# Comparing State SAT Scores Using a Mixture Modeling Approach

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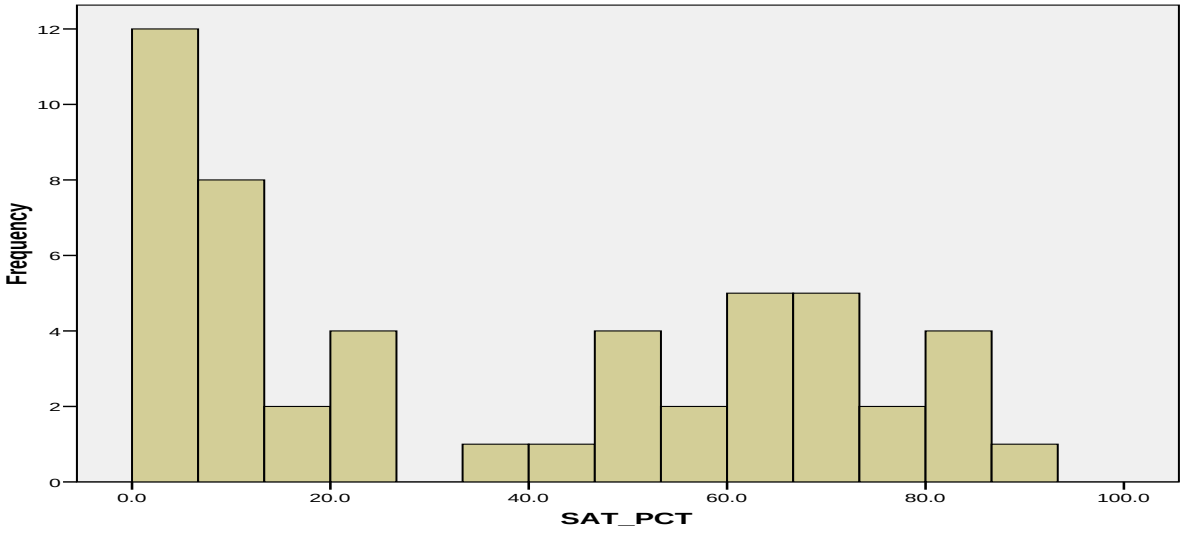
# Introduction

- Difficulty exists in comparing state-by-state SAT scores because of the problem of “self-selection”
- Group heterogeneity of the SAT population exists in terms of SAT participation and performance
- If subpopulations are identified, a state-by-state comparison of SAT scores within such populations can be appropriate






Note: Results are preliminary and analysis still in progress.

# Mixture Modeling

- Modeling with categorical latent variables that represent subpopulations
- Latent Class Analysis (LCA)
  - Model-based clustering method
  - Types of Indicators: Binary, Ordinal, Continuous
  - Using indicators, estimates the probability of being in each latent class and the conditional probability of observing the indicators given each class
  - Classifies individuals into classes based on posterior probability





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# LCA models and Indicators

- Model 1: SAT data only
  - Percentage of SAT takers for each of the 50 States + D.C
  - SAT scores on all three sections – Critical Reading, Mathematics and Writing – broken down by State
- Model 2: ACT data as additional indicators
  - Percentage of ACT takers for each of the 50 State + D.C
  - ACT Composite score by State
- Model 3: School-level Information
  - 2006 PSAT/NMSQT scores on all three sections – CR, M, W
  - Average score of the three SAT sections by school





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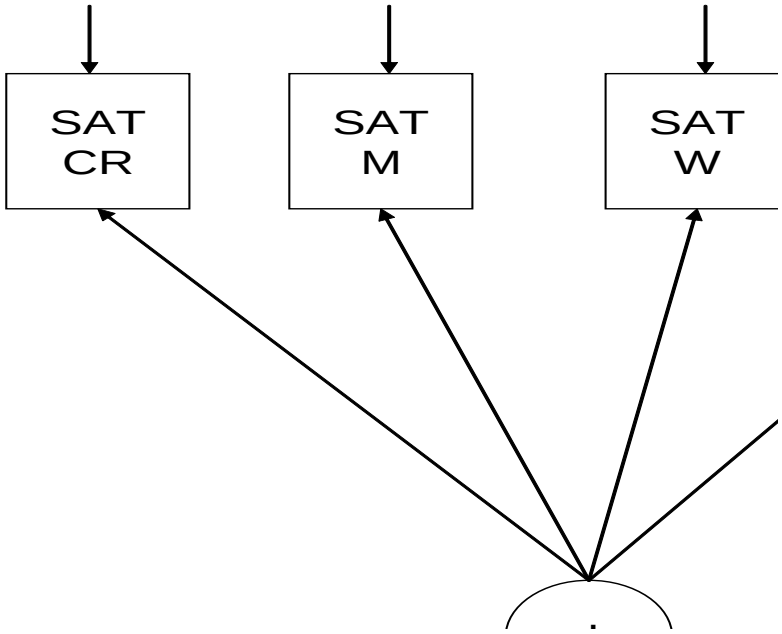
# Model 1 for Grouping States



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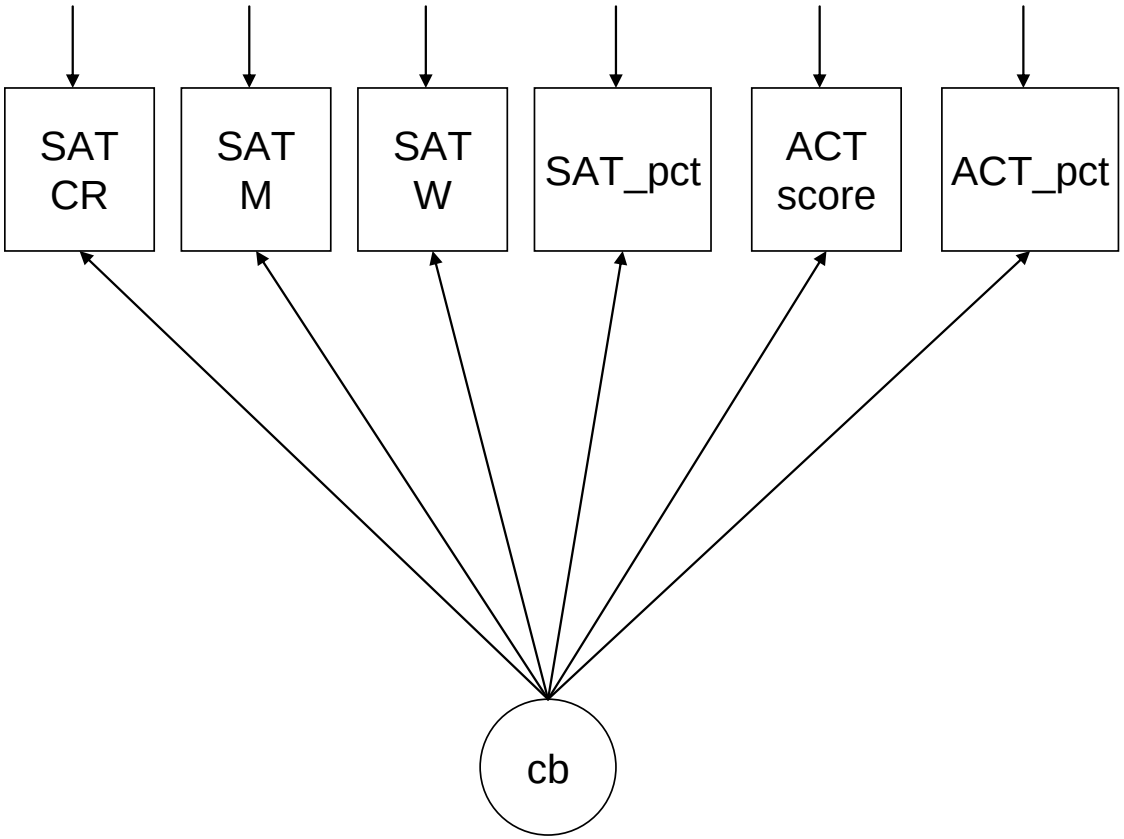
# Model 2 with Additional Indictors



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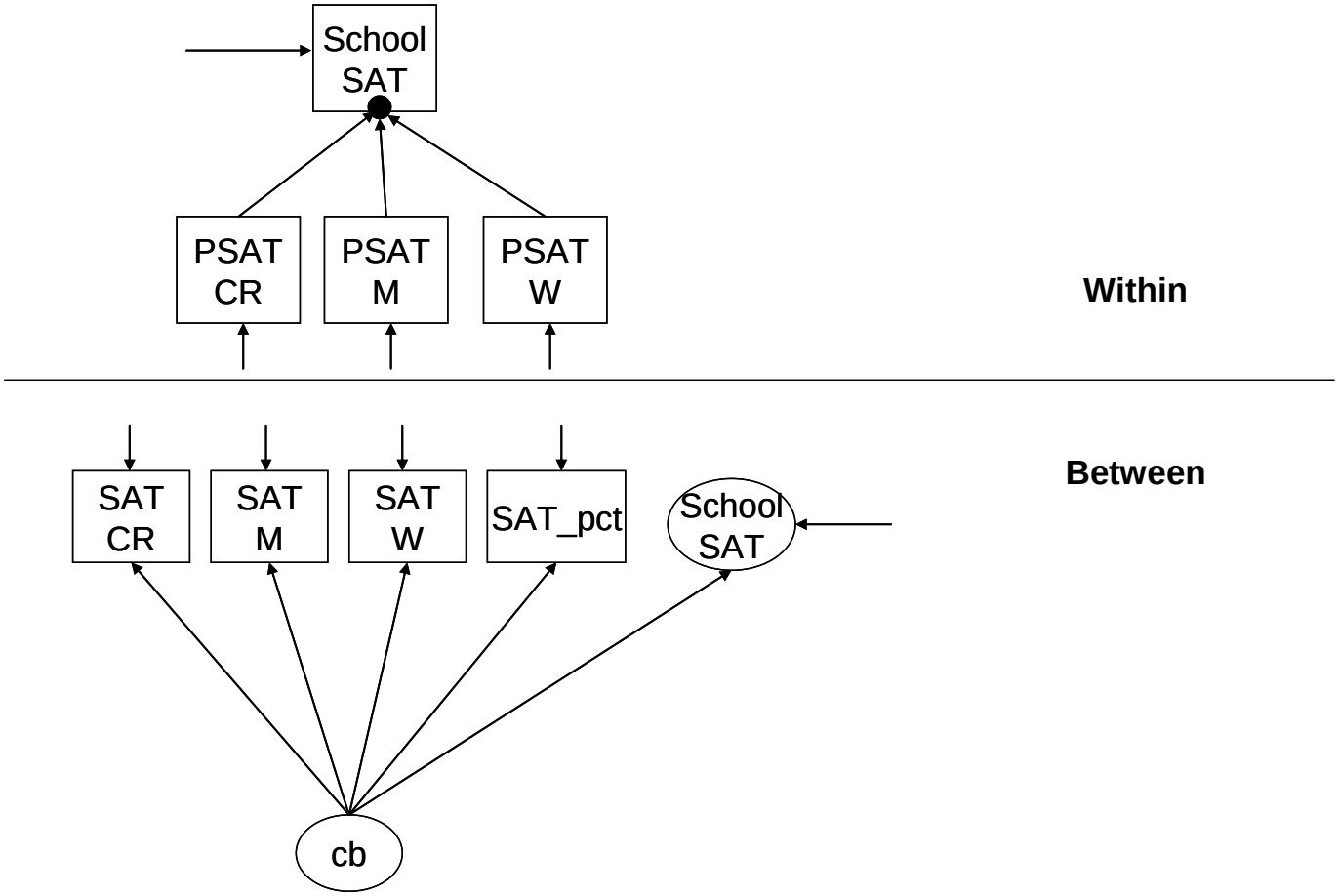
# Model 3 : Two-level Mixture Model






Note: Results are preliminary and analysis still in progress.

# Results of Model 1: Model Fit

**Results of LCA model 1 with SAT indicators only**

| Model | Log-likelihood | Num of Parameter | BIC | AIC |
|---|---|---|---|---|
| LCA 2C | -539.756 | 13 | 1130.626 | 1105.512 |
| LCA 3C | -513.615 | 18 | 1098.003 | 1063.231 |
| LCA 4C | -488.593 | 23 | 1067.618 | 1023.186 |
| LCA 4C Free var | -459.460 | 26 | 1021.148 | 970.921 |
| LCA 5C | -462.605 | 28 | 1035.301 | 981.210 |

*Note*. Free var: class-specific variance



Note: Results are preliminary and analysis still in progress.

# Results of Model 1: Estimates

**Estimated Class size, Performance and Participation by LCA model 1**

| | Estimated Class Size | SAT PCT | SAT CR | SAT M | SAT W |
|---|---|---|---|---|---|
| Class 1 | 0.33 | 65.70 | 49.07 | 49.82 | 48.19 |
| Class 2 | 0.22 | 8.39 | 56.69 | 56.43 | 55.38 |
| Class 3 | 0.26 | 48.57 | 52.17 | 52.54 | 50.81 |
| Class 4 | 0.19 | 5.30 | 58.95 | 59.96 | 57.47 |





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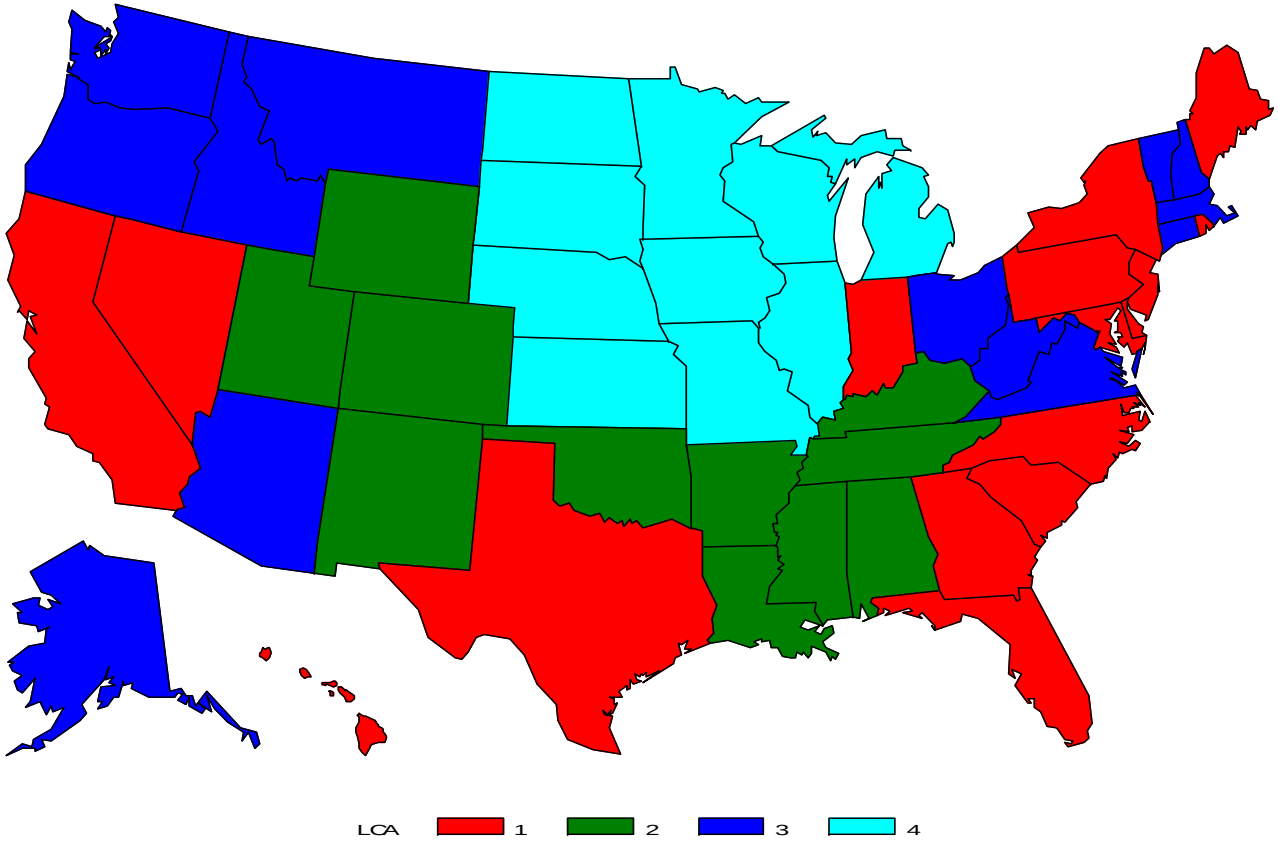
# Results of Model 1: Classification



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# Results of Model 2: Model Fit

**Results of LCA model 2 with SAT and ACT indicators**

| Model | Log-likelihood | Num of Parameter | BIC | AIC |
|---|---|---|---|---|
| LCA 2C | -815.968 | 19 | 1706.641 | 1669.937 |
| LCA 3C | -785.639 | 21 | 1673.505 | 1623.277 |
| LCA 4C | -764.583 | 33 | 1658.916 | 1595.165 |
| LCA 4C Free var | -732.629 | 39 | 1618.600 | 1543.259 |
| LCA 5C | -733.380 | 40 | 1624.032 | 1546.759 |

*Note*. Free var: class-specific variance





Note: Results are preliminary and analysis still in progress.

# Results of Model 2: Estimates

**Estimated class size, Performance and Participation by LCA model 2**

| | Estimated Class Size | SAT PCT | SAT CR | SAT M | SAT W | ACT PCT | ACT Composite |
|---|---|---|---|---|---|---|---|
| Class 1 | 0.34 | 65.63 | 49.09 | 49.84 | 48.21 | 23.17 | 21.51 |
| Class 2 | 0.22 | 8.40 | 56.69 | 56.42 | 55.38 | 79.27 | 20.57 |
| Class 3 | 0.25 | 48.38 | 52.20 | 52.56 | 50.82 | 32.86 | 22.15 |
| Class 4 | 0.20 | 5.31 | 58.94 | 59.95 | 57.46 | 76.70 | 21.69 |



Note: Results are preliminary and analysis still in progress.

# Results of Model 3: Model Fit

**Results of LCA model 3 with school indicators**

| Model | Log-likelihood | Num of Parameter | BIC | AIC |
|---|---|---|---|---|
| LCA 2C | -52136.345 | 20 | 104468.292 | 104312.691 |
| LCA 3C | -52107.681 | 26 | 104469.635 | 104267.353 |
| LCA 4C | -52077.305 | 32 | 104467.572 | 104218.610 |
| LCA 4C Free var | -52058.053 | 35 | 104458.408 | 104186.105 |
| LCA 5C | -52052.028 | 38 | 104475.699 | 104180.056 |

*Note*. Free var: class-specific variance





Note: Results are preliminary and analysis still in progress.

# Results of Model 3: Estimates

**Estimated class size, Performance and Participation by Two-Level Mixture Model**

| | Estimated Class Size | SAT PCT | SAT CR | SAT M | SAT W | School SAT intercept |
|---|---|---|---|---|---|---|
| Class 1 | 0.49 | 66.07 | 49.05 | 49.77 | 48.15 | 12.29 |
| Class 2 | 0.16 | 10.80 | 56.23 | 56.14 | 54.88 | 14.48 |
| Class 3 | 0.21 | 53.04 | 51.80 | 52.14 | 50.52 | 11.68 |
| Class 4 | 0.14 | 5.29 | 58.93 | 59.92 | 57.45 | 16.28 |





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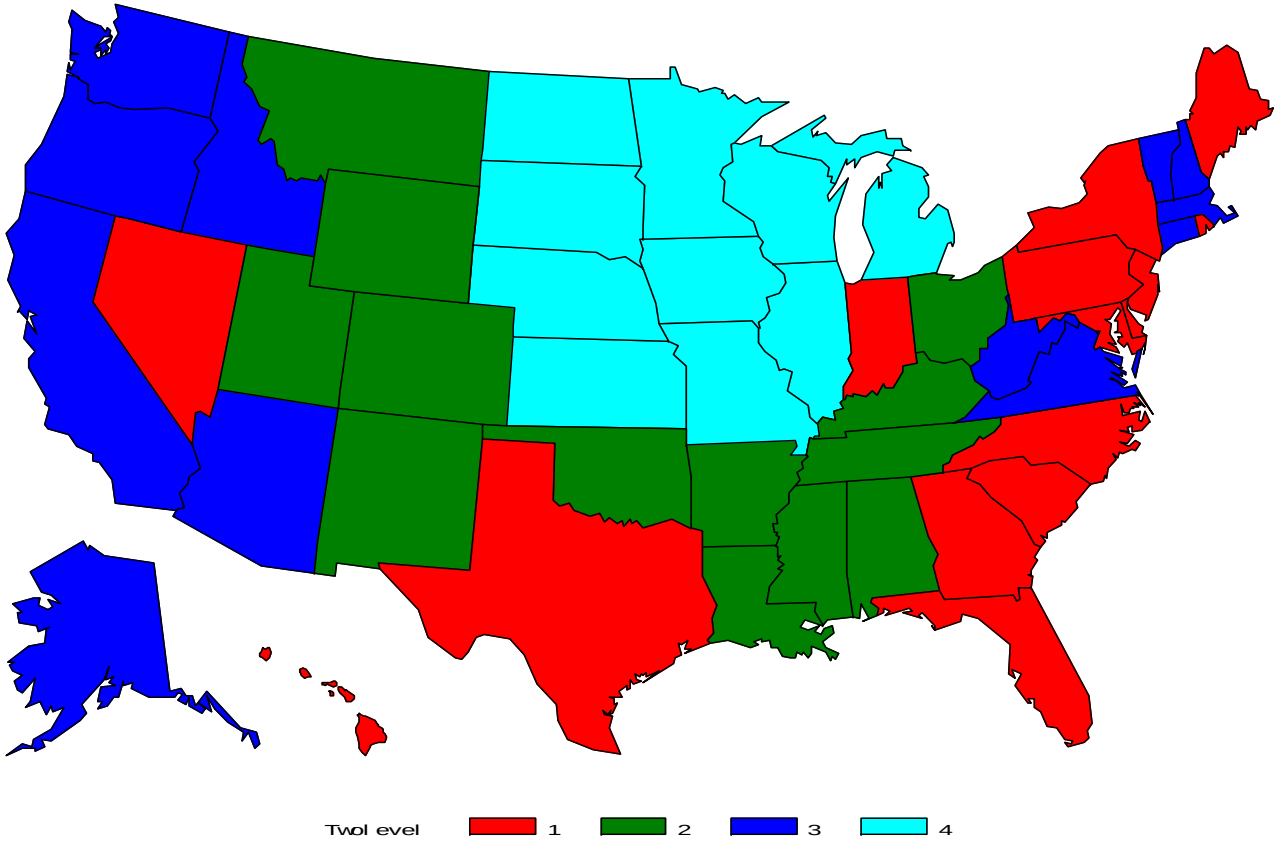
# Results of Model 3: Classification



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# Results of Model 3: Classification

- Changes from Model 1
  - CA: Class 1 to Class 3
  - OH and MT: Class 3 to Class 2
- Three States are borderline states
  - The combined SAT section scores for these states are the highest within each class in Model 1.
  - PSAT/NMSQT participation is relatively low compared to other states within each class in Model 1.





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# Discussion and Future Study

- Three models found four latent classes with similar compositions of SAT participation and performance for each latent class
- Used only limited indicators. Additional educational and demographic variables can be included.
- Extend the model to include distal outcomes such as high school dropout rates or first year College GPA and examine how the classification affects the distal outcome





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# Questions, Comments, Suggestions

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