# Exploring Achievement Gaps

Presentation to the Minnesota Assessment Group

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# Topics for Today

- Toward a theory of cognitive disparities and achievement gaps
- The role of school composition
- Examination of MN Student Achievement
  - School Composition
  - The role of Race
  - Variability in Achievement
- Preliminary results of modeling variability
  - Proportion of variance within v. between schools
  - Relative roles of race and SES
  - Potential role of social-emotional characteristics

Cottrell, J.M., Newman, D.A., & Roisman, G.I. (2015).

**Explaining the Black-White gap in cognitive test scores: Toward a theory of adverse impact.**

*Journal of Applied Psychology*, *100*(6), 1713-1736.

# Cognitive Test Score Gap

- Cognitive tests robustly predict job performance
- Cognitive tests also show large Black-White differences, an average Cohen's *d* (standardized mean difference) of 1.0
- This gap in cognitive tests is near 3 times as large as the gap in job performance itself
- Black-White gap has been studied since as least 1922
- No strong theoretical basis for the cognitive ability gap

Source: Cottrell (2015).

## Model C. 3-Step Model plus Verbal Socialization and Culturally-Specific Parenting

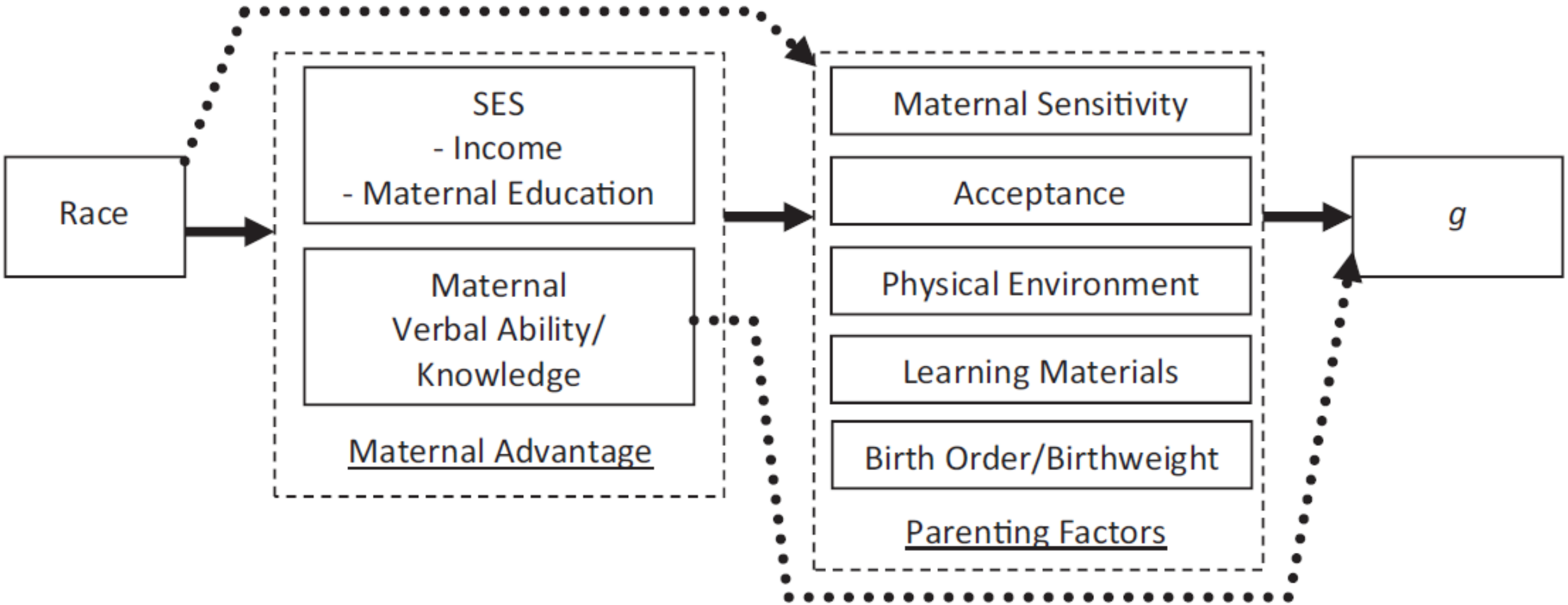



*Figure 1.* Theoretical models of the race/cognitive-test-score relationship.

Source: Cottrell (2015).

# Race

- Race may have its origins in biologically based human characteristics (phenotype), but racial categories are subjectively created, reflecting cultural experiences and identity and sociopolitical history.
- Slavery from 1600s to 1865 → legalized education and employment segregation until 1964 → farm worker and hospitality worker rights and wage protection more recently.
- Concept of race implies a history of housing segregation, education segregation, and occupational segregation.
  - occupational segregation ~ income disparities
  - education segregation ~ disparities in maternal education and verbal abilities
  - housing segregation ~ educational & occupational disparities

Source: Cottrell (2015).

# Study Methods

- Study of Early Child Care and Youth Development (2005, National Institute of Child Health and Human Development)
- 54 months, 1st grade, 3rd grade, 5th grade, 15 years old
- Woodcock Johnson Battery-Revised + Family interviews/observations
- Structural Equation Model – Latent Growth Models

Source: Cottrell (2015).

# Findings

- Large race gaps in cognitive ability exist at every age

  Initially established by 54 months of age

  *d* ranged from -1.24 to -1.39
- Race was not related to growth over time
- After adding the explanatory variables, the race difference was no longer statistically significant
- The 3-step model fit well across ages, where maternal sensitivity might slightly decrease in importance and maternal verbal ability might slightly increase in important with the onset of schooling.
- Accounted for 84% of the total race gap in cognitive test scores.

Source: Cottrell (2015).

# Model Results

| Factor | Percent of Race Gap Explained |
|---|---|
| Maternal Sensitivity | 25% |
| Maternal Acceptance | 3% |
| Physical Environment | 5% |
| Learning Materials | 7% |
| Birth Order | 5% |
| Birth Weight | 2% |
| Maternal Verbal Ability | 34% |
| Income | 1% |
| Maternal Education | 3% |

Source: Cottrell (2015).

# Summary

- Race results in differences in maternal (family) advantage factors
  - Income
  - Maternal education and verbal ability
- Maternal advantage results in differences in parenting factors
  - Maternal sensitivity, acceptance
  - Physical environment, learning materials
  - Birth weight, birth order
- Parenting factors promote cognitive ability in children

→ Black-White differences in developmental conditions are strongly associated with disparities in cognitive abilities

Source: Cottrell (2015).

# Implications

- Important implications for personnel selection
- Implications in the ways test materials are presented, particularly regarding the sensitivity of items and extent to which they are race-loaded
- Some aspects of tests may “unintentionally assess aspects of socially privileged life experiences, including familiarity with testing styles and situations” (p. 12).

Source: Cottrell (2015).

Bohrnstedt, G., Kitmitto, S., Ogut, B., Sherman, D., & Chan, D. (2015).

***School Composition and the Black–White Achievement Gap*** (NCES 2015-018).

U.S. Department of Education, Washington, DC: National Center for Education Statistics.

Retrieved from http://nces.ed.gov/pubsearch.

# The Role of Black Student Density in Schools

Prior research identified relation between **%Black in a school** and

- disparities in distribution of academic supports (e.g., experienced teachers)
- Higher proportions of families from low-SES backgrounds, with parents of lower education levels
- Possibility of peer effects creating an oppositional culture
- Lower expectations for student performance
- Increase in disciplinary reports

Source: Bohrnstedt, 2015.

# School Composition

- On average, White students attend schools that are 9% Black, whereas Black students attend schools that are 48% Black.
- Schools with greater than 60% Black students tend to be located in urban areas and in the South and the Midwest.
- Achievement is lower for Black and White students in the highest Black density schools; the achievement gap was not different.

Source: Bohrnstedt, 2015.

# AG & School Composition

Created model accounting for student, teacher, and school contexts

| Student | Teacher | School |
|---|---|---|
| • Race<br>• Gender<br>• Special Ed status<br>• SES variables<br>Parent ed, FRL, more than 25 books @ home | • Education level<br>• Major in math<br>• Teaching practices:<br>Differentiation<br>Homework use | • Proportion of students in school:<br>Spec Ed<br>Male<br>FRL<br>Parent higher ed<br>More than 25 books @ home |

# AG & School Composition

**After accounting for SES and student, teacher, school characteristics:**

- White student achievement in the highest Black-density schools was not different than White student achievement in the lowest density schools.
- Black student achievement was still lower in the highest density schools than the lowest density schools.
- Black-White achievement gap was larger in the highest density schools for males but not for females.
- The size of achievement gaps within each category of Black student density was smaller when accounting for SES and other characteristics.

Source: Bohrnstedt, 2015.

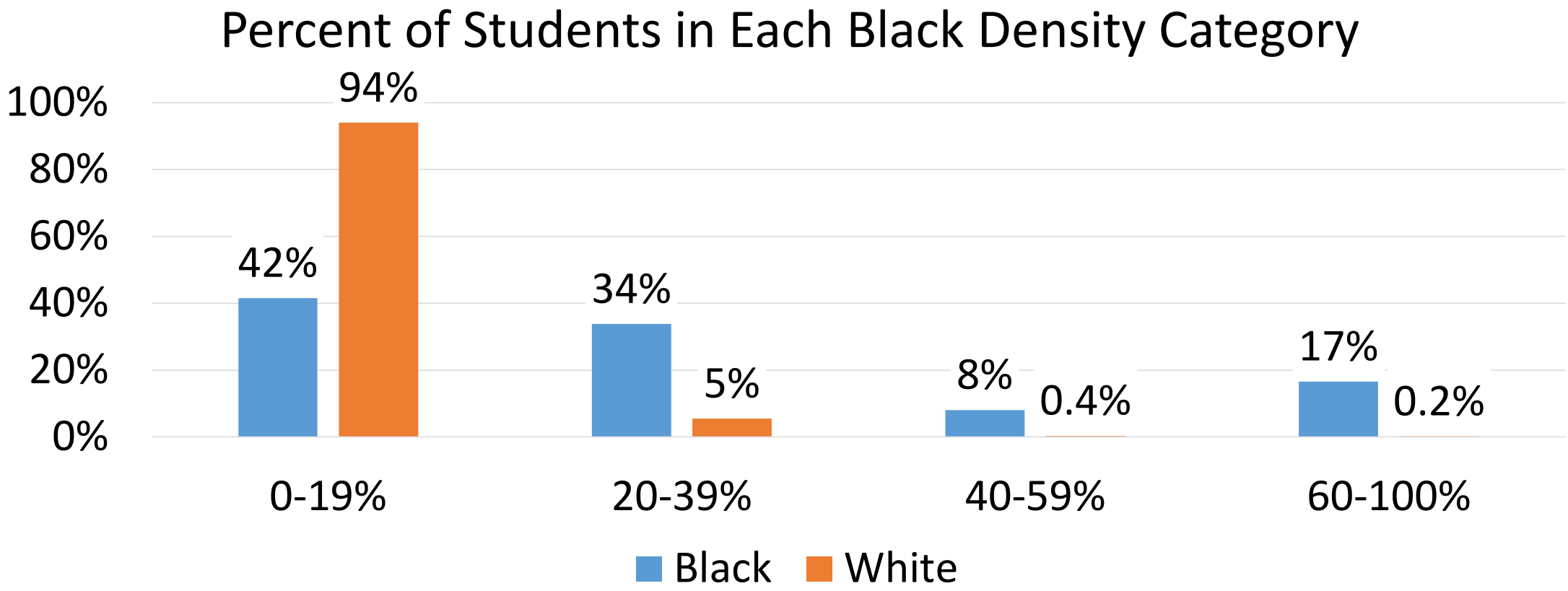
# MN Replication

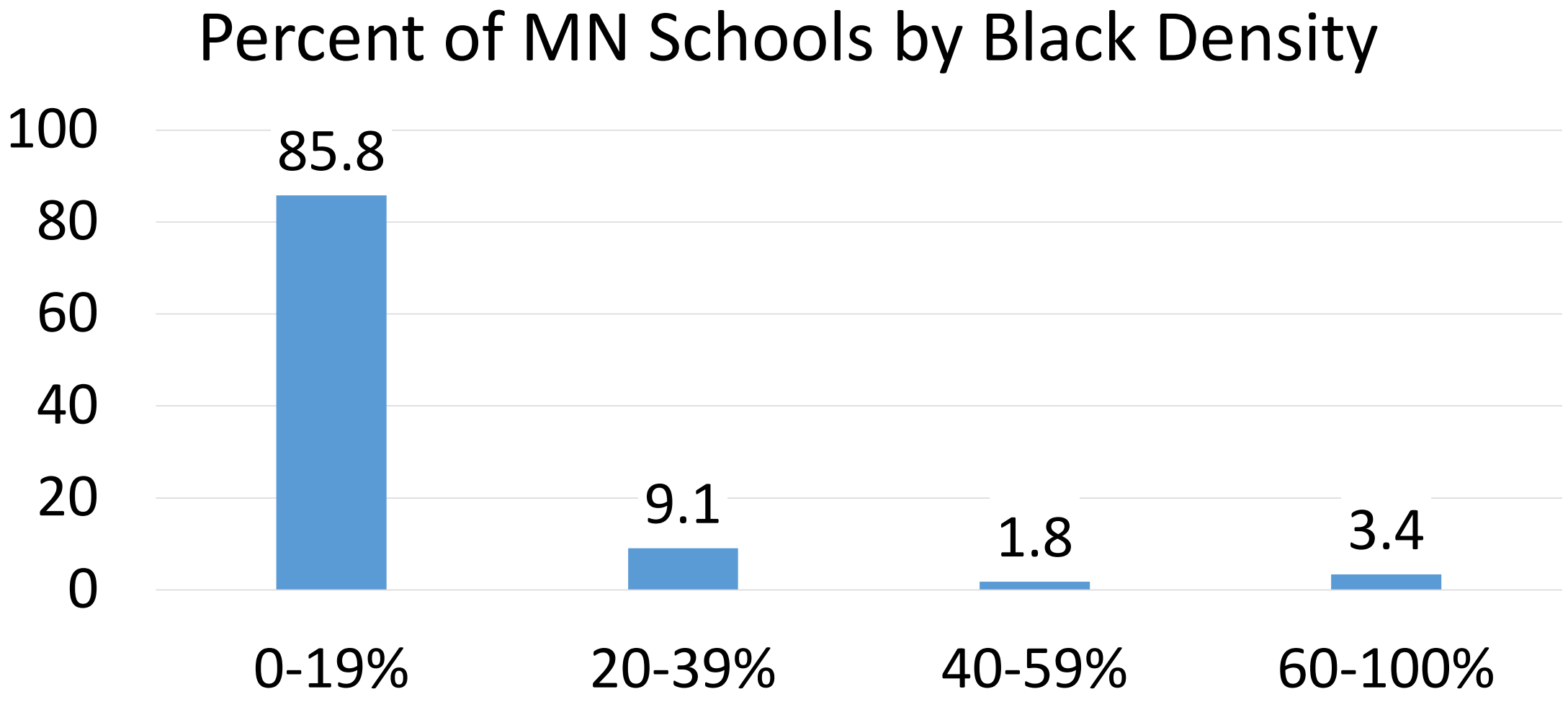
- Describe and explore the role of student of color *density* and school composition more generally
- Explore the association between school composition and achievement and achievement gaps
- Account for student characteristics and school characteristics and potential gender differences
- Explore the extent to which achievement gaps can be attributed to within-school versus between-school differences

Implications for equitable distribution of key education resources across schools or to focus equitable use of resources within specific schools to reduce achievement gaps.

# MN School Composition

- On average, White students attend schools that are 5% Black, whereas Black students attend schools that are 30% Black.




Percent of MN Schools by Black Density
100
80
60
40
20
0
85.8
9.1
1.8
3.4
0-19%
20-39%
40-59%
60-100%

# MN School Location & Black Density

| School Location | Black Density | | | | |
|---|---|---|---|---|---|
| | 0-19% | 20-39% | 40-59% | 60-100% | Total |
| Cities | 49% | 30% | 6% | 15% | 314 |
| Suburban | 83% | 13% | 2% | 2% | 407 |
| Rural | >99% | <1% | | | 902 |
| Total | 86% | 9% | 2% | 3% | 1623 |

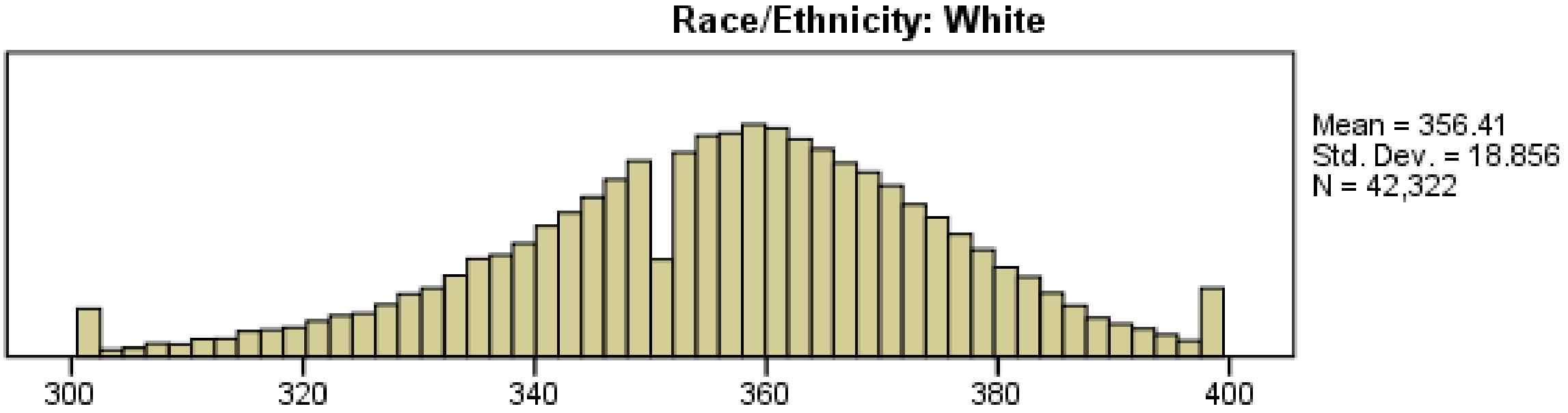
# The Role of Race in MCA Scores

- 2014 MCA Scores
- MARSS Student Characteristics
  - Gender, LEP, Special Ed, Race/Ethnicity, FRL, Title I
- NCES School Characteristics
  - School Type, %FRL, %SPED, Title I, Diversity, Location
- MSS Data (2013, Grades 5, 8, high school [9/11])
  - Commitment to Learning, Positive Identity, Empowerment
  - Family/Community Support, Teacher/School Support, Social Competence
  - Afterschool Activity Participation, Attendance, Mobility

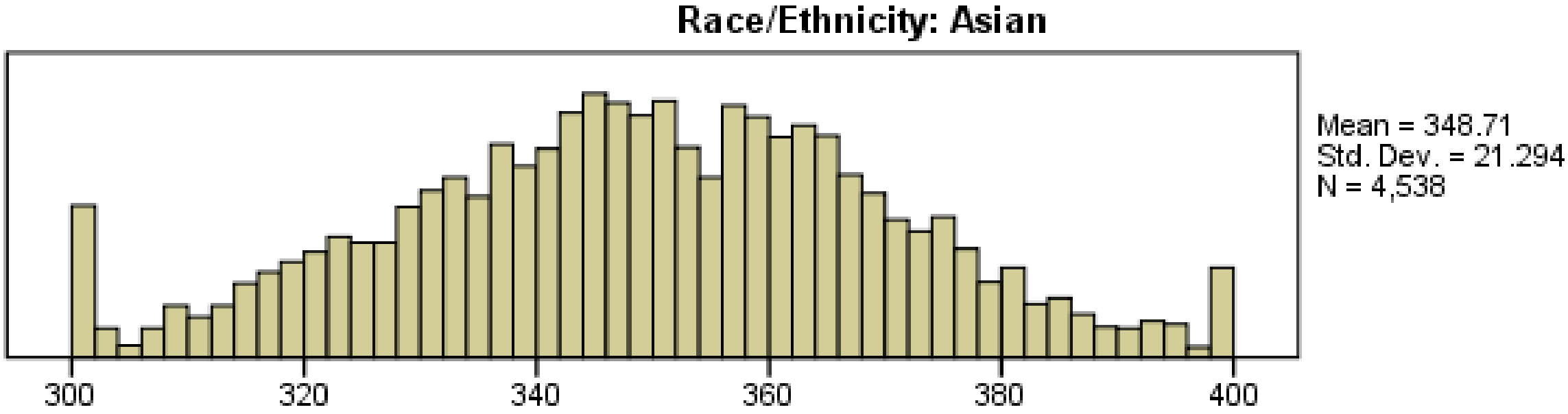
# MN MCA Exploration

- How much variation in student achievement is within versus between schools?
- How much variation is a function of student characteristics?
  - To what extent are factors like race, SES, LEP, or gender explaining variation?
  - Do student characteristics function the same way across schools?
- How much variation is a function of school characteristics?
  - How much does school composition matter?
  - Are there malleable school factors that explain variation in achievement?

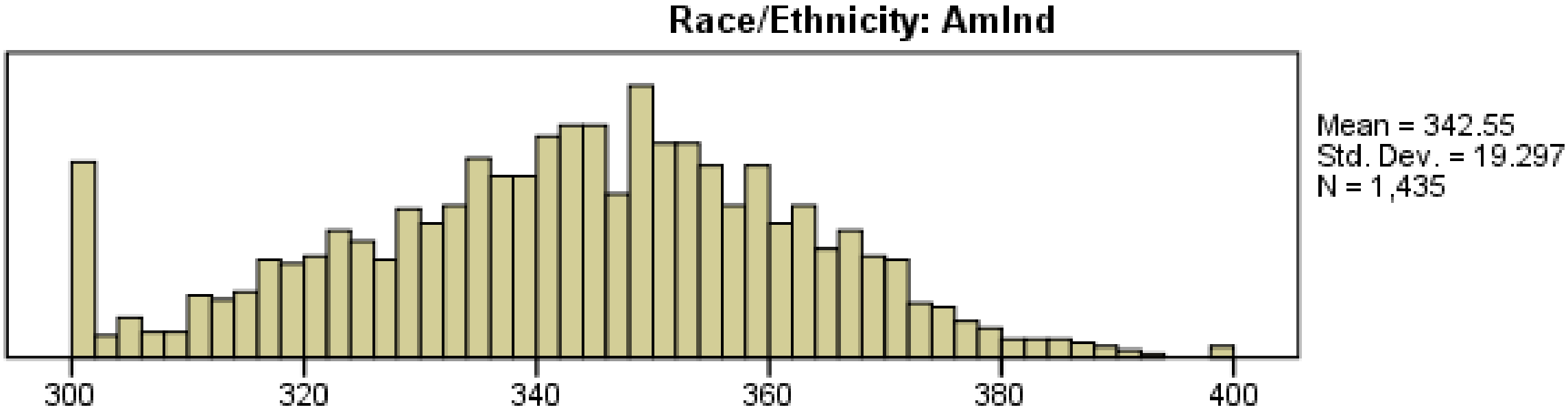
# 2014 MCA Grade 3 Reading - White



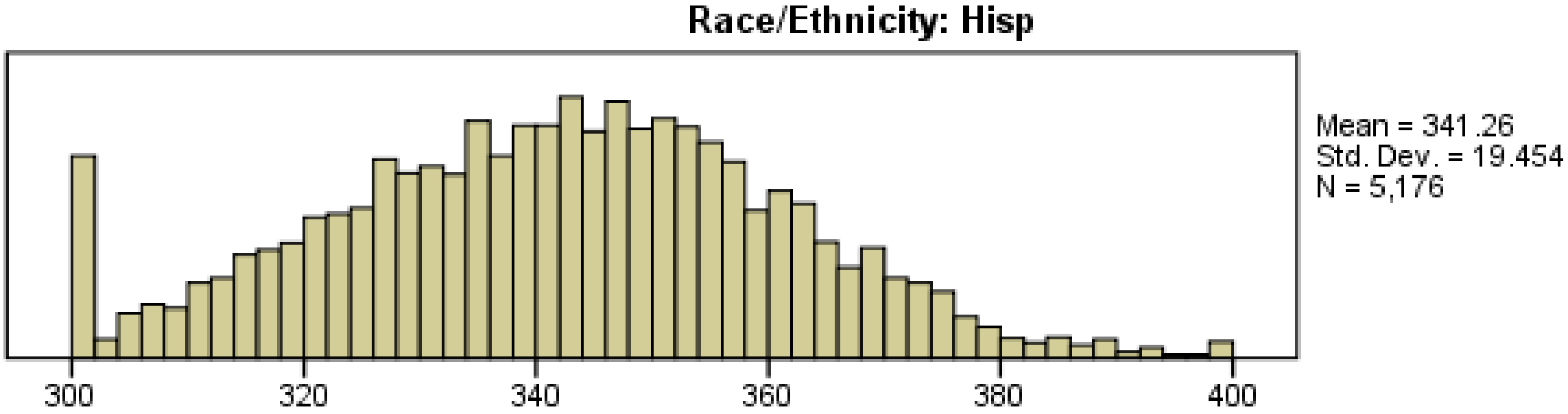
# 2014 MCA Grade 3 Reading - Asian



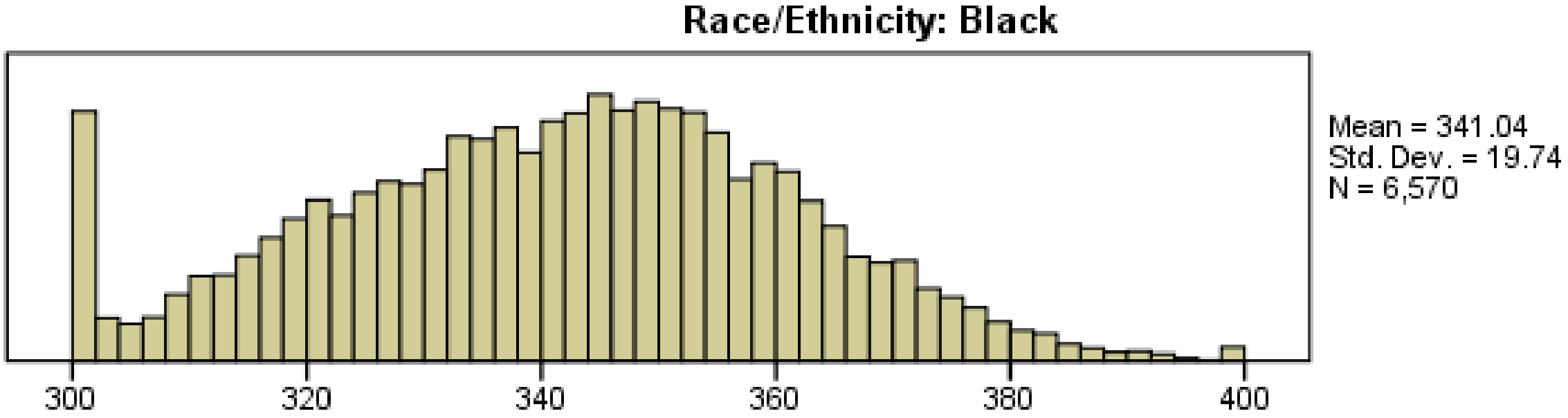
# 2014 MCA Grade 3 Reading - American Indian



# 2014 MCA Grade 3 Reading - Latino/Hispanic

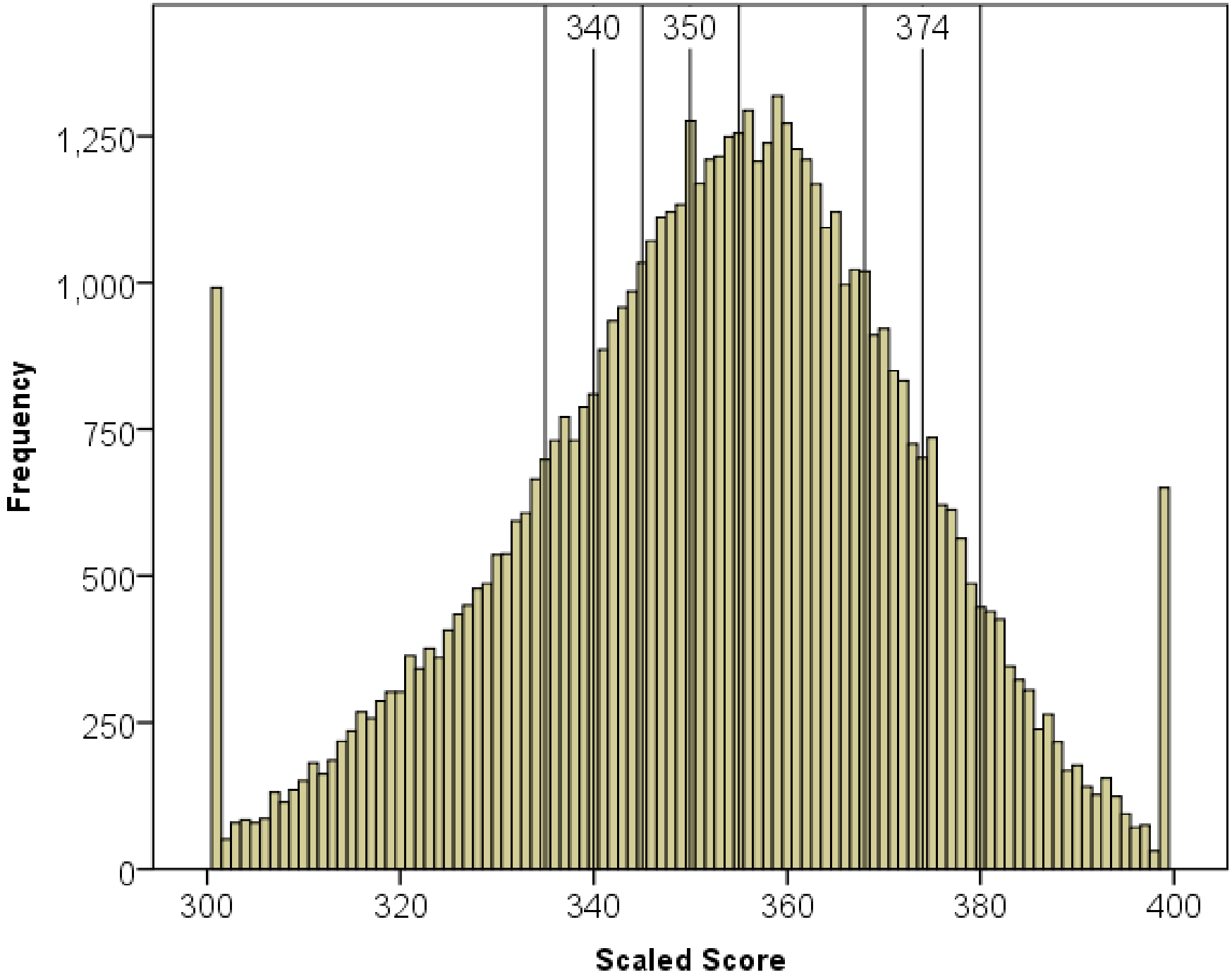


# 2014 MCA Grade 3 Reading - Black



# Displaying Variability and Precision

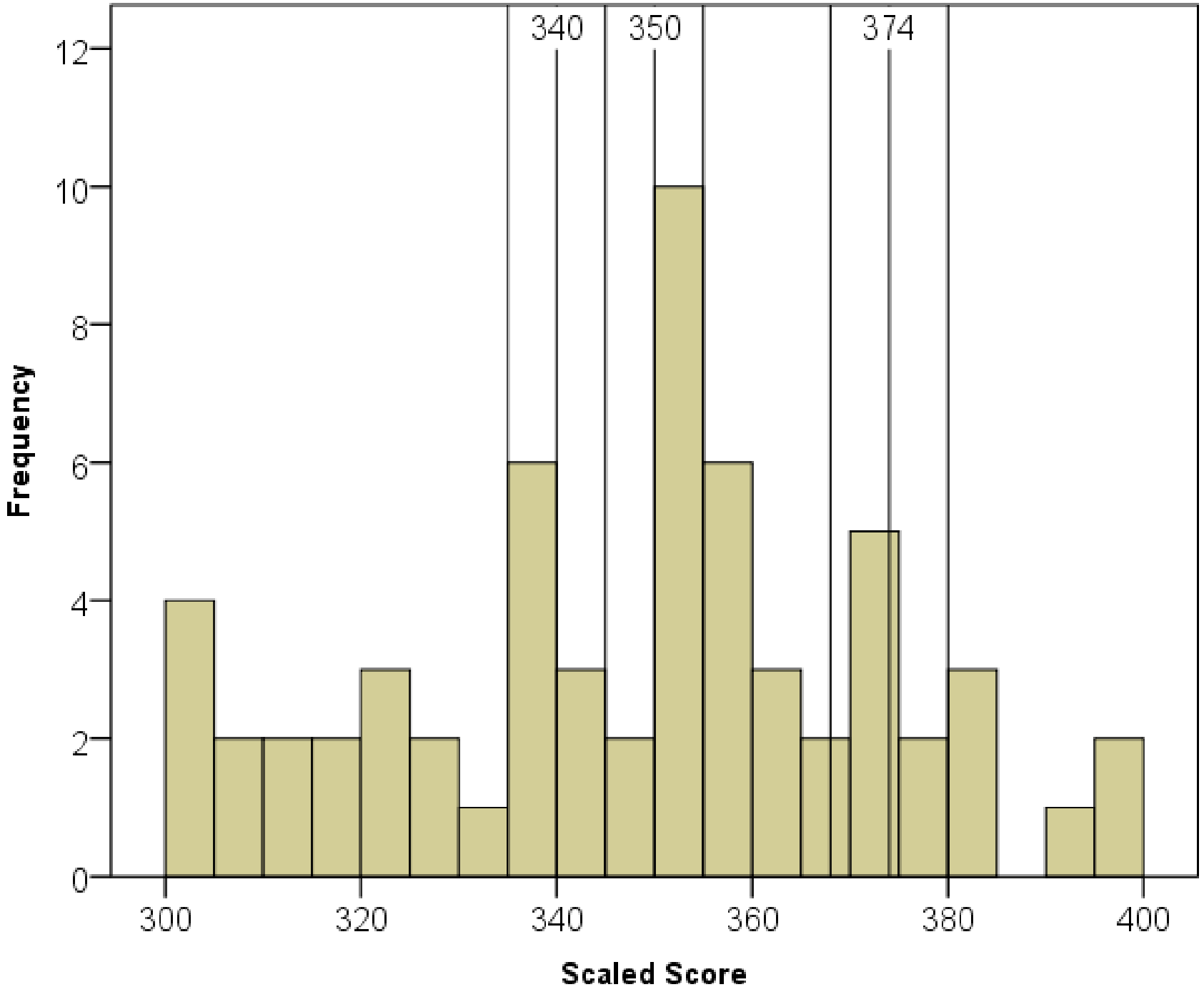
- The mean score or percent proficient is not informative when there is substantial variation in scores
- Some schools and districts have much greater variability in achievement than others; some have much less variability




Statewide
Reading
Grade 3

*N* = 60,041
*M* = 353
*SD* = 20

± 1 SEM



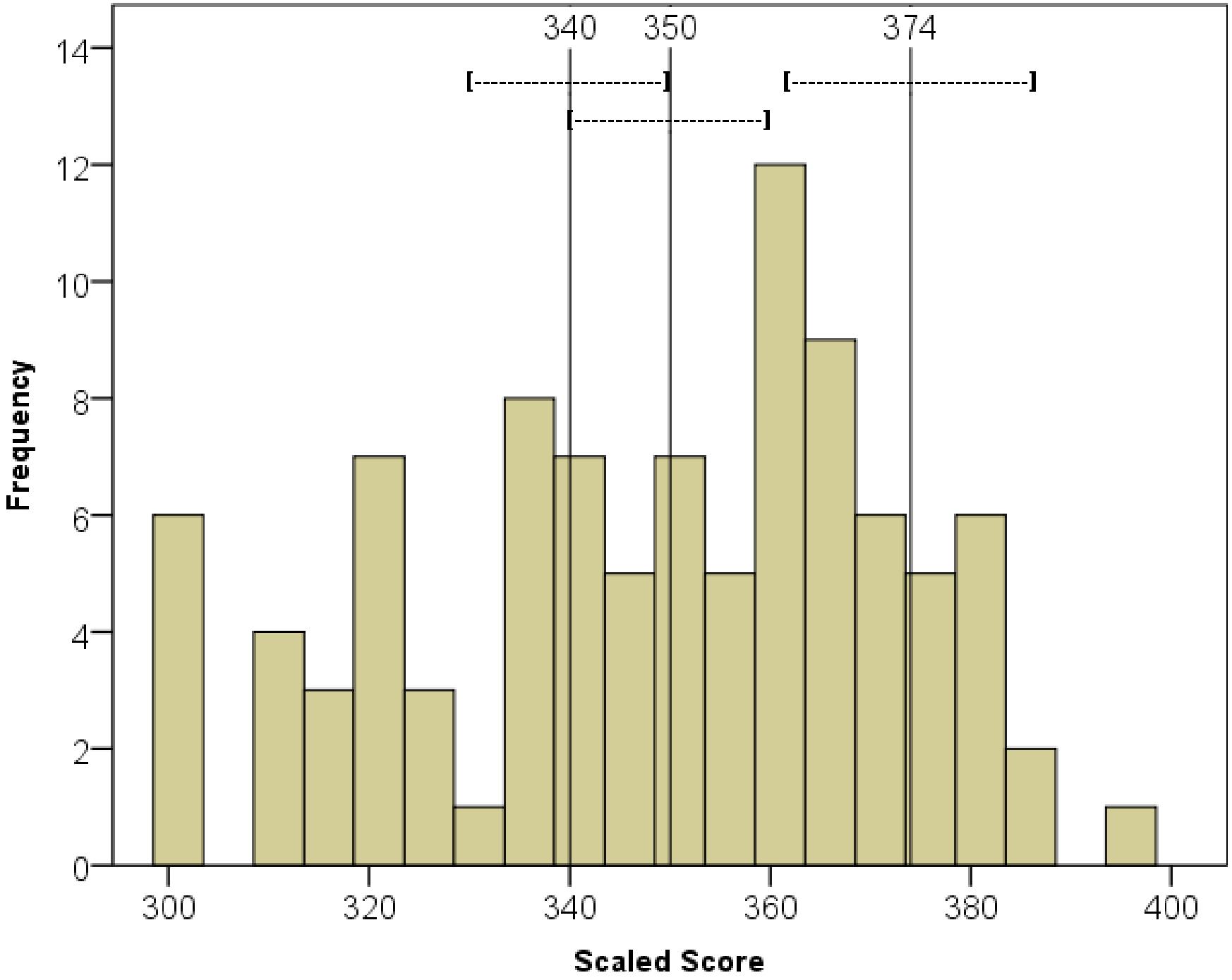

# Hypothetical School A Reading Grade 3

*N* = 61

*M* = 348

*SD* = 25

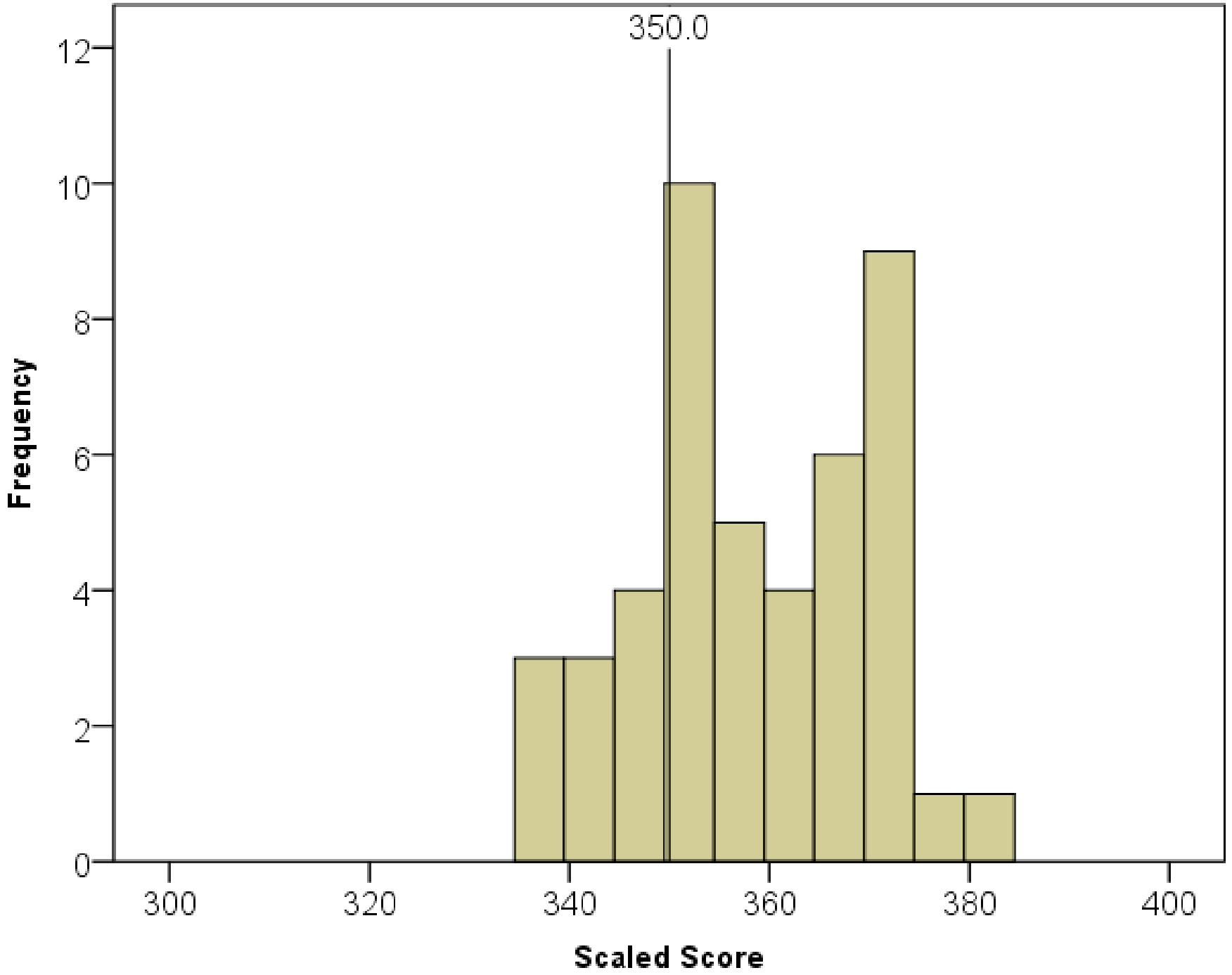
± 1 SEM




Hypothetical
School B
Reading
Grade 3

$N = 100$
$M = 350$
$SD = 25$

95% CIs

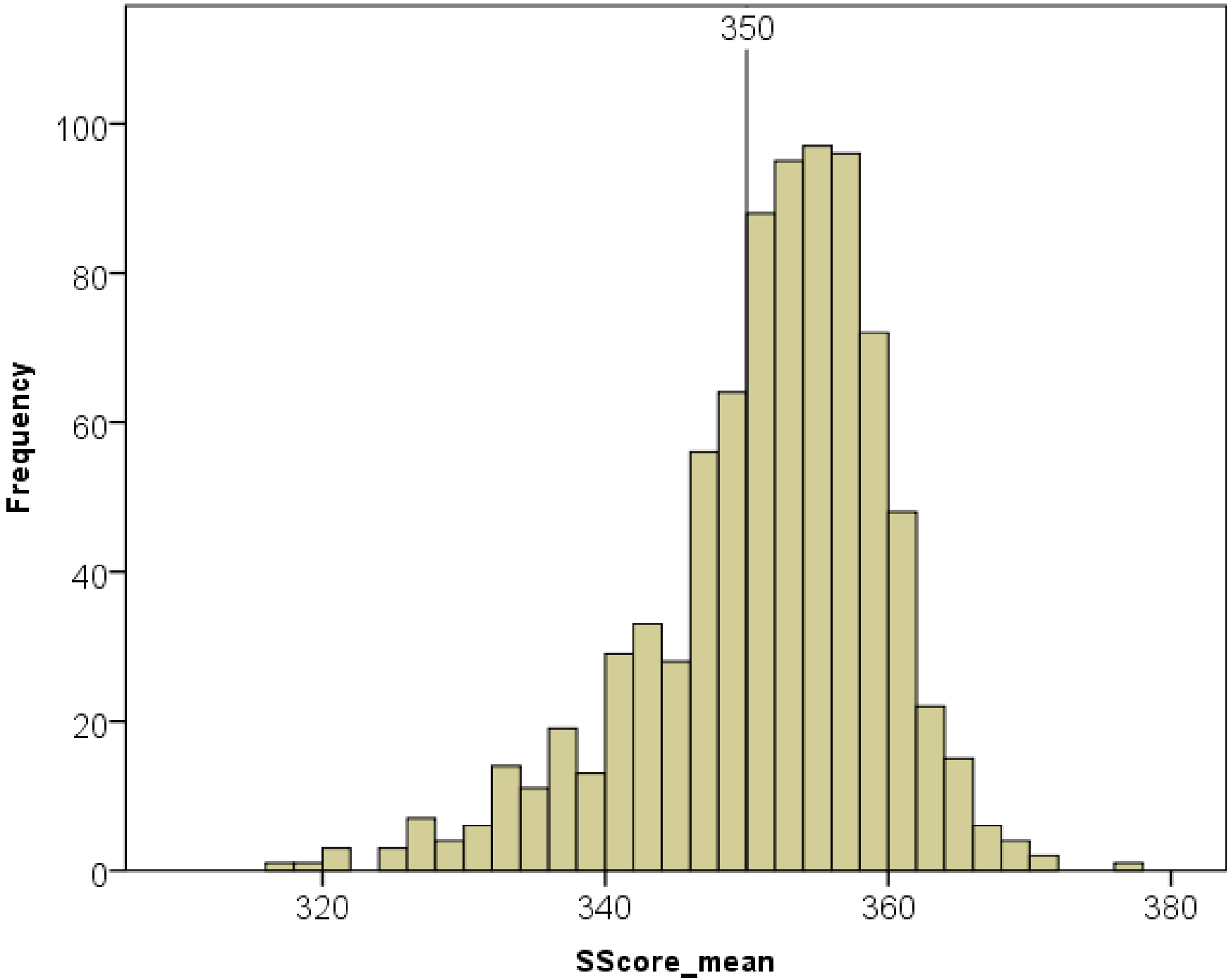



Hypothetical School C Reading Grade 3

$N = 46$

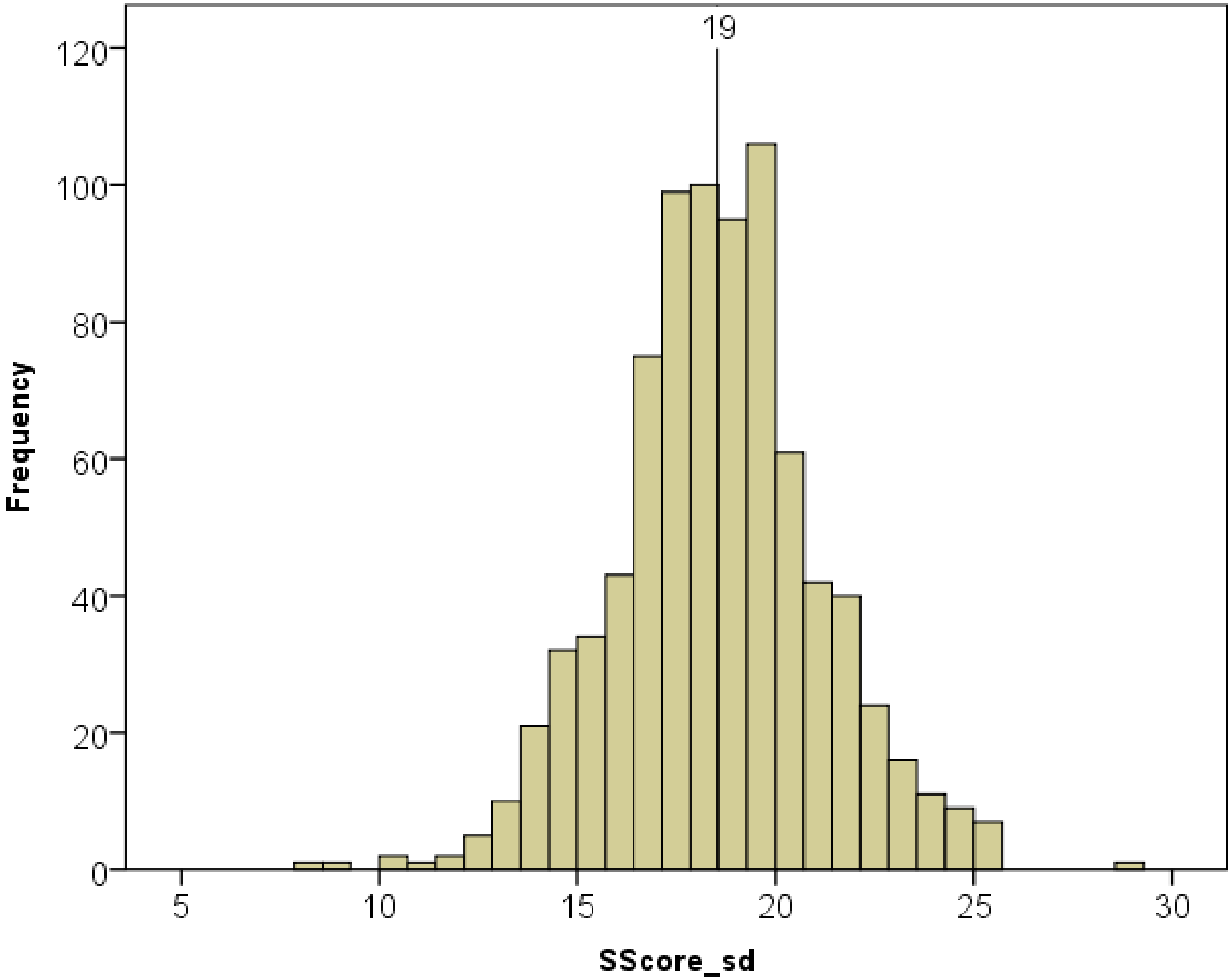
$M = 358$

$SD = 12$



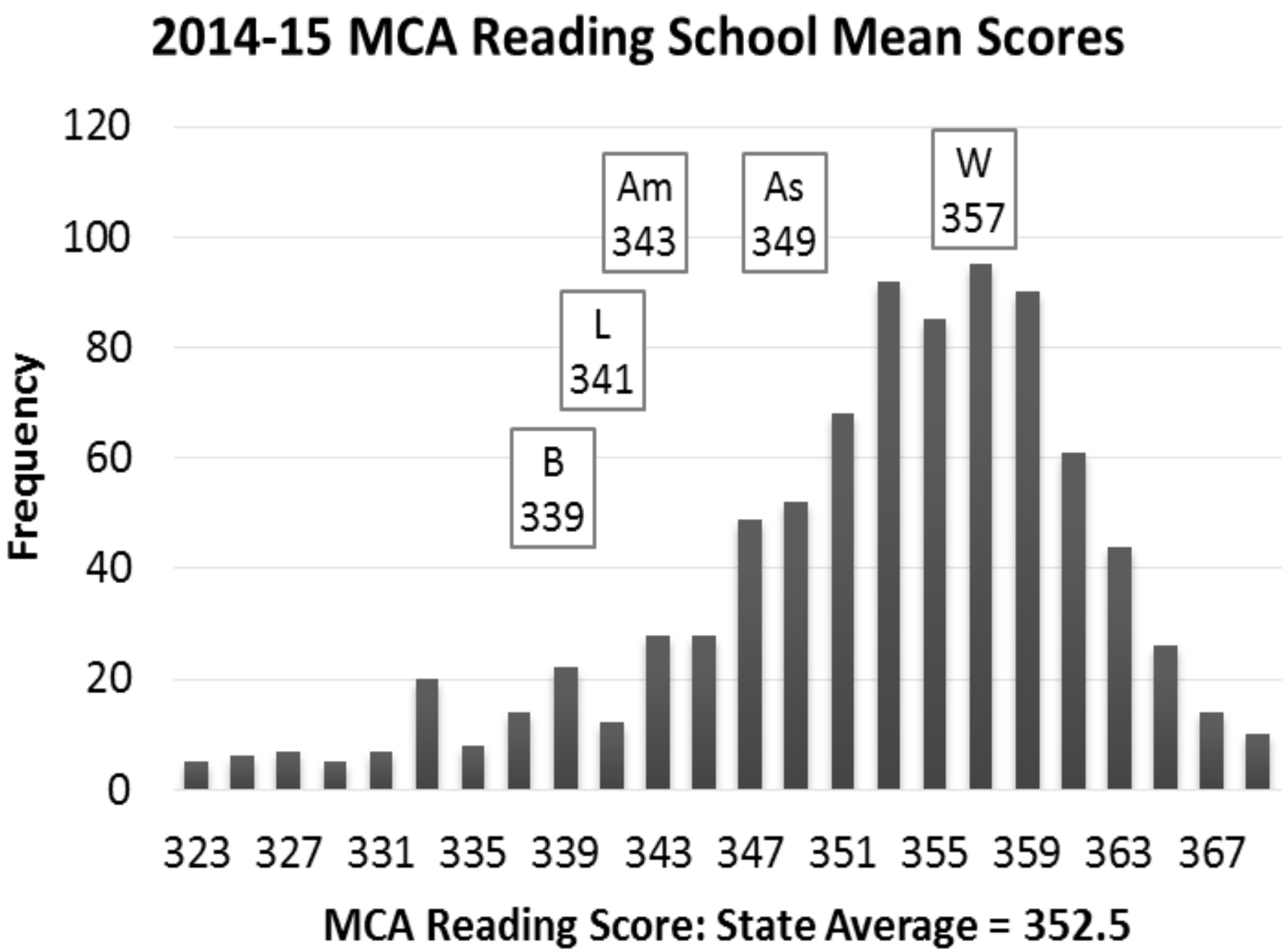

Reading
Grade 3

School Means
where $n \geq 10$

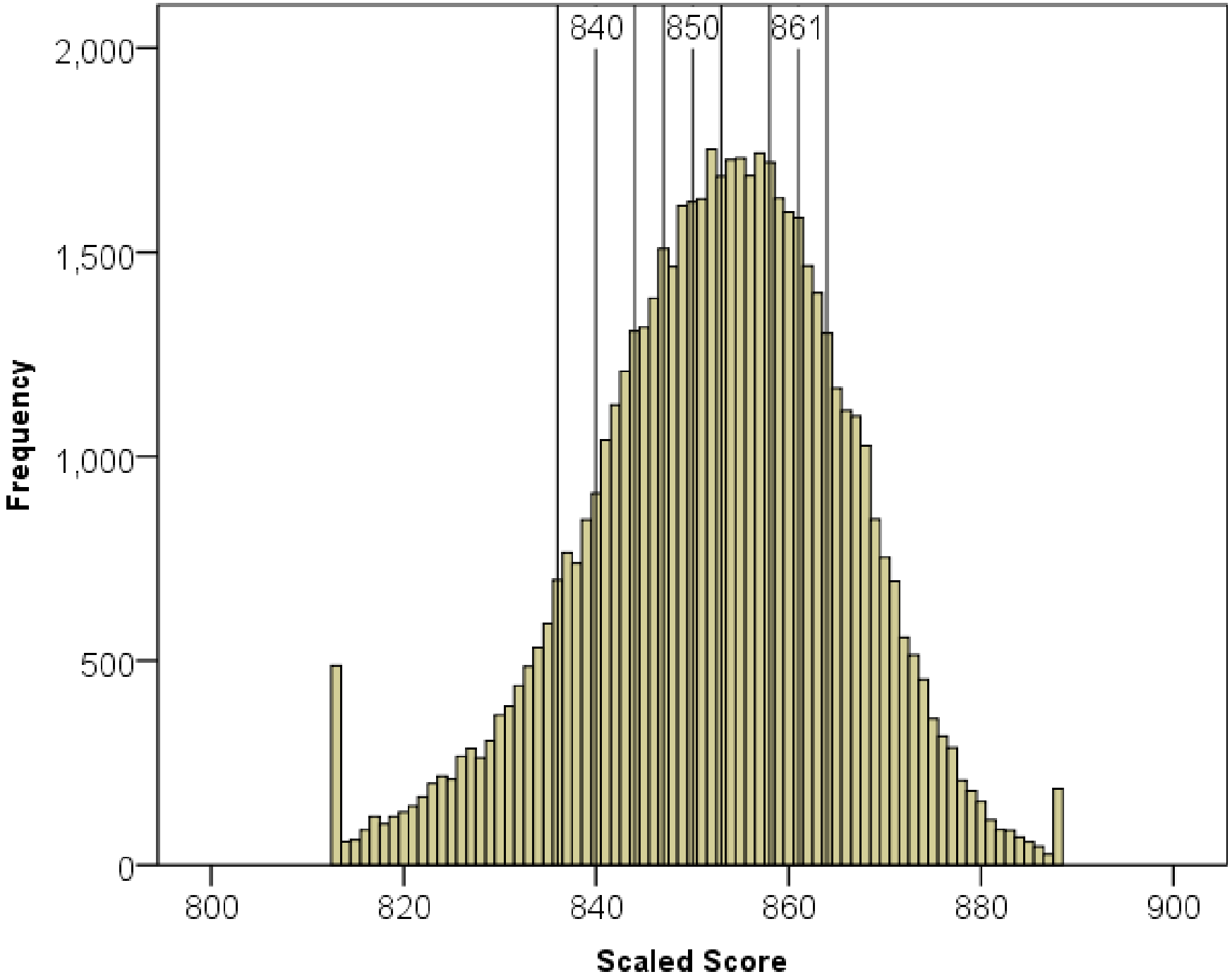



Reading
Grade 3

School SDs
where $n \geq 10$




# 2015 READING School Means & Race/ Ethnicity Means



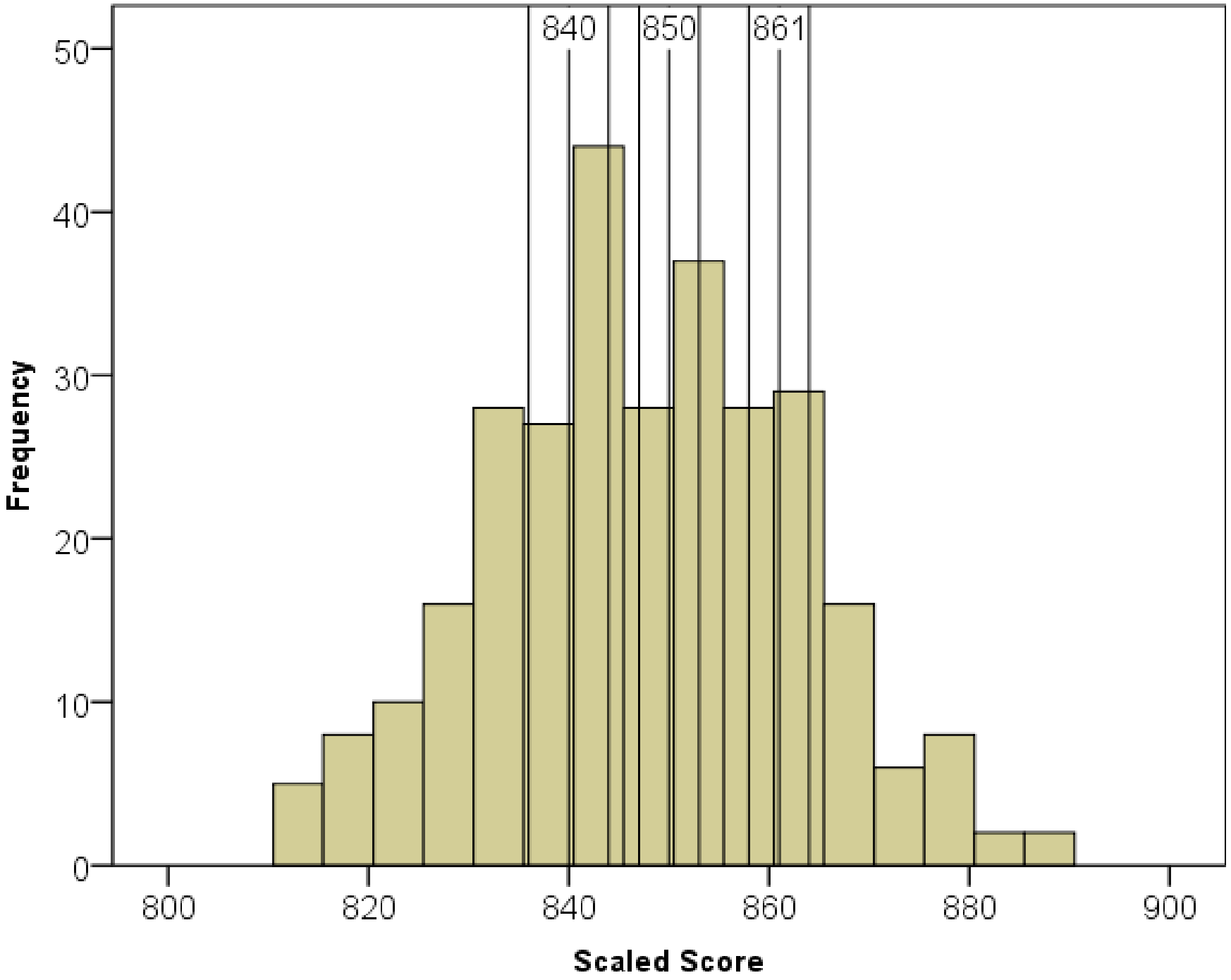

# Statewide Mathematics Grade 8

*N* = 56,627

*M* = 852

*SD* = 14

± 1 SEM



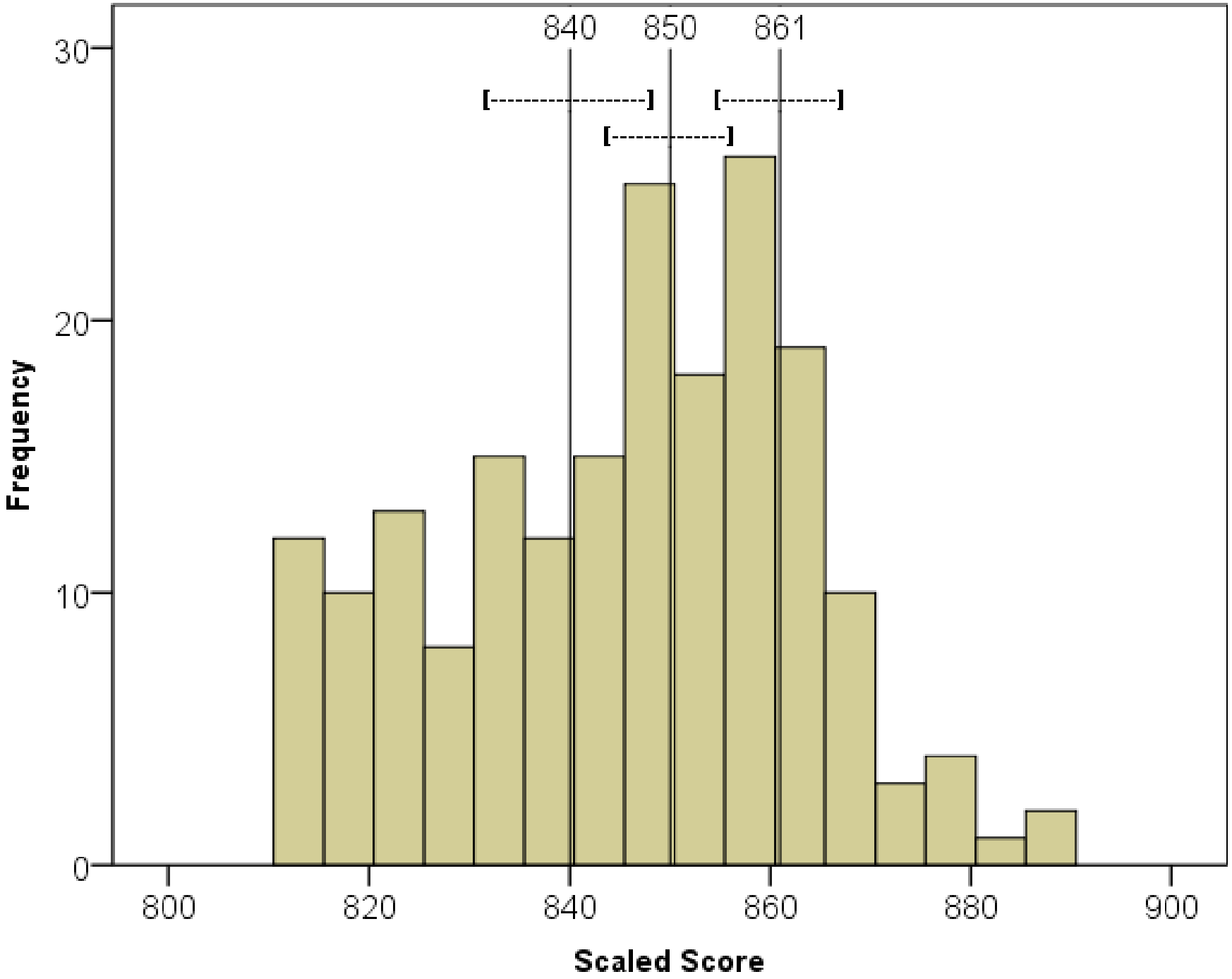

# Hypothetical School D Mathematics Grade 8

*N* = 294

*M* = 847

*SD* = 15

± 1 SEM



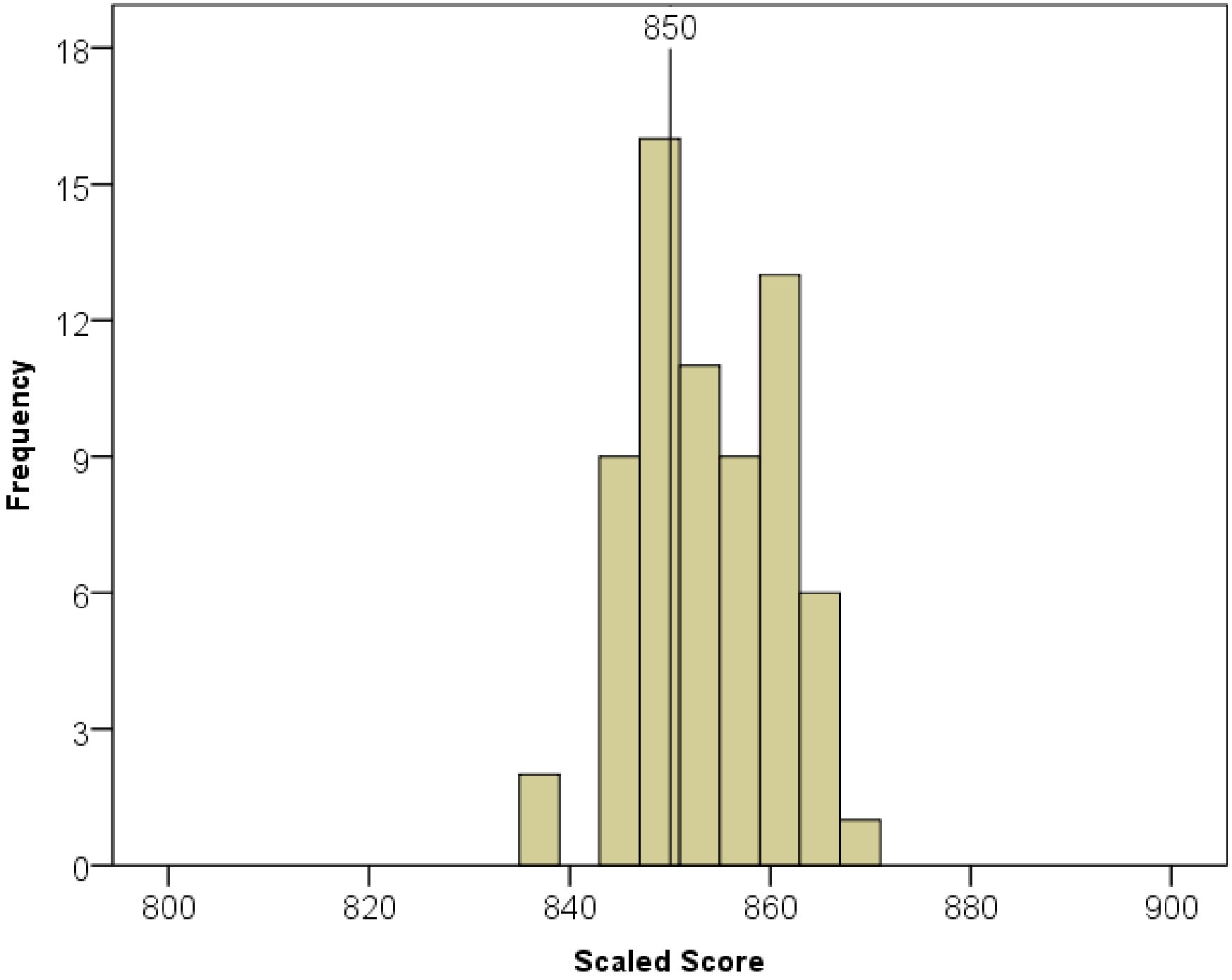

# Hypothetical School E Mathematics Grade 8

*N* = 193

*M* = 846

*SD* = 18

95% CIs

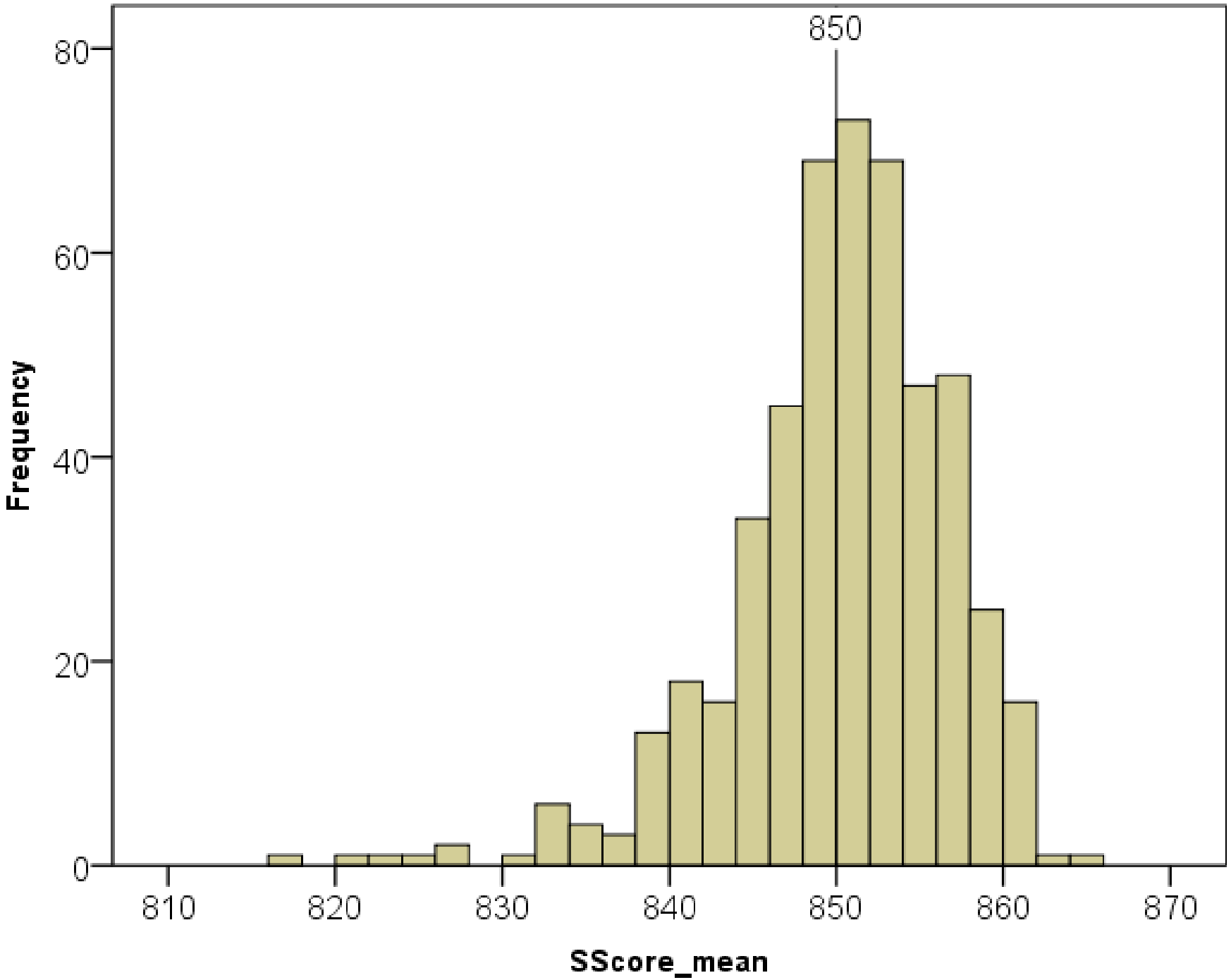



# Hypothetical School F Mathematics Grade 8

*N* = 67

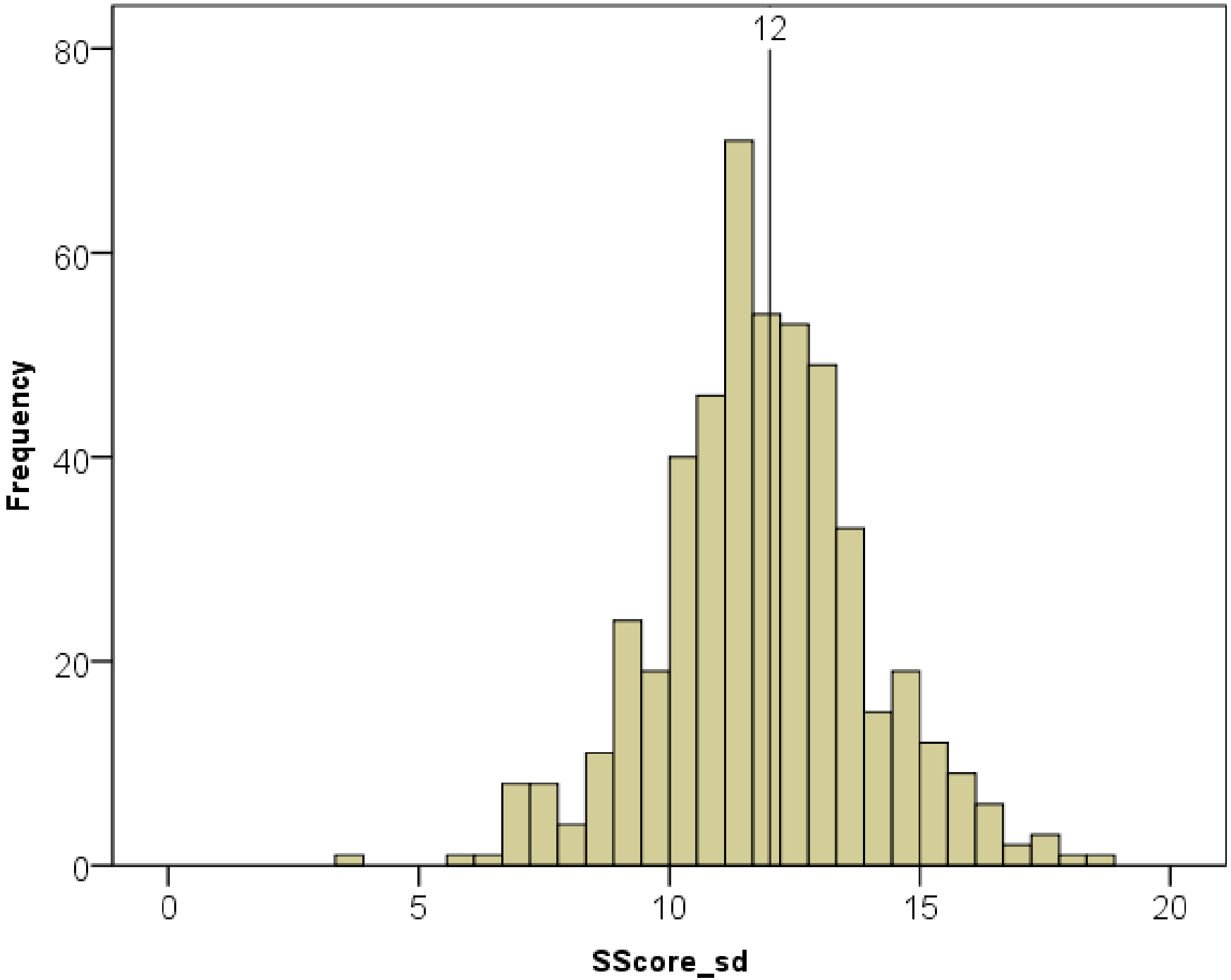
*M* = 853

*SD* = 7



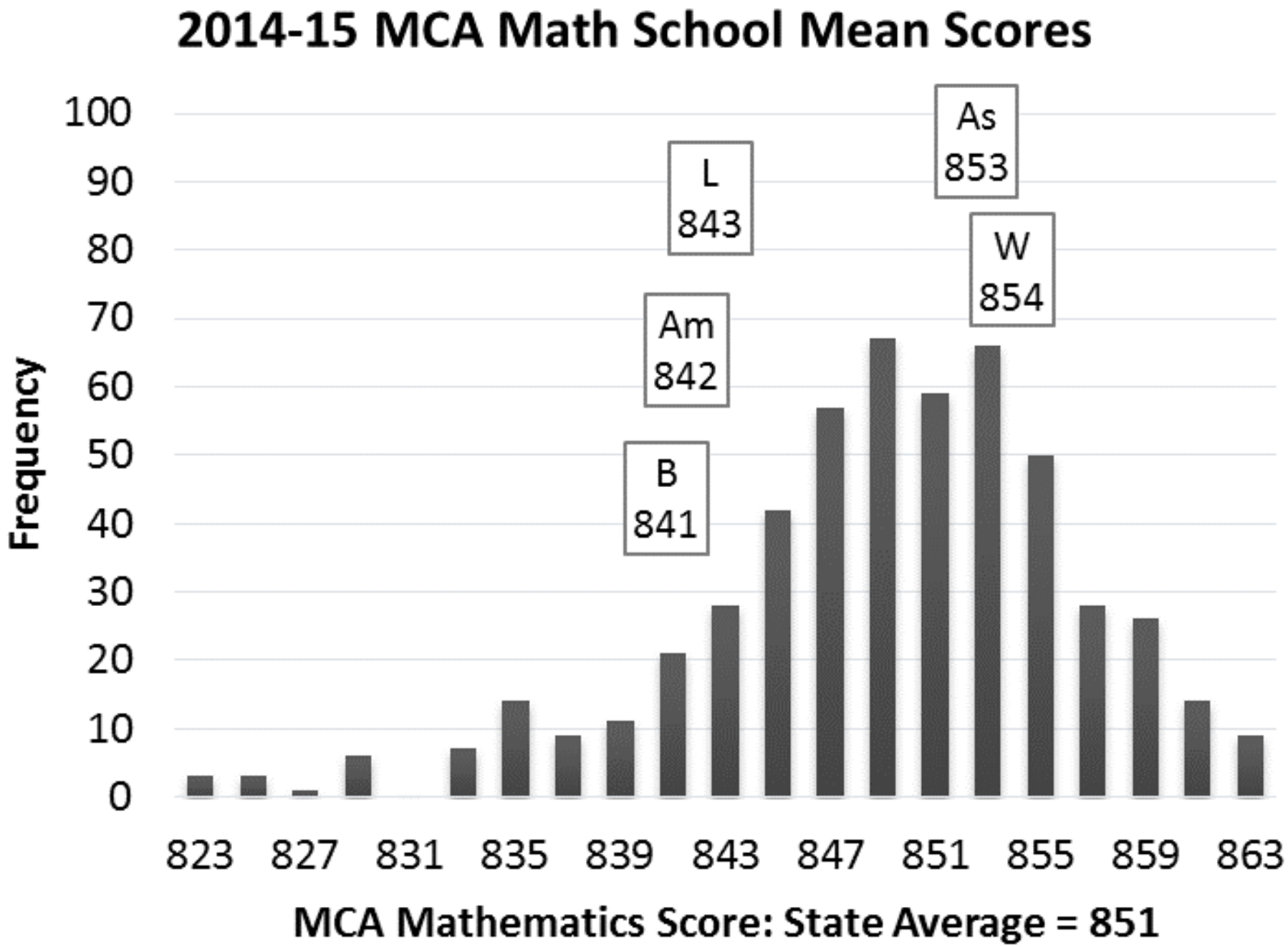

Mathematics
Grade 8

School Means
where $n \geq 10$




Mathematics
Grade 8

School SDs
where $n \geq 10$




# 2015 MATH School Means & Race/ Ethnicity Means

# Partitioning Variance in Math Scores (all schools)

| Grade | # Students | # Schools | Mean Score | Variance Between | Variance Within | Proportion V(Between) |
|---|---|---|---|---|---|---|
| **3** | 60091 | 910 | 356.68 | 52.82 | 202.94 | **.21** |
| **4** | 60520 | 902 | 456.58 | 70.00 | 255.12 | **.22** |
| **5** | 58482 | 874 | 550.80 | 37.96 | 142.12 | **.21** |
| **6** | 56727 | 650 | 649.19 | 47.27 | 156.76 | **.23** |
| **7** | 57659 | 595 | 748.37 | 30.84 | 108.64 | **.22** |
| **8** | 56594 | 611 | 848.66 | 52.81 | 155.06 | **.25** |
| **11** | 55072 | 653 | 1141.82 | 123.43 | 231.76 | **.35** |

# Partitioning Variance in Reading Scores (all schools)

| Grade | # Students | # Schools | Mean Score | Variance Between | Variance Within | Proportion V(Between) |
|---|---|---|---|---|---|---|
| **3** | 59980 | 910 | 351.23 | 66.72 | 351.49 | **.16** |
| **4** | 60407 | 901 | 449.68 | 40.12 | 195.51 | **.17** |
| **5** | 58195 | 879 | 553.85 | 36.79 | 169.89 | **.18** |
| **6** | 56612 | 654 | 651.88 | 49.41 | 255.39 | **.16** |
| **7** | 57776 | 599 | 748.71 | 51.11 | 261.61 | **.16** |
| **8** | 56918 | 614 | 848.20 | 58.07 | 260.93 | **.18** |
| **10** | 56770 | 631 | 1048.31 | 59.73 | 189.54 | **.24** |