Demographic Effects Regarding Universal College Entrance Testing

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Background

- In recent years, some School Districts and Statewide educational agencies have offered or even mandated universal college entrance exams for all of their high school students.

- Prior to this, SAT and/or ACT testing was generally discretionary, both initiated and paid for by individual students who anticipated attending post-secondary education.

- Local and State education agencies must weigh the direct and indirect costs of universal test with any potential benefits.

Background

- College Readiness indicators (as measured on the SAT/ACT are being elevated in importance in State accountability metrics.

- An analysis was made of the effects of universal testing on a large school district in San Antonio, comparing the results by race/ethnicity and economic disadvantaged status.

Research Questions

- Do the same patterns of results exist both before and after the universal testing change for ***Asian***, ***African-American,*** and ***Hispanic*** students compared to ***White*** students?

- Do the same patterns of results exist both before and after the universal testing change for ***Economically Disadvantaged*** students compared to ***Non-Economically Disadvantaged*** students?

Literature Review

- Approximately half of states provide for/mandate SAT and/or ACT testing of all students, as do many school districts in the other states (Adams 2014; Adams 2015)

- Most academic analysis has focused on college enrollment effects (Hurwitz et al 2015; Hyman 2016)

- Historically, SAT results have shown considerable variation among race/ethnicity and other demographic factors (Wyatt et al 2011)

Data

- In SY 2014-15, the District paid for all 11th grade students to take the SAT exam during a school day.
- While not mandatory, approximately 87% of students took it.

Prior Data (SY 2013-14)

3,875 Critical Reading and Math SAT scores

Demographics:

- Asian – 4%
- African-American – 8%
- Hispanic – 61%
- White – 26%
- Economically Disadvantaged – 37%

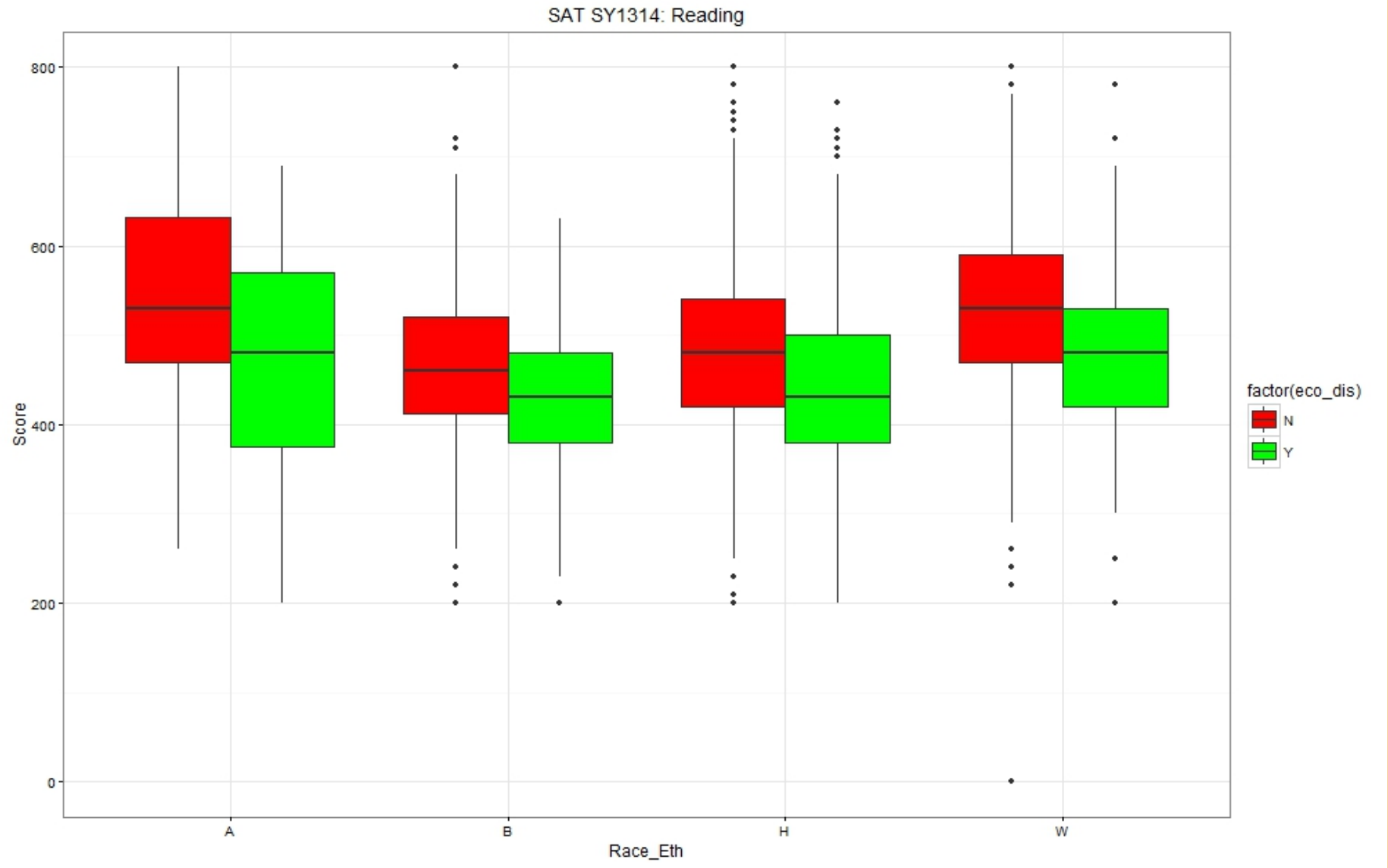
After Policy Change (Spring 2015):

6,257 Critical Reading and Math SAT scores

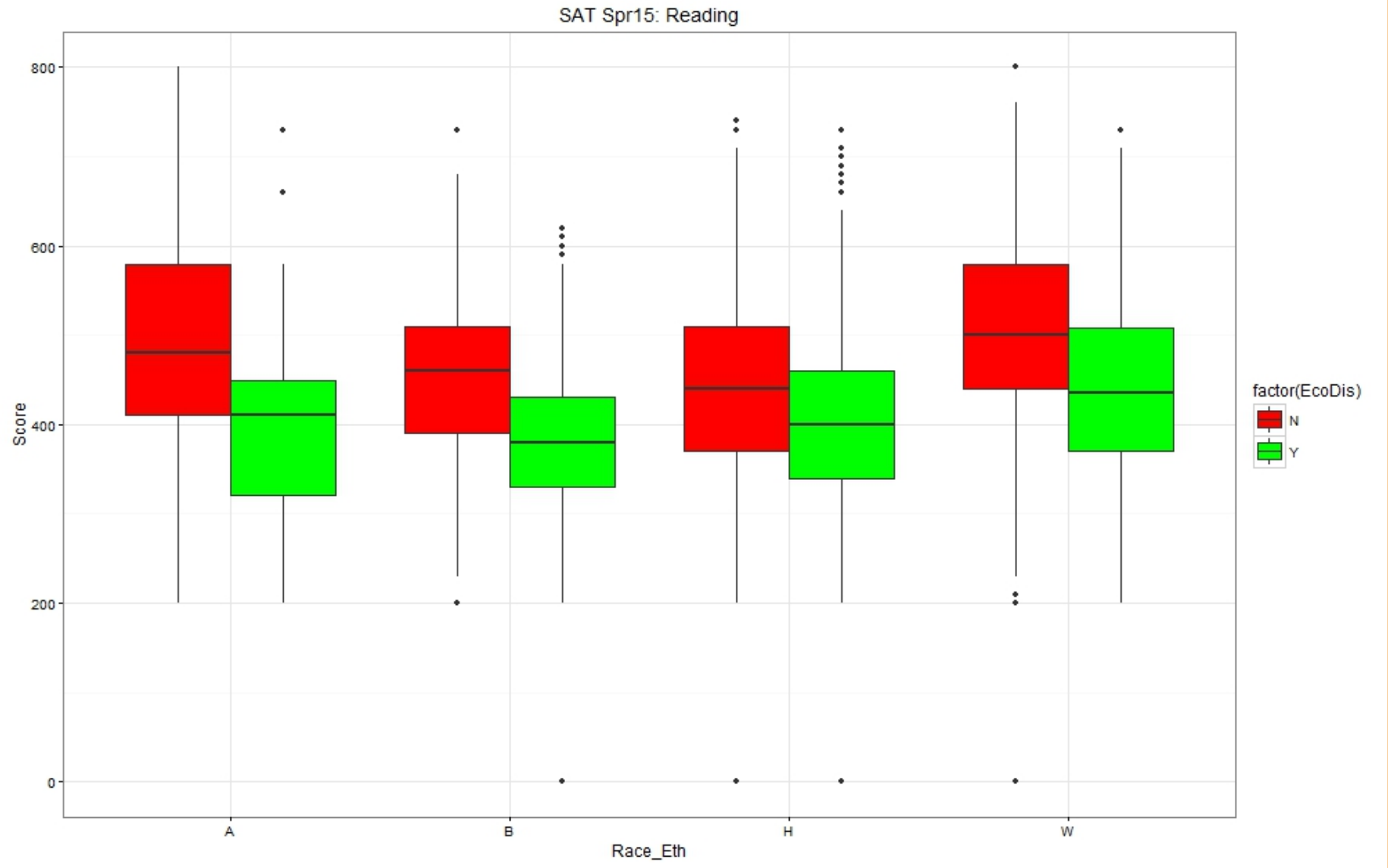
Demographics:

- Asian – 4%
- African-American – 7%
- Hispanic – 66%
- White – 22%
- Economically Disadvantaged – 42%

Boxplot


SAT SY1314: Reading
800
600
400
200
0
Score
A
B
H
W
Race_Eth
factor(eco_dis)
N
Y

Boxplot


SAT Spr15: Reading
Score
800
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Race_Eth
factor(EcoDis)
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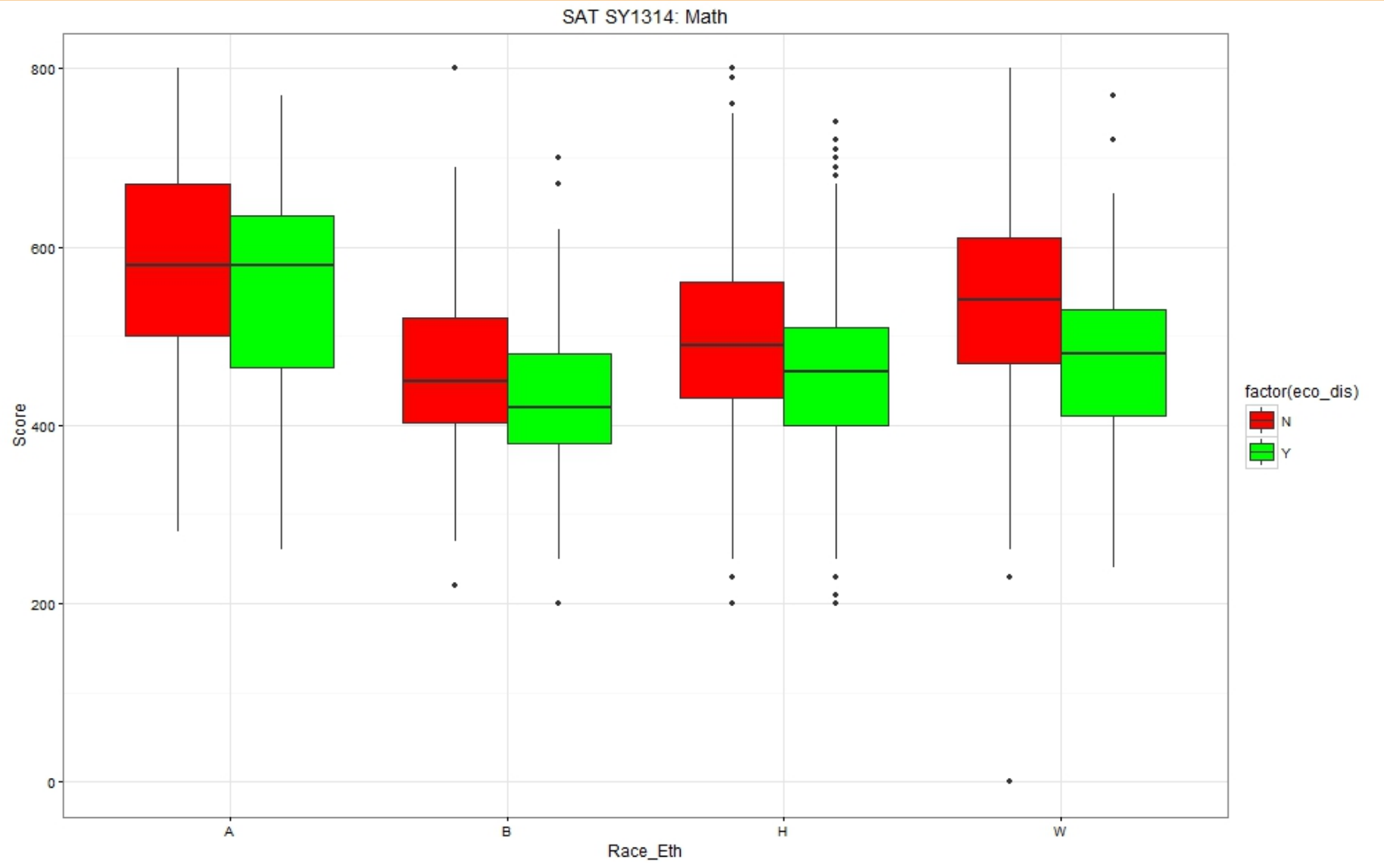
Boxplot


SAT SY1314: Math
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600
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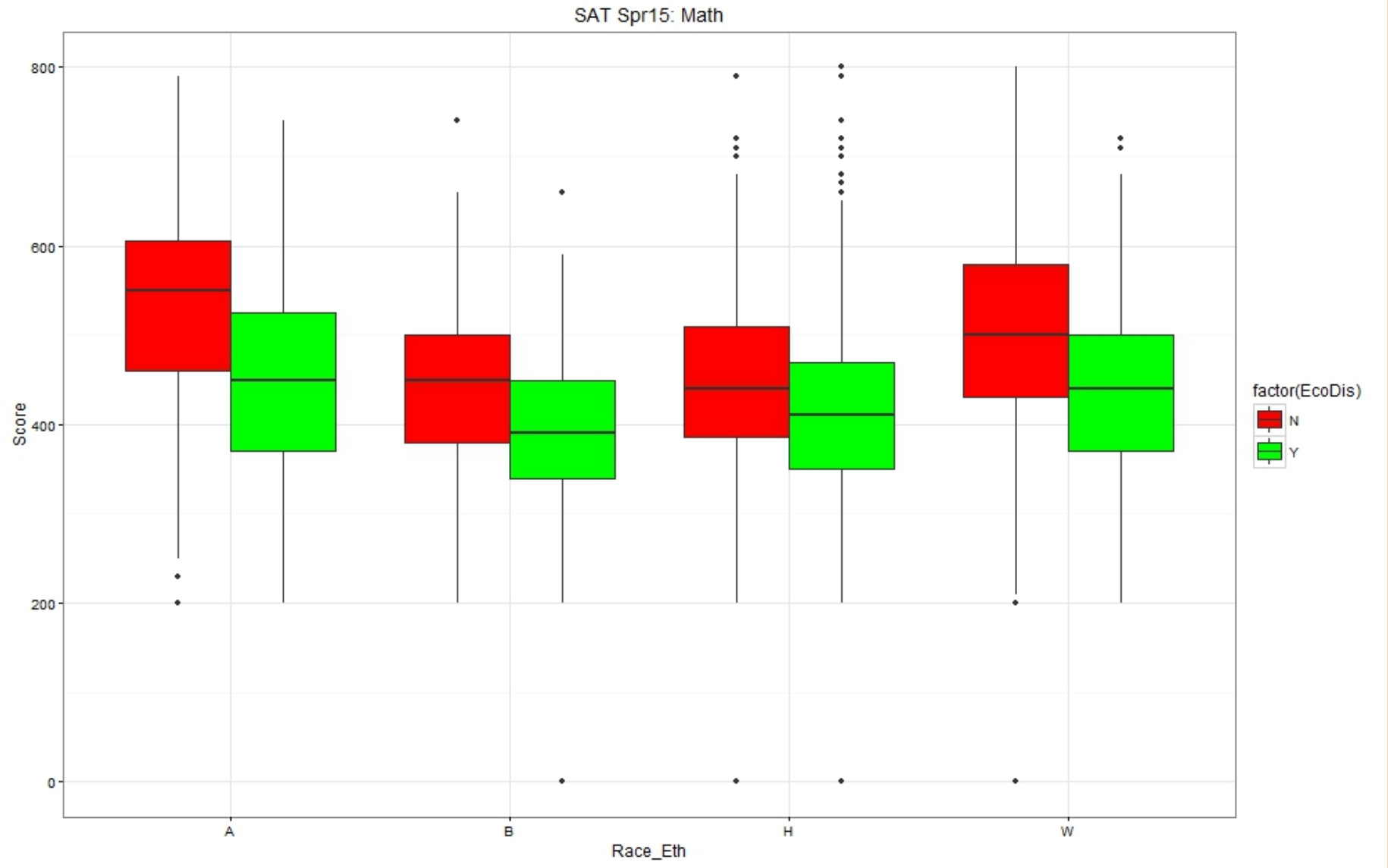
200
0
A
B
H
W
Race_Eth
factor(eco_dis)
N
Y

Boxplot


SAT Spr15: Math
800
600
400
200
0
Score
A
B
H
W
Race_Eth
factor(EcoDis)
N
Y

Methodology

- Methods:
  - 2-Way ANOVA
  - Logistic Regression
  - Decision Trees (CTREE method in R)
- Demographic Factors:
  - Asian, African-American, and Hispanic students compared to White students
  - Economically Disadvantaged students compared to Not Economically Disadvantaged students

Results

- 2-Way ANOVA, Logistic Regression, and Decision Tree analyses indicated that patterns shift for:
  - Asian, African-American, and Hispanic students compared to White students
  - Economically Disadvantaged students compared to Not Economically Disadvantaged students
- These pattern shifts were evident for both reading and mathematics.

2-Way ANOVA (Pattern Shift: ⟷)

READ

Fit: aov(formula = SATTestScCritRd ~ race_eth:eco_dis, data = df_1314_race)

$`race_eth:eco_dis`

	diff	lwr	upr	p adj
B:N-A:N	-87.378589	-120.672012	-54.085167	0.0000000
H:N-A:N	-68.160411	-95.082155	-41.238668	0.0000000
W:N-A:N	-19.213076	-46.680226	8.254074	0.4011880
A:Y-A:N	-82.704426	-133.305232	-32.103620	0.0000206
B:Y-A:N	-124.336177	-160.872411	-87.799943	0.0000000
H:Y-A:N	-112.371479	-139.450205	-85.292753	0.0000000
W:Y-A:N	-72.119021	-107.091431	-37.146611	0.0000000
H:N-B:N	19.218178	-3.468416	41.904772	0.1676511
W:N-B:N	68.165513	44.834298	91.496728	0.0000000
A:Y-B:N	4.674163	-43.806171	53.154497	0.9999911
B:Y-B:N	-36.957588	-70.495591	-3.419585	0.0190344
H:Y-B:N	-24.992889	-47.865551	-2.120228	0.0208839
W:Y-B:N	15.259568	-16.567633	47.086769	0.8316785
W:N-H:N	48.947336	36.271615	61.623056	0.0000000
A:Y-H:N	-14.544015	-58.891180	29.803151	0.9753197
B:Y-H:N	-56.175766	-83.399394	-28.952137	0.0000000
H:Y-H:N	-44.211067	-56.021527	-32.400608	0.0000000
W:Y-H:N	-3.958610	-29.044443	21.127224	0.9997489
A:Y-W:N	-63.491350	-108.171716	-18.810984	0.0004455
B:Y-W:N	-105.123101	-132.886206	-77.359996	0.0000000
H:Y-W:N	-93.158403	-106.164209	-80.152596	0.0000000
W:Y-W:N	-52.905945	-78.576221	-27.235669	0.0000000
B:Y-A:Y	-41.631751	-92.393815	9.130314	0.2011069
H:Y-A:Y	-29.667053	-74.109692	14.775587	0.4653522
W:Y-A:Y	10.585405	-39.062961	60.233771	0.9981969
H:Y-B:Y	11.964698	-15.414182	39.343578	0.8894579
W:Y-B:Y	52.217156	17.011828	87.422484	0.0001901
W:Y-H:Y	40.252457	14.998227	65.506688	0.0000382

Fit: aov(formula = READING_CONVERTED_SCR ~ Race_Eth:EcoDis, data = df_Spr15_race)

$`Race_Eth:EcoDis`

	diff	lwr	upr	p adj
B:N-A:N	-40.880489	-71.894009	-9.866968	0.0016712
H:N-A:N	-46.544862	-72.259780	-20.829944	0.0000012
W:N-A:N	15.784796	-10.685720	42.255311	0.6146390
A:Y-A:N	-90.336038	-131.712846	-48.959230	0.0000000
B:Y-A:N	-104.064535	-137.283381	-70.845689	0.0000000
H:Y-A:N	-86.974086	-112.707571	-61.240600	0.0000000
W:Y-A:N	-49.251701	-79.763923	-18.739479	0.0000278
H:N-B:N	-5.664373	-25.348097	14.019350	0.9884606
W:N-B:N	56.665284	36.004205	77.326363	0.0000000
A:Y-B:N	-49.455549	-87.379582	-11.531517	0.0019877
B:Y-B:N	-63.184046	-91.988277	-34.379815	0.0000000
H:Y-B:N	-46.093597	-65.801572	-26.385623	0.0000000
W:Y-B:N	-8.371212	-34.006884	17.264460	0.9759550
W:N-H:N	62.329658	51.091386	73.567929	0.0000000
A:Y-H:N	-43.791176	-77.520256	-10.062097	0.0021322
B:Y-H:N	-57.519673	-80.521897	-34.517449	0.0000000
H:Y-H:N	-40.429224	-49.800607	-31.057840	0.0000000
W:Y-H:N	-2.706839	-21.590859	16.177182	0.9998684
A:Y-W:N	-106.120834	-140.429463	-71.812205	0.0000000
B:Y-W:N	-119.849331	-143.693271	-96.005390	0.0000000
H:Y-W:N	-102.758881	-114.039574	-91.478188	0.0000000
W:Y-W:N	-65.036496	-84.937186	-45.135807	0.0000000
B:Y-A:Y	-13.728497	-53.476271	26.019277	0.9670996
H:Y-A:Y	3.361952	-30.381286	37.105190	0.9999889
W:Y-A:Y	41.084337	3.569147	78.599528	0.0203694
H:Y-B:Y	17.090449	-5.932530	40.113429	0.3215740
W:Y-B:Y	54.812834	26.549059	83.076609	0.0000001
W:Y-H:Y	37.722385	18.813088	56.631682	0.0000000

2-Way ANOVA (Pattern Shift: ⟷)

MATH

Fit: aov(formula = SATTestScMath ~ race_eth:eco_dis, data = df_1314_race)

$`race_eth:eco_dis`

	diff	lwr	upr	p adj
B:N-A:N	-118.021978	-150.330997	-85.712959	0.0000000
H:N-A:N	-84.647436	-110.773171	-58.521701	0.0000000
W:N-A:N	-38.370198	-65.025213	-11.715183	0.0003472
A:Y-A:N	-32.093023	-81.197689	17.011643	0.4942524
B:Y-A:N	-143.471074	-178.927023	-108.015126	0.0000000
H:Y-A:N	-121.312217	-147.590293	-95.034142	0.0000000
W:Y-A:N	-101.517241	-135.455605	-67.578878	0.0000000
H:N-B:N	33.374542	11.358734	55.390350	0.0001197
W:N-B:N	79.651780	57.010411	102.293149	0.0000000
A:Y-B:N	85.928955	38.882063	132.975846	0.0000009
B:Y-B:N	-25.449096	-57.995464	7.097272	0.2558285
H:Y-B:N	-3.290239	-25.486613	18.906135	0.9998348
W:Y-B:N	16.504737	-14.381413	47.390887	0.7379813
W:N-H:N	46.277238	33.976307	58.578169	0.0000000
A:Y-H:N	52.554413	9.518482	95.590343	0.0053021
B:Y-H:N	-58.823638	-85.242332	-32.404945	0.0000000
H:Y-H:N	-36.664781	-48.126035	-25.203528	0.0000000
W:Y-H:N	-16.869805	-41.213913	7.474302	0.4140104
A:Y-W:N	6.277175	-37.082105	49.636454	0.9998590
B:Y-W:N	-105.100876	-132.043096	-78.158657	0.0000000
H:Y-W:N	-82.942019	-95.563277	-70.320762	0.0000000
W:Y-W:N	-63.147043	-88.058314	-38.235773	0.0000000
B:Y-A:Y	-111.378051	-160.639208	-62.116894	0.0000000
H:Y-A:Y	-89.219194	-132.347775	-46.090612	0.0000000
W:Y-A:Y	-69.424218	-117.604606	-21.243830	0.0003406
H:Y-B:Y	22.158857	-4.410498	48.728212	0.1833794
W:Y-B:Y	41.953833	7.789438	76.118228	0.0049052
W:Y-H:Y	19.794976	-4.712550	44.302501	0.2179598

Fit: aov(formula = MATH_CONVERTED_SCR ~ Race_Eth:EcoDis, data = df_Spr15_race)

$`Race_Eth:EcoDis`

	diff	lwr	upr	p adj
B:N-A:N	-88.862090	-119.650938	-58.0732421	0.0000000
H:N-A:N	-83.085820	-108.614450	-57.5571891	0.0000000
W:N-A:N	-25.634652	-51.913406	0.6441031	0.0619223
A:Y-A:N	-75.620031	-116.697092	-34.5429698	0.0000007
B:Y-A:N	-140.519844	-173.498043	-107.5416460	0.0000000
H:Y-A:N	-120.880663	-146.427727	-95.3335991	0.0000000
W:Y-A:N	-90.749238	-121.040419	-60.4580560	0.0000000
H:N-B:N	5.776271	-13.764858	25.3173990	0.9864751
W:N-B:N	63.227439	42.716035	83.7388420	0.0000000
A:Y-B:N	13.242059	-24.407239	50.8913578	0.9636504
B:Y-B:N	-51.657754	-80.253318	-23.0621900	0.0000012
H:Y-B:N	-32.018573	-51.583777	-12.4533691	0.0000197
W:Y-B:N	-1.887147	-27.337106	23.5628114	0.9999986
W:N-H:N	57.451168	46.294310	68.6080259	0.0000000
A:Y-H:N	7.465789	-26.018947	40.9505238	0.9976063
B:Y-H:N	-57.434025	-80.269613	-34.5984364	0.0000000
H:Y-H:N	-37.794843	-47.098338	-28.4913492	0.0000000
W:Y-H:N	-7.663418	-26.410637	11.0838007	0.9201813
A:Y-W:N	-49.985379	-84.045466	-15.9252934	0.0002349
B:Y-W:N	-114.885193	-138.556400	-91.2139853	0.0000000
H:Y-W:N	-95.246011	-106.444983	-84.0470394	0.0000000
W:Y-W:N	-65.114586	-84.871108	-45.3580636	0.0000000
B:Y-A:Y	-64.899813	-104.359642	-25.4399845	0.0000174
H:Y-A:Y	-45.260632	-78.759423	-11.7618411	0.0011049
W:Y-A:Y	-15.129206	-52.372625	22.1142117	0.9226381
H:Y-B:Y	19.639181	-3.217012	42.4953748	0.1540598
W:Y-B:Y	49.770607	21.711583	77.8296300	0.0000022
W:Y-H:Y	30.131425	11.359113	48.9037377	0.0000319

Logistic Regression

READ

SY1314

```
> exp(coef(lr_read))  # Odds Ratio
(Intercept)    eco_disY  race_eth2A  race_eth2B  race_eth2H
  1.8806419   0.4721566   0.9457211   0.2579493   0.3815340
```

Spr2015

```
> exp(coef(lr_read))  # Odds Ratio
(Intercept)     EcoDisY  Race_Eth2A  Race_Eth2B  Race_Eth2H
  1.0516252   0.4022707   0.7382608   0.4142845   0.3906220
```

MATH

SY1314

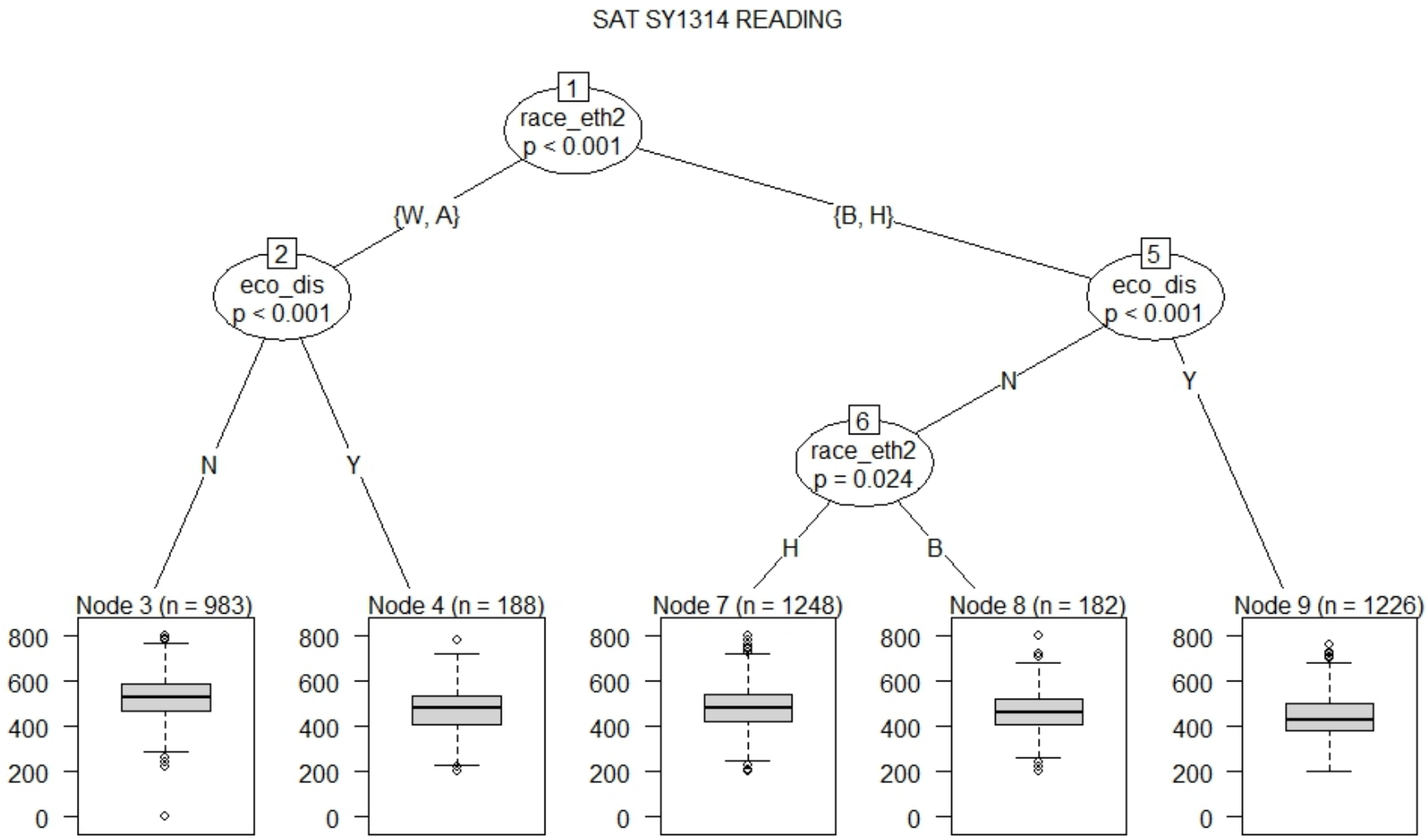
```
> exp(coef(lr_math))  # Odds Ratio
(Intercept)    eco_disY  race_eth2A  race_eth2B  race_eth2H
  2.0592382   0.5031949   1.8210447   0.2679086   0.4470340
```

Spr2015

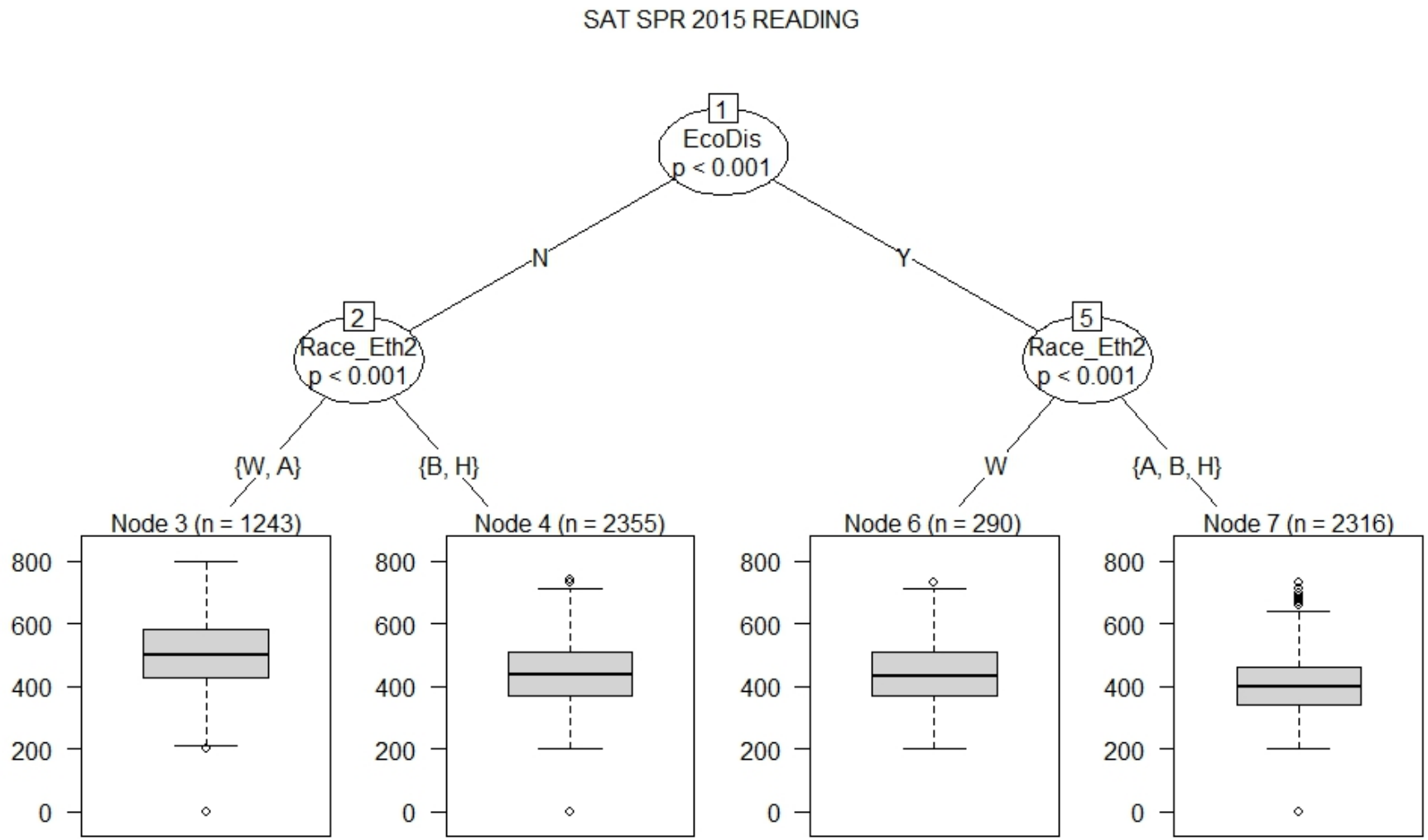
```
> exp(coef(lr_math))  # Odds Ratio
(Intercept)     EcoDisY  Race_Eth2A  Race_Eth2B  Race_Eth2H
  0.9878569   0.4221627   1.4279885   0.3566887   0.4420284
```

Odds Ratios show a shift, especially for Asian and African-American compared to White and for Economically Disadvantaged

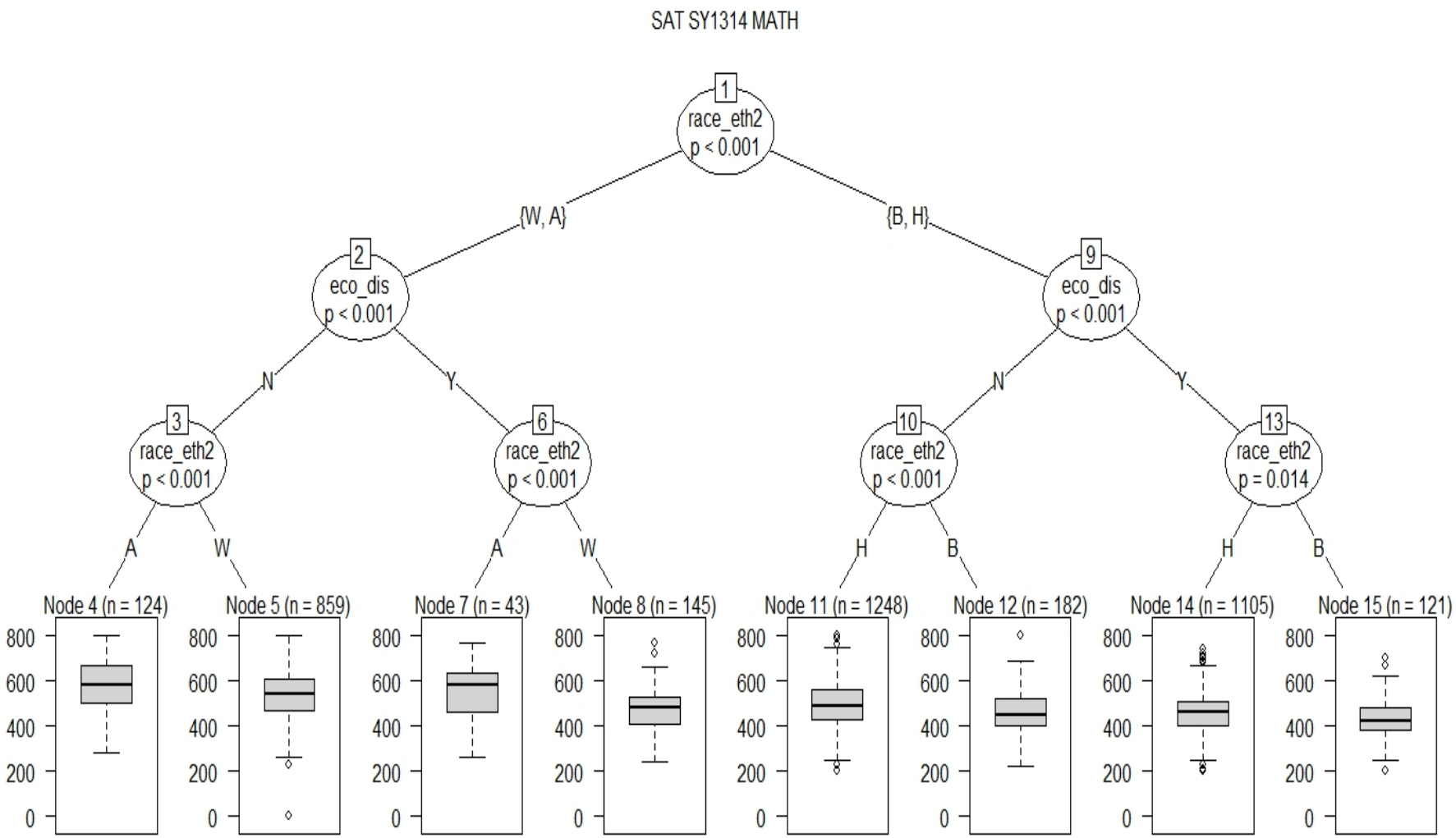
Decision Tree



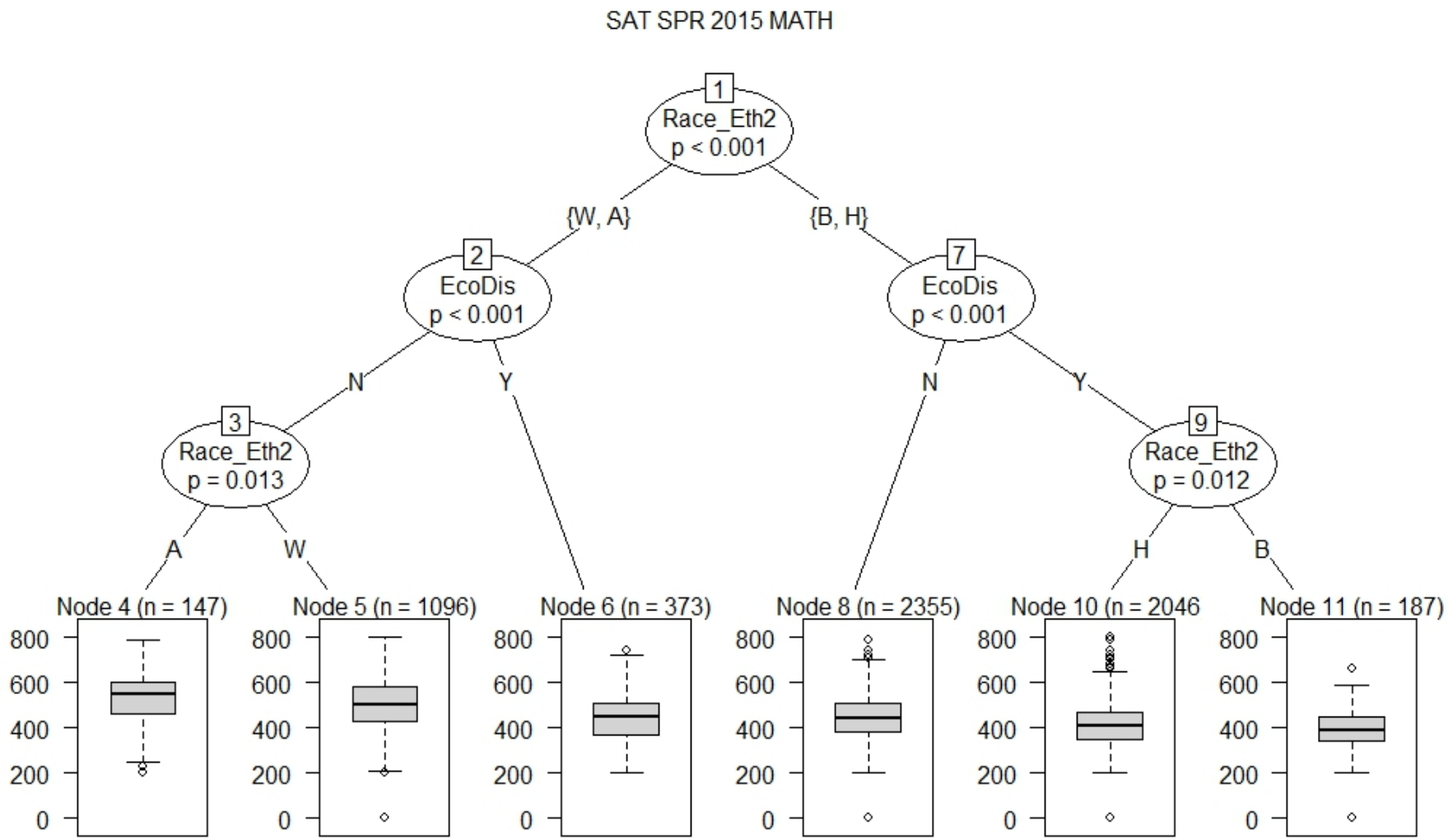
Decision Tree



Decision Tree



Decision Tree



Discussion

- All three methods indicate that the demographic factors relating to SAT scores in both Reading and Math shift after universal testing.
  - Odds Ratio gaps narrowed for some groups
  - Number of decision tree nodes and most important predictors changed

- In March 2016, the SAT underwent extensive changes, and thus the latest testing results could not be included in this analysis.

- As Spring 2017 and future data become available, more analysis will be conducted to quantify the effects with the new exam.

Sources

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