Chapter 7

Thalles Quinaglia Liduares

2022-07-18

Exercise 7.8

Upload packages

```
library(wooldridge)
library(lmreg)
```

Upload database

```
data<-wooldridge::loanapp

attach(data)
```

Use the data in LOANAPP.RAW for this exercise. The binary variable to be explained is approve, which is equal to one if a mortgage loan to an individual was approved. The key explanatory variable is white, a dummy variable equal to one if the applicant was white. The other applicants in the data set are black and Hispanic.To test for discrimination in the mortgage loan market, a linear probability model can be used:

$$approve = \beta_0 + \beta_1 white + u$$

(i) If there is discrimination against minorities, and the appropriate factors have been controlled for, what is the sign of β_1?

In this case, we expect a positive sign for β_1

(ii) Regress approve on white and report the results in the usual form. Interpret the coefficient on white. Is it statistically significant? Is it practically large?

```
summary(lm(approve~white))
```

```
##
## Call:
## lm(formula = approve ~ white)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.90839  0.09161  0.09161  0.09161  0.29221
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.70779    0.01824   38.81   <2e-16 ***
## white        0.20060    0.01984   10.11   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3201 on 1987 degrees of freedom
## Multiple R-squared:  0.04893,    Adjusted R-squared:  0.04845
## F-statistic: 102.2 on 1 and 1987 DF,  p-value: < 2.2e-16
```

The estimated equation is given by

$$\widehat{approve} = 0.7 + 0.2white$$

Hence, white people have 20% more chances of being approved in a loan request.

(iii) As controls, add the variables hrat, obrat, loanprc, unem, male, married, dep, sch, cosign, chist, pubrec, mortlat1, mortlat2, and vr. What happens to the coefficient on white? Is there still evidence of discrimination against nonwhites?

```
summary(lm(approve~hrat+obrat+loanprc+unem+male+married+dep+sch+cosign+chist+
             pubrec+mortlat1+mortlat2+vr+white))
```

```
##
## Call:
## lm(formula = approve ~ hrat + obrat + loanprc + unem + male +
##     married + dep + sch + cosign + chist + pubrec + mortlat1 +
##     mortlat2 + vr + white)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.06482  0.00781  0.06387  0.13673  0.71105
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.936731   0.052735  17.763  < 2e-16 ***
## hrat         0.001833   0.001263   1.451   0.1469
## obrat       -0.005432   0.001102  -4.930 8.92e-07 ***
## loanprc     -0.147300   0.037516  -3.926 8.92e-05 ***
## unem        -0.007299   0.003198  -2.282   0.0226 *
## male        -0.004144   0.018864  -0.220   0.8261
## married      0.045824   0.016308   2.810   0.0050 **
## dep         -0.006827   0.006701  -1.019   0.3084
## sch          0.001753   0.016650   0.105   0.9162
## cosign       0.009772   0.041139   0.238   0.8123
## chist        0.133027   0.019263   6.906 6.72e-12 ***
## pubrec      -0.241927   0.028227  -8.571  < 2e-16 ***
## mortlat1    -0.057251   0.050012  -1.145   0.2525
## mortlat2    -0.113723   0.066984  -1.698   0.0897 .
## vr          -0.031441   0.014031  -2.241   0.0252 *
## white        0.128820   0.019732   6.529 8.44e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3021 on 1955 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1656, Adjusted R-squared:  0.1592
## F-statistic: 25.86 on 15 and 1955 DF,  p-value: < 2.2e-16
```

In this case, the coefficient of `white` reduces to 0.12 and still significant at the 1% level.

(iv) Now, allow the effect of race to interact with the variable measuring other obligations as a percentage of income (obrat). Is the interaction term significant?

```
lm4<- lm(approve~hrat+obrat+loanprc+unem+male+married+dep+sch+cosign+chist+
             pubrec+mortlat1+mortlat2+vr+white+white*obrat)
summary(lm4)
```

```
##
## Call:
## lm(formula = approve ~ hrat + obrat + loanprc + unem + male +
##     married + dep + sch + cosign + chist + pubrec + mortlat1 +
##     mortlat2 + vr + white + white * obrat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.05523  0.01253  0.06320  0.12692  0.83284
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.180648   0.086808  13.601  < 2e-16 ***
## hrat         0.001790   0.001260   1.421 0.155521
## obrat       -0.012226   0.002216  -5.518 3.88e-08 ***
## loanprc     -0.152536   0.037436  -4.075 4.79e-05 ***
## unem        -0.007528   0.003189  -2.360 0.018352 *
## male        -0.006015   0.018817  -0.320 0.749241
## married      0.045536   0.016260   2.800 0.005154 **
## dep         -0.007630   0.006686  -1.141 0.253905
## sch          0.001777   0.016601   0.107 0.914787
## cosign       0.017709   0.041081   0.431 0.666458
## chist        0.129855   0.019227   6.754 1.90e-11 ***
## pubrec      -0.240325   0.028149  -8.538  < 2e-16 ***
## mortlat1    -0.062782   0.049891  -1.258 0.208400
## mortlat2    -0.126845   0.066891  -1.896 0.058071 .
## vr          -0.030540   0.013993  -2.183 0.029188 *
## white       -0.145975   0.080263  -1.819 0.069109 .
## obrat:white  0.008088   0.002290   3.531 0.000423 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3012 on 1954 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1709, Adjusted R-squared:  0.1641
## F-statistic: 25.17 on 16 and 1954 DF,  p-value: < 2.2e-16
```

Yes, the coefficient associated to interaction term is positive and significant at the 1% level.

(v) Using the model from part (iv), what is the effect of being white on the probability of approval when obrat = 32, which is roughly the mean value in the sample? Obtain a 95% confidence interval for this effect.

$$\widehat{approve} = -0.14 \cdot (1) + 0.008 \cdot (32) \approx 0.11$$

```
confint(lm4,level = 0.95)
```

```
##                     2.5 %       97.5 %
## (Intercept)  1.0104031912  1.350893738
## hrat        -0.0006805882  0.004259899
## obrat       -0.0165712619 -0.007881157
## loanprc     -0.2259537291 -0.079117468
## unem        -0.0137828695 -0.001273277
## male        -0.0429184285  0.030887544
## married      0.0136464989  0.077425128
## dep         -0.0207417050  0.005481720
## sch         -0.0307811967  0.034334383
## cosign      -0.0628575594  0.098275725
## chist        0.0921463636  0.167563211
## pubrec      -0.2955295628 -0.185120522
## mortlat1    -0.1606262045  0.035062377
## mortlat2    -0.2580305988  0.004341430
## vr          -0.0579816262 -0.003097495
## white       -0.3033851227  0.011434944
## obrat:white  0.0035962719  0.012579558
```

The 95% confidence interval is equal to [0.003,0.012].