# biostats_final_combined

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## Descriptive summary statistics for all variables

Two table with summary information on the descriptive statistics of all variables are listed below. The frequency and percentage of each categories in each categorical variable is listed out. For each numeric variable, the table includes values of mean, median, standard deviation, minimum, maximum, Q1 and Q3 values.

### Categorical Variables

| variable | category | count | percent |
|---|---|---|---|
| gender | female | 315 | 53.662692 |
| gender | male | 272 | 46.337308 |
| ethnic_group | group A | 50 | 8.517888 |
| ethnic_group | group B | 123 | 20.954003 |
| ethnic_group | group C | 174 | 29.642249 |
| ethnic_group | group D | 155 | 26.405451 |
| ethnic_group | group E | 85 | 14.480409 |
| parent_educ | associate's degree | 128 | 21.805792 |
| parent_educ | bachelor's degree | 71 | 12.095400 |
| parent_educ | high school | 122 | 20.783646 |
| parent_educ | master's degree | 39 | 6.643952 |
| parent_educ | some college | 116 | 19.761499 |
| parent_educ | some high school | 111 | 18.909710 |
| lunch_type | free/reduced | 206 | 35.093697 |
| lunch_type | standard | 381 | 64.906303 |
| test_prep | completed | 208 | 35.434412 |
| test_prep | none | 379 | 64.565588 |
| parent_marital_status | divorced | 92 | 15.672913 |
| parent_marital_status | married | 343 | 58.432709 |
| parent_marital_status | single | 137 | 23.339012 |
| parent_marital_status | widowed | 15 | 2.555366 |
| practice_sport | never | 68 | 11.584327 |
| practice_sport | regularly | 218 | 37.137990 |
| practice_sport | sometimes | 301 | 51.277683 |
| is_first_child | no | 192 | 32.708688 |
| is_first_child | yes | 395 | 67.291312 |
| transport_means | private | 229 | 39.011925 |
| transport_means | school_bus | 358 | 60.988075 |
| wkly_study_hours | < 5 | 154 | 26.235094 |
| wkly_study_hours | > 10 | 104 | 17.717206 |
| wkly_study_hours | 5-10 | 329 | 56.047700 |

## Numeric Variables

| variable | mean | median | sd | minimum | maximum | q1 | q3 |
|---|---|---|---|---|---|---|---|
| nr_siblings | 2.139693 | 2 | 1.481712 | 0 | 7 | 1 | 3 |
| math_score | 66.676320 | 67 | 16.113744 | 0 | 100 | 56 | 78 |
| reading_score | 69.846678 | 70 | 15.166662 | 17 | 100 | 60 | 81 |
| writing_score | 68.901192 | 69 | 15.550000 | 10 | 100 | 58 | 79 |

# Exploration of outcome variables

The outcome of this study includes the following variables: maths scores, reading scores, and writing scores. QQplots of the outcome variables are created to explore the distribution of each score. QQplot compares the quantiles of the data against the quantiles of a normal distribution. According the plots, majority of the data points of all three scores follow the straight qqline, which indicates they follow the normal distribution. However, there are some deviations from the line on the two ends of the distribution, which indicates the distributions might have heavier tails than normal distribution. To further explore the distribution of outcomes, histograms and boxplots for the scores were incorporated. They are slightly left-tailed but mainly normally distributed. Thus, transformations are tested in the later section to further investigate the variables.
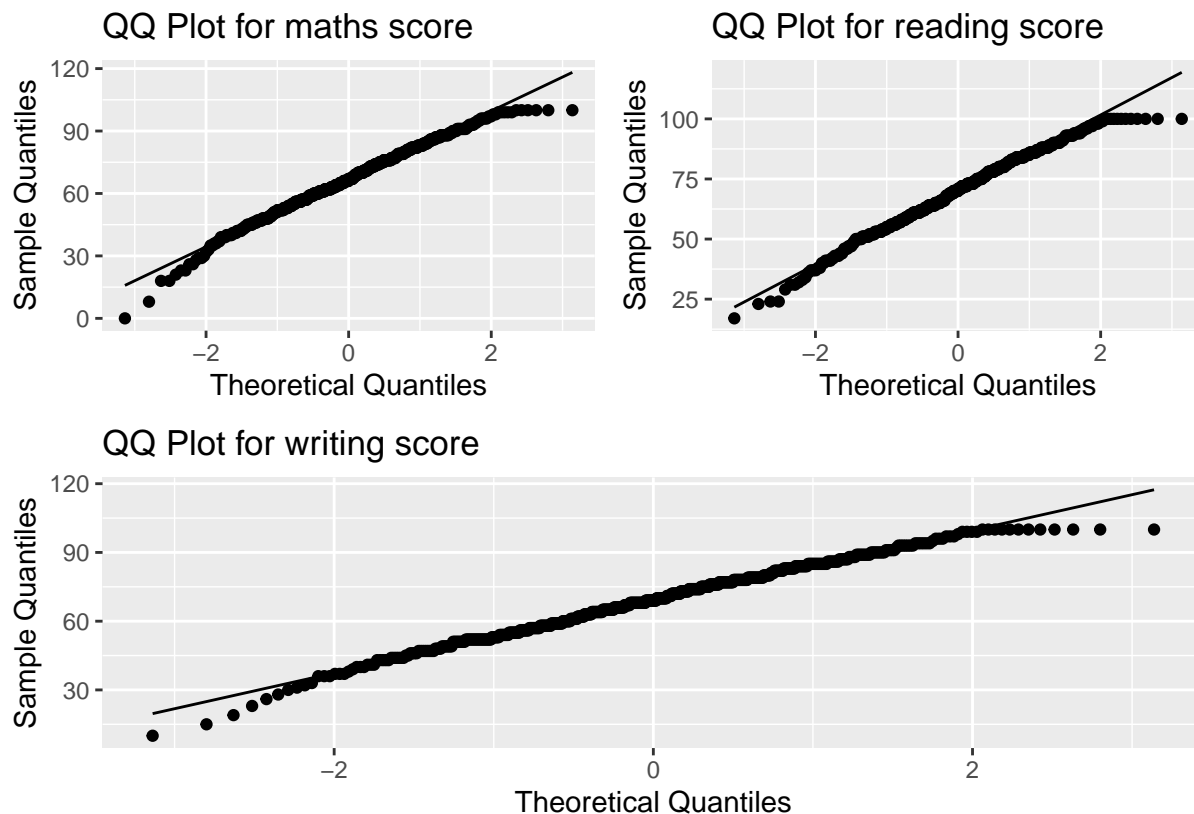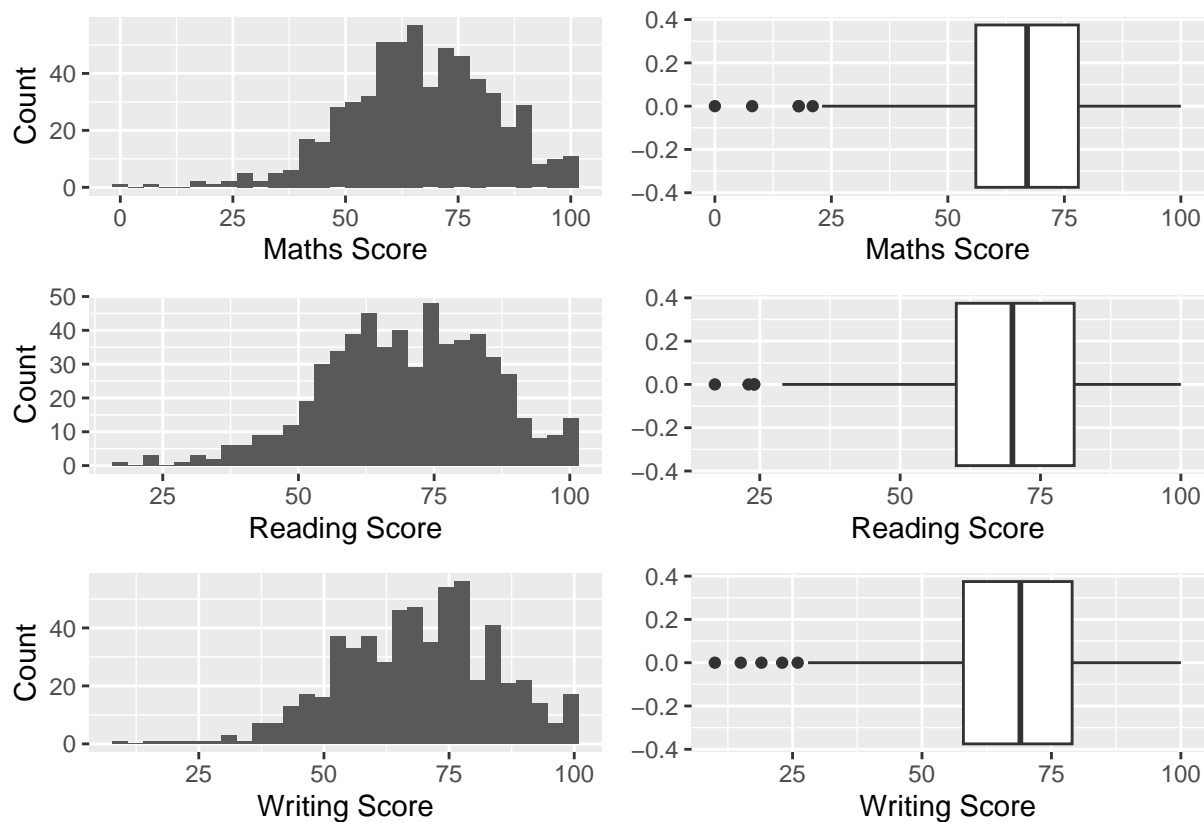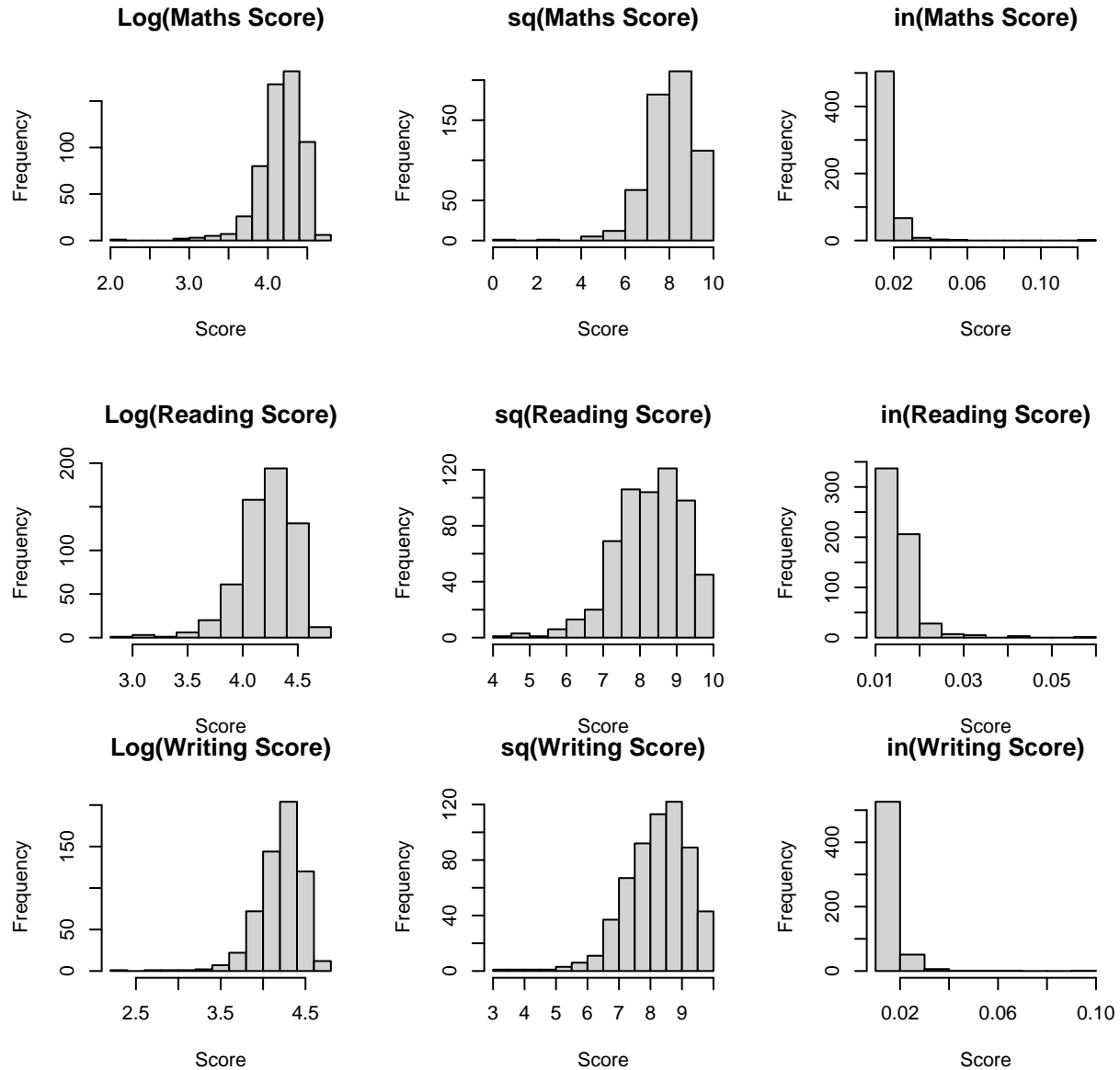
## Exploration of predictor variables
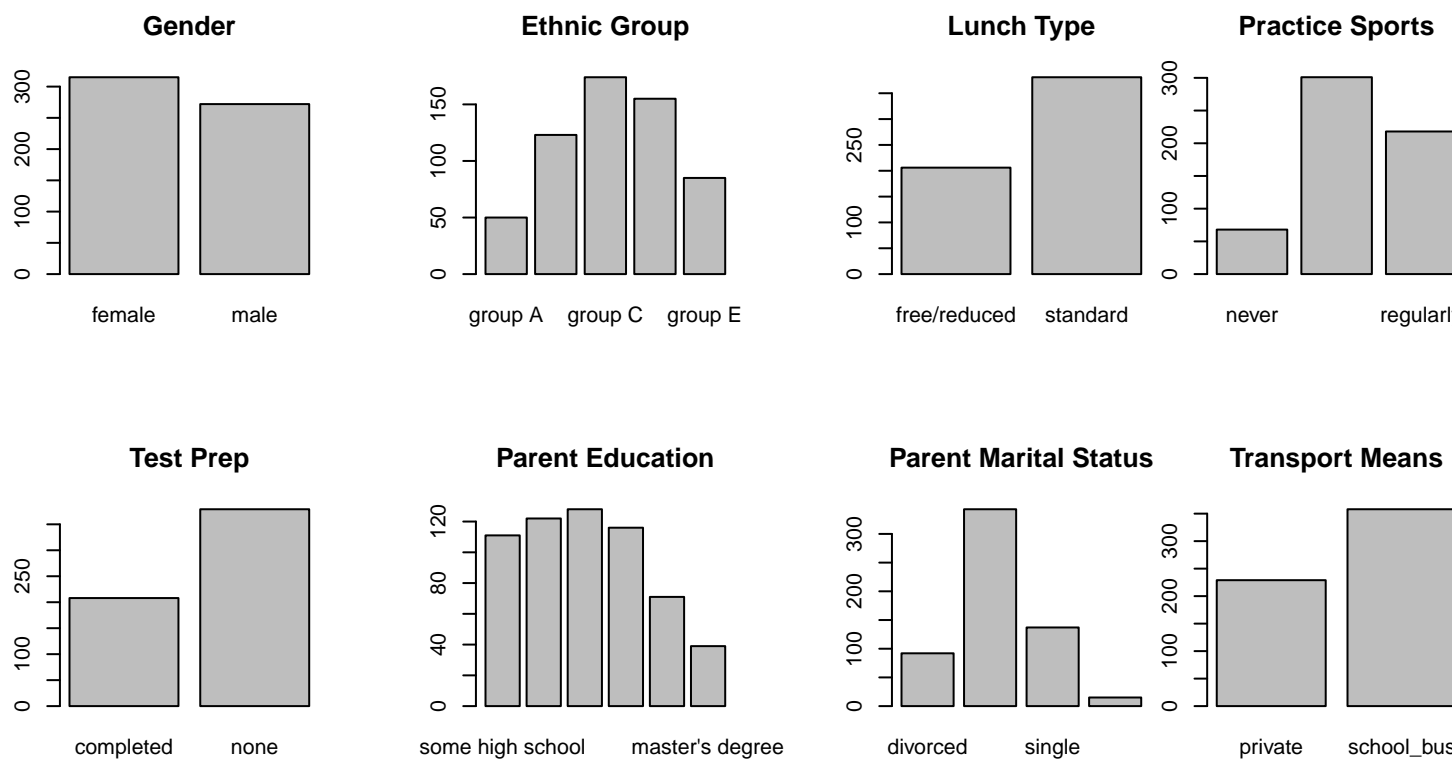


From the distribution bar graphs, it was decided that no transformation is needed for any predictor variables.

Admittedly, the distributions might not be good references for transformation because the variables are all categorical.

## Potential transformations for outcome variables



Since the distribution of the three scores showed slightly left-tailed, three types of transformations were tested: 1) Natural logarithm 2) Square Root 3) Inverse. The resulting plots are plotted in histograms shown above. There is no apparent improvement on the distribution of the outcome through the three transformations. Thus, the orignial outcome data were chosen to be used in following statistical modeling steps.

# Pairwise relationships
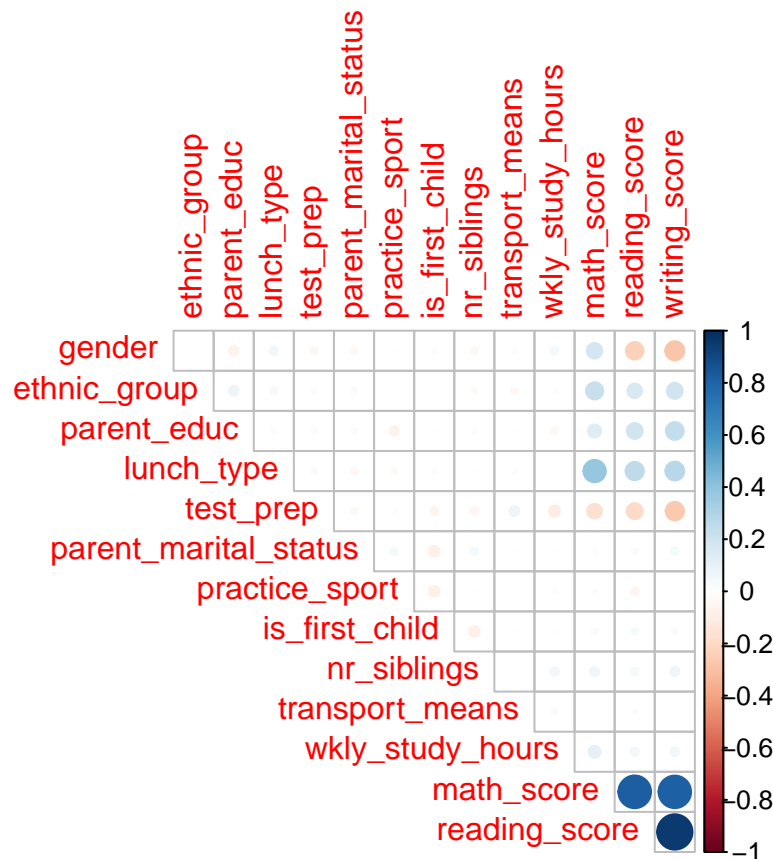


By plotting our the pairwise correlation between variables, there is apparent linearity among the three scores. Other correlation coefficients are relatively small, indicating weak linear relationship between the variables.

# MLR lm()

## MLR - Math

```
##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + practice_sport +
##     is_first_child + nr_siblings + transport_means + wkly_study_hours,
##     data = df_transformed)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.916  -9.265   0.725  10.104  33.013
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             44.1006     3.6704  12.015  < 2e-16 ***
## gendermale               5.0855     1.1386   4.467 9.61e-06 ***
## ethnic_groupgroup B     -0.1788     2.3136  -0.077  0.93841
## ethnic_groupgroup C     -0.2089     2.2149  -0.094  0.92489
```

```
## ethnic_groupgroup D             3.6247    2.2286    1.626   0.10441
## ethnic_groupgroup E            11.1752    2.4434    4.574 5.90e-06 ***
## parent_educhigh school         -0.3235    1.8015   -0.180   0.85757
## parent_educassociate's degree   4.9058    1.7728    2.767   0.00584 **
## parent_educsome college         3.1933    1.8163    1.758   0.07927 .
## parent_educbachelor's degree    6.6652    2.0763    3.210   0.00140 **
## parent_educmaster's degree      6.8096    2.5417    2.679   0.00760 **
## lunch_typestandard             12.3539    1.1771   10.495   < 2e-16 ***
## test_prepnone                  -4.7717    1.2007   -3.974 7.99e-05 ***
## parent_marital_statusmarried    5.4805    1.6170    3.389   0.00075 ***
## parent_marital_statussingle     2.1682    1.8454    1.175   0.24053
## parent_marital_statuswidowed    7.7944    3.8119    2.045   0.04134 *
## practice_sportsometimes         1.5255    1.8439    0.827   0.40838
## practice_sportregularly         1.6701    1.9046    0.877   0.38092
## is_first_childyes               1.1303    1.2125    0.932   0.35162
## nr_siblings                     0.7403    0.3844    1.926   0.05461 .
## transport_meansschool_bus      -0.4319    1.1629   -0.371   0.71050
## wkly_study_hours5-10            3.5394    1.3429    2.636   0.00863 **
## wkly_study_hours> 10            3.0384    1.7540    1.732   0.08378 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.52 on 564 degrees of freedom
## Multiple R-squared:  0.3221, Adjusted R-squared:  0.2956
## F-statistic: 12.18 on 22 and 564 DF,  p-value: < 2.2e-16
```

**Coefficients and Significance Levels:**

- Intercept (44.1006): The expected value of math_score when all other predictors are at their reference level or zero.
- gendermale (5.0855, p < 0.001): Being male is associated with an average increase of 5.0855 points in math_score compared to females, holding all else constant. This is statistically significant.
- ethnic_group: Only ethnic_groupgroup E (11.1752, p < 0.001) is significant, suggesting students in this group score higher in math compared to the reference group.
- parent_educ: The associate's degree (4.9058, p = 0.00584), bachelor's degree (6.6652, p = 0.00140), and master's degree (6.8096, p = 0.00760) are significant and associated with higher math scores compared to the reference category.
- lunch_typestandard (12.3539, p < 0.001): Students with standard lunch type score significantly higher.
- test_prepnone (-4.7717, p < 0.001): Not participating in test preparation is associated with lower math scores.
- parent_marital_status: Married (5.4805, p = 0.00075) and Widowed (7.7944, p = 0.04134) are associated with higher scores.
- practice_sport: Not significant.
- is_first_childyes: Not significant.
- nr_siblings (0.7403, p = 0.05461): A borderline significant positive association with math scores.
- transport_meansschool_bus: Not significant.
- wkly_study_hours: Studying 5-10 hours (3.5394, p = 0.00863) shows a significant positive effect.

**Residuals:**

The spread of residuals suggests the errors are somewhat symmetrically distributed around the predicted values, which is a good sign for linear regression assumptions.

**Model Fit:**

Residual Standard Error (13.52): Indicates the average difference between the observed values and the values predicted by the model.

**R-squared:**

- Multiple R-squared (0.3221): About 32.21% of the variability in math_score is explained by the model.
- Adjusted R-squared (0.2956): Adjusts the R-squared for the number of predictors, a better measure for models with multiple predictors.

**Statistic & p-value**

F-statistic (12.18) and p-value (< 2.2e-16): The model is statistically significant, meaning it performs better than a model with no predictors.

# MLR - reading

```
##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + practice_sport +
##     is_first_child + nr_siblings + transport_means + wkly_study_hours,
##     data = df_transformed)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -41.754  -8.793   0.635   9.118  30.513
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  60.8028     3.5826  16.972  < 2e-16 ***
## gendermale                   -7.6725     1.1114  -6.904 1.37e-11 ***
## ethnic_groupgroup B          -1.4287     2.2582  -0.633 0.527220
## ethnic_groupgroup C          -0.8558     2.1619  -0.396 0.692355
## ethnic_groupgroup D           2.5663     2.1753   1.180 0.238600
## ethnic_groupgroup E           5.9165     2.3850   2.481 0.013402 *
## parent_educhigh school       -0.5785     1.7584  -0.329 0.742303
## parent_educassociate's degree 4.7948    1.7305   2.771 0.005776 **
## parent_educsome college       2.4082     1.7729   1.358 0.174896
## parent_educbachelor's degree  7.3496     2.0266   3.627 0.000313 ***
## parent_educmaster's degree    8.7149     2.4809   3.513 0.000479 ***
## lunch_typestandard            8.4374     1.1489   7.344 7.31e-13 ***
## test_prepnone                -6.2822     1.1720  -5.360 1.21e-07 ***
## parent_marital_statusmarried  5.2439     1.5783   3.322 0.000950 ***
## parent_marital_statussingle   1.9235     1.8013   1.068 0.286046
## parent_marital_statuswidowed  5.5863     3.7208   1.501 0.133813
## practice_sportsometimes       0.6757     1.7998   0.375 0.707488
## practice_sportregularly      -0.6843     1.8590  -0.368 0.712923
## is_first_childyes             1.3046     1.1835   1.102 0.270780
## nr_siblings                   0.3882     0.3752   1.035 0.301309
## transport_meansschool_bus     0.2841     1.1351   0.250 0.802472
## wkly_study_hours5-10          2.6835     1.3108   2.047 0.041104 *
## wkly_study_hours> 10          1.0970     1.7121   0.641 0.521971
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.2 on 564 degrees of freedom
## Multiple R-squared:  0.2709, Adjusted R-squared:  0.2425
## F-statistic: 9.527 on 22 and 564 DF,  p-value: < 2.2e-16
```

**Coefficients and Significance Levels:**

- **Intercept (60.8028)**: The expected value of `reading_score` when all other predictors are at their reference level or zero.
- **gendermale (-7.6725, p < 0.001)**: Being male is associated with an average decrease of 7.6725 points in `reading_score` compared to females, holding all else constant. This is statistically significant.
- **ethnic_group**: Only `ethnic_groupgroup E` (5.9165, p = 0.013402) is significant, suggesting students in this group score higher in reading compared to the reference group.
- **parent_educ**: The `associate's degree` (4.7948, p = 0.005776), `bachelor's degree` (7.3496, p = 0.000313), and `master's degree` (8.7149, p = 0.000479) are significant and associated with higher reading scores compared to the reference category.
- **lunch_typestandard (8.4374, p < 0.001)**: Students with standard lunch type score significantly higher.
- **test_prepnone (-6.2822, p < 0.001)**: Not participating in test preparation is associated with lower reading scores.
- **parent_marital_statusmarried (5.2439, p = 0.000950)**: Children of married parents score higher.
- **practice_sport**: Not significant.
- **is_first_childyes**: Not significant.
- **nr_siblings (0.3882, p = 0.301309)**: No significant association with reading scores.
- **transport_meansschool_bus**: Not significant.
- **wkly_study_hours**: Studying 5-10 hours (2.6835, p = 0.041104) shows a significant positive effect.

**Residuals:**

The spread of residuals suggests the errors are somewhat symmetrically distributed around the predicted values, which is a good sign for linear regression assumptions.

**Model Fit:**

- **Residual Standard Error (13.2)**: Indicates the average difference between the observed values and the values predicted by the model.

**R-squared:**

- **Multiple R-squared (0.2709)**: About 27.09% of the variability in `reading_score` is explained by the model.
- **Adjusted R-squared (0.2425)**: Adjusts the R-squared for the number of predictors, a better measure for models with multiple predictors.

**Statistic & p-value**

- **F-statistic (9.527)** and **p-value (< 2.2e-16)**: The model is statistically significant, meaning it performs better than a model with no predictors.

## MLR - writing

```
##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
```

```
##      lunch_type + test_prep + parent_marital_status + practice_sport +
##      is_first_child + nr_siblings + transport_means + wkly_study_hours,
##      data = df_transformed)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -46.922  -8.043   1.071   8.811  26.214
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    57.808758   3.432409  16.842  < 2e-16 ***
## gendermale                     -9.268845   1.064760  -8.705  < 2e-16 ***
## ethnic_groupgroup B            -1.372239   2.163560  -0.634 0.526175
## ethnic_groupgroup C             0.005008   2.071256   0.002 0.998072
## ethnic_groupgroup D             5.010576   2.084123   2.404 0.016531 *
## ethnic_groupgroup E             6.018419   2.284980   2.634 0.008673 **
## parent_educhigh school         -0.230994   1.684700  -0.137 0.890990
## parent_educassociate's degree   6.130783   1.657904   3.698 0.000239 ***
## parent_educsome college         4.338798   1.698536   2.554 0.010898 *
## parent_educbachelor's degree    9.217680   1.941668   4.747 2.62e-06 ***
## parent_educmaster's degree     11.712279   2.376896   4.928 1.10e-06 ***
## lunch_typestandard              9.390698   1.100772   8.531  < 2e-16 ***
## test_prepnone                  -8.754351   1.122889  -7.796 3.09e-14 ***
## parent_marital_statusmarried    5.246610   1.512157   3.470 0.000561 ***
## parent_marital_statussingle     2.144248   1.725778   1.242 0.214575
## parent_marital_statuswidowed    6.877832   3.564779   1.929 0.054184 .
## practice_sportsometimes         1.674659   1.724312   0.971 0.331863
## practice_sportregularly         1.606102   1.781092   0.902 0.367574
## is_first_childyes               1.045414   1.133850   0.922 0.356921
## nr_siblings                     0.546033   0.359485   1.519 0.129340
## transport_meansschool_bus       0.240107   1.087508   0.221 0.825338
## wkly_study_hours5-10            2.802323   1.255870   2.231 0.026048 *
## wkly_study_hours> 10            1.188892   1.640324   0.725 0.468881
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.65 on 564 degrees of freedom
## Multiple R-squared:  0.3634, Adjusted R-squared:  0.3385
## F-statistic: 14.63 on 22 and 564 DF,  p-value: < 2.2e-16
```

**Coefficients and Significance Levels:**

- **Intercept (57.808758)**: The expected value of `writing_score` when all other predictors are at their reference level or zero.
- **gendermale (-9.268845, p < 0.001)**: Being male is associated with an average decrease of 9.268845 points in `writing_score` compared to females, holding all else constant. This is statistically significant.
- **ethnic_group**: `ethnic_groupgroup D` (5.010576, p = 0.016531) and `ethnic_groupgroup E` (6.018419, p = 0.008673) are significant, suggesting students in these groups score higher in writing compared to the reference group.
- **parent_educ**: `associate's degree` (6.130783, p = 0.000239), `some college` (4.338798, p = 0.010898), `bachelor's degree` (9.217680, p = 2.62e-06), and `master's degree` (11.712279, p = 1.10e-06) are significant and associated with higher writing scores compared to the reference category.
- **lunch_typestandard (9.390698, p < 0.001)**: Students with standard lunch type score significantly higher.

- **test_prepnone (-8.754351, p < 0.001)**: Not participating in test preparation is associated with lower writing scores.
- **parent_marital_statusmarried (5.246610, p = 0.000561)**: Children of married parents score higher.
- **practice_sport**: Not significant.
- **is_first_childyes**: Not significant.
- **nr_siblings (0.546033, p = 0.129340)**: No significant association with writing scores.
- **transport_meansschool_bus**: Not significant.
- **wkly_study_hours**: Studying 5-10 hours (2.802323, p = 0.026048) shows a significant positive effect.

**Residuals:**

The spread of residuals suggests the errors are somewhat symmetrically distributed around the predicted values, which is a good sign for linear regression assumptions.

**Model Fit:**

- **Residual Standard Error (12.65)**: Indicates the average difference between the observed values and the values predicted by the model.

**R-squared:**

- **Multiple R-squared (0.3634)**: About 36.34% of the variability in `writing_score` is explained by the model.
- **Adjusted R-squared (0.3385)**: Adjusts the R-squared for the number of predictors, a better measure for models with multiple predictors.

**Statistic & p-value**

- **F-statistic (14.63)** and **p-value (< 2.2e-16)**: The model is statistically significant, meaning it performs better than a model with no predictors.

## Cleaned datasets - updated by Nisha

## Step-wise: Backwards Elimination

Math Score

```
##
## Call:
## lm(formula = math_score ~ ., data = math_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.864  -9.425   0.975  10.116  32.369
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            23.0924     5.9271   3.896 0.000109 ***
## gender                  5.3175     1.1517   4.617 4.80e-06 ***
## ethnic_group            2.7588     0.4910   5.618 3.00e-08 ***
## parent_educ             1.5290     0.3843   3.979 7.81e-05 ***
## lunch_type             12.6192     1.2000  10.516  < 2e-16 ***
## test_prep              -5.2239     1.2078  -4.325 1.80e-05 ***
## parent_marital_status   0.7239     0.8331   0.869 0.385282
## practice_sport          0.6461     0.8845   0.730 0.465418
```

```
## is_first_child           0.7792      1.2313    0.633 0.527061
## nr_siblings               0.6981      0.3884    1.797 0.072825 .
## transport_means           0.2551      1.1745    0.217 0.828116
## wkly_study_hours          2.0684      0.8749    2.364 0.018402 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 575 degrees of freedom
## Multiple R-squared:  0.2779, Adjusted R-squared:  0.2641
## F-statistic: 20.11 on 11 and 575 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + practice_sport +
##     is_first_child + nr_siblings + wkly_study_hours, data = math_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -54.777  -9.369   1.069  10.160  32.206
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)             23.4423     5.6992    4.113 4.47e-05 ***
## gender                   5.3217     1.1506    4.625 4.62e-06 ***
## ethnic_group             2.7555     0.4904    5.619 2.99e-08 ***
## parent_educ              1.5300     0.3839    3.985 7.61e-05 ***
## lunch_type              12.6219     1.1990   10.527  < 2e-16 ***
## test_prep               -5.2041     1.2033   -4.325 1.80e-05 ***
## parent_marital_status    0.7256     0.8324    0.872   0.3837
## practice_sport           0.6470     0.8837    0.732   0.4644
## is_first_child           0.7826     1.2301    0.636   0.5249
## nr_siblings              0.6981     0.3881    1.799   0.0726 .
## wkly_study_hours         2.0752     0.8736    2.376   0.0178 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.81 on 576 degrees of freedom
## Multiple R-squared:  0.2778, Adjusted R-squared:  0.2653
## F-statistic: 22.16 on 10 and 576 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + practice_sport +
##     nr_siblings + wkly_study_hours, data = math_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -54.413  -9.258   0.787   9.904  32.464
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)             25.0419     5.1120    4.899 1.25e-06 ***
## gender                   5.3263     1.1500    4.632 4.48e-06 ***
```

```
## ethnic_group              2.7538      0.4901    5.619 3.00e-08 ***
## parent_educ               1.5308      0.3837    3.989 7.48e-05 ***
## lunch_type               12.6288      1.1983   10.539   < 2e-16 ***
## test_prep                -5.2506      1.2005   -4.374 1.45e-05 ***
## parent_marital_status     0.6824      0.8292    0.823    0.4109
## practice_sport            0.6017      0.8804    0.683    0.4946
## nr_siblings               0.6776      0.3866    1.753    0.0802 .
## wkly_study_hours          2.0800      0.8731    2.382    0.0175 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.81 on 577 degrees of freedom
## Multiple R-squared:  0.2773, Adjusted R-squared:  0.266
## F-statistic:  24.6 on 9 and 577 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + nr_siblings +
##     wkly_study_hours, data = math_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.042  -9.171   0.792  10.144  32.974
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             26.4222     4.6939    5.629 2.83e-08 ***
## gender                   5.3307     1.1494    4.638 4.36e-06 ***
## ethnic_group             2.7553     0.4899    5.624 2.90e-08 ***
## parent_educ              1.5138     0.3828    3.955 8.60e-05 ***
## lunch_type              12.6050     1.1973   10.528   < 2e-16 ***
## test_prep               -5.2588     1.1999   -4.383 1.39e-05 ***
## parent_marital_status    0.7058     0.8281    0.852    0.3944
## nr_siblings              0.6790     0.3864    1.757    0.0794 .
## wkly_study_hours         2.0891     0.8726    2.394    0.0170 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.8 on 578 degrees of freedom
## Multiple R-squared:  0.2767, Adjusted R-squared:  0.2667
## F-statistic: 27.64 on 8 and 578 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + nr_siblings + wkly_study_hours,
##     data = math_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.440  -8.894   0.776  10.134  32.889
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)          28.0713      4.2756    6.565 1.15e-10 ***
## gender                 5.3017      1.1486    4.616 4.83e-06 ***
## ethnic_group           2.7439      0.4896    5.605 3.23e-08 ***
## parent_educ            1.5210      0.3826    3.976 7.90e-05 ***
## lunch_type            12.5737      1.1964   10.510  < 2e-16 ***
## test_prep             -5.2926      1.1989   -4.414 1.21e-05 ***
## nr_siblings            0.6927      0.3860    1.795   0.0732 .
## wkly_study_hours       2.0825      0.8723    2.387   0.0173 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.8 on 579 degrees of freedom
## Multiple R-squared:  0.2758, Adjusted R-squared:  0.2671
## F-statistic:  31.5 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + wkly_study_hours, data = math_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.943  -9.439   0.630  10.403  31.459
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      29.7605     4.1787   7.122 3.16e-12 ***
## gender            5.2204     1.1499   4.540 6.85e-06 ***
## ethnic_group      2.7208     0.4904   5.549 4.39e-08 ***
## parent_educ       1.5128     0.3833   3.947 8.88e-05 ***
## lunch_type       12.5868     1.1987  10.501  < 2e-16 ***
## test_prep        -5.3895     1.2000  -4.491 8.55e-06 ***
## wkly_study_hours  2.1599     0.8729   2.474   0.0136 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 580 degrees of freedom
## Multiple R-squared:  0.2718, Adjusted R-squared:  0.2642
## F-statistic: 36.08 on 6 and 580 DF,  p-value: < 2.2e-16

## Start:  AIC=3095.24
## math_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + is_first_child +
##     nr_siblings + transport_means + wkly_study_hours
##
##                         Df Sum of Sq    RSS    AIC
## - transport_means        1       9.0 109886 3093.3
## - is_first_child         1      76.5 109954 3093.6
## - practice_sport         1     102.0 109979 3093.8
## - parent_marital_status  1     144.3 110022 3094.0
## <none>                               109877 3095.2
## - nr_siblings            1     617.2 110495 3096.5
## - wkly_study_hours       1    1068.1 110945 3098.9
## - parent_educ            1    3025.1 112902 3109.2
## - test_prep              1    3574.7 113452 3112.0
```

```
## - gender                      1     4073.6 113951 3114.6
## - ethnic_group                1     6032.2 115910 3124.6
## - lunch_type                   1    21130.5 131008 3196.5
##
## Step:  AIC=3093.29
## math_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + is_first_child +
##     nr_siblings + wkly_study_hours
##
##                          Df Sum of Sq    RSS    AIC
## - is_first_child          1      77.2 109964 3091.7
## - practice_sport          1     102.3 109989 3091.8
## - parent_marital_status   1     145.0 110031 3092.1
## <none>                                 109886 3093.3
## - nr_siblings             1     617.2 110504 3094.6
## - wkly_study_hours        1    1076.6 110963 3097.0
## - parent_educ             1    3029.8 112916 3107.3
## - test_prep               1    3568.0 113454 3110.0
## - gender                  1    4081.2 113968 3112.7
## - ethnic_group            1    6023.6 115910 3122.6
## - lunch_type              1   21141.9 131028 3194.6
##
## Step:  AIC=3091.7
## math_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + nr_siblings +
##     wkly_study_hours
##
##                          Df Sum of Sq    RSS    AIC
## - practice_sport          1      89.0 110053 3090.2
## - parent_marital_status   1     129.1 110093 3090.4
## <none>                                 109964 3091.7
## - nr_siblings             1     585.5 110549 3092.8
## - wkly_study_hours        1    1081.6 111045 3095.4
## - parent_educ             1    3032.9 112996 3105.7
## - test_prep               1    3645.7 113609 3108.8
## - gender                  1    4088.5 114052 3111.1
## - ethnic_group            1    6016.6 115980 3121.0
## - lunch_type              1   21166.9 131130 3193.0
##
## Step:  AIC=3090.18
## math_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + nr_siblings + wkly_study_hours
##
##                          Df Sum of Sq    RSS    AIC
## - parent_marital_status   1     138.3 110191 3088.9
## <none>                                 110053 3090.2
## - nr_siblings             1     587.9 110640 3091.3
## - wkly_study_hours        1    1091.4 111144 3094.0
## - parent_educ             1    2978.5 113031 3103.9
## - test_prep               1    3657.3 113710 3107.4
## - gender                  1    4095.3 114148 3109.6
## - ethnic_group            1    6022.9 116075 3119.5
## - lunch_type              1   21105.0 131158 3191.2
##
```

```
## Step:  AIC=3088.91
## math_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + nr_siblings + wkly_study_hours
##
##                      Df Sum of Sq    RSS    AIC
## <none>                            110191 3088.9
## - nr_siblings         1     613.0 110804 3090.2
## - wkly_study_hours    1    1084.6 111275 3092.7
## - parent_educ         1    3008.2 113199 3102.7
## - test_prep           1    3708.6 113900 3106.3
## - gender              1    4054.4 114245 3108.1
## - ethnic_group        1    5977.9 116169 3117.9
## - lunch_type          1   21020.1 131211 3189.4

##
## Call:
## lm(formula = math_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + nr_siblings + wkly_study_hours,
##     data = math_df)
##
## Coefficients:
##     (Intercept)           gender     ethnic_group      parent_educ
##         28.0713           5.3017           2.7439           1.5210
##      lunch_type        test_prep      nr_siblings  wkly_study_hours
##         12.5737          -5.2926           0.6927           2.0825
```

With manual elimination, the model we obtained was Math Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep + Weekly Study Hours.

When using the single-function method, the model obtained with the lowest AIC was Math Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep + Number of Siblings + Weekly Study Hours.

Reading Score

```
##
## Call:
## lm(formula = reading_score ~ ., data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -46.401  -9.051   0.404   9.807  33.637
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            61.3874     5.7518  10.673  < 2e-16 ***
## gender                 -7.5190     1.1176  -6.728 4.18e-11 ***
## ethnic_group            1.8185     0.4765   3.816  0.00015 ***
## parent_educ             1.7505     0.3729   4.694 3.35e-06 ***
## lunch_type              8.6295     1.1646   7.410 4.53e-13 ***
## test_prep              -6.6530     1.1721  -5.676 2.19e-08 ***
## parent_marital_status   0.5050     0.8085   0.625  0.53247
## practice_sport         -0.6974     0.8583  -0.813  0.41684
## is_first_child          0.9079     1.1949   0.760  0.44768
## nr_siblings             0.3178     0.3770   0.843  0.39960
## transport_means         0.8813     1.1398   0.773  0.43969
## wkly_study_hours        1.0163     0.8490   1.197  0.23180
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.41 on 575 degrees of freedom
## Multiple R-squared:  0.2323, Adjusted R-squared:  0.2177
## F-statistic: 15.82 on 11 and 575 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + practice_sport + is_first_child +
##     nr_siblings + transport_means + wkly_study_hours, data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.962  -9.031   0.340   9.774  33.510
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      62.6218     5.3988  11.599  < 2e-16 ***
## gender           -7.5395     1.1166  -6.752 3.56e-11 ***
## ethnic_group      1.8103     0.4761   3.803 0.000158 ***
## parent_educ       1.7562     0.3726   4.713 3.06e-06 ***
## lunch_type        8.6086     1.1635   7.399 4.88e-13 ***
## test_prep        -6.6809     1.1706  -5.707 1.84e-08 ***
## practice_sport   -0.6789     0.8574  -0.792 0.428771
## is_first_child    0.8467     1.1902   0.711 0.477108
## nr_siblings       0.3259     0.3765   0.865 0.387178
## transport_means   0.8883     1.1391   0.780 0.435820
## wkly_study_hours  1.0114     0.8485   1.192 0.233773
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.41 on 576 degrees of freedom
## Multiple R-squared:  0.2318, Adjusted R-squared:  0.2185
## F-statistic: 17.38 on 10 and 576 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + practice_sport + nr_siblings + transport_means +
##     wkly_study_hours, data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.609  -8.970   0.378   9.579  32.976
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      64.2344     4.8978  13.115  < 2e-16 ***
## gender           -7.5327     1.1161  -6.749 3.62e-11 ***
## ethnic_group      1.8094     0.4759   3.802 0.000159 ***
## parent_educ       1.7565     0.3725   4.716 3.02e-06 ***
## lunch_type        8.6180     1.1629   7.411 4.49e-13 ***
## test_prep        -6.7298     1.1681  -5.761 1.36e-08 ***
```

```
## practice_sport    -0.7300      0.8540   -0.855 0.393012
## nr_siblings         0.3027      0.3750    0.807 0.419780
## transport_means     0.8979      1.1386    0.789 0.430634
## wkly_study_hours     1.0168      0.8481    1.199 0.231087
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 577 degrees of freedom
## Multiple R-squared:  0.2312, Adjusted R-squared:  0.2192
## F-statistic: 19.27 on 9 and 577 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + practice_sport + nr_siblings + wkly_study_hours,
##     data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.293  -8.920   0.575   9.576  32.489
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    65.5028     4.6247  14.164  < 2e-16 ***
## gender         -7.5180     1.1155  -6.739 3.86e-11 ***
## ethnic_group    1.7978     0.4755   3.781 0.000172 ***
## parent_educ     1.7603     0.3723   4.728 2.85e-06 ***
## lunch_type      8.6274     1.1625   7.422 4.16e-13 ***
## test_prep      -6.6611     1.1645  -5.720 1.71e-08 ***
## practice_sport -0.7272     0.8537  -0.852 0.394695
## nr_siblings     0.3025     0.3748   0.807 0.419988
## wkly_study_hours 1.0410     0.8473   1.229 0.219699
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 578 degrees of freedom
## Multiple R-squared:  0.2303, Adjusted R-squared:  0.2197
## F-statistic: 21.62 on 8 and 578 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + practice_sport + wkly_study_hours,
##     data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.079  -8.940   0.773   9.687  32.757
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    66.2290     4.5350  14.604  < 2e-16 ***
## gender         -7.5535     1.1143  -6.779 3.00e-11 ***
## ethnic_group    1.7877     0.4752   3.762 0.000186 ***
## parent_educ     1.7569     0.3722   4.721 2.95e-06 ***
```

```
## lunch_type          8.6333      1.1621    7.429 3.94e-13 ***
## test_prep          -6.7034      1.1629   -5.764 1.33e-08 ***
## practice_sport     -0.7223      0.8534   -0.846 0.397676
## wkly_study_hours    1.0748      0.8460    1.270 0.204455
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.39 on 579 degrees of freedom
## Multiple R-squared:  0.2295, Adjusted R-squared:  0.2201
## F-statistic: 24.63 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + wkly_study_hours, data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.551  -8.822   0.863   9.721  32.252
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      64.5007     4.0483  15.933  < 2e-16 ***
## gender           -7.5573     1.1140  -6.784 2.90e-11 ***
## ethnic_group      1.7865     0.4751   3.761 0.000187 ***
## parent_educ       1.7770     0.3713   4.786 2.16e-06 ***
## lunch_type        8.6631     1.1613   7.460 3.18e-13 ***
## test_prep        -6.6919     1.1626  -5.756 1.39e-08 ***
## wkly_study_hours  1.0638     0.8457   1.258 0.208928
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.39 on 580 degrees of freedom
## Multiple R-squared:  0.2285, Adjusted R-squared:  0.2205
## F-statistic: 28.63 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep, data = reading_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.354  -8.959   0.802   9.901  32.216
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    66.7121     3.6485  18.285  < 2e-16 ***
## gender         -7.5066     1.1139  -6.739 3.84e-11 ***
## ethnic_group    1.7930     0.4753   3.773 0.000178 ***
## parent_educ     1.7606     0.3713   4.742 2.66e-06 ***
## lunch_type      8.6667     1.1618   7.459 3.18e-13 ***
## test_prep      -6.8289     1.1580  -5.897 6.28e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 13.4 on 581 degrees of freedom
## Multiple R-squared:  0.2264, Adjusted R-squared:  0.2197
## F-statistic: 34.01 on 5 and 581 DF,  p-value: < 2.2e-16

## Start:  AIC=3060.01
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + is_first_child +
##     nr_siblings + transport_means + wkly_study_hours
##
##                         Df Sum of Sq    RSS    AIC
## - parent_marital_status  1      70.2 103547 3058.4
## - is_first_child         1     103.9 103581 3058.6
## - transport_means        1     107.6 103584 3058.6
## - practice_sport         1     118.8 103595 3058.7
## - nr_siblings            1     127.9 103605 3058.7
## - wkly_study_hours       1     257.8 103734 3059.5
## <none>                              103477 3060.0
## - ethnic_group           1    2621.0 106098 3072.7
## - parent_educ            1    3965.2 107442 3080.1
## - test_prep              1    5798.3 109275 3090.0
## - gender                 1    8145.0 111622 3102.5
## - lunch_type             1    9881.5 113358 3111.6
##
## Step:  AIC=3058.41
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + practice_sport + is_first_child + nr_siblings +
##     transport_means + wkly_study_hours
##
##                   Df Sum of Sq    RSS    AIC
## - is_first_child   1      91.0 103638 3056.9
## - transport_means  1     109.3 103656 3057.0
## - practice_sport   1     112.7 103660 3057.1
## - nr_siblings      1     134.6 103681 3057.2
## - wkly_study_hours 1     255.4 103802 3057.8
## <none>                        103547 3058.4
## - ethnic_group     1    2599.5 106146 3071.0
## - parent_educ      1    3993.6 107540 3078.6
## - test_prep        1    5855.5 109402 3088.7
## - gender           1    8196.5 111743 3101.1
## - lunch_type       1    9841.8 113389 3109.7
##
## Step:  AIC=3056.92
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + practice_sport + nr_siblings + transport_means +
##     wkly_study_hours
##
##                   Df Sum of Sq    RSS    AIC
## - transport_means  1     111.7 103750 3055.6
## - nr_siblings      1     117.1 103755 3055.6
## - practice_sport   1     131.2 103769 3055.7
## - wkly_study_hours 1     258.1 103896 3056.4
## <none>                        103638 3056.9
## - ethnic_group     1    2597.0 106235 3069.4
```

```
## - parent_educ        1    3994.8 107633 3077.1
## - test_prep          1    5962.1 109600 3087.8
## - gender             1    8182.2 111820 3099.5
## - lunch_type         1    9864.6 113502 3108.3
##
## Step:  AIC=3055.56
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + practice_sport + nr_siblings + wkly_study_hours
##
##                    Df Sum of Sq    RSS    AIC
## - nr_siblings       1     116.9 103866 3054.2
## - practice_sport    1     130.2 103880 3054.3
## - wkly_study_hours  1     271.0 104021 3055.1
## <none>                          103750 3055.6
## - ethnic_group      1    2566.2 106316 3067.9
## - parent_educ       1    4012.9 107762 3075.8
## - test_prep         1    5873.7 109623 3085.9
## - gender            1    8152.7 111902 3098.0
## - lunch_type        1    9887.1 113637 3107.0
##
## Step:  AIC=3054.22
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + practice_sport + wkly_study_hours
##
##                    Df Sum of Sq    RSS    AIC
## - practice_sport    1     128.5 103995 3052.9
## - wkly_study_hours  1     289.5 104156 3053.8
## <none>                          103866 3054.2
## - ethnic_group      1    2539.1 106406 3066.4
## - parent_educ       1    3997.8 107864 3074.4
## - test_prep         1    5960.5 109827 3085.0
## - gender            1    8242.7 112109 3097.0
## - lunch_type        1    9901.1 113768 3105.7
##
## Step:  AIC=3052.94
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + wkly_study_hours
##
##                    Df Sum of Sq    RSS    AIC
## - wkly_study_hours  1     283.7 104279 3052.5
## <none>                          103995 3052.9
## - ethnic_group      1    2535.8 106531 3065.1
## - parent_educ       1    4106.5 108102 3073.7
## - test_prep         1    5941.0 109936 3083.6
## - gender            1    8251.2 112246 3095.8
## - lunch_type        1    9978.6 113974 3104.7
##
## Step:  AIC=3052.54
## reading_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep
##
##                 Df Sum of Sq    RSS    AIC
## <none>                       104279 3052.5
## - ethnic_group   1    2554.7 106833 3064.8
```

```
## - parent_educ    1    4036.2 108315 3072.8
## - test_prep      1    6241.3 110520 3084.7
## - gender         1    8151.5 112430 3094.7
## - lunch_type     1    9987.0 114266 3104.2
##
## Call:
## lm(formula = reading_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep, data = reading_df)
##
## Coefficients:
##  (Intercept)         gender  ethnic_group    parent_educ     lunch_type
##       66.712         -7.507         1.793          1.761          8.667
##    test_prep
##       -6.829
```

With manual elimination, the model we obtained was Reading Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep.

When using the single-function method, the model obtained with the lowest AIC was Reading Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep.

Writing Score

```
##
## Call:
## lm(formula = writing_score ~ ., data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.711  -8.503   0.758   9.459  28.543
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            59.1030     5.5195  10.708  < 2e-16 ***
## gender                 -9.1137     1.0725  -8.498  < 2e-16 ***
## ethnic_group            2.2059     0.4572   4.824 1.80e-06 ***
## parent_educ             2.3308     0.3579   6.513 1.61e-10 ***
## lunch_type              9.5265     1.1175   8.525  < 2e-16 ***
## test_prep              -8.9524     1.1247  -7.960 9.25e-15 ***
## parent_marital_status   0.7645     0.7758   0.985    0.325
## practice_sport          0.4809     0.8237   0.584    0.560
## is_first_child          0.6009     1.1466   0.524    0.600
## nr_siblings             0.4607     0.3617   1.274    0.203
## transport_means         0.7647     1.0937   0.699    0.485
## wkly_study_hours        1.1007     0.8147   1.351    0.177
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 575 degrees of freedom
## Multiple R-squared:  0.3275, Adjusted R-squared:  0.3147
## F-statistic: 25.46 on 11 and 575 DF,  p-value: < 2.2e-16
##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + practice_sport +
```

```
##     nr_siblings + transport_means + wkly_study_hours, data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.434  -8.291   0.834   9.509  28.702
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             60.3211     5.0031  12.057  < 2e-16 ***
## gender                  -9.1103     1.0718  -8.500  < 2e-16 ***
## ethnic_group             2.2047     0.4570   4.825 1.80e-06 ***
## parent_educ              2.3314     0.3576   6.519 1.55e-10 ***
## lunch_type               9.5317     1.1168   8.535  < 2e-16 ***
## test_prep               -8.9887     1.1219  -8.012 6.28e-15 ***
## parent_marital_status    0.7312     0.7727   0.946    0.344
## practice_sport           0.4462     0.8205   0.544    0.587
## nr_siblings              0.4449     0.3602   1.235    0.217
## transport_means          0.7719     1.0930   0.706    0.480
## wkly_study_hours         1.1041     0.8142   1.356    0.176
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.86 on 576 degrees of freedom
## Multiple R-squared:  0.3272, Adjusted R-squared:  0.3155
## F-statistic: 28.01 on 10 and 576 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + nr_siblings +
##     transport_means + wkly_study_hours, data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.159  -8.417   0.695   9.645  28.655
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             61.3413     4.6352  13.234  < 2e-16 ***
## gender                  -9.1071     1.0711  -8.502  < 2e-16 ***
## ethnic_group             2.2058     0.4567   4.830 1.75e-06 ***
## parent_educ              2.3188     0.3567   6.501 1.72e-10 ***
## lunch_type               9.5141     1.1156   8.528  < 2e-16 ***
## test_prep               -8.9949     1.1211  -8.023 5.79e-15 ***
## parent_marital_status    0.7486     0.7716   0.970    0.332
## nr_siblings              0.4460     0.3600   1.239    0.216
## transport_means          0.7742     1.0923   0.709    0.479
## wkly_study_hours         1.1108     0.8136   1.365    0.173
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.86 on 577 degrees of freedom
## Multiple R-squared:  0.3269, Adjusted R-squared:  0.3164
## F-statistic: 31.13 on 9 and 577 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + parent_marital_status + nr_siblings +
##     wkly_study_hours, data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.889  -8.443   0.979   9.527  28.924
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)             62.4294     4.3717  14.280  < 2e-16 ***
## gender                  -9.0942     1.0705  -8.495  < 2e-16 ***
## ethnic_group             2.1959     0.4563   4.813 1.90e-06 ***
## parent_educ              2.3220     0.3565   6.514 1.60e-10 ***
## lunch_type               9.5223     1.1151   8.540  < 2e-16 ***
## test_prep               -8.9355     1.1175  -7.996 7.04e-15 ***
## parent_marital_status    0.7535     0.7712   0.977    0.329
## nr_siblings              0.4457     0.3599   1.238    0.216
## wkly_study_hours         1.1318     0.8127   1.393    0.164
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.85 on 578 degrees of freedom
## Multiple R-squared:  0.3263, Adjusted R-squared:  0.317
## F-statistic: 34.99 on 8 and 578 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + nr_siblings + wkly_study_hours,
##     data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.246  -8.263   0.690   9.167  28.855
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      64.1899     3.9829  16.116  < 2e-16 ***
## gender           -9.1252     1.0700  -8.528  < 2e-16 ***
## ethnic_group      2.1838     0.4561   4.788 2.14e-06 ***
## parent_educ       2.3296     0.3564   6.537 1.38e-10 ***
## lunch_type        9.4888     1.1145   8.514  < 2e-16 ***
## test_prep        -8.9716     1.1169  -8.033 5.35e-15 ***
## nr_siblings       0.4603     0.3595   1.280    0.201
## wkly_study_hours  1.1248     0.8126   1.384    0.167
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.85 on 579 degrees of freedom
## Multiple R-squared:  0.3252, Adjusted R-squared:  0.317
## F-statistic: 39.86 on 7 and 579 DF,  p-value: < 2.2e-16
```

```
## 
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + wkly_study_hours, data = writing_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.917  -8.391   0.613   9.143  29.293
## 
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       65.3125     3.8874  16.801  < 2e-16 ***
## gender            -9.1792     1.0698  -8.581  < 2e-16 ***
## ethnic_group       2.1684     0.4562   4.753 2.53e-06 ***
## parent_educ        2.3242     0.3566   6.519 1.54e-10 ***
## lunch_type         9.4976     1.1151   8.517  < 2e-16 ***
## test_prep         -9.0360     1.1163  -8.094 3.40e-15 ***
## wkly_study_hours   1.1762     0.8121   1.448    0.148
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 12.86 on 580 degrees of freedom
## Multiple R-squared:  0.3233, Adjusted R-squared:  0.3163
## F-statistic: 46.18 on 6 and 580 DF,  p-value: < 2.2e-16

## 
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep, data = writing_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.594  -8.422   0.710   9.201  29.415
## 
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   67.7575     3.5050  19.332  < 2e-16 ***
## gender        -9.1231     1.0701  -8.526  < 2e-16 ***
## ethnic_group   2.1756     0.4566   4.765 2.39e-06 ***
## parent_educ    2.3061     0.3567   6.466 2.14e-10 ***
## lunch_type     9.5016     1.1161   8.513  < 2e-16 ***
## test_prep     -9.1875     1.1125  -8.258 9.99e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 12.87 on 581 degrees of freedom
## Multiple R-squared:  0.3208, Adjusted R-squared:  0.315
## F-statistic: 54.89 on 5 and 581 DF,  p-value: < 2.2e-16

## Start:  AIC=3011.6
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + is_first_child +
##     nr_siblings + transport_means + wkly_study_hours
## 
##                         Df Sum of Sq    RSS    AIC
```

```
## - is_first_child          1        45.5   95330  3009.9
## - practice_sport          1        56.5   95341  3009.9
## - transport_means         1        81.0   95366  3010.1
## - parent_marital_status   1       160.9   95446  3010.6
## - nr_siblings             1       268.8   95554  3011.2
## - wkly_study_hours        1       302.5   95587  3011.5
## <none>                                    95285  3011.6
## - ethnic_group            1      3856.7   99142  3032.9
## - parent_educ             1      7030.2  102315  3051.4
## - test_prep               1     10498.8  105784  3070.9
## - gender                  1     11966.3  107251  3079.0
## - lunch_type              1     12042.4  107327  3079.5
##
## Step:  AIC=3009.88
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + practice_sport + nr_siblings +
##     transport_means + wkly_study_hours
##
##                           Df Sum of Sq    RSS     AIC
## - practice_sport          1        48.9   95379  3008.2
## - transport_means         1        82.6   95413  3008.4
## - parent_marital_status   1       148.2   95479  3008.8
## - nr_siblings             1       252.5   95583  3009.4
## - wkly_study_hours        1       304.4   95635  3009.8
## <none>                                    95330  3009.9
## - ethnic_group            1      3852.7   99183  3031.1
## - parent_educ             1      7033.6  102364  3049.7
## - test_prep               1     10624.5  105955  3069.9
## - gender                  1     11957.7  107288  3077.2
## - lunch_type              1     12056.6  107387  3077.8
##
## Step:  AIC=3008.18
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + nr_siblings + transport_means +
##     wkly_study_hours
##
##                           Df Sum of Sq    RSS     AIC
## - transport_means         1        83.0   95462  3006.7
## - parent_marital_status   1       155.6   95535  3007.1
## - nr_siblings             1       253.7   95633  3007.7
## - wkly_study_hours        1       308.2   95688  3008.1
## <none>                                    95379  3008.2
## - ethnic_group            1      3856.6   99236  3029.4
## - parent_educ             1      6987.2  102367  3047.7
## - test_prep               1     10640.3  106020  3068.3
## - gender                  1     11949.7  107329  3075.5
## - lunch_type              1     12022.2  107402  3075.9
##
## Step:  AIC=3006.69
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + parent_marital_status + nr_siblings + wkly_study_hours
##
##                           Df Sum of Sq    RSS     AIC
## - parent_marital_status   1       157.7   95620  3005.7
```

```
## - nr_siblings          1     253.3   95716 3006.2
## - wkly_study_hours      1     320.3   95783 3006.7
## <none>                                95462 3006.7
## - ethnic_group          1    3825.5   99288 3027.8
## - parent_educ           1    7007.4  102470 3046.3
## - test_prep             1   10559.2  106022 3066.3
## - gender                1   11919.4  107382 3073.8
## - lunch_type            1   12044.3  107507 3074.4
##
## Step:  AIC=3005.66
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + nr_siblings + wkly_study_hours
##
##                   Df Sum of Sq     RSS    AIC
## - nr_siblings      1     270.7   95891 3005.3
## - wkly_study_hours 1     316.4   95936 3005.6
## <none>                           95620 3005.7
## - ethnic_group     1    3786.2   99406 3026.4
## - parent_educ      1    7057.0  102677 3045.5
## - test_prep        1   10656.5  106277 3065.7
## - lunch_type       1   11971.1  107591 3072.9
## - gender           1   12011.2  107631 3073.1
##
## Step:  AIC=3005.32
## writing_score ~ gender + ethnic_group + parent_educ + lunch_type +
##     test_prep + wkly_study_hours
##
##                   Df Sum of Sq     RSS    AIC
## <none>                           95891 3005.3
## - wkly_study_hours 1     346.8   96238 3005.4
## - ethnic_group     1    3735.6   99626 3025.8
## - parent_educ      1    7025.2  102916 3044.8
## - test_prep        1   10832.0  106723 3066.1
## - lunch_type       1   11993.5  107884 3072.5
## - gender           1   12172.7  108064 3073.5
##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group + parent_educ +
##     lunch_type + test_prep + wkly_study_hours, data = writing_df)
##
## Coefficients:
##      (Intercept)            gender      ethnic_group         parent_educ
##           65.312            -9.179             2.168               2.324
##       lunch_type         test_prep  wkly_study_hours
##            9.498            -9.036             1.176
```

With manual elimination, the model we obtained was Writing Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep.

When using the single-function method, the model obtained with the lowest AIC was Writing Score ~ Gender + Ethnic Group + Parent Education + Lunch Type + Test Prep + Weekly Study Hours.

## Step-wise: Forward Elimination

Math Score

```
##
## Call:
## lm(formula = math_score ~ gender, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q    Max
## -63.933 -10.393   0.147  11.107  36.067
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   58.014      2.029  28.596  < 2e-16 ***
## gender         5.920      1.312   4.511  7.8e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.85 on 585 degrees of freedom
## Multiple R-squared:  0.03362,    Adjusted R-squared:  0.03196
## F-statistic: 20.35 on 1 and 585 DF,  p-value: 7.801e-06

##
## Call:
## lm(formula = math_score ~ ethnic_group, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q    Max
## -66.134  -9.256   0.744  10.805  39.112
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   56.7656     1.8778  30.230  < 2e-16 ***
## ethnic_group   3.1227     0.5553   5.624  2.9e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.71 on 585 degrees of freedom
## Multiple R-squared:  0.05129,    Adjusted R-squared:  0.04967
## F-statistic: 31.62 on 1 and 585 DF,  p-value: 2.9e-08

##
## Call:
## lm(formula = math_score ~ parent_educ, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q    Max
## -63.753  -9.889   0.823  11.399  35.247
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  62.3292     1.4986  41.591   <2e-16 ***
## parent_educ   1.4240     0.4408   3.231   0.0013 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.99 on 585 degrees of freedom
## Multiple R-squared:  0.01753,    Adjusted R-squared:  0.01585
```

```
## F-statistic: 10.44 on 1 and 585 DF,  p-value: 0.001304

##
## Call:
## lm(formula = math_score ~ lunch_type, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.286 -10.286   0.787  10.787  41.714
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   45.360      2.212   20.51   <2e-16 ***
## lunch_type    12.926      1.288   10.03   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.9 on 585 degrees of freedom
## Multiple R-squared:  0.1468, Adjusted R-squared:  0.1454
## F-statistic: 100.7 on 1 and 585 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -67.017 -10.235  -0.017  11.374  33.765
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            65.8442     2.1578  30.514   <2e-16 ***
## parent_marital_status   0.3911     0.9647   0.405    0.685
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.13 on 585 degrees of freedom
## Multiple R-squared:  0.0002809,  Adjusted R-squared:  -0.001428
## F-statistic: 0.1644 on 1 and 585 DF,  p-value: 0.6853

##
## Call:
## lm(formula = math_score ~ practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -66.873 -10.344   0.127  11.391  33.391
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  66.0793     2.4052  27.473   <2e-16 ***
## practice_sport 0.2647     1.0247   0.258    0.796
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 16.13 on 585 degrees of freedom
## Multiple R-squared:  0.000114,   Adjusted R-squared:  -0.001595
## F-statistic: 0.06671 on 1 and 585 DF,  p-value: 0.7963

##
## Call:
## lm(formula = math_score ~ is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -67.008 -10.008  -0.008  11.005  34.005
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)      64.982      2.464  26.371   <2e-16 ***
## is_first_child    1.013      1.418   0.714    0.475
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.12 on 585 degrees of freedom
## Multiple R-squared:  0.000871,   Adjusted R-squared:  -0.0008369
## F-statistic:  0.51 on 1 and 585 DF,  p-value: 0.4754

##
## Call:
## lm(formula = math_score ~ nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -67.271 -10.234   0.112  11.037  33.803
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 65.1969     1.1675  55.841   <2e-16 ***
## nr_siblings  0.6914     0.4487   1.541    0.124
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.09 on 585 degrees of freedom
## Multiple R-squared:  0.004042,   Adjusted R-squared:  0.00234
## F-statistic: 2.374 on 1 and 585 DF,  p-value: 0.1239

##
## Call:
## lm(formula = math_score ~ transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -66.696 -10.646   0.304  11.304  33.354
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     66.59705    2.29558  29.011   <2e-16 ***
## transport_means  0.04924    1.36467   0.036    0.971
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.13 on 585 degrees of freedom
## Multiple R-squared:  2.226e-06,  Adjusted R-squared:  -0.001707
## F-statistic: 0.001302 on 1 and 585 DF,  p-value: 0.9712

##
## Call:
## lm(formula = math_score ~ wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -69.545  -9.902   0.098  11.598  33.742
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        61.614      2.038  30.236  < 2e-16 ***
## wkly_study_hours    2.644      1.007   2.627  0.00885 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.03 on 585 degrees of freedom
## Multiple R-squared:  0.01166,   Adjusted R-squared:  0.009966
## F-statistic: 6.899 on 1 and 585 DF,  p-value: 0.008851

##
## Call:
## lm(formula = math_score ~ test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -64.715  -9.715  -0.250  11.285  35.285
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   75.785      2.353  32.214  < 2e-16 ***
## test_prep     -5.535      1.373  -4.032 6.26e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.91 on 585 degrees of freedom
## Multiple R-squared:  0.02704,   Adjusted R-squared:  0.02538
## F-statistic: 16.26 on 1 and 585 DF,  p-value: 6.26e-05

##
## Call:
## lm(formula = math_score ~ lunch_type + gender, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.033 -10.487   0.692  10.335  38.692
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   38.127      2.744  13.894  < 2e-16 ***
```

```
## lunch_type     12.632       1.271    9.939  < 2e-16 ***
## gender           5.274       1.216    4.336 1.71e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 584 degrees of freedom
## Multiple R-squared:  0.1734, Adjusted R-squared:  0.1706
## F-statistic: 61.27 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.960  -9.607   0.552  10.353  36.199
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  36.5522     2.6533  13.776  < 2e-16 ***
## lunch_type   12.6467     1.2560  10.069  < 2e-16 ***
## ethnic_group  2.9205     0.5134   5.688 2.03e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.51 on 584 degrees of freedom
## Multiple R-squared:  0.1916, Adjusted R-squared:  0.1888
## F-statistic: 69.22 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.223 -10.409   0.879  10.845  41.828
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  40.7657     2.5292  16.118  < 2e-16 ***
## lunch_type   12.9827     1.2752  10.181  < 2e-16 ***
## parent_educ   1.4745     0.4066   3.627 0.000312 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.74 on 584 degrees of freedom
## Multiple R-squared:  0.1656, Adjusted R-squared:  0.1628
## F-statistic: 57.96 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + parent_marital_status,
##     data = step_df)
##
## Residuals:
```

```
##      Min      1Q  Median      3Q      Max
## -58.875 -10.434   0.865  10.845  41.826
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            43.8110     2.9633  14.785   <2e-16 ***
## lunch_type             12.9612     1.2895  10.052   <2e-16 ***
## parent_marital_status   0.7009     0.8920   0.786    0.432
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.9 on 584 degrees of freedom
## Multiple R-squared:  0.1477, Adjusted R-squared:  0.1448
## F-statistic: 50.61 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.678 -10.536   0.919  10.893  41.322
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  44.0952     3.1203  14.132   <2e-16 ***
## lunch_type   12.9480     1.2896  10.041   <2e-16 ***
## practice_sport 0.5449     0.9475   0.575    0.565
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.91 on 584 degrees of freedom
## Multiple R-squared:  0.1473, Adjusted R-squared:  0.1444
## F-statistic: 50.45 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.571 -10.529   0.513  10.513  42.279
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  43.9538     3.0975  14.190   <2e-16 ***
## lunch_type   12.9159     1.2890  10.020   <2e-16 ***
## is_first_child 0.8508     1.3113   0.649    0.517
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.9 on 584 degrees of freedom
## Multiple R-squared:  0.1474, Adjusted R-squared:  0.1445
## F-statistic:  50.5 on 2 and 584 DF,  p-value: < 2.2e-16
```

```
## 
## Call:
## lm(formula = math_score ~ lunch_type + nr_siblings, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.877 -10.432   0.756  10.529  41.123
## 
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  43.9040     2.3785  18.459   <2e-16 ***
## lunch_type   12.9222     1.2864  10.045   <2e-16 ***
## nr_siblings   0.6836     0.4147   1.648   0.0998 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 14.87 on 584 degrees of freedom
## Multiple R-squared:  0.1508, Adjusted R-squared:  0.1479
## F-statistic: 51.84 on 2 and 584 DF,  p-value: < 2.2e-16

## 
## Call:
## lm(formula = math_score ~ lunch_type + transport_means, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.246 -10.246   0.754  10.827  41.652
## 
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      45.5226     2.9870  15.240   <2e-16 ***
## lunch_type       12.9274     1.2895  10.025   <2e-16 ***
## transport_means  -0.1021     1.2617  -0.081    0.936
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 14.91 on 584 degrees of freedom
## Multiple R-squared:  0.1468, Adjusted R-squared:  0.1439
## F-statistic: 50.26 on 2 and 584 DF,  p-value: < 2.2e-16

## 
## Call:
## lm(formula = math_score ~ lunch_type + wkly_study_hours, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -61.136 -10.433   0.947  10.485  41.485
## 
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       40.3568     2.8257  14.282  < 2e-16 ***
## lunch_type        12.9173     1.2807  10.086  < 2e-16 ***
## wkly_study_hours   2.6206     0.9297   2.819  0.00498 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 14.81 on 584 degrees of freedom
## Multiple R-squared:  0.1583, Adjusted R-squared:  0.1554
## F-statistic: 54.91 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.071 -10.175   0.899  10.377  38.003
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   54.819      2.965   18.49  < 2e-16 ***
## lunch_type    13.104      1.266   10.35  < 2e-16 ***
## test_prep     -5.926      1.264   -4.69 3.41e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.64 on 584 degrees of freedom
## Multiple R-squared:  0.1778, Adjusted R-squared:  0.175
## F-statistic: 63.14 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.960  -9.607   0.552  10.353  36.199
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   36.5522     2.6533  13.776  < 2e-16 ***
## lunch_type    12.6467     1.2560  10.069  < 2e-16 ***
## ethnic_group   2.9205     0.5134   5.688 2.03e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.51 on 584 degrees of freedom
## Multiple R-squared:  0.1916, Adjusted R-squared:  0.1888
## F-statistic: 69.22 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + gender,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.717  -9.148   0.015   9.845  34.370
##
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   29.3670     3.0731   9.556  < 2e-16 ***
## lunch_type    12.3544     1.2382   9.978  < 2e-16 ***
## ethnic_group   2.9138     0.5054   5.765 1.32e-08 ***
## gender         5.2540     1.1842   4.437 1.09e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.29 on 583 degrees of freedom
## Multiple R-squared:  0.218,  Adjusted R-squared:  0.214
## F-statistic: 54.18 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + parent_educ,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.234  -9.790   0.258  10.355  36.529
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   32.8065     2.8632  11.458  < 2e-16 ***
## lunch_type    12.7088     1.2456  10.203  < 2e-16 ***
## ethnic_group   2.7998     0.5104   5.486 6.14e-08 ***
## parent_educ    1.3189     0.3978   3.315 0.000972 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.39 on 583 degrees of freedom
## Multiple R-squared:  0.2066, Adjusted R-squared:  0.2025
## F-statistic:  50.6 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + parent_marital_status,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.657  -9.579   0.554  10.482  36.308
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            34.6762     3.2998  10.509  < 2e-16 ***
## lunch_type             12.6870     1.2568  10.094  < 2e-16 ***
## ethnic_group            2.9334     0.5136   5.711 1.79e-08 ***
## parent_marital_status   0.8312     0.8691   0.956    0.339
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.51 on 583 degrees of freedom
## Multiple R-squared:  0.1929, Adjusted R-squared:  0.1887
## F-statistic: 46.44 on 3 and 583 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + practice_sport,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.356  -9.474   0.605  10.400  35.802
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     35.2709     3.4130  10.334  < 2e-16 ***
## lunch_type      12.6688     1.2573  10.076  < 2e-16 ***
## ethnic_group     2.9209     0.5137   5.686 2.06e-08 ***
## practice_sport   0.5514     0.9231   0.597    0.551
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.52 on 583 degrees of freedom
## Multiple R-squared:  0.1921, Adjusted R-squared:  0.188
## F-statistic: 46.21 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + is_first_child,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.244  -9.840   0.756  10.162  36.762
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     35.1542     3.3914  10.366  < 2e-16 ***
## lunch_type      12.6365     1.2567  10.055  < 2e-16 ***
## ethnic_group     2.9203     0.5137   5.685 2.07e-08 ***
## is_first_child   0.8461     1.2775   0.662    0.508
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.52 on 583 degrees of freedom
## Multiple R-squared:  0.1922, Adjusted R-squared:  0.1881
## F-statistic: 46.25 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + nr_siblings,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.600  -9.548   0.345  10.095  35.510
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)   34.8937     2.7968  12.476   < 2e-16 ***
## lunch_type    12.6400     1.2535  10.084   < 2e-16 ***
## ethnic_group   2.9450     0.5125   5.746 1.47e-08 ***
## nr_siblings    0.7439     0.4039   1.842    0.066 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.48 on 583 degrees of freedom
## Multiple R-squared:  0.1963, Adjusted R-squared:  0.1922
## F-statistic: 47.46 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + transport_means,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.006  -9.633   0.620  10.310  36.265
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      36.3653     3.3263  10.933   < 2e-16 ***
## lunch_type       12.6452     1.2572  10.058   < 2e-16 ***
## ethnic_group      2.9220     0.5141   5.684 2.08e-08 ***
## transport_means   0.1147     1.2297   0.093    0.926
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.52 on 583 degrees of freedom
## Multiple R-squared:  0.1916, Adjusted R-squared:  0.1875
## F-statistic: 46.07 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + wkly_study_hours,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -60.754  -9.175   0.814   9.769  36.003
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       31.6953     3.1451  10.078   < 2e-16 ***
## lunch_type        12.6394     1.2485  10.123   < 2e-16 ***
## ethnic_group       2.9056     0.5104   5.693 1.98e-08 ***
## wkly_study_hours   2.5674     0.9057   2.835  0.00474 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.43 on 583 degrees of freedom
## Multiple R-squared:  0.2026, Adjusted R-squared:  0.1985
## F-statistic: 49.38 on 3 and 583 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.800  -9.572   1.075  10.329  32.657
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    45.9342     3.2818  13.997  < 2e-16 ***
## lunch_type     12.8245     1.2345  10.389  < 2e-16 ***
## ethnic_group    2.8753     0.5044   5.700 1.91e-08 ***
## test_prep      -5.7920     1.2310  -4.705 3.17e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.26 on 583 degrees of freedom
## Multiple R-squared:  0.2212, Adjusted R-squared:  0.2172
## F-statistic: 55.19 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.800  -9.572   1.075  10.329  32.657
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    45.9342     3.2818  13.997  < 2e-16 ***
## lunch_type     12.8245     1.2345  10.389  < 2e-16 ***
## ethnic_group    2.8753     0.5044   5.700 1.91e-08 ***
## test_prep      -5.7920     1.2310  -4.705 3.17e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.26 on 583 degrees of freedom
## Multiple R-squared:  0.2212, Adjusted R-squared:  0.2172
## F-statistic: 55.19 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.734 -10.013   0.383   9.970  32.599
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)       38.700        3.642   10.627   < 2e-16 ***
## lunch_type        12.538        1.218   10.294   < 2e-16 ***
## ethnic_group       2.870        0.497    5.776  1.25e-08 ***
## test_prep         -5.573        1.214   -4.591  5.40e-06 ***
## gender             5.031        1.165    4.317  1.86e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.05 on 582 degrees of freedom
## Multiple R-squared:  0.2454, Adjusted R-squared:  0.2402
## F-statistic: 47.31 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.947  -9.121   1.049  10.283  32.938
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    42.2241     3.4203  12.345   < 2e-16 ***
## lunch_type     12.8917     1.2230  10.541   < 2e-16 ***
## ethnic_group    2.7498     0.5010   5.489  6.04e-08 ***
## test_prep      -5.8907     1.2197  -4.830  1.75e-06 ***
## parent_educ     1.3626     0.3905   3.489  0.000521 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.12 on 582 degrees of freedom
## Multiple R-squared:  0.2371, Adjusted R-squared:  0.2319
## F-statistic: 45.23 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.400  -9.670   1.073  10.241  32.769
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            44.2993     3.8406  11.534   < 2e-16 ***
## lunch_type             12.8575     1.2355  10.407   < 2e-16 ***
## ethnic_group            2.8864     0.5048   5.718  1.72e-08 ***
## test_prep              -5.7590     1.2320  -4.674  3.67e-06 ***
## parent_marital_status   0.7007     0.8544   0.820     0.413
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.26 on 582 degrees of freedom
```

```
## Multiple R-squared:  0.2221, Adjusted R-squared:  0.2167
## F-statistic: 41.54 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.155  -9.277   1.001  10.183  32.311
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     44.7832     3.9179  11.430  < 2e-16 ***
## lunch_type      12.8438     1.2358  10.393  < 2e-16 ***
## ethnic_group     2.8757     0.5048   5.697 1.94e-08 ***
## test_prep       -5.7822     1.2319  -4.694 3.35e-06 ***
## practice_sport   0.4885     0.9070   0.539     0.59
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.27 on 582 degrees of freedom
## Multiple R-squared:  0.2216, Adjusted R-squared:  0.2162
## F-statistic: 41.42 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     is_first_child, data = step_df)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -55.99  -9.71   1.07  10.31  33.03
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     45.0129     3.9442  11.412  < 2e-16 ***
## lunch_type      12.8173     1.2355  10.374  < 2e-16 ***
## ethnic_group     2.8753     0.5048   5.696 1.95e-08 ***
## test_prep       -5.7640     1.2337  -4.672 3.70e-06 ***
## is_first_child   0.5302     1.2571   0.422    0.673
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.27 on 582 degrees of freedom
## Multiple R-squared:  0.2214, Adjusted R-squared:  0.2161
## F-statistic: 41.38 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     nr_siblings, data = step_df)
##
## Residuals:
```

```
##      Min      1Q  Median      3Q     Max
## -56.400  -9.375   1.049  10.075  32.111
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    44.3155     3.4213  12.953  < 2e-16 ***
## lunch_type     12.8156     1.2327  10.396  < 2e-16 ***
## ethnic_group    2.8976     0.5039   5.750 1.44e-08 ***
## test_prep      -5.6936     1.2307  -4.626 4.59e-06 ***
## nr_siblings     0.6545     0.3975   1.647      0.1
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.24 on 582 degrees of freedom
## Multiple R-squared:  0.2248, Adjusted R-squared:  0.2195
## F-statistic: 42.19 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.993  -9.355   0.889  10.216  32.935
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      45.1465     3.7597  12.008  < 2e-16 ***
## lunch_type       12.8187     1.2354  10.376  < 2e-16 ***
## ethnic_group      2.8817     0.5050   5.706 1.84e-08 ***
## test_prep        -5.8298     1.2350  -4.720 2.95e-06 ***
## transport_means   0.5211     1.2110   0.430    0.667
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.27 on 582 degrees of freedom
## Multiple R-squared:  0.2214, Adjusted R-squared:  0.2161
## F-statistic: 41.38 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.284  -9.309   0.857   9.743  32.666
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      41.3369     3.7728  10.957  < 2e-16 ***
## lunch_type       12.8095     1.2293  10.420  < 2e-16 ***
## ethnic_group      2.8648     0.5023   5.703 1.88e-08 ***
## test_prep        -5.5040     1.2315  -4.469 9.44e-06 ***
```

```
## wkly_study_hours   2.1836     0.8954   2.439    0.015 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.2 on 582 degrees of freedom
## Multiple R-squared:  0.2291, Adjusted R-squared:  0.2238
## F-statistic: 43.23 on 4 and 582 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -53.734 -10.013   0.383   9.970  32.599
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    38.700      3.642  10.627  < 2e-16 ***
## lunch_type     12.538      1.218  10.294  < 2e-16 ***
## ethnic_group    2.870      0.497   5.776 1.25e-08 ***
## test_prep      -5.573      1.214  -4.591 5.40e-06 ***
## gender          5.031      1.165   4.317 1.86e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.05 on 582 degrees of freedom
## Multiple R-squared:  0.2454, Adjusted R-squared:  0.2402
## F-statistic: 47.31 on 4 and 582 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -50.514  -9.535   0.837  10.037  30.067
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   34.2503     3.7807   9.059  < 2e-16 ***
## lunch_type    12.5942     1.2039  10.461  < 2e-16 ***
## ethnic_group   2.7340     0.4925   5.552 4.31e-08 ***
## test_prep     -5.6676     1.2000  -4.723 2.92e-06 ***
## gender         5.3234     1.1542   4.612 4.91e-06 ***
## parent_educ    1.4796     0.3847   3.846 0.000133 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.88 on 581 degrees of freedom
## Multiple R-squared:  0.2641, Adjusted R-squared:  0.2578
## F-statistic:  41.7 on 5 and 581 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.421  -9.827   0.520  10.165  32.709
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            36.7294     4.1646   8.820  < 2e-16 ***
## lunch_type             12.5744     1.2187  10.318  < 2e-16 ***
## ethnic_group            2.8835     0.4972   5.800 1.09e-08 ***
## test_prep              -5.5329     1.2146  -4.555 6.38e-06 ***
## gender                  5.0681     1.1660   4.347 1.63e-05 ***
## parent_marital_status   0.8215     0.8420   0.976     0.33
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.05 on 581 degrees of freedom
## Multiple R-squared:  0.2466, Adjusted R-squared:  0.2401
## F-statistic: 38.03 on 5 and 581 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.066  -9.907   0.260  10.048  32.249
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     37.6369     4.2012   8.959  < 2e-16 ***
## lunch_type      12.5562     1.2193  10.298  < 2e-16 ***
## ethnic_group     2.8709     0.4973   5.773 1.27e-08 ***
## test_prep       -5.5643     1.2148  -4.581 5.68e-06 ***
## gender           5.0253     1.1661   4.310 1.92e-05 ***
## practice_sport   0.4544     0.8936   0.509    0.611
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.06 on 581 degrees of freedom
## Multiple R-squared:  0.2457, Adjusted R-squared:  0.2392
## F-statistic: 37.85 on 5 and 581 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -53.902  -9.853   0.541  10.069  32.437
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     37.8925     4.2227   8.973  < 2e-16 ***
## lunch_type      12.5318     1.2190  10.280  < 2e-16 ***
## ethnic_group     2.8706     0.4974   5.772 1.28e-08 ***
## test_prep       -5.5487     1.2165  -4.561 6.21e-06 ***
## gender           5.0255     1.1662   4.309 1.92e-05 ***
## is_first_child   0.4690     1.2386   0.379    0.705
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.06 on 581 degrees of freedom
## Multiple R-squared:  0.2455, Adjusted R-squared:  0.239
## F-statistic: 37.82 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.359  -9.453   0.056  10.049  34.165
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   36.8121     3.7775   9.745  < 2e-16 ***
## lunch_type    12.5237     1.2156  10.303  < 2e-16 ***
## ethnic_group   2.8949     0.4962   5.835 8.96e-09 ***
## test_prep     -5.4619     1.2129  -4.503 8.10e-06 ***
## gender         5.1091     1.1637   4.390 1.35e-05 ***
## nr_siblings    0.7178     0.3917   1.833   0.0674 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.02 on 581 degrees of freedom
## Multiple R-squared:  0.2497, Adjusted R-squared:  0.2432
## F-statistic: 38.67 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.896 -10.039   0.299   9.852  32.878
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   38.0574     4.0535   9.389  < 2e-16 ***
## lunch_type    12.5335     1.2190  10.282  < 2e-16 ***
## ethnic_group   2.8759     0.4976   5.780 1.22e-08 ***
```

```
## test_prep        -5.6049      1.2179  -4.602 5.14e-06 ***
## gender            5.0233      1.1663   4.307 1.94e-05 ***
## transport_means   0.4322      1.1933   0.362    0.717
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.06 on 581 degrees of freedom
## Multiple R-squared:  0.2455, Adjusted R-squared:  0.239
## F-statistic: 37.81 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##      gender + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.095  -9.508   0.175  10.116  34.314
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        34.5555     4.0481   8.536  < 2e-16 ***
## lunch_type         12.5298     1.2135  10.325  < 2e-16 ***
## ethnic_group        2.8609     0.4952   5.778 1.24e-08 ***
## test_prep          -5.3087     1.2148  -4.370 1.47e-05 ***
## gender              4.9272     1.1618   4.241 2.59e-05 ***
## wkly_study_hours    2.0392     0.8833   2.309   0.0213 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.99 on 581 degrees of freedom
## Multiple R-squared:  0.2522, Adjusted R-squared:  0.2458
## F-statistic: 39.19 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##      gender + parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.514  -9.535   0.837  10.037  30.067
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  34.2503     3.7807   9.059  < 2e-16 ***
## lunch_type   12.5942     1.2039  10.461  < 2e-16 ***
## ethnic_group  2.7340     0.4925   5.552 4.31e-08 ***
## test_prep    -5.6676     1.2000  -4.723 2.92e-06 ***
## gender        5.3234     1.1542   4.612 4.91e-06 ***
## parent_educ   1.4796     0.3847   3.846 0.000133 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.88 on 581 degrees of freedom
```

```
## Multiple R-squared:  0.2641, Adjusted R-squared:  0.2578
## F-statistic:  41.7 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.161  -9.524   0.562  10.079  30.168
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            32.4681     4.2647   7.613 1.09e-13 ***
## lunch_type             12.6273     1.2047  10.482  < 2e-16 ***
## ethnic_group            2.7467     0.4928   5.574 3.82e-08 ***
## test_prep              -5.6302     1.2009  -4.688 3.44e-06 ***
## gender                  5.3563     1.1550   4.637 4.36e-06 ***
## parent_educ             1.4721     0.3849   3.825 0.000145 ***
## parent_marital_status   0.7524     0.8325   0.904 0.366512
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.88 on 580 degrees of freedom
## Multiple R-squared:  0.2651, Adjusted R-squared:  0.2575
## F-statistic: 34.88 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.967  -9.382   0.825   9.975  29.595
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     32.6121     4.3479   7.501 2.40e-13 ***
## lunch_type      12.6220     1.2049  10.475  < 2e-16 ***
## ethnic_group     2.7329     0.4927   5.547 4.42e-08 ***
## test_prep       -5.6556     1.2005  -4.711 3.09e-06 ***
## gender           5.3193     1.1547   4.607 5.03e-06 ***
## parent_educ      1.4986     0.3857   3.886 0.000114 ***
## practice_sport   0.6758     0.8848   0.764 0.445283
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.89 on 580 degrees of freedom
## Multiple R-squared:  0.2648, Adjusted R-squared:  0.2572
## F-statistic: 34.82 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
```

```
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + is_first_child, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -50.673  -9.645   0.774   9.999  30.373
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    33.5052     4.3272   7.743 4.35e-14 ***
## lunch_type     12.5885     1.2050  10.447  < 2e-16 ***
## ethnic_group    2.7342     0.4929   5.548 4.41e-08 ***
## test_prep      -5.6448     1.2026  -4.694 3.35e-06 ***
## gender          5.3185     1.1552   4.604 5.10e-06 ***
## parent_educ     1.4786     0.3850   3.840 0.000136 ***
## is_first_child  0.4345     1.2242   0.355 0.722808
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.89 on 580 degrees of freedom
## Multiple R-squared:  0.2643, Adjusted R-squared:  0.2566
## F-statistic: 34.72 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + nr_siblings, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -51.136  -9.280   0.816  10.107  31.298
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   32.2786     3.9112   8.253 1.05e-15 ***
## lunch_type    12.5799     1.2012  10.472  < 2e-16 ***
## ethnic_group   2.7582     0.4915   5.611 3.11e-08 ***
## test_prep     -5.5537     1.1988  -4.633 4.46e-06 ***
## gender         5.4060     1.1524   4.691 3.39e-06 ***
## parent_educ    1.4896     0.3839   3.880 0.000116 ***
## nr_siblings    0.7382     0.3871   1.907 0.056968 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.85 on 580 degrees of freedom
## Multiple R-squared:  0.2687, Adjusted R-squared:  0.2611
## F-statistic: 35.51 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + transport_means, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
```

```
## -50.661   -9.669    0.663    9.877   30.273
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      33.6893     4.1648   8.089 3.53e-15 ***
## lunch_type       12.5902     1.2049  10.449  < 2e-16 ***
## ethnic_group      2.7389     0.4931   5.555 4.25e-08 ***
## test_prep        -5.6954     1.2040  -4.730 2.82e-06 ***
## gender            5.3167     1.1553   4.602 5.15e-06 ***
## parent_educ       1.4782     0.3850   3.839 0.000137 ***
## transport_means   0.3801     1.1795   0.322 0.747350
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.89 on 580 degrees of freedom
## Multiple R-squared:  0.2642, Adjusted R-squared:  0.2566
## F-statistic: 34.71 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.943  -9.439   0.630  10.403  31.459
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      29.7605     4.1787   7.122 3.16e-12 ***
## lunch_type       12.5868     1.1987  10.501  < 2e-16 ***
## ethnic_group      2.7208     0.4904   5.549 4.39e-08 ***
## test_prep        -5.3895     1.2000  -4.491 8.55e-06 ***
## gender            5.2204     1.1499   4.540 6.85e-06 ***
## parent_educ       1.5128     0.3833   3.947 8.88e-05 ***
## wkly_study_hours  2.1599     0.8729   2.474   0.0136 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 580 degrees of freedom
## Multiple R-squared:  0.2718, Adjusted R-squared:  0.2642
## F-statistic: 36.08 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.943  -9.439   0.630  10.403  31.459
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      29.7605     4.1787   7.122 3.16e-12 ***
```

```
## lunch_type          12.5868      1.1987   10.501   < 2e-16 ***
## ethnic_group          2.7208      0.4904    5.549 4.39e-08 ***
## test_prep            -5.3895      1.2000   -4.491 8.55e-06 ***
## gender                5.2204      1.1499    4.540 6.85e-06 ***
## parent_educ           1.5128      0.3833    3.947 8.88e-05 ***
## wkly_study_hours      2.1599      0.8729    2.474   0.0136 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 580 degrees of freedom
## Multiple R-squared:  0.2718, Adjusted R-squared:  0.2642
## F-statistic: 36.08 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + parent_marital_status,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.608  -9.405   0.583  10.152  31.582
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             27.9334     4.6228   6.043 2.72e-09 ***
## lunch_type              12.6206     1.1994  10.523   < 2e-16 ***
## ethnic_group             2.7336     0.4906   5.572 3.87e-08 ***
## test_prep               -5.3507     1.2009  -4.456 1.00e-05 ***
## gender                   5.2537     1.1506   4.566 6.08e-06 ***
## parent_educ              1.5052     0.3834   3.926 9.68e-05 ***
## wkly_study_hours         2.1654     0.8731   2.480   0.0134 *
## parent_marital_status    0.7665     0.8289   0.925   0.3555
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 579 degrees of freedom
## Multiple R-squared:  0.2729, Adjusted R-squared:  0.2641
## F-statistic: 31.04 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + practice_sport,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.363  -9.358   0.643  10.342  30.921
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      28.2228     4.6818   6.028 2.95e-09 ***
## lunch_type       12.6133     1.1997  10.514   < 2e-16 ***
## ethnic_group      2.7197     0.4906   5.544 4.49e-08 ***
```

```
## test_prep        -5.3794      1.2006  -4.481 8.97e-06 ***
## gender             5.2170      1.1504   4.535 7.01e-06 ***
## parent_educ        1.5307      0.3842   3.984 7.64e-05 ***
## wkly_study_hours   2.1502      0.8734   2.462   0.0141 *
## practice_sport     0.6427      0.8811   0.729   0.4660
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 579 degrees of freedom
## Multiple R-squared:  0.2724, Adjusted R-squared:  0.2636
## F-statistic: 30.97 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + is_first_child,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.096  -9.567   0.708  10.528  31.314
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      29.0370     4.6723   6.215 9.84e-10 ***
## lunch_type       12.5812     1.1997  10.487  < 2e-16 ***
## ethnic_group      2.7209     0.4907   5.545 4.48e-08 ***
## test_prep        -5.3675     1.2026  -4.463 9.71e-06 ***
## gender            5.2157     1.1509   4.532 7.10e-06 ***
## parent_educ       1.5119     0.3836   3.941 9.09e-05 ***
## wkly_study_hours  2.1588     0.8736   2.471   0.0138 *
## is_first_child    0.4232     1.2189   0.347   0.7286
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 579 degrees of freedom
## Multiple R-squared:  0.2719, Adjusted R-squared:  0.2631
## F-statistic: 30.89 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.440  -8.894   0.776  10.134  32.889
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      28.0713     4.2756   6.565 1.15e-10 ***
## lunch_type       12.5737     1.1964  10.510  < 2e-16 ***
## ethnic_group      2.7439     0.4896   5.605 3.23e-08 ***
## test_prep        -5.2926     1.1989  -4.414 1.21e-05 ***
## gender            5.3017     1.1486   4.616 4.83e-06 ***
```

```
## parent_educ          1.5210     0.3826   3.976 7.90e-05 ***
## wkly_study_hours      2.0825     0.8723   2.387   0.0173 *
## nr_siblings           0.6927     0.3860   1.795   0.0732 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.8 on 579 degrees of freedom
## Multiple R-squared:  0.2758, Adjusted R-squared:  0.2671
## F-statistic:  31.5 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + transport_means,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.041  -9.471   0.579  10.519  31.633
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       29.3703     4.5026   6.523 1.50e-10 ***
## lunch_type        12.5840     1.1997  10.489  < 2e-16 ***
## ethnic_group       2.7243     0.4910   5.549 4.39e-08 ***
## test_prep         -5.4106     1.2044  -4.493 8.50e-06 ***
## gender             5.2159     1.1510   4.531 7.12e-06 ***
## parent_educ        1.5117     0.3836   3.941 9.12e-05 ***
## wkly_study_hours   2.1524     0.8742   2.462   0.0141 *
## transport_means    0.2749     1.1752   0.234   0.8151
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 579 degrees of freedom
## Multiple R-squared:  0.2718, Adjusted R-squared:  0.263
## F-statistic: 30.88 on 7 and 579 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.943  -9.439   0.630  10.403  31.459
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       29.7605     4.1787   7.122 3.16e-12 ***
## lunch_type        12.5868     1.1987  10.501  < 2e-16 ***
## ethnic_group       2.7208     0.4904   5.549 4.39e-08 ***
## test_prep         -5.3895     1.2000  -4.491 8.55e-06 ***
## gender             5.2204     1.1499   4.540 6.85e-06 ***
## parent_educ        1.5128     0.3833   3.947 8.88e-05 ***
## wkly_study_hours   2.1599     0.8729   2.474   0.0136 *
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 580 degrees of freedom
## Multiple R-squared:  0.2718, Adjusted R-squared:  0.2642
## F-statistic: 36.08 on 6 and 580 DF,  p-value: < 2.2e-16

## Start:  AIC=3264.33
## math_score ~ 1
##
##                         Df Sum of Sq    RSS    AIC
## + lunch_type             1   22340.6 129816 3173.1
## + ethnic_group           1    7803.7 144353 3235.4
## + gender                 1    5114.8 147042 3246.3
## + test_prep              1    4114.3 148042 3250.2
## + parent_educ            1    2667.1 149489 3256.0
## + wkly_study_hours       1    1773.4 150383 3259.5
## + nr_siblings            1     615.0 151541 3264.0
## <none>                              152157 3264.3
## + is_first_child         1     132.5 152024 3265.8
## + parent_marital_status  1      42.7 152114 3266.2
## + practice_sport         1      17.3 152139 3266.3
## + transport_means        1       0.3 152156 3266.3
##
## Step:  AIC=3173.12
## math_score ~ lunch_type
##
##                         Df Sum of Sq    RSS    AIC
## + ethnic_group           1    6815.3 123001 3143.5
## + test_prep              1    4711.5 125104 3153.4
## + gender                 1    4049.1 125767 3156.5
## + parent_educ            1    2859.4 126956 3162.0
## + wkly_study_hours       1    1742.6 128073 3167.2
## + nr_siblings            1     601.2 129215 3172.4
## <none>                              129816 3173.1
## + parent_marital_status  1     137.1 129679 3174.5
## + is_first_child         1      93.5 129722 3174.7
## + practice_sport         1      73.5 129742 3174.8
## + transport_means        1       1.5 129814 3175.1
##
## Step:  AIC=3143.47
## math_score ~ lunch_type + ethnic_group
##
##                         Df Sum of Sq    RSS    AIC
## + test_prep              1    4499.7 118501 3123.6
## + gender                 1    4017.7 118983 3126.0
## + parent_educ            1    2276.0 120725 3134.5
## + wkly_study_hours       1    1672.4 121328 3137.4
## + nr_siblings            1     711.4 122289 3142.1
## <none>                              123001 3143.5
## + parent_marital_status  1     192.7 122808 3144.6
## + is_first_child         1      92.5 122908 3145.0
## + practice_sport         1      75.2 122925 3145.1
## + transport_means        1       1.8 122999 3145.5
```

```
##
## Step:  AIC=3123.59
## math_score ~ lunch_type + ethnic_group + test_prep
##
##                          Df Sum of Sq    RSS    AIC
## + gender                  1    3676.9 114824 3107.1
## + parent_educ             1    2428.1 116073 3113.4
## + wkly_study_hours        1    1198.6 117302 3119.6
## + nr_siblings             1     549.5 117951 3122.9
## <none>                                118501 3123.6
## + parent_marital_status   1     136.8 118364 3124.9
## + practice_sport          1      59.0 118442 3125.3
## + transport_means         1      37.7 118463 3125.4
## + is_first_child          1      36.2 118465 3125.4
##
## Step:  AIC=3107.09
## math_score ~ lunch_type + ethnic_group + test_prep + gender
##
##                          Df Sum of Sq    RSS    AIC
## + parent_educ             1   2850.64 111973 3094.3
## + wkly_study_hours        1   1043.73 113780 3103.7
## + nr_siblings             1    659.98 114164 3105.7
## <none>                                114824 3107.1
## + parent_marital_status   1    187.79 114636 3108.1
## + practice_sport          1     51.08 114773 3108.8
## + is_first_child          1     28.33 114796 3108.9
## + transport_means         1     25.92 114798 3109.0
##
## Step:  AIC=3094.33
## math_score ~ lunch_type + ethnic_group + test_prep + gender +
##     parent_educ
##
##                          Df Sum of Sq    RSS    AIC
## + wkly_study_hours        1   1169.53 110804 3090.2
## + nr_siblings             1    697.97 111275 3092.7
## <none>                                111973 3094.3
## + parent_marital_status   1    157.45 111816 3095.5
## + practice_sport          1    112.52 111861 3095.7
## + is_first_child          1     24.31 111949 3096.2
## + transport_means         1     20.05 111953 3096.2
##
## Step:  AIC=3090.17
## math_score ~ lunch_type + ethnic_group + test_prep + gender +
##     parent_educ + wkly_study_hours
##
##                          Df Sum of Sq    RSS    AIC
## + nr_siblings             1    613.00 110191 3088.9
## <none>                                110804 3090.2
## + parent_marital_status   1    163.41 110640 3091.3
## + practice_sport          1    101.74 110702 3091.6
## + is_first_child          1     23.06 110781 3092.1
## + transport_means         1     10.47 110793 3092.1
##
## Step:  AIC=3088.91
```

```
## math_score ~ lunch_type + ethnic_group + test_prep + gender +
##     parent_educ + wkly_study_hours + nr_siblings
##
##                           Df Sum of Sq    RSS    AIC
## <none>                                 110191 3088.9
## + parent_marital_status  1   138.323 110053 3090.2
## + practice_sport         1    98.281 110093 3090.4
## + is_first_child         1    48.607 110142 3090.7
## + transport_means        1    10.595 110180 3090.9
##
## Call:
## lm(formula = math_score ~ lunch_type + ethnic_group + test_prep +
##     gender + parent_educ + wkly_study_hours + nr_siblings, data = math_df)
##
## Coefficients:
##      (Intercept)         lunch_type       ethnic_group          test_prep
##          28.0713            12.5737             2.7439            -5.2926
##           gender        parent_educ   wkly_study_hours        nr_siblings
##           5.3017             1.5210             2.0825             0.6927
```

The model we obtained is Math Score ~ Lunch Type + Ethnic Group + Test Prep + Gender + Parent Education + Weekly Study Hours.

When using the single-function method, the model obtained with the lowest AIC was Math Score ~ Lunch Type + Ethnic Group + Test Prep + Gender + Parent Education + Weekly Study Hours + Number of Siblings.

Reading Score

```
##
## Call:
## lm(formula = reading_score ~ gender, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -56.152 -10.018  -0.152  10.915  33.982
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   80.286      1.888  42.521  < 2e-16 ***
## gender        -7.134      1.221  -5.841  8.6e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.76 on 585 degrees of freedom
## Multiple R-squared:  0.05511,    Adjusted R-squared:  0.05349
## F-statistic: 34.12 on 1 and 585 DF,  p-value: 8.604e-09

##
## Call:
## lm(formula = reading_score ~ ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.477 -10.415   0.398  10.523  34.773
##
```

```
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   63.1022     1.7901  35.251  < 2e-16 ***
## ethnic_group   2.1251     0.5293   4.015 6.73e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.97 on 585 degrees of freedom
## Multiple R-squared:  0.02681,    Adjusted R-squared:  0.02515
## F-statistic: 16.12 on 1 and 585 DF,  p-value: 6.732e-05

##
## Call:
## lm(formula = reading_score ~ parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.850 -10.691   0.363  10.756  34.150
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  63.9035     1.3965   45.76  < 2e-16 ***
## parent_educ   1.9468     0.4107    4.74 2.69e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.9 on 585 degrees of freedom
## Multiple R-squared:  0.03698,    Adjusted R-squared:  0.03534
## F-statistic: 22.47 on 1 and 585 DF,  p-value: 2.688e-06

##
## Call:
## lm(formula = reading_score ~ lunch_type, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -47.558  -9.558   0.294  10.442  35.442
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   56.410      2.178  25.898  < 2e-16 ***
## lunch_type     8.148      1.269   6.422 2.79e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 585 degrees of freedom
## Multiple R-squared:  0.06585,    Adjusted R-squared:  0.06425
## F-statistic: 41.24 on 1 and 585 DF,  p-value: 2.791e-10

##
## Call:
## lm(formula = reading_score ~ parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -53.351 -10.195   0.649  11.227  30.805
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            68.6169     2.0306  33.792   <2e-16 ***
## parent_marital_status   0.5780     0.9078   0.637    0.525
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.17 on 585 degrees of freedom
## Multiple R-squared:  0.0006925,  Adjusted R-squared:  -0.001016
## F-statistic: 0.4054 on 1 and 585 DF,  p-value: 0.5246

##
## Call:
## lm(formula = reading_score ~ practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.008 -10.135   0.739  10.992  30.992
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     72.3876     2.2614  32.011   <2e-16 ***
## practice_sport  -1.1265     0.9634  -1.169    0.243
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.16 on 585 degrees of freedom
## Multiple R-squared:  0.002332,   Adjusted R-squared:  0.0006262
## F-statistic: 1.367 on 1 and 585 DF,  p-value: 0.2428

##
## Call:
## lm(formula = reading_score ~ is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.256 -10.256   0.744  11.744  30.995
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     67.755      2.319  29.223   <2e-16 ***
## is_first_child   1.250      1.334   0.937    0.349
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.17 on 585 degrees of freedom
## Multiple R-squared:  0.001499,   Adjusted R-squared:  -0.000208
## F-statistic: 0.8781 on 1 and 585 DF,  p-value: 0.3491

##
## Call:
## lm(formula = reading_score ~ nr_siblings, data = step_df)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.241 -10.199   0.676  11.217  31.134
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 68.8661     1.1000  62.603   <2e-16 ***
## nr_siblings  0.4583     0.4228   1.084    0.279
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.16 on 585 degrees of freedom
## Multiple R-squared:  0.002004,   Adjusted R-squared:  0.0002984
## F-statistic: 1.175 on 1 and 585 DF,  p-value: 0.2788

##
## Call:
## lm(formula = reading_score ~ transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.989  -9.989   0.376  11.193  30.376
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      69.2601     2.1605  32.057   <2e-16 ***
## transport_means   0.3644     1.2844   0.284    0.777
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.18 on 585 degrees of freedom
## Multiple R-squared:  0.0001376, Adjusted R-squared:  -0.001572
## F-statistic: 0.08048 on 1 and 585 DF,  p-value: 0.7767

##
## Call:
## lm(formula = reading_score ~ wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.127 -10.127   1.053  11.553  30.233
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      67.5878     1.9267   35.08   <2e-16 ***
## wkly_study_hours  1.1797     0.9517    1.24    0.216
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.16 on 585 degrees of freedom
## Multiple R-squared:  0.00262,    Adjusted R-squared:  0.0009147
## F-statistic: 1.537 on 1 and 585 DF,  p-value: 0.2156

##
## Call:
```

```
## lm(formula = reading_score ~ test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.644  -9.861   1.139  10.748  32.356
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   80.077      2.201   36.38  < 2e-16 ***
## test_prep     -6.217      1.284   -4.84 1.66e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.88 on 585 degrees of freedom
## Multiple R-squared:  0.03851,    Adjusted R-squared:  0.03686
## F-statistic: 23.43 on 1 and 585 DF,  p-value: 1.662e-06

##
## Call:
## lm(formula = reading_score ~ lunch_type, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -47.558  -9.558   0.294  10.442  35.442
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   56.410      2.178  25.898  < 2e-16 ***
## lunch_type     8.148      1.269   6.422 2.79e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 585 degrees of freedom
## Multiple R-squared:  0.06585,    Adjusted R-squared:  0.06425
## F-statistic: 41.24 on 1 and 585 DF,  p-value: 2.791e-10

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.793  -9.292   0.779  10.207  39.779
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   66.795      2.653  25.175  < 2e-16 ***
## lunch_type     8.570      1.229   6.974 8.37e-12 ***
## gender        -7.572      1.176  -6.438 2.53e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.19 on 584 degrees of freedom
## Multiple R-squared:  0.1278, Adjusted R-squared:  0.1248
## F-statistic: 42.77 on 2 and 584 DF,  p-value: < 2.2e-16
```

```
## 
## Call:
## lm(formula = reading_score ~ lunch_type + ethnic_group, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -47.335  -9.333  -0.287  10.664  34.663 
## 
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)    
## (Intercept)   50.3851     2.6504  19.010  < 2e-16 ***
## lunch_type     7.9566     1.2547   6.342 4.56e-10 ***
## ethnic_group   1.9978     0.5128   3.896 0.000109 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 14.5 on 584 degrees of freedom
## Multiple R-squared:  0.08951,    Adjusted R-squared:  0.08639 
## F-statistic: 28.71 on 2 and 584 DF,  p-value: 1.283e-12

## 
## Call:
## lm(formula = reading_score ~ lunch_type + parent_educ, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -43.447  -9.436   0.372  10.505  35.595 
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept)  50.2445     2.4668  20.369  < 2e-16 ***
## lunch_type    8.2236     1.2437   6.612 8.57e-11 ***
## parent_educ   1.9788     0.3965   4.990 7.97e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 14.38 on 584 degrees of freedom
## Multiple R-squared:  0.1041, Adjusted R-squared:  0.101 
## F-statistic: 33.91 on 2 and 584 DF,  p-value: 1.165e-14

## 
## Call:
## lm(formula = reading_score ~ lunch_type + parent_marital_status, 
##     data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -48.208  -9.528   0.379  10.606  36.339 
## 
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)    
## (Intercept)            54.7005     2.9181  18.745  < 2e-16 ***
## lunch_type              8.1864     1.2698   6.447 2.39e-10 ***
## parent_marital_status   0.7737     0.8784   0.881    0.379    
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 584 degrees of freedom
## Multiple R-squared:  0.06709,    Adjusted R-squared:  0.06389
## F-statistic:    21 on 2 and 584 DF,  p-value: 1.561e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + practice_sport, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -46.875  -9.777   0.064  11.015  36.125
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    58.6184     3.0712  19.086  < 2e-16 ***
## lunch_type      8.1097     1.2693   6.389 3.41e-10 ***
## practice_sport -0.9510     0.9326  -1.020    0.308
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 584 degrees of freedom
## Multiple R-squared:  0.06751,    Adjusted R-squared:  0.06432
## F-statistic: 21.14 on 2 and 584 DF,  p-value: 1.368e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + is_first_child, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -47.943  -9.943   0.057  10.923  36.206
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)      54.512      3.050  17.875  < 2e-16 ***
## lunch_type        8.134      1.269   6.409 3.02e-10 ***
## is_first_child    1.148      1.291   0.890    0.374
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 584 degrees of freedom
## Multiple R-squared:  0.06711,    Adjusted R-squared:  0.06392
## F-statistic: 21.01 on 2 and 584 DF,  p-value: 1.549e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + nr_siblings, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -47.950  -9.595  -0.043  10.657  36.410
##
## Coefficients:
```

```
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  55.4448      2.3455  23.639  < 2e-16 ***
## lunch_type    8.1452      1.2686   6.421 2.81e-10 ***
## nr_siblings   0.4533      0.4090   1.109    0.268
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.67 on 584 degrees of freedom
## Multiple R-squared:  0.06781,    Adjusted R-squared:  0.06462
## F-statistic: 21.24 on 2 and 584 DF,  p-value: 1.245e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -47.665  -9.541   0.190  10.604  35.604
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)        55.983      2.942  19.030  < 2e-16 ***
## lunch_type          8.145      1.270   6.413 2.94e-10 ***
## transport_means     0.269      1.243   0.216    0.829
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.68 on 584 degrees of freedom
## Multiple R-squared:  0.06592,    Adjusted R-squared:  0.06273
## F-statistic: 20.61 on 2 and 584 DF,  p-value: 2.246e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.825  -9.232   0.196  11.031  35.340
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       54.1859     2.7980  19.366  < 2e-16 ***
## lunch_type         8.1438     1.2681   6.422 2.79e-10 ***
## wkly_study_hours   1.1651     0.9206   1.266    0.206
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.66 on 584 degrees of freedom
## Multiple R-squared:  0.06841,    Adjusted R-squared:  0.06522
## F-statistic: 21.44 on 2 and 584 DF,  p-value: 1.033e-09

##
## Call:
## lm(formula = reading_score ~ lunch_type + test_prep, data = step_df)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.142  -9.312   0.517  10.222  31.393
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   66.731       2.907  22.952  < 2e-16 ***
## lunch_type     8.341       1.242   6.717 4.41e-11 ***
## test_prep     -6.466       1.239  -5.218 2.52e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.35 on 584 degrees of freedom
## Multiple R-squared:  0.1075, Adjusted R-squared:  0.1044
## F-statistic: 35.16 on 2 and 584 DF,  p-value: 3.829e-15

##
## Call:
## lm(formula = reading_score ~ lunch_type + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -47.335  -9.333  -0.287  10.664  34.663
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   50.3851     2.6504  19.010  < 2e-16 ***
## lunch_type     7.9566     1.2547   6.342 4.56e-10 ***
## ethnic_group   1.9978     0.5128   3.896 0.000109 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.5 on 584 degrees of freedom
## Multiple R-squared:  0.08951,    Adjusted R-squared:  0.08639
## F-statistic: 28.71 on 2 and 584 DF,  p-value: 1.283e-12

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + ethnic_group,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.575  -8.989   0.425  10.621  35.996
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   60.7592     3.0128  20.167  < 2e-16 ***
## lunch_type     8.3786     1.2138   6.903 1.34e-11 ***
## gender        -7.5858     1.1609  -6.534 1.39e-10 ***
## ethnic_group   2.0076     0.4955   4.052 5.77e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.01 on 583 degrees of freedom
```

```
## Multiple R-squared:  0.1516, Adjusted R-squared:  0.1473
## F-statistic: 34.74 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + parent_educ,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -46.857  -9.511   0.684   9.884  39.712
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  60.6267     2.9148  20.799  < 2e-16 ***
## lunch_type    8.6194     1.2071   7.141 2.77e-12 ***
## gender       -7.2082     1.1578  -6.226 9.16e-10 ***
## parent_educ   1.8194     0.3852   4.724 2.90e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.94 on 583 degrees of freedom
## Multiple R-squared:  0.1599, Adjusted R-squared:  0.1556
## F-statistic: 36.99 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + parent_marital_status,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.286  -9.439   1.115  10.061  39.860
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             65.4297     3.2818  19.937  < 2e-16 ***
## lunch_type               8.5985     1.2300   6.991 7.52e-12 ***
## gender                  -7.5453     1.1772  -6.410 3.01e-10 ***
## parent_marital_status    0.6012     0.8501   0.707     0.48
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.2 on 583 degrees of freedom
## Multiple R-squared:  0.1285, Adjusted R-squared:  0.124
## F-statistic: 28.65 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + practice_sport,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.144  -9.527   0.987   9.973  40.417
```

```
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    68.8601     3.3707  20.429  < 2e-16 ***
## lunch_type      8.5334     1.2294   6.941 1.04e-11 ***
## gender         -7.5607     1.1762  -6.428 2.69e-10 ***
## practice_sport -0.8962     0.9020  -0.994    0.321
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.19 on 583 degrees of freedom
## Multiple R-squared:  0.1292, Adjusted R-squared:  0.1247
## F-statistic: 28.84 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + is_first_child,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.221  -9.298   0.811  10.295  40.625
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)      64.736      3.348  19.337  < 2e-16 ***
## lunch_type        8.556      1.229   6.962 9.07e-12 ***
## gender           -7.588      1.176  -6.451 2.33e-10 ***
## is_first_child    1.259      1.249   1.008    0.314
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.19 on 583 degrees of freedom
## Multiple R-squared:  0.1293, Adjusted R-squared:  0.1248
## F-statistic: 28.85 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + nr_siblings,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -51.092  -9.393   0.876  10.073  39.442
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 65.9647     2.8018  23.544  < 2e-16 ***
## lunch_type   8.5657     1.2290   6.970 8.62e-12 ***
## gender      -7.5340     1.1770  -6.401 3.17e-10 ***
## nr_siblings  0.3653     0.3959   0.923    0.357
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.19 on 583 degrees of freedom
```

```
## Multiple R-squared:  0.129,   Adjusted R-squared:  0.1245
## F-statistic: 28.79 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + transport_means,
##     data = step_df)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -50.95  -9.44   1.01  10.06  40.01
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      66.1997     3.2578  20.320  < 2e-16 ***
## lunch_type        8.5656     1.2299   6.965 8.91e-12 ***
## gender           -7.5770     1.1771  -6.437 2.55e-10 ***
## transport_means   0.3787     1.2018   0.315    0.753
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.2 on 583 degrees of freedom
## Multiple R-squared:  0.1279, Adjusted R-squared:  0.1234
## F-statistic:  28.5 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + wkly_study_hours,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median     3Q     Max
## -52.360  -9.194   0.891  10.101  39.701
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       64.2095     3.1118  20.634  < 2e-16 ***
## lunch_type         8.5696     1.2273   6.983 7.91e-12 ***
## gender            -7.6506     1.1757  -6.508 1.65e-10 ***
## wkly_study_hours   1.4107     0.8904   1.584    0.114
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.17 on 583 degrees of freedom
## Multiple R-squared:  0.1315, Adjusted R-squared:  0.127
## F-statistic: 29.42 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep,
##     data = step_df)
##
## Residuals:
##    Min      1Q  Median     3Q     Max
## -48.365  -9.154  -0.154  10.259  35.673
```

```
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    78.035      3.251  24.004  < 2e-16 ***
## lunch_type      8.789      1.198   7.339 7.27e-13 ***
## gender         -7.845      1.147  -6.842 1.98e-11 ***
## test_prep      -6.807      1.194  -5.700 1.90e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 583 degrees of freedom
## Multiple R-squared:  0.1738, Adjusted R-squared:  0.1695
## F-statistic: 40.88 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.365  -9.154  -0.154  10.259  35.673
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    78.035      3.251  24.004  < 2e-16 ***
## lunch_type      8.789      1.198   7.339 7.27e-13 ***
## gender         -7.845      1.147  -6.842 1.98e-11 ***
## test_prep      -6.807      1.194  -5.700 1.90e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 583 degrees of freedom
## Multiple R-squared:  0.1738, Adjusted R-squared:  0.1695
## F-statistic: 40.88 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.185  -9.696   0.309  10.143  32.043
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   72.0069     3.5370  20.358  < 2e-16 ***
## lunch_type     8.5998     1.1830   7.269 1.17e-12 ***
## gender        -7.8550     1.1318  -6.940 1.05e-11 ***
## test_prep     -6.7166     1.1790  -5.697 1.94e-08 ***
## ethnic_group   1.9554     0.4827   4.051 5.79e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 13.64 on 582 degrees of freedom
## Multiple R-squared:  0.1965, Adjusted R-squared:  0.1909
## F-statistic: 35.57 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.299  -9.218   0.751   9.968  35.537
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  71.9074     3.4168  21.045  < 2e-16 ***
## lunch_type    8.8432     1.1740   7.532 1.91e-13 ***
## gender       -7.4774     1.1264  -6.638 7.29e-11 ***
## test_prep    -6.9179     1.1709  -5.908 5.89e-09 ***
## parent_educ   1.8616     0.3745   4.971 8.78e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 582 degrees of freedom
## Multiple R-squared:  0.2074, Adjusted R-squared:  0.202
## F-statistic: 38.08 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.737  -9.103  -0.278  10.348  35.746
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            76.9929     3.7914  20.307  < 2e-16 ***
## lunch_type              8.8095     1.1989   7.348 6.86e-13 ***
## gender                 -7.8246     1.1480  -6.816 2.34e-11 ***
## test_prep              -6.7856     1.1956  -5.675 2.19e-08 ***
## parent_marital_status   0.4435     0.8287   0.535    0.593
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 582 degrees of freedom
## Multiple R-squared:  0.1742, Adjusted R-squared:  0.1685
## F-statistic: 30.69 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     practice_sport, data = step_df)
##
```

```
## Residuals:
##     Min     1Q  Median     3Q     Max
## -47.657  -9.459   0.208  10.426  36.350
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)     80.2982     3.8445  20.887  < 2e-16 ***
## lunch_type       8.7502     1.1979   7.305 9.20e-13 ***
## gender          -7.8337     1.1465  -6.833 2.10e-11 ***
## test_prep       -6.8260     1.1941  -5.716 1.74e-08 ***
## practice_sport  -0.9684     0.8786  -1.102    0.271
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 582 degrees of freedom
## Multiple R-squared:  0.1755, Adjusted R-squared:  0.1699
## F-statistic: 30.97 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     is_first_child, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -48.685  -9.416   0.207  10.392  36.301
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)     76.499      3.870  19.768  < 2e-16 ***
## lunch_type       8.777      1.198   7.326 7.97e-13 ***
## gender          -7.854      1.147  -6.847 1.92e-11 ***
## test_prep       -6.760      1.196  -5.651 2.50e-08 ***
## is_first_child   0.892      1.218   0.732    0.464
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 582 degrees of freedom
## Multiple R-squared:  0.1746, Adjusted R-squared:  0.1689
## F-statistic: 30.77 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     nr_siblings, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -48.590  -9.317  -0.259  10.162  35.459
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   77.3862     3.3955  22.791  < 2e-16 ***
## lunch_type     8.7848     1.1982   7.332 7.65e-13 ***
## gender        -7.8168     1.1480  -6.809 2.45e-11 ***
```

```
## test_prep    -6.7676     1.1963  -5.657 2.41e-08 ***
## nr_siblings   0.2569     0.3862   0.665    0.506
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 582 degrees of freedom
## Multiple R-squared:  0.1744, Adjusted R-squared:  0.1687
## F-statistic: 30.74 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.692  -9.409   0.168  10.344  36.162
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      76.7815     3.6696  20.924  < 2e-16 ***
## lunch_type        8.7812     1.1981   7.329 7.78e-13 ***
## gender           -7.8595     1.1473  -6.851 1.88e-11 ***
## test_prep        -6.8710     1.1978  -5.736 1.56e-08 ***
## transport_means   0.8653     1.1733   0.737    0.461
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.83 on 582 degrees of freedom
## Multiple R-squared:  0.1746, Adjusted R-squared:  0.1689
## F-statistic: 30.77 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.466  -9.300  -0.300   9.722  35.695
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       76.0874     3.7085  20.517  < 2e-16 ***
## lunch_type         8.7848     1.1974   7.336 7.40e-13 ***
## gender            -7.8932     1.1473  -6.880 1.55e-11 ***
## test_prep         -6.6835     1.1994  -5.572 3.85e-08 ***
## wkly_study_hours   0.9514     0.8722   1.091    0.276
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.82 on 582 degrees of freedom
## Multiple R-squared:  0.1755, Adjusted R-squared:  0.1698
## F-statistic: 30.97 on 4 and 582 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.299  -9.218   0.751   9.968  35.537
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  71.9074     3.4168  21.045  < 2e-16 ***
## lunch_type    8.8432     1.1740   7.532 1.91e-13 ***
## gender       -7.4774     1.1264  -6.638 7.29e-11 ***
## test_prep    -6.9179     1.1709  -5.908 5.89e-09 ***
## parent_educ   1.8616     0.3745   4.971 8.78e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 582 degrees of freedom
## Multiple R-squared:  0.2074, Adjusted R-squared:  0.202
## F-statistic: 38.08 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.354  -8.959   0.802   9.901  32.216
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   66.7121     3.6485  18.285  < 2e-16 ***
## lunch_type     8.6667     1.1618   7.459 3.18e-13 ***
## gender        -7.5066     1.1139  -6.739 3.84e-11 ***
## test_prep     -6.8289     1.1580  -5.897 6.28e-09 ***
## parent_educ    1.7606     0.3713   4.742 2.66e-06 ***
## ethnic_group   1.7930     0.4753   3.773 0.000178 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 581 degrees of freedom
## Multiple R-squared:  0.2264, Adjusted R-squared:  0.2197
## F-statistic: 34.01 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.611  -9.180   0.629   9.997  35.598
```

```
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           71.0626     3.9046  18.200  < 2e-16 ***
## lunch_type             8.8598     1.1754   7.538 1.85e-13 ***
## gender                -7.4614     1.1278  -6.616 8.39e-11 ***
## test_prep             -6.9001     1.1724  -5.886 6.71e-09 ***
## parent_educ            1.8582     0.3748   4.958 9.38e-07 ***
## parent_marital_status  0.3641     0.8126   0.448    0.654
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.56 on 581 degrees of freedom
## Multiple R-squared:  0.2077, Adjusted R-squared:  0.2009
## F-statistic: 30.47 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -43.833  -9.145   0.826  10.176  36.026
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     73.5975     4.0101  18.353  < 2e-16 ***
## lunch_type       8.8147     1.1749   7.502 2.36e-13 ***
## gender          -7.4732     1.1268  -6.632 7.57e-11 ***
## test_prep       -6.9303     1.1713  -5.917 5.62e-09 ***
## parent_educ      1.8421     0.3754   4.907 1.20e-06 ***
## practice_sport  -0.6958     0.8635  -0.806    0.421
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 581 degrees of freedom
## Multiple R-squared:  0.2083, Adjusted R-squared:  0.2015
## F-statistic: 30.58 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.608  -9.313   0.700  10.098  36.135
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     70.4526     3.9845  17.682  < 2e-16 ***
## lunch_type       8.8320     1.1746   7.519 2.10e-13 ***
## gender          -7.4870     1.1270  -6.643 7.06e-11 ***
## test_prep       -6.8734     1.1731  -5.859 7.79e-09 ***
```

```
## parent_educ        1.8596     0.3747    4.963 9.11e-07 ***
## is_first_child   0.8488      1.1944    0.711     0.478
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 581 degrees of freedom
## Multiple R-squared:  0.2081, Adjusted R-squared:  0.2013
## F-statistic: 30.54 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.540  -9.254   0.737  10.246  35.299
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  71.1703     3.5545  20.023  < 2e-16 ***
## lunch_type    8.8386     1.1745   7.526 2.01e-13 ***
## gender       -7.4452     1.1277  -6.602 9.14e-11 ***
## test_prep    -6.8742     1.1727  -5.862 7.69e-09 ***
## parent_educ   1.8659     0.3747   4.980 8.39e-07 ***
## nr_siblings   0.2862     0.3786   0.756     0.45
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 581 degrees of freedom
## Multiple R-squared:  0.2082, Adjusted R-squared:  0.2014
## F-statistic: 30.56 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.611  -9.130   0.694  10.057  35.997
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      70.7390     3.7978  18.626  < 2e-16 ***
## lunch_type        8.8358     1.1746   7.523 2.05e-13 ***
## gender           -7.4916     1.1271  -6.647 6.91e-11 ***
## test_prep        -6.9777     1.1744  -5.941 4.88e-09 ***
## parent_educ       1.8591     0.3747   4.962 9.18e-07 ***
## transport_means   0.8121     1.1502   0.706     0.48
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.55 on 581 degrees of freedom
## Multiple R-squared:  0.2081, Adjusted R-squared:  0.2013
```

```
## F-statistic: 30.54 on 5 and 581 DF,  p-value: < 2.2e-16
##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.535  -9.074   0.847   9.928  35.562
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        69.6040     3.8570  18.046  < 2e-16 ***
## lunch_type          8.8388     1.1734   7.533 1.91e-13 ***
## gender             -7.5299     1.1266  -6.684 5.46e-11 ***
## test_prep          -6.7761     1.1754  -5.765 1.33e-08 ***
## parent_educ         1.8781     0.3745   5.015 7.06e-07 ***
## wkly_study_hours    1.0987     0.8552   1.285    0.199
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.54 on 581 degrees of freedom
## Multiple R-squared:  0.2097, Adjusted R-squared:  0.2029
## F-statistic: 30.83 on 5 and 581 DF,  p-value: < 2.2e-16
##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.354  -8.959   0.802   9.901  32.216
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   66.7121     3.6485  18.285  < 2e-16 ***
## lunch_type     8.6667     1.1618   7.459 3.18e-13 ***
## gender        -7.5066     1.1139  -6.739 3.84e-11 ***
## test_prep     -6.8289     1.1580  -5.897 6.28e-09 ***
## parent_educ    1.7606     0.3713   4.742 2.66e-06 ***
## ethnic_group   1.7930     0.4753   3.773 0.000178 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 581 degrees of freedom
## Multiple R-squared:  0.2264, Adjusted R-squared:  0.2197
## F-statistic: 34.01 on 5 and 581 DF,  p-value: < 2.2e-16
##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + parent_marital_status, data = step_df)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.741  -8.668   0.860  10.107  32.276
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             65.6456     4.1173  15.944  < 2e-16 ***
## lunch_type               8.6865     1.1631   7.469 2.99e-13 ***
## gender                  -7.4869     1.1151  -6.714 4.51e-11 ***
## test_prep               -6.8065     1.1594  -5.871 7.31e-09 ***
## parent_educ              1.7561     0.3716   4.726 2.88e-06 ***
## ethnic_group             1.8006     0.4757   3.785  0.00017 ***
## parent_marital_status    0.4502     0.8037   0.560  0.57557
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 580 degrees of freedom
## Multiple R-squared:  0.2268, Adjusted R-squared:  0.2188
## F-statistic: 28.36 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -43.882  -9.319   0.845  10.001  32.709
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     68.4230     4.1955  16.309  < 2e-16 ***
## lunch_type       8.6377     1.1627   7.429 3.93e-13 ***
## gender          -7.5024     1.1142  -6.734 3.99e-11 ***
## test_prep       -6.8414     1.1584  -5.906 5.98e-09 ***
## parent_educ      1.7408     0.3721   4.678 3.61e-06 ***
## ethnic_group     1.7943     0.4754   3.774 0.000177 ***
## practice_sport  -0.7058     0.8538  -0.827 0.408769
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 580 degrees of freedom
## Multiple R-squared:  0.2273, Adjusted R-squared:  0.2193
## F-statistic: 28.44 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.665  -9.187   0.886  10.213  32.816
##
## Coefficients:
```

```
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      65.2492     4.1744  15.631  < 2e-16 ***
## lunch_type        8.6555     1.1624   7.446 3.50e-13 ***
## gender           -7.5162     1.1144  -6.745 3.72e-11 ***
## test_prep        -6.7841     1.1602  -5.848 8.33e-09 ***
## parent_educ       1.7587     0.3714   4.735 2.76e-06 ***
## ethnic_group      1.7934     0.4755   3.772 0.000179 ***
## is_first_child    0.8529     1.1810   0.722 0.470481
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 580 degrees of freedom
## Multiple R-squared:  0.2271, Adjusted R-squared:  0.2191
## F-statistic:  28.4 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.626  -8.902   0.850   9.677  32.420
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    65.8499     3.7839  17.403  < 2e-16 ***
## lunch_type      8.6605     1.1621   7.452 3.35e-13 ***
## gender         -7.4705     1.1149  -6.701 4.92e-11 ***
## test_prep      -6.7791     1.1597  -5.845 8.44e-09 ***
## parent_educ     1.7650     0.3714   4.752 2.54e-06 ***
## ethnic_group    1.8036     0.4755   3.793 0.000165 ***
## nr_siblings     0.3228     0.3744   0.862 0.388988
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 580 degrees of freedom
## Multiple R-squared:  0.2274, Adjusted R-squared:  0.2194
## F-statistic: 28.45 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.717  -8.855   0.790   9.849  32.728
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      65.3191     4.0171  16.260  < 2e-16 ***
## lunch_type        8.6569     1.1622   7.449 3.44e-13 ***
## gender           -7.5233     1.1144  -6.751 3.56e-11 ***
## test_prep        -6.8978     1.1613  -5.940 4.93e-09 ***
```

```
## parent_educ        1.7571      0.3714    4.731 2.81e-06 ***
## ethnic_group       1.8051      0.4756    3.795 0.000163 ***
## transport_means    0.9440      1.1377    0.830 0.407036
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.4 on 580 degrees of freedom
## Multiple R-squared:  0.2273, Adjusted R-squared:  0.2193
## F-statistic: 28.44 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -45.551  -8.822   0.863   9.721  32.252
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       64.5007     4.0483  15.933  < 2e-16 ***
## lunch_type         8.6631     1.1613   7.460 3.18e-13 ***
## gender            -7.5573     1.1140  -6.784 2.90e-11 ***
## test_prep         -6.6919     1.1626  -5.756 1.39e-08 ***
## parent_educ        1.7770     0.3713   4.786 2.16e-06 ***
## ethnic_group       1.7865     0.4751   3.761 0.000187 ***
## wkly_study_hours   1.0638     0.8457   1.258 0.208928
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.39 on 580 degrees of freedom
## Multiple R-squared:  0.2285, Adjusted R-squared:  0.2205
## F-statistic: 28.63 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.354  -8.959   0.802   9.901  32.216
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   66.7121     3.6485  18.285  < 2e-16 ***
## lunch_type     8.6667     1.1618   7.459 3.18e-13 ***
## gender        -7.5066     1.1139  -6.739 3.84e-11 ***
## test_prep     -6.8289     1.1580  -5.897 6.28e-09 ***
## parent_educ    1.7606     0.3713   4.742 2.66e-06 ***
## ethnic_group   1.7930     0.4753   3.773 0.000178 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 13.4 on 581 degrees of freedom
## Multiple R-squared:  0.2264, Adjusted R-squared:  0.2197
## F-statistic: 34.01 on 5 and 581 DF,  p-value: < 2.2e-16

## Start:  AIC=3193.22
## reading_score ~ 1
##
##                          Df Sum of Sq    RSS    AIC
## + lunch_type              1    8876.3 125920 3155.2
## + gender                  1    7428.6 127368 3161.9
## + test_prep               1    5190.3 129606 3172.2
## + parent_educ             1    4985.3 129811 3173.1
## + ethnic_group            1    3614.0 131182 3179.3
## <none>                                 134796 3193.2
## + wkly_study_hours        1     353.1 134443 3193.7
## + practice_sport          1     314.3 134482 3193.9
## + nr_siblings             1     270.2 134526 3194.0
## + is_first_child          1     202.0 134594 3194.3
## + parent_marital_status   1      93.3 134703 3194.8
## + transport_means         1      18.5 134778 3195.1
##
## Step:  AIC=3155.24
## reading_score ~ lunch_type
##
##                          Df Sum of Sq    RSS    AIC
## + gender                  1    8344.3 117576 3117.0
## + test_prep               1    5609.0 120311 3130.5
## + parent_educ             1    5149.8 120770 3132.7
## + ethnic_group            1    3189.3 122731 3142.2
## <none>                                 125920 3155.2
## + wkly_study_hours        1     344.5 125575 3155.6
## + nr_siblings             1     264.4 125655 3156.0
## + practice_sport          1     223.8 125696 3156.2
## + is_first_child          1     170.4 125749 3156.4
## + parent_marital_status   1     167.1 125753 3156.5
## + transport_means         1      10.1 125910 3157.2
##
## Step:  AIC=3116.99
## reading_score ~ lunch_type + gender
##
##                          Df Sum of Sq    RSS    AIC
## + test_prep               1    6206.4 111369 3087.2
## + parent_educ             1    4334.5 113241 3096.9
## + ethnic_group            1    3220.4 114355 3102.7
## + wkly_study_hours        1     504.0 117072 3116.5
## <none>                                 117576 3117.0
## + is_first_child          1     204.6 117371 3118.0
## + practice_sport          1     198.7 117377 3118.0
## + nr_siblings             1     171.4 117404 3118.1
## + parent_marital_status   1     100.8 117475 3118.5
## + transport_means         1      20.0 117556 3118.9
##
## Step:  AIC=3087.16
## reading_score ~ lunch_type + gender + test_prep
```

```
##
##                              Df Sum of Sq    RSS    AIC
## + parent_educ            1    4535.8 106833 3064.8
## + ethnic_group           1    3054.3 108315 3072.8
## <none>                                111369 3087.2
## + practice_sport         1     232.0 111137 3087.9
## + wkly_study_hours       1     227.2 111142 3088.0
## + transport_means        1     104.0 111265 3088.6
## + is_first_child         1     102.5 111267 3088.6
## + nr_siblings            1      84.6 111285 3088.7
## + parent_marital_status  1      54.8 111314 3088.9
##
## Step:  AIC=3064.75
## reading_score ~ lunch_type + gender + test_prep + parent_educ
##
##                              Df Sum of Sq    RSS    AIC
## + ethnic_group           1    2554.69 104279 3052.5
## <none>                               106833 3064.8
## + wkly_study_hours       1     302.64 106531 3065.1
## + practice_sport         1     119.26 106714 3066.1
## + nr_siblings            1     104.94 106728 3066.2
## + is_first_child         1      92.77 106741 3066.2
## + transport_means        1      91.59 106742 3066.2
## + parent_marital_status  1      36.91 106796 3066.6
##
## Step:  AIC=3052.54
## reading_score ~ lunch_type + gender + test_prep + parent_educ +
##     ethnic_group
##
##                              Df Sum of Sq    RSS    AIC
## <none>                               104279 3052.5
## + wkly_study_hours       1    283.719 103995 3052.9
## + nr_siblings            1    133.453 104145 3053.8
## + transport_means        1    123.629 104155 3053.8
## + practice_sport         1    122.719 104156 3053.8
## + is_first_child         1     93.682 104185 3054.0
## + parent_marital_status  1     56.388 104222 3054.2
##
## Call:
## lm(formula = reading_score ~ lunch_type + gender + test_prep +
##     parent_educ + ethnic_group, data = reading_df)
##
## Coefficients:
##  (Intercept)    lunch_type        gender     test_prep   parent_educ
##       66.712         8.667        -7.507        -6.829         1.761
## ethnic_group
##        1.793
```

The model we obtained is Reading Score ~ Lunch Type + Ethnic Group + Test Prep + Gender + Parent Education + Weekly Study Hours.

When using the single-function method, the model obtained with the lowest AIC was Reading Score ~ Lunch Type + Gender + Test Prep + Parent Education + Ethnic Group.

Writing Score

```
## 
## Call:
## lm(formula = writing_score ~ gender, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.943 -10.221   1.057  11.057  35.779
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   81.665      1.912  42.714  < 2e-16 ***
## gender        -8.722      1.237  -7.053 4.96e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 14.94 on 585 degrees of freedom
## Multiple R-squared:  0.07837,    Adjusted R-squared:  0.07679
## F-statistic: 49.74 on 1 and 585 DF,  p-value: 4.964e-12

## 
## Call:
## lm(formula = writing_score ~ ethnic_group, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.452 -10.868   0.548  11.548  33.716
## 
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   60.6995     1.8250  33.259  < 2e-16 ***
## ethnic_group   2.5842     0.5397   4.788 2.13e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 15.27 on 585 degrees of freedom
## Multiple R-squared:  0.03772,    Adjusted R-squared:  0.03607
## F-statistic: 22.93 on 1 and 585 DF,  p-value: 2.132e-06

## 
## Call:
## lm(formula = writing_score ~ parent_educ, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.707 -10.533   0.172  11.232  36.293
## 
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  61.1771     1.4150   43.23  < 2e-16 ***
## parent_educ   2.5301     0.4162    6.08 2.18e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 15.09 on 585 degrees of freedom
## Multiple R-squared:  0.05943,    Adjusted R-squared:  0.05782
```

```
## F-statistic: 36.96 on 1 and 585 DF,  p-value: 2.176e-09

##
## Call:
## lm(formula = writing_score ~ lunch_type, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.165  -9.584   0.835  10.997  36.835
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   54.327      2.224  24.430  < 2e-16 ***
## lunch_type     8.838      1.295   6.822 2.24e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.98 on 585 degrees of freedom
## Multiple R-squared:  0.0737, Adjusted R-squared:  0.07212
## F-statistic: 46.54 on 1 and 585 DF,  p-value: 2.242e-11

##
## Call:
## lm(formula = writing_score ~ parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.767 -10.774   0.226  10.726  32.218
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            66.7887     2.0806  32.101   <2e-16 ***
## parent_marital_status   0.9928     0.9301   1.067    0.286
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.55 on 585 degrees of freedom
## Multiple R-squared:  0.001944,   Adjusted R-squared:  0.0002376
## F-statistic: 1.139 on 1 and 585 DF,  p-value: 0.2862

##
## Call:
## lm(formula = writing_score ~ practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -58.898 -10.902   0.102  10.102  31.102
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)    68.91193    2.32122  29.688   <2e-16 ***
## practice_sport -0.00476    0.98893  -0.005    0.996
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 15.56 on 585 degrees of freedom
## Multiple R-squared:  3.96e-08,   Adjusted R-squared:  -0.001709
## F-statistic: 2.317e-05 on 1 and 585 DF,  p-value: 0.9962

##
## Call:
## lm(formula = writing_score ~ is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.182 -11.182  -0.182  10.677  31.677
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     67.4636     2.3781  28.368   <2e-16 ***
## is_first_child   0.8594     1.3688   0.628     0.53
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.56 on 585 degrees of freedom
## Multiple R-squared:  0.0006734,  Adjusted R-squared:  -0.001035
## F-statistic: 0.3942 on 1 and 585 DF,  p-value: 0.5304

##
## Call:
## lm(formula = writing_score ~ nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.469 -10.639   0.531  10.851  32.511
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   67.489      1.127  59.898   <2e-16 ***
## nr_siblings    0.660      0.433   1.524    0.128
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.53 on 585 degrees of freedom
## Multiple R-squared:  0.003955,   Adjusted R-squared:  0.002252
## F-statistic: 2.323 on 1 and 585 DF,  p-value: 0.128

##
## Call:
## lm(formula = writing_score ~ transport_means, data = step_df)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -58.93 -10.86   0.14  10.14  31.14
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     68.79315    2.21527  31.054   <2e-16 ***
## transport_means  0.06711    1.31692   0.051    0.959
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.56 on 585 degrees of freedom
## Multiple R-squared:  4.439e-06,  Adjusted R-squared:  -0.001705
## F-statistic: 0.002597 on 1 and 585 DF,  p-value: 0.9594

##
## Call:
## lm(formula = writing_score ~ wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -60.381 -10.654   0.346  10.346  32.346
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       66.2897     1.9747  33.569   <2e-16 ***
## wkly_study_hours   1.3638     0.9754   1.398    0.163
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.54 on 585 degrees of freedom
## Multiple R-squared:  0.003331,   Adjusted R-squared:  0.001627
## F-statistic: 1.955 on 1 and 585 DF,  p-value: 0.1626

##
## Call:
## lm(formula = writing_score ~ test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.902 -10.365   1.098  10.635  34.098
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   82.828      2.222  37.276  < 2e-16 ***
## test_prep     -8.463      1.297  -6.527 1.46e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.03 on 585 degrees of freedom
## Multiple R-squared:  0.06788,    Adjusted R-squared:  0.06629
## F-statistic:  42.6 on 1 and 585 DF,  p-value: 1.455e-10

##
## Call:
## lm(formula = writing_score ~ gender, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.943 -10.221   1.057  11.057  35.779
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   81.665      1.912  42.714  < 2e-16 ***
```

```
## gender         -8.722       1.237  -7.053 4.96e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.94 on 585 degrees of freedom
## Multiple R-squared:  0.07837,    Adjusted R-squared:  0.07679
## F-statistic: 49.74 on 1 and 585 DF,  p-value: 4.964e-12

##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.505  -9.545   0.098  10.042  31.042
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  73.4485     2.4855  29.550  < 2e-16 ***
## gender       -8.7532     1.2118  -7.223 1.59e-12 ***
## ethnic_group  2.6032     0.5175   5.030 6.53e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.64 on 584 degrees of freedom
## Multiple R-squared:  0.1166, Adjusted R-squared:  0.1136
## F-statistic: 38.56 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.908  -9.667   1.092  10.506  32.092
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  73.8127     2.2951  32.162  < 2e-16 ***
## gender       -8.2503     1.2058  -6.842 1.98e-11 ***
## parent_educ   2.3460     0.4017   5.840 8.65e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.54 on 584 degrees of freedom
## Multiple R-squared:  0.1292, Adjusted R-squared:  0.1262
## F-statistic: 43.33 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + parent_marital_status,
##     data = step_df)
##
## Residuals:
##     Min      1Q Median      3Q     Max
```

```
## -63.61 -10.14   0.86  11.17  35.08
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             79.9463     2.7411  29.166  < 2e-16 ***
## gender                  -8.6860     1.2376  -7.018 6.25e-12 ***
## parent_marital_status    0.7829     0.8945   0.875    0.382
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.94 on 584 degrees of freedom
## Multiple R-squared:  0.07958,    Adjusted R-squared:  0.07642
## F-statistic: 25.25 on 2 and 584 DF,  p-value: 3.051e-11

##
## Call:
## lm(formula = writing_score ~ gender + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.979 -10.208   1.021  11.069  35.744
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   81.55789    2.86260  28.491  < 2e-16 ***
## gender        -8.72276    1.23778  -7.047 5.17e-12 ***
## practice_sport 0.04786    0.95023   0.050     0.96
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07837,    Adjusted R-squared:  0.07522
## F-statistic: 24.83 on 2 and 584 DF,  p-value: 4.469e-11

##
## Call:
## lm(formula = writing_score ~ gender + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -63.274 -10.538   0.726  10.726  35.462
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   80.0245     2.8956  27.636  < 2e-16 ***
## gender        -8.7356     1.2373  -7.060 4.73e-12 ***
## is_first_child 0.9924     1.3151   0.755    0.451
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07927,    Adjusted R-squared:  0.07611
## F-statistic: 25.14 on 2 and 584 DF,  p-value: 3.366e-11

##
```

```
## Call:
## lm(formula = writing_score ~ gender + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -63.397 -10.338   0.827  11.044  33.032
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  80.3850     2.1355  37.643  < 2e-16 ***
## gender       -8.6648     1.2366  -7.007 6.73e-12 ***
## nr_siblings   0.5590     0.4165   1.342     0.18
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.93 on 584 degrees of freedom
## Multiple R-squared:  0.0812, Adjusted R-squared:  0.07806
## F-statistic: 25.81 on 2 and 584 DF,  p-value: 1.821e-11

##
## Call:
## lm(formula = writing_score ~ gender + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -63.022 -10.197   0.978  10.978  35.902
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      81.3488     2.7755  29.310  < 2e-16 ***
## gender           -8.7252     1.2379  -7.049 5.12e-12 ***
## transport_means   0.1991     1.2655   0.157    0.875
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07841,    Adjusted R-squared:  0.07525
## F-statistic: 24.84 on 2 and 584 DF,  p-value: 4.419e-11

##
## Call:
## lm(formula = writing_score ~ gender + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -64.774  -9.664   0.874  10.874  35.689
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       78.6452     2.5677  30.629  < 2e-16 ***
## gender            -8.8145     1.2356  -7.134  2.9e-12 ***
## wkly_study_hours   1.6476     0.9371   1.758   0.0793 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 14.91 on 584 degrees of freedom
## Multiple R-squared:  0.08322,    Adjusted R-squared:  0.08008
## F-statistic: 26.51 on 2 and 584 DF,  p-value: 9.578e-12

##
## Call:
## lm(formula = writing_score ~ gender + test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.967  -9.747   1.033   9.143  32.095
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    96.714      2.795  34.605  < 2e-16 ***
## gender         -9.063      1.188  -7.629  9.7e-14 ***
## test_prep      -8.842      1.239  -7.139  2.8e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.34 on 584 degrees of freedom
## Multiple R-squared:  0.1523, Adjusted R-squared:  0.1494
## F-statistic: 52.48 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.095  -9.170   0.754   9.754  37.105
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    66.944      2.668  25.087  < 2e-16 ***
## gender         -9.200      1.183  -7.777 3.37e-14 ***
## lunch_type      9.351      1.236   7.566 1.51e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.27 on 584 degrees of freedom
## Multiple R-squared:  0.1606, Adjusted R-squared:  0.1578
## F-statistic: 55.88 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.908  -9.667   1.092  10.506  32.092
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   73.8127     2.2951  32.162  < 2e-16 ***
```

```
## gender        -8.2503       1.2058   -6.842 1.98e-11 ***
## parent_educ    2.3460       0.4017    5.840 8.65e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.54 on 584 degrees of freedom
## Multiple R-squared:  0.1292, Adjusted R-squared:  0.1262
## F-statistic: 43.33 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.505  -9.545   0.098  10.042  31.042
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  73.4485      2.4855  29.550  < 2e-16 ***
## gender       -8.7532      1.2118  -7.223 1.59e-12 ***
## ethnic_group  2.6032      0.5175   5.030 6.53e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.64 on 584 degrees of freedom
## Multiple R-squared:  0.1166, Adjusted R-squared:  0.1136
## F-statistic: 38.56 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -57.908  -9.667   1.092  10.506  32.092
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  73.8127      2.2951  32.162  < 2e-16 ***
## gender       -8.2503      1.2058  -6.842 1.98e-11 ***
## parent_educ   2.3460      0.4017   5.840 8.65e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.54 on 584 degrees of freedom
## Multiple R-squared:  0.1292, Adjusted R-squared:  0.1262
## F-statistic: 43.33 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + parent_marital_status,
##     data = step_df)
##
## Residuals:
```

```
##     Min      1Q Median      3Q     Max
## -63.61 -10.14   0.86  11.17  35.08
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           79.9463     2.7411  29.166  < 2e-16 ***
## gender                -8.6860     1.2376  -7.018 6.25e-12 ***
## parent_marital_status  0.7829     0.8945   0.875    0.382
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.94 on 584 degrees of freedom
## Multiple R-squared:  0.07958,    Adjusted R-squared:  0.07642
## F-statistic: 25.25 on 2 and 584 DF,  p-value: 3.051e-11

##
## Call:
## lm(formula = writing_score ~ gender + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -62.979 -10.208   1.021  11.069  35.744
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  81.55789    2.86260  28.491  < 2e-16 ***
## gender       -8.72276    1.23778  -7.047 5.17e-12 ***
## practice_sport 0.04786    0.95023   0.050     0.96
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07837,    Adjusted R-squared:  0.07522
## F-statistic: 24.83 on 2 and 584 DF,  p-value: 4.469e-11

##
## Call:
## lm(formula = writing_score ~ gender + is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q Median      3Q     Max
## -63.274 -10.538   0.726  10.726  35.462
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  80.0245     2.8956  27.636  < 2e-16 ***
## gender       -8.7356     1.2373  -7.060 4.73e-12 ***
## is_first_child 0.9924     1.3151   0.755    0.451
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07927,    Adjusted R-squared:  0.07611
## F-statistic: 25.14 on 2 and 584 DF,  p-value: 3.366e-11
```

```
##
## Call:
## lm(formula = writing_score ~ gender + nr_siblings, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -63.397 -10.338   0.827  11.044  33.032
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  80.3850     2.1355  37.643  < 2e-16 ***
## gender       -8.6648     1.2366  -7.007 6.73e-12 ***
## nr_siblings   0.5590     0.4165   1.342     0.18
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.93 on 584 degrees of freedom
## Multiple R-squared:  0.0812, Adjusted R-squared:  0.07806
## F-statistic: 25.81 on 2 and 584 DF,  p-value: 1.821e-11

##
## Call:
## lm(formula = writing_score ~ gender + transport_means, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -63.022 -10.197   0.978  10.978  35.902
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      81.3488     2.7755  29.310  < 2e-16 ***
## gender           -8.7252     1.2379  -7.049 5.12e-12 ***
## transport_means   0.1991     1.2655   0.157    0.875
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.95 on 584 degrees of freedom
## Multiple R-squared:  0.07841,    Adjusted R-squared:  0.07525
## F-statistic: 24.84 on 2 and 584 DF,  p-value: 4.419e-11

##
## Call:
## lm(formula = writing_score ~ gender + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min     1Q  Median     3Q     Max
## -64.774  -9.664   0.874  10.874  35.689
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       78.6452     2.5677  30.629  < 2e-16 ***
## gender            -8.8145     1.2356  -7.134  2.9e-12 ***
## wkly_study_hours   1.6476     0.9371   1.758   0.0793 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 14.91 on 584 degrees of freedom
## Multiple R-squared:  0.08322,    Adjusted R-squared:  0.08008
## F-statistic: 26.51 on 2 and 584 DF,  p-value: 9.578e-12

##
## Call:
## lm(formula = writing_score ~ gender + test_prep, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -59.967  -9.747   1.033   9.143  32.095
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    96.714      2.795  34.605  < 2e-16 ***
## gender         -9.063      1.188  -7.629  9.7e-14 ***
## test_prep      -8.842      1.239  -7.139  2.8e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.34 on 584 degrees of freedom
## Multiple R-squared:  0.1523, Adjusted R-squared:  0.1494
## F-statistic: 52.48 on 2 and 584 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep,
##     data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.831  -8.831   0.523  10.523  31.585
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    82.055      3.197  25.665  < 2e-16 ***
## gender         -9.567      1.128  -8.484  < 2e-16 ***
## lunch_type      9.645      1.178   8.189 1.67e-15 ***
## test_prep      -9.151      1.174  -7.791 3.05e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.59 on 583 degrees of freedom
## Multiple R-squared:  0.2398, Adjusted R-squared:  0.2359
## F-statistic:  61.3 on 3 and 583 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.611  -8.743   0.158   9.306  30.331
```

```
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   74.6928     3.4518  21.639  < 2e-16 ***
## gender        -9.5795     1.1045  -8.673  < 2e-16 ***
## lunch_type     9.4139     1.1545   8.154 2.17e-15 ***
## test_prep     -9.0404     1.1506  -7.857 1.91e-14 ***
## ethnic_group   2.3883     0.4711   5.070 5.36e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.31 on 582 degrees of freedom
## Multiple R-squared:  0.2719, Adjusted R-squared:  0.2669
## F-statistic: 54.35 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.527  -8.462   1.122   9.869  31.408
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   74.0611     3.3057  22.404  < 2e-16 ***
## gender        -9.0877     1.0898  -8.339 5.44e-16 ***
## lunch_type     9.7157     1.1358   8.554  < 2e-16 ***
## test_prep     -9.2954     1.1328  -8.206 1.48e-15 ***
## parent_educ    2.4286     0.3623   6.703 4.83e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.11 on 582 degrees of freedom
## Multiple R-squared:  0.2943, Adjusted R-squared:  0.2894
## F-statistic: 60.67 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.489  -8.733   0.295  10.431  31.714
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            80.2119     3.7267  21.524  < 2e-16 ***
## gender                 -9.5312     1.1284  -8.447 2.40e-16 ***
## lunch_type              9.6811     1.1785   8.215 1.38e-15 ***
## test_prep              -9.1130     1.1752  -7.754 4.00e-14 ***
## parent_marital_status   0.7844     0.8146   0.963    0.336
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.59 on 582 degrees of freedom
## Multiple R-squared:  0.241,  Adjusted R-squared:  0.2358
## F-statistic:  46.2 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.946  -8.831   0.403  10.517  31.475
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     81.6893     3.7848  21.584  < 2e-16 ***
## gender          -9.5689     1.1287  -8.478  < 2e-16 ***
## lunch_type       9.6514     1.1793   8.184 1.74e-15 ***
## test_prep       -9.1478     1.1756  -7.781 3.29e-14 ***
## practice_sport   0.1566     0.8649   0.181    0.856
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.6 on 582 degrees of freedom
## Multiple R-squared:  0.2398, Adjusted R-squared:  0.2346
## F-statistic: 45.91 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     is_first_child, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.971  -8.971   0.389  10.403  31.857
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     81.3888     3.8074  21.376  < 2e-16 ***
## gender          -9.5713     1.1286  -8.480  < 2e-16 ***
## lunch_type       9.6400     1.1788   8.178 1.82e-15 ***
## test_prep       -9.1306     1.1771  -7.757 3.91e-14 ***
## is_first_child   0.3871     1.1987   0.323    0.747
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.6 on 582 degrees of freedom
## Multiple R-squared:  0.2399, Adjusted R-squared:  0.2347
## F-statistic: 45.93 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
```

```
##      nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.183  -8.822   0.580  10.432  31.251
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  81.0394     3.3375  24.282  < 2e-16 ***
## gender       -9.5231     1.1283  -8.440 2.53e-16 ***
## lunch_type    9.6385     1.1777   8.184 1.74e-15 ***
## test_prep    -9.0891     1.1758  -7.730 4.75e-14 ***
## nr_siblings   0.4023     0.3796   1.060     0.29
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.59 on 582 degrees of freedom
## Multiple R-squared:  0.2413, Adjusted R-squared:  0.236
## F-statistic: 46.26 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.114  -8.753   0.370  10.598  32.008
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     80.9705     3.6093  22.434  < 2e-16 ***
## gender          -9.5797     1.1284  -8.490  < 2e-16 ***
## lunch_type       9.6383     1.1784   8.179 1.81e-15 ***
## test_prep       -9.2062     1.1782  -7.814 2.60e-14 ***
## transport_means  0.7488     1.1540   0.649    0.517
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.6 on 582 degrees of freedom
## Multiple R-squared:  0.2403, Adjusted R-squared:  0.2351
## F-statistic: 46.03 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.020  -8.634   0.366  10.344  31.608
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       79.9537     3.6464  21.927  < 2e-16 ***
```

```
## gender            -9.6192      1.1281   -8.527   < 2e-16 ***
## lunch_type          9.6405      1.1774    8.188 1.69e-15 ***
## test_prep          -9.0175      1.1793   -7.646 8.60e-14 ***
## wkly_study_hours    1.0266      0.8576    1.197    0.232
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.59 on 582 degrees of freedom
## Multiple R-squared:  0.2417, Adjusted R-squared:  0.2364
## F-statistic: 46.37 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.527  -8.462   1.122   9.869  31.408
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  74.0611     3.3057  22.404  < 2e-16 ***
## gender       -9.0877     1.0898  -8.339 5.44e-16 ***
## lunch_type    9.7157     1.1358   8.554  < 2e-16 ***
## test_prep    -9.2954     1.1328  -8.206 1.48e-15 ***
## parent_educ   2.4286     0.3623   6.703 4.83e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.11 on 582 degrees of freedom
## Multiple R-squared:  0.2943, Adjusted R-squared:  0.2894
## F-statistic: 60.67 on 4 and 582 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.594  -8.422   0.710   9.201  29.415
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   67.7575     3.5050  19.332  < 2e-16 ***
## gender        -9.1231     1.0701  -8.526  < 2e-16 ***
## lunch_type     9.5016     1.1161   8.513  < 2e-16 ***
## test_prep     -9.1875     1.1125  -8.258 9.99e-16 ***
## parent_educ    2.3061     0.3567   6.466 2.14e-10 ***
## ethnic_group   2.1756     0.4566   4.765 2.39e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 581 degrees of freedom
```

```
## Multiple R-squared:  0.3208, Adjusted R-squared:  0.315
## F-statistic: 54.89 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.111  -8.640   1.036   9.795  31.521
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             72.4812     3.7758  19.196  < 2e-16 ***
## gender                  -9.0578     1.0906  -8.305 7.02e-16 ***
## lunch_type               9.7468     1.1367   8.575  < 2e-16 ***
## test_prep               -9.2621     1.1337  -8.170 1.94e-15 ***
## parent_educ              2.4224     0.3625   6.683 5.49e-11 ***
## parent_marital_status    0.6809     0.7858   0.867    0.387
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.11 on 581 degrees of freedom
## Multiple R-squared:  0.2952, Adjusted R-squared:  0.2891
## F-statistic: 48.67 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.874  -8.565   1.021   9.907  31.045
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     72.8024     3.8806  18.761  < 2e-16 ***
## gender          -9.0908     1.0904  -8.337 5.53e-16 ***
## lunch_type       9.7369     1.1370   8.564  < 2e-16 ***
## test_prep       -9.2862     1.1335  -8.192 1.64e-15 ***
## parent_educ      2.4431     0.3633   6.725 4.20e-11 ***
## practice_sport   0.5182     0.8356   0.620    0.535
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.11 on 581 degrees of freedom
## Multiple R-squared:  0.2947, Adjusted R-squared:  0.2887
## F-statistic: 48.56 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + is_first_child, data = step_df)
```

```
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.647  -8.375   1.027   9.788  31.641
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      73.4943     3.8563  19.058  < 2e-16 ***
## gender           -9.0914     1.0907  -8.335 5.62e-16 ***
## lunch_type        9.7114     1.1368   8.542  < 2e-16 ***
## test_prep        -9.2781     1.1353  -8.172 1.90e-15 ***
## parent_educ       2.4278     0.3626   6.695 5.08e-11 ***
## is_first_child    0.3307     1.1560   0.286    0.775
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.12 on 581 degrees of freedom
## Multiple R-squared:  0.2944, Adjusted R-squared:  0.2883
## F-statistic: 48.48 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + nr_siblings, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.897  -8.679   0.964   9.568  31.042
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 72.9266     3.4363  21.222  < 2e-16 ***
## gender      -9.0381     1.0902  -8.291 7.85e-16 ***
## lunch_type   9.7086     1.1354   8.551  < 2e-16 ***
## test_prep   -9.2282     1.1337  -8.140 2.42e-15 ***
## parent_educ  2.4353     0.3622   6.723 4.25e-11 ***
## nr_siblings  0.4404     0.3660   1.203    0.229
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.1 on 581 degrees of freedom
## Multiple R-squared: 0.296,  Adjusted R-squared:   0.29
## F-statistic: 48.86 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + transport_means, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.788  -8.350   1.076   9.626  31.792
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)        73.0836      3.6747  19.888  < 2e-16 ***
## gender             -9.0996      1.0906  -8.344 5.25e-16 ***
## lunch_type          9.7095      1.1365   8.543  < 2e-16 ***
## test_prep          -9.3455      1.1364  -8.224 1.29e-15 ***
## parent_educ         2.4265      0.3625   6.693 5.14e-11 ***
## transport_means     0.6794      1.1129   0.610    0.542
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.12 on 581 degrees of freedom
## Multiple R-squared:  0.2947, Adjusted R-squared:  0.2887
## F-statistic: 48.56 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.897  -8.394   0.862   9.572  31.435
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      71.5065     3.7299  19.171  < 2e-16 ***
## gender           -9.1459     1.0894  -8.395 3.56e-16 ***
## lunch_type        9.7108     1.1347   8.558  < 2e-16 ***
## test_prep        -9.1382     1.1367  -8.039 5.08e-15 ***
## parent_educ       2.4469     0.3622   6.756 3.44e-11 ***
## wkly_study_hours  1.2185     0.8270   1.473    0.141
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.09 on 581 degrees of freedom
## Multiple R-squared:  0.2969, Adjusted R-squared:  0.2909
## F-statistic: 49.07 on 5 and 581 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.594  -8.422   0.710   9.201  29.415
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     67.7575     3.5050  19.332  < 2e-16 ***
## gender          -9.1231     1.0701  -8.526  < 2e-16 ***
## lunch_type       9.5016     1.1161   8.513  < 2e-16 ***
## test_prep       -9.1875     1.1125  -8.258 9.99e-16 ***
## parent_educ      2.3061     0.3567   6.466 2.14e-10 ***
## ethnic_group     2.1756     0.4566   4.765 2.39e-06 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 581 degrees of freedom
## Multiple R-squared:  0.3208, Adjusted R-squared:  0.315
## F-statistic: 54.89 on 5 and 581 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + parent_marital_status, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.269  -8.482   0.835   9.426  29.473
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)             65.8964     3.9529  16.670  < 2e-16 ***
## gender                  -9.0888     1.0706  -8.490  < 2e-16 ***
## lunch_type               9.5362     1.1166   8.540  < 2e-16 ***
## test_prep               -9.1484     1.1131  -8.219 1.35e-15 ***
## parent_educ              2.2982     0.3567   6.442 2.47e-10 ***
## ethnic_group             2.1888     0.4567   4.792 2.10e-06 ***
## parent_marital_status    0.7856     0.7717   1.018    0.309
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 580 degrees of freedom
## Multiple R-squared:  0.322,  Adjusted R-squared:  0.315
## F-statistic: 45.92 on 6 and 580 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + practice_sport, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.933  -8.411   0.853   9.389  29.030
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    66.5308     4.0315  16.503  < 2e-16 ***
## gender         -9.1262     1.0706  -8.524  < 2e-16 ***
## lunch_type      9.5224     1.1173   8.523  < 2e-16 ***
## test_prep      -9.1785     1.1132  -8.245 1.11e-15 ***
## parent_educ     2.3203     0.3576   6.489 1.86e-10 ***
## ethnic_group    2.1747     0.4568   4.761 2.44e-06 ***
## practice_sport  0.5060     0.8204   0.617    0.538
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.88 on 580 degrees of freedom
## Multiple R-squared:  0.3213, Adjusted R-squared:  0.3142
## F-statistic: 45.75 on 6 and 580 DF,  p-value: < 2.2e-16
```

```
## 
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + is_first_child, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.716  -8.536   0.728   9.239  29.303
## 
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     67.1816     4.0118  16.746  < 2e-16 ***
## gender          -9.1269     1.0710  -8.522  < 2e-16 ***
## lunch_type       9.4971     1.1171   8.501  < 2e-16 ***
## test_prep       -9.1698     1.1150  -8.224 1.29e-15 ***
## parent_educ      2.3054     0.3570   6.458 2.24e-10 ***
## ethnic_group     2.1757     0.4569   4.762 2.43e-06 ***
## is_first_child   0.3357     1.1350   0.296    0.767
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 12.88 on 580 degrees of freedom
## Multiple R-squared:  0.3209, Adjusted R-squared:  0.3139
## F-statistic: 45.68 on 6 and 580 DF,  p-value: < 2.2e-16

## 
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + nr_siblings, data = step_df)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.002  -8.116   0.877   9.056  28.949
## 
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     66.4622     3.6317  18.301  < 2e-16 ***
## gender          -9.0688     1.0701  -8.475  < 2e-16 ***
## lunch_type       9.4922     1.1154   8.510  < 2e-16 ***
## test_prep       -9.1126     1.1131  -8.187 1.71e-15 ***
## parent_educ      2.3127     0.3564   6.488 1.87e-10 ***
## ethnic_group     2.1915     0.4564   4.802 2.01e-06 ***
## nr_siblings      0.4849     0.3594   1.349    0.178
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 12.86 on 580 degrees of freedom
## Multiple R-squared:  0.3229, Adjusted R-squared:  0.3159
## F-statistic: 46.11 on 6 and 580 DF,  p-value: < 2.2e-16

## 
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + transport_means, data = step_df)
## 
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.917  -8.476   0.575   9.219  29.122
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      66.5192     3.8595  17.235  < 2e-16 ***
## gender           -9.1379     1.0706  -8.535  < 2e-16 ***
## lunch_type        9.4928     1.1166   8.502  < 2e-16 ***
## test_prep        -9.2487     1.1157  -8.289 7.95e-16 ***
## parent_educ       2.3030     0.3568   6.454 2.30e-10 ***
## ethnic_group      2.1863     0.4569   4.785 2.18e-06 ***
## transport_means   0.8391     1.0930   0.768    0.443
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 580 degrees of freedom
## Multiple R-squared:  0.3215, Adjusted R-squared:  0.3145
## F-statistic: 45.81 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + wkly_study_hours, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.917  -8.391   0.613   9.143  29.293
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      65.3125     3.8874  16.801  < 2e-16 ***
## gender           -9.1792     1.0698  -8.581  < 2e-16 ***
## lunch_type        9.4976     1.1151   8.517  < 2e-16 ***
## test_prep        -9.0360     1.1163  -8.094 3.40e-15 ***
## parent_educ       2.3242     0.3566   6.519 1.54e-10 ***
## ethnic_group      2.1684     0.4562   4.753 2.53e-06 ***
## wkly_study_hours  1.1762     0.8121   1.448    0.148
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.86 on 580 degrees of freedom
## Multiple R-squared:  0.3233, Adjusted R-squared:  0.3163
## F-statistic: 46.18 on 6 and 580 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group, data = step_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -48.594  -8.422   0.710   9.201  29.415
##
## Coefficients:
```

```
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)    67.7575     3.5050  19.332  < 2e-16 ***
## gender         -9.1231     1.0701  -8.526  < 2e-16 ***
## lunch_type      9.5016     1.1161   8.513  < 2e-16 ***
## test_prep      -9.1875     1.1125  -8.258 9.99e-16 ***
## parent_educ     2.3061     0.3567   6.466 2.14e-10 ***
## ethnic_group    2.1756     0.4566   4.765 2.39e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.87 on 581 degrees of freedom
## Multiple R-squared:  0.3208, Adjusted R-squared:  0.315
## F-statistic: 54.89 on 5 and 581 DF,  p-value: < 2.2e-16

## Start:  AIC=3222.53
## writing_score ~ 1
##
##                         Df Sum of Sq    RSS    AIC
## + gender                 1   11104.5 130592 3176.6
## + lunch_type             1   10442.9 131253 3179.6
## + test_prep              1    9618.7 132078 3183.3
## + parent_educ            1    8420.5 133276 3188.6
## + ethnic_group           1    5344.3 136352 3202.0
## + nr_siblings            1     560.4 141136 3222.2
## <none>                             141696 3222.5
## + wkly_study_hours       1     472.0 141224 3222.6
## + parent_marital_status  1     275.4 141421 3223.4
## + is_first_child         1      95.4 141601 3224.1
## + transport_means        1       0.6 141696 3224.5
## + practice_sport         1       0.0 141696 3224.5
##
## Step:  AIC=3176.62
## writing_score ~ gender
##
##                         Df Sum of Sq    RSS    AIC
## + lunch_type             1   11657.0 118935 3123.7
## + test_prep              1   10482.9 120109 3129.5
## + parent_educ            1    7206.7 123385 3145.3
## + ethnic_group           1    5423.0 125169 3153.7
## + wkly_study_hours       1     687.6 129904 3175.5
## <none>                             130592 3176.6
## + nr_siblings            1     401.5 130190 3176.8
## + parent_marital_status  1     171.1 130421 3177.9
## + is_first_child         1     127.2 130465 3178.0
## + transport_means        1       5.5 130586 3178.6
## + practice_sport         1       0.6 130591 3178.6
##
## Step:  AIC=3123.74
## writing_score ~ gender + lunch_type
##
##                         Df Sum of Sq    RSS    AIC
## + test_prep              1   11216.2 107719 3067.6
## + parent_educ            1    7367.0 111568 3088.2
## + ethnic_group           1    4829.4 114105 3101.4
```

```
## + wkly_study_hours        1     686.4 118248 3122.3
## <none>                                 118935 3123.7
## + nr_siblings             1     385.6 118549 3123.8
## + parent_marital_status   1     276.7 118658 3124.4
## + is_first_child          1     100.6 118834 3125.2
## + practice_sport          1      15.9 118919 3125.7
## + transport_means         1       1.3 118933 3125.7
##
## Step:  AIC=3067.59
## writing_score ~ gender + lunch_type + test_prep
##
##                          Df Sum of Sq    RSS    AIC
## + parent_educ            1    7719.9  99999 3025.9
## + ethnic_group           1    4556.1 103162 3044.2
## <none>                               107719 3067.6
## + wkly_study_hours       1     264.6 107454 3068.2
## + nr_siblings            1     207.4 107511 3068.5
## + parent_marital_status  1     171.3 107547 3068.7
## + transport_means        1      77.9 107641 3069.2
## + is_first_child         1      19.3 107699 3069.5
## + practice_sport         1       6.1 107713 3069.6
##
## Step:  AIC=3025.94
## writing_score ~ gender + lunch_type + test_prep + parent_educ
##
##                          Df Sum of Sq    RSS    AIC
## + ethnic_group           1    3761.0  96238 3005.4
## + wkly_study_hours       1     372.2  99626 3025.8
## <none>                                99999 3025.9
## + nr_siblings            1     248.6  99750 3026.5
## + parent_marital_status  1     129.1  99870 3027.2
## + practice_sport         1      66.2  99933 3027.6
## + transport_means        1      64.1  99935 3027.6
## + is_first_child         1      14.1  99985 3027.9
##
## Step:  AIC=3005.44
## writing_score ~ gender + lunch_type + test_prep + parent_educ +
##     ethnic_group
##
##                          Df Sum of Sq   RSS    AIC
## + wkly_study_hours       1    346.82 95891 3005.3
## <none>                               96238 3005.4
## + nr_siblings            1    301.18 95936 3005.6
## + parent_marital_status  1    171.69 96066 3006.4
## + transport_means        1     97.68 96140 3006.8
## + practice_sport         1     63.09 96175 3007.1
## + is_first_child         1     14.52 96223 3007.3
##
## Step:  AIC=3005.32
## writing_score ~ gender + lunch_type + test_prep + parent_educ +
##     ethnic_group + wkly_study_hours
##
##                          Df Sum of Sq   RSS    AIC
## <none>                               95891 3005.3
```

```
## + nr_siblings           1    270.733 95620 3005.7
## + parent_marital_status 1    175.061 95716 3006.2
## + transport_means       1     84.868 95806 3006.8
## + practice_sport        1     58.664 95832 3007.0
## + is_first_child        1     13.991 95877 3007.2
##
## Call:
## lm(formula = writing_score ~ gender + lunch_type + test_prep +
##     parent_educ + ethnic_group + wkly_study_hours, data = writing_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.917  -8.391   0.613   9.143  29.293
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      65.3125     3.8874  16.801  < 2e-16 ***
## gender           -9.1792     1.0698  -8.581  < 2e-16 ***
## lunch_type        9.4976     1.1151   8.517  < 2e-16 ***
## test_prep        -9.0360     1.1163  -8.094 3.40e-15 ***
## parent_educ       2.3242     0.3566   6.519 1.54e-10 ***
## ethnic_group      2.1684     0.4562   4.753 2.53e-06 ***
## wkly_study_hours  1.1762     0.8121   1.448    0.148
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.86 on 580 degrees of freedom
## Multiple R-squared:  0.3233, Adjusted R-squared:  0.3163
## F-statistic: 46.18 on 6 and 580 DF,  p-value: < 2.2e-16
```

The model we obtained is Writing Score ~ Lunch Type + Ethnic Group + Test Prep + Gender + Parent Education + Weekly Study Hours.

When using the single-function method, the model obtained with the lowest AIC was Writing Score ~ Gender + Lunch Type + Test Prep + Parent Education + Ethnic Group + Weekly Study Hours.

It seems that when using the single-function method, for all scores and for both forwards and backwards elimination, extra variables were included despite their individual p-values > 0.05; therefore the manually-selected models should be used for comparison and validation.

## Criteria-based approach - Adjusted R^2, Cp, BIC
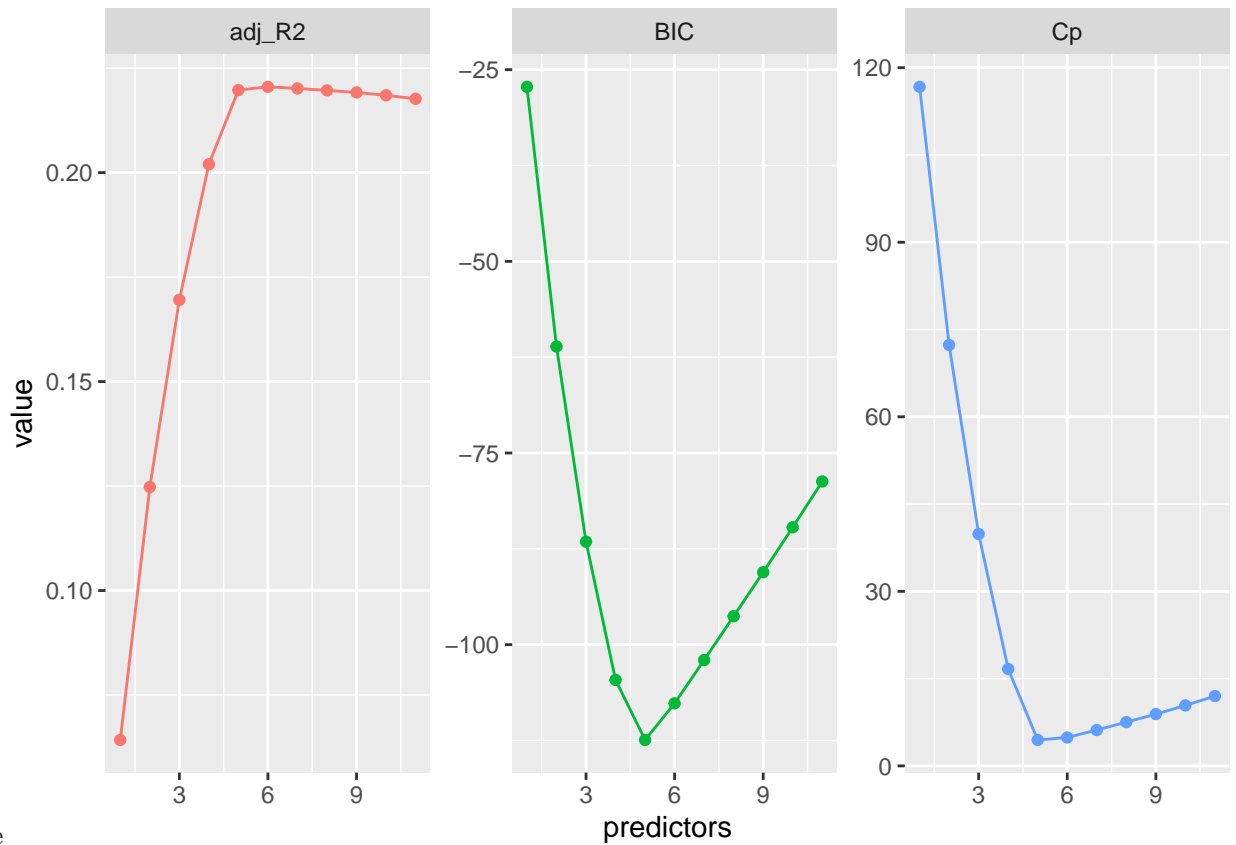
(Note: BIC has a larger penalty, leading to less predictors present within the model.)
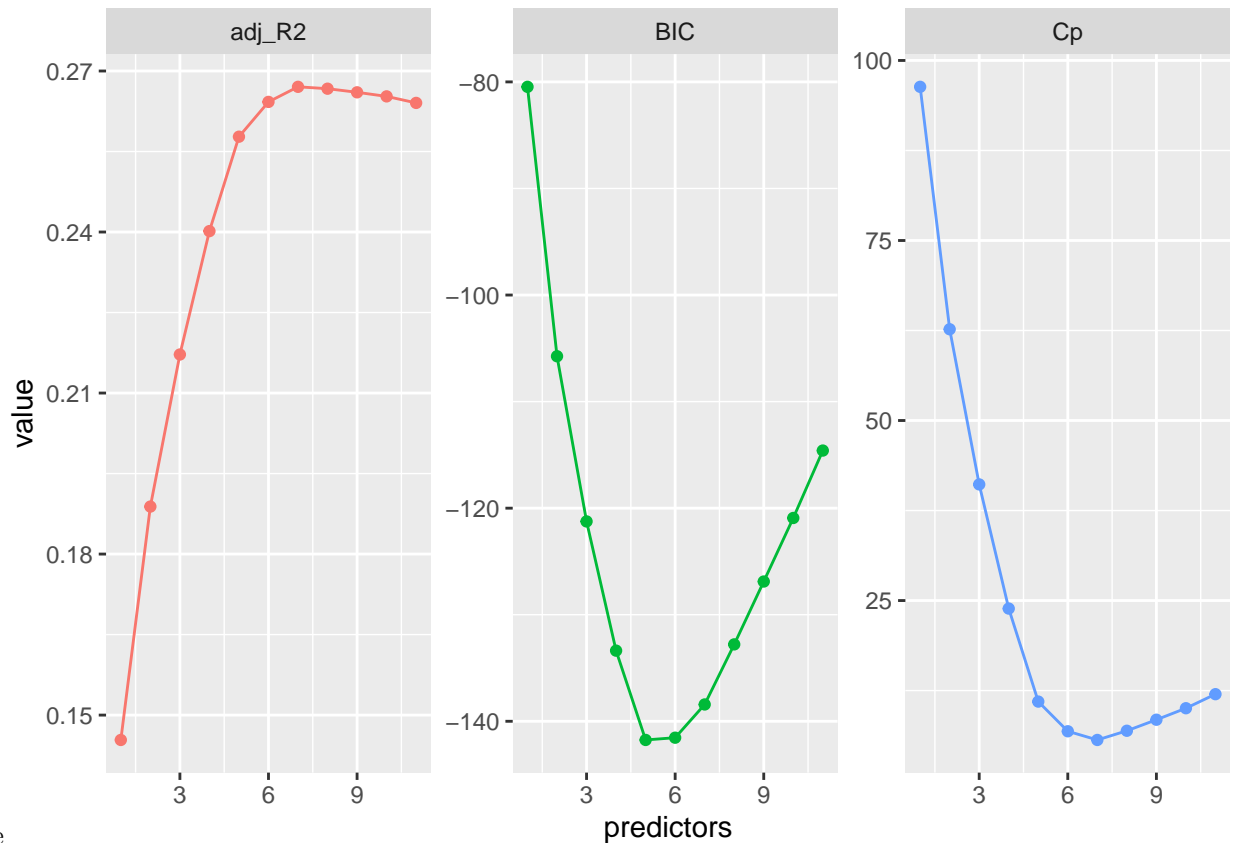
Math Score

```
##         (Intercept)             gender       ethnic_group
##                TRUE               TRUE               TRUE
##         parent_educ         lunch_type          test_prep
##                TRUE               TRUE               TRUE
## parent_marital_status    practice_sport     is_first_child
##               FALSE              FALSE              FALSE
##         nr_siblings     transport_means    wkly_study_hours
##                TRUE              FALSE               TRUE
```
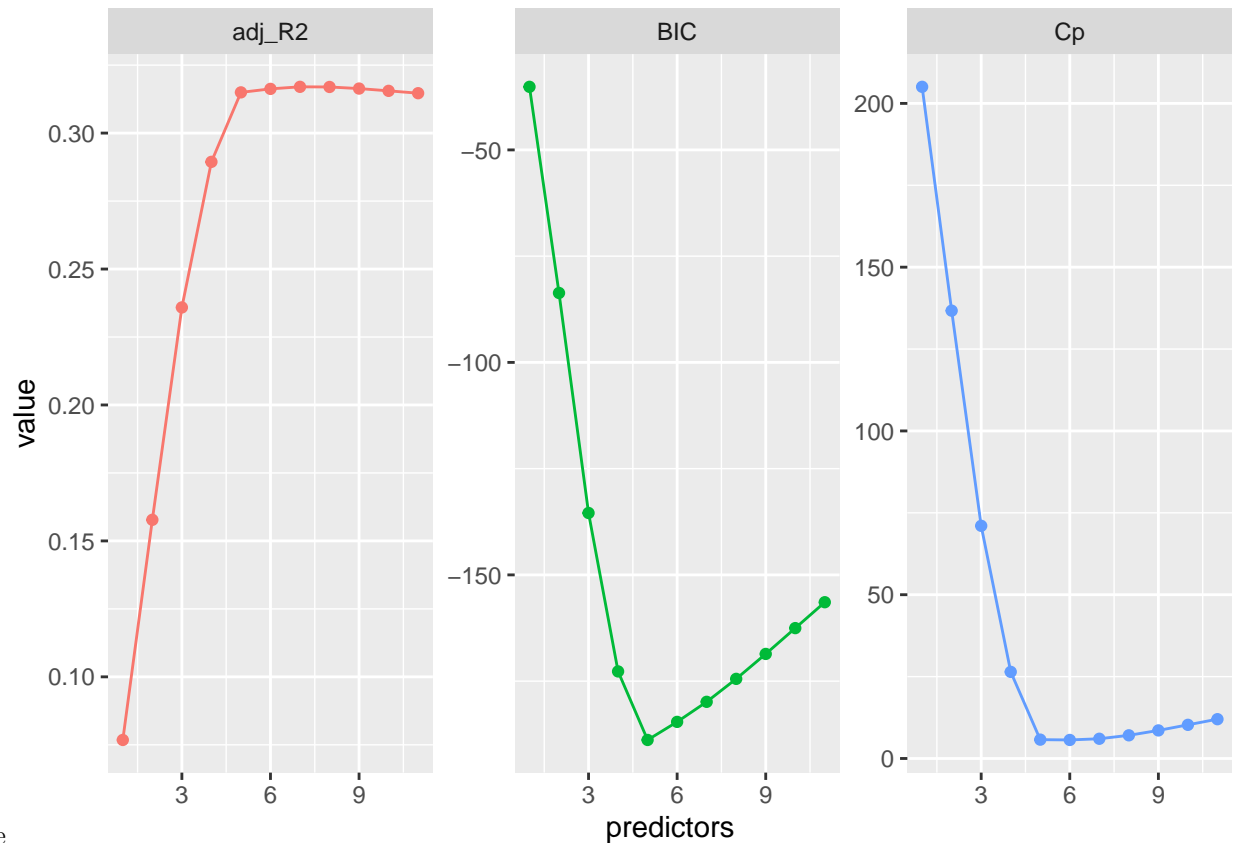
To predict math score, the adjusted R^2 statistic, Cp, and BIC plots in combination show that a 7-variable model is optimal. The predictors selected are: gender, ethnic_group, parent_educ, lunch_type, test_prep, nr_siblings, and wkly study_hours.

Reading Score

```
##            (Intercept)              gender          ethnic_group
##                   TRUE                TRUE                  TRUE
##            parent_educ          lunch_type             test_prep
##                   TRUE                TRUE                  TRUE
## parent_marital_status      practice_sport         is_first_child
##                  FALSE               FALSE                 FALSE
##            nr_siblings     transport_means       wkly_study_hours
##                  FALSE               FALSE                 FALSE
```

To predict reading score, the adjusted R^2 statistic and Cp and BIC plots shows that a 5-variable model is optimal. The predictors selected are: gender, ethnic_grouop, parent_educ, lunch_type, test_prep, practice_sport, and wkly_study_hours.

Writing Score

```
##              (Intercept)                  gender            ethnic_group
##                     TRUE                    TRUE                    TRUE
##              parent_educ              lunch_type               test_prep
##                     TRUE                    TRUE                    TRUE
## parent_marital_status          practice_sport          is_first_child
##                    FALSE                   FALSE                   FALSE
##              nr_siblings         transport_means        wkly_study_hours
##                    FALSE                   FALSE                   FALSE
```
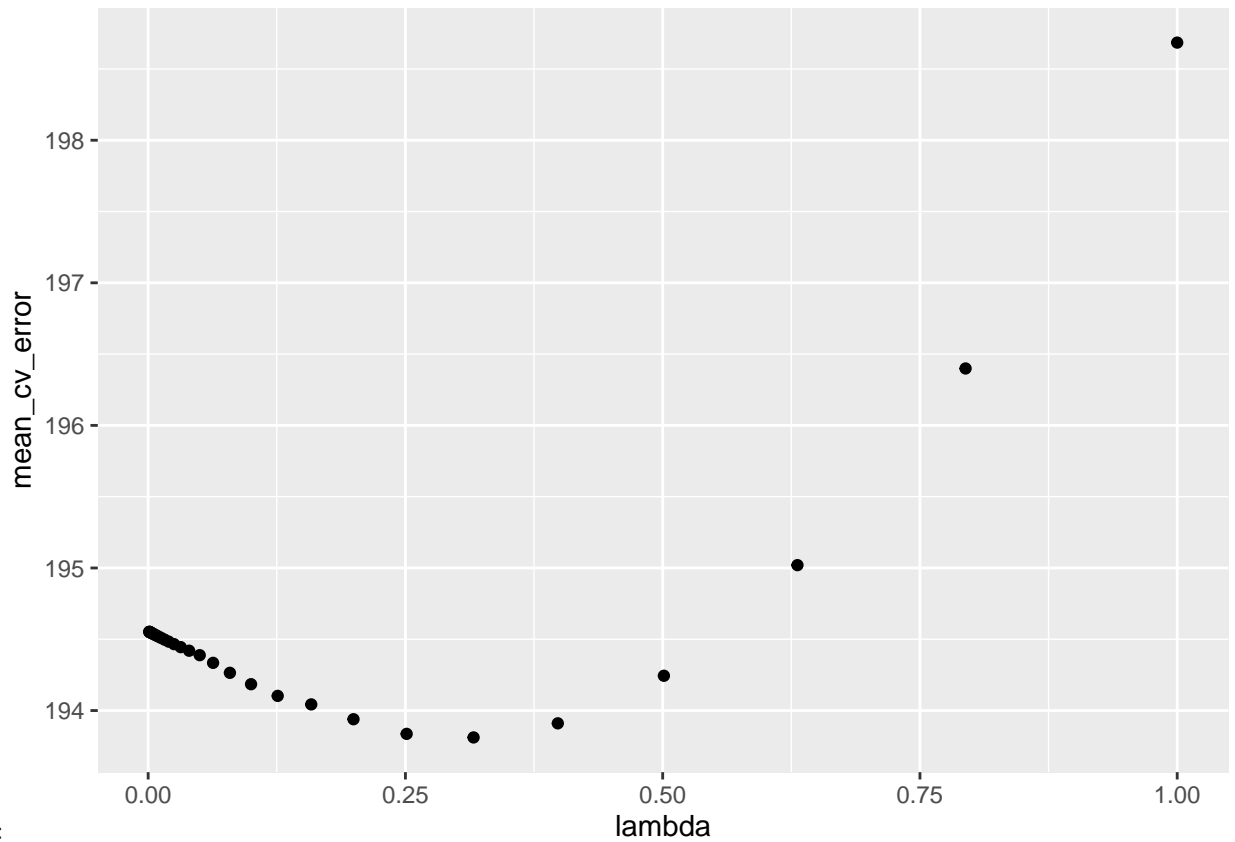
To predict writing score, the adjusted R^2, Cp, and BIC statistics show that a 5-variable model is optimal. The predictors selected are: gender, ethnic_group, parent_educ, lunch_type, test_prep

Limitation: noting that the plots maximum and minimum are not that obvious.

**LASSO approach -**



Maths score:

```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                                 s0
## (Intercept)           30.9514949
## gender                  4.6893056
## ethnic_group            2.5085903
## parent_educ             1.2932847
## lunch_type             11.9603880
## test_prep              -4.7061459
## parent_marital_status   0.2406793
## practice_sport          0.1053101
## is_first_child          .
## nr_siblings             0.4775542
## transport_means         .
## wkly_study_hours        1.6725295
```
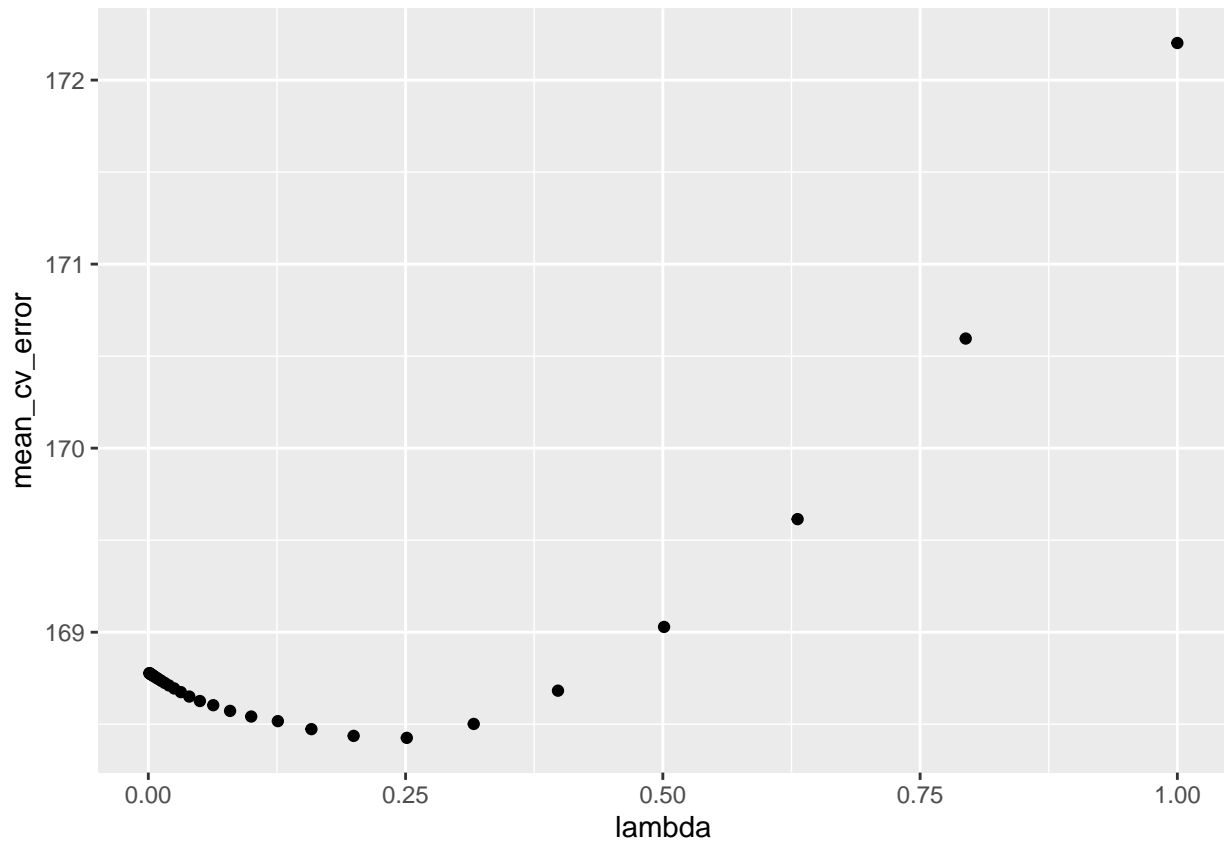
Reading score:
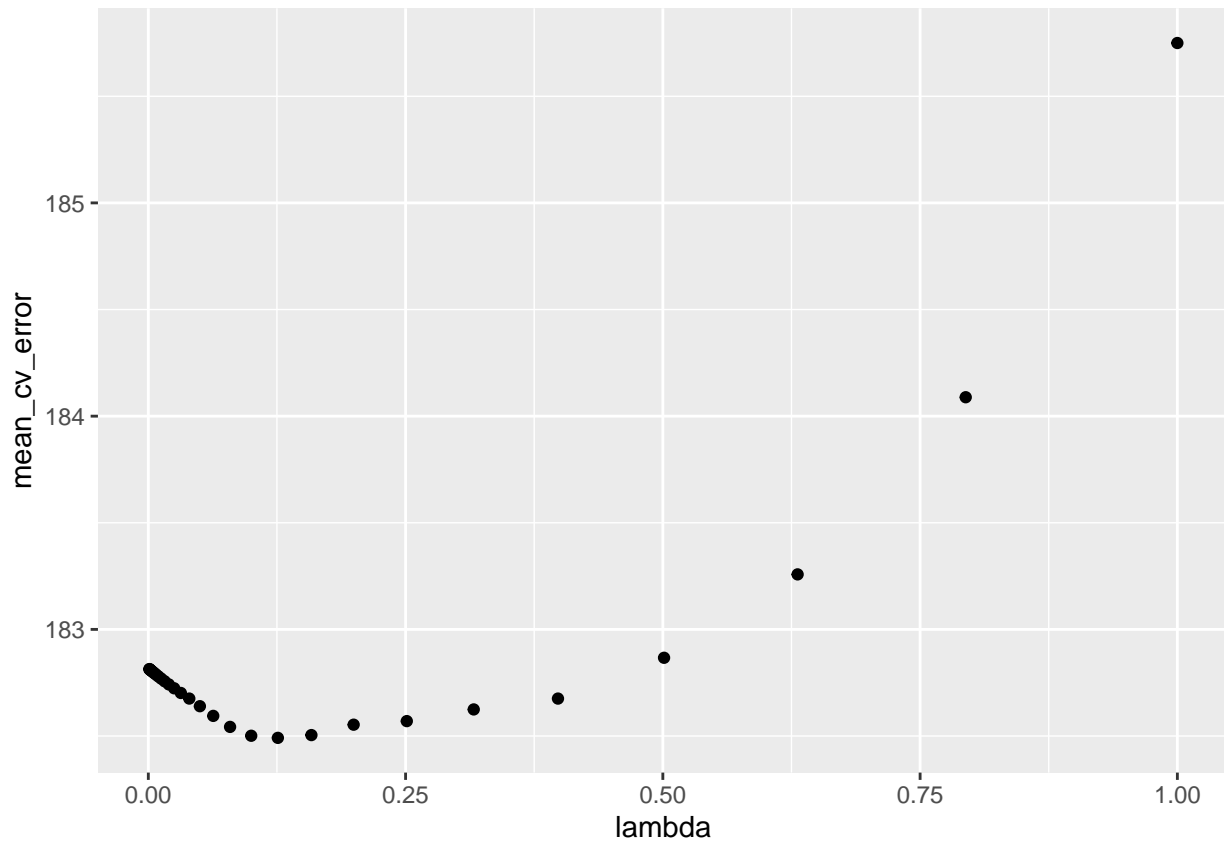
```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                              s0
## (Intercept)          63.0168462
## gender               -7.2578814
## ethnic_group          1.7148165
## parent_educ           1.6792539
## lunch_type            8.3560449
## test_prep            -6.4054407
## parent_marital_status 0.3113991
## practice_sport       -0.5218650
## is_first_child        0.6325478
## nr_siblings           0.2364662
## transport_means       0.6090418
## wkly_study_hours      0.8425385
```

Writing score:

```
## 12 x 1 sparse Matrix of class "dgCMatrix"
##                                s0
## (Intercept)            64.24045111
## gender                 -8.58684295
## ethnic_group            2.00086017
## parent_educ             2.16675381
## lunch_type              8.95045903
## test_prep              -8.47239858
## parent_marital_status   0.40572033
## practice_sport          0.04910284
## is_first_child          .
## nr_siblings             0.29894240
## transport_means         0.22598323
## wkly_study_hours        0.76604805
```

## Leverage one score

Since according to the corr plot, there are strong collinearity between the scores. We can just add one score (reading_score for example) to another score's model (maths_score for example) and see if the resulting model is improved.