



How do we increase SAT participation rate?



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DSI-16

Agenda

- 1. Executive Summary**
- 2. Research Method & Analysis**
- 3. Key Takeaways**
- 4. Recommendations**
- 5. Further Research**

Executive Summary

PROBLEM STATEMENT

There are still many states in the USA which have **very low to negligible rate of SAT participation** among high schoolers.

There is a need for a focused approach, to **improve state level SAT participation across the nation**.

WHAT WE WILL BE DOING

DATA ANALYSED:

SAT

ACT

KEY METRICS:

Participation rate

Total Scores

Test Score per Subject



External Research



Key Trends and Insights



Recommendations

Research Method & Analysis

Data Preparation – Data Description

SAT 2017 Data List

	State	Participation	Evidence-Based Reading and Writing	Math	Total
0	Alabama	5%		593	572 1165
1	Alaska	38%		547	533 1080
2	Arizona	30%		563	553 1116

ACT 2017 Data List

	State	Participation	English	Math	Reading	Science	Composite
0	National	60%	20.3	20.7	21.4	21.0	21.0
1	Alabama	100%	18.9	18.4	19.7	19.4	19.2
2	Alaska	65%	18.7	19.8	20.4	19.9	19.8

SAT Examination:

- Number of subjects: 2 (Evidence-based Reading and Writing, Math)
- Each component is scored on a scale of 200 to 800.
- Total score ranges from 400 to 1600.

ACT Examination:

- Number of subjects: 4 (English, Math, Reading, Science)
- Each component is scored on a scale of 1 to 36.
- Average composite score ranges from 1 to 36

Research Method & Analysis

Data Preparation – Data Cleaning

- There were 3 errors found in the data and have been replaced with the **correct values**.

```
sat_2017 = sat_2017.replace({'Math':52},524)
act_2017 = act_2017.replace({'Science':2.3},23.2)
act_2017 = act_2017.replace({'Composite':'20.2x'},20.2)
```

- The data type of participation rates and scores were set to **either integer or float**.

```
sat_2017['Participation'] = sat_2017['Participation'].map(lambda x: x.rstrip('%'))
sat_2017['Participation'] = sat_2017['Participation'].astype(int)
```

- Column names have been changed to **more expressive and unique names**.

```
sat_2017.rename(columns={
    'participation' : 'sat_2017_participation',
    'total' : 'sat_2017_total',
    'evidence-based reading and writing' : 'sat_2017_reading_and_writing',
    'math': 'sat_2017_math'
},inplace=True)
```

Research Method & Analysis

Data Preparation – Merging Dataframes

- The row information for national from act_2017 has been removed
- Data from SAT 2017 and ACT 2017 are then combined together and saved as a new file combined_2017.csv.
- Same steps were repeated for SAT_2018 and ACT_2018.
- 2017 and 2018 data were then combined and saved as final.csv.
- This file will be used for the rest of investigation and analysis.

	state	sat_2017_participation	sat_2017_reading_and_writing	sat_2017_math	sat_2017_total	act_2017_participation	act_2017_english	act_2017_math
0	Alabama	5	593	572	1165	100	18.9	18.4
1	Alaska	38	547	533	1080	65	18.7	19.8
2	Arizona	30	563	553	1116	62	18.6	19.8

Research Method & Analysis

Data Preparation – Data Dictionary

Feature	Type	Dataset	Description
state	object	sat_2017/act_2017/final	The list of states of the country that has participations in the respective test.
sat_2017_participation	integer	sat_2017/final	The participation rate indicates the percentage of people who take part in SAT 2017 in each state.
sat_2017_reading_and_writing	integer	sat_2017/final	The average score of the evidence-based reading and writing component in SAT by state.
sat_2017_math	integer	sat_2017/final	The average score of the mathematics component in SAT by state.
sat_2017_total	integer	sat_2017/final	The average of total SAT scores in 2017 by state.
act_2017_participation	integer	act_2017/final	The participation rate indicates the percentage of people who take part in ACT 2017 in each state.
act_2017_english	float	act_2017/final	The average score of the english component in ACT by state.
act_2017_math	float	act_2017/final	The average score of the mathematics component in ACT by state.
act_2017_reading	float	act_2017/final	The average score of the reading component in ACT by state.
act_2017_science	float	act_2017/final	The average score of the science component in ACT by state.
act_2017_total	float	act_2017/final	The average composite ACT score in 2017 which shows the average across all components.

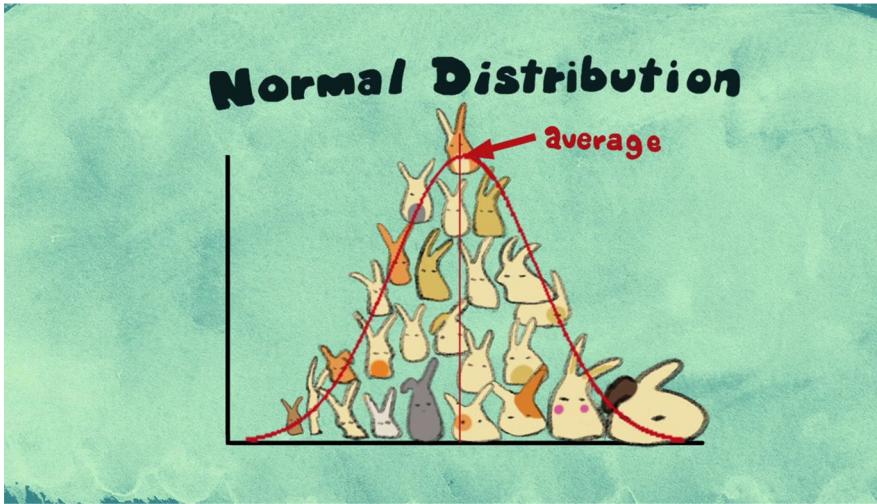
Research Method & Analysis

Exploratory Data Analysis - Key Trends

	SAT	ACT
States with Mandatory Testing	<10	~20
Lowest participating states (in terms of participation rates %)	Mostly ~0%	7% - 30%
Largest jump in participation rates (by states, 2017 to 2018)	Illinois: +90% Colorado: +89%	Ohio: +25% Nebraska: +16%
Top 10 scoring states (in terms of participation rates %)	2% - 4%	7% - 43%
Bottom 10 scoring states (in terms of participation rates %)	Mostly >90% Outliers: Hawaii(56%), West Virginia (28%), Utah(4%)	Mostly 100% Outliers: Arizona (66%), Hawaii (89%)

Research Method & Analysis

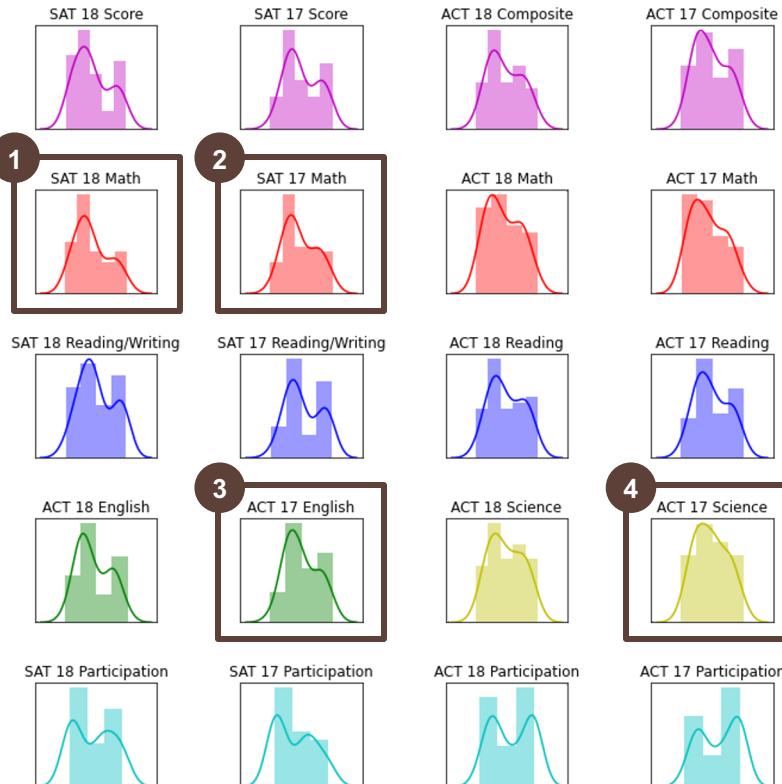
Exploratory Data Analysis - Statistical Analysis



DOES CENTRAL LIMIT THEOREM HOLD
IN OUR PLOTS?

Research Method & Analysis

Exploratory Data Analysis - Statistical Analysis



Which plots are approximately normal?

Using '`stats.normaltest`' function from scipy stats library, we analyse each plot to see if they are approximately normal at 5% significance level

```
sat_18_math: p value = 0.089 - Distribution is approximately normal at 5% significance  
Skew:0.53; kurtosis:-0.76
```

```
sat_18_total: p value = 0.015 - Distribution is not normal  
Skew:0.47; kurtosis:-1.02
```

1 SAT 2018 MATH

- SKEW: 0.53
- KURTOSIS: -0.76
- P-VALUE: 8.9%

3 ACT 2017 ENGLISH

- SKEW: 0.35
- KURTOSIS: -0.88
- P-VALUE: 8.4%

2 SAT 2017 MATH

- SKEW: 0.37
- KURTOSIS: -0.93
- P-VALUE: 5.6%

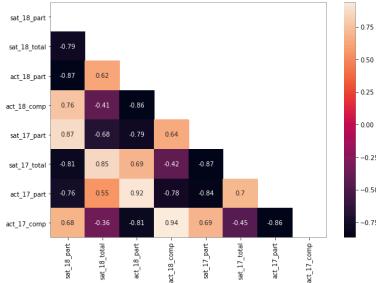
4 ACT 2017 SCIENCE

- SKEW: 0.22
- KURTOSIS: -0.94
- P-VALUE: 7.2%

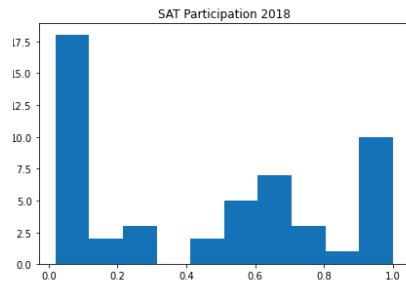
Research Method & Analysis

Data Visualisation

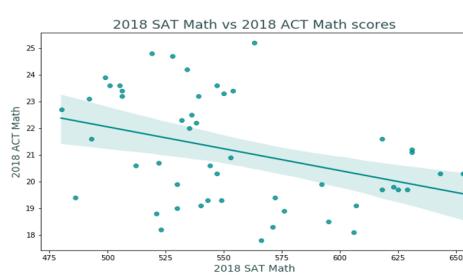
Heatmaps



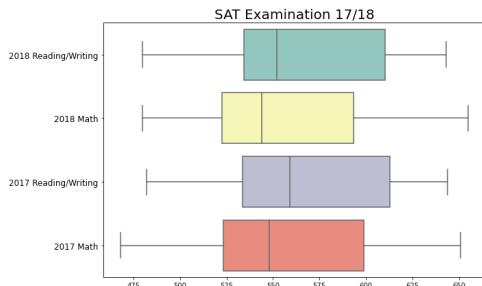
Histograms



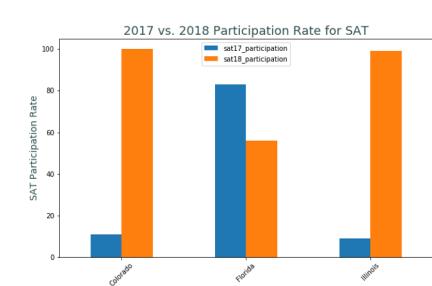
Scatterplots



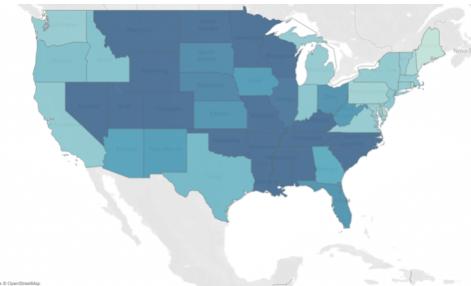
Boxplots



Bar Charts

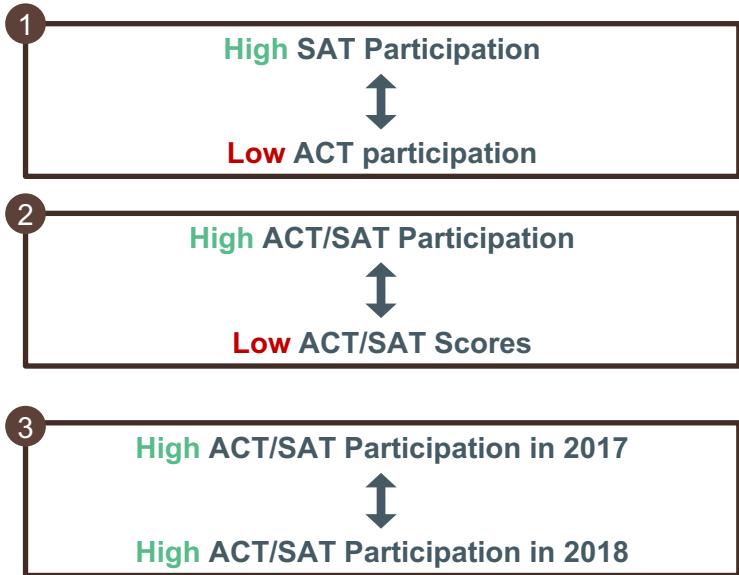
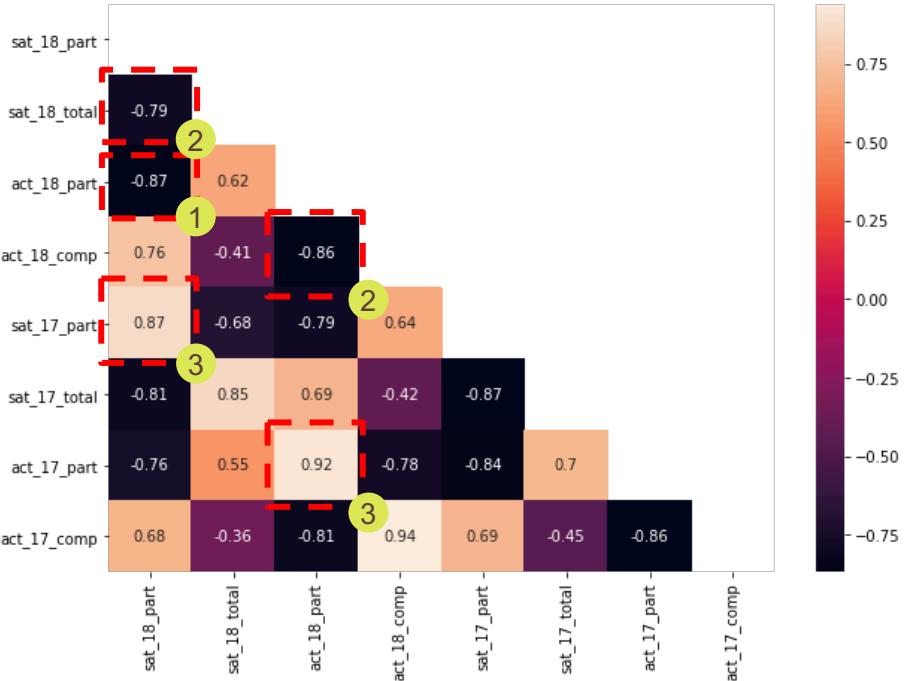


Choropleth Maps



Research Method & Analysis

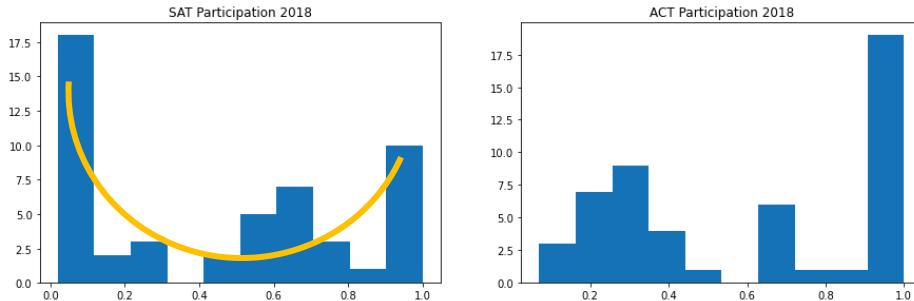
Data Visualization – Key Takeaways



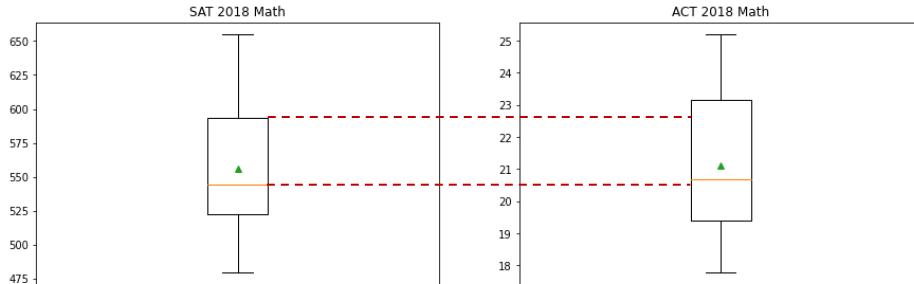
Research Method & Analysis

Data Visualization – Key Takeaways

SAT & ACT Participation Rates



SAT & ACT Math



HISTOGRAM ANALYSIS

SAT Participation:

U shape with the bulk of states at lower participation rates

ACT Participation:

Extremely high number of states with near 100% participation.
Bulk of the rest falls in range of 20 - 40%

BOXPLOT ANALYSIS

SAT Math Scores:

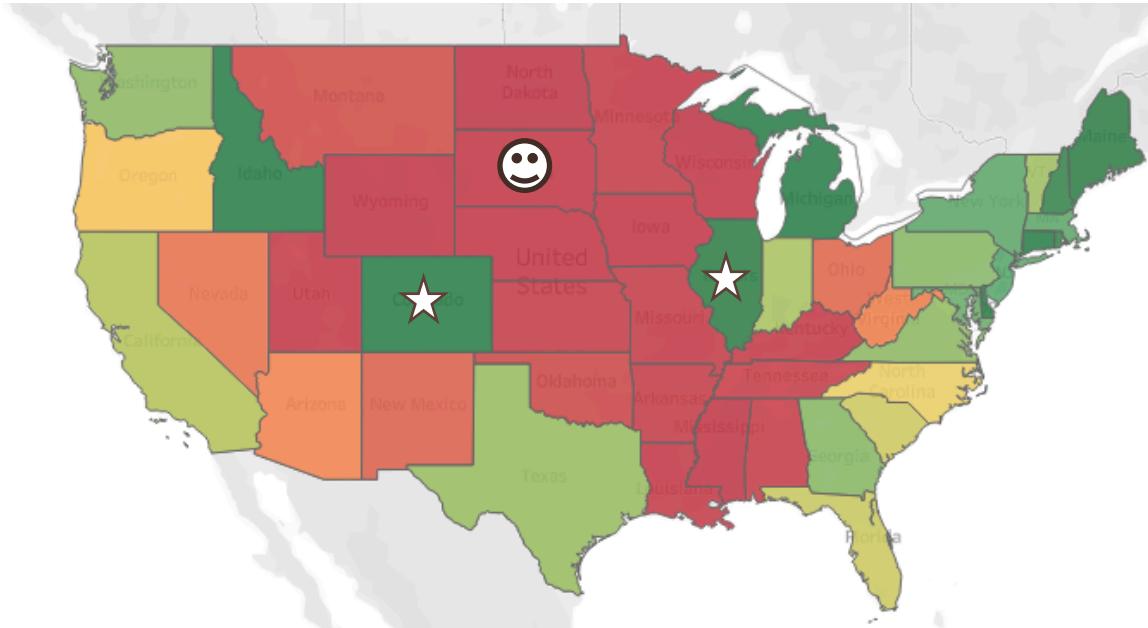
Higher deviation of scores in the top 75% quantile
→ Students who score well, score exceptionally well.

ACT Math Scores:

Median score is slightly higher than SAT.
Less differentiation of scores amongst high performers

Research Method & Analysis

Data Visualization – Key Takeaways



CHOROPLATH MAP

SAT Participation:
Highly concentrated amongst coastal states

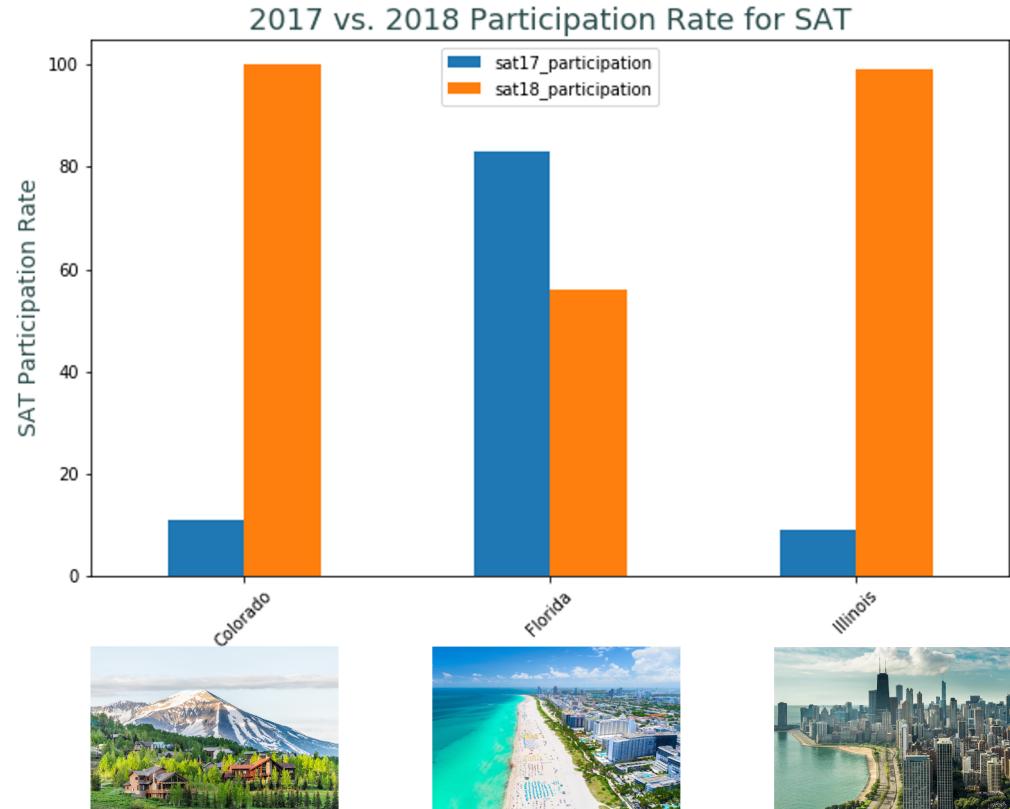
ACT Participation:
Highly concentrated amongst inland states

★ Massive increase in SAT participation rates from 2017-2018

😊 My recommendation: South Dakota

Research Method & Analysis

External Research



Research Method & Analysis

External Research

Colorado



```
# Viewing participation rates for Colorado
pan_merged_final[pan_merged_final['state_sat_2017'] == 'Colorado']\
[[column for column in pan_merged_final.columns if 'participation' in column]]
```

	participation_sat_2017	participation_act_2017	participation_sat_2018	participation_act_2018
5	11.0	100.0	100.0	30.0

High ACT participation rates in 2017

Low ACT participation rates in 2018



Low SAT participation rates in 2017

High SAT participation rates in 2018

Research Method & Analysis

External Research

Illinois



```
# Viewing participation rates for Illinois
pan_merged_final[pan_merged_final['state_sat_2017'] == 'Illinois']\
[[column for column in pan_merged_final.columns if 'participation' in column]]
```

	participation_sat_2017	participation_act_2017	participation_sat_2018	participation_act_2018
13	9.0	93.0	99.0	43.0

High ACT participation rates in 2017

Low ACT participation rates in 2018

Low SAT participation rates in 2017

High SAT participation rates in 2018



Research Method & Analysis

External Research

Florida



```
# Viewing participation rates for Florida
pan_merged_final[pan_merged_final['state_sat_2017'] == 'Florida']\
[[column for column in pan_merged_final.columns if 'participation' in column]]
```

	participation_sat_2017	participation_act_2017	participation_sat_2018	participation_act_2018
9	83.0	73.0	56.0	66.0

Research Method & Analysis

External Research

Florida



```
# Viewing participation rates for Florida
pan_merged_final[pan_merged_final['state_sat_2017'] == 'Florida']\
[[column for column in pan_merged_final.columns if 'participation' in column]]
```

	participation_sat_2017	participation_act_2017	participation_sat_2018	participation_act_2018
9	83.0	73.0	97% 	66.0

High ACT participation rates in 2017

Average ACT Participation rates in 2018

High SAT Participation rates in 2017

Very High SAT participation rates in 2018



<https://reports.collegeboard.org/pdf/2018-florida-sat-suite-assessments-annual-report.pdf>

Research Method & Analysis

External Research



Colorado



Illinois



Florida

What do these three states have in common?

Research Method & Analysis

External Research



Research Method & Analysis

External Research

Colorado

- Implemented mandatory statewide SAT testing
 - <https://www.denverpost.com/2017/03/06/colorado-juniors-sat-college-exam/>

Illinois

- Implemented mandatory statewide SAT testing
 - <https://www.chicagotribune.com/news/ct-illinois-chooses-sat-met-20160211-story.html>

Florida

- Free “school day” event
 - <https://www.orlandosentinel.com/news/education/os-ne-act-sat-florida-scores-20181024-story.html>

Key Takeaways

What have we learnt from our data analysis?

1

High Participation in SAT



Low Participation in ACT

2

High Participation



Low Scores

3

**Popularity of SAT
Popularity of ACT**



**Coastal States
Inland States**

4

Key drivers for recent growth:

1. State Sponsorship
2. School's Realisation of the value of SAT examination

Recommendations

What are our key criterions for choosing the state of interest?

1 No ACT mandatory testing

No existing contract with state as this drastically depresses SAT participation

2 Mid - high ACT participation rate

Shows the examination culture amongst high school students and high schools in the state in taking college-entrance exams

3 High ACT Composite Scores

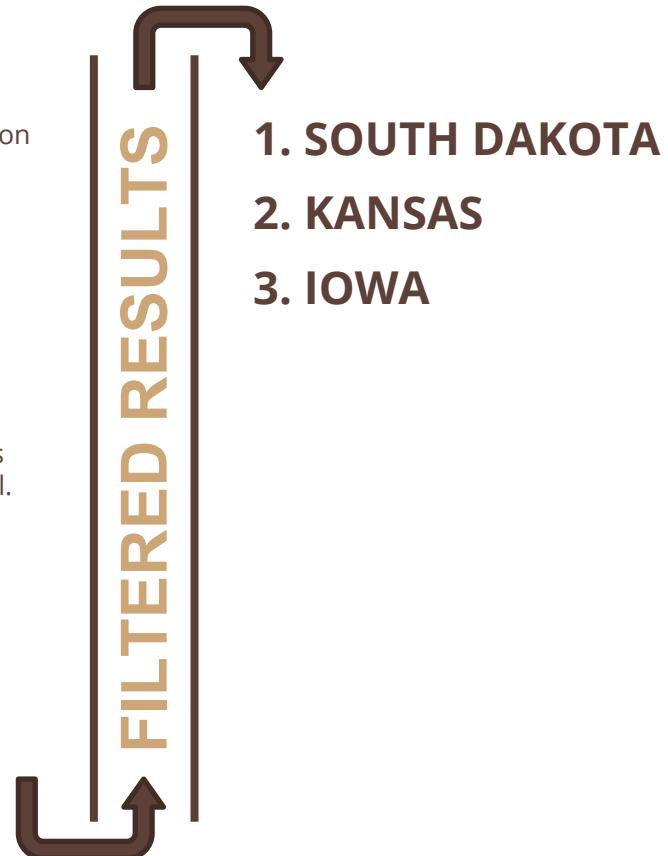
Shows that the generate competency of students in the state is high. This is because SAT is concluded to be slightly tougher than the SAT to do well.

4 High SAT Average Scores

Good track record necessary for any partnership efforts with the education board.

5 Located near Coastal States

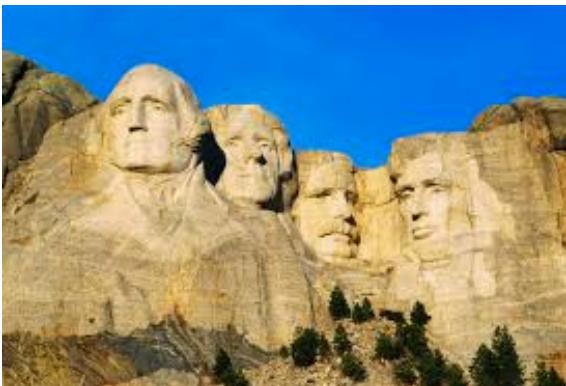
Optional: SAT is very popular amongst coastal states. Hence influence to take the SAT is strong.



Recommendations

Suggest to focus our efforts in increasing SAT participation rates in **South Dakota**

SOUTH DAKOTA



- ① No SAT/ ACT mandatory testing**
With voluntary participation, it would be easier to build a relationship with the education board for future collaborations.
- ② Culture of taking college entrance examinations**
Astounding participation rate of 77% in the ACT exam despite not having mandatory testing.
- ③ Higher-than-average ACT scores**
Despite high ACT participation rate, students perform higher than national average across all ACT subjects. This indicates student's competency and exam-readiness.
- ④ Ranked 10th for SAT scores**
Exceptional track record helps in building a business case with the education board for partnership opportunities
- ⑤ Midwestern State**
Located near Illinois and the East Coast states, popularity of the SAT might gradually spread to the Midwest.

Recommendations

How can we increase SAT take-up rate?

Increased Marketing Efforts



- Marketing Campaigns to increase awareness of SAT
- Highlight SAT's key selling points

Free Testing / Subsidies



- To negotiate for state-wide contracts
- Subsidies for SAT exams

Increased Convenience for Students



- Weekday testing
- Collaboration with schools to align syllabus

Increased Resources



- More online resources for students
- Practice SAT exams
- Free online tutoring

Further Research Materials

What additional data do we need for deeper and more insightful research?

1. Socioeconomic indicators for each state:

- High school graduate (%) and College graduates (%)
- Household Income

2. At least 5 years worth of data

3. Student-level data

- Test taken + Test Results
- College admitted

4. City/District-level participation rate for each test