

```
library(VIM)
```

```
## Loading required package: colorspace
```

```
## Loading required package: grid
```

```
## VIM is ready to use.
```

```
## Suggestions and bug-reports can be submitted at: https://github.com/statistikat/VIM/issues
```

```
##
```

```
## Attaching package: 'VIM'
```

```
## The following object is masked from 'package:datasets':
```

```
##
```

```
##     sleep
```

```
library(stats)
```

```
library(labelled) # Used to remove value labels
```

```
library(mice) # Used to impute data
```

```
##
```

```
## Attaching package: 'mice'
```

```
## The following object is masked from 'package:stats':
```

```
##
```

```
##     filter
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##     cbind, rbind
```

```
## Abridged dataset with relevant columns
```

```
# abdata <- data[c('maeduc', 'paeduc', 'educ', 'paocc10', 'sibs', 'incom16', 'family16', 'race', 'sex',
```

```
abdata <- read.csv('filtered_data.csv')
```

```
abdata$mobility <- ifelse(abdata$maeduc < abdata$paeduc, abdata$educ - abdata$paeduc, abdata$educ - abd
```

```
abdata$pared <- ifelse(abdata$maeduc < abdata$paeduc, abdata$paeduc, abdata$maeduc) ## Higher education
```

```
abdata$race <- ifelse(abdata$race == 1, 0, 1) ## Set race to be White as 0, black or other POC as 1
```

```
abdata$attain <- ifelse(abdata$educ >= 13, 1, 0)
```

```
non_impute <- na.omit(abdata) ## Used for linear analysis
```

```
imputed <- read.csv("imputed_data.csv") ## Used for causal analysis
```

```
imputed$mobility <- ifelse(imputed$maeduc < imputed$paeduc, imputed$educ - imputed$paeduc, imputed$educ
```

```
imputed$pared <- ifelse(imputed$maeduc < imputed$paeduc, imputed$paeduc, imputed$maeduc) ## Higher educ
```

```
imputed$race <- ifelse(imputed$race == 1, 0, 1) ## Set race to be White as 0, black or other POC as 1
```

```
imputed$attain <- ifelse(imputed$educ >= 13, 1, 0)
```

```

## Form terciles for parental education, ** FOR JUST NON-IMPUTED DATA **
low_thresh <- quantile(non_impute$pared, 0.33)
high_thresh <- quantile(non_impute$pared, 0.66)

low_dat_non <- subset(non_impute, pared < low_thresh)
med_dat_non <- subset(non_impute, pared >= low_thresh & pared <= high_thresh)
high_dat_non <- subset(non_impute, pared > high_thresh)

## Get sizes of the corresponding datasets
nrow(low_dat_non)

```

```
## [1] 7699
```

```
nrow(med_dat_non)
```

```
## [1] 9977
```

```
nrow(high_dat_non)
```

```
## [1] 8419
```

```

## Form terciles for parental education, ** FOR JUST IMPUTED DATA **
low_thresh <- quantile(imputed$pared, 0.33)
high_thresh <- quantile(imputed$pared, 0.66)

low_dat <- subset(imputed, pared < low_thresh)
med_dat <- subset(imputed, pared >= low_thresh & pared <= high_thresh)
high_dat <- subset(imputed, pared > high_thresh)

## Get sizes of the corresponding datasets
nrow(low_dat)

```

```
## [1] 15062
```

```
nrow(med_dat)
```

```
## [1] 19120
```

```
nrow(high_dat)
```

```
## [1] 15509
```

```

## Form cohorts
cohort1940 = subset(imputed, cohort >= 1940 & cohort < 1948)
cohort1948 = subset(imputed, cohort >= 1948 & cohort < 1956)
cohort1956 = subset(imputed, cohort >= 1956 & cohort < 1964)
cohort1964 = subset(imputed, cohort >= 1964 & cohort < 1972)
cohort1972 = subset(imputed, cohort >= 1972 & cohort < 1980)
cohort1980 = subset(imputed, cohort >= 1980 & cohort < 1988)

```

```
cohort1988 = subset(imputed, cohort >= 1988)
```

```
## Sizes of each cohort
```

```
nrow(cohort1940)
```

```
## [1] 7099
```

```
nrow(cohort1948)
```

```
## [1] 9008
```

```
nrow(cohort1956)
```

```
## [1] 9209
```

```
nrow(cohort1964)
```

```
## [1] 6256
```

```
nrow(cohort1972)
```

```
## [1] 4130
```

```
nrow(cohort1980)
```

```
## [1] 2487
```

```
nrow(cohort1988)
```

```
## [1] 1045
```

```
## Linear Analysis - replicate Table 3 here and Appendix Tables 1 and 2
```

```
## Models to replicate Table 3 here
```

```
## Full Model 1
```

```
total_model1 <- lm(mobility ~ race + sex + race:sex, data = non_impute)
summary(total_model1)
```

```
##
```

```
## Call:
```

```
## lm(formula = mobility ~ race + sex + race:sex, data = non_impute)
```

```
##
```

```
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -17.5563  -1.5563  -0.3907   2.4437  17.8542
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.72179    0.07370  23.363  < 2e-16 ***
## race        -0.25119    0.19185  -1.309  0.190451
## sex         -0.16553    0.04571  -3.621  0.000294 ***
## race:sex     0.50311    0.11684   4.306  1.67e-05 ***
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## Residual standard error: 3.386 on 26091 degrees of freedom
```

```
## Multiple R-squared:  0.004111, Adjusted R-squared:  0.003997
```

```
## F-statistic: 35.9 on 3 and 26091 DF, p-value: < 2.2e-16
```

```
## Full Model 2
```

```
total_model2 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16, data = non_impute)
summary(total_model2)
```

```
##
```

```
## Call:
```

```
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16, data = non_impute)
```

```
##
```

```
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -14.9957  -1.6549  -0.1904   1.5913  11.9776
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  9.926e+00  1.029e-01  96.457  < 2e-16 ***
## race        -6.415e-01  1.435e-01  -4.471  7.81e-06 ***
## sex         -2.116e-01  3.410e-02  -6.205  5.56e-10 ***
## pared       -6.427e-01  4.670e-03 -137.638  < 2e-16 ***
## paocc10     -2.896e-05  4.918e-06  -5.889  3.92e-09 ***
## family16    -7.089e-02  1.534e-02  -4.623  3.80e-06 ***
## sibs        -1.620e-01  5.861e-03 -27.645  < 2e-16 ***
## incom16     1.702e-01  2.027e-02   8.397  < 2e-16 ***
## race:sex     5.111e-01  8.714e-02   5.865  4.53e-09 ***
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.525 on 26086 degrees of freedom
## Multiple R-squared:  0.4463, Adjusted R-squared:  0.4461
## F-statistic: 2628 on 8 and 26086 DF, p-value: < 2.2e-16
```

### ## Full Model 3

```
total_model3 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
summary(total_model3)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2), data = non_impute)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.1022  -1.6585  -0.1738   1.5728  11.6422
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -3.750e+03  5.467e+02  -6.859 7.10e-12 ***
## race          -3.294e+03  1.427e+03  -2.308  0.0210 *
## sex            1.383e+03  3.393e+02   4.076 4.60e-05 ***
## pared         -6.681e-01  4.973e-03 -134.336 < 2e-16 ***
## paocc10       -3.717e-05  4.896e-06  -7.592 3.25e-14 ***
## family16      -6.881e-02  1.526e-02  -4.510 6.50e-06 ***
## sibs          -1.628e-01  5.831e-03 -27.924 < 2e-16 ***
## incom16        1.811e-01  2.012e-02   9.002 < 2e-16 ***
## cohort         3.871e+00  5.608e-01   6.903 5.21e-12 ***
## I(cohort^2)    -9.962e-04  1.438e-04  -6.928 4.36e-12 ***
## race:sex       3.027e+01  8.721e+02   0.035  0.9723
## race:cohort    3.337e+00  1.461e+00   2.284  0.0224 *
## race:I(cohort^2) -8.452e-04  3.739e-04  -2.260  0.0238 *
## sex:cohort     -1.434e+00  3.480e-01  -4.121 3.78e-05 ***
## sex:I(cohort^2)  3.718e-04  8.924e-05   4.166 3.11e-05 ***
## race:sex:cohort -1.707e-02  8.928e-01  -0.019  0.9847
## race:sex:I(cohort^2) 9.158e-07  2.285e-04   0.004  0.9968
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.504 on 26078 degrees of freedom
## Multiple R-squared:  0.4558, Adjusted R-squared:  0.4554
## F-statistic: 1365 on 16 and 26078 DF, p-value: < 2.2e-16
```

### ## Full Model 4

```
total_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
summary(total_model4)
```

```
##
## Call:
```

```
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##     pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##     pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##     pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = non_impute)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.1133  -1.6568  -0.1712   1.5698  11.4188
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -6.979e+03  1.867e+03  -3.738 0.000186 ***
## race           -1.304e+03  3.639e+03  -0.358 0.720016
## sex             3.443e+03  1.152e+03   2.989 0.002798 **
## pared           2.475e+02  1.437e+02   1.722 0.085121 .
## paocc10        -3.715e-05  4.925e-06  -7.542 4.78e-14 ***
## family16       -6.904e-02  1.526e-02  -4.524 6.09e-06 ***
## sibs           -1.632e-01  5.838e-03 -27.950 < 2e-16 ***
## incom16         1.807e-01  2.013e-02   8.979 < 2e-16 ***
## cohort          7.201e+00  1.919e+00   3.752 0.000176 ***
## I(cohort^2)     -1.855e-03  4.932e-04  -3.760 0.000170 ***
## race:sex        -1.889e+03  2.248e+03  -0.840 0.400839
## race:cohort      1.241e+00  3.734e+00   0.332 0.739669
## race:I(cohort^2) -2.937e-04  9.578e-04  -0.307 0.759094
## sex:cohort       -3.556e+00  1.184e+00  -3.004 0.002665 **
## sex:I(cohort^2)   9.182e-04  3.041e-04   3.019 0.002538 **
## pared:cohort     -2.556e-01  1.475e-01  -1.732 0.083242 .
## pared:I(cohort^2)  6.581e-05  3.786e-05   1.738 0.082187 .
## race:pared       6.707e+01  3.101e+02   0.216 0.828771
## sex:pared        -1.639e+02  8.945e+01  -1.832 0.066909 .
## race:sex:cohort   1.979e+00  2.306e+00   0.858 0.390889
## race:sex:I(cohort^2) -5.179e-04  5.916e-04  -0.875 0.381384
## race:pared:cohort -6.239e-02  3.176e-01  -0.196 0.844267
## race:pared:I(cohort^2) 1.439e-05  8.132e-05   0.177 0.859549
## sex:pared:cohort   1.686e-01  9.181e-02   1.836 0.066300 .
## sex:pared:I(cohort^2) -4.336e-05  2.356e-05  -1.841 0.065673 .
## race:sex:pared     4.403e+01  1.929e+02   0.228 0.819494
## race:sex:pared:cohort -4.841e-02  1.976e-01  -0.245 0.806454
## race:sex:pared:I(cohort^2) 1.323e-05  5.059e-05   0.261 0.793744
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.503 on 26067 degrees of freedom
## Multiple R-squared:  0.4565, Adjusted R-squared:  0.4559
## F-statistic: 810.9 on 27 and 26067 DF, p-value: < 2.2e-16
```

*## Over the terciles, replicate appendix tables 1 and 2 using model 3*

*## Linear Regression Models for Attainment Appendix 1 Re-Analysis*

```
low_model3 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort +
summary(low_model3)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2), data = low_dat_non)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.7441  -1.5032  -0.1008   1.4166  11.2200
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -6.569e+03  1.389e+03  -4.731 2.27e-06 ***
## race           -1.793e+03  2.700e+03  -0.664 0.506754
## sex             2.879e+03  8.346e+02   3.449 0.000565 ***
## pared          -6.850e-01  1.335e-02 -51.321 < 2e-16 ***
## paocc10         5.348e-05  9.949e-06   5.375 7.87e-08 ***
## family16        6.479e-03  2.680e-02   0.242 0.808946
## sibs           -1.529e-01  9.813e-03 -15.581 < 2e-16 ***
## incom16         2.226e-01  3.976e-02   5.599 2.23e-08 ***
## cohort          6.773e+00  1.430e+00   4.736 2.21e-06 ***
## I(cohort^2)     -1.743e-03  3.682e-04  -4.735 2.23e-06 ***
## race:sex        -1.165e+03  1.632e+03  -0.714 0.475314
## race:cohort      1.779e+00  2.773e+00   0.642 0.521015
## race:I(cohort^2) -4.413e-04  7.117e-04  -0.620 0.535268
## sex:cohort       -2.973e+00  8.594e-01  -3.459 0.000544 ***
## sex:I(cohort^2)   7.674e-04  2.212e-04   3.469 0.000525 ***
## race:sex:cohort   1.217e+00  1.676e+00   0.726 0.467916
## race:sex:I(cohort^2) -3.173e-04  4.303e-04  -0.738 0.460835
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.817 on 7682 degrees of freedom
## Multiple R-squared:  0.2705, Adjusted R-squared:  0.269
## F-statistic: 178 on 16 and 7682 DF, p-value: < 2.2e-16
```

```
med_model3 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort +
summary(med_model3)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2), data = med_dat_non)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.4551  -1.6675  -0.5573   1.7238   7.9058
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.169e+03  9.770e+02  -2.220 0.026413 *
```

```
## race          -2.439e+03  2.796e+03  -0.872  0.383090
## sex           4.773e+02  6.034e+02   0.791  0.428983
## pared        -2.700e-01  7.801e-02  -3.461  0.000540 ***
## paocc10      -6.592e-05  7.847e-06  -8.401  < 2e-16 ***
## family16     -9.395e-02  2.453e-02  -3.830  0.000129 ***
## sibs         -1.684e-01  9.759e-03 -17.251  < 2e-16 ***
## incom16       1.115e-01  3.305e-02   3.372  0.000748 ***
## cohort        2.263e+00  1.001e+00   2.260  0.023839 *
## I(cohort^2)   -5.882e-04  2.565e-04  -2.294  0.021834 *
## race:sex      -1.179e+02  1.729e+03  -0.068  0.945639
## race:cohort    2.467e+00  2.859e+00   0.863  0.388268
## race:I(cohort^2) -6.238e-04  7.309e-04  -0.853  0.393427
## sex:cohort     -5.155e-01  6.182e-01  -0.834  0.404425
## sex:I(cohort^2)  1.388e-04  1.584e-04   0.876  0.380941
## race:sex:cohort  1.289e-01  1.767e+00   0.073  0.941841
## race:sex:I(cohort^2) -3.504e-05  4.516e-04  -0.078  0.938155
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.379 on 9960 degrees of freedom
## Multiple R-squared:  0.05645,    Adjusted R-squared:  0.05494
## F-statistic: 37.24 on 16 and 9960 DF,  p-value: < 2.2e-16
```

```
high_model3 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort + race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort + race:sex:I(cohort^2), data = high_dat_non)
summary(high_model3)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2), data = high_dat_non)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.3262  -1.6191   0.0815   1.4799   7.3700
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -2.931e+03  9.517e+02  -3.080  0.00207 **
## race           1.128e+03  2.864e+03   0.394  0.69354
## sex            8.803e+02  5.947e+02   1.480  0.13885
## pared        -6.928e-01  1.439e-02 -48.147  < 2e-16 ***
## paocc10      -8.705e-05  8.399e-06 -10.364  < 2e-16 ***
## family16     -1.466e-01  2.905e-02  -5.045  4.62e-07 ***
## sibs         -1.576e-01  1.176e-02 -13.408  < 2e-16 ***
## incom16       1.810e-01  3.196e-02   5.664  1.52e-08 ***
## cohort        3.031e+00  9.732e-01   3.115  0.00185 **
## I(cohort^2)   -7.807e-04  2.488e-04  -3.138  0.00171 **
## race:sex      -2.059e+03  1.773e+03  -1.161  0.24556
## race:cohort    -1.144e+00  2.922e+00  -0.391  0.69558
## race:I(cohort^2)  2.897e-04  7.456e-04   0.389  0.69759
## sex:cohort     -9.192e-01  6.082e-01  -1.511  0.13076
## sex:I(cohort^2)  2.398e-04  1.555e-04   1.542  0.12313
```



```
## race:sex:cohort      2.096e+00  1.809e+00   1.158  0.24675
## race:sex:I(cohort^2) -5.332e-04  4.615e-04  -1.155  0.24796
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.303 on 8402 degrees of freedom
## Multiple R-squared:  0.2353, Adjusted R-squared:  0.2339
## F-statistic: 161.6 on 16 and 8402 DF,  p-value: < 2.2e-16
```

```
## Logistic Regression Models for Attainment (Appendix 2 Re-Analysis)
```

```
low_logmodel3 <- glm(attain ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
summary(low_logmodel3)
```

```
##
## Call:
## glm(formula = attain ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2), family = binomial, data = low_dat_non)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.6340  -0.8583  -0.6384   1.2055   2.6645
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -4.523e+03  1.172e+03  -3.859 0.000114 ***
## race           2.162e+03  2.473e+03   0.874 0.382085
## sex           2.365e+03  7.087e+02   3.337 0.000847 ***
## pared         1.075e-01  1.186e-02   9.062 < 2e-16 ***
## paocc10       -2.565e-07  8.275e-06  -0.031 0.975277
## family16      2.114e-02  2.139e-02   0.988 0.323085
## sibs         -1.103e-01  9.244e-03 -11.930 < 2e-16 ***
## incom16       6.738e-02  3.283e-02   2.052 0.040137 *
## cohort        4.666e+00  1.207e+00   3.867 0.000110 ***
## I(cohort^2)   -1.203e-03  3.106e-04  -3.875 0.000107 ***
## race:sex      -2.791e+03  1.495e+03  -1.867 0.061858 .
## race:cohort   -2.250e+00  2.536e+00  -0.887 0.375107
## race:I(cohort^2) 5.851e-04  6.503e-04   0.900 0.368309
## sex:cohort    -2.452e+00  7.293e-01  -3.362 0.000773 ***
## sex:I(cohort^2) 6.355e-04  1.876e-04   3.387 0.000706 ***
## race:sex:cohort 2.878e+00  1.533e+00   1.878 0.060416 .
## race:sex:I(cohort^2) -7.416e-04  3.929e-04  -1.888 0.059057 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 9210.8  on 7698  degrees of freedom
## Residual deviance: 8581.5  on 7682  degrees of freedom
## AIC: 8615.5
##
## Number of Fisher Scoring iterations: 4
```

```
med_logmodel3 <- glm(attain ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort + race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort + race:sex:I(cohort^2), family = binomial, data = med_dat_non)
summary(med_logmodel3)
```

```
##
## Call:
## glm(formula = attain ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2), family = binomial, data = med_dat_non)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.0524  -1.1977   0.7863   1.0714   2.1593
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -1.248e+03  8.501e+02  -1.468   0.142
## race           -3.170e+03  2.541e+03  -1.248   0.212
## sex             2.728e+02  5.305e+02   0.514   0.607
## pared           8.261e-01  7.422e-02  11.131 < 2e-16 ***
## paocc10        -5.035e-05  6.883e-06  -7.315 2.58e-13 ***
## family16       -1.718e-02  2.133e-02  -0.806   0.420
## sibs           -1.204e-01  8.881e-03 -13.556 < 2e-16 ***
## incom16         1.339e-01  2.887e-02   4.637 3.53e-06 ***
## cohort          1.293e+00  8.711e-01   1.484   0.138
## I(cohort^2)     -3.373e-04  2.231e-04  -1.512   0.131
## race:sex        6.869e+02  1.569e+03   0.438   0.662
## race:cohort     3.222e+00  2.598e+00   1.240   0.215
## race:I(cohort^2) -8.186e-04  6.638e-04  -1.233   0.218
## sex:cohort      -3.009e-01  5.436e-01  -0.553   0.580
## sex:I(cohort^2)  8.249e-05  1.392e-04   0.592   0.554
## race:sex:cohort -6.908e-01  1.604e+00  -0.431   0.667
## race:sex:I(cohort^2) 1.737e-04  4.097e-04   0.424   0.672
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 13734  on 9976  degrees of freedom
## Residual deviance: 13158  on 9960  degrees of freedom
## AIC: 13192
##
## Number of Fisher Scoring iterations: 4
```

```
high_logmodel3 <- glm(attain ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort + race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort + race:sex:I(cohort^2), family = binomial, data = high_dat_non)
summary(high_logmodel3)
```

```
##
## Call:
## glm(formula = attain ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2), family = binomial, data = high_dat_non)
```

```

##      race:sex:I(cohort^2), family = binomial, data = high_dat_non)
##
## Deviance Residuals:
##      Min        1Q      Median        3Q        Max
## -2.6009    0.3470    0.5009    0.6575    1.9091
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -2.563e+03  1.056e+03  -2.426 0.015253 *
## race           4.348e+02  2.978e+03   0.146 0.883920
## sex           8.980e+02  6.655e+02   1.349 0.177221
## pared         2.165e-01  1.947e-02  11.119 < 2e-16 ***
## paocc10       -7.310e-05  9.653e-06  -7.572 3.66e-14 ***
## family16      -9.933e-02  2.965e-02  -3.350 0.000808 ***
## sibs          -1.169e-01  1.253e-02  -9.330 < 2e-16 ***
## incom16       2.921e-01  3.764e-02   7.762 8.39e-15 ***
## cohort        2.631e+00  1.081e+00   2.433 0.014954 *
## I(cohort^2)   -6.756e-04  2.766e-04  -2.443 0.014585 *
## race:sex      -2.095e+03  1.876e+03  -1.117 0.264104
## race:cohort   -4.556e-01  3.041e+00  -0.150 0.880926
## race:I(cohort^2) 1.193e-04  7.764e-04   0.154 0.877929
## sex:cohort    -9.336e-01  6.813e-01  -1.370 0.170561
## sex:I(cohort^2) 2.426e-04  1.744e-04   1.391 0.164110
## race:sex:cohort 2.151e+00  1.915e+00   1.123 0.261505
## race:sex:I(cohort^2) -5.519e-04  4.889e-04  -1.129 0.258963
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 7782.4  on 8418  degrees of freedom
## Residual deviance: 7182.2  on 8402  degrees of freedom
## AIC: 7216.2
##
## Number of Fisher Scoring iterations: 5

```

```
## Causal Analysis
```

```
## Full Model 1 and 4 for Low Tercile
```

```
low_model1 <- lm(mobility ~ race + sex + race:sex, data = low_dat)
low_race1 = as.numeric(coefficients((low_model1))[2])
low_race1err = summary(low_model1)$coefficients["race","Std. Error"]
low_race1
```

```
## [1] -0.5202674
```

```
low_race1err
```

```
## [1] 0.20669
```

```
summary(low_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = low_dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.1246  -1.9734   0.0266   2.0266  16.3004
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.24720    0.10570  40.183  < 2e-16 ***
## race        -0.52027    0.20669  -2.517  0.011842 *
## sex         -0.27378    0.06454  -4.242  2.23e-05 ***
## race:sex     0.47259    0.12386   3.816  0.000136 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.34 on 15058 degrees of freedom
## Multiple R-squared:  0.002349,    Adjusted R-squared:  0.00215
## F-statistic: 11.82 on 3 and 15058 DF,  p-value: 9.994e-08
```

```
low_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohor
low_race4 = as.numeric(coefficients((low_model4))[2])
low_race4err = summary(low_model4)$coefficients["race","Std. Error"]
low_race4
```

```
## [1] 1377.484
```

```
low_race4err
```

```
## [1] 4418.933
```

```
summary(low_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##     pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##     pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##     pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = low_dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.3447  -1.5037   0.0138   1.4814  11.7426
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -6.273e+03  2.950e+03  -2.126   0.0335 *
## race             1.377e+03  4.419e+03   0.312   0.7553
## sex             2.732e+03  1.795e+03   1.522   0.1281
## pared           1.734e+02  3.714e+02   0.467   0.6406
## paocc10          4.132e-05  7.216e-06   5.726 1.05e-08 ***
## family16        -8.028e-02  1.201e-02  -6.684 2.41e-11 ***
## sibs            -1.329e-01  6.633e-03 -20.043 < 2e-16 ***
## incom16          1.985e-01  2.743e-02   7.238 4.76e-13 ***
## cohort           6.466e+00  3.038e+00   2.129   0.0333 *
## I(cohort^2)     -1.664e-03  7.819e-04  -2.128   0.0334 *
## race:sex        -3.861e+03  2.695e+03  -1.433   0.1520
## race:cohort     -1.479e+00  4.543e+00  -0.326   0.7447
## race:I(cohort^2)  3.958e-04  1.167e-03   0.339   0.7346
## sex:cohort      -2.827e+00  1.848e+00  -1.529   0.1262
## sex:I(cohort^2)   7.312e-04  4.757e-04   1.537   0.1243
## pared:cohort     -1.800e-01  3.823e-01  -0.471   0.6378
## pared:I(cohort^2)  4.654e-05  9.837e-05   0.473   0.6362
## race:pared       -2.089e+02  5.952e+02  -0.351   0.7256
## sex:pared        -1.282e+02  2.253e+02  -0.569   0.5693
## race:sex:cohort   3.989e+00  2.770e+00   1.440   0.1499
## race:sex:I(cohort^2) -1.030e-03  7.118e-04  -1.447   0.1480
## race:pared:cohort  2.163e-01  6.115e-01   0.354   0.7236
## race:pared:I(cohort^2) -5.593e-05  1.570e-04  -0.356   0.7217
## sex:pared:cohort   1.330e-01  2.319e-01   0.573   0.5663
## sex:pared:I(cohort^2) -3.448e-05  5.965e-05  -0.578   0.5632
## race:sex:pared    2.402e+02  3.600e+02   0.667   0.5046
## race:sex:pared:cohort -2.479e-01  3.698e-01  -0.670   0.5026
## race:sex:pared:I(cohort^2) 6.395e-05  9.497e-05   0.673   0.5007
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.837 on 15034 degrees of freedom
## Multiple R-squared:  0.2815, Adjusted R-squared:  0.2802
## F-statistic: 218.1 on 27 and 15034 DF,  p-value: < 2.2e-16
```

```
## Full Model 1 and 4 for Medium Tercile
```

```
med_model1 <- lm(mobility ~ race + sex + race:sex, data = med_dat)
med_race1 = as.numeric(coefficients((med_model1))[2])
med_race1err = summary(med_model1)$coefficients["race","Std. Error"]
med_race1
```

```
## [1] -0.6163042
```

```
med_race1err
```

```
## [1] 0.1563038
```

```
summary(med_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = med_dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.2643  -1.4365  -0.4365   1.7357   7.0691
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.60860    0.06489  24.788 < 2e-16 ***
## race        -0.61630    0.15630  -3.943 8.08e-05 ***
## sex         -0.17213    0.04024  -4.278 1.90e-05 ***
## race:sex     0.14145    0.09451   1.497  0.135
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.505 on 19116 degrees of freedom
## Multiple R-squared:  0.004811, Adjusted R-squared:  0.004655
## F-statistic: 30.8 on 3 and 19116 DF, p-value: < 2.2e-16
```

```
med_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort16, data = med_dat)
med_race4 = as.numeric(coefficients((med_model4))[2])
med_race4err = summary(med_model4)$coefficients["race","Std. Error"]
med_race4
```

```
## [1] -41917.46
```

```
med_race4err
```

```
## [1] 80980.91
```

```
summary(med_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##     pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##     pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##     pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = med_dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.0763  -1.5636  -0.5048   1.6469   8.7792
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      2.067e+04  2.852e+04   0.725   0.469
## race             -4.192e+04  8.098e+04  -0.518   0.605
## sex              -1.893e+04  1.774e+04  -1.067   0.286
## pared            -1.873e+03  2.354e+03  -0.796   0.426
## paocc10          -5.058e-05  5.738e-06 -8.815 < 2e-16 ***
## family16         -1.060e-01  1.010e-02 -10.491 < 2e-16 ***
## sibs             -1.404e-01  6.424e-03 -21.853 < 2e-16 ***
## incom16           1.239e-01  2.248e-02   5.510 3.63e-08 ***
## cohort           -2.117e+01  2.917e+01  -0.726   0.468
## I(cohort^2)       5.419e-03  7.459e-03   0.726   0.468
## race:sex          3.165e+04  4.783e+04   0.662   0.508
## race:cohort       4.202e+01  8.261e+01   0.509   0.611
## race:I(cohort^2)  -1.053e-02  2.107e-02  -0.500   0.617
## sex:cohort        1.936e+01  1.814e+01   1.067   0.286
## sex:I(cohort^2)   -4.950e-03  4.639e-03  -1.067   0.286
## pared:cohort      1.920e+00  2.408e+00   0.797   0.425
## pared:I(cohort^2) -4.919e-04  6.158e-04  -0.799   0.424
## race:pared        3.141e+03  6.710e+03   0.468   0.640
## sex:pared         1.578e+03  1.465e+03   1.077   0.281
## race:sex:cohort   -3.179e+01  4.878e+01  -0.652   0.515
## race:sex:I(cohort^2) 7.982e-03  1.244e-02   0.642   0.521
## race:pared:cohort -3.145e+00  6.845e+00  -0.459   0.646
## race:pared:I(cohort^2) 7.870e-04  1.746e-03   0.451   0.652
## sex:pared:cohort  -1.616e+00  1.498e+00  -1.078   0.281
## sex:pared:I(cohort^2) 4.135e-04  3.831e-04   1.079   0.280
## race:sex:pared    -2.528e+03  3.961e+03  -0.638   0.523
## race:sex:pared:cohort 2.539e+00  4.040e+00   0.629   0.530
## race:sex:pared:I(cohort^2) -6.373e-04  1.030e-03  -0.619   0.536
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.437 on 19092 degrees of freedom
## Multiple R-squared:  0.05981,    Adjusted R-squared:  0.05848
## F-statistic: 44.98 on 27 and 19092 DF,  p-value: < 2.2e-16
```

```
## Full Model 1 and 4 for High Tercile
```

```
high_model1 <- lm(mobility ~ race + sex + race:sex, data = high_dat)
high_race1 = as.numeric(coefficients((high_model1))[2])
```

```
high_race1err = summary(high_model1)$coefficients["race","Std. Error"]
high_race1
```

```
## [1] -0.4399113
```

```
high_race1err
```

```
## [1] 0.1892782
```

```
summary(high_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = high_dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18.941  -1.941   0.059   1.200   7.200
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.78384    0.07806  -10.041  < 2e-16 ***
## race        -0.43991    0.18928   -2.324  0.02013 *
## sex         -0.13759    0.04838   -2.844  0.00446 **
## race:sex     0.16083    0.11491    1.400  0.16164
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.721 on 15505 degrees of freedom
## Multiple R-squared:  0.00126,    Adjusted R-squared:  0.001067
## F-statistic:  6.52 on 3 and 15505 DF,  p-value: 0.0002105
```

```
high_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
high_race4 = as.numeric(coefficients((high_model4))[2])
high_race4err = summary(high_model4)$coefficients["race","Std. Error"]
high_race4
```

```
## [1] 41488.43
```

```
high_race4err
```

```
## [1] 20442.17
```

```
summary(high_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
```



```
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = high_dat)
##
## Residuals:
##      Min        1Q      Median        3Q        Max
## -15.1660  -1.6898   0.0698   1.5477   8.1669
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -4.172e+03  6.508e+03  -0.641  0.5215
## race           4.149e+04  2.044e+04   2.030  0.0424 *
## sex           1.796e+03  4.067e+03   0.442  0.6587
## pared          9.447e+01  4.021e+02   0.235  0.8143
## paocc10       -8.835e-05  6.293e-06 -14.039 <2e-16 ***
## family16     -1.742e-01  1.165e-02 -14.957 <2e-16 ***
## sibs         -1.410e-01  7.847e-03 -17.964 <2e-16 ***
## incom16       1.947e-01  2.327e-02   8.370 <2e-16 ***
## cohort        4.299e+00  6.650e+00   0.646  0.5180
## I(cohort^2)   -1.104e-03  1.699e-03  -0.650  0.5158
## race:sex      -2.708e+04  1.218e+04  -2.223  0.0262 *
## race:cohort   -4.228e+01  2.082e+01  -2.031  0.0423 *
## race:I(cohort^2) 1.077e-02  5.301e-03   2.032  0.0422 *
## sex:cohort    -1.882e+00  4.155e+00  -0.453  0.6507
## sex:I(cohort^2) 4.921e-04  1.061e-03   0.464  0.6429
## pared:cohort   -9.808e-02  4.108e-01  -0.239  0.8113
## pared:I(cohort^2) 2.525e-05  1.049e-04   0.241  0.8098
## race:pared    -2.383e+03  1.285e+03  -1.854  0.0638 .
## sex:pared     -6.366e+01  2.522e+02  -0.252  0.8007
## race:sex:cohort 2.761e+01  1.240e+01   2.226  0.0260 *
## race:sex:I(cohort^2) -7.037e-03  3.159e-03  -2.228  0.0259 *
## race:pared:cohort 2.428e+00  1.309e+00   1.855  0.0636 .
## race:pared:I(cohort^2) -6.184e-04  3.332e-04  -1.856  0.0634 .
## sex:pared:cohort 6.708e-02  2.576e-01   0.260  0.7946
## sex:pared:I(cohort^2) -1.764e-05  6.579e-05  -0.268  0.7886
## race:sex:pared 1.561e+03  7.667e+02   2.036  0.0417 *
## race:sex:pared:cohort -1.592e+00  7.808e-01  -2.039  0.0415 *
## race:sex:pared:I(cohort^2) 4.057e-04  1.988e-04   2.041  0.0413 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.38 on 15481 degrees of freedom
## Multiple R-squared:  0.2369, Adjusted R-squared:  0.2356
## F-statistic: 178 on 27 and 15481 DF, p-value: < 2.2e-16
```

*## Full Model 1 and 4 for Each Cohort*

*## 1940*

```
co1940_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1940)
co1940_race1 = as.numeric(coefficients((co1940_model1))[2])
co1940_race1err = summary(co1940_model1)$coefficients["race", "Std. Error"]
co1940_race1
```

```
## [1] -0.5759783
```

```
co1940_race1err
```

```
## [1] 0.3687375
```

```
summary(co1940_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1940)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.5354  -1.9807  -0.5354   2.0193  17.2296
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.42610    0.13993   17.339 < 2e-16 ***
## race         -0.57598    0.36874   -1.562   0.118
## sex          -0.44536    0.08637   -5.156 2.59e-07 ***
## race:sex      0.90550    0.22227    4.074 4.67e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.334 on 7095 degrees of freedom
## Multiple R-squared:  0.01265,    Adjusted R-squared:  0.01223
## F-statistic: 30.3 on 3 and 7095 DF,  p-value: < 2.2e-16
```

```
co1940_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + col
co1940_race4 = as.numeric(coefficients((co1940_model4))[2])
co1940_race4err = summary(co1940_model4)$coefficients["race", "Std. Error"]
co1940_race4
```

```
## [1] 1247394
```

```
co1940_race4err
```

```
## [1] 695769.1
```

```
summary(co1940_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
```

```
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1940)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.0655  -1.5949  -0.2198   1.6207  11.5417
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.432e+05  3.239e+05   0.442   0.6585
## race           1.247e+06  6.958e+05   1.793   0.0730 .
## sex           -4.010e+04  1.996e+05  -0.201   0.8408
## pared         -1.100e+03  2.649e+04  -0.042   0.9669
## paocc10       -4.805e-05  9.737e-06  -4.935  8.20e-07 ***
## family16      -8.878e-02  1.842e-02  -4.820  1.47e-06 ***
## sibs         -1.591e-01  1.047e-02 -15.194 < 2e-16 ***
## incom16       2.247e-01  3.888e-02   5.779  7.85e-09 ***
## cohort       -1.475e+02  3.333e+02  -0.443   0.6580
## I(cohort^2)    3.802e-02  8.573e-02   0.443   0.6575
## race:sex      -8.407e+05  4.172e+05  -2.015   0.0439 *
## race:cohort   -1.284e+03  7.159e+02  -1.794   0.0729 .
## race:I(cohort^2) 3.305e-01  1.841e-01   1.795   0.0727 .
## sex:cohort     4.138e+01  2.054e+02   0.201   0.8403
## sex:I(cohort^2) -1.068e-02  5.284e-02  -0.202   0.8399
## pared:cohort    1.149e+00  2.726e+01   0.042   0.9664
## pared:I(cohort^2) -3.002e-04  7.013e-03  -0.043   0.9659
## race:pared     -8.402e+04  6.256e+04  -1.343   0.1793
## sex:pared      1.681e+02  1.635e+04   0.010   0.9918
## race:sex:cohort 8.655e+02  4.293e+02   2.016   0.0438 *
## race:sex:I(cohort^2) -2.227e-01  1.104e-01  -2.017   0.0437 *
## race:pared:cohort 8.651e+01  6.437e+01   1.344   0.1790
## race:pared:I(cohort^2) -2.227e-02  1.656e-02  -1.345   0.1787
## sex:pared:cohort -1.847e-01  1.683e+01  -0.011   0.9912
## sex:pared:I(cohort^2) 5.052e-05  4.329e-03   0.012   0.9907
## race:sex:pared  5.418e+04  3.796e+04   1.427   0.1535
## race:sex:pared:cohort -5.578e+01  3.906e+01  -1.428   0.1532
## race:sex:pared:I(cohort^2) 1.436e-02  1.005e-02   1.429   0.1529
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.575 on 7071 degrees of freedom
## Multiple R-squared:  0.4133, Adjusted R-squared:  0.411
## F-statistic: 184.5 on 27 and 7071 DF, p-value: < 2.2e-16
```

```
## 1948
co1948_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1948)
co1948_race1 = as.numeric(coefficients((co1948_model1))[2])
co1948_race1err = summary(co1948_model1)$coefficients["race","Std. Error"]
co1948_race1
```

```
## [1] 0.6742248
```

```
co1948_race1err
```

```
## [1] 0.2965273
```

```
summary(co1948_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1948)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.2783  -1.4560  -0.3585   2.5440  14.6415
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   1.55350    0.12201  12.733  <2e-16 ***
## race           0.67422    0.29653   2.274   0.023 *
## sex          -0.09748    0.07595  -1.284   0.199
## race:sex       0.12275    0.17788   0.690   0.490
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.241 on 9004 degrees of freedom
## Multiple R-squared:  0.01096,    Adjusted R-squared:  0.01063
## F-statistic: 33.25 on 3 and 9004 DF,  p-value: < 2.2e-16
```

```
co1948_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
co1948_race4 = as.numeric(coefficients((co1948_model4))[2])
co1948_race4err = summary(co1948_model4)$coefficients["race", "Std. Error"]
co1948_race4
```

```
## [1] 642929.1
```

```
co1948_race4err
```

```
## [1] 497355.4
```

```
summary(co1948_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1948)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.0814  -1.6010  -0.1653   1.5755   9.3359
##
## Coefficients: (1 not defined because of singularities)
```

```
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)      7.622e+04  1.233e+05   0.618   0.5365
## race             6.429e+05  4.974e+05   1.293   0.1961
## sex            -2.168e+04  4.818e+04  -0.450   0.6527
## pared          -3.657e+03  7.551e+03  -0.484   0.6282
## paocc10        -6.078e-05  8.437e-06  -7.203 6.34e-13 ***
## family16       -1.415e-01  1.609e-02  -8.794 < 2e-16 ***
## sibs           -1.301e-01  8.882e-03 -14.653 < 2e-16 ***
## incom16         7.791e-02  3.317e-02   2.349   0.0189 *
## cohort         -7.777e+01  1.264e+02  -0.615   0.5384
## I(cohort^2)      1.984e-02  3.238e-02   0.613   0.5401
## race:sex        -2.937e+05  2.963e+05  -0.991   0.3215
## race:cohort     -6.597e+02  5.097e+02  -1.294   0.1956
## race:I(cohort^2) 1.693e-01  1.306e-01   1.296   0.1950
## sex:cohort       2.206e+01  4.938e+01   0.447   0.6552
## sex:I(cohort^2)  -5.608e-03  1.265e-02  -0.443   0.6576
## pared:cohort     3.733e+00  7.738e+00   0.482   0.6295
## pared:I(cohort^2) -9.529e-04  1.983e-03  -0.481   0.6308
## race:pared      -3.863e+04  4.298e+04  -0.899   0.3688
## sex:pared        1.360e+01  1.553e+01   0.876   0.3812
## race:sex:cohort   3.013e+02  3.036e+02   0.992   0.3210
## race:sex:I(cohort^2) -7.729e-02  7.779e-02  -0.994   0.3205
## race:pared:cohort 3.966e+01  4.405e+01   0.900   0.3680
## race:pared:I(cohort^2) -1.018e-02  1.129e-02  -0.902   0.3672
## sex:pared:cohort  -6.980e-03  7.960e-03  -0.877   0.3806
## sex:pared:I(cohort^2) NA          NA          NA          NA
## race:sex:pared    1.700e+04  2.579e+04   0.659   0.5096
## race:sex:pared:cohort -1.745e+01  2.643e+01  -0.660   0.5090
## race:sex:pared:I(cohort^2) 4.478e-03  6.771e-03   0.661   0.5084
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.486 on 8981 degrees of freedom
## Multiple R-squared:  0.4194, Adjusted R-squared:  0.4177
## F-statistic: 249.5 on 26 and 8981 DF, p-value: < 2.2e-16
```

```
## 1956
co1956_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1956)
co1956_race1 = as.numeric(coefficients((co1956_model1))[2])
co1956_race1err = summary(co1956_model1)$coefficients["race","Std. Error"]
co1956_race1
```

```
## [1] 0.5973452
```

```
co1956_race1err
```

```
## [1] 0.2727793
```

```
summary(co1956_model1)
```

```
##
## Call:
```

```
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1956)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.535  -1.773  -0.773   2.196  17.227
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.74208    0.12255   6.055 1.45e-09 ***
## race          0.59735    0.27278   2.190  0.0286 *
## sex           0.03088    0.07562   0.408  0.6830
## race:sex      0.16452    0.16417   1.002  0.3163
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.198 on 9205 degrees of freedom
## Multiple R-squared:  0.01244,    Adjusted R-squared:  0.01212
## F-statistic: 38.66 on 3 and 9205 DF,  p-value: < 2.2e-16

co1956_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
co1956_race4 = as.numeric(coefficients((co1956_model4))[2])
co1956_race4err = summary(co1956_model4)$coefficients["race", "Std. Error"]
co1956_race4

## [1] -194218.9

co1956_race4err

## [1] 501527.8

summary(co1956_model4)

##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1956)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.0748  -1.5430  -0.2204   1.4873   9.8551
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -3.269e+04  1.236e+05  -0.264  0.791464
## race          -1.942e+05  5.015e+05  -0.387  0.698577
## sex           -4.844e+03  4.803e+04  -0.101  0.919657
## pared          1.375e+03  7.351e+03   0.187  0.851592
```

```
## paocc10          -6.462e-05  8.154e-06  -7.925  2.55e-15 ***
## family16         -8.722e-02  1.444e-02  -6.040  1.60e-09 ***
## sibs             -9.612e-02  9.088e-03 -10.577  < 2e-16 ***
## incom16          1.124e-01  3.105e-02   3.620  0.000296 ***
## cohort           3.309e+01  1.262e+02   0.262  0.793142
## I(cohort^2)       -8.373e-03  3.220e-02  -0.260  0.794882
## race:sex          7.405e+04  2.958e+05   0.250  0.802321
## race:cohort       1.983e+02  5.119e+02   0.387  0.698447
## race:I(cohort^2)  -5.064e-02  1.306e-01  -0.388  0.698316
## sex:cohort        5.090e+00  4.903e+01   0.104  0.917315
## sex:I(cohort^2)   -1.336e-03  1.251e-02  -0.107  0.914975
## pared:cohort      -1.387e+00  7.503e+00  -0.185  0.853350
## pared:I(cohort^2)  3.495e-04  1.915e-03   0.183  0.855180
## race:pared        5.697e+04  4.062e+04   1.403  0.160764
## sex:pared         -1.702e+01  1.517e+01  -1.122  0.261729
## race:sex:cohort   -7.548e+01  3.019e+02  -0.250  0.802600
## race:sex:I(cohort^2) 1.923e-02  7.705e-02   0.250  0.802875
## race:pared:cohort -5.814e+01  4.146e+01  -1.402  0.160838
## race:pared:I(cohort^2) 1.483e-02  1.058e-02   1.402  0.160911
## sex:pared:cohort   8.689e-03  7.740e-03   1.123  0.261666
## sex:pared:I(cohort^2) NA          NA          NA          NA
## race:sex:pared     -2.867e+04  2.409e+04  -1.190  0.234000
## race:sex:pared:cohort 2.925e+01  2.459e+01   1.189  0.234293
## race:sex:pared:I(cohort^2) -7.458e-03  6.274e-03  -1.189  0.234586
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.386 on 9182 degrees of freedom
## Multiple R-squared:  0.4517, Adjusted R-squared:  0.4502
## F-statistic: 291 on 26 and 9182 DF, p-value: < 2.2e-16
```

```
## 1964
co1964_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1964)
co1964_race1 = as.numeric(coefficients((co1964_model1))[2])
co1964_race1err = summary(co1964_model1)$coefficients["race","Std. Error"]
co1964_race1
```

```
## [1] 0.7132222
```

```
co1964_race1err
```

```
## [1] 0.3143394
```

```
summary(co1964_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1964)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.5307  -1.6159  -0.5307   1.4693  18.8006
```

```
##
## Coefficients:
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.44546    0.15800   2.819  0.00483 **
## race         0.71322    0.31434   2.269  0.02330 *
## sex          0.08521    0.09762   0.873  0.38275
## race:sex     -0.06485    0.19006  -0.341  0.73294
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.289 on 6252 degrees of freedom
## Multiple R-squared:  0.006946, Adjusted R-squared:  0.00647
## F-statistic: 14.58 on 3 and 6252 DF, p-value: 1.852e-09

co1964_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort + race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) + pared:race + pared:race:cohort + pared:race:I(cohort^2) + pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex + pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1964)
co1964_race4 = as.numeric(coefficients((co1964_model4))[2])
co1964_race4err = summary(co1964_model4)$coefficients["race", "Std. Error"]
co1964_race4

## [1] 214208.4

co1964_race4err

## [1] 563822.8

summary(co1964_model4)

##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort + race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) + pared:race + pared:race:cohort + pared:race:I(cohort^2) + pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex + pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1964)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.0664  -1.6039  -0.1465   1.5759  11.1300
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      8.171e+04  1.627e+05   0.502  0.615623
## race             2.142e+05  5.638e+05   0.380  0.704017
## sex             -3.194e+04  6.230e+04  -0.513  0.608144
## pared            -4.156e+03  9.285e+03  -0.448  0.654471
## paocc10          -5.905e-05  1.019e-05  -5.797  7.08e-09 ***
## family16         -1.387e-01  1.701e-02  -8.156  4.15e-16 ***
## sibs             -1.037e-01  1.084e-02  -9.570  < 2e-16 ***
## incom16           1.288e-01  3.756e-02   3.429  0.000611 ***
## cohort           -8.331e+01  1.655e+02  -0.504  0.614620
```



```
## I(cohort^2)          2.124e-02  4.205e-02   0.505 0.613580
## race:sex            -1.046e+05  3.391e+05  -0.309 0.757660
## race:cohort        -2.165e+02  5.732e+02  -0.378 0.705591
## race:I(cohort^2)     5.472e-02  1.457e-01   0.376 0.707165
## sex:cohort          3.259e+01  6.334e+01   0.515 0.606905
## sex:I(cohort^2)     -8.312e-03  1.610e-02  -0.516 0.605678
## pared:cohort         4.242e+00  9.439e+00   0.449 0.653200
## pared:I(cohort^2)   -1.082e-03  2.399e-03  -0.451 0.651887
## race:pared          -2.022e+04  4.306e+04  -0.470 0.638712
## sex:pared           -1.767e+01  1.910e+01  -0.925 0.354842
## race:sex:cohort      1.057e+02  3.447e+02   0.307 0.759149
## race:sex:I(cohort^2) -2.669e-02  8.760e-02  -0.305 0.760638
## race:pared:cohort    2.047e+01  4.377e+01   0.468 0.640127
## race:pared:I(cohort^2) -5.179e-03  1.112e-02  -0.466 0.641543
## sex:pared:cohort     8.953e-03  9.708e-03   0.922 0.356480
## sex:pared:I(cohort^2)      NA      NA      NA      NA
## race:sex:pared       1.655e+04  2.595e+04   0.638 0.523580
## race:sex:pared:cohort -1.678e+01  2.638e+01  -0.636 0.524801
## race:sex:pared:I(cohort^2) 4.251e-03  6.704e-03   0.634 0.526023
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.467 on 6229 degrees of freedom
## Multiple R-squared:  0.4436, Adjusted R-squared:  0.4413
## F-statistic: 191 on 26 and 6229 DF, p-value: < 2.2e-16
```

```
## 1972
co1972_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1972)
co1972_race1 = as.numeric(coefficients((co1972_model1))[2])
co1972_race1err = summary(co1972_model1)$coefficients["race", "Std. Error"]
co1972_race1
```

```
## [1] 0.8290306
```

```
co1972_race1err
```

```
## [1] 0.3820907
```

```
summary(co1972_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1972)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.9319  -2.1436  -0.1436   1.8564  16.0681
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.1696     0.2047  -0.829   0.4073
## race           0.8290     0.3821   2.170   0.0301 *
```

```
## sex          0.3132      0.1265    2.476    0.0133 *
## race:sex     -0.1770      0.2306   -0.767    0.4429
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.37 on 4126 degrees of freedom
## Multiple R-squared:  0.007547,    Adjusted R-squared:  0.006826
## F-statistic: 10.46 on 3 and 4126 DF,  p-value: 7.487e-07
```

```
co1972_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
pared:race + pared:race:cohort + pared:race:I(cohort^2) +
pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1972)
co1972_race4 = as.numeric(coefficients((co1972_model4))[2])
co1972_race4err = summary(co1972_model4)$coefficients["race", "Std. Error"]
co1972_race4
```

```
## [1] 391383
```

```
co1972_race4err
```

```
## [1] 643497.3
```

```
summary(co1972_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1972)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.0397  -1.5706  -0.1215   1.6235  10.6456
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -8.146e+03  2.068e+05  -0.039   0.9686
## race             3.914e+05  6.435e+05   0.608   0.5431
## sex            -4.088e+04  7.944e+04  -0.515   0.6069
## pared           5.770e+03  1.142e+04   0.505   0.6134
## paocc10        -5.113e-05  1.269e-05  -4.028 5.73e-05 ***
## family16       -1.151e-01  2.053e-02  -5.606 2.21e-08 ***
## sibs           -1.298e-01  1.404e-02  -9.246 < 2e-16 ***
## incom16         1.837e-01  4.532e-02   4.054 5.13e-05 ***
## cohort          8.327e+00  2.093e+02   0.040   0.9683
## I(cohort^2)     -2.126e-03  5.299e-02  -0.040   0.9680
## race:sex        -6.141e+05  3.813e+05  -1.611   0.1073
## race:cohort     -3.966e+02  6.515e+02  -0.609   0.5428
## race:I(cohort^2) 1.005e-01  1.649e-01   0.609   0.5424
## sex:cohort       4.141e+01  8.044e+01   0.515   0.6067
```

```
## sex:I(cohort^2)          -1.049e-02  2.036e-02  -0.515  0.6066
## pared:cohort             -5.844e+00  1.156e+01  -0.505  0.6133
## pared:I(cohort^2)        1.479e-03  2.927e-03   0.505  0.6132
## race:pared              -4.279e+04  4.827e+04  -0.887  0.3754
## sex:pared                -6.289e+00  2.341e+01  -0.269  0.7883
## race:sex:cohort          6.219e+02  3.860e+02   1.611  0.1072
## race:sex:I(cohort^2)     -1.575e-01  9.771e-02  -1.612  0.1071
## race:pared:cohort         4.336e+01  4.887e+01   0.887  0.3751
## race:pared:I(cohort^2)   -1.098e-02  1.237e-02  -0.888  0.3748
## sex:pared:cohort          3.157e-03  1.185e-02   0.266  0.7900
## sex:pared:I(cohort^2)      NA         NA         NA         NA
## race:sex:pared            5.116e+04  2.854e+04   1.793  0.0731 .
## race:sex:pared:cohort     -5.181e+01  2.890e+01  -1.793  0.0730 .
## race:sex:pared:I(cohort^2) 1.312e-02  7.314e-03   1.793  0.0730 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.514 on 4103 degrees of freedom
## Multiple R-squared:  0.4509, Adjusted R-squared:  0.4474
## F-statistic: 129.6 on 26 and 4103 DF,  p-value: < 2.2e-16
```

```
## 1980
co1980_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1980)
co1980_race1 = as.numeric(coefficients((co1980_model1))[2])
co1980_race1err = summary(co1980_model1)$coefficients["race","Std. Error"]
co1980_race1
```

```
## [1] 1.668288
```

```
co1980_race1err
```

```
## [1] 0.4817222
```

```
summary(co1980_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1980)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -11.8434  -1.8550  -0.4514   2.1566  15.1937
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.7646     0.2738  -2.793  0.005265 **
## race           1.6683     0.4817   3.463  0.000543 ***
## sex           0.6080     0.1675   3.629  0.000290 ***
## race:sex      -0.6567     0.2902  -2.263  0.023722 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 3.373 on 2483 degrees of freedom
## Multiple R-squared:  0.01332,    Adjusted R-squared:  0.01213
## F-statistic: 11.18 on 3 and 2483 DF,  p-value: 2.765e-07
```

```
co1980_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + col
co1980_race4 = as.numeric(coefficients((co1980_model4))[2])
co1980_race4err = summary(co1980_model4)$coefficients["race","Std. Error"]
co1980_race4
```

```
## [1] 1478186
```

```
co1980_race4err
```

```
## [1] 886489.3
```

```
summary(co1980_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##      family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##      race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##      race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##      pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##      pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##      pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1980)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.0534  -1.7002  -0.0333   1.7126   8.4706
##
## Coefficients: (1 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -2.484e+05  3.114e+05  -0.798  0.425143
## race              1.478e+06  8.865e+05   1.667  0.095550 .
## sex             -8.197e+04  1.122e+05  -0.731  0.465061
## pared            2.374e+04  1.672e+04   1.420  0.155839
## paocc10         -3.347e-05  1.672e-05  -2.001  0.045469 *
## family16        -1.295e-01  2.611e-02  -4.961  7.51e-07 ***
## sibs            -1.632e-01  2.021e-02  -8.076  1.04e-15 ***
## incom16          2.171e-01  5.880e-02   3.691  0.000228 ***
## cohort           2.501e+02  3.140e+02   0.797  0.425797
## I(cohort^2)      -6.297e-02  7.917e-02  -0.795  0.426469
## race:sex         -3.488e+05  5.377e+05  -0.649  0.516636
## race:cohort      -1.490e+03  8.939e+02  -1.667  0.095701 .
## race:I(cohort^2)  3.754e-01  2.254e-01   1.666  0.095853 .
## sex:cohort        8.264e+01  1.131e+02   0.730  0.465195
## sex:I(cohort^2)   -2.083e-02  2.853e-02  -0.730  0.465335
## pared:cohort      -2.392e+01  1.686e+01  -1.418  0.156272
## pared:I(cohort^2)  6.022e-03  4.251e-03   1.417  0.156719
## race:pared        -1.180e+05  6.470e+04  -1.823  0.068364 .
## sex:pared         3.349e-01  3.402e+01   0.010  0.992145
```

```
## race:sex:cohort      3.515e+02  5.422e+02   0.648 0.516882
## race:sex:I(cohort^2) -8.856e-02  1.367e-01  -0.648 0.517128
## race:pared:cohort    1.189e+02  6.525e+01   1.823 0.068463 .
## race:pared:I(cohort^2) -2.997e-02  1.645e-02  -1.822 0.068562 .
## sex:pared:cohort     -1.767e-04  1.715e-02  -0.010 0.991784
## sex:pared:I(cohort^2)      NA      NA      NA      NA
## race:sex:pared       3.618e+04  3.958e+04   0.914 0.360817
## race:sex:pared:cohort  -3.647e+01  3.991e+01  -0.914 0.361001
## race:sex:pared:I(cohort^2) 9.189e-03  1.006e-02   0.913 0.361186
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.57 on 2460 degrees of freedom
## Multiple R-squared:  0.4326, Adjusted R-squared:  0.4266
## F-statistic: 72.12 on 26 and 2460 DF,  p-value: < 2.2e-16
```

```
## 1988
```

```
co1988_model1 <- lm(mobility ~ race + sex + race:sex, data = cohort1988)
co1988_race1 = as.numeric(coefficients((co1988_model1))[2])
co1988_race1err = summary(co1988_model1)$coefficients["race","Std. Error"]
co1988_race1
```

```
## [1] -0.1797642
```

```
co1988_race1err
```

```
## [1] 0.6608205
```

```
summary(co1988_model1)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex, data = cohort1988)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -9.8412 -1.8412  0.1588  2.1588 15.1588
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.33585    0.41036  -0.818   0.413
## race        -0.17976    0.66082  -0.272   0.786
## sex          0.08854    0.25029   0.354   0.724
## race:sex     0.35811    0.40171   0.891   0.373
##
## Residual standard error: 3.136 on 1041 degrees of freedom
## Multiple R-squared:  0.005613, Adjusted R-squared:  0.002747
## F-statistic: 1.959 on 3 and 1041 DF,  p-value: 0.1185
```

```
co1988_model4 <- lm(mobility ~ race + sex + race:sex + pared + paocc10 + family16 + sibs + incom16 + col
co1988_race4 = as.numeric(coefficients((co1988_model4))[2])
co1988_race4err = summary(co1988_model4)$coefficients["race","Std. Error"]
co1988_race4
```

```
## [1] -633484.6
```

```
co1988_race4err
```

```
## [1] 619266
```

```
summary(co1988_model4)
```

```
##
## Call:
## lm(formula = mobility ~ race + sex + race:sex + pared + paocc10 +
##     family16 + sibs + incom16 + cohort + I(cohort^2) + race:cohort +
##     race:I(cohort^2) + sex:cohort + sex:I(cohort^2) + race:sex:cohort +
##     race:sex:I(cohort^2) + pared:cohort + pared:I(cohort^2) +
##     pared:race + pared:race:cohort + pared:race:I(cohort^2) +
##     pared:sex + pared:sex:cohort + pared:sex:I(cohort^2) + pared:race:sex +
##     pared:race:sex:cohort + pared:race:sex:I(cohort^2), data = cohort1988)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.0709  -1.5595   0.0846   1.4135   6.7864
##
## Coefficients: (2 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      1.071e+05  4.171e+05   0.257  0.79746
## race             -6.335e+05  6.193e+05  -1.023  0.30657
## sex              -1.040e+05  1.394e+05  -0.746  0.45559
## pared             1.073e+04  2.275e+04   0.472  0.63729
## paocc10          -3.380e-05  2.302e-05  -1.468  0.14234
## family16         -9.459e-02  3.528e-02  -2.681  0.00746 **
## sibs             -7.561e-02  2.625e-02  -2.880  0.00406 **
## incom16           1.833e-01  7.835e-02   2.339  0.01952 *
## cohort           -1.072e+02  4.190e+02  -0.256  0.79818
## I(cohort^2)       2.682e-02  1.052e-01   0.255  0.79888
## race:sex          4.583e+05  2.213e+05   2.071  0.03858 *
## race:cohort       6.361e+02  6.220e+02   1.023  0.30673
## race:I(cohort^2)  -1.597e-01  1.562e-01  -1.022  0.30689
## sex:cohort        1.041e+02  1.400e+02   0.743  0.45738
## sex:I(cohort^2)   -2.605e-02  3.518e-02  -0.741  0.45917
## pared:cohort      -1.081e+01  2.285e+01  -0.473  0.63628
## pared:I(cohort^2)  2.722e-03  5.737e-03   0.474  0.63529
## race:pared        -1.614e+04  3.369e+04  -0.479  0.63199
## sex:pared         5.492e+01  5.644e+01   0.973  0.33075
## race:sex:cohort   -4.603e+02  2.222e+02  -2.071  0.03860 *
## race:sex:I(cohort^2) 1.156e-01  5.581e-02   2.071  0.03863 *
## race:pared:cohort  1.622e+01  3.385e+01   0.479  0.63182
## race:pared:I(cohort^2) -4.076e-03  8.499e-03  -0.480  0.63165
## sex:pared:cohort  -2.757e-02  2.835e-02  -0.973  0.33102
## sex:pared:I(cohort^2)      NA         NA      NA      NA
## race:sex:pared     9.129e-01  8.521e+01   0.011  0.99145
## race:sex:pared:cohort -4.089e-04  4.281e-02  -0.010  0.99238
## race:sex:pared:I(cohort^2)      NA         NA      NA      NA
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.329 on 1019 degrees of freedom
## Multiple R-squared:  0.463, Adjusted R-squared:  0.4498
## F-statistic: 35.14 on 25 and 1019 DF, p-value: < 2.2e-16
```