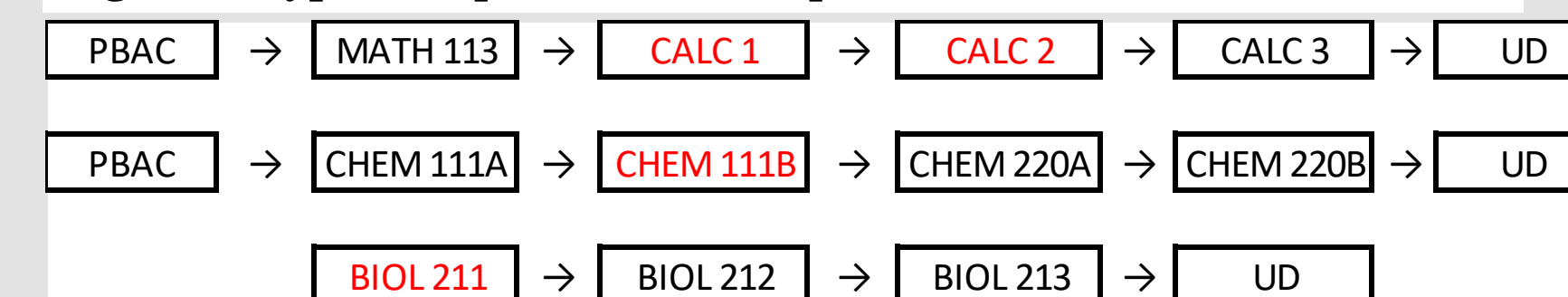
Failing grade in algebra or chemistry is a strong predictor of switching out of CNSM. Moreover, a grade of "C" in any prerequisite course is a strong predictor of failing the next course in the MATH, CHEM, and BIOL sequence.

		COMPLETION RATE OF		
		MATH 123	CHEM 111B	BIOL 212
GRADES RECEIVED IN MATH 122, CHEM 111A, OR BIOL 211 IN PREVIOUS SEMESTER	A	98%	99%	98%
	B	83%	86%	96%
	C	54%	44%	67%

Figure 6. Typical completion rates for the 2nd semester calculus, general chemistry, and general biology courses as a function of grade received in the prerequisite course (completion rates vary ca. ± 10% in different semesters).

RQ 3: What are the academic performance patterns for freshmen admitted as undeclared who later successfully declared CNSM major?

Figure 7. Academic performance of Fall 2016 UNDCL freshman who have declared CNSM major (as of Jan 2019). The first semester refers to Fall 2016, 2nd semester refers to Spring 2017. The "% grades" refers to the percentage of students within the UNDCL/CNSM cohort who received a particular grade.

FIRST CNSM MSDR COURSE	% GRADES 1ST SEM	% GRADES 2ND SEM
CHEM 111A "A"		23%
CHEM 111A "B"		50%
CHEM 111A "C"		27%
CHEM 90 CR	100%	100%
MATH 119A PASS	100%	100%
MATH 113 "A"	28%	50%
MATH 113 "B"	39%	38%
MATH 113 "C"	22%	13%
MATH 122 PASS	100%	100%
MATH 123 PASS	67%	100%

RQ 4: What was the academic performance in previous chemistry courses for students who successfully completed CHEM 441B (Biochemistry II)

Figure 8. Analysis of grades in previous chemistry courses (CHEM 111A, CHEM 111B, CHEM 220A, CHEM 220B, CHEM 441A) for students who successfully completed CHEM 441B (Biochemistry II) in Fall 2018.

CHEM 441B grade	Average # of A/B in earlier CHEM classes	# of Students
A	4.9±0.2	7
B	2.9±0.9	12
C	2.5±0.8	15
all	3.2±0.9	34
Earned all C's and passed 441B	0	

RQ 5: Is CNSM academic advising effective for students switching majors out of CNSM, i.e. are native CNSM freshman able to declare non-CNSM major within a reasonable time-frame?

Figure 9. Analysis of migration of CNSM Fall 2016 freshman cohort.

FALL 2016 CNSM FTF MIGRATION				
COLLEGE	ENROLLED IN S'19	DECLARED MAJORS	% FTF COHORT	% DECLARED
CBA	12	5	3%	42%
CED	7	6	2%	86%
COE	22	22	6%	100%
CHHS	62	50	16%	81%
CLA	42	35	11%	83%
CNSM	169	157	43%	93%
COTA	7	6	2%	86%
UNDCL	6		2%	
NOT ENROLLED	66		17%	
	393	281		72%

Our analysis of migration patterns for Fall 2016 incoming CNSM freshman class indicates that >80% of students in this cohort declared major by Jan 2019 in one of the academic colleges.

Conclusion / Discussion

- Grades in the first year science and math courses have a significant impact upon student retention in a CNSM major.

- Starting science and math class also has an impact on student retention suggesting that summer adaptive ALEKS placement (both MATH and CHEM) is important strategy for STEM success.

- Students receiving "C" grades in early science and math courses are at significant risk of failing UD courses and switching out of STEM.

Implications for Action

- Recommendations for advising approaches – find additional ways to allow for student career exploration. Personalize advisement by focusing on non-cognitive factors (rather than analysis of purely academic milestones). Focus on proactive advising of students earning "C" grades in key courses (as this predicts potential risk of switching out of CNSM).

- Recommendations for EAB upgrades – automated analysis of major switching patterns in real time.

- Recommendations for institutional communication changes – work with part-time lecturers teaching introductory courses to strategize ways for students to talk together in small groups and to sit together by major during class. This is to assist students in "finding each other", to encourage student study groups, and foster a sense of belonging within the college.

- Holistic approaches to student success – focus on building learning communities and emphasize motivation and metacognitive learning strategies

- Recommendations for advising of undeclared students – allow for additional exploration of careers and the coursework necessary to aim in particular directions. Stress the importance of As and Bs in coursework.

- Recommendations for advising of switching students – more specific questioning of the students to find out their interests and areas to success to help to steer them in the right direction, additional help in choosing what type of course might be most beneficial.

Next Steps / Future Directions

- Meet with advisement group to discuss major switching data and trends. Formalize advising approaches focused on proactive developmental advising of students at risk (mainly those consistently earning grades below "B" in freshman and sophomore courses). Expand CNSM Early Alert program.
- Develop workshops aimed at students who might benefit from exploring options outside of CNSM.
- Collaborate with other CSU campuses to investigate discrepancies in switching patterns across institutions.