

Figure 1: SLO lab assessment data. PHYC 190 & 200 show higher scores holding steady due to improvements in content, equipment, and instructor support. PHYC 210 shows the data skills from 190/200 are sticking, but equipment shortages as the class grows have led to large lab groups and corresponding drops in student engagement and success on the lab concepts.

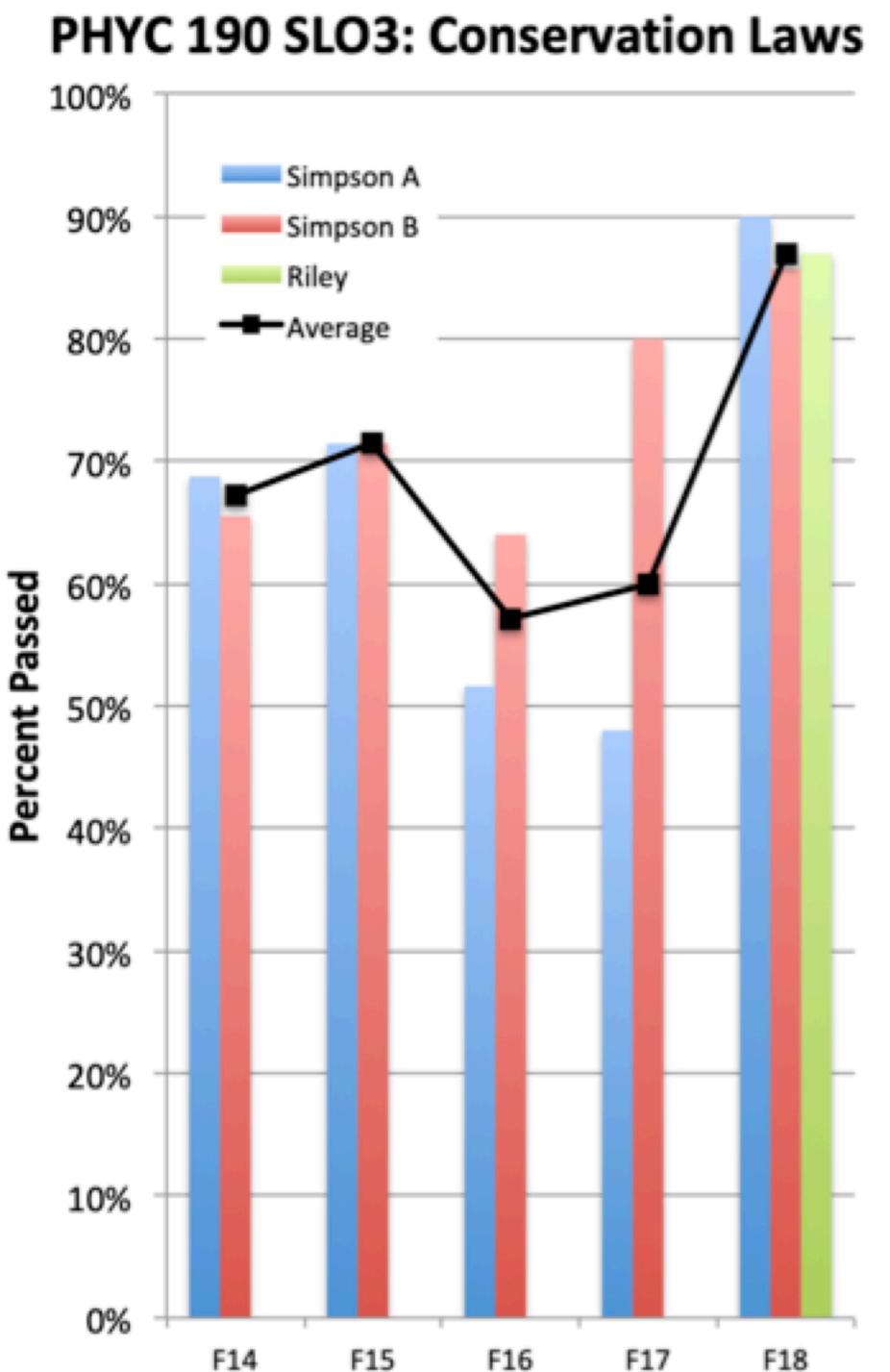
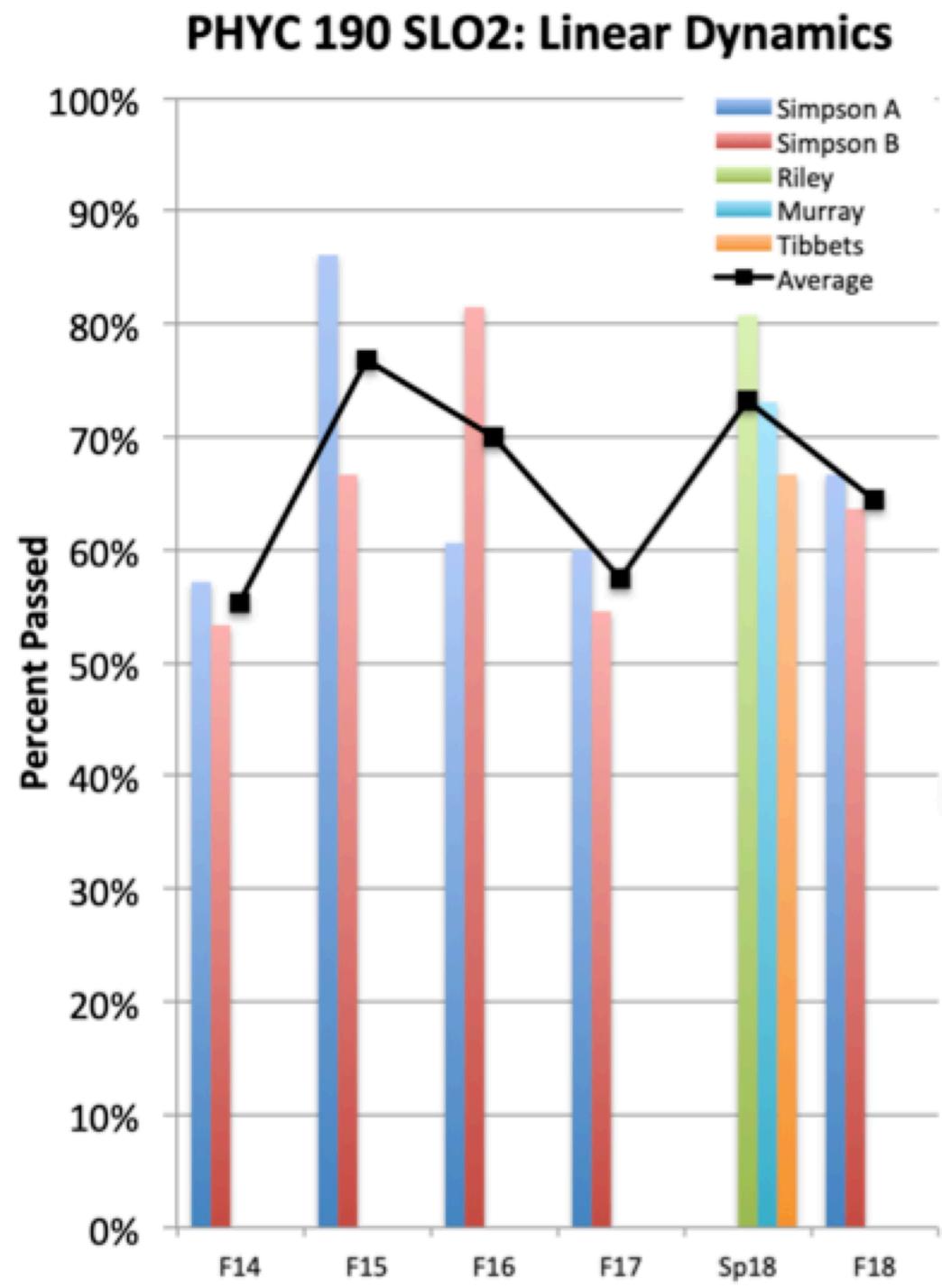
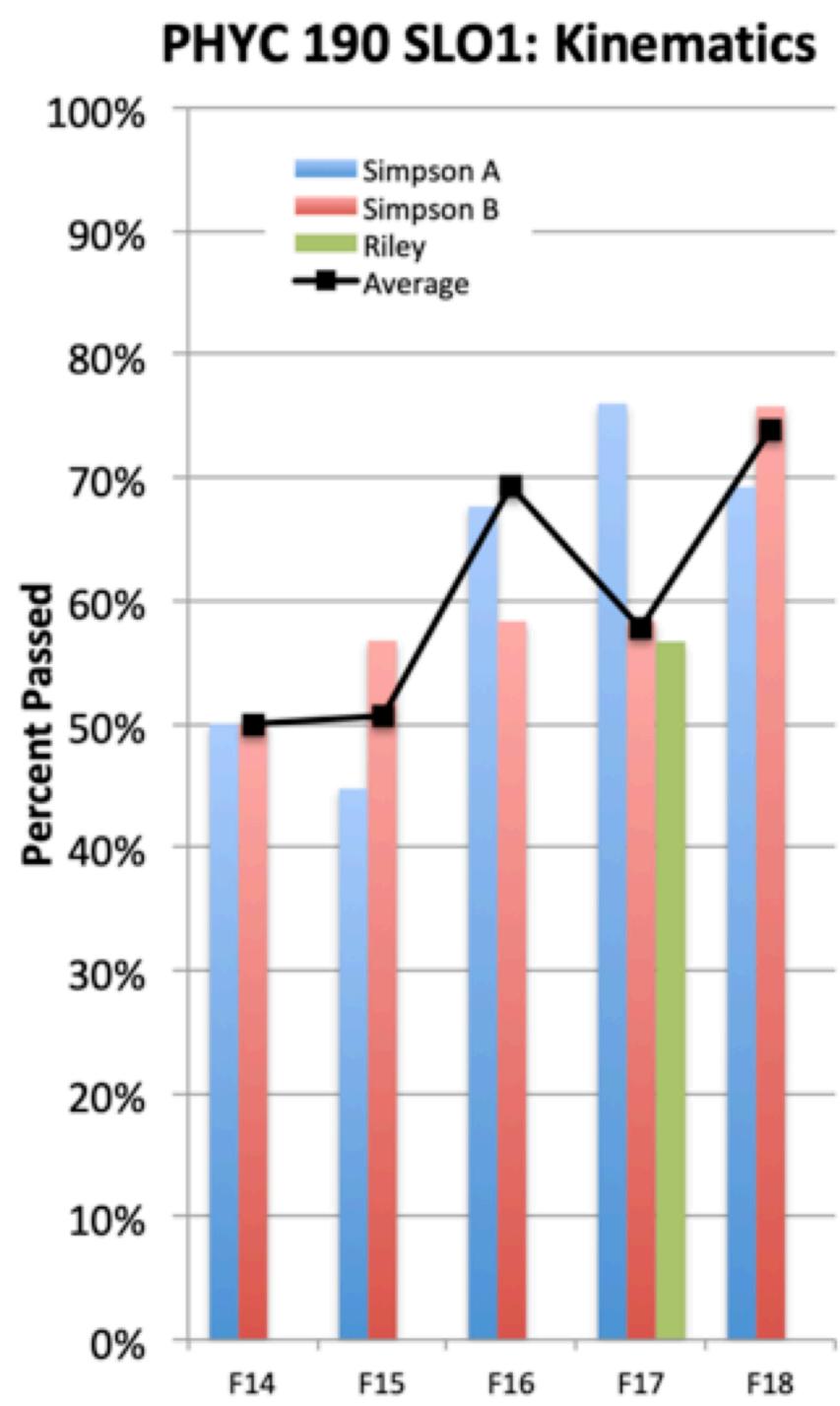


Figure 2: PHYC 190 SLO lecture assessment data.

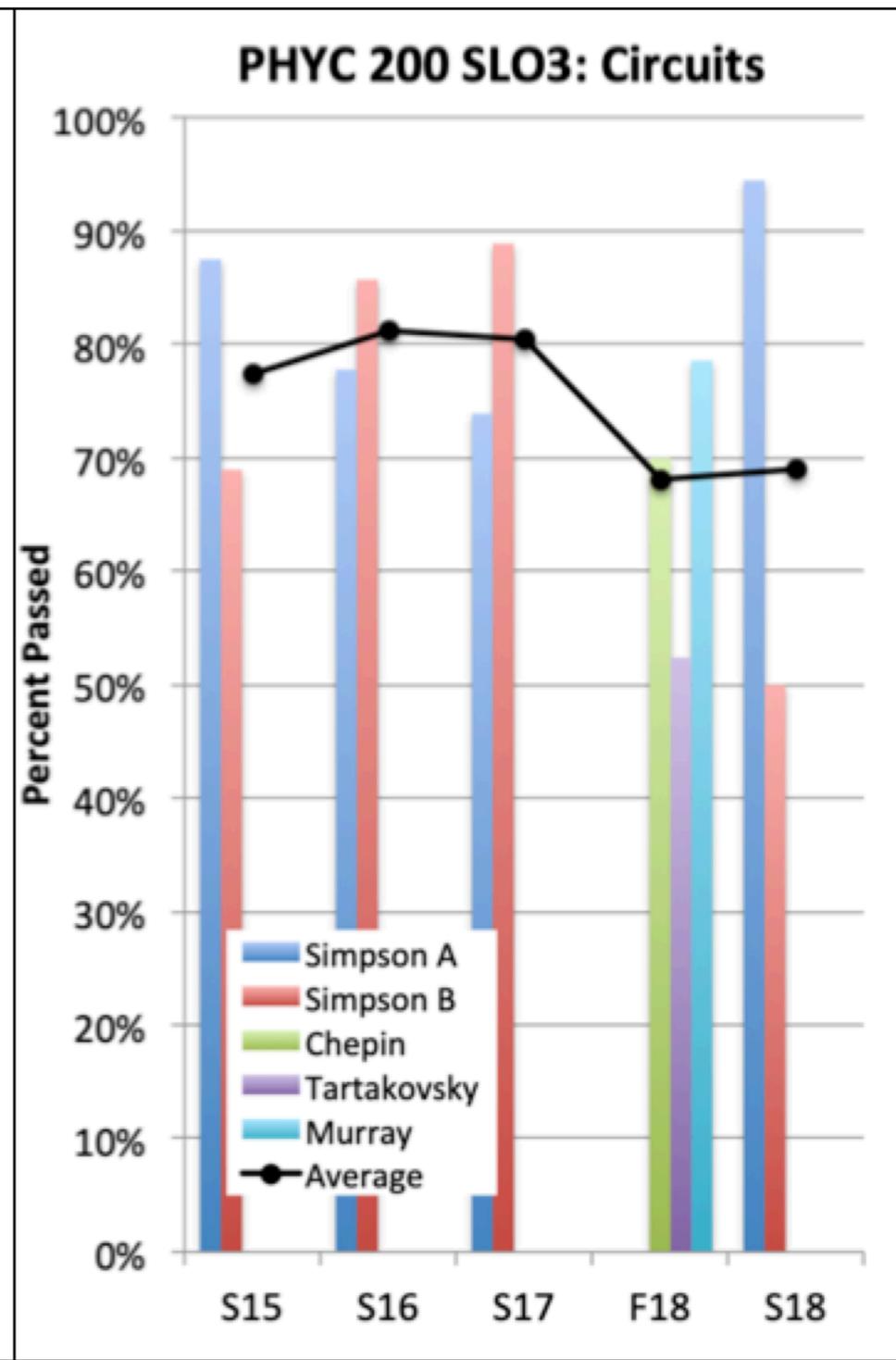
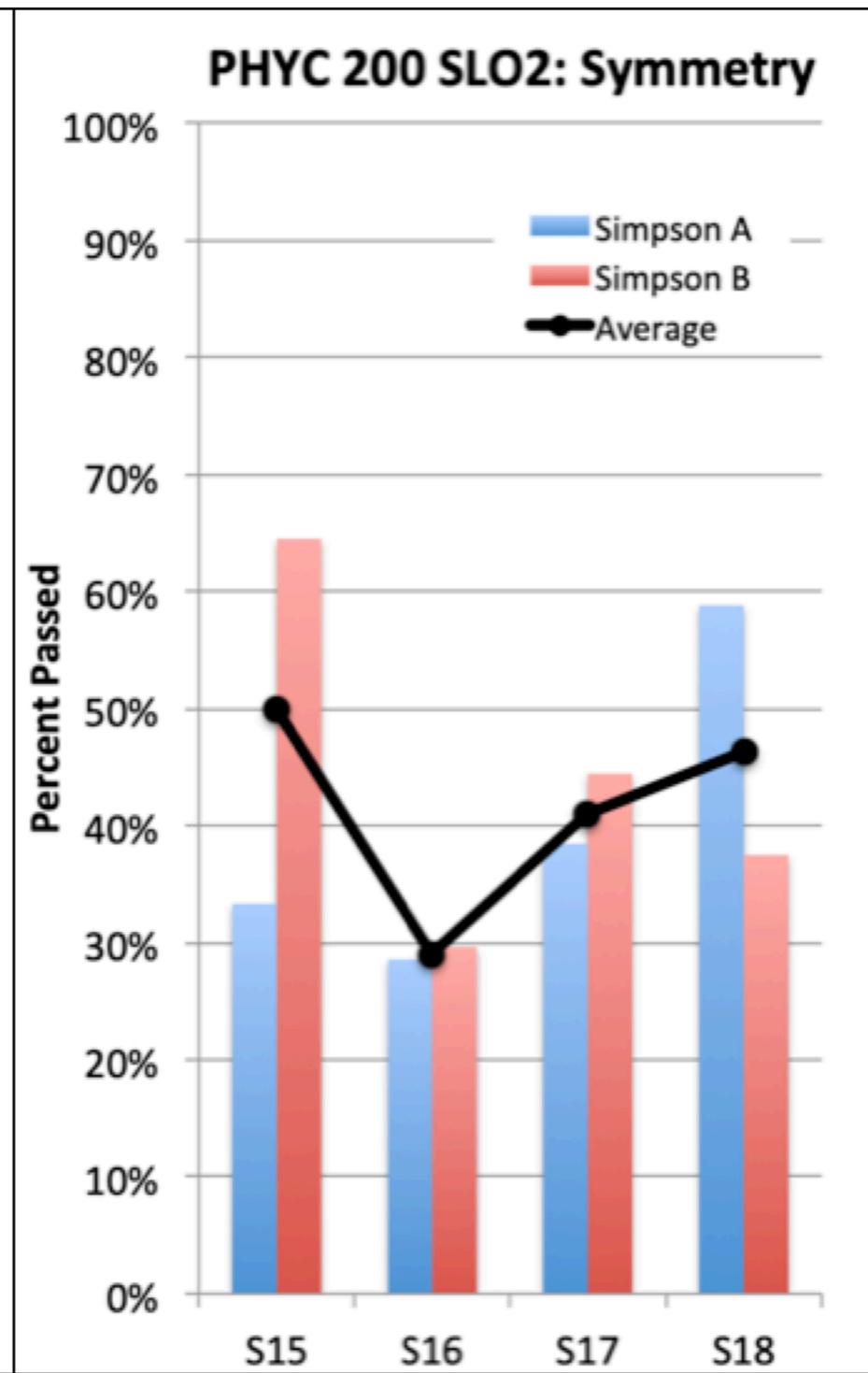
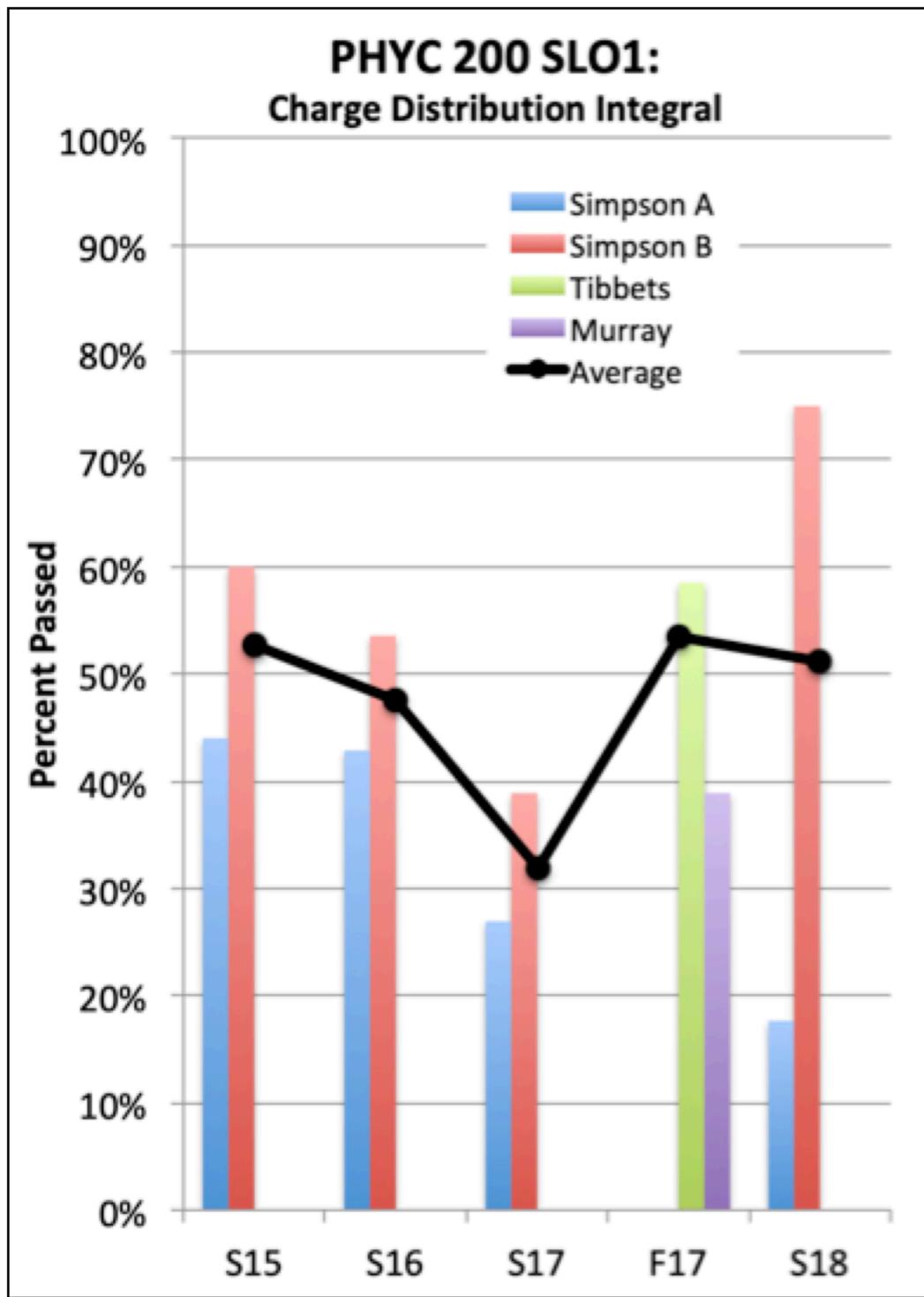


Figure 3: PHYC 200 SLO lecture assessment data.

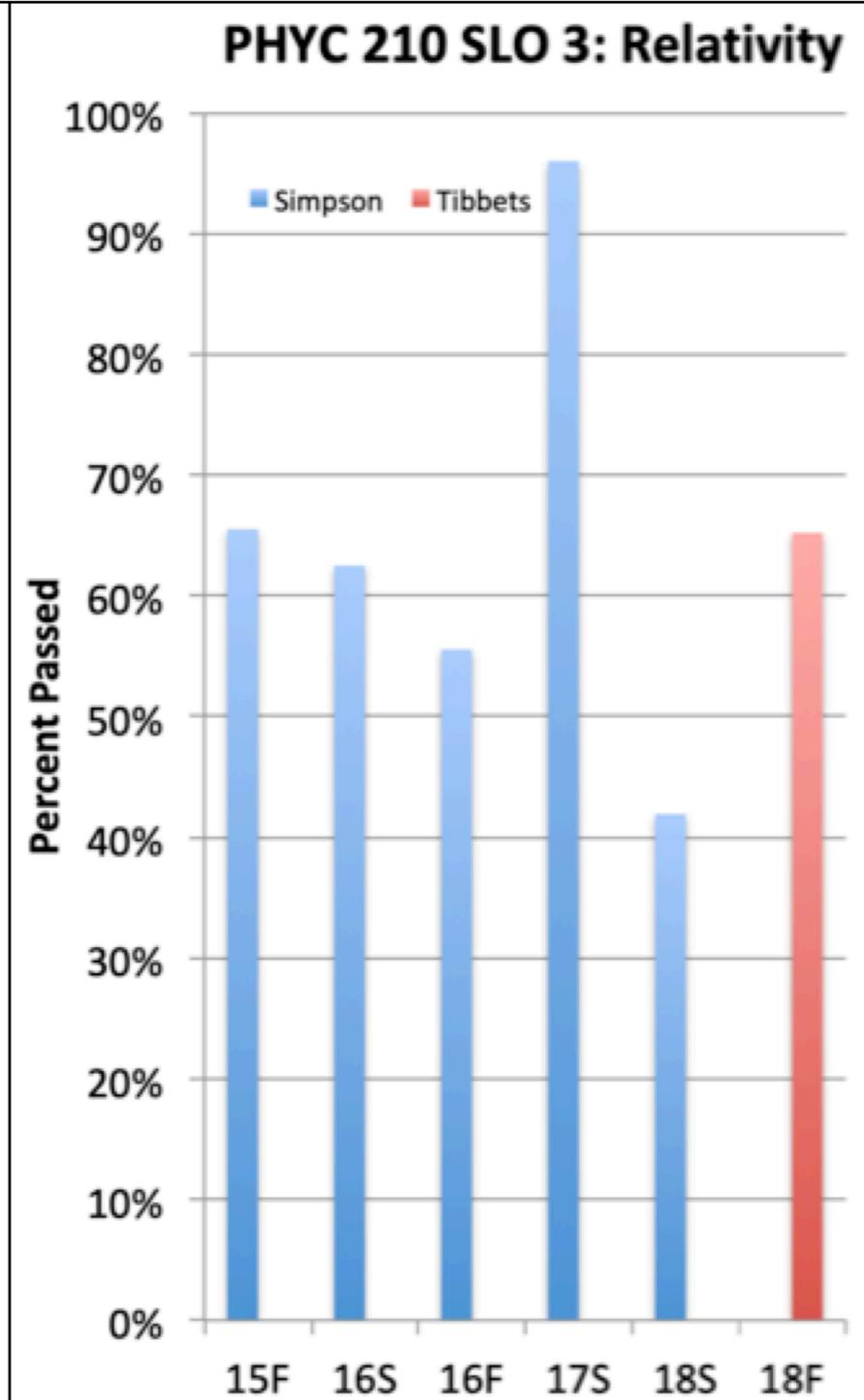
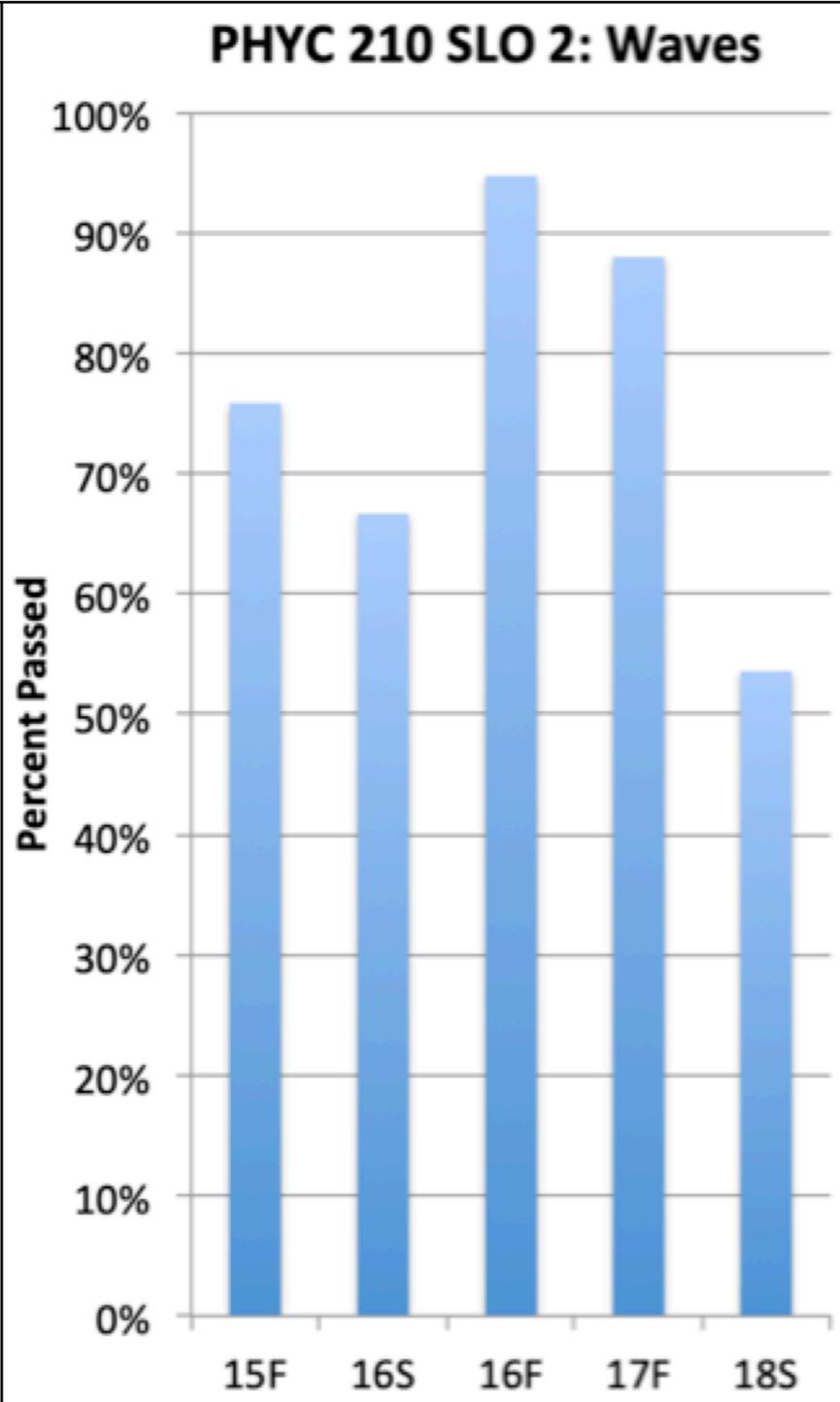
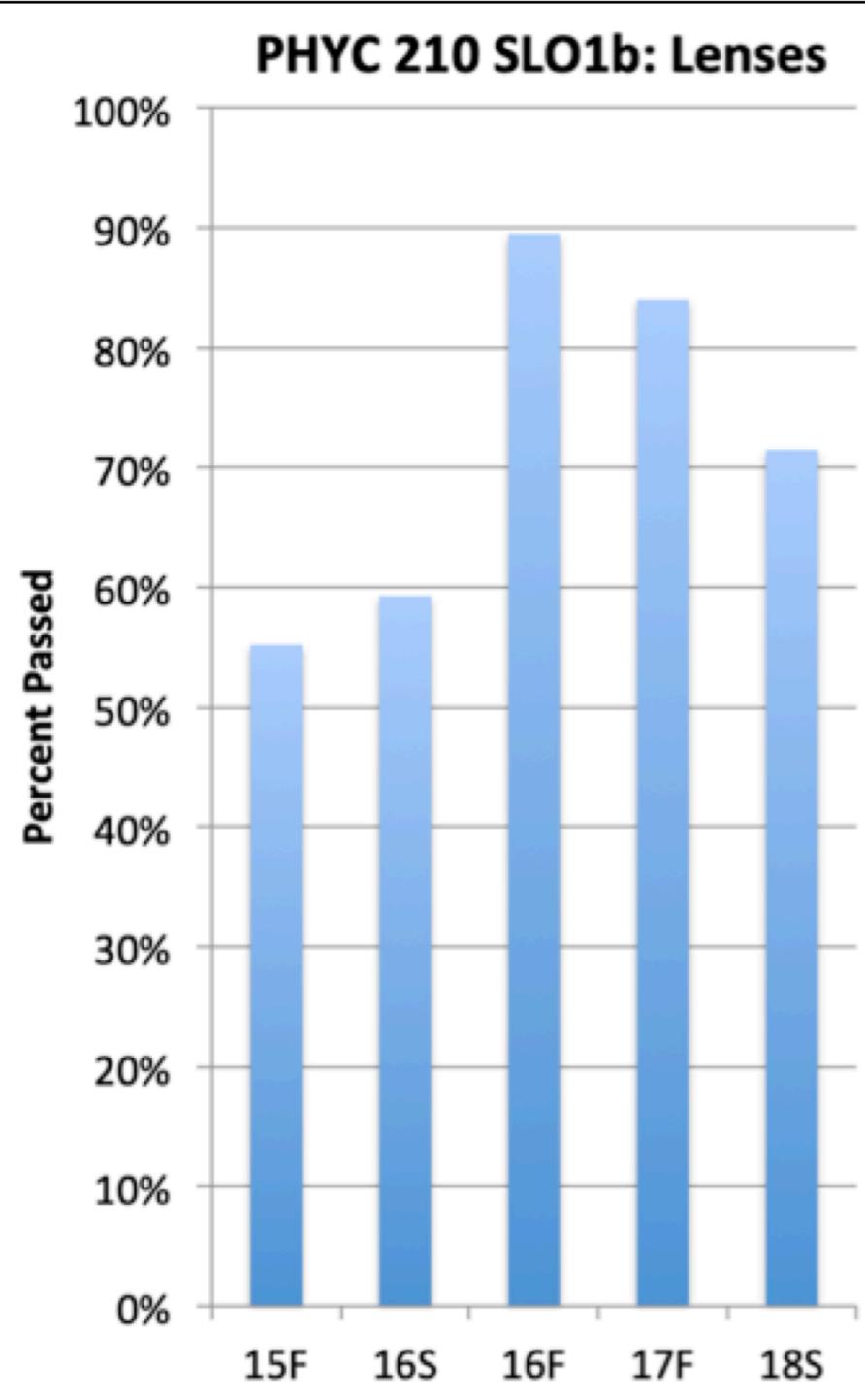


Figure 4: PHYC 210 SLO lecture assessment data.

Table 2: PLO map

PLO	SLO	Notes
1 (AS-T)	MATH180 SLO 5, 6	Assessed by Math
2 (AS-T)	MATH 280 SLO 1, 2, 3	Assessed by Math
3 (AS-T)	Maps to nothing	Maps to math content no longer offered in course
4 (AS-T)	PHYC190 all	All evaluated within the last 4 years
5 (AS-T)	PHYC200 all	All evaluated within the last 4 years
6 (AS-T)	PHYC210 all	All evaluated within the last 4 years
1	CHEM141 SLO 2	Assessed by Chemistry
2	CHEM142 SLO 1	Assessed by Chemistry
3	Maps to nothing	Needs possible revision

Table 1: Physics 130/131 SLO results

PHYC		Fall 2017	Spring 2018	Fall 2018	Spring 2019
130	1	32/56 (57%) fail			
	2	46/54 (85%) pass			
	3	42/52 (81%) pass		25/37 (67%) fail	
	4	28/51 (55%) fail		28/39 (71%) pass	
	5	22/54 (41%) fail			
	6	33/53 (62%) fail			
131	1		31/57 (54%) fail		
	2		32/56 (57%) fail		
	3		42/55 (76%) pass		<u>scheduled</u>
	4		37/56 (66%) fail		<u>scheduled</u>
	5		21/53 (39%) fail		
	6		32/56 (57%) fail		

Table 3: SLO Assessment Schedule

	F17		Sp18		F18		Sp19		F19		Sp20	
190	1	Riley	2	Tibbets	3	Riley	4	Riley	5		6	
		Simpson		Riley		Simpson		Tibbets				
		Simpson		Murray		Simpson		Stambach				
200	1	Tibbets	2	Simpson	3	Tartakovsky	4	Simpson	5		6	
		Tibbets		Simpson		Chepin		Simpson				
		Murray		Tibbets		Murray		Hinton				
210	1	Simpson	2	Simpson	3	Tibbets	4	Simpson	5		6	
		x		x		x		Simpson/Tibbets				
130	1,2	Rafferty			3,4	Stambach			5,6			
131			1,2	Rafferty			3,4	Stambach			5,6	

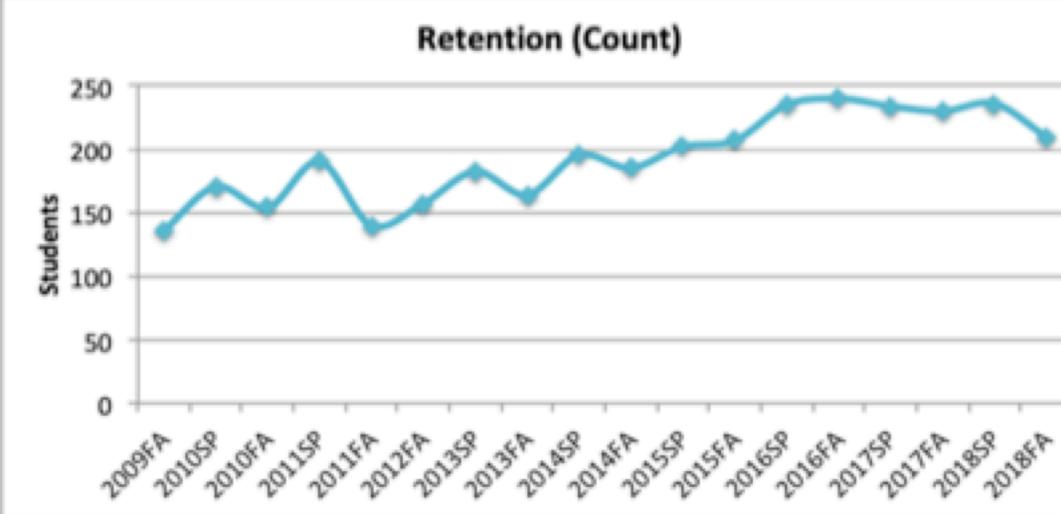
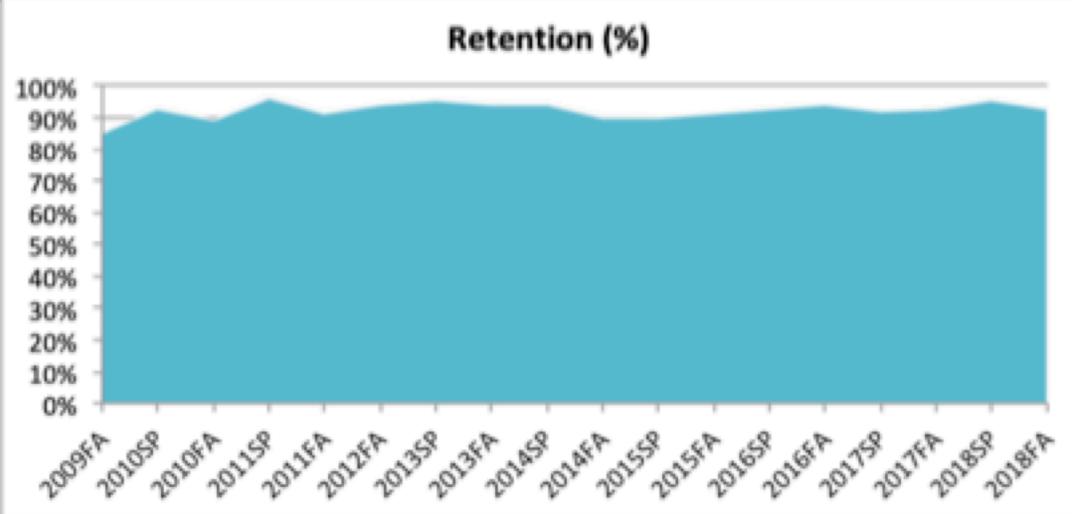
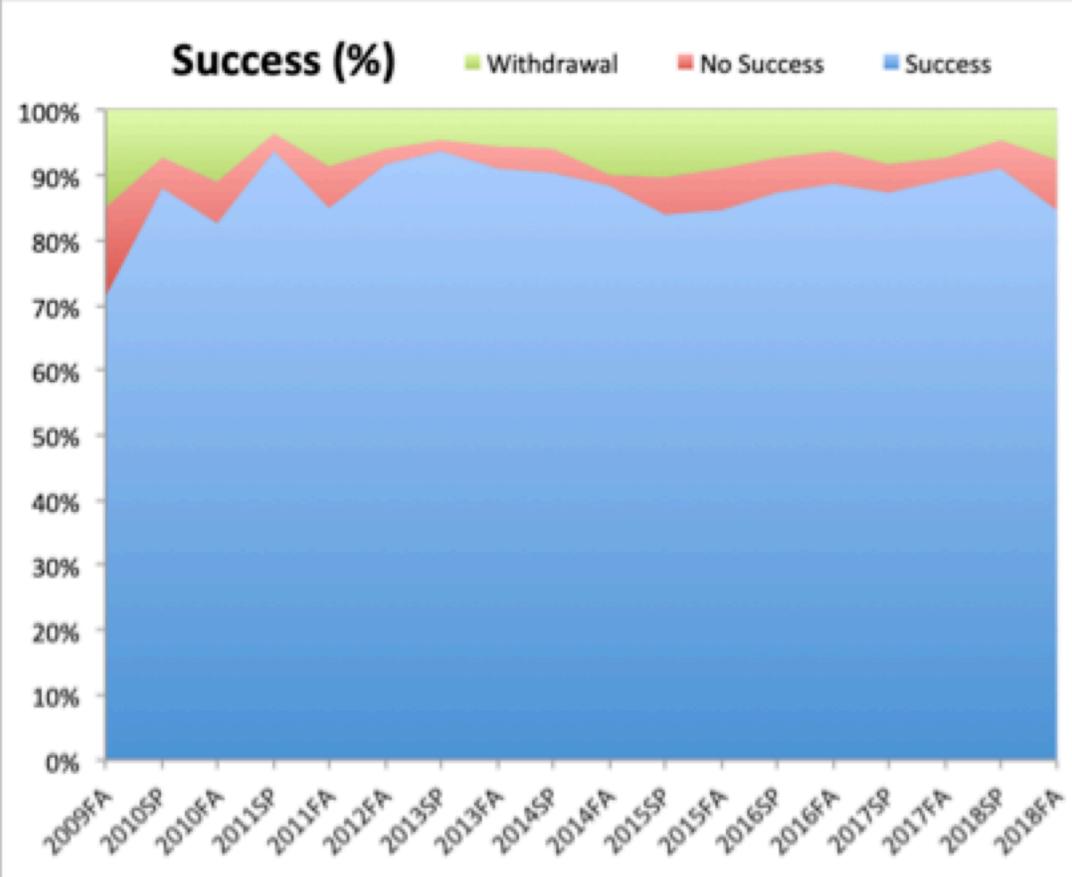


Figure 5: Physics success and retention

Fig. 6
Success Rate Over All Astronomy Courses vs Semester
Number

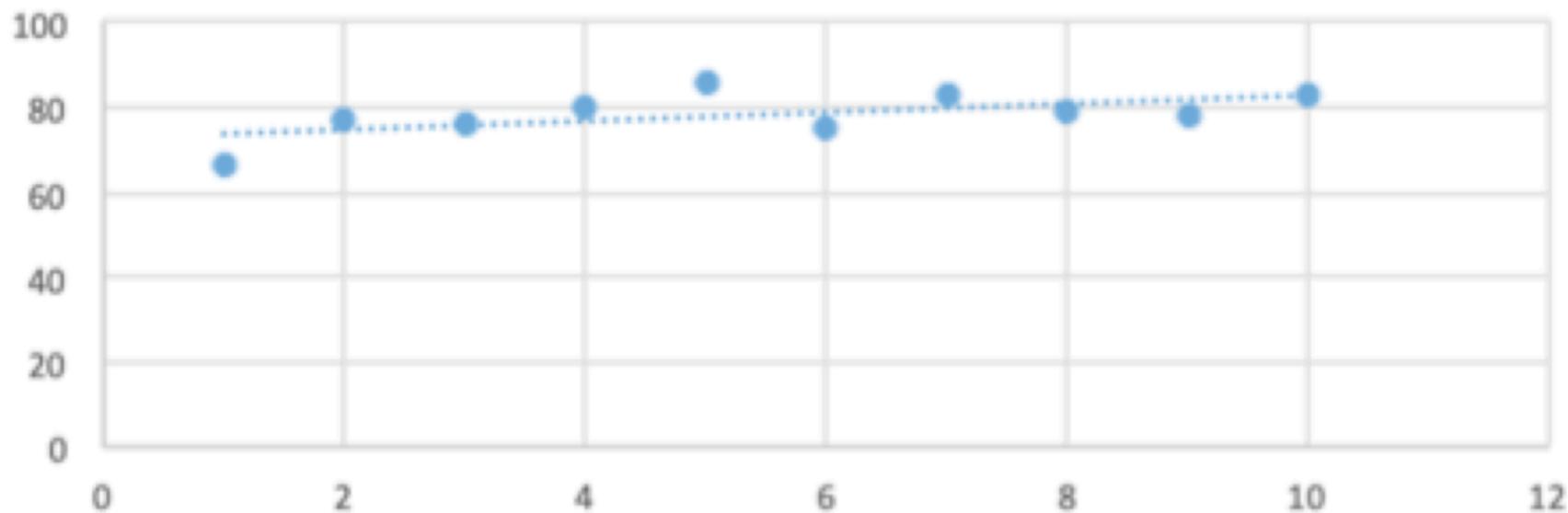
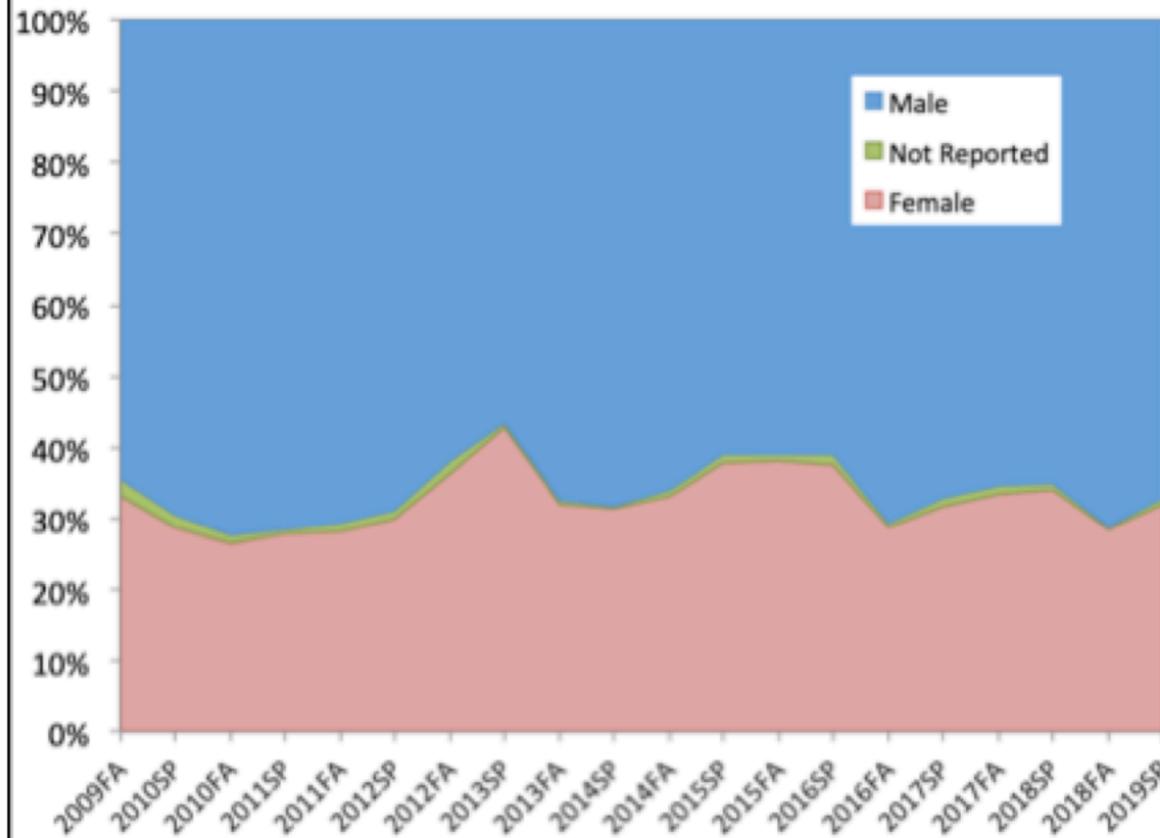


Figure 6: Astronomy success from fall 2013 (1) to spring 2018 (10)

Physics Gender Distribution



Physics Success by Gender

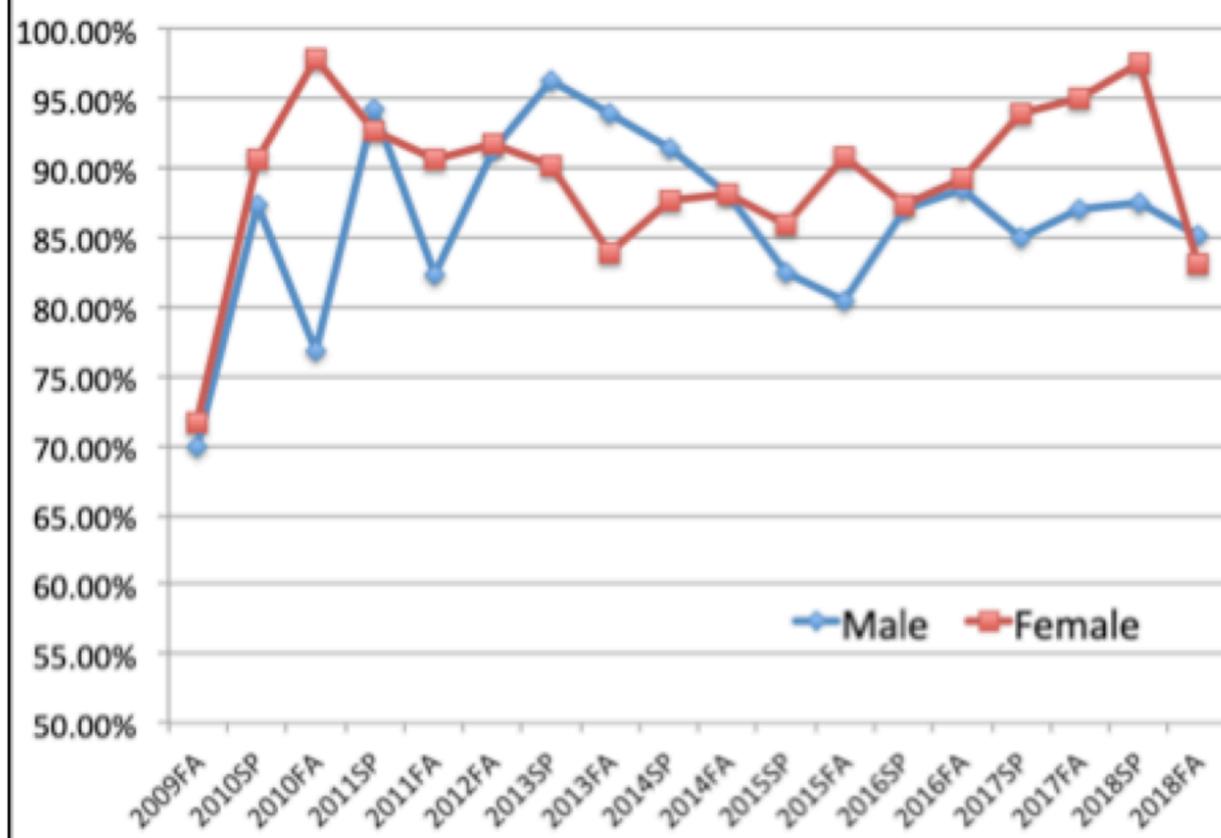
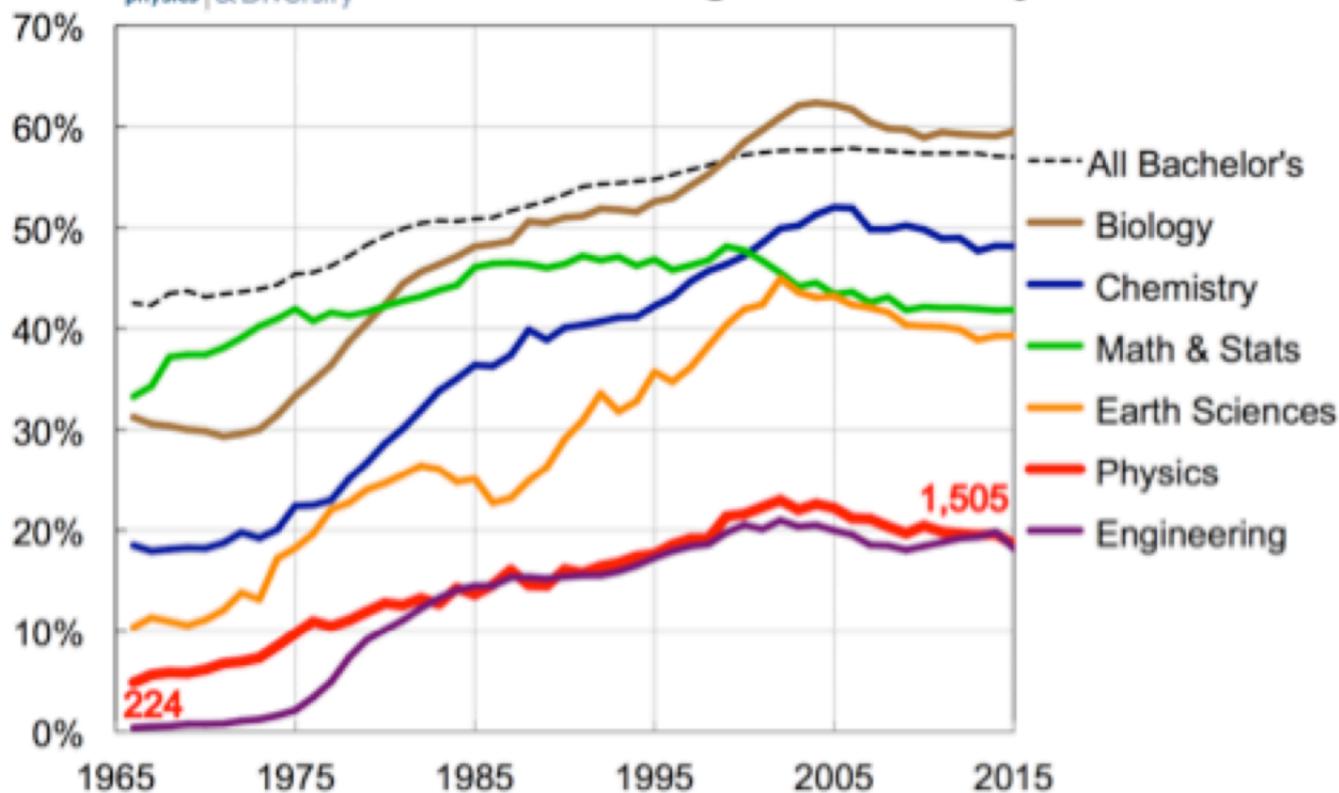


Figure 7: Physics enrollment trends and success disaggregated by gender.

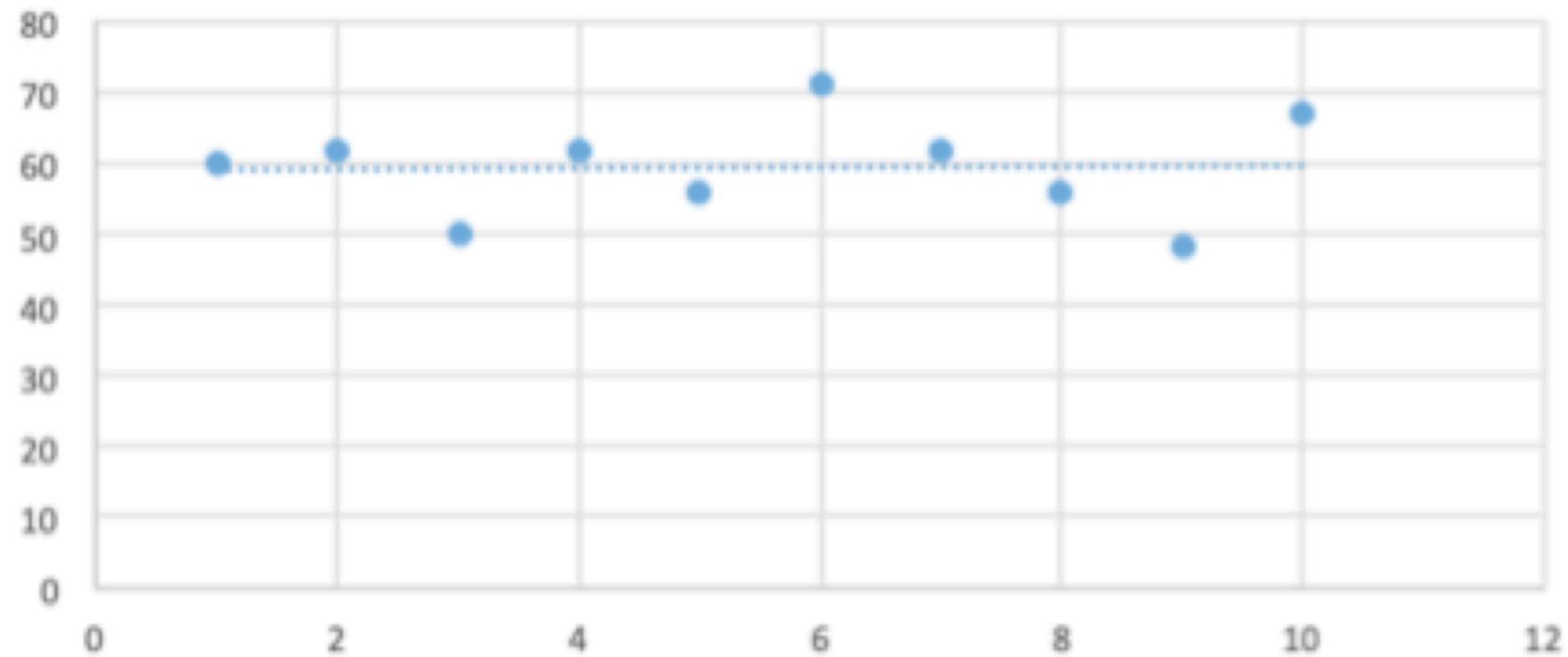
Bachelor's Degrees Earned by Women



Source: IPEDS and APS

Figure 8: Comparison of degrees earned by women.

Female Astronomy Enrollment vs. Semester Number



Male Astronomy Enrolment vs. Semester Number

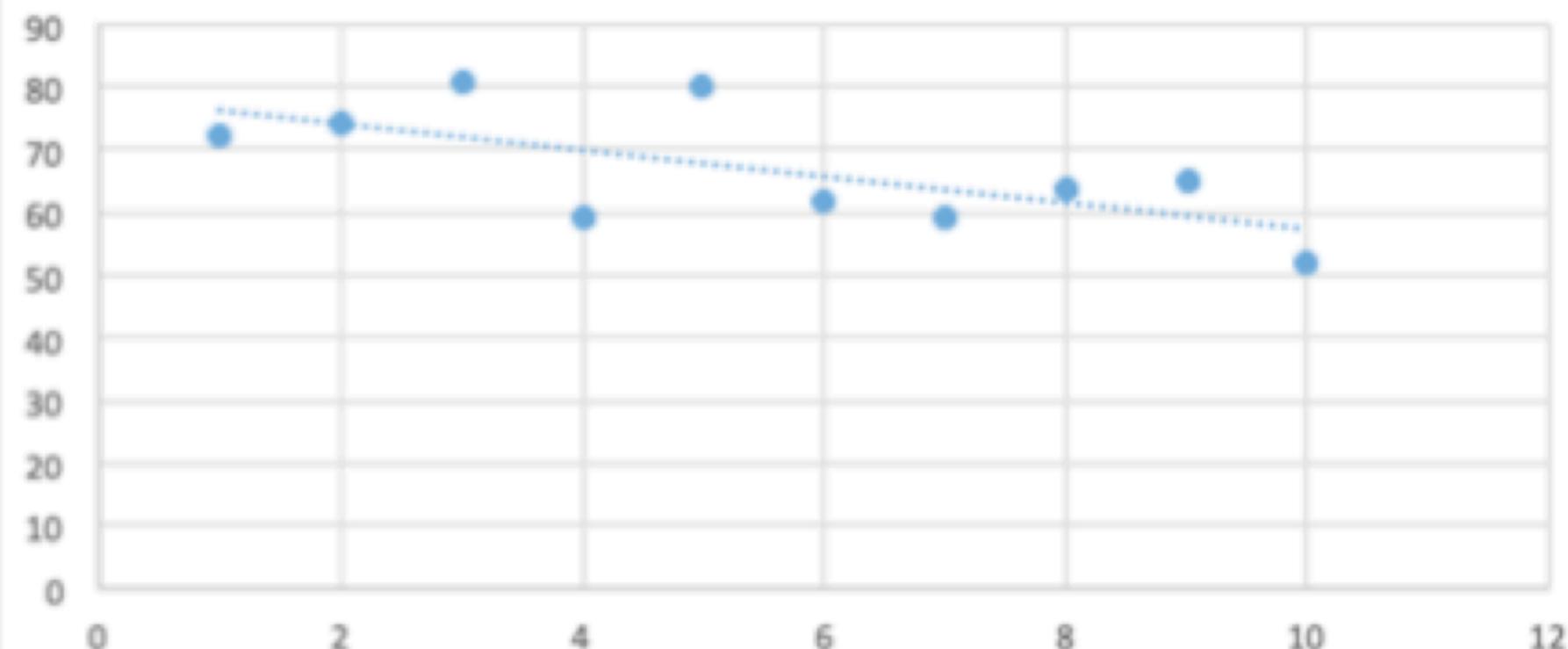


Figure 9: Astronomy enrollment trends disaggregated by gender from fall 2013 (1) to spring 2018 (10)

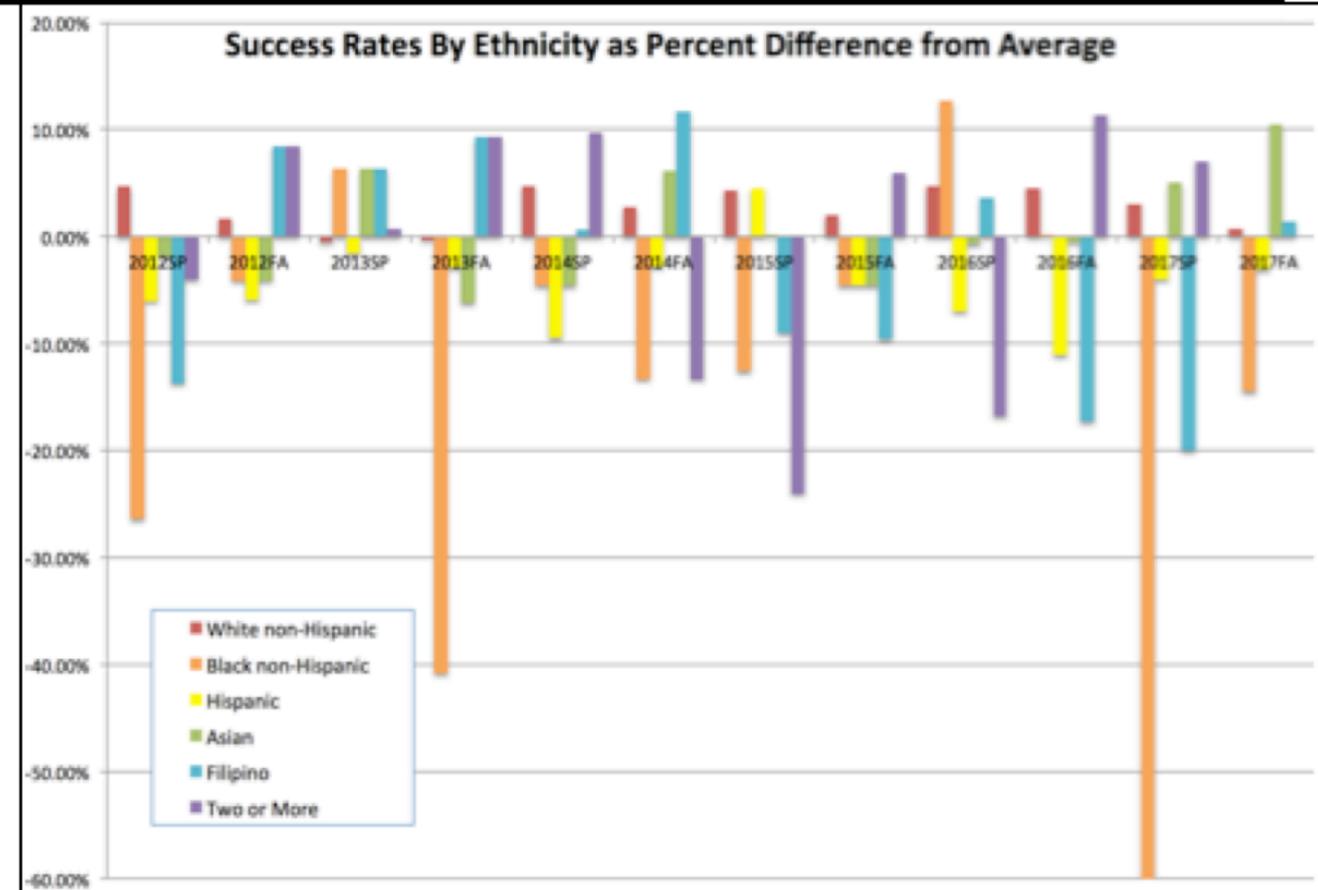
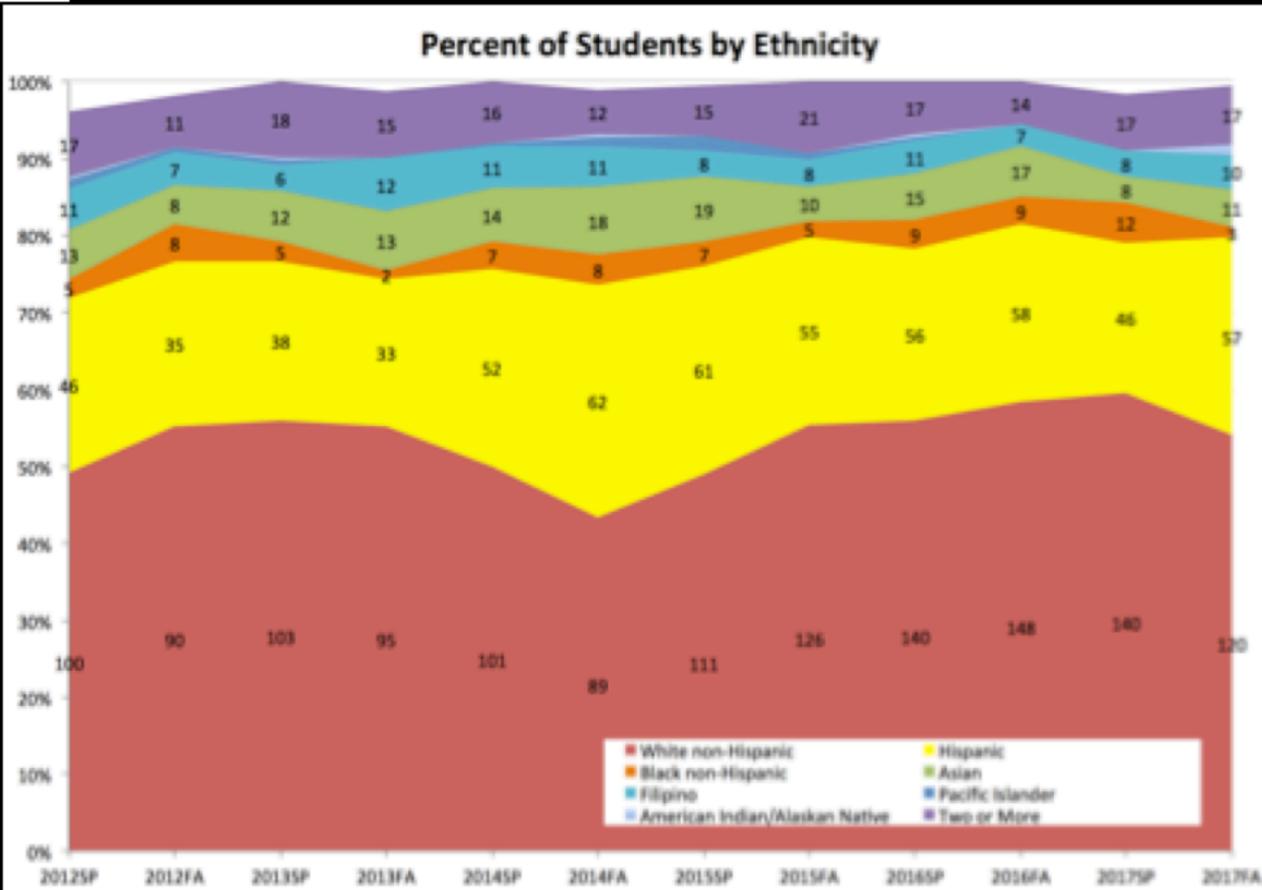
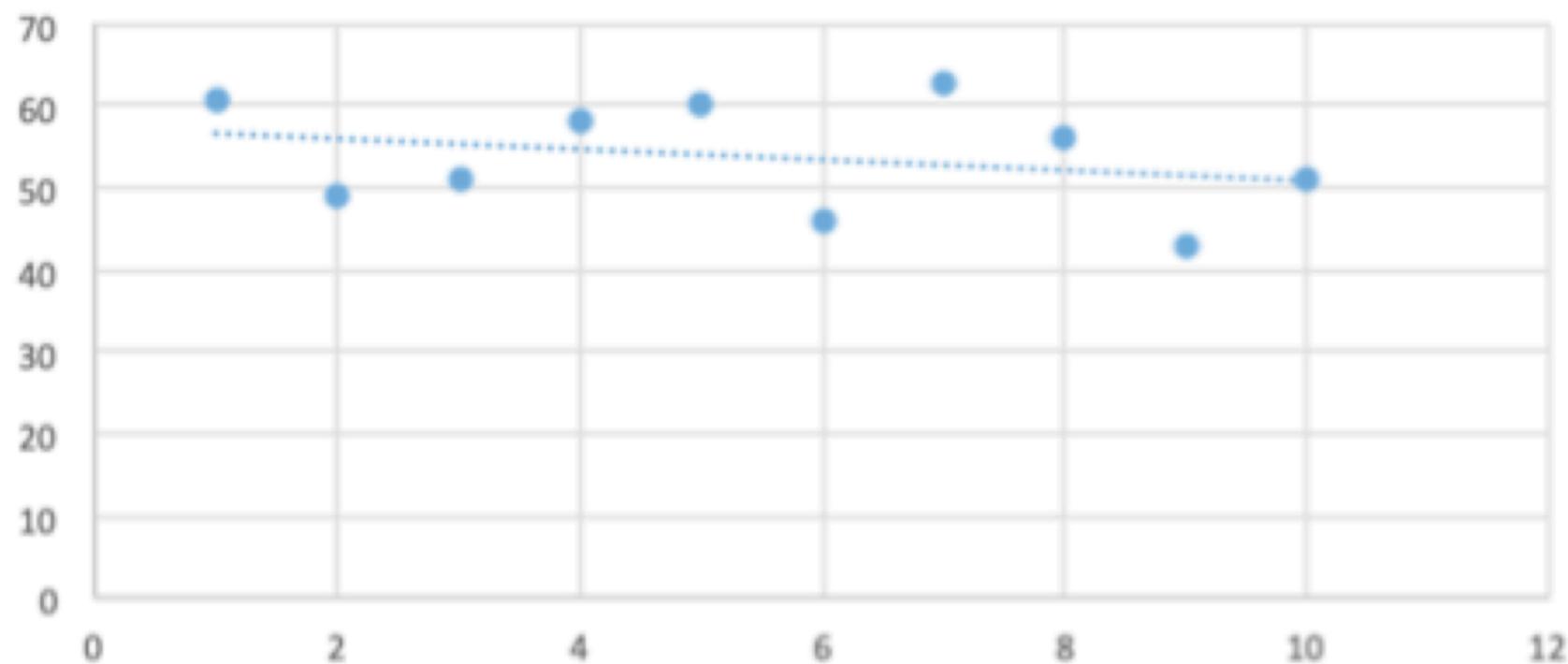


Figure 10: Success rates broken down by ethnicity as a difference from overall success (right) with population size to the right for comparison. (Note that small populations result in large success rate fluctuations.)

White Astronomy Enrollment vs. Semester Number



Hispanic Astronomy Enrollment vs. Semester Number

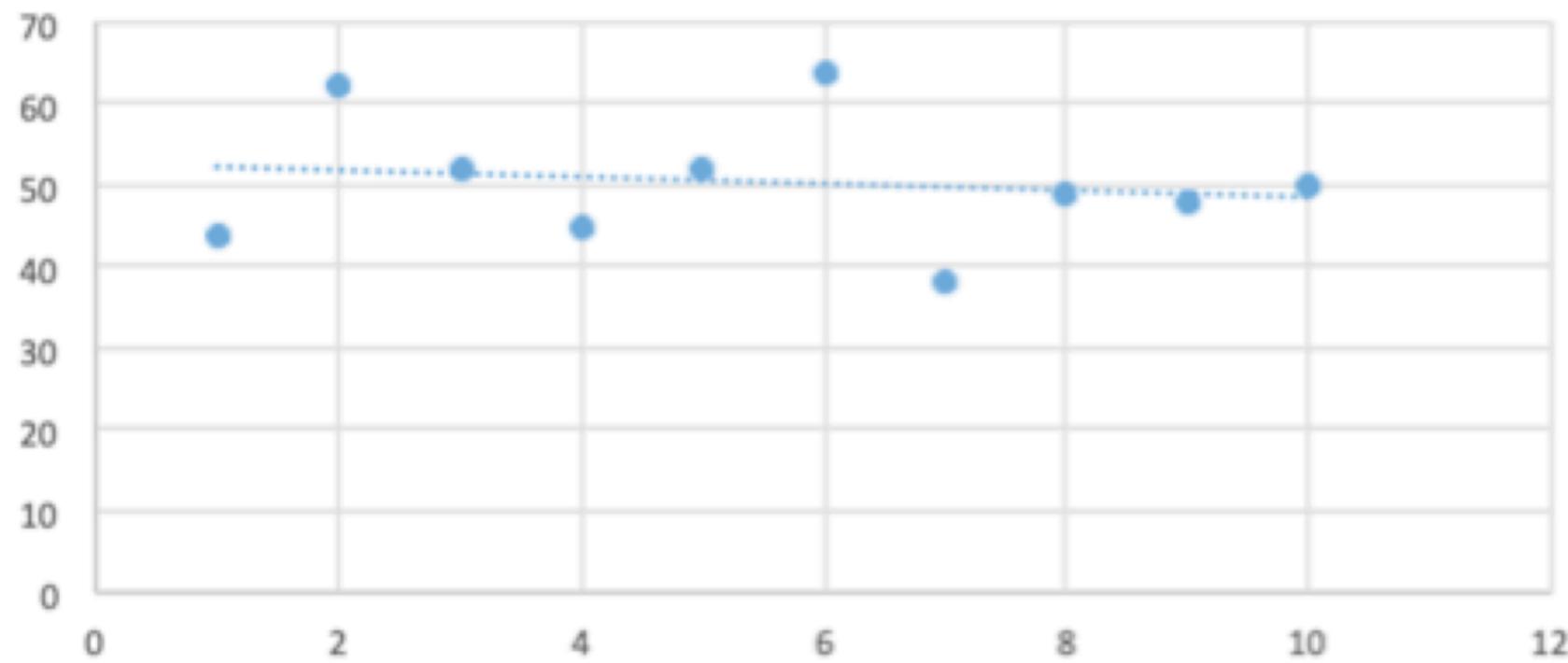


Figure 11: Astronomy enrollment from fall 2013 (1) to spring 2018 (10)

Table 4

Product	Vendor	Order Code	Count	Unit Price	Total Price
Millikan Oil Drop Apparatus	PASCO	AP-8210A	1	\$2,000.00	\$2,000.00
Millikan LED Light Source	PASCO	AP-8212	1	\$105.00	\$105.00
Digital Video Flex	PASCO	SE-7235A	1	\$700.00	\$700.00
Kilovolt Power Supply	PASCO	SF-9586B	1	\$800.00	\$800.00
Student Power Supply, 18VDC, 3A	PASCO	SE-8828	8	\$149.00	\$1,192.00
Mini Laser with Bracket	PASCO	OS-8514	1	\$1,500.00	\$1,500.00
Speed of Light Diode Laser	PASCO	OS-8475	12	\$280.00	\$3,360.00
Vernier Circuit Board 2	Vernier	VCB2	12	\$129.00	\$1,548.00
Differential Voltage Probe	Vernier	DVP-BTA	12	\$39.00	\$468.00
Current Probe	Vernier	DCP-BTA	4	\$39.00	\$156.00
Replacement Lamps	Vernier	VCB-BULB	12	\$12.00	\$144.00
Total					\$11,973.00

Table 5: Cigar Box Guitar

Name	#	Link	Cost per unit	Total
<u>Piezo</u> Pickups	4	https://www.amazon.com/Luvay-12Pcs-Pickup-Transducer-Prewired/dp/B0775V78D1/ref=sr_1_3?ie=UTF8&qid=1548715383&sr=8-3&keywords=piezo+pickup	6.66	26.64
Potentiometers	4	https://www.amazon.com/Guitar-Potentiometer-Audio-Replacement-Electric/dp/B018Z5C2M0/ref=sr_1_3?ie=UTF8&qid=1548715545&sr=8-3&keywords=guitar+potentiometer	6.99	27.96
1/4 inch jack	4	https://www.amazon.com/Honbay-Socket-Stratocaster-Replacement-Electric/dp/B01M0IQ5QI/ref=pd_bxgy_267_img_2/133-8599457-8017522?encoding=UTF8&pd_rd_i=B01M0IQ5QI&pd_rd_r=85532298-234e-11e9-841b-4d76d22006a0&pd_rd_w=iYzsd&pd_rd_wg=uf2ki&pf_rd_p=3f9889ac-6c45-46e8-b515-3af650557207&pf_rd_r=HT8YKSGYXMT0X4CBR6A9&psc=1&refRID=HT8YKSGYXMT0X4CBR6A9	6.29	25.16
Fret wire	4	https://www.amazon.com/Guitar-Fret-Wire-Jescar-Nickel-Silver/dp/B004VXGW7W/ref=sr_1_5?ie=UTF8&qid=1548717467&sr=8-5&keywords=fret+wire	11.79	47.16
Tuning Pegs	15	https://www.amazon.com/YMC-Pieces-Machine-Electric-Acoustic/dp/B01MFB6RBR/ref=sr_1_4?ie=UTF8&qid=1548717779&sr=8-4&keywords=electric+guitar+tuning+pegs	9.95	149.25
Grommets	5	https://www.amazon.com/RAM-PRO-50pc-Quality-Brass-Grommets/dp/B003PWIW64/ref=sr_1_5?ie=UTF8&qid=1548717981&sr=8-5&keywords=grommets+1%2F2+inch	8.15	40.75
Fret boards	10	https://www.homedepot.com/p/Builders-Choice-1-in-x-2-in-x-8-ft-S4S-Poplar-Board-HLPO10208X/206201562	10.16	101.6
			Total	418.52

Table 6: Rocket Launch

Name	Quantity	Link	Cost per unit	Total
D Engines	20	https://www.discountrocketry.com/estes-model-rocket-motor-pack-p-1601.html	9.59	191.8
BT-60 Body Tubes	20	https://www.discountrocketry.com/estes-body-tube-pack-p-1742.html	7.43	148.6
BT-80 Body Tubes	20	https://www.discountrocketry.com/estes-body-tube-pack-p-1743.html	7.03	140.6
NC-60 Nose Cones	10	https://www.discountrocketry.com/estes-nose-cone-pack-p-1752.html	7.03	70.3
NC-80 Nose Cones	20	https://www.discountrocketry.com/estes-nose-cone-p-1753.html	3.43	68.6
BT-60 Couplers	25	https://www.discountrocketry.com/modelrocketsus-body-tube-staging-coupler-p-2011.html	1.59	39.75
BT-80 Couplers	20	https://www.discountrocketry.com/modelrocketsus-body-tube-staging-coupler-p-2013.html	2.39	47.8
Launch Lugs	40	https://www.discountrocketry.com/modelrocketsus-14in-launch-100in-long-p-2023.html	0.79	31.6
BT-60 Engine Mounts	25	https://www.discountrocketry.com/modelrocketsus-5060-motor-mount-p-1966.html	3.99	99.75
BT-80 Engine Mounts	20	https://www.discountrocketry.com/modelrocketsus-5080-motor-mount-p-1967.html	4.79	95.8
Basswood	40	http://www.nationalbalsa.com/basswood_sheet_p/18324bsh.htm	1.38	55.2
Altimeter	1	https://www.amazon.com/Jolly-Logic-AltimeterThree/dp/B00TZ8LW2S/ref=sr_1_4?ie=UTF8&qid=1548643780&sr=8-4&keywords=model+rocket+altimeter	99.95	99.95
			Total	1089.75

Math Skills Triage & Concurrent Remediation in Introductory Physics

M. Graf Simpson, V. Glasser



CUYAMACA
COLLEGE

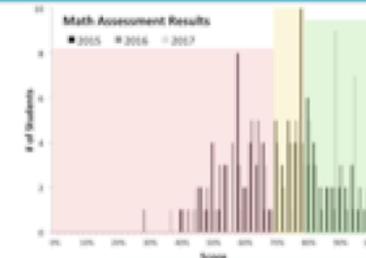
STUDENT BACKGROUND

- 35% took calculus more than 2 years ago
- 13% took their last non-calculus math class more than 5 years ago
- 20% say they do not like math
- 35% english not first language
- 73% work at least 10 hours a week outside of school
- 15% are parents

183 students
3 years



TRIAGE assessment & sorting
Multiple choice assessment test. 50 questions. One hour. No calculators. In class, first day. Last points can be made up with remediation.
5 categories: Algebra, geometry, trigonometry, graphical analysis, & unit analysis.



Results determine intervention

MATH IS FOUNDATIONAL
Mathematical skill is a significant obstacle for beginning physics students. Assessment paired with remediation can significantly improve success of at-risk students

High Pass
>85%

No intervention. Students perform well and are not consider at-risk



Pass
70%-84.99%

2015: no intervention
2016/2017: some intervention (worksheets on failed topics), no significant changes have been seen



AT-RISK STUDENTS

Students who fail or drop

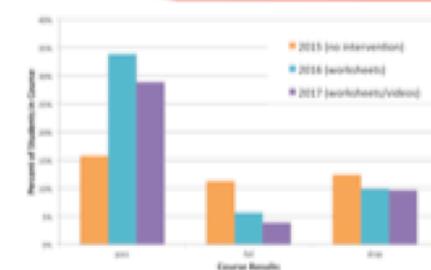
- 43% took calculus more than 2 years ago
- 22% took their last non-calculus math class over 5 years ago
- 70% say they do not like math
- 57% performed poorly in, did not take, or failed a prerequisite math course
- 89% said they did not know how to find resources to improve math skills when not provided

**50% of students who drop did not do so for academic reasons

Fail <70%

2015: no interventions
2016: worksheets provided on failed topics (remediation)
2017: worksheets and videos provided on ALL topics (remediation)
2016 & 2017: worksheets made up points lost on test (incentive)

Results: Interventions appear to have doubled the average pass rate over the two years they were implemented. Intervention success seemed most pronounced for students with long gaps in their math education, and less effective for students with poor math grades and/or poor math confidence/enjoyment.



LONG TERM PROJECT GOALS

- Establish relationship between math skills and success in physics.
students who fail the math assessment have a much higher drop/failure rate
- Using basic interventions (worksheets) determine if remediation is effective for at risk students.
preliminary results show promise
- Develop & test online math for physics modules to be integrated within relevant topics in intro courses.



DATA SOURCES

Data from assessment tests, student grades, and departmental surveys was collected over three years during calculus-based, introductory, mechanics and heat courses
*Further data and analysis will be provided in an upcoming paper later this year

Figure 12: Preliminary research results (New Goal 2)