Labor Market Analysis

Revised Econometric Model

Marjorie Blanco, Joe Thomson, Haodi Tu

Research Questions

1) How do earnings vary by education level?
2) How does the premium for education vary by gender?

Revised Model

$Earning = \beta_0 + Divorced * \beta_1 + NeverMarried * \beta_2 + Female * \beta_3 + RaceBlack * \beta_4 + RaceOther * \beta_5 +$
$SomeCollege * \beta_6 + Associate * \beta_7 + Bachelor * \beta_8 + Master * \beta_9 + Professional * \beta_10 + Doctoral * \beta_11 + Age * \beta_12$

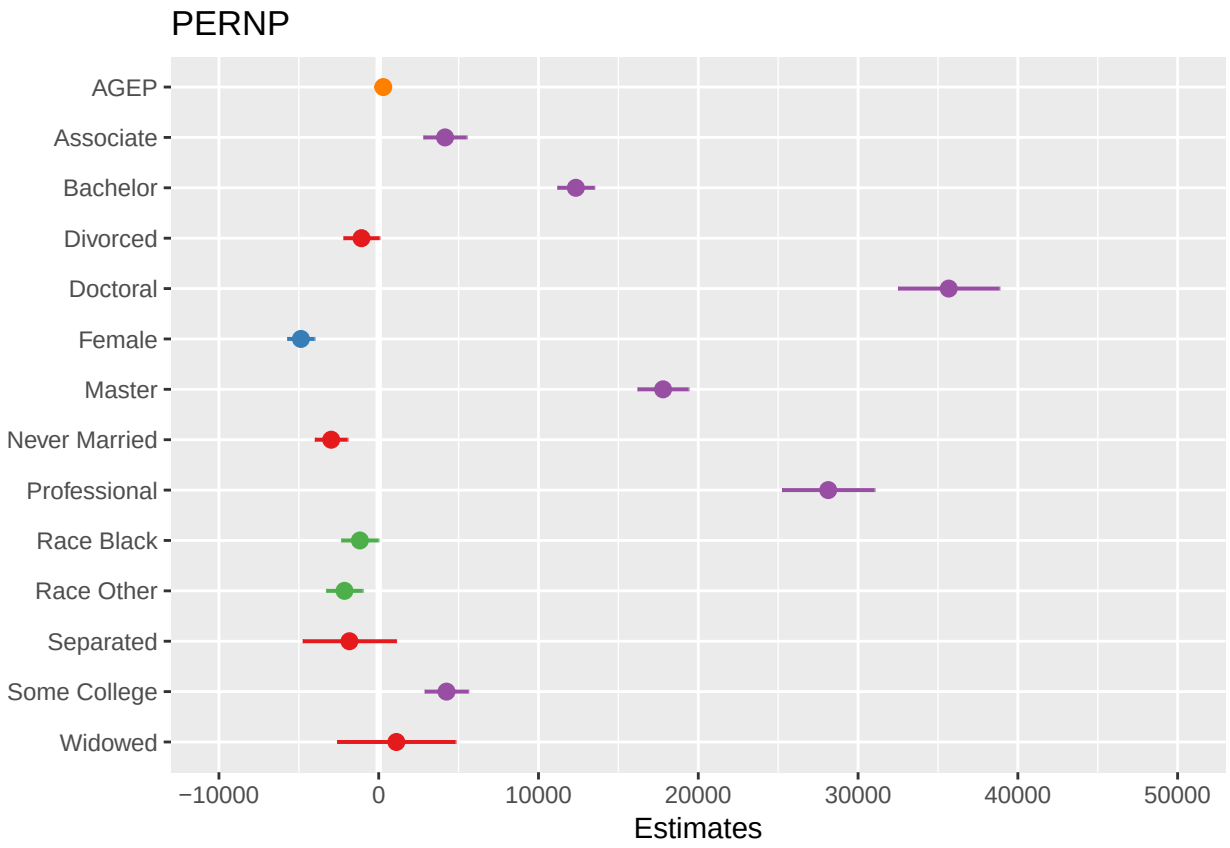
```
##
## Call:
## lm(formula = PERNP ~ Widowed + Divorced + Separated + NeverMarried +
##     Female + RaceBlack + RaceOther + SomeCollege + Associate +
##     Bachelor + Master + Professional + Doctoral + AGEP, data = ss16ppr)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -43683  -9228  -2919   5341  98762
##
## Coefficients:
##              Estimate Std. Error t value             Pr(>|t|)
## (Intercept)  12598.97    1110.28  11.348 < 0.0000000000000002 ***
## Widowed       1104.92    1888.02   0.585             0.558422
## Divorced     -1078.74     571.98  -1.886             0.059353 .
## Separated    -1833.17    1489.22  -1.231             0.218393
## NeverMarried -2974.75     520.48  -5.715        0.00000001155 ***
## Female       -4868.47     432.66 -11.252 < 0.0000000000000002 ***
## RaceBlack    -1178.01     591.36  -1.992             0.046421 *
## RaceOther    -2141.04     579.98  -3.692             0.000225 ***
## SomeCollege   4241.63     694.73   6.105        0.00000000110 ***
## Associate     4150.43     688.45   6.029        0.00000000177 ***
## Bachelor     12337.16     587.07  21.015 < 0.0000000000000002 ***
## Master       17795.40     812.61  21.899 < 0.0000000000000002 ***
## Professional 28133.37    1476.36  19.056 < 0.0000000000000002 ***
## Doctoral     35674.46    1617.08  22.061 < 0.0000000000000002 ***
## AGEP           284.94      21.12  13.488 < 0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14920 on 5179 degrees of freedom
## Multiple R-squared:  0.2466, Adjusted R-squared:  0.2446
## F-statistic: 121.1 on 14 and 5179 DF,  p-value: < 0.00000000000000022
```

Interpretation

- Coefficients Explanation

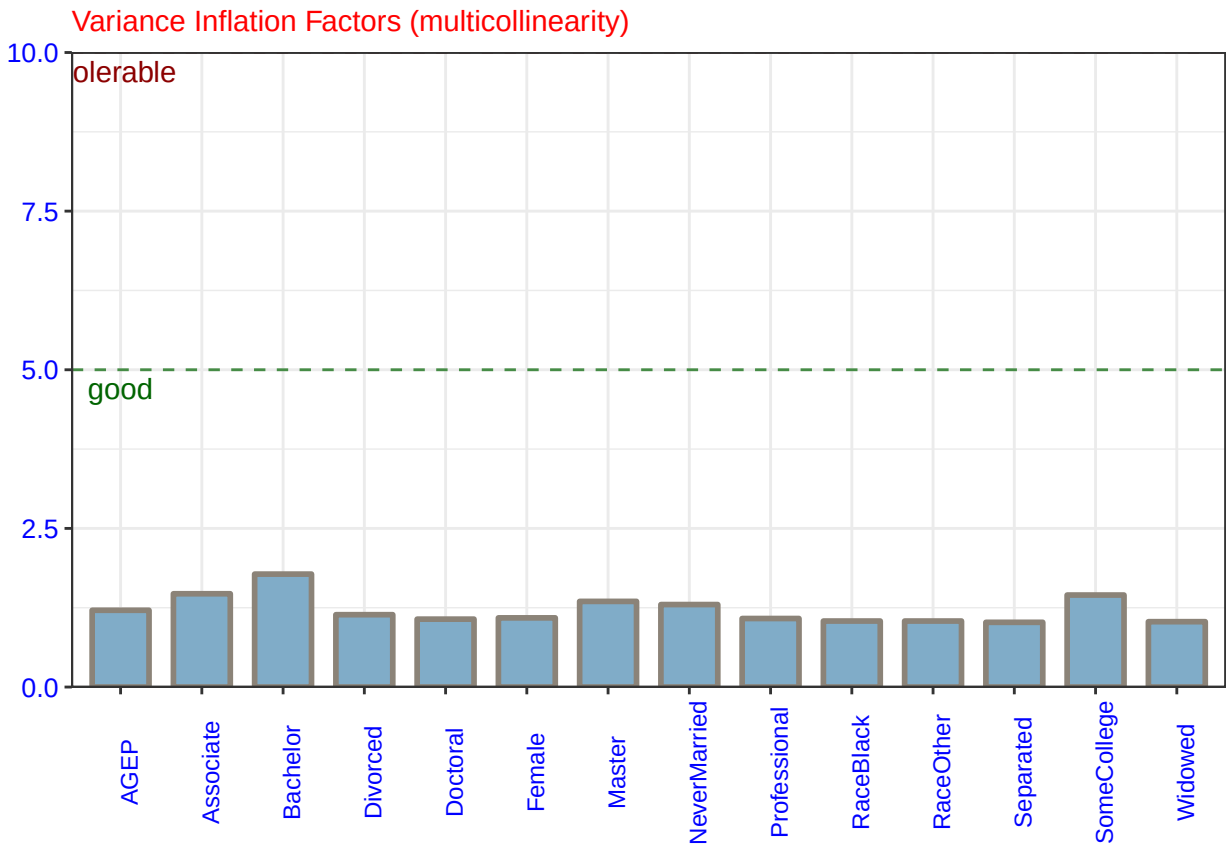
- Holding gender, race, education and age constant, married people makes $1104.92 less than people who widowed on average.
- Holding gender, race, education and age constant, married people makes $1078.74 more than people who divorced on average.
- Holding gender, race, education and age constant, married people makes $1833.17 more than people who separated on average.
- Holding gender, race, education and age constant, married people makes $2974.75 more than people who never married on average.
- Holding marriage, race, education and age constant, male makes $4868.47 more than female on average.
- Holding marriage, gender, education and age constant, White makes $1178.01 more than Black on average.
- Holding marriage, gender, education and age constant, White makes $2141.04 more than Other race on average.
- Holding marriage, gender, race and age constant, people have high school education makes $4241.63 less than people have some college education on average.
- Holding marriage, gender, race and age constant, people have high school education makes $4150.43 less than people have associate education on average.
- Holding marriage, gender, race and age constant, people have high school education makes $12337.16 less than people have bachelor's degree on average.
- Holding marriage, gender, race and age constant, people have high school education makes $17795.4 less than people have master's degree on average.
- Holding marriage, gender, race and age constant, people have high school education makes $28133.37 less than people have Professional education on average.
- Holding marriage, gender, race and age constant, people have high school education makes $35674.46 less than people have doctor's degree on average.
- Holding marriage, gender, race and education constant, people make $284.94 more as age increases on average between the age of 18 to 64.

Model Diagnostics



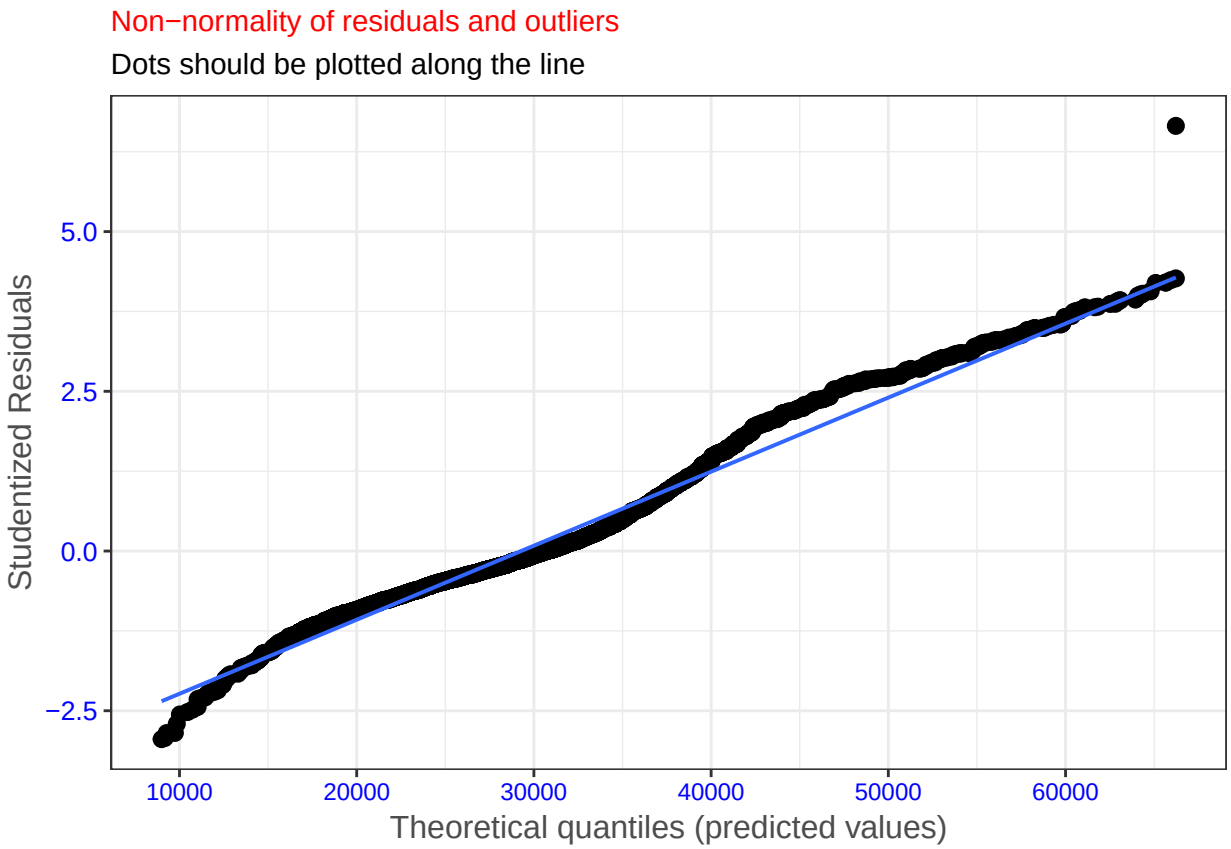
Variables	Tolerance	VIF
Widowed	0.9729050	1.027850
Divorced	0.8808670	1.135245
Separated	0.9756434	1.024965
NeverMarried	0.7702636	1.298257
Female	0.9159123	1.091808
RaceBlack	0.9633247	1.038072
RaceOther	0.9650376	1.036229
SomeCollege	0.6878124	1.453885
Associate	0.6814727	1.467410
Bachelor	0.5604312	1.784341
Master	0.7394234	1.352405
Professional	0.9238792	1.082393
Doctoral	0.9320203	1.072938
AGEP	0.8267426	1.209566

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



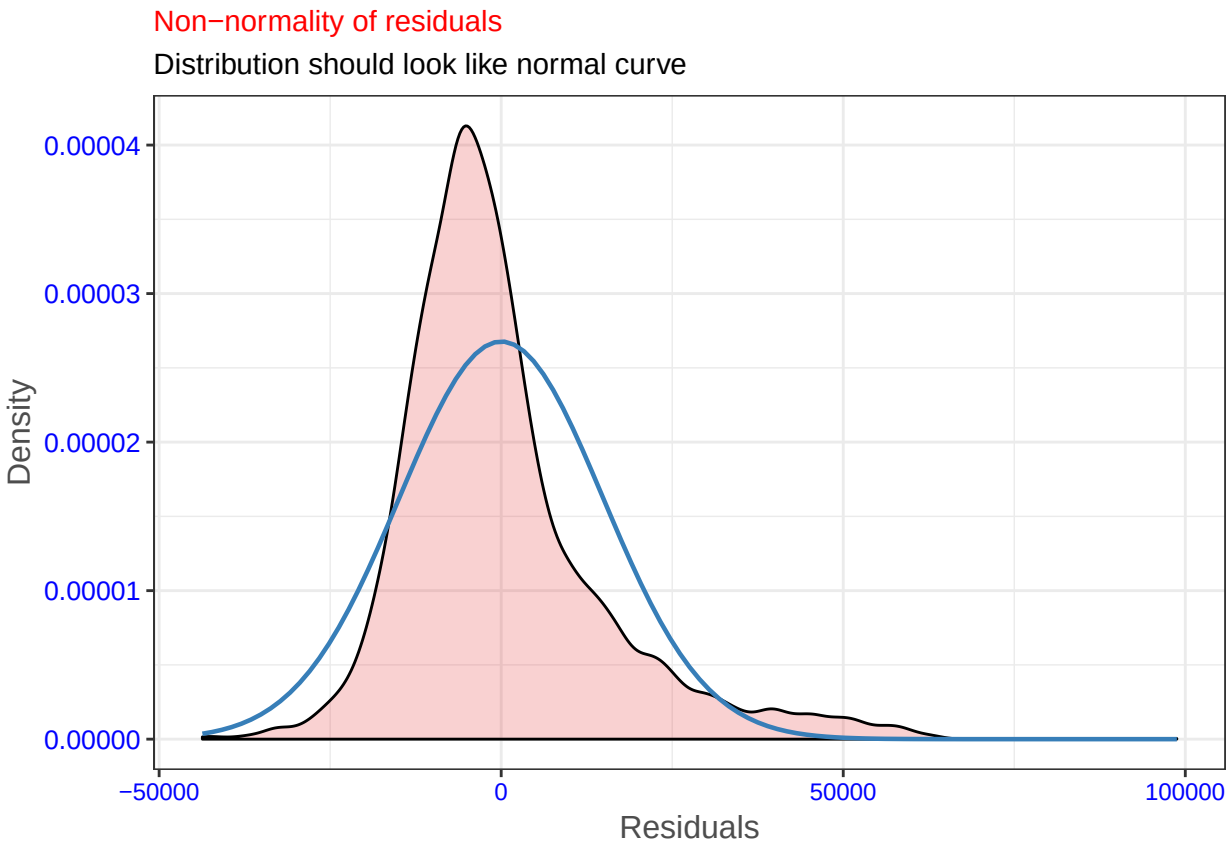
A VIF chart shows that there is no correlation among the kth predictor and the remaining predictor variables.

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



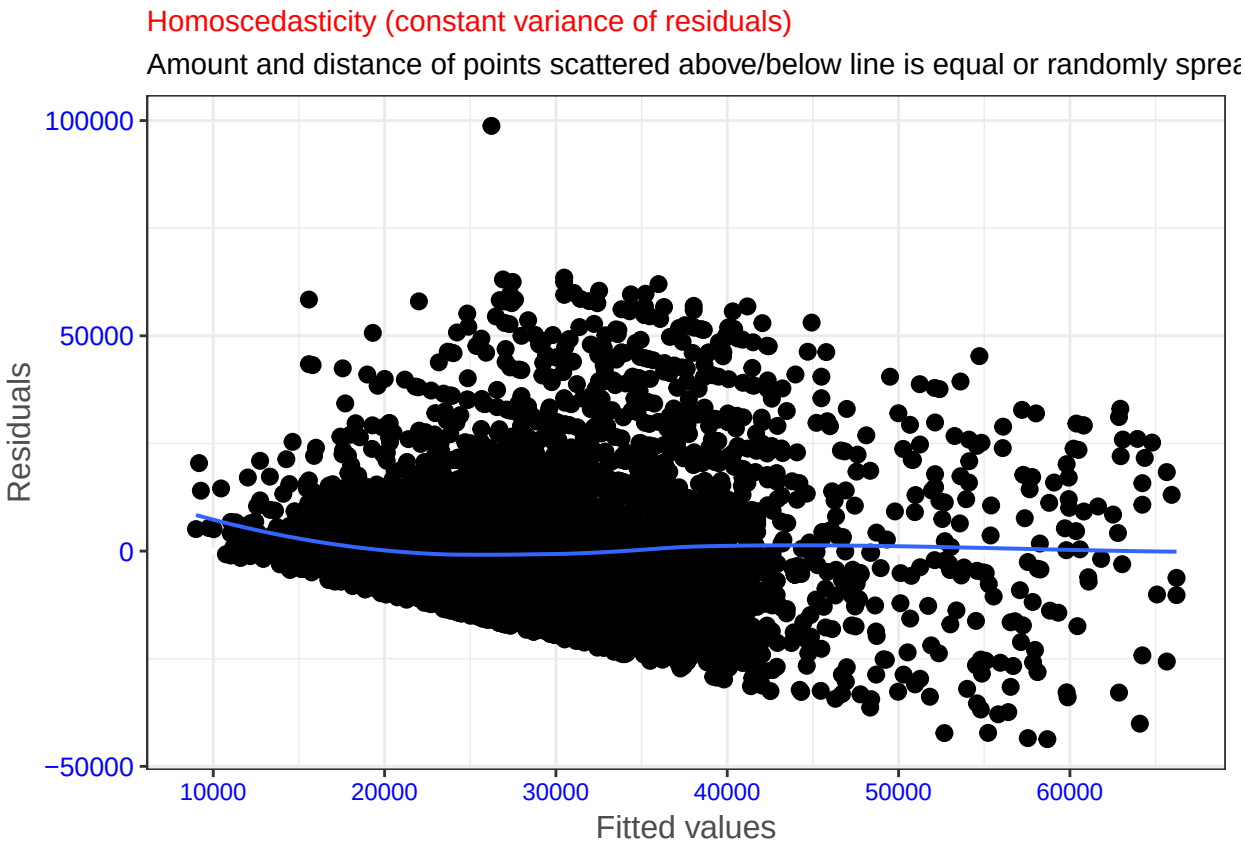
The plot shows that the distribution of the residuals are not approximately normally distributed. The "thin tail" correspond to the first quantiles occurring at less than expected values and there is an outlier point.

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



The plot shows that the distribution of the residuals is not approximately normally distributed but skewed to the right.

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



The plot shows heteroscedasticity as the variance of the residuals are not constant.

Breusch-Pagan test

$H0$: Variance is unchanging in the residual

$H1$: Variance is changing in the residual

```
##
##  studentized Breusch-Pagan test
##
## data:  Model_1
## BP = 297.55, df = 14, p-value < 0.00000000000000022
```

The p-Value < 0.05 which indicates that the null hypothesis (the variance is unchanging in the residual) can be rejected and therefore heterscedasticity exists.

Revised Model wit robust standard errors

```
##
## Call:
## lm(formula = residuals(Model_1) * residuals(Model_1) ~ Widowed +
##     Divorced + Separated + NeverMarried + Female + RaceBlack +
##     RaceOther + SomeCollege + Associate + Bachelor + Master +
##     Professional + Doctoral + AGEP, data = ss16ppr)
##
## Residuals:
```

```
##        Min         1Q     Median         3Q        Max
## -620286278 -187332480  -89004449   -6623206 9554893533
##
## Coefficients:
##               Estimate Std. Error t value             Pr(>|t|)
## (Intercept)  -22272288   35096119  -0.635                0.5257
## Widowed       10526294   59680719   0.176                0.8600
## Divorced      -9634464   18080343  -0.533                0.5941
## Separated    -74925738   47074515  -1.592                0.1115
## NeverMarried -41219294   16452372  -2.505                0.0123 *
## Female       -86614125   13676418  -6.333  0.00000000026057555 ***
## RaceBlack    -30492334   18693117  -1.631                0.1029
## RaceOther    -56411117   18333200  -3.077                0.0021 **
## SomeCollege   54139584   21960626   2.465                0.0137 *
## Associate     38592334   21762198   1.773                0.0762 .
## Bachelor     167802881   18557574   9.042 < 0.0000000000000002 ***
## Master       240588080   25686793   9.366 < 0.0000000000000002 ***
## Professional 363259303   46668182   7.784  0.00000000000000843 ***
## Doctoral     283832422   51116425   5.553  0.00000002953675723 ***
## AGEP           4843548     667752   7.254  0.00000000000046605 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 471600000 on 5179 degrees of freedom
## Multiple R-squared:  0.05729,    Adjusted R-squared:  0.05474
## F-statistic: 22.48 on 14 and 5179 DF,  p-value: < 0.00000000000000022
```

```
##               (Intercept)     Widowed    Divorced   Separated NeverMarried
## (Intercept)   1007933.05   58087.062 -81847.4203  -49419.377  -267638.579
## Widowed         58087.06 3995751.368 105877.9224  111739.704    61877.649
## Divorced       -81847.42  105877.922 349056.7354  102495.813    95360.449
## Separated      -49419.38  111739.704 102495.8126 1565899.963    91581.434
## NeverMarried  -267638.58   61877.649  95360.4487   91581.434   242152.106
## Female         -24269.36  -37296.786 -22584.5663   -9502.521     3535.426
## RaceBlack      -54050.20    4154.512   -261.2336   -1778.827    -1474.294
## RaceOther      -43361.05  -17198.587   3064.7362   28165.922    -2030.508
## SomeCollege   -164587.00    5864.731   2716.6330  -30536.341    -9191.626
## Associate     -156276.57   28238.641  14270.5777   26369.734    16901.438
## Bachelor      -140253.26   58869.676  15822.7991   22192.750    11420.935
## Master         -98238.23   19298.737   4166.7095  -29561.887     4120.858
## Professional  -178405.52   47377.351  -9202.0646   36275.425   -25373.156
## Doctoral       -51307.89  115905.356  47855.5908  140337.165    29949.062
## AGEP           -18128.79   -3587.834   -293.0243   -1156.124     3781.175
##                   Female    RaceBlack  RaceOther SomeCollege   Associate
## (Intercept)  -24269.3559 -54050.20464 -43361.053 -164587.002 -156276.572
## Widowed      -37296.7857   4154.51196 -17198.587    5864.731   28238.641
## Divorced     -22584.5663   -261.23364   3064.736    2716.633   14270.578
## Separated     -9502.5212  -1778.82702  28165.922  -30536.341   26369.734
## NeverMarried   3535.4265  -1474.29397  -2030.508   -9191.626   16901.438
## Female       194048.3723  -8630.04524  -8397.285  -29487.201  -42117.858
## RaceBlack     -8630.0452 315761.19749  66096.740  -10264.752   -6036.723
## RaceOther     -8397.2851  66096.74016 278637.804    3569.363   -4820.559
## SomeCollege  -29487.2014 -10264.75223   3569.363  332091.081  125594.576
## Associate    -42117.8578  -6036.72309  -4820.559  125594.576  319016.024
## Bachelor     -78511.6369   6202.41918 -10349.806  130275.001  135533.527
## Master       -92998.9918  -6855.66175  28720.700  131019.704  135614.524
## Professional -48793.0798  28726.41028  17513.253  130357.805  129838.545
```

```
## Doctoral     -37589.1845    758.93490  80827.611  112338.880  124924.530
## AGEP           -787.2688    -97.32446   -420.435    1437.587    1046.660
##                  Bachelor      Master Professional     Doctoral
## (Intercept)  -140253.2646 -98238.2349  -178405.520  -51307.8937
## Widowed        58869.6759  19298.7370    47377.351  115905.3561
## Divorced       15822.7991   4166.7095    -9202.065   47855.5908
## Separated      22192.7500 -29561.8868    36275.425  140337.1654
## NeverMarried   11420.9348   4120.8577   -25373.156   29949.0622
## Female        -78511.6369 -92998.9918   -48793.080  -37589.1845
## RaceBlack       6202.4192  -6855.6618    28726.410     758.9349
## RaceOther     -10349.8064  28720.6998    17513.253   80827.6113
## SomeCollege   130275.0011 131019.7043   130357.805  112338.8799
## Associate     135533.5269 135614.5236   129838.545  124924.5305
## Bachelor      307695.2759 152567.2493   140083.610  133715.9622
## Master        152567.2493 847427.5870   140245.690  140031.3156
## Professional  140083.6102 140245.6899  4394423.380  124345.5782
## Doctoral      133715.9622 140031.3156   124345.578 4770075.3429
## AGEP             949.8206    127.4089     1732.881   -2150.9231
##                     AGEP
## (Intercept)  -18128.78819
## Widowed       -3587.83358
## Divorced       -293.02429
## Separated     -1156.12421
## NeverMarried   3781.17492
## Female         -787.26885
## RaceBlack       -97.32446
## RaceOther      -420.43504
## SomeCollege    1437.58685
## Associate      1046.66000
## Bachelor        949.82059
## Master          127.40891
## Professional   1732.88105
## Doctoral      -2150.92312
## AGEP            413.64705

##  (Intercept)      Widowed     Divorced    Separated NeverMarried
##   1003.95869   1998.93756    590.81024   1251.35925    492.08953
##       Female    RaceBlack    RaceOther  SomeCollege    Associate
##    440.50922    561.92633    527.86154    576.27344    564.81504
##     Bachelor       Master Professional     Doctoral         AGEP
##    554.70287    920.55830   2096.28800   2184.05022     20.33831
```

Revised Logarithmic Model

$Log(Earning) = \beta_0 + Divorced * \beta_1 + NeverMarried * \beta_2 + Female * \beta_3 + RaceBlack * \beta_4 + RaceOther * \beta_5 + SomeCollege * \beta_6 + Associate * \beta_7 + Bachelor * \beta_8 + Master * \beta_9 + Professional * \beta_10 + Doctoral * \beta_11 + Age * \beta_12$

```
##
## Call:
## lm(formula = log(PERNP, base = exp(1)) ~ Widowed + Divorced +
##     Separated + NeverMarried + Female + RaceBlack + RaceOther +
##     SomeCollege + Associate + Bachelor + Master + Professional +
##     Doctoral + AGEP, data = ss16ppr)
##
## Residuals:
```

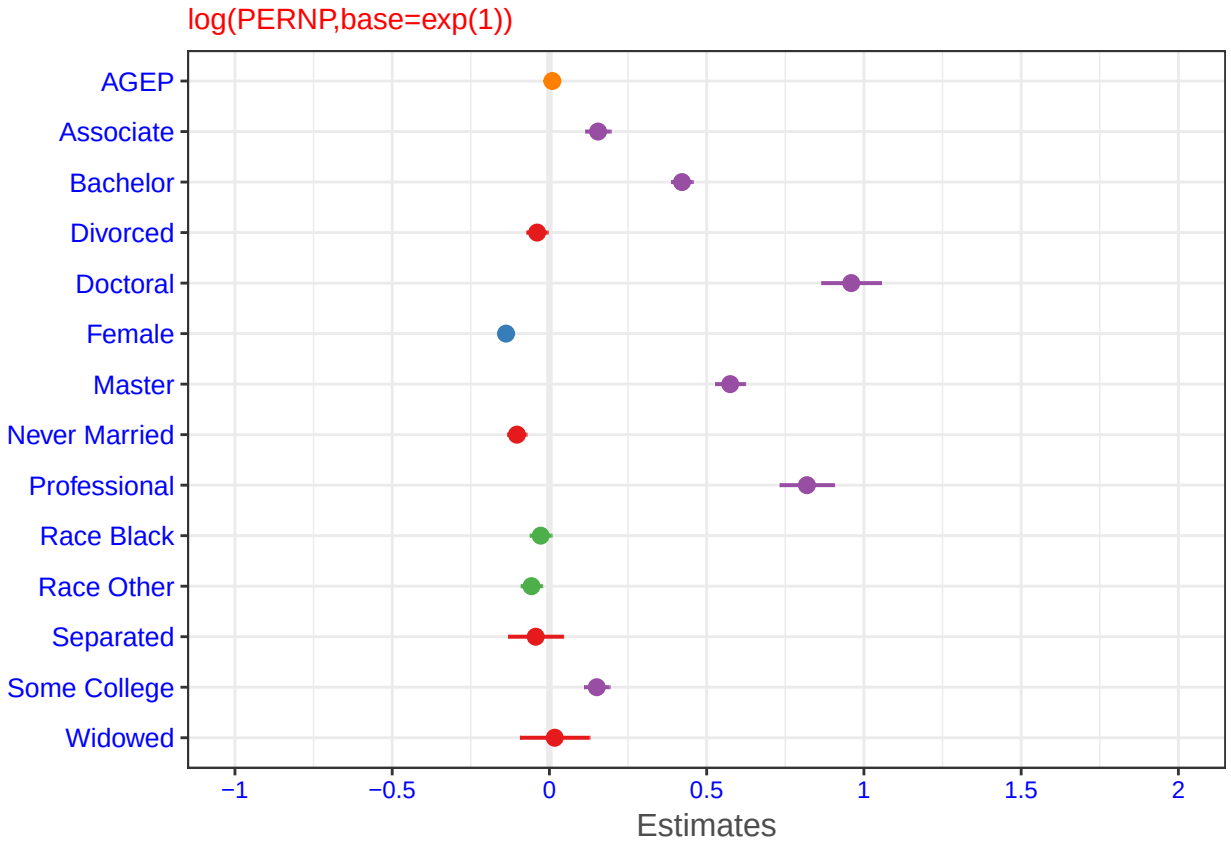
```
##      Min       1Q   Median       3Q      Max
## -1.56195 -0.30715 -0.03111  0.27690  1.69792
##
## Coefficients:
##                Estimate Std. Error t value             Pr(>|t|)
## (Intercept)   9.5841704  0.0331471 289.140 < 0.0000000000000002 ***
## Widowed       0.0167914  0.0563665   0.298             0.765794
## Divorced     -0.0391735  0.0170763  -2.294             0.021829 *
## Separated    -0.0437489  0.0444603  -0.984             0.325162
## NeverMarried -0.1033310  0.0155387  -6.650   0.0000000000323503 ***
## Female       -0.1380595  0.0129169 -10.688 < 0.0000000000000002 ***
## RaceBlack    -0.0278297  0.0176550  -1.576             0.115017
## RaceOther    -0.0570606  0.0173151  -3.295             0.000989 ***
## SomeCollege   0.1505241  0.0207411   7.257   0.0000000000004534 ***
## Associate     0.1546604  0.0205537   7.525   0.0000000000000619 ***
## Bachelor      0.4214137  0.0175270  24.044 < 0.0000000000000002 ***
## Master        0.5748312  0.0242603  23.694 < 0.0000000000000002 ***
## Professional  0.8187333  0.0440766  18.575 < 0.0000000000000002 ***
## Doctoral      0.9597258  0.0482778  19.879 < 0.0000000000000002 ***
## AGEP          0.0092656  0.0006307  14.692 < 0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4454 on 5179 degrees of freedom
## Multiple R-squared:  0.2556, Adjusted R-squared:  0.2536
## F-statistic:   127 on 14 and 5179 DF,  p-value: < 0.00000000000000022
```

Interpretation

- Coefficients Explanation
- Holding gender, race, education and age constant, married people makes 1.69% less than people who widowed on average.
- Holding gender, race, education and age constant, married people makes 3.84% more than people who divorced on average.
- Holding gender, race, education and age constant, married people makes 4.28% more than people who separated on average.
- Holding gender, race, education and age constant, married people makes 9.82% more than people who never married on average.
- Holding marriage, race, education and age constant, male makes 12.9% more than female on average.
- Holding marriage, gender, education and age constant, White makes 2.74% more than Black on average.
- Holding marriage, gender, education and age constant, White makes 5.55% more than Other race on average.
- Holding marriage, gender, race and age constant, people have high school education makes 16.24% less than people have some college education on average.
- Holding marriage, gender, race and age constant, people have high school education makes 16.73% less than people have associate education on average.
- Holding marriage, gender, race and age constant, people have high school education makes 52.41% less than people have bachelor's degree on average.

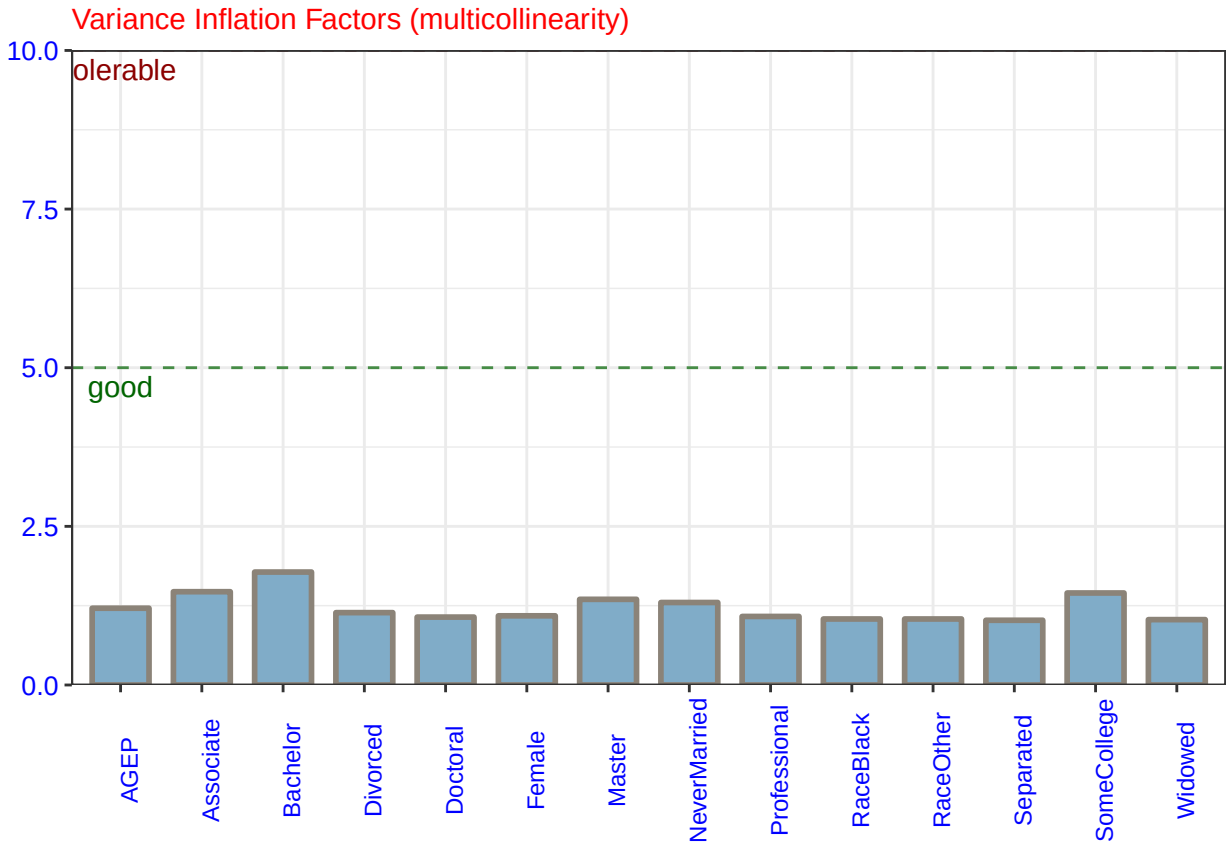
- Holding marriage, gender, race and age constant, people have high school education makes 77.68% less than people have master's degree on average.
- Holding marriage, gender, race and age constant, people have high school education makes 126.76% less than people have Professional education on average.
- Holding marriage, gender, race and age constant, people have high school education makes 161.1% less than people have doctor's degree on average.
- Holding marriage, gender, race and education constant, people make 0.93% more as age increases on average between the age of 18 to 64.

Model Diagnostics



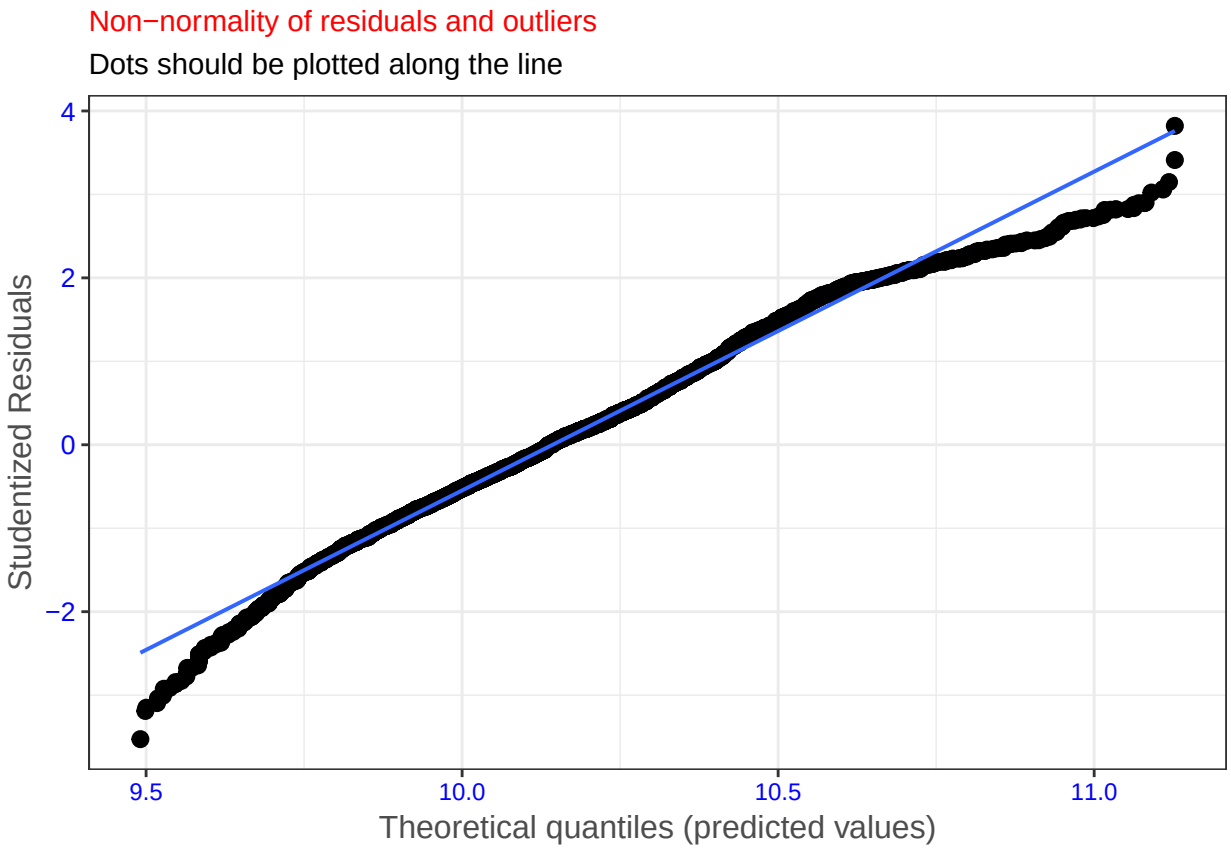
Variables	Tolerance	VIF
Widowed	0.9729050	1.027850
Divorced	0.8808670	1.135245
Separated	0.9756434	1.024965
NeverMarried	0.7702636	1.298257
Female	0.9159123	1.091808
RaceBlack	0.9633247	1.038072
RaceOther	0.9650376	1.036229
SomeCollege	0.6878124	1.453885
Associate	0.6814727	1.467410
Bachelor	0.5604312	1.784341
Master	0.7394234	1.352405
Professional	0.9238792	1.082393
Doctoral	0.9320203	1.072938
AGEP	0.8267426	1.209566

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



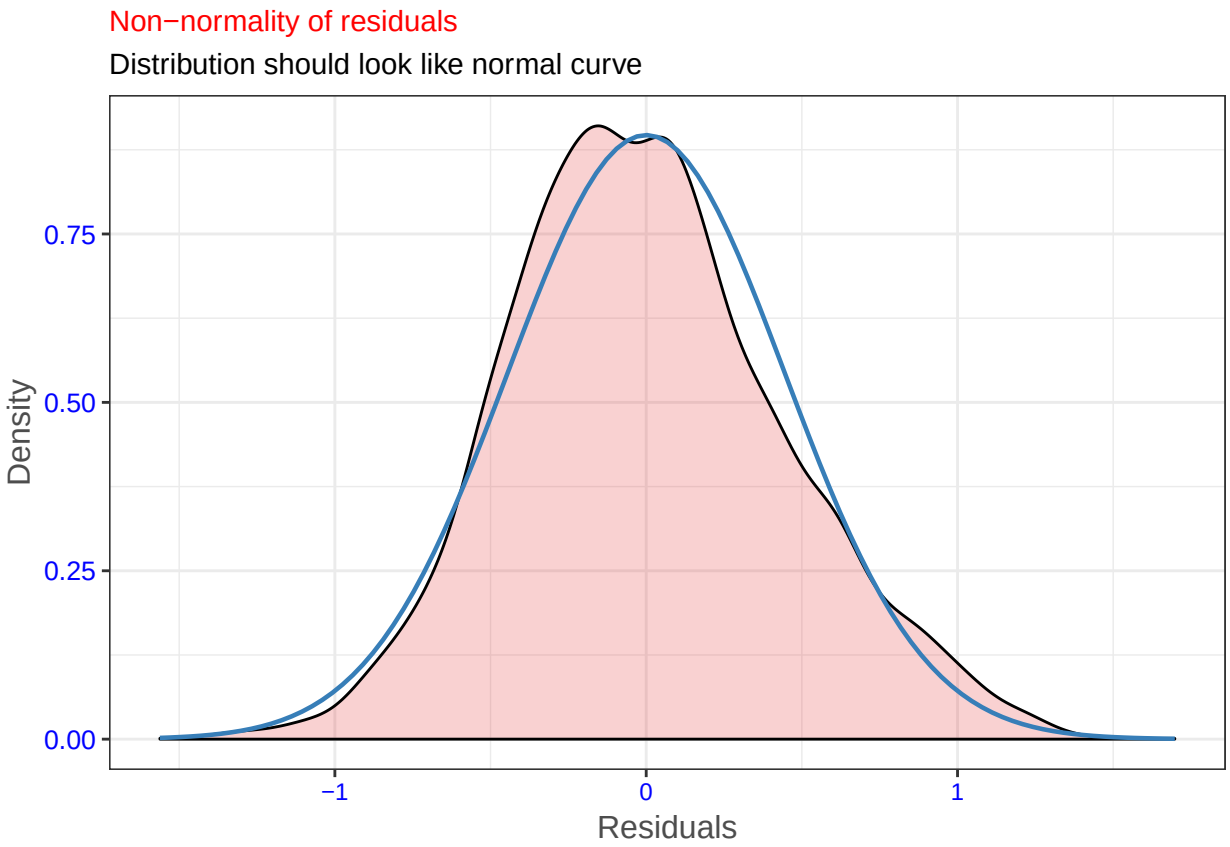
A VIF chart shows that there is no correlation among the kth predictor and the remaining predictor variables.

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



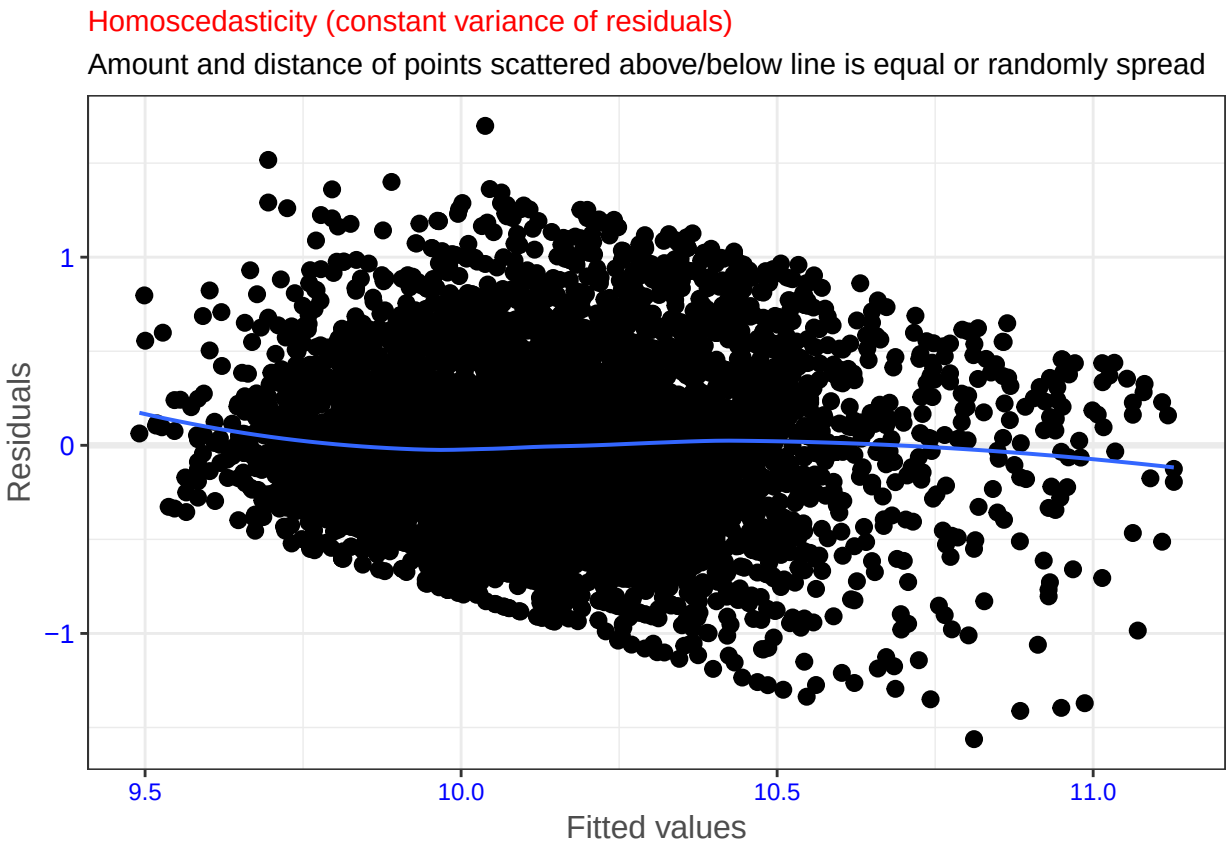
The plot shows that the distribution of the residuals are approximately normally distributed. The "thin tails" correspond to the first quantiles occurring at less than expected values and the last quantiles occurring at larger than expected values.

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



The plot shows that the distribution of the residuals are approximately normally distributed.

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



The plot shows heteroscedasticity as the variance of the residuals are not constant.