



ANALYSIS OF 2021 STATE OF CS SUCCESS, OPTIMIZATION, AND RELATIVE STRENGTH METRICS USING THE ECEP CAPE FRAMEWORK (INITIAL DRAFT)

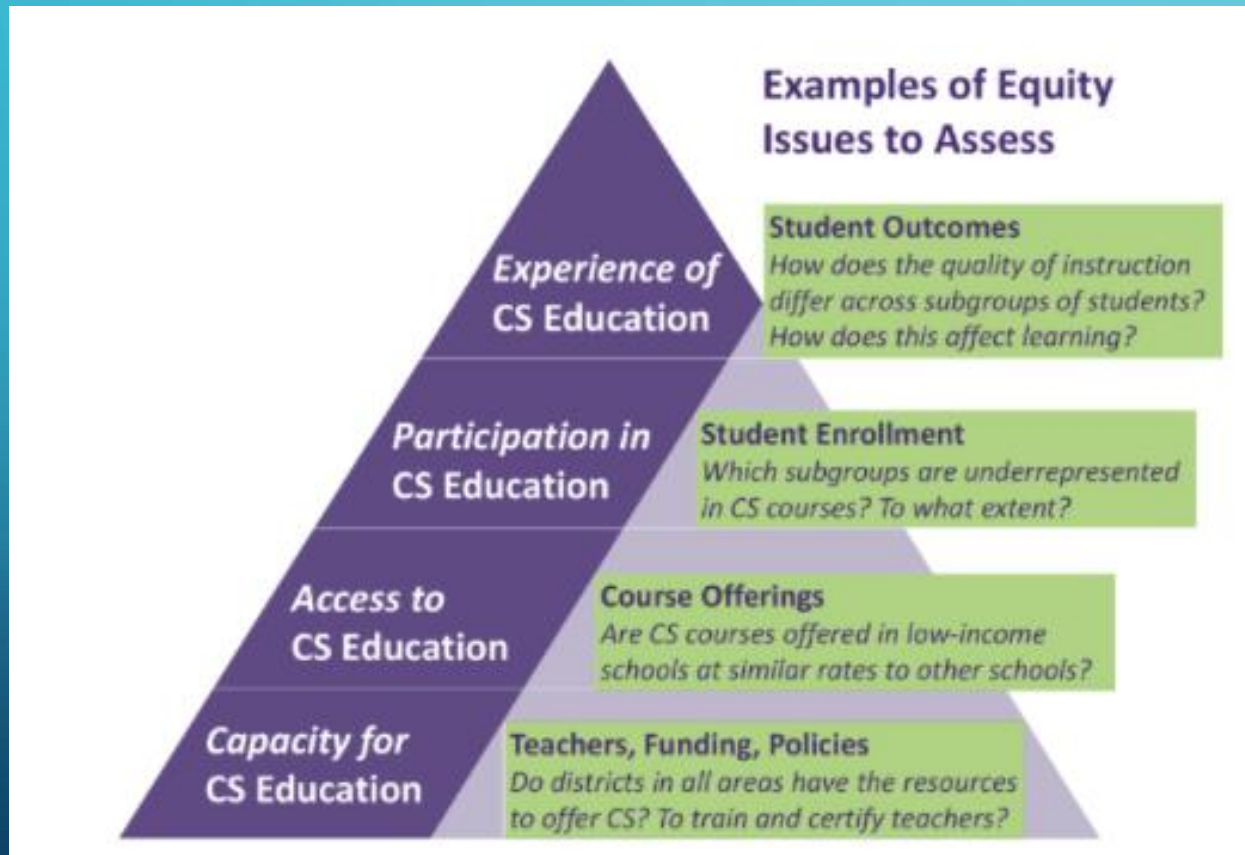
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OBJECTIVES

- Better understand the success metrics in 2021 State of CS Ed Report and how they relate to each other
- Understand how success at lower layers in the CAPE framework affect higher layers
- Understand how different traditionally underrepresented populations fare in comparison
- Help states better pinpoint areas of strength, weakness in HS computer science education

CSEd Success Metrics and CAPE Framework

ECEP CAPE Framework



Corresponding Success Metric

% of students taking AP Exam (StAP)

% of students in Foundational CS (StFCS)

% of student in HS with FCS (StHSCS)

% of HS with FCS (HSCS)

The background is a dark blue gradient. In the corners, there are white line-art graphics resembling circuit boards or data paths, with lines connecting to small circles.

REPORT SUCCESS METRICS

SUCCESS METRIC SUMMARY

	% of HS with FCS (HSCS)	% Students in HS w/ FCS (StHSCS)	% Students Enrolled in FCS (StFCS)	% Students Taking AP Exam (StAP)
State Avg	57.4%	77.6%	4.9%	0.9%
State Std Dev	17.7%	11.9%	3.3%	0.9%
National Avg	51.3%	77.7%	4.7%	1.1%
States w/Data	51	51	36	51

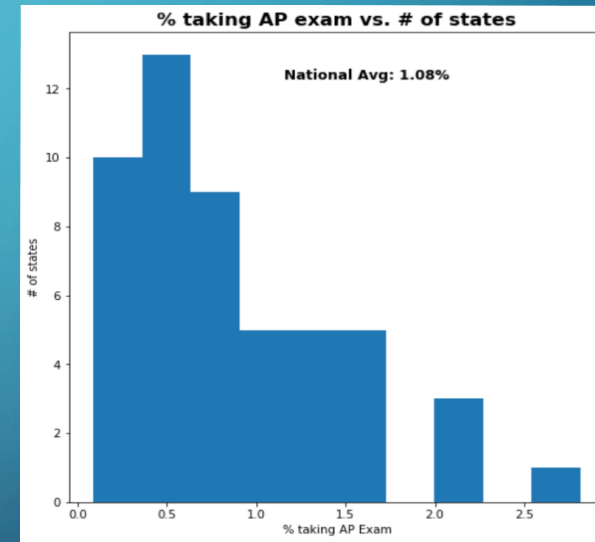
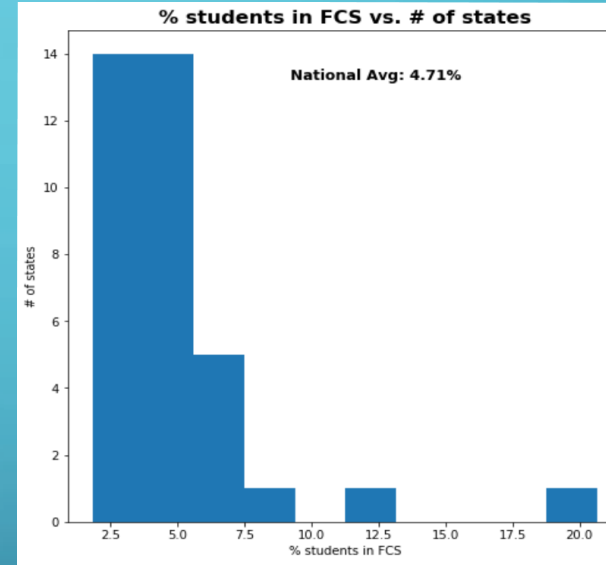
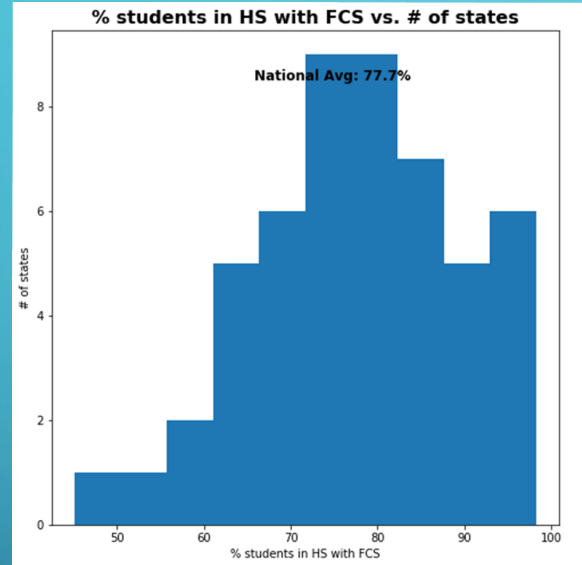
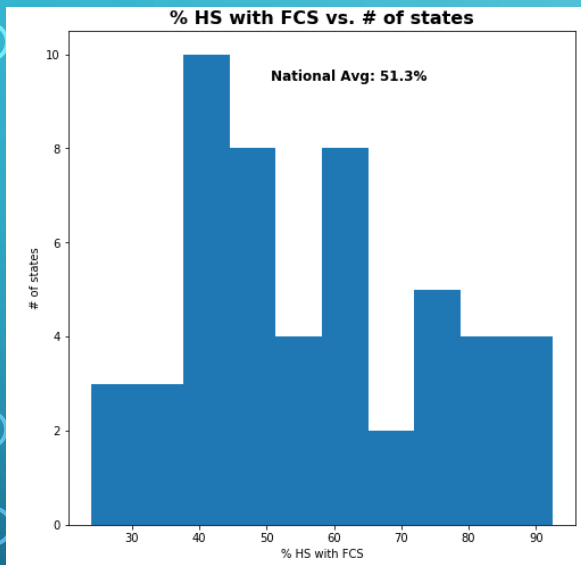
State Avg is average where each state has equal weight

National Avg is average weighted by number of schools or number of students

State of CSEd report focuses on # of policies implemented but not included in this study

AP Exams include both AP CS A and AP CS Principles

SUCCESS METRIC HISTOGRAMS



% of HS with FCS

% Students in HS w/ FCS

% Students Enrolled in FCS

% Students Taking AP CS Exam

SUCCESS METRICS TOP STATES

• % of HS with FCS

- Arkansas 92.5% (1.98)
- South Carolina 92.2% (1.96)
- Maryland 90.1% (1.84)

• % Students in HS w/ FCS

- South Carolina 98.2% (1.74)
- Arkansas 96.5% (1.59)
- Maryland 96.1% (1.56)

• % Students Enrolled in FCS

- South Carolina 20.7% (4.67)
- Maryland 12.5% (2.26)
- Utah 9.35% (1.31)

• % Students Taking AP Exam

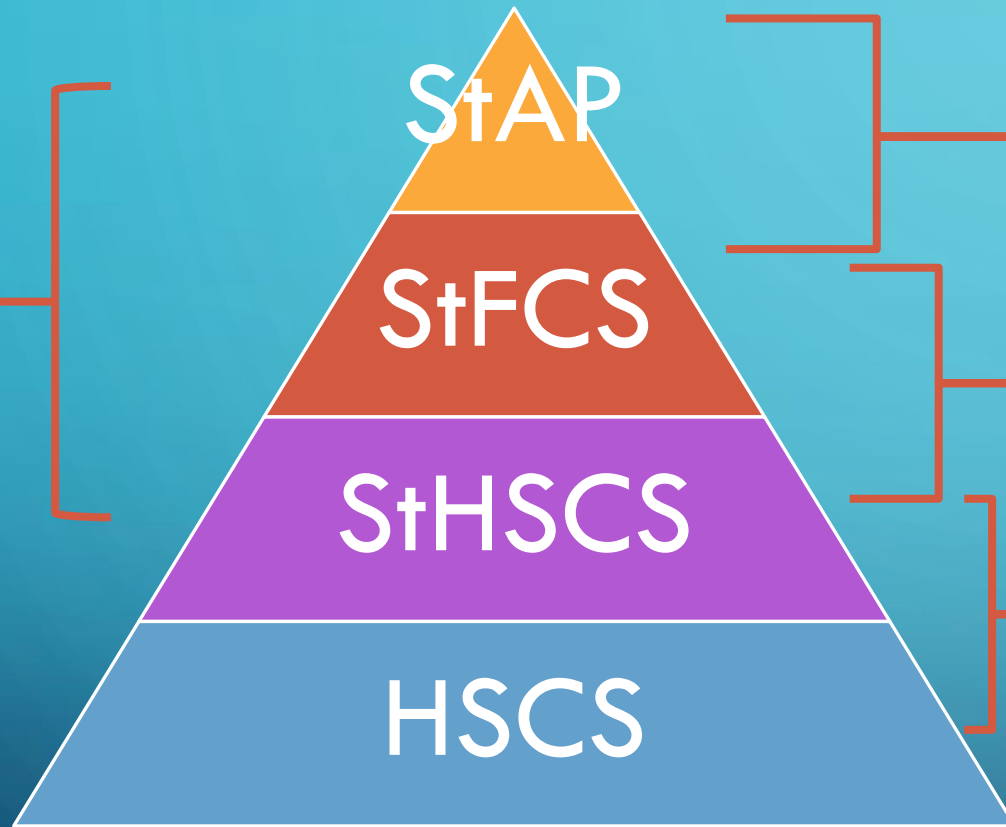
- Maryland 2.82% (3.26)
- New Jersey 2.06% (1.98)
- Connecticut 2.04% (1.95)
- District of Columbia 2.04% (1.95)

() indicates Z-Score using avg/stdev of all states reporting

The background is a dark blue gradient. In the corners, there are white line-art graphics resembling circuit traces or data paths. These lines connect to small white circles, some of which are arranged in a grid-like pattern. The lines are thin and sharp, creating a technical, digital feel.

CAPE OPTIMIZATION METRICS

CAPE OPTIMIZATION METRICS



AP/FCS Uptake Ratio (CP_StAP_StFCS)
What percentage of students taking an FCS course took an AP CS Exam?

FCS/School Uptake Ratio (CP_StFCS_StHSCS)
What percentage of students in a school with FCS took an FCS course?

FCS School Size Ratio (CP_StHSCS_HSCS)
How does size of schools with FCS compare to average school size?

AP/School Uptake Ratio (CP_StAP_StHSCS)
What percentage of students in a school with FCS took an AP CS Exam?

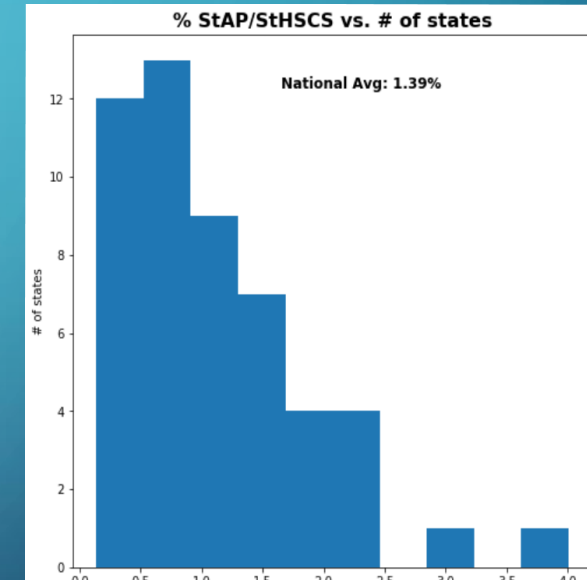
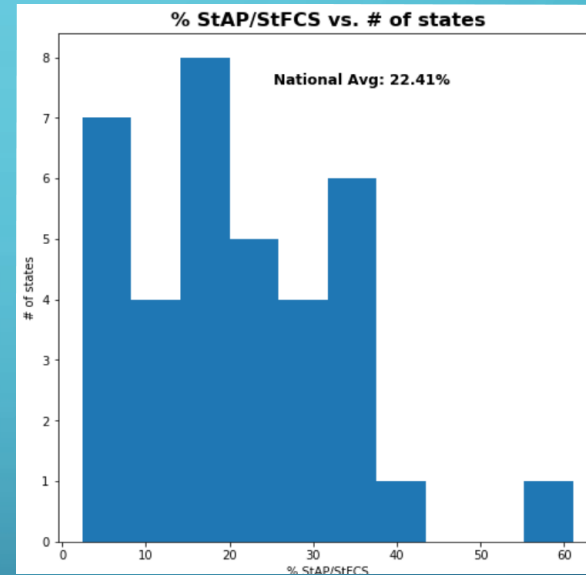
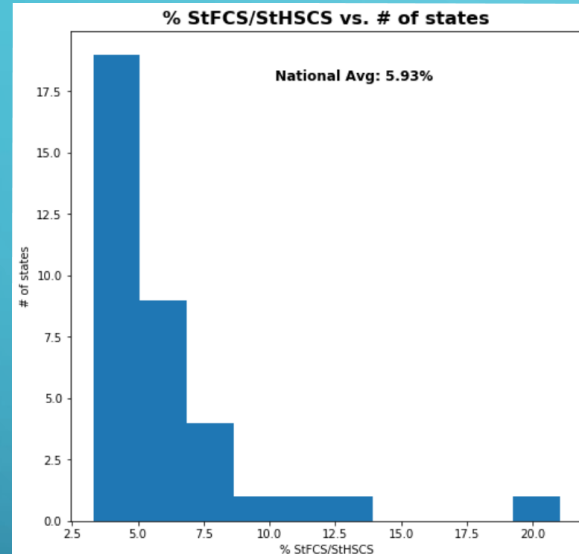
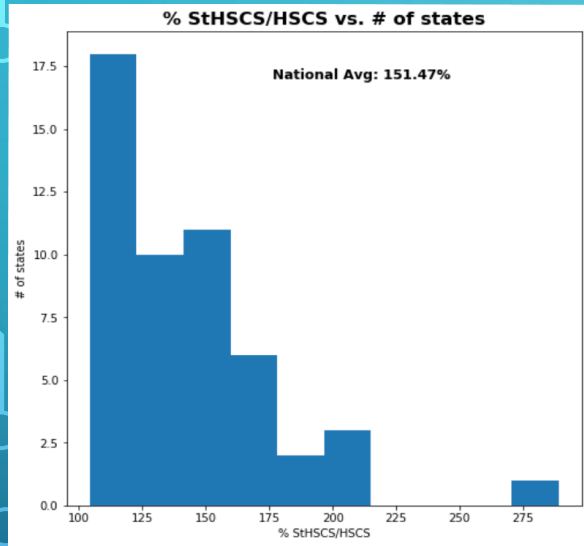
CAPE OPTIMIZATION METRIC SUMMARY

	FCS School Size Ratio (CP_StHSCS_HSCS)	FCS/School Uptake Ratio (CP_StFCS_StHSCS)	AP/FCS Uptake Ratio (CP_StAP_StFCS)	AP/School Uptake Ratio (CP_StAP_StHSCS)
State Avg	143.8%	6.00%	20.5%	1.11%
State Std Dev	34.4%	3.34%	12.7%	0.77%
National Avg	151.5%	5.92%	22.4%	1.39%
States w/Data	51	36	36	51

State Avg is average where each state has equal weight

National Avg is average weighted by number of schools or number of students

CAPE OPTIMIZATION METRIC HISTOGRAMS



FCS School Size Ratio
(CP_StHSCS_HSCS)

FCS/School Uptake Ratio
(CP_StFCS_StHSCS)

AP/FCS Uptake Ratio
(CP_StAP_StFCS)

AP/School Uptake Ratio
(CP_StAP_StHSCS)

OPTIMIZATION METRICS TOP STATES

• FCS School Size Ratio

- Minnesota 288.9% (4.26)
- Kansas 207.7% (1.88)
- Arizona 205.3% (1.81)

• FCS/School Uptake Ratio

- South Carolina 21.0% (4.57)
- Maryland 13.0% (2.14)
- Utah 10.4% (1.35)

• AP/FCS Uptake Ratio

- Florida 61.1% (3.24)
- Connecticut 38.5% (1.43)
- Georgia 37.5% (1.36)

• AP/School Uptake Ratio

- District of Columbia 4.01% (3.82)
- Maryland 2.93% (2.39)
- New Jersey 2.35% (1.63)

() indicates Z-Score using avg/stdev of all states reporting

RELATIVE STRENGTH METRICS

FEMALE/MALE, BLACK/WHITE, HLLL/WHITE

RELATIVE STRENGTH OPTIMIZATION METRICS

Metric	Description
RS FCS School Size Ratio (RS_CP_StHSCS_HSCS)	Relatively how many more/less Group A students attend a HS with FCS compared to Group B?
RS FCS/School Uptake Ratio (RS_CP_StFCS_StHSCS)	Given that a student is at a HS with FCS, relatively how many more/less Group A students take an FCS class compared to Group B?
RS AP/FCS Uptake Ratio (RS_CP_StAP_StFCS)	Given that a student is taking an FCS course, relatively how many more/less Group A students are taking an AP CS exam compared to Group B
RS AP/School Uptake Ratio (RS_CP_StAP_StHSCS)	Given that a student is at a HS with FCS, relatively how many more/less Group A students are taking an AP CS exam compared to Group B?

- Relative Strength Metric divides the optimization metric for Group A by the same metric for Group B
- In future should report on relative strength of success metrics
- Small states can greatly skew these metrics

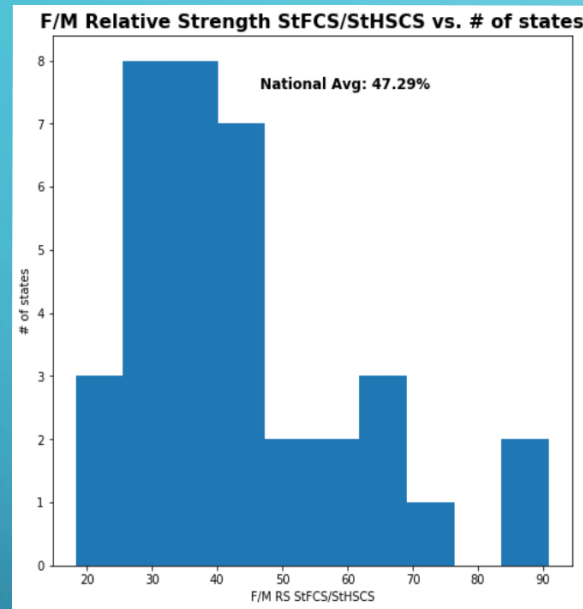
FEMALE/MALE RELATIVE STRENGTH METRICS

	RS FCS School Size Ratio (RS_CP_StHSCS_HSCS)	RS FCS/School Uptake Ratio (RS_CP_StFCS_StHSCS)	RS AP/FCS Uptake Ratio (RS_CP_StAP_StFCS)	RS AP/School Uptake Ratio (RS_CP_StAP_StHSCS)
State Avg	100%	42.9%	109.9%	42.3%
State Std Dev	0.0	17.3%	24.3%	12.6%
National Avg	100%	47.3%	98.4%	46.1%
States w/Data	0	36	36	51

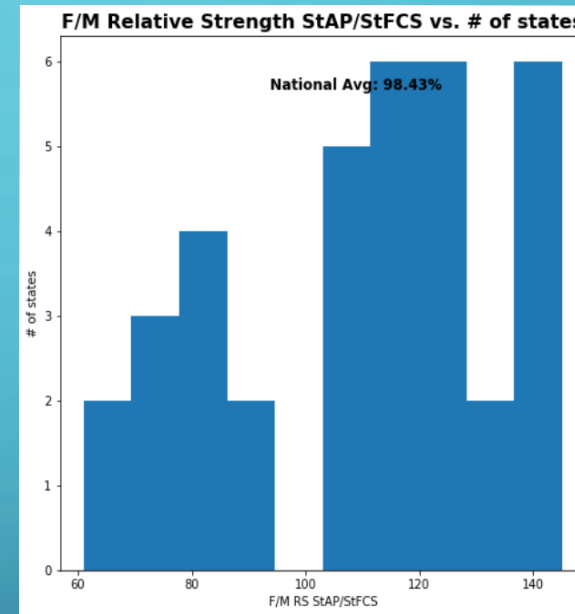
CSEd report does not contain female/male breakdowns for total students or student in HS with FCS. This report assumes that all states have 51 /49 male/female division for both total students and students in HS with FCS

FEMALE/MALE RS METRICS HISTOGRAMS

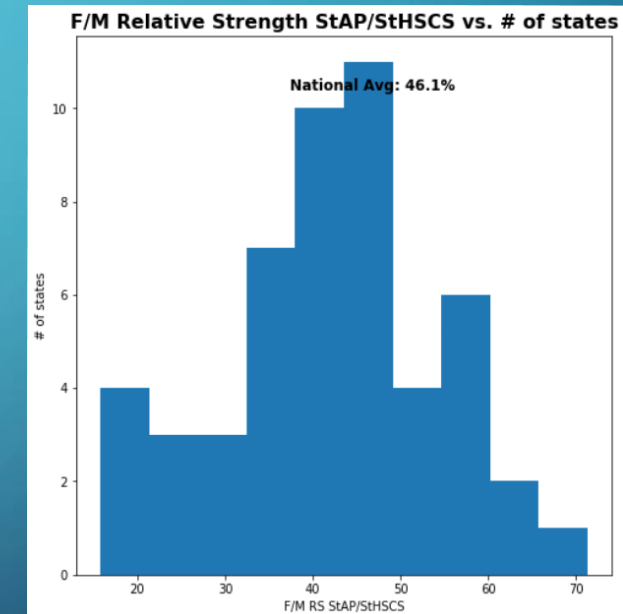
N/A Assumed to be 1.0 for all states



RS FCS/School Uptake Ratio
(RS_CP_StFCS_StHSCS)



RS AP/FCS Uptake Ratio
(RS_CP_StAP_StFCS)



RS AP/School Uptake Ratio
(RS_CP_StAP_StHSCS)

FEMALE/MALE RELATIVE STRENGTH TOP STATES

• F/M RS FCS/School Uptake Ratio

- Mississippi 90.9% (2.81)
- South Carolina 88.1% (2.65)
- Maryland 71.2% (1.66)

• F/M RS AP/FCS Uptake Ratio

- Wyoming 145.0% (1.46)
- Hawaii 145.0% (1.46)
- Arizona 141.8% (1.33)

• F/M RS AP/School Uptake Ratio

- District of Columbia 71.3% (2.32)
- Mississippi 63.5% (1.70)
- Alabama 60.7% (1.47)

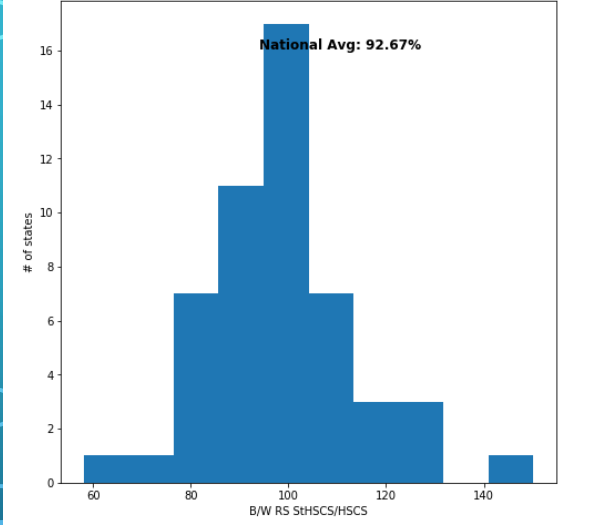
() indicates Z-Score using avg/stdev of all states reporting

BLACK/WHITE RELATIVE STRENGTH METRICS

	RS FCS School Size Ratio (RS_CP_StHSCS_HSCS)	RS FCS/School Uptake Ratio (RS_CP_StFCS_StHSCS)	RS AP/FCS Uptake Ratio (RS_CP_StAP_StFCS)	RS AP/School Uptake Ratio (RS_CP_StAP_StHSCS)
State Avg	98.8%	91.8%	63.5%	45.5%
State Std Dev	16.0%	40.9%	89.3%	40.8%
National Avg	92.7%	106.2%	44.6%	46.8%
States w/Data	0	35	35	51

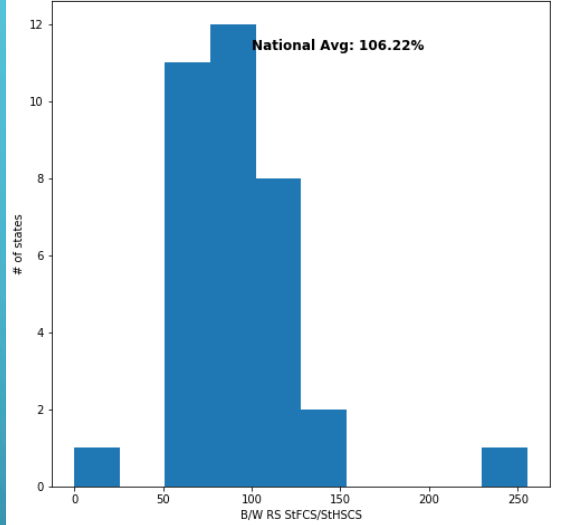
BLACK/WHITE RS METRICS HISTOGRAMS

Black/White Relative Strength StHSCS/HSCS vs. # of states



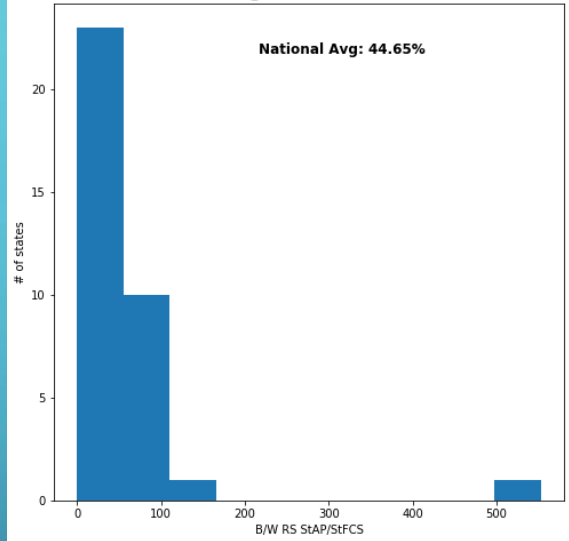
RS FCS School Size Ratio
(RS_CP_StHSCS_HSCS)

B/W Relative Strength StFCS/StHSCS vs. # of states



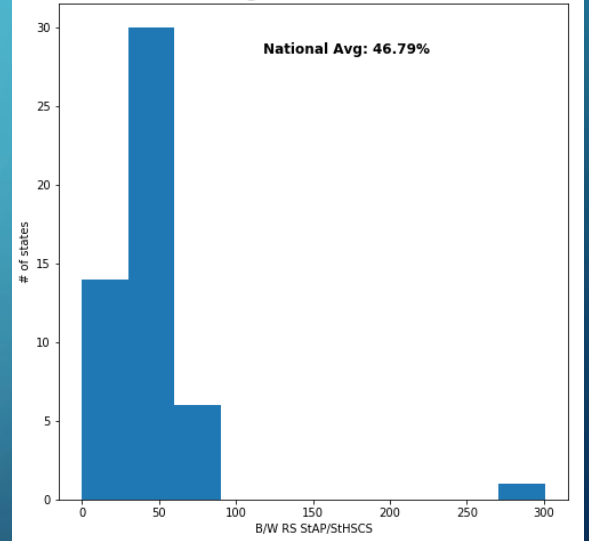
RS FCS/School Uptake Ratio
(RS_CP_StFCS_StHSCS)

B/W Relative Strength StAP/StFCS vs. # of states



RS AP/FCS Uptake Ratio
(RS_CP_StAP_StFCS)

B/W Relative Strength StAP/StHSCS vs. # of states



RS AP/School Uptake
Ratio
(RS_CP_StAP_StHSCS)

BLACK/WHITE RELATIVE STRENGTH TOP STATES

• B/W RS FCS School Size Ratio

- Kansas 150.2% (3.25)
- South Dakota 130.6% (2.01)
- Nebraska 129.9% (1.97)

• B/W RS FCS/School Uptake Ratio

- Illinois 255.5% (4.06)
- Louisiana 149.9% (1.44)
- New York 139.3% (1.18)

• B/W RS AP/FCS Uptake Ratio

- Idaho 553.2% (5.56)
- Iowa 125.8% (0.71)
- Arizona 101.8% (0.43)

• B/W RS AP/School Uptake Ratio

- Montana 300.9% (6.32)
- Utah 86.1% (1.00)
- New York 82.7% (0.92)

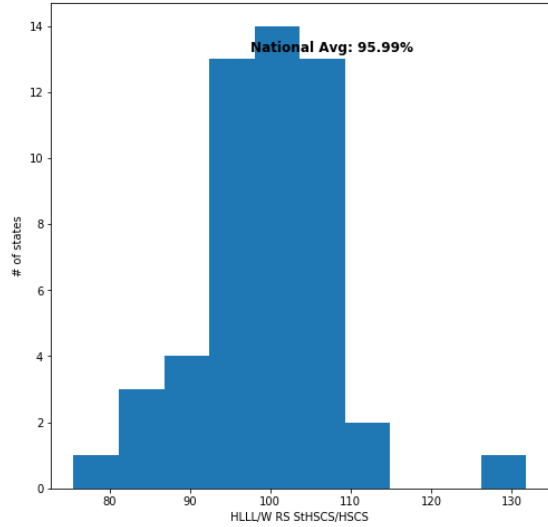
() indicates Z-Score using avg/stdev of all states reporting

HISPANIC-LATINX/WHITE RELATIVE STRENGTH METRICS

	RS FCS School Size Ratio (RS_CP_StHSCS_HSCS)	RS FCS/School Uptake Ratio (RS_CP_StFCS_StHSCS)	RS AP/FCS Uptake Ratio (RS_CP_StAP_StFCS)	RS AP/School Uptake Ratio (RS_CP_StAP_StHSCS)
State Avg	99.4%	89.5%	76.3%	78.4%
State Std Dev	8.9%	25.3%	35.3%	57.0%
National Avg	96.0%	79.2%	88.2%	70.4%
States w/Data	0	35	35	51

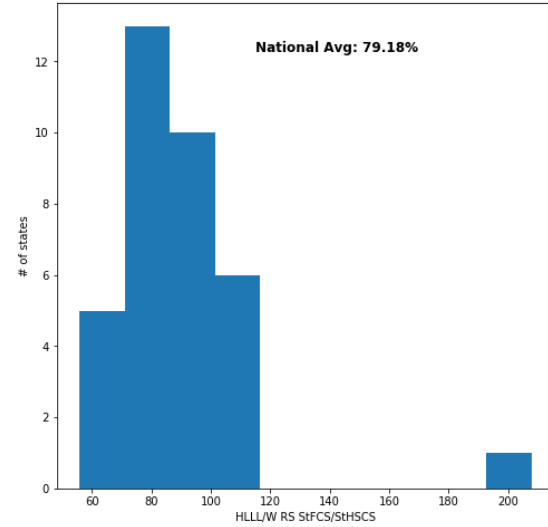
HISPANIC-LATINX/WHITE RS METRICS HISTOGRAMS

HLLL/White Relative Strength StHSCS/HSCS vs. # of states



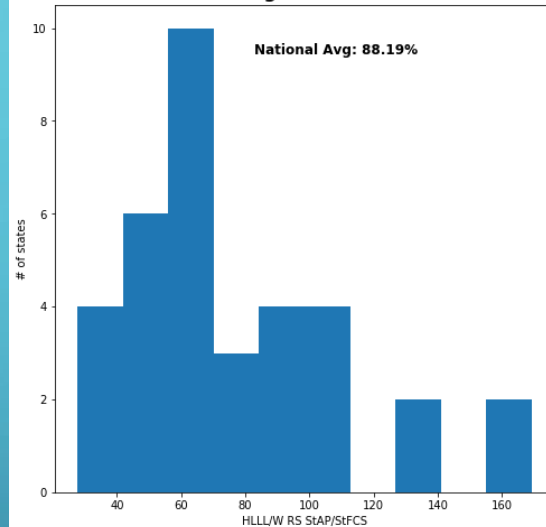
RS FCS School Size Ratio
(RS_CP_StHSCS_HSCS)

HLLL/White Relative Strength StFCS/StHSCS vs. # of states



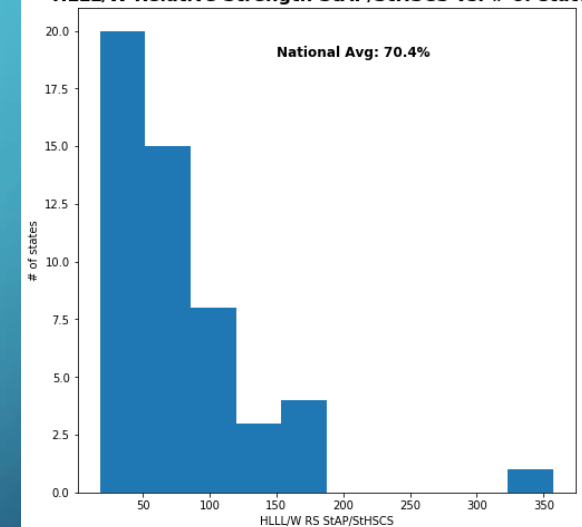
RS FCS/School Uptake Ratio
(RS_CP_StFCS_StHSCS)

HLLL/W Relative Strength StAP/StFCS vs. # of states



RS AP/FCS Uptake Ratio
(RS_CP_StAP_StFCS)

HLLL/W Relative Strength StAP/StHSCS vs. # of states



RS AP/School Uptake Ratio
(RS_CP_StAP_StHSCS)

HISPANIC-LATINX/WHITE RELATIVE STRENGTH TOP STATES

• HL/W RS FCS School Size Ratio

- Kansas 131.8% (3.67)
- Nebraska 112.6% (1.50)
- Illinois 109.6% (1.16)

• HL/W RS FCS/School Uptake Ratio

- Illinois 208.0% (4.74)
- New York 113.9% (0.98)
- Utah 112.9% (0.94)

• HL/W RS AP/FCS Uptake Ratio

- West Virginia 169.3% (2.67)
- Hawaii 168.3% (2.64)
- Iowa 130.4% (1.55)

• HL/W RS AP/School Uptake Ratio

- Montana 357.0% (4.94)
- West Virginia 186.0% (1.91)
- Maine 185.1% (1.89)

() indicates Z-Score using avg/stdev of all states reporting

OVERALL OBSERVATIONS

- TBD/For Discussion

LINKS

- Google Colab Notebooks

- <https://colab.research.google.com/drive/1mm5IGc2qBlawCukNfp6MEE9J3JSvpCX-?usp=sharing>

- Data Files

- https://drive.google.com/file/d/1jCUBaWoe52GdzlwLaM7TcZ_SQll9Jglv/view?usp=sharing (CSV)
- <https://docs.google.com/spreadsheets/d/1MZpi5Nid-BfpQ833Uy9rYgrvD8H3Yads/edit?usp=sharing&oid=112866292549895118363&rtpof=true&sd=true> (XLSX used to create CSV)

- Original Data Sources

- https://advocacy.code.org/2021_State_of_CS_data.xlsx (Numeric Data)
- <http://bit.ly/9policies> (Policy data)

PLANNED NEXT STEPS

- More background data for gender/ethnic metrics (success metrics RS), outlier handling
- Further Jupyter file cleanup and documentation
- Public Github Checkin. Kaggle? Others?
- Location/FRL Data Study
- FCS/CS P/CS A Comparison Data Study