An Analysis of SOL Test Pass Rates in the Commonwealth 2018-2021

Justin Newman, Matt Mee

VIRGINIA
Standards of Learning Assessments

What is an SOL test?

   The Virginia "Standards of Living" (SOL) are the established minimum expectations that the Board of Education has for what a student should learn or achieve in a given year in English, mathematics, and science. The SOL tests measure the students' success in meeting these standardized expectations. Three of these tests are taken annually.

We analyzed the SOL pass rates across the Commonwealth of VA from years 2018-2021, and broke it down by subgroups including race, gender, and economic disadvantage.

Fig. 1.1 shown here, is the distribution of the total pass rates of students in VA Public Schools in 2021.

Fig. 1.1 indicates that this sample has a normal distribution with a slight skew to the left.
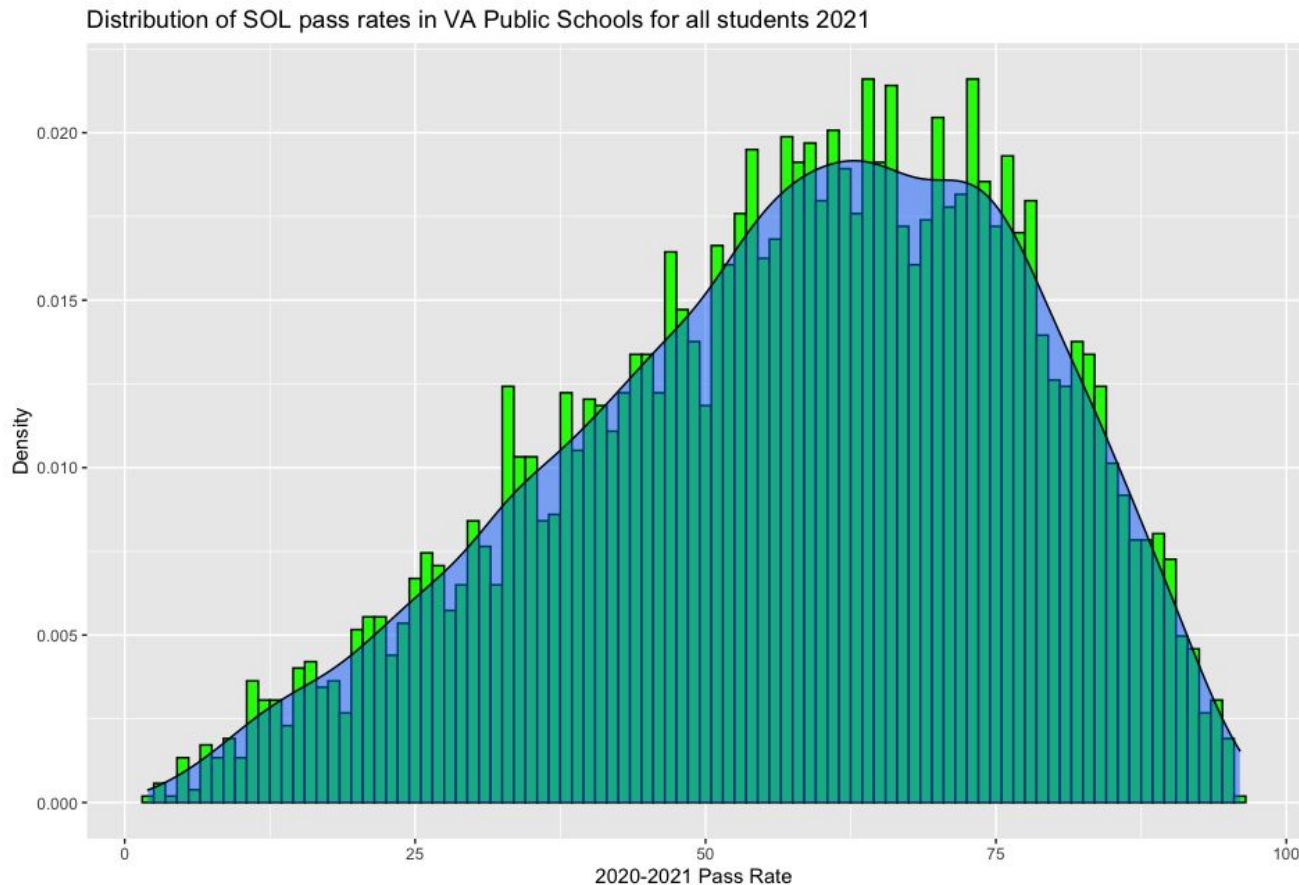

Distribution of SOL pass rates in VA Public Schools for all students 2021

Figure 1.1

Pass Rate by Gender

Fig. 1.2 shown here depicts the pass rate broken down by gender.

Female students have a higher median pass rate compared to the male students.
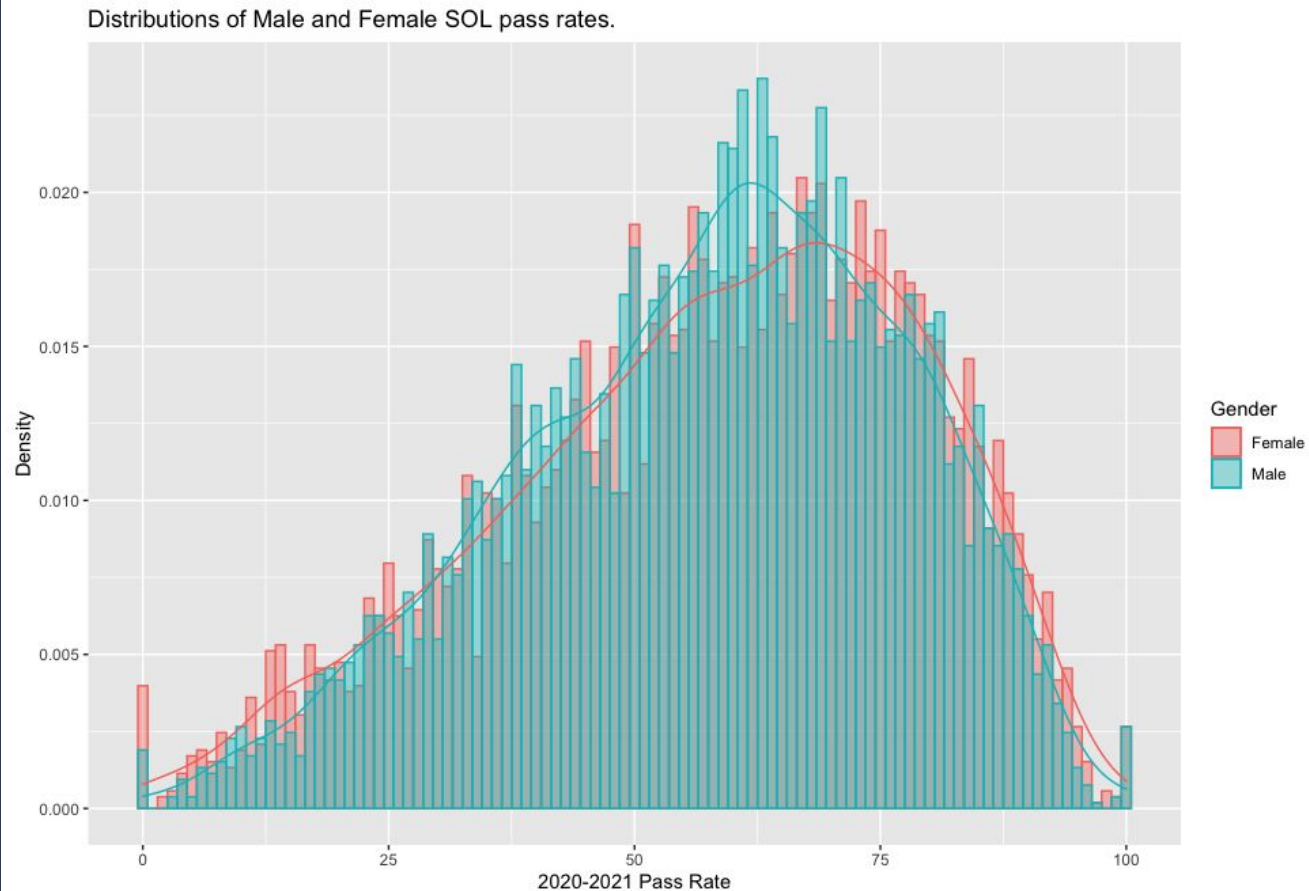

Distributions of Male and Female SOL pass rates.

Figure 1.2

Distributions of Pass Rates – Math

Fig. 1.4 illustrates the pass rates of the schools for the mathematical SOL tests. These scores have a mostly normal distribution with a skew to the left. The skew is much stronger to the left, even though there are a few notable outliers for the math scores.
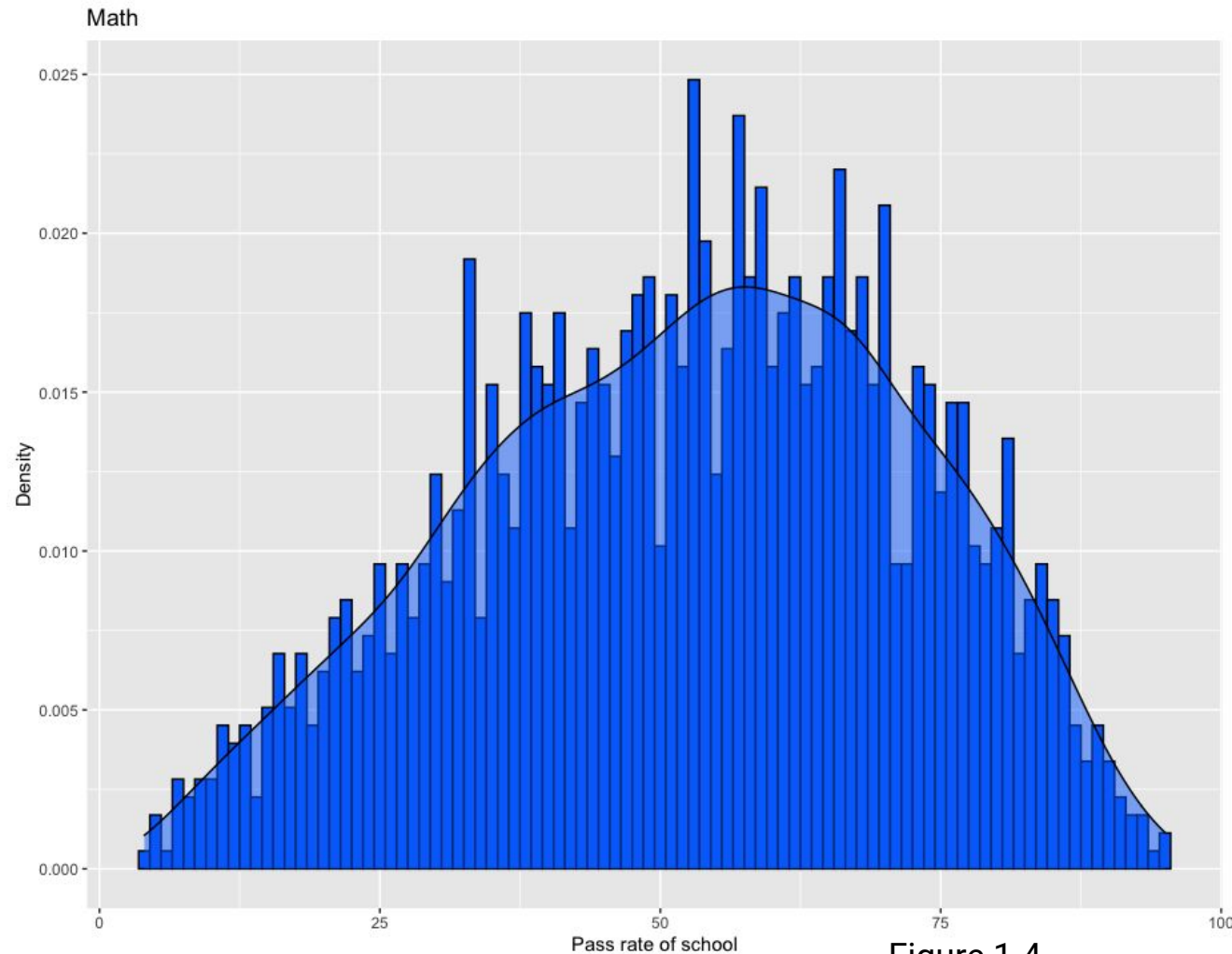
Figure 1.4

Distributions of Pass Rates – Science

Fig. 1.5 shows the pass rates for the science SOL scores. These scores have a more skewed and wide distribution and a much stronger skew to the left than Fig. 1.4. There were some notable dips in the distribution close to the 70% mark.
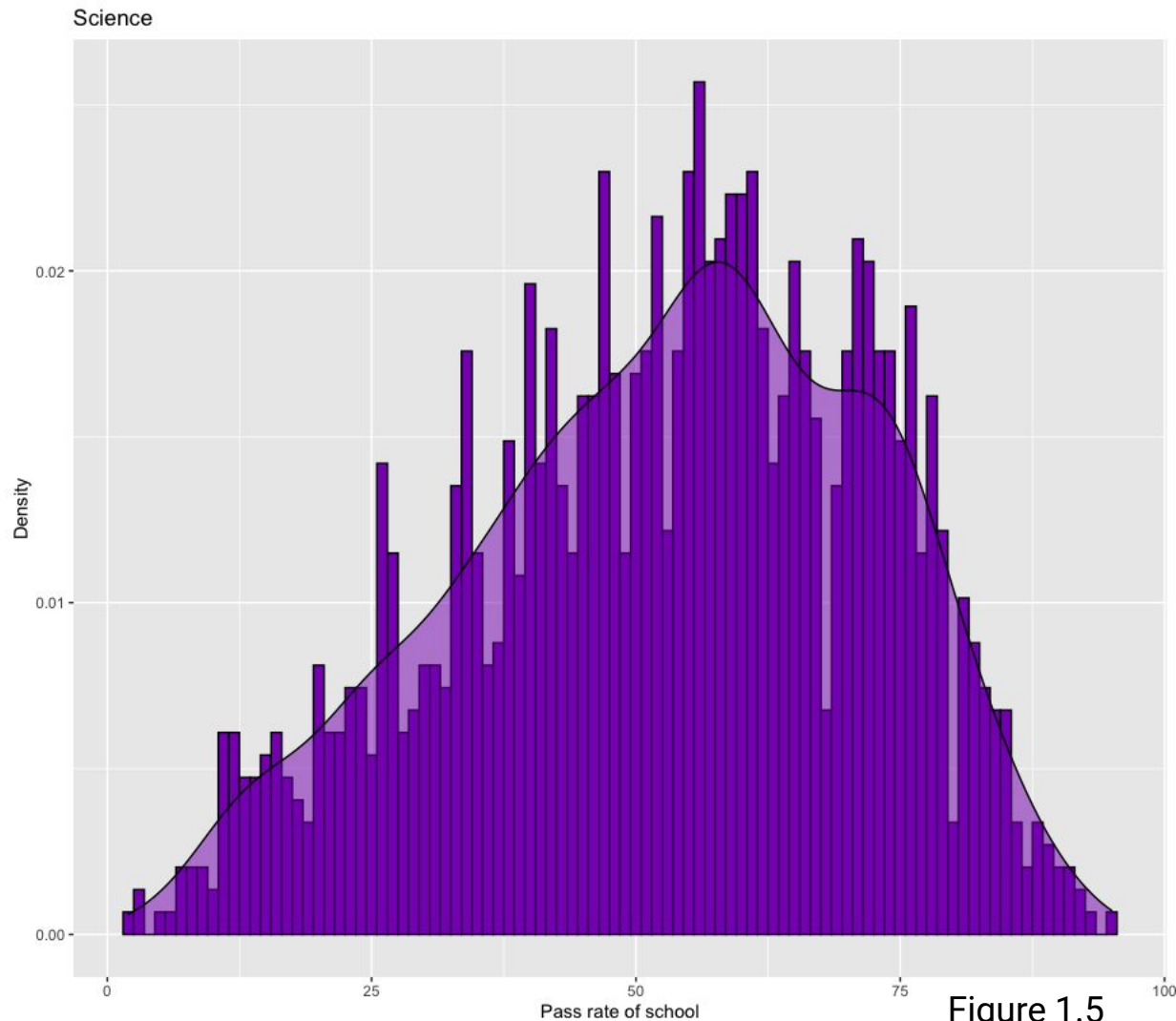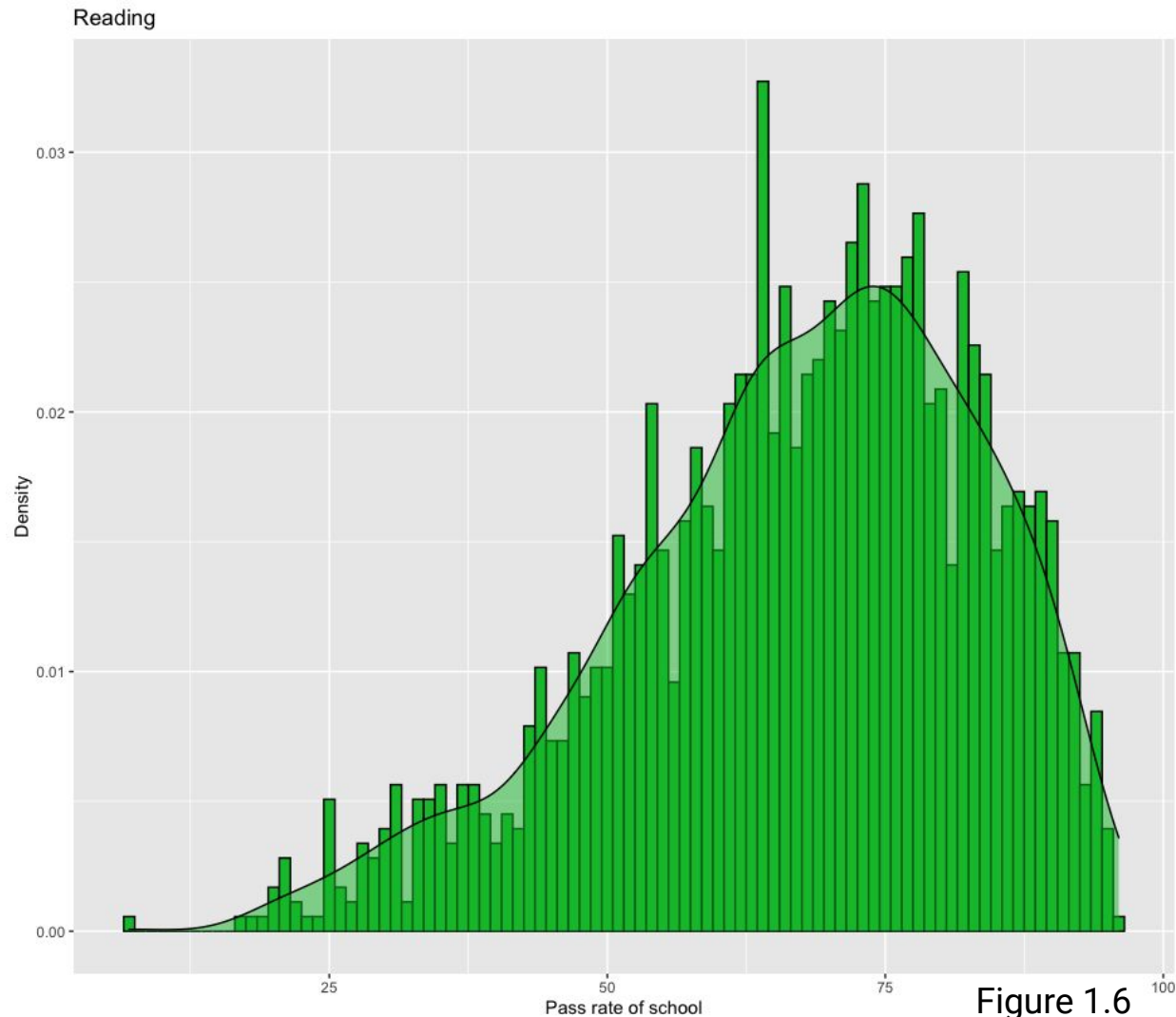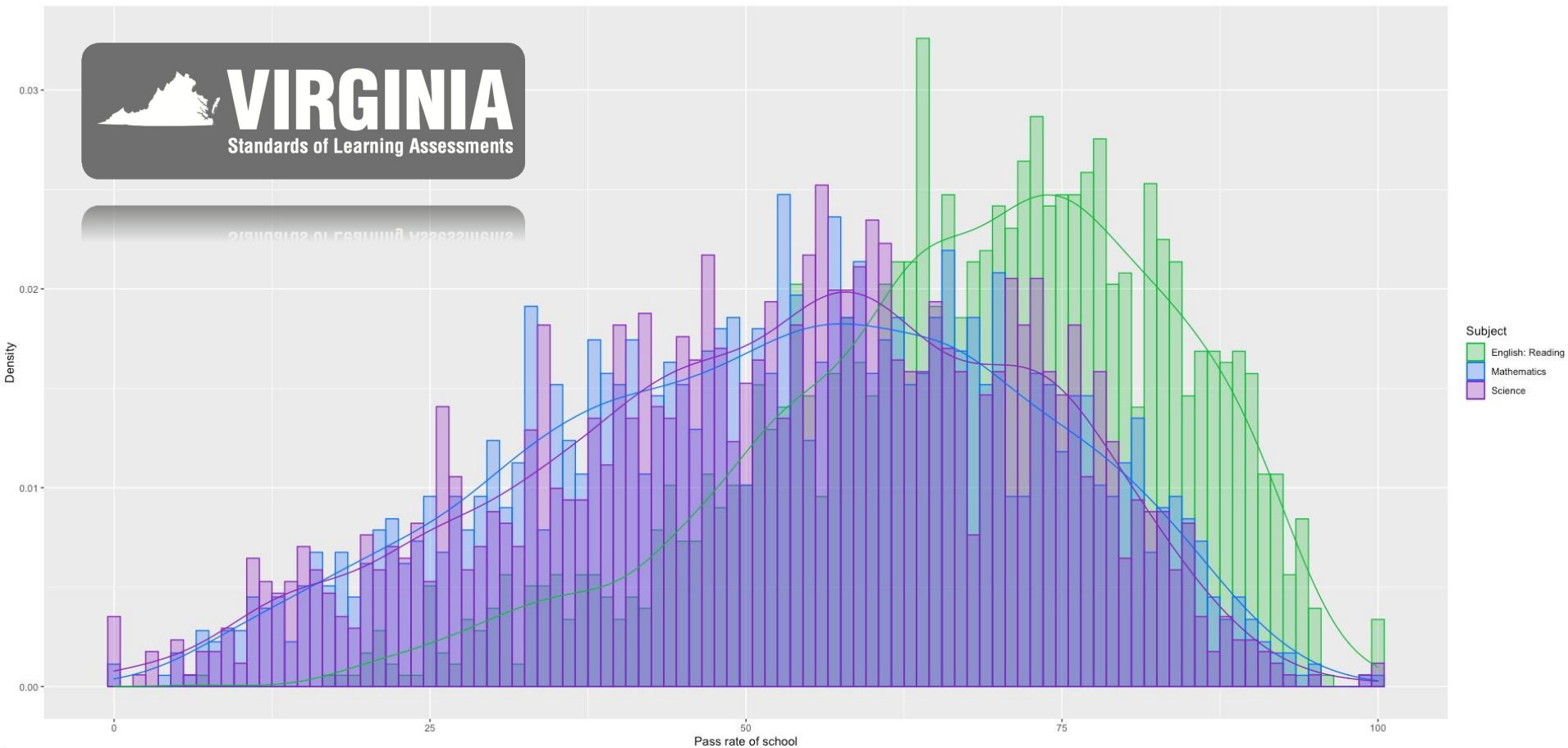

Figure 1.5

Distributions of Pass Rates – Reading

Fig. 1.6 shows the English–Reading SOL scores. This set has a normal distribution with a strong skew to the left. It also clearly has a higher median than both the mathematic and science SOL tests.

Figure 1.6

Distributions of Pass Rates by Subject

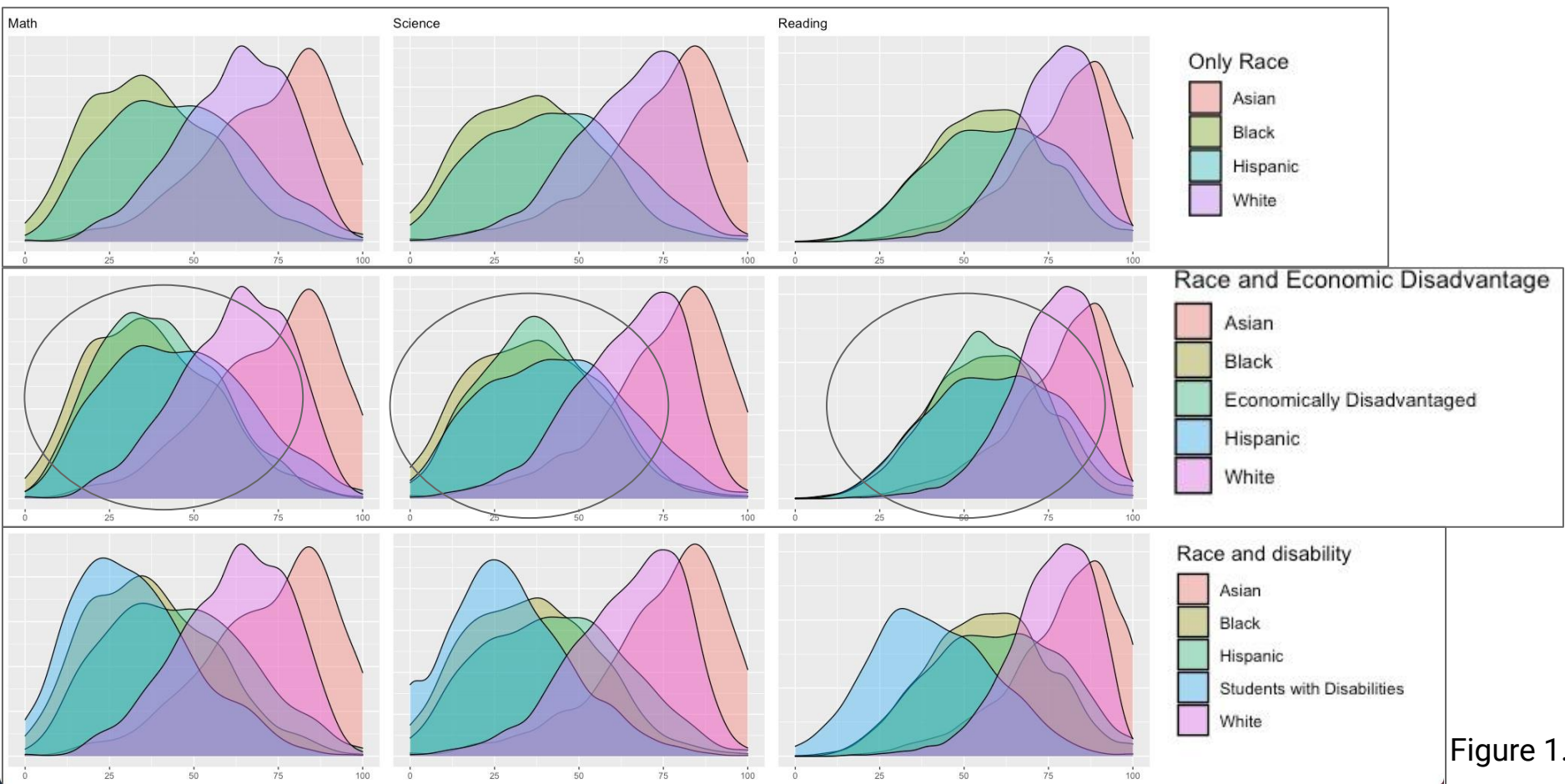Figure 1.7

Comparing subgroups with density plots
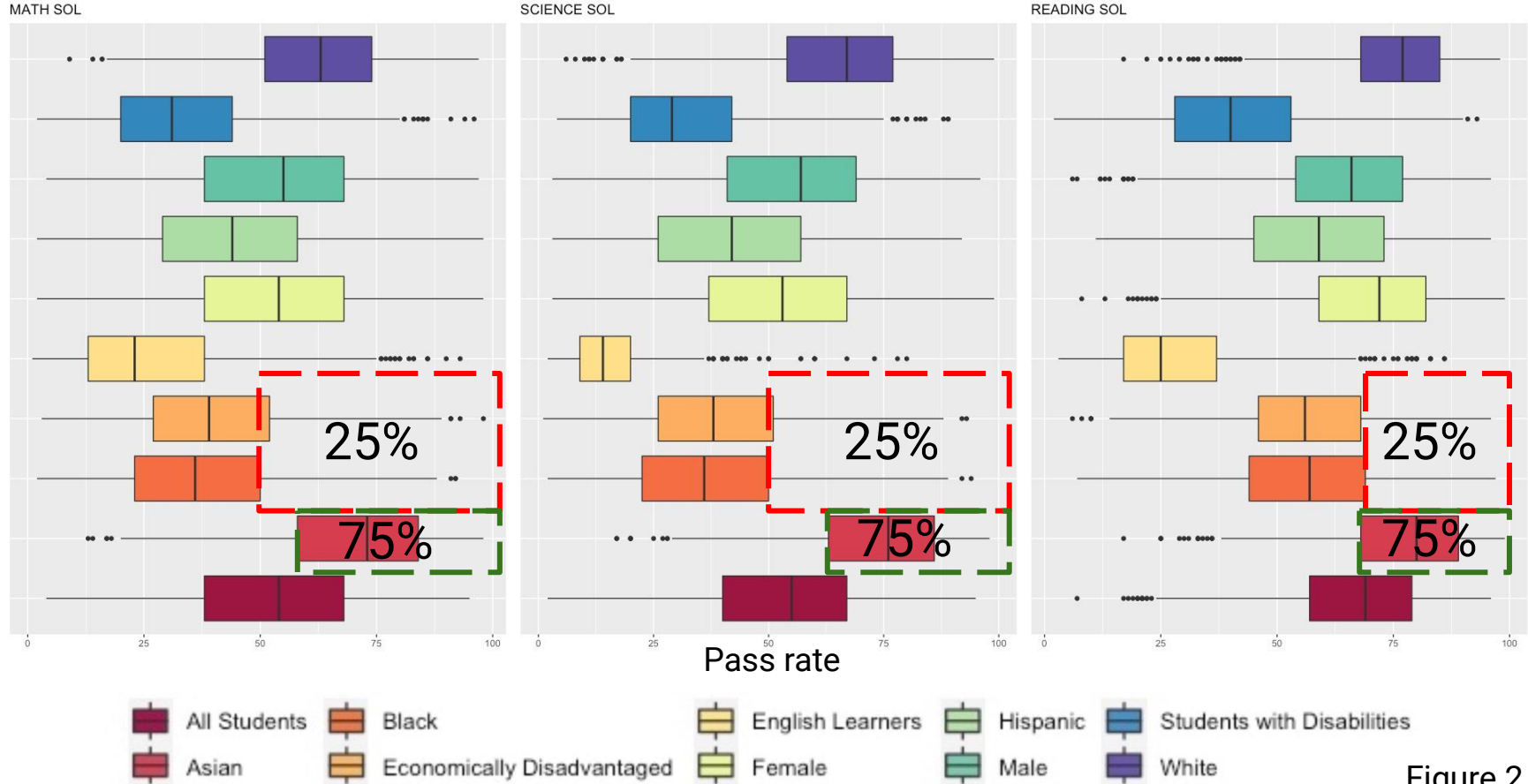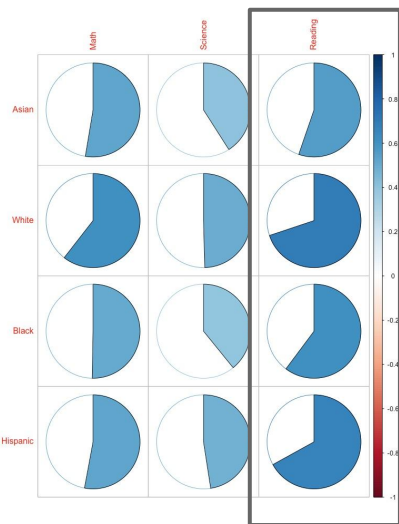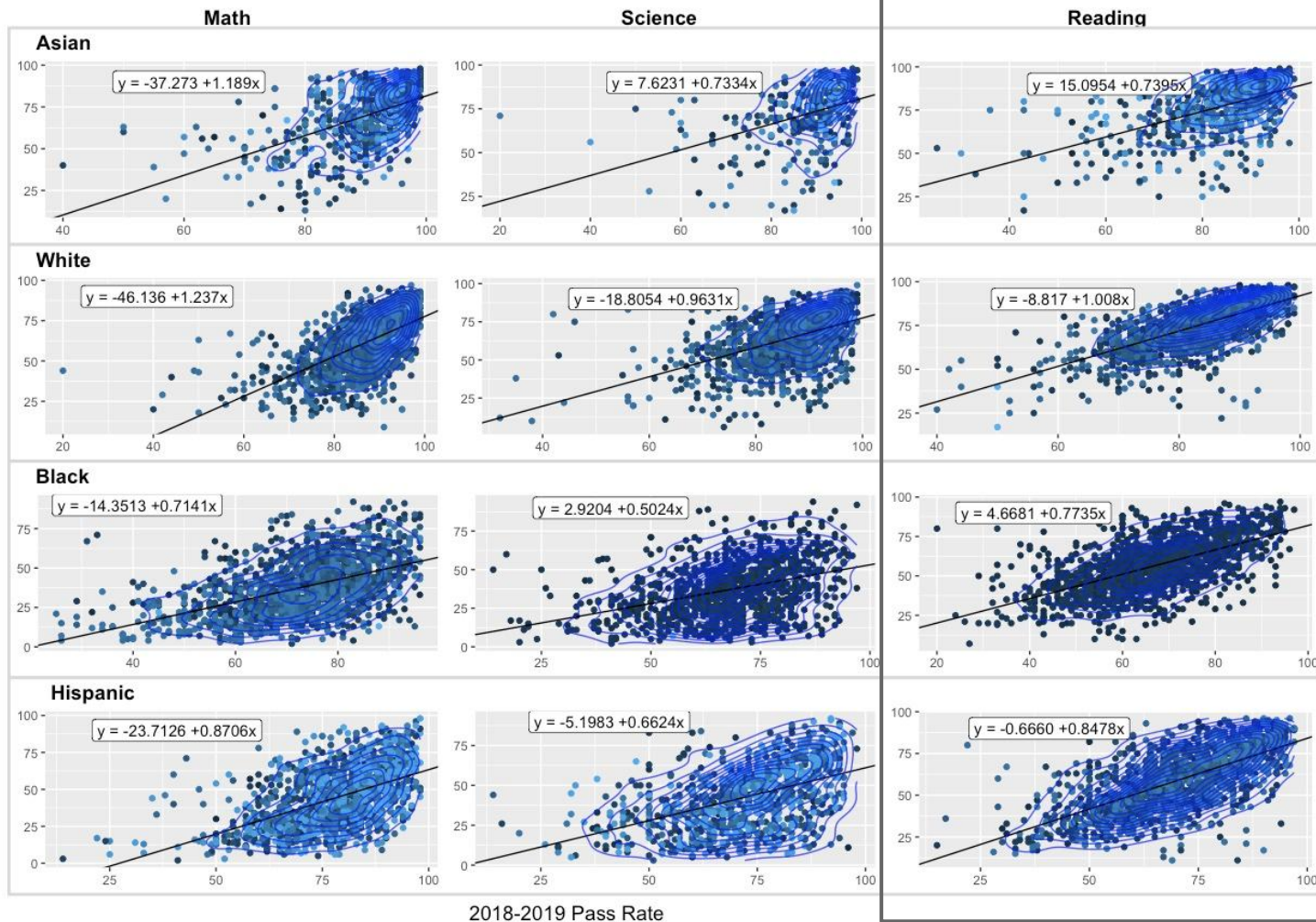

Figure 1.9

Comparing Subgroups with box plots

Figure 2.2

Linear Regression Matrix

Figure 2.4

Residuals Matrix

Heterogeneity in all except reading SOL.

AsianMath:W = 0.98356, p-value = 9.236e-07
AsianScience:W = 0.93608, p-value = 4.435e-11
AsianReading:W = 0.94835, p-value = 3.444e-15

WhiteMath:W = 0.98853, p-value = 2.417e-10
WhiteScience:W = 0.9659, p-value < 2.2e-16
WhiteReading:W = 0.94056, p-value < 2.2e-16

BlackMath:W = 0.99174, p-value = 2.49e-07
BlackScience:W = 0.9936, p-value = 0.0002323
BlackReading:W = 0.99377, p-value = 7.696e-06

HispanicMath:W = 0.99361, p-value = 9.005e-06
HispanicScience:W = 0.99446, p-value = 0.001752
HispanicReading:W = 0.99255, p-value = 1.506e-06
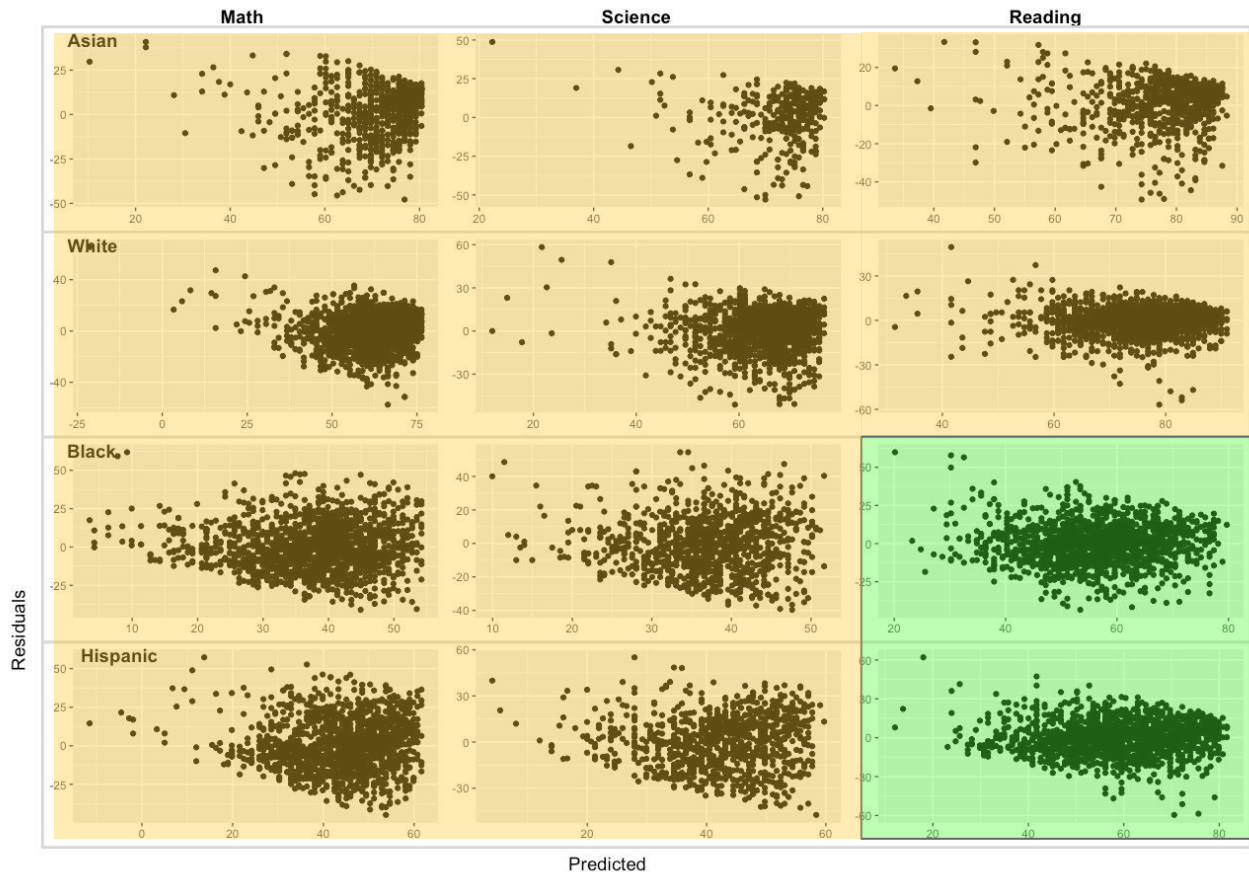
Multiple Linear Regression

English: $r^2 = 0.8616326$

Math: $r^2 = 0.7450685$

Science: $r^2 = 0.6705424$

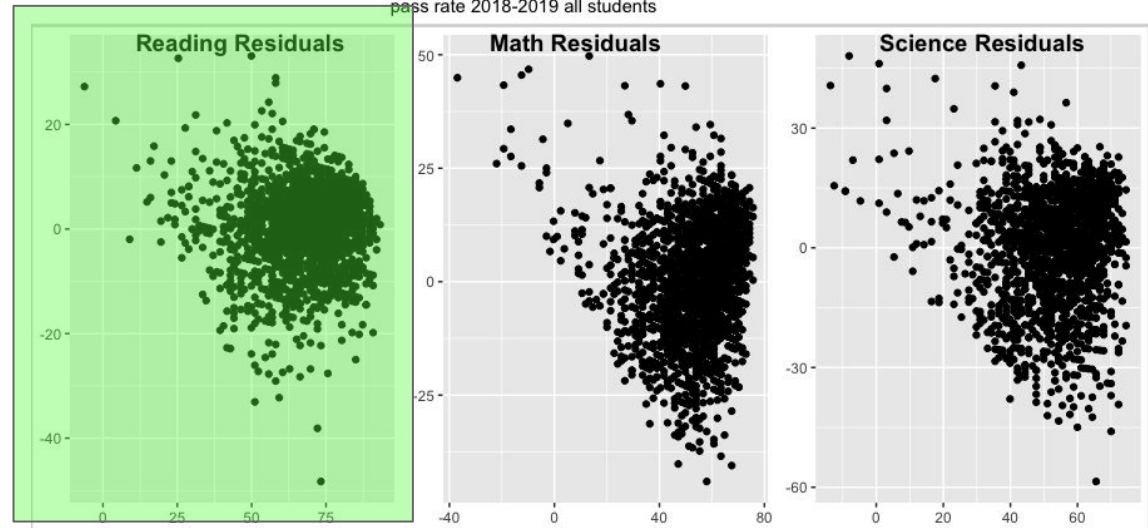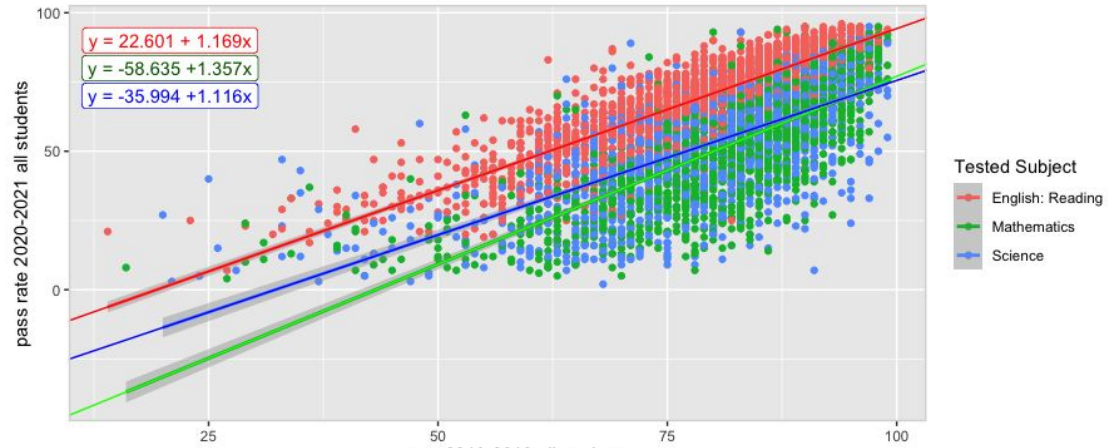English: W = 0.97605, p-value < 2.2e-16
Math: W = 0.99519, p-value = 1.81e-05
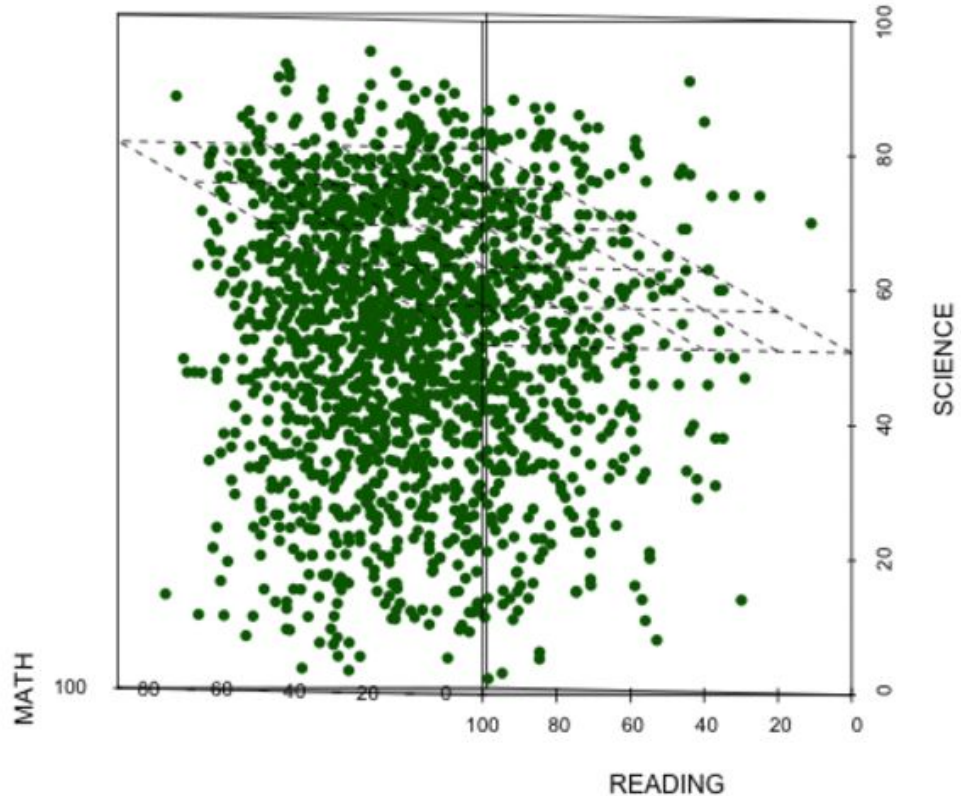Science: W = 0.98187, p-value = 8.949e-14

VIRGINIA
Standards of Learning Assessments

Rotating 3D Scatter plot

scatterplot3D

Pseudo code:

for i in range 1:180 :
    export frame: plot(angle = i)

Upload frames:
https://gifmaker.me/

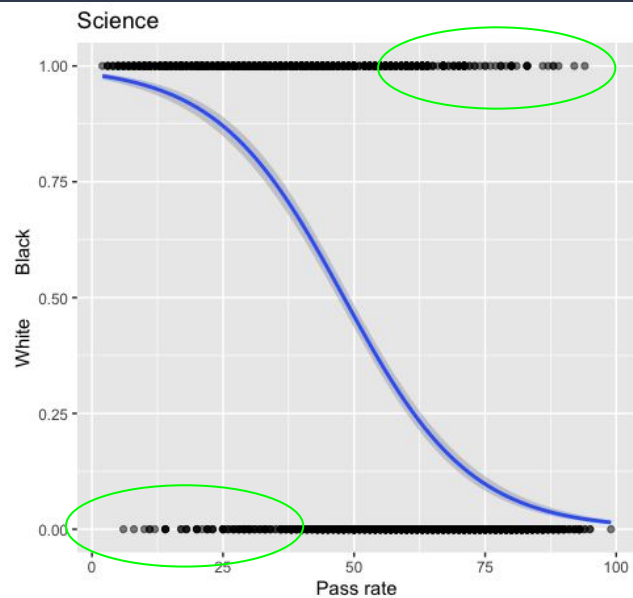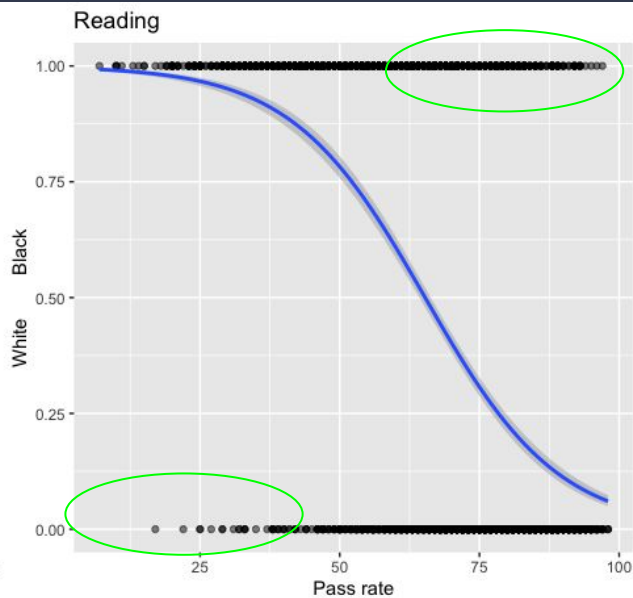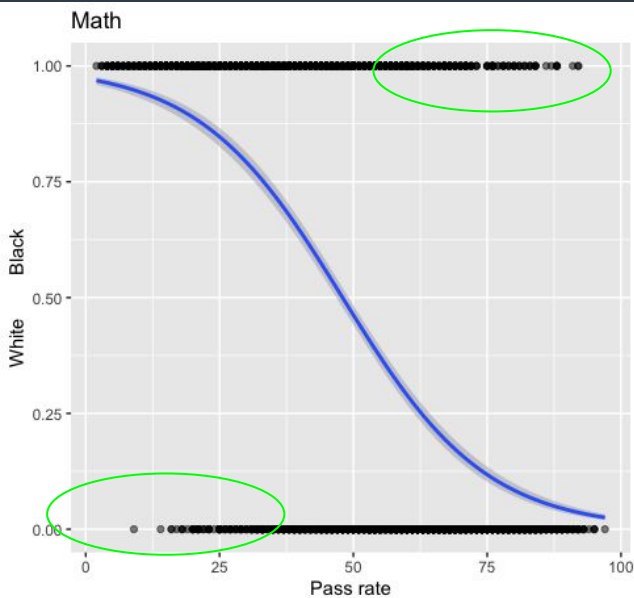# Logistic Regression

$$log_e(\frac{P}{1-P}) = b_0 + b_1 x \qquad P = \frac{e^{b_0+b_1 x}}{1 + e^{b_0+b_1 x}}$$

Predicting whether a student is White
or black by a given SOL pass rate.

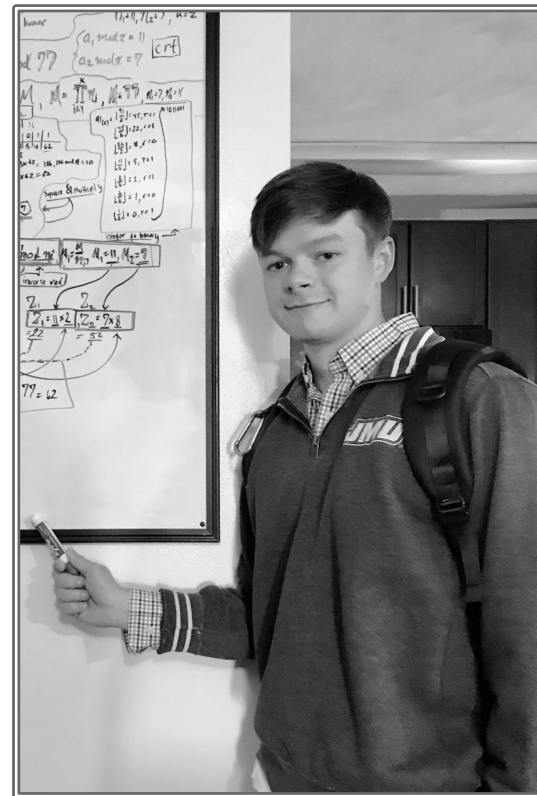$$p = \frac{e^{3.5749+-0.0745x}}{1 + e^{3.5749+-0.0745x}} \qquad p = \frac{e^{5.469+-0.0745x}}{1 + e^{5.469+-0.0745x}} \qquad p = \frac{e^{3.97119+-0.08263x}}{1 + e^{3.97119+-0.08263x}}$$

Analysis of SOL Test Pass Rates in the Commonwealth 2018-2021 by

JAMES MADISON UNIVERSITY

KNOWLEDGE IS LIBERTY

1908

VIRGINIA
Standards of Learning Assessments

Mr. Matthew Mee

Mr. Justin M Newman