Lending Mortage Analysis

Exploratory Data Analysis

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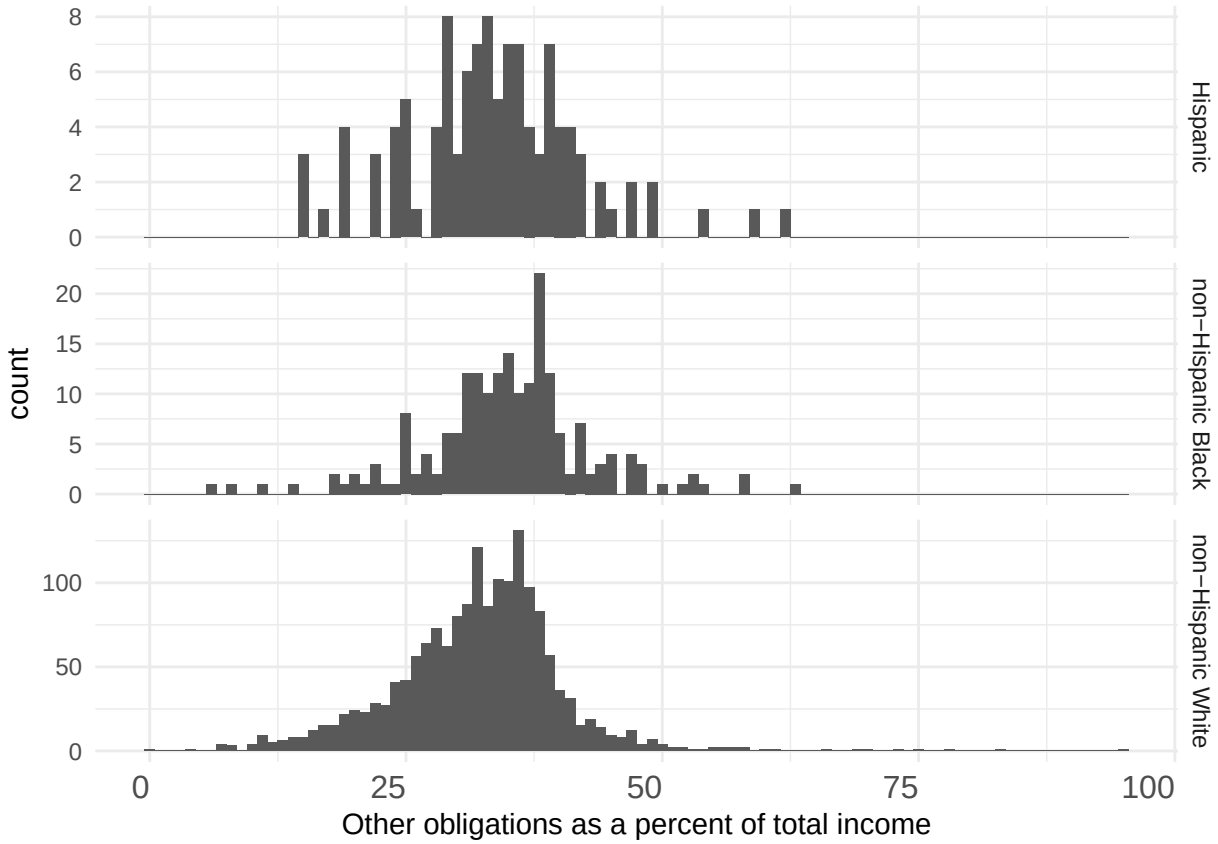
The data set contains 1989 records. The overall descriptive statistics:

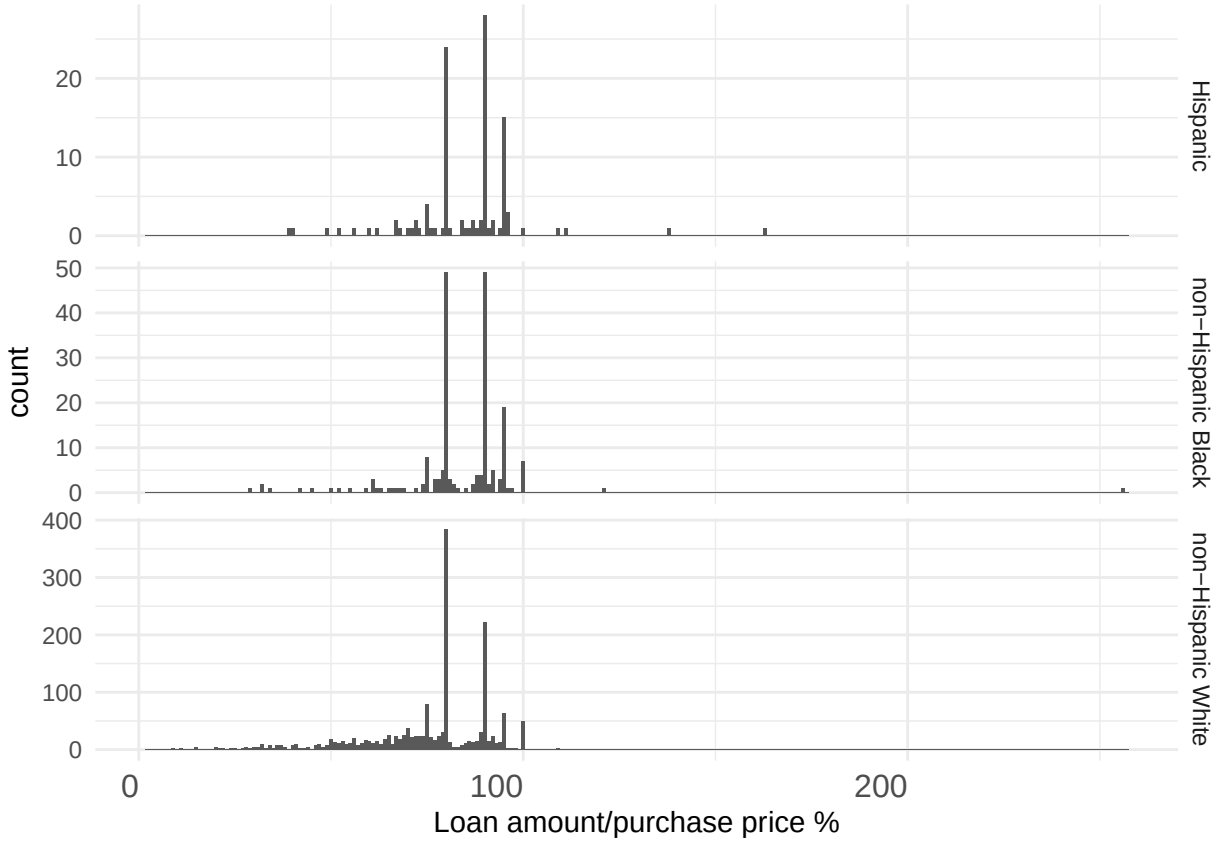
```
##     Married     Meet credit history guidelines
##  No     : 678   0  : 171
##  Unknown:   3   1  :1816
##  Yes    :1308   666:   2
##
##
##
##  Other obligations as a percent of total income non-Hispanic Black
##  Min.   : 0.00                                  No :1792
##  1st Qu.:28.00                                  Yes: 197
##  Median :33.00
##  Mean   :32.39
##  3rd Qu.:37.00
##  Max.   :95.00
##  Hispanic        Male      Mortgage loan approved
##  No :1878   No     : 369   No : 244
##  Yes: 111   Unknown:  15   Yes:1745
##             Yes    :1605
##
##
##
##  Loan amount/purchase price                Race
##  Min.   :  2.105            Hispanic          : 111
##  1st Qu.: 70.000            non-Hispanic Black: 197
##  Median : 80.000            non-Hispanic White:1681
##  Mean   : 77.064
##  3rd Qu.: 89.894
##  Max.   :257.143
```

Descriptive statistics by Race:

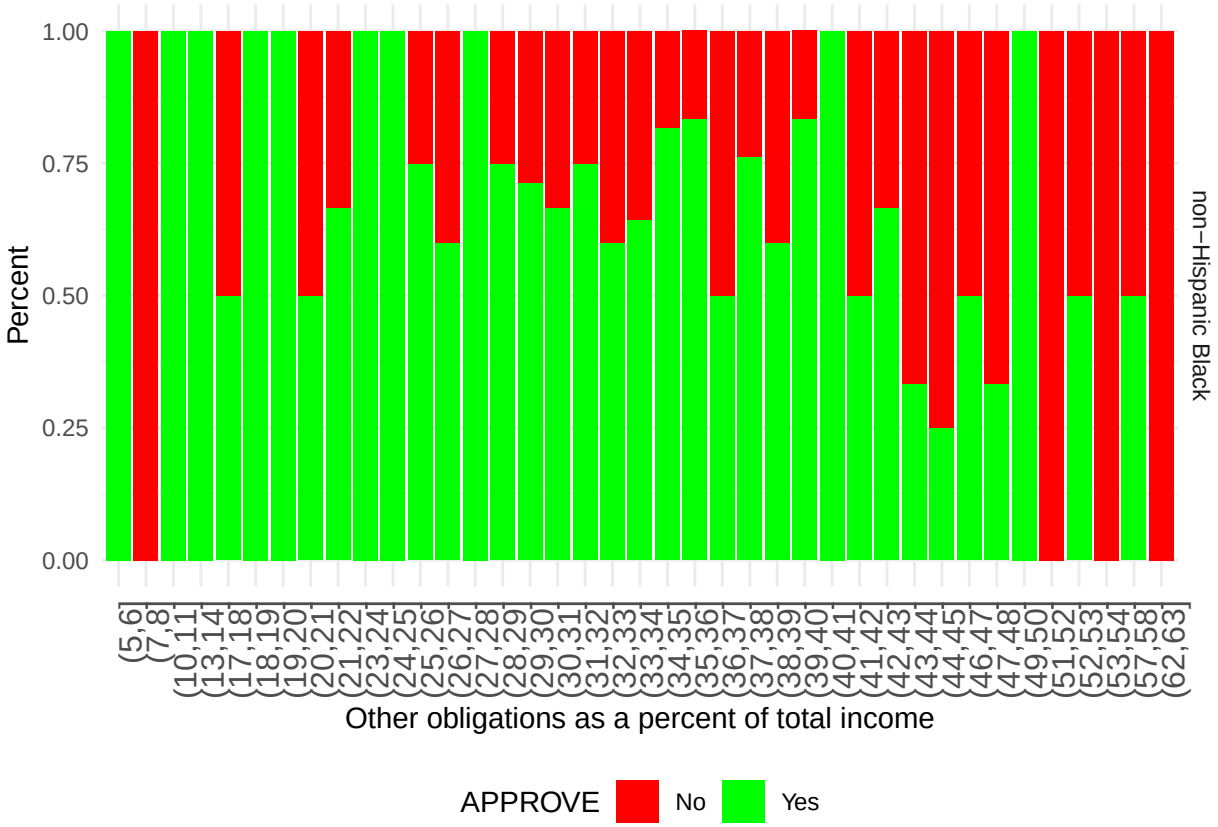
```
## $Hispanic
##     MARRIED   GDLIN        OBRAT            MALE    APPROVE
##  No     :31   0  :16   Min.   :14.60   No     :22   No :26
##  Unknown: 1   1  :95   1st Qu.:29.00   Unknown: 2   Yes:85
##  Yes    :79   666: 0   Median :33.00   Yes    :87
##                        Mean   :33.46
##                        3rd Qu.:38.45
##                        Max.   :62.00
##     LOANPRC                       RACE
##  Min.   : 39.39   Hispanic          :111
##  1st Qu.: 80.00   non-Hispanic Black:  0
##  Median : 89.39   non-Hispanic White:  0
##  Mean   : 85.17
##  3rd Qu.: 90.42
##  Max.   :162.63
```

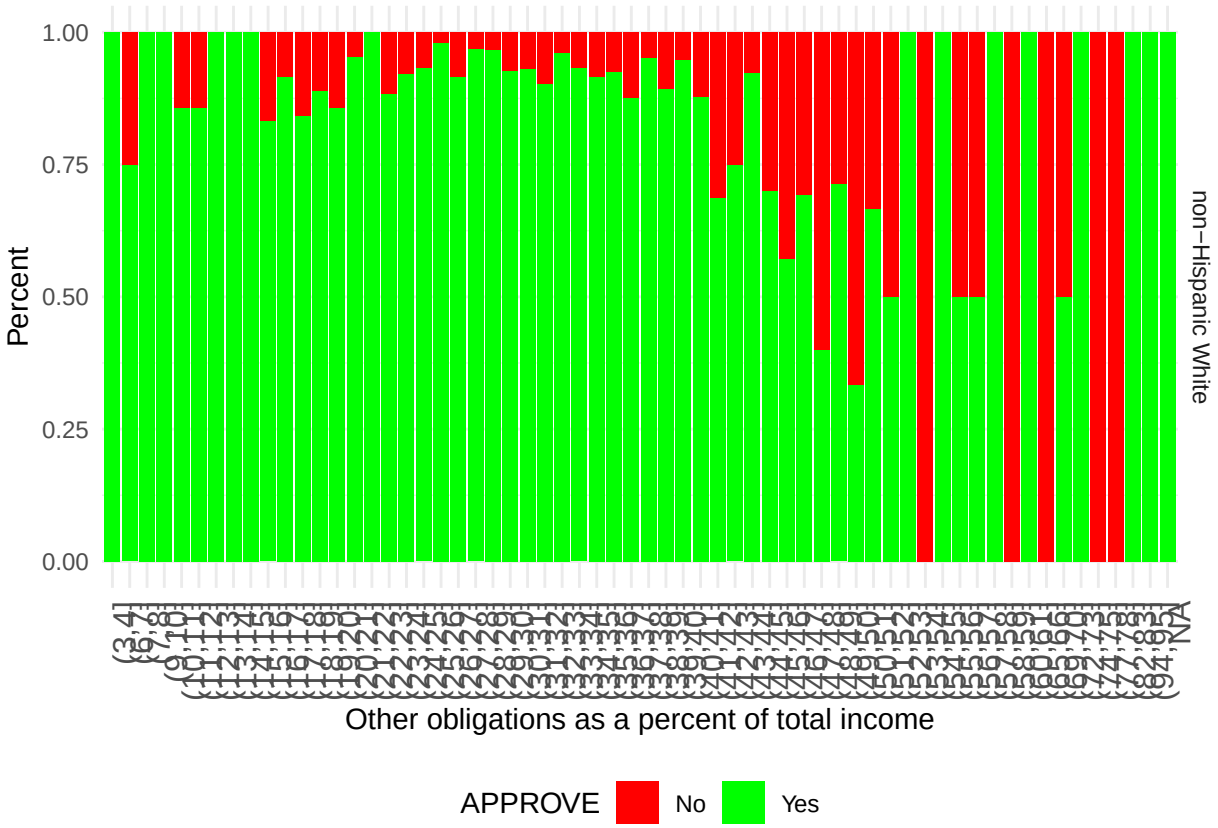
```
##
## $`non-Hispanic Black`
##     MARRIED    GDLIN         OBRAT            MALE     APPROVE
##  No     : 76   0  : 53   Min.   : 5.60   No     : 51   No : 64
##  Unknown:  0   1  :144   1st Qu.:31.00   Unknown:  2   Yes:133
##  Yes    :121   666:  0   Median :35.00   Yes    :144
##                          Mean   :34.94
##                          3rd Qu.:38.90
##                          Max.   :63.00
##     LOANPRC                      RACE
##  Min.   : 28.99   Hispanic          :  0
##  1st Qu.: 80.00   non-Hispanic Black:197
##  Median : 87.02   non-Hispanic White:  0
##  Mean   : 83.97
##  3rd Qu.: 90.24
##  Max.   :255.52
##
## $`non-Hispanic White`
##     MARRIED     GDLIN          OBRAT            MALE      APPROVE
##  No     : 571   0  : 102   Min.   : 0.00   No     : 296   No : 154
##  Unknown:   2   1  :1577   1st Qu.:27.60   Unknown:  11   Yes:1527
##  Yes    :1108   666:   2   Median :32.50   Yes    :1374
##                             Mean   :32.02
##                             3rd Qu.:36.50
##                             Max.   :95.00
##     LOANPRC                       RACE
##  Min.   :  2.105   Hispanic          :   0
##  1st Qu.: 68.182   non-Hispanic Black:   0
##  Median : 79.888   non-Hispanic White:1681
##  Mean   : 75.719
##  3rd Qu.: 89.623
##  Max.   :257.143
```

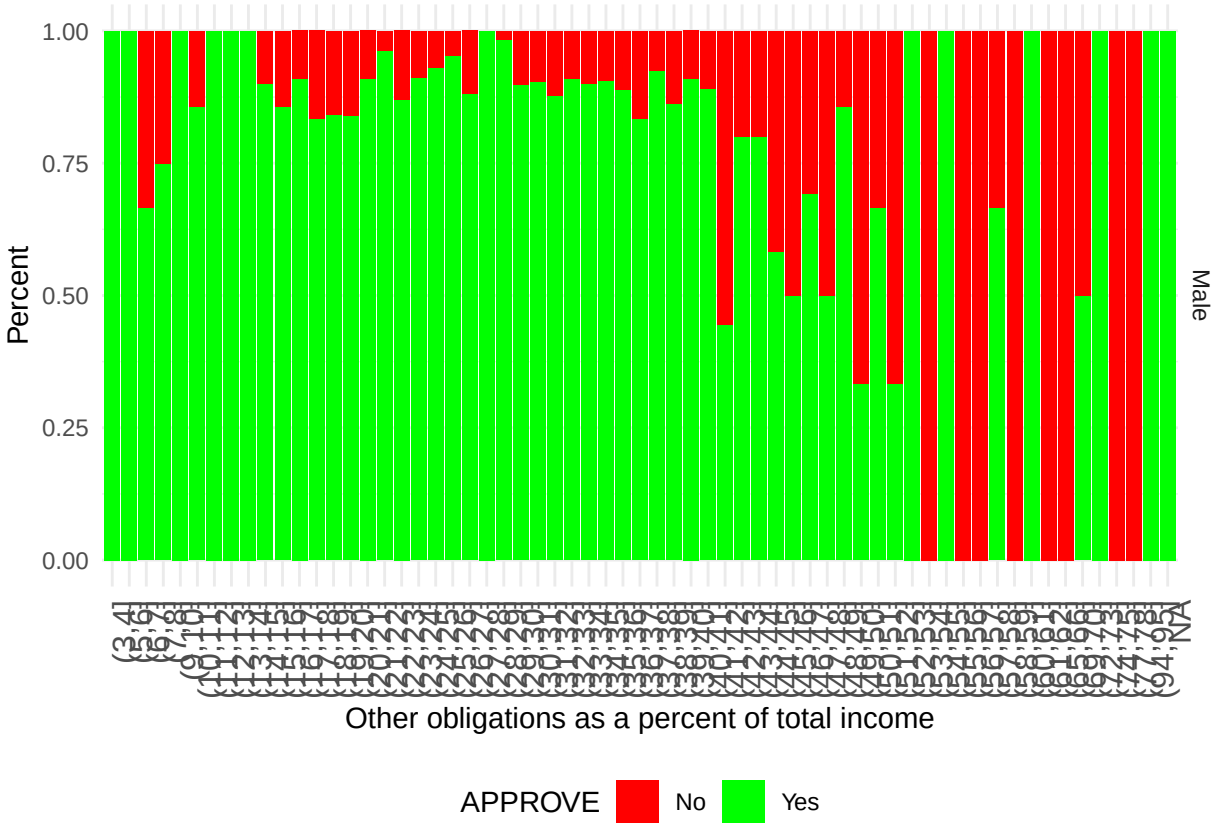

Hispanic
non−Hispanic Black
non−Hispanic White
count
0
2
4
6
8
0
5
10
15
20
0
50
100
0
25
50
75
100
Other obligations as a percent of total income

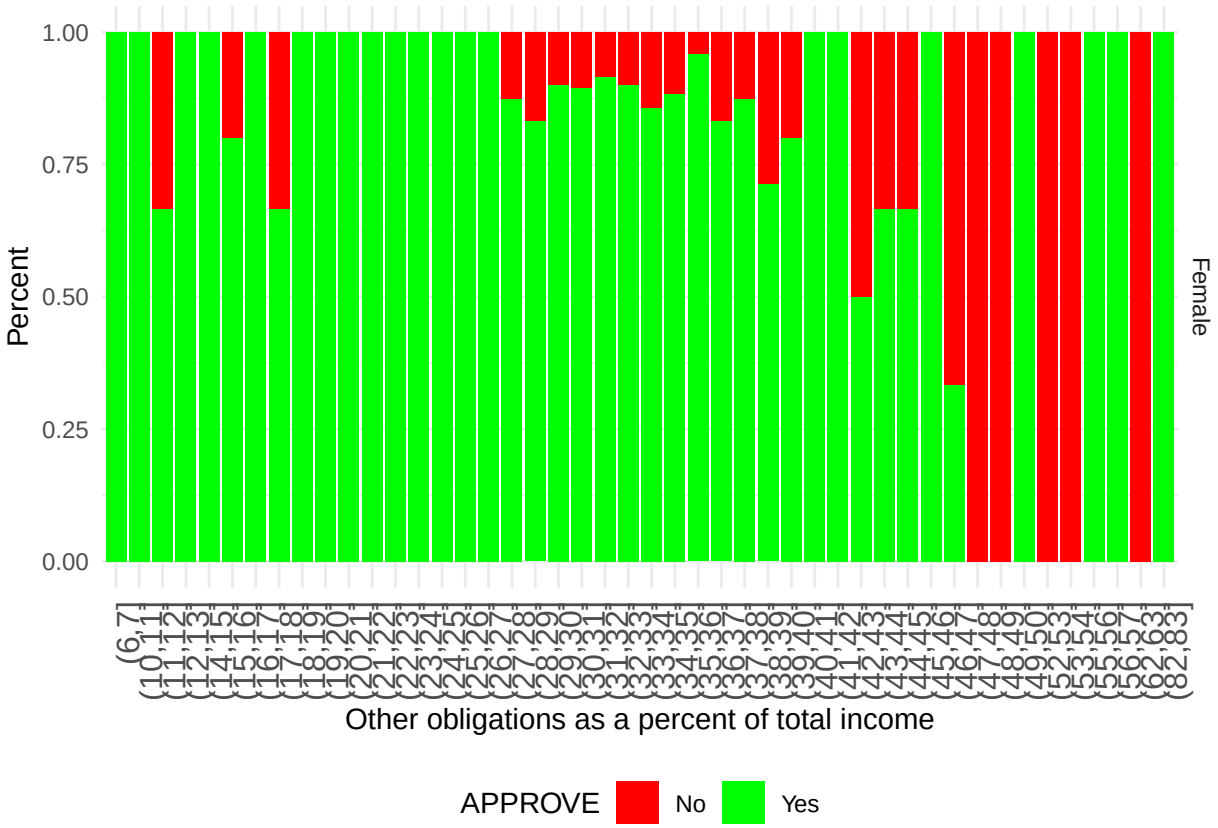

Hispanic
non−Hispanic Black
non−Hispanic White
count
0
10
20
0
10
20
30
40
50
0
100
200
300
400
0
100
200
Loan amount/purchase price %

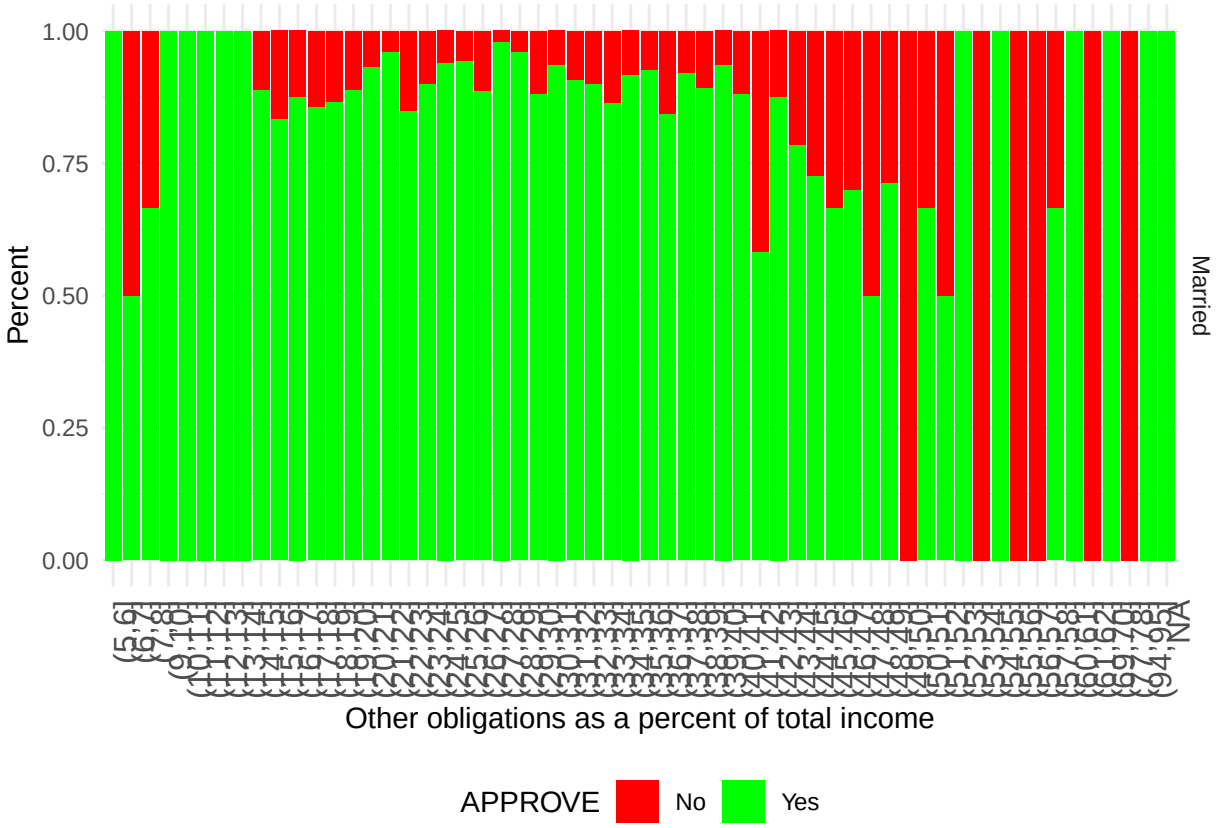

1.00
0.75
0.50
0.25
0.00
Percent
Hispanic
(14,15]
(16,17]
(18,19]
(21,22]
(23,24]
(24,25]
(26,27]
(27,28]
(28,29]
(29,30]
(30,31]
(31,32]
(32,33]
(33,34]
(34,35]
(35,36]
(36,37]
(37,38]
(38,39]
(39,40]
(40,41]
(41,42]
(42,43]
(43,44]
(44,45]
(46,47]
(48,49]
(53,54]
(58,59]
(61,62]
Other obligations as a percent of total income
APPROVE
No
Yes


1.00
0.75
0.50
0.25
0.00
Percent
non−Hispanic Black
(5,6]
(7,8]
(10,11]
(13,14]
(17,18]
(18,19]
(19,20]
(20,21]
(21,22]
(23,24]
(24,25]
(25,26]
(26,27]
(27,28]
(28,29]
(29,30]
(30,31]
(31,32]
(32,33]
(33,34]
(34,35]
(35,36]
(36,37]
(37,38]
(38,39]
(39,40]
(40,41]
(41,42]
(42,43]
(43,44]
(44,45]
(46,47]
(47,48]
(49,50]
(51,52]
(52,53]
(53,54]
(57,58]
(62,63]
Other obligations as a percent of total income
APPROVE
No
Yes

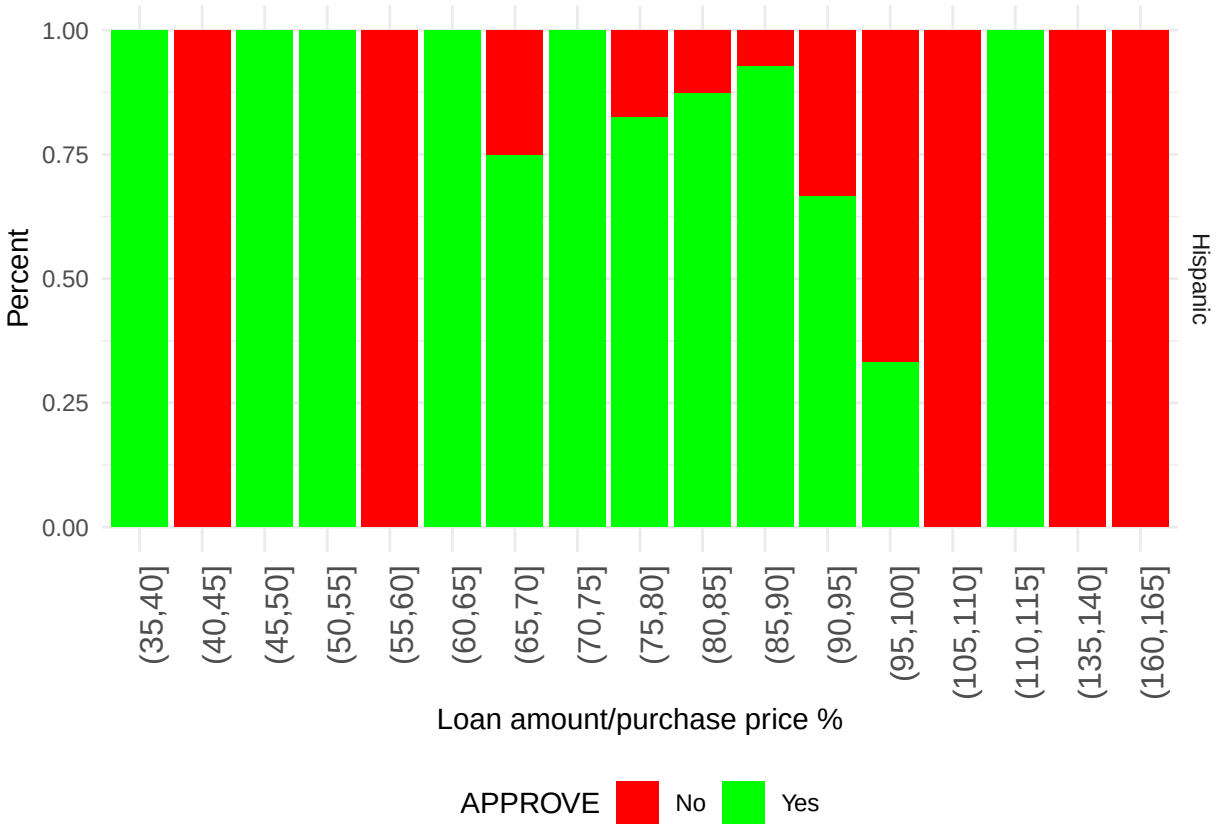

1.00
0.75
0.50
0.25
0.00
Percent
non−Hispanic White
Other obligations as a percent of total income
APPROVE
No
Yes

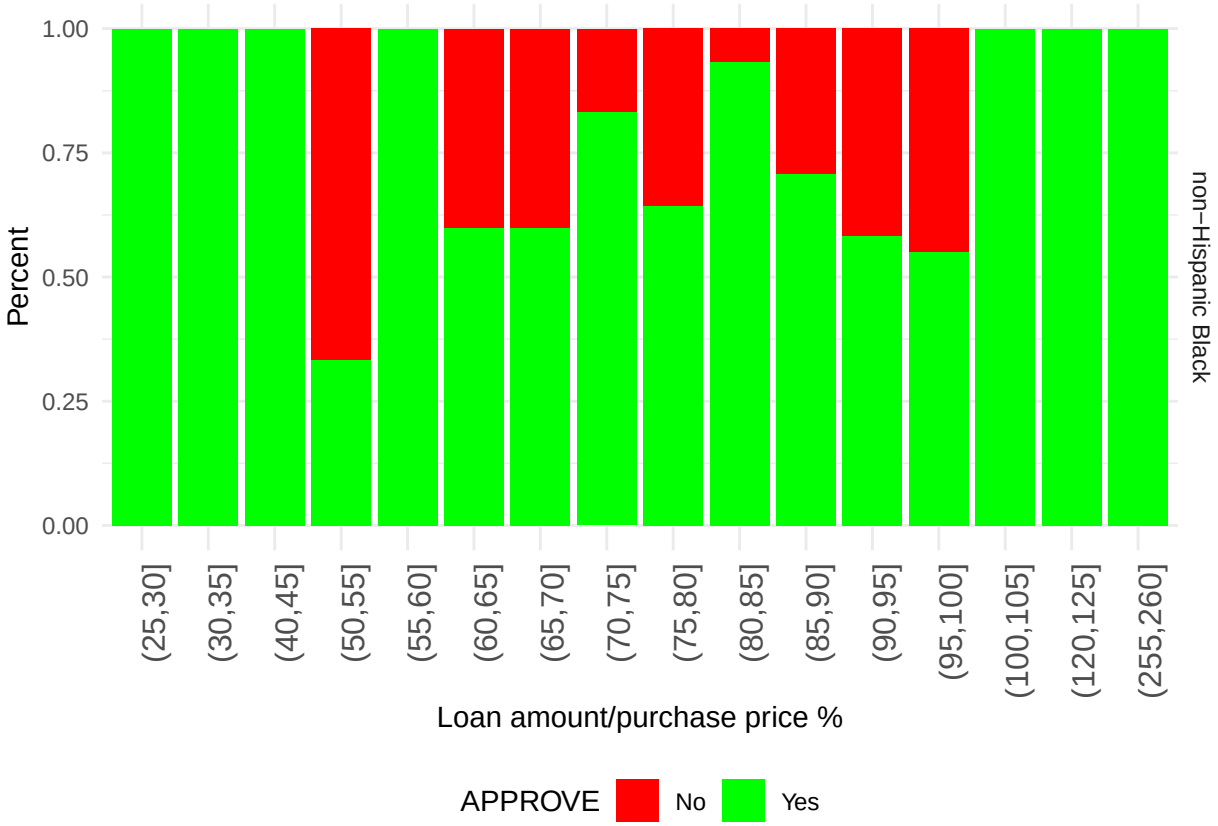

1.00
0.75
0.50
0.25
0.00
Percent
Male
Other obligations as a percent of total income
APPROVE
No
Yes

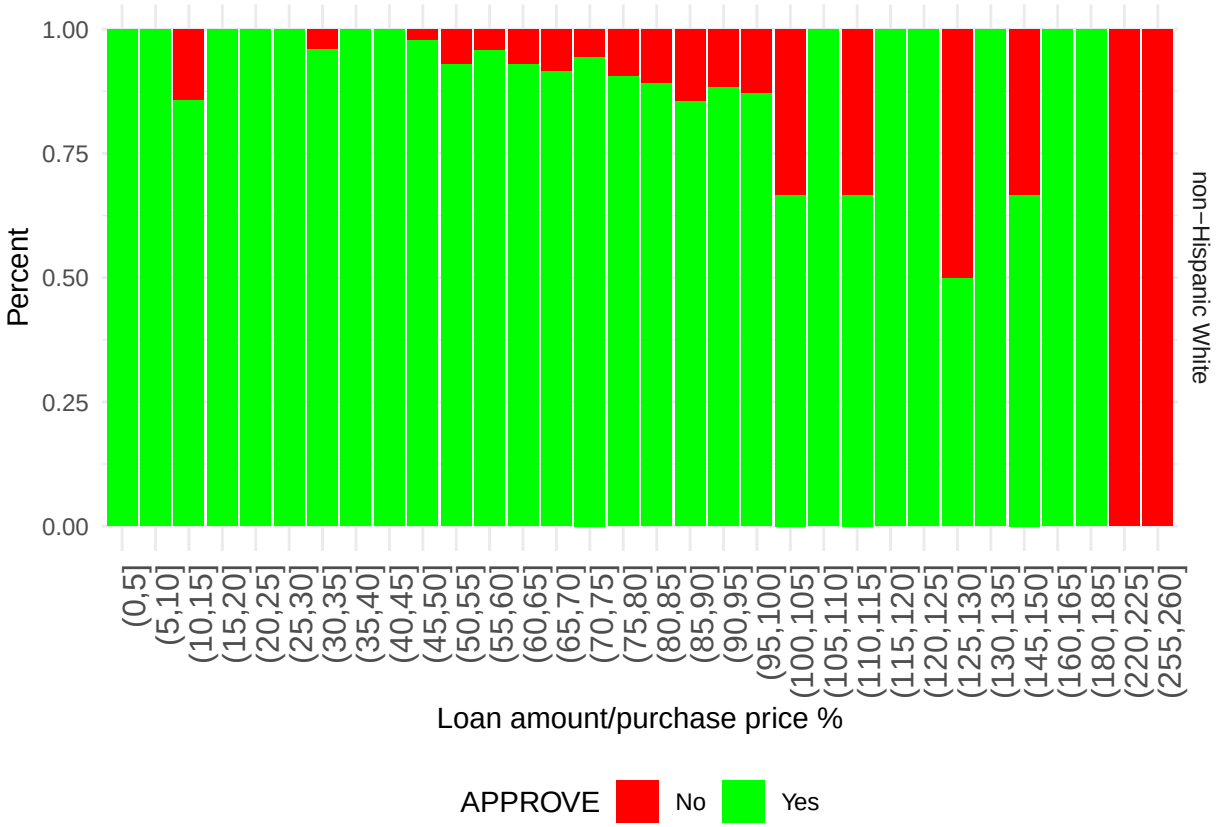

1.00
0.75
0.50
0.25
0.00
Percent
Female
Other obligations as a percent of total income
APPROVE
No
Yes

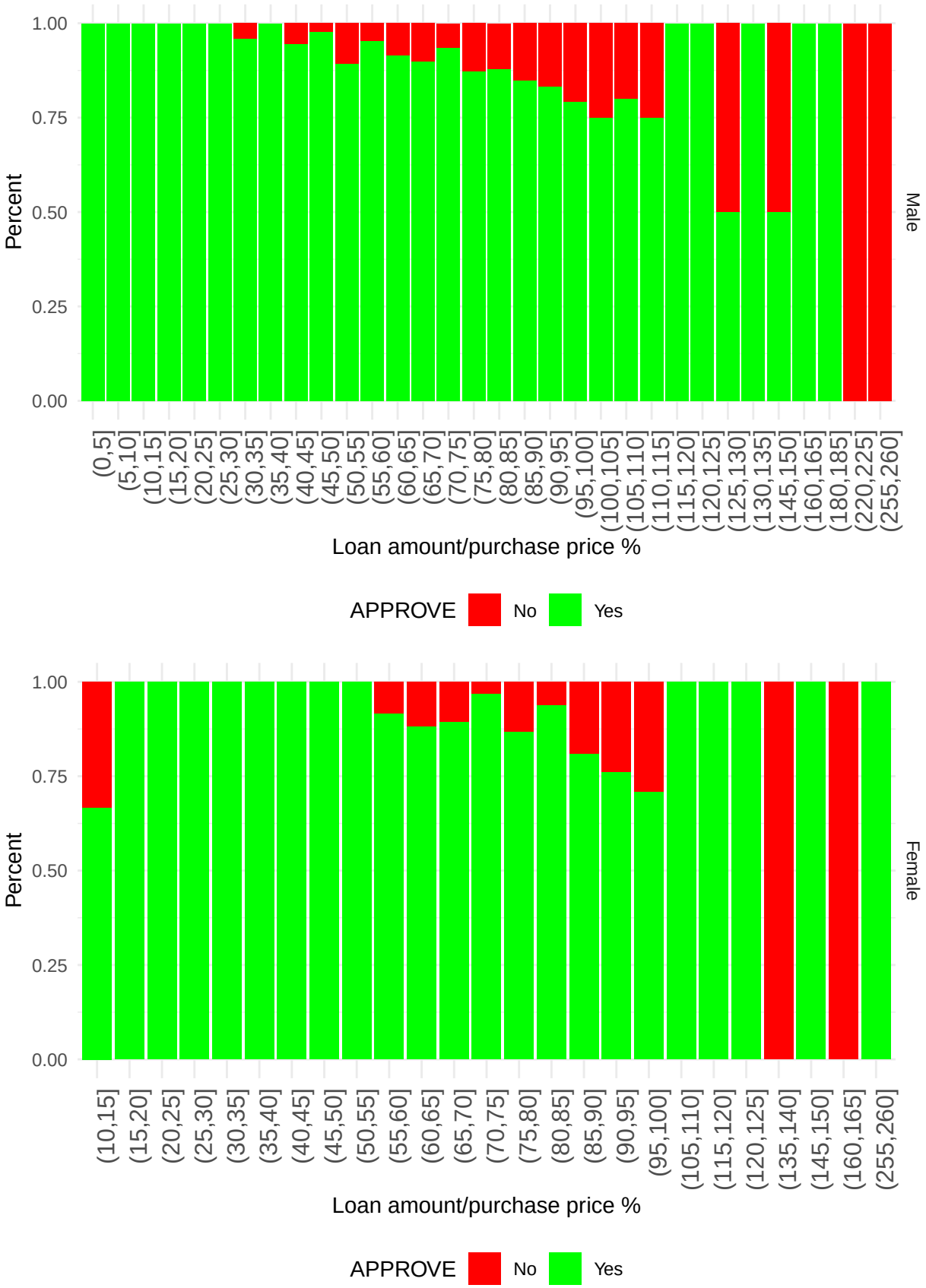

1.00
0.75
0.50
0.25
0.00
Percent
Married
Other obligations as a percent of total income
APPROVE
No
Yes

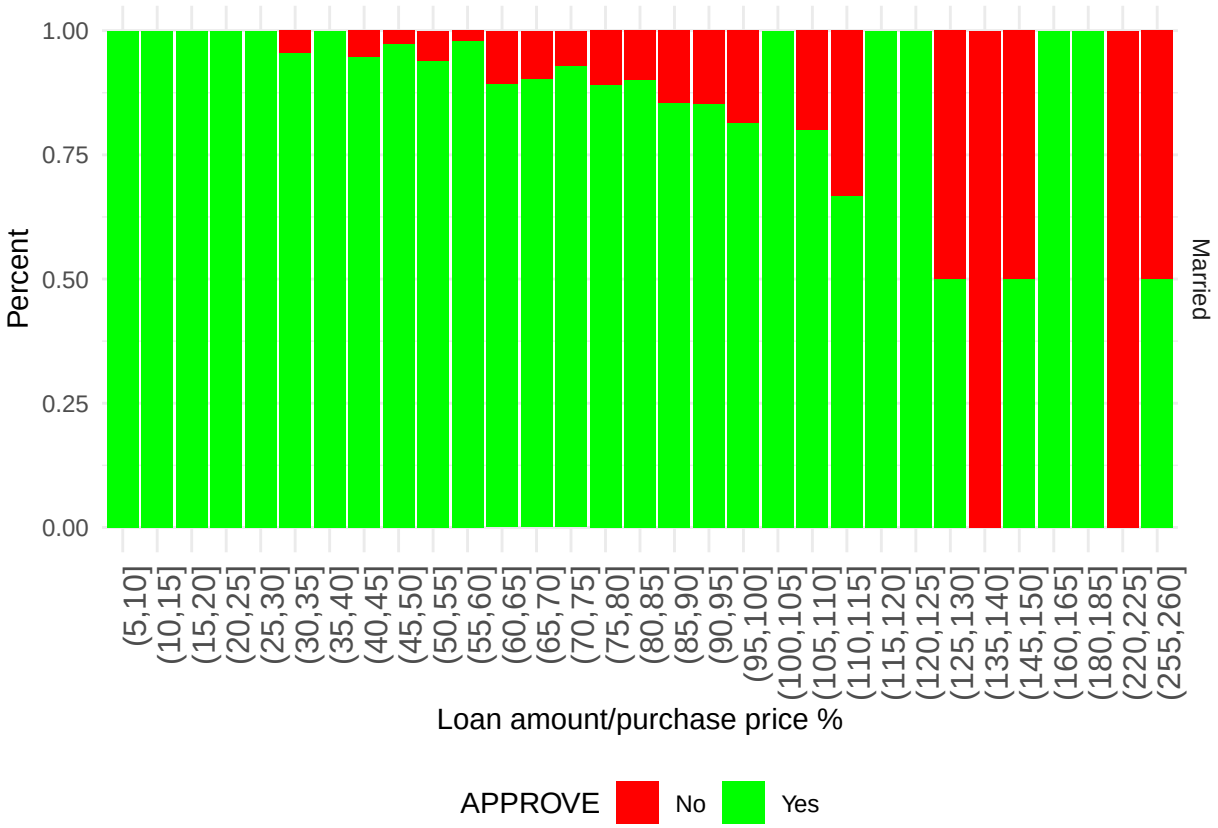

1.00
0.75
0.50
0.25
0.00
Percent
Not Married
(3,4]
(6,7]
(7,8]
(9,10]
(10,11]
(11,12]
(12,13]
(14,15]
(15,16]
(16,17]
(17,18]
(18,19]
(19,20]
(20,21]
(21,22]
(22,23]
(23,24]
(24,25]
(25,26]
(26,27]
(27,28]
(28,29]
(29,30]
(30,31]
(31,32]
(32,33]
(33,34]
(34,35]
(35,36]
(36,37]
(37,38]
(38,39]
(39,40]
(40,41]
(41,42]
(42,43]
(43,44]
(44,45]
(45,46]
(46,47]
(47,48]
(48,49]
(49,50]
(51,52]
(52,53]
(53,54]
(55,56]
(56,57]
(58,59]
(59,60]
(60,61]
(61,62]
(62,63]
(63,64]
(64,65]
(65,66]
(66,67]
(67,68]
(68,69]
(69,70]
(70,71]
(71,72]
(72,73]
(74,75]
(82,83]
Other obligations as a percent of total income
APPROVE
No
Yes

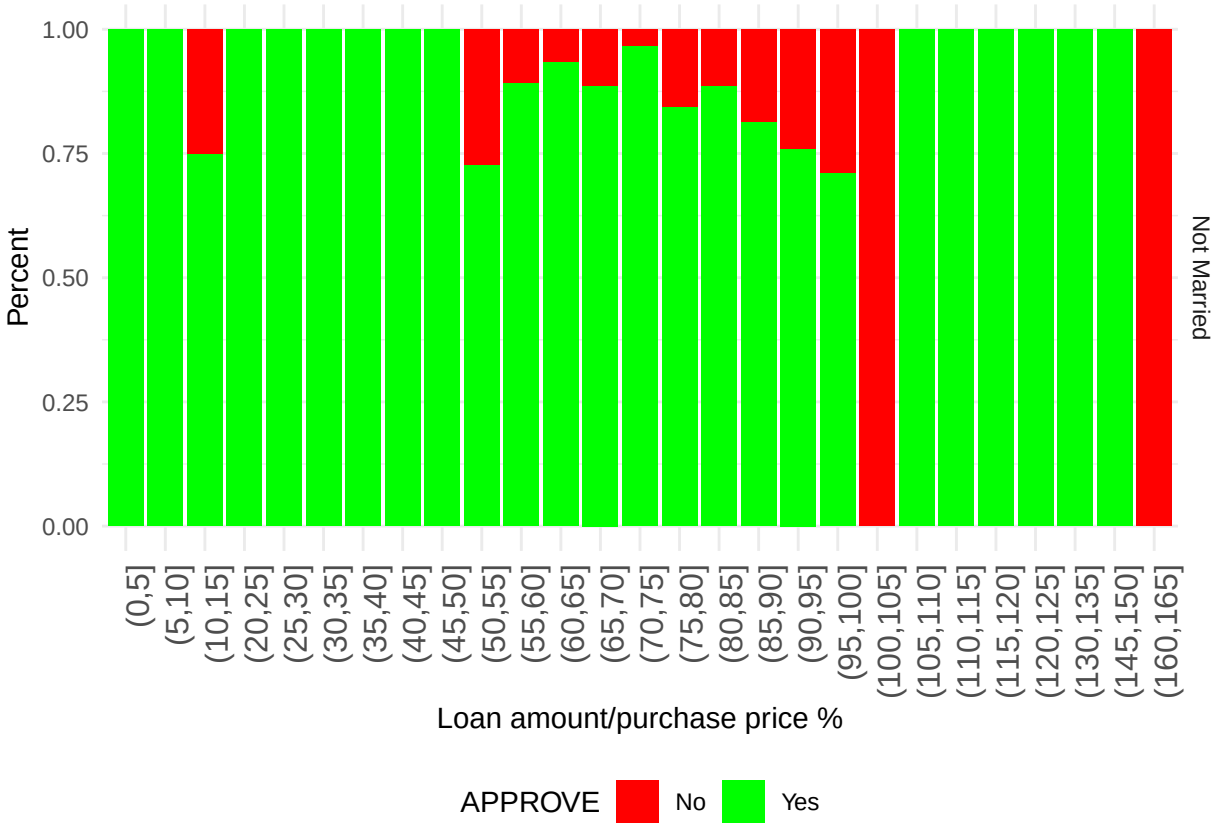

1.00
0.75
0.50
0.25
0.00
Percent
Hispanic
(35,40]
(40,45]
(45,50]
(50,55]
(55,60]
(60,65]
(65,70]
(70,75]
(75,80]
(80,85]
(85,90]
(90,95]
(95,100]
(105,110]
(110,115]
(135,140]
(160,165]
Loan amount/purchase price %
APPROVE
No
Yes


1.00
0.75
0.50
0.25
0.00
Percent
non−Hispanic Black
(25,30]
(30,35]
(40,45]
(50,55]
(55,60]
(60,65]
(65,70]
(70,75]
(75,80]
(80,85]
(85,90]
(90,95]
(95,100]
(100,105]
(120,125]
(255,260]
Loan amount/purchase price %
APPROVE
No
Yes


1.00
0.75
0.50
0.25
0.00
Percent
non−Hispanic White
(0,5]
(5,10]
(10,15]
(15,20]
(20,25]
(25,30]
(30,35]
(35,40]
(40,45]
(45,50]
(50,55]
(55,60]
(60,65]
(65,70]
(70,75]
(75,80]
(80,85]
(85,90]
(90,95]
(95,100]
(100,105]
(105,110]
(110,115]
(115,120]
(120,125]
(125,130]
(130,135]
(145,150]
(160,165]
(180,185]
(220,225]
(255,260]
Loan amount/purchase price %
APPROVE
No
Yes


1.00
0.75
0.50
0.25
0.00
Percent
Male
(0,5]
(5,10]
(10,15]
(15,20]
(20,25]
(25,30]
(30,35]
(35,40]
(40,45]
(45,50]
(50,55]
(55,60]
(60,65]
(65,70]
(70,75]
(75,80]
(80,85]
(85,90]
(90,95]
(95,100]
(100,105]
(105,110]
(110,115]
(115,120]
(120,125]
(125,130]
(130,135]
(145,150]
(160,165]
(180,185]
(220,225]
(255,260]
Loan amount/purchase price %
APPROVE
No
Yes
1.00
0.75
0.50
0.25
0.00
Percent
Female
(10,15]
(15,20]
(20,25]
(25,30]
(30,35]
(35,40]
(40,45]
(45,50]
(50,55]
(55,60]
(60,65]
(65,70]
(70,75]
(75,80]
(80,85]
(85,90]
(90,95]
(95,100]
(105,110]
(115,120]
(120,125]
(135,140]
(145,150]
(160,165]
(255,260]
Loan amount/purchase price %
APPROVE
No
Yes





Descriptive statistics by Marital Status:

```
## $No
##     MARRIED    GDLIN         OBRAT            MALE     APPROVE
##  No     :678   0  : 64   Min.   : 4.00   No     :252   No :102
##  Unknown:  0   1  :614   1st Qu.:28.00   Unknown:  7   Yes:576
##  Yes    :  0   666:  0   Median :33.00   Yes    :419
##                           Mean   :32.74
##                           3rd Qu.:37.00
##                           Max.   :83.00
##     LOANPRC                        RACE
##  Min.   :  2.105   Hispanic          : 31
##  1st Qu.: 72.426   non-Hispanic Black: 76
##  Median : 80.000   non-Hispanic White:571
##  Mean   : 77.967
##  3rd Qu.: 89.978
##  Max.   :162.626
##
## $Unknown
##     MARRIED  GDLIN       OBRAT           MALE   APPROVE    LOANPRC
##  No     :0   0  :0   Min.   :13.0   No     :1   No :0   Min.   : 86.96
##  Unknown:3   1  :3   1st Qu.:23.3   Unknown:0   Yes:3   1st Qu.: 88.62
##  Yes    :0   666:0   Median :33.6   Yes    :2           Median : 90.29
##                      Mean   :27.2                       Mean   : 98.16
##                      3rd Qu.:34.3                       3rd Qu.:103.76
##                      Max.   :35.0                       Max.   :117.24
##                  RACE
##  Hispanic          :1
##  non-Hispanic Black:0
##  non-Hispanic White:2
##
##
##
##
## $Yes
##     MARRIED     GDLIN          OBRAT            MALE      APPROVE
##  No     :   0   0  : 107   Min.   : 0.00   No     : 116   No : 142
##  Unknown:   0   1  :1199   1st Qu.:28.00   Unknown:   8   Yes:1166
##  Yes    :1308   666:   2   Median :33.00   Yes    :1184
##                             Mean   :32.22
##                             3rd Qu.:37.00
##                             Max.   :95.00
##     LOANPRC                         RACE
##  Min.   :  8.772   Hispanic          :  79
##  1st Qu.: 68.857   non-Hispanic Black: 121
##  Median : 80.000   non-Hispanic White:1108
##  Mean   : 76.547
##  3rd Qu.: 89.866
##  Max.   :257.143
```

Descriptive statistics by Gender:

```
## $No
##     MARRIED    GDLIN         OBRAT            MALE     APPROVE
##  No     :252   0  : 31   Min.   : 6.99   No     :369   No : 50
##  Unknown:  1   1  :338   1st Qu.:28.00   Unknown:  0   Yes:319
##  Yes    :116   666:  0   Median :33.00   Yes    :  0
##                           Mean   :32.64
```

```
##                          3rd Qu.:37.00
##                          Max.   :83.00
##     LOANPRC                       RACE
##  Min.   : 11.01   Hispanic          : 22
##  1st Qu.: 70.83   non-Hispanic Black: 51
##  Median : 80.00   non-Hispanic White:296
##  Mean   : 77.66
##  3rd Qu.: 90.00
##  Max.   :255.52
##
## $Unknown
##     MARRIED  GDLIN        OBRAT            MALE    APPROVE
##  No     :7   0  : 0   Min.   :24.00   No     : 0   No : 0
##  Unknown:0   1  :15   1st Qu.:29.95   Unknown:15   Yes:15
##  Yes    :8   666: 0   Median :34.50   Yes    : 0
##                       Mean   :33.33
##                       3rd Qu.:37.65
##                       Max.   :40.30
##     LOANPRC                      RACE
##  Min.   :39.39   Hispanic          : 2
##  1st Qu.:74.93   non-Hispanic Black: 2
##  Median :75.42   non-Hispanic White:11
##  Mean   :75.59
##  3rd Qu.:80.43
##  Max.   :92.90
##
## $Yes
##     MARRIED     GDLIN          OBRAT            MALE      APPROVE
##  No     : 419   0  : 140   Min.   : 0.00   No     :   0   No : 194
##  Unknown:   2   1  :1463   1st Qu.:28.00   Unknown:   0   Yes:1411
##  Yes    :1184   666:   2   Median :33.00   Yes    :1605
##                             Mean   :32.32
##                             3rd Qu.:37.00
##                             Max.   :95.00
##     LOANPRC                       RACE
##  Min.   :  2.105   Hispanic          :  87
##  1st Qu.: 69.655   non-Hispanic Black: 144
##  Median : 80.000   non-Hispanic White:1374
##  Mean   : 76.942
##  3rd Qu.: 89.881
##  Max.   :257.143
```

There are 3 records are missing married (MARRIED) field.

ID	MARRIED	GDLIN	OBRAT	BLACK	HISPAN	MALE	APPROVE	LOANPRC
356	Unknown	1	35.0	No	Yes	Yes	Yes	86.95652
759	Unknown	1	33.6	No	No	Yes	Yes	90.28571
1392	Unknown	1	13.0	No	No	No	Yes	117.24140

There are 3 records are missing married (GDLIN) field.

ID	MARRIED	GDLIN	OBRAT	BLACK	HISPAN	MALE	APPROVE	LOANPRC
881	Yes	666	35	No	No	Yes	Yes	75.82939
1229	Yes	666	26	No	No	Yes	Yes	100.00000

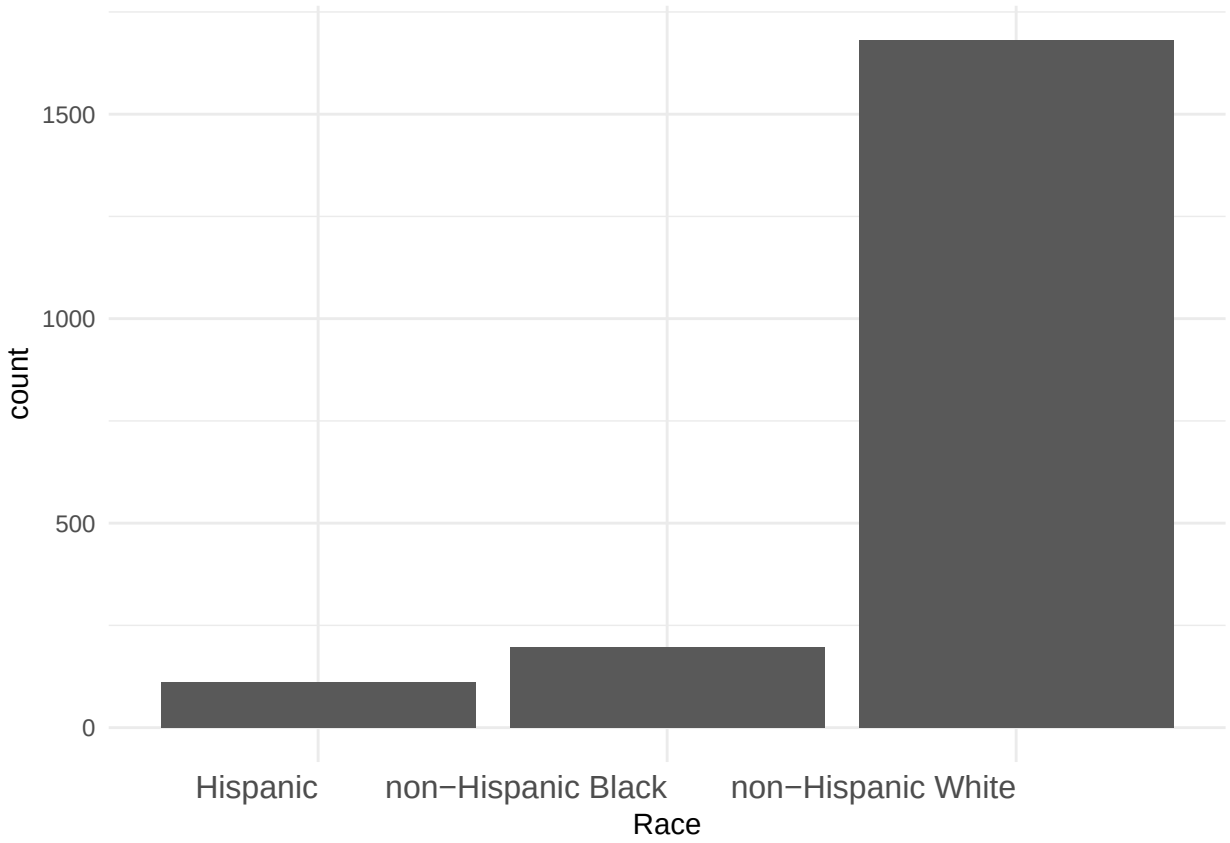
There are 15 records are missing gender (MALE) field.

ID	MARRIED	GDLIN	OBRAT	BLACK	HISPAN	MALE	APPROVE	LOANPRC
1	No	1	34.5	No	No	Unknown	Yes	75.42373
127	No	1	31.6	No	No	Unknown	Yes	80.80000
286	Yes	1	37.3	No	No	Unknown	Yes	80.05337
452	Yes	1	40.1	Yes	No	Unknown	Yes	75.00000
618	Yes	1	38.5	No	No	Unknown	Yes	92.90323
695	Yes	1	25.0	No	No	Unknown	Yes	64.48276
762	Yes	1	27.6	No	No	Unknown	Yes	75.55556
768	No	1	35.6	No	No	Unknown	Yes	64.74397
833	Yes	1	24.0	No	Yes	Unknown	Yes	79.80769
979	No	1	31.7	No	No	Unknown	Yes	74.86033
1040	No	1	38.0	Yes	No	Unknown	Yes	75.38462
1070	Yes	1	40.3	No	Yes	Unknown	Yes	39.39394
1092	Yes	1	29.7	No	No	Unknown	Yes	90.10239
1613	No	1	30.2	No	No	Unknown	Yes	90.00000
1924	No	1	35.8	No	No	Unknown	Yes	75.32051

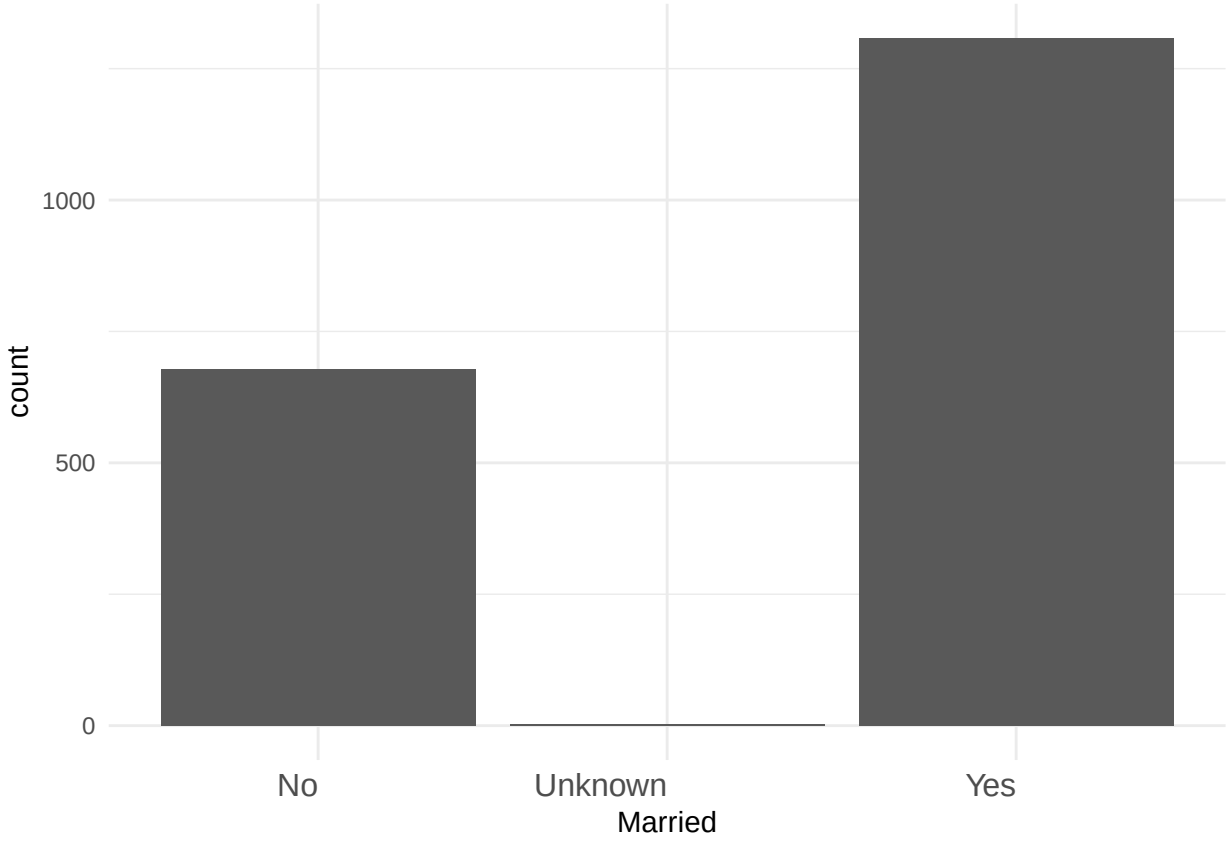
There are 33 records (1.6591252 %) that have LOANPRC > 100%. There are a total of 1989 records.

ID	MARRIED	GDLIN	OBRAT	BLACK	HISPAN	MALE	APPROVE	LOANPRC
9	Yes	1	30.7	No	No	Yes	Yes	100.3009
37	Yes	1	35.0	No	No	Yes	No	112.7119
53	Yes	1	38.0	No	No	Yes	Yes	108.5714
132	Yes	1	27.6	No	No	Yes	Yes	101.1905
162	Yes	1	25.0	No	No	Yes	Yes	164.7059
233	Yes	1	18.0	No	No	Yes	Yes	105.5556
258	Yes	1	45.0	No	No	Yes	No	220.0000
262	Yes	0	56.0	No	No	Yes	No	257.1429
294	Yes	1	37.0	No	No	Yes	Yes	148.8095
490	Yes	1	25.0	Yes	No	Yes	Yes	120.5480
544	Yes	0	52.0	No	No	Yes	Yes	117.6471
560	Yes	1	33.0	No	Yes	No	No	137.9310
565	No	1	10.0	No	No	Yes	Yes	133.3333
750	Yes	1	35.0	No	No	Yes	No	147.8261
793	Yes	1	37.0	No	No	Yes	No	130.0000
798	No	1	36.0	No	No	No	Yes	147.3684
841	No	1	41.2	No	No	Yes	No	100.0676
904	Yes	1	24.0	No	No	Yes	Yes	183.3333
914	Yes	1	40.0	No	Yes	Yes	Yes	111.4286
940	Yes	1	38.0	No	No	Yes	Yes	128.9474
947	Yes	1	18.0	Yes	No	Yes	Yes	100.3521
963	Yes	0	41.3	No	Yes	Yes	No	109.4118
1112	No	0	35.5	No	Yes	No	No	162.6263
1206	No	1	41.0	No	No	No	Yes	125.0000
1322	No	1	32.0	No	No	Yes	Yes	110.5263
1392	Unknown	1	13.0	No	No	No	Yes	117.2414
1394	Yes	1	37.0	No	No	Yes	Yes	114.0845
1457	Yes	1	19.0	No	No	Yes	Yes	108.0000
1623	Yes	1	29.0	No	No	Yes	Yes	109.0909
1632	Yes	1	36.8	Yes	No	No	Yes	255.5248
1667	No	1	43.0	No	No	Yes	Yes	120.0000
1683	No	1	25.0	No	No	No	Yes	118.7500
1759	No	1	46.0	No	No	No	Yes	107.2000

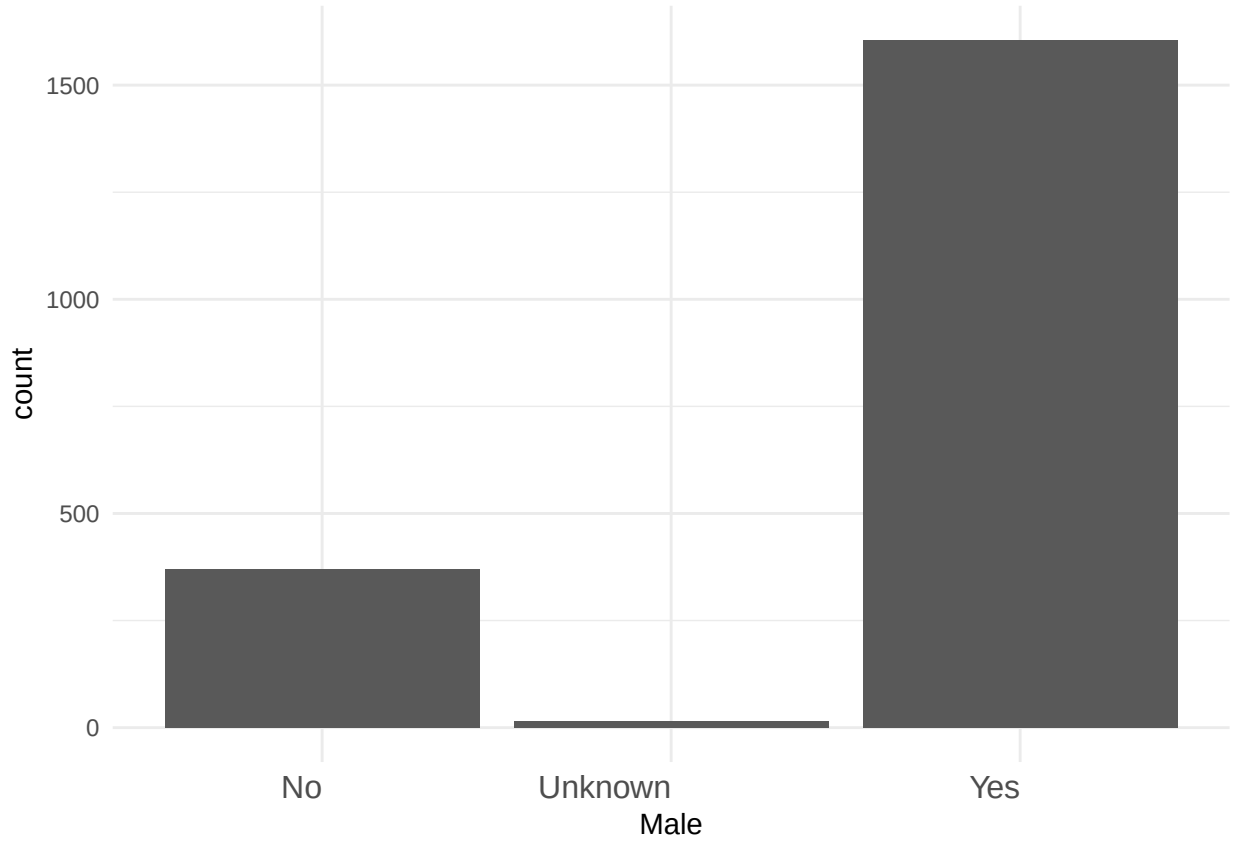
```
## $Hispanic
##     MARRIED   GDLIN        OBRAT            MALE    APPROVE
##  No     :30   0  :14   Min.   :14.60   No     :20   No :23
##  Unknown: 1   1  :93   1st Qu.:29.00   Unknown: 2   Yes:84
##  Yes    :76   666: 0   Median :33.00   Yes    :85
##                        Mean   :33.31
##                        3rd Qu.:38.10
##                        Max.   :62.00
##     LOANPRC                      RACE
##  Min.   : 39.39   Hispanic          :107
##  1st Qu.: 80.00   non-Hispanic Black:  0
##  Median : 88.46   non-Hispanic White:  0
##  Mean   : 83.48
##  3rd Qu.: 90.23
##  Max.   :100.00
##
## $`non-Hispanic Black`
##     MARRIED    GDLIN         OBRAT            MALE     APPROVE
##  No     : 76   0  : 53   Min.   : 5.60   No     : 50   No : 64
##  Unknown:  0   1  :141   1st Qu.:31.00   Unknown:  2   Yes:130
##  Yes    :118   666:  0   Median :35.00   Yes    :142
##                          Mean   :35.07
##                          3rd Qu.:38.90
##                          Max.   :63.00
##     LOANPRC                      RACE
##  Min.   : 28.99   Hispanic          :  0
##  1st Qu.: 79.96   non-Hispanic Black:194
##  Median : 84.22   non-Hispanic White:  0
##  Mean   : 82.81
##  3rd Qu.: 90.23
##  Max.   :100.00
##
## $`non-Hispanic White`
##     MARRIED     GDLIN          OBRAT            MALE      APPROVE
##  No     : 563   0  : 100   Min.   : 0.00   No     : 291   No : 148
##  Unknown:   1   1  :1553   1st Qu.:27.65   Unknown:  11   Yes:1507
##  Yes    :1091   666:   2   Median :32.50   Yes    :1353
##                             Mean   :32.00
##                             3rd Qu.:36.40
##                             Max.   :95.00
##     LOANPRC                       RACE
##  Min.   :  2.105   Hispanic          :   0
##  1st Qu.: 67.797   non-Hispanic Black:   0
##  Median : 79.861   non-Hispanic White:1655
##  Mean   : 74.832
##  3rd Qu.: 89.237
##  Max.   :100.000

##                     APPROVE
## RACE                   No  Yes
##   Hispanic             26   85
##   non-Hispanic Black   64  133
##   non-Hispanic White  154 1527
```



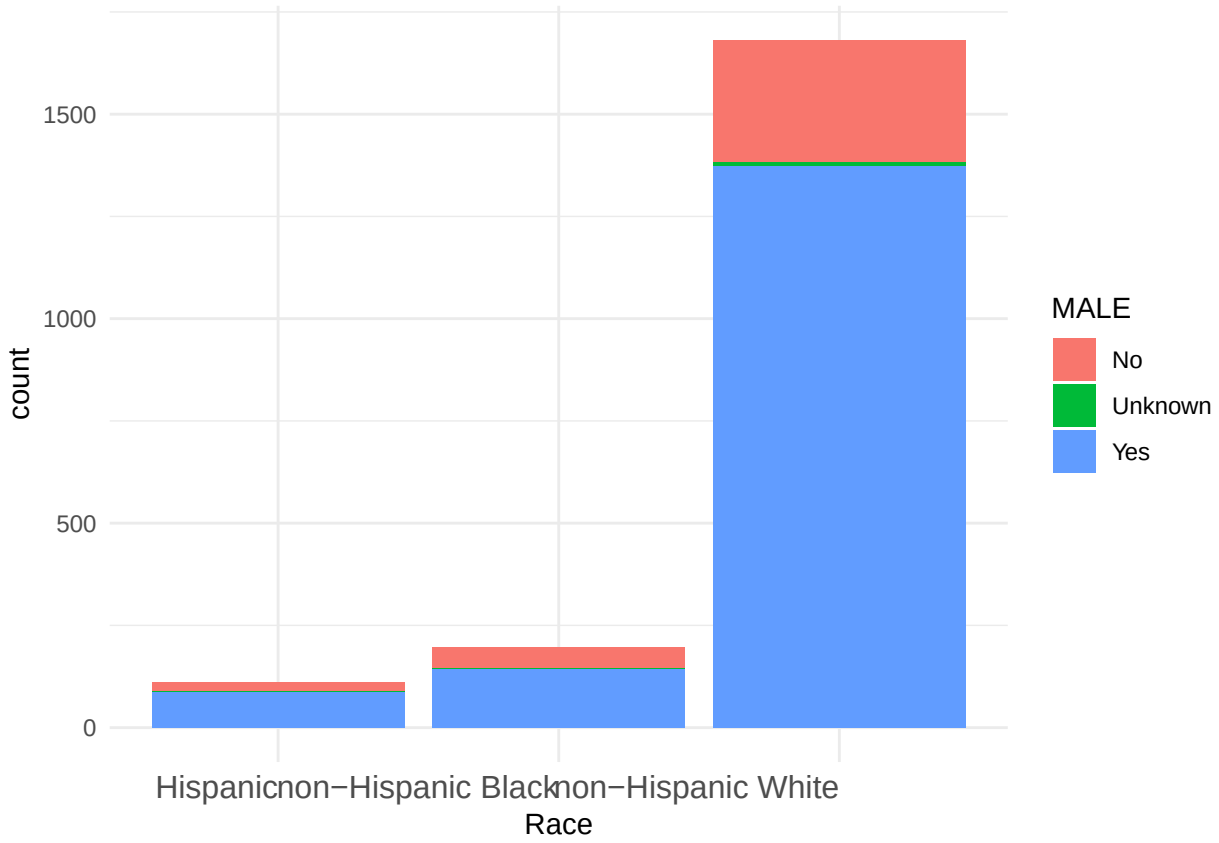

```
##          APPROVE
## MARRIED     No  Yes
##   No       102  576
##   Unknown    0    3
##   Yes      142 1166
```

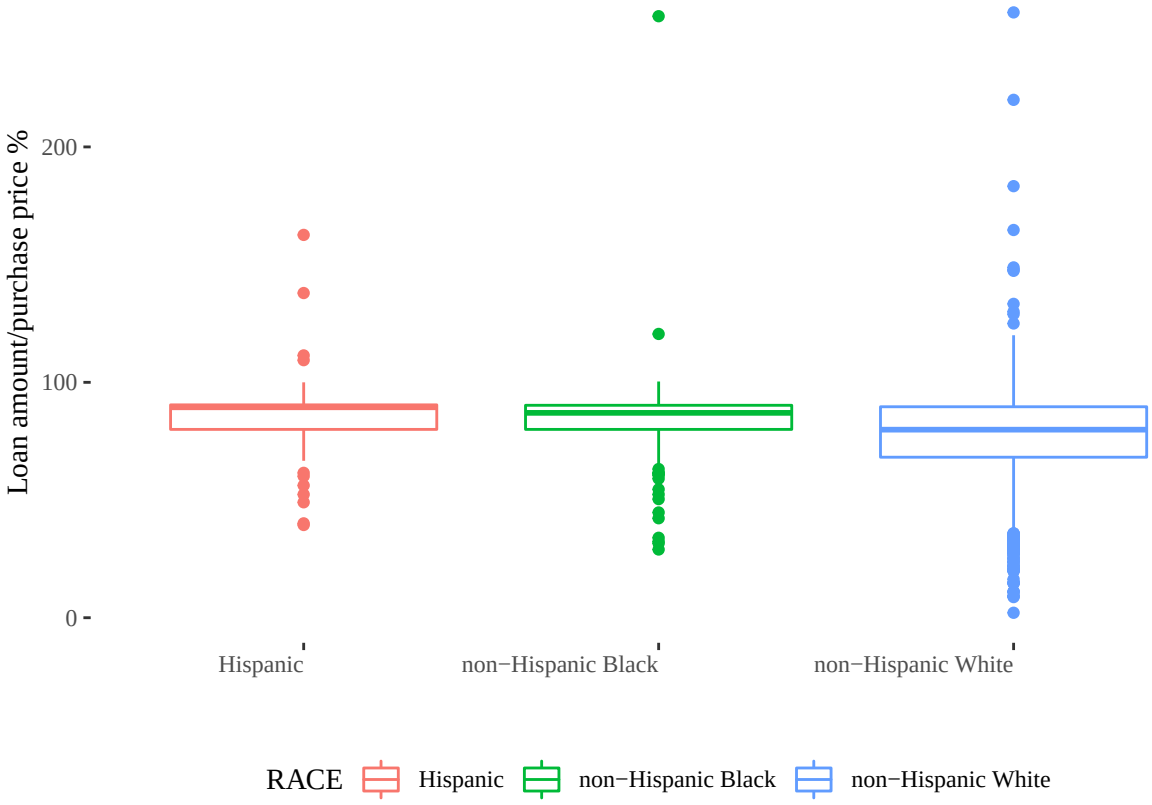


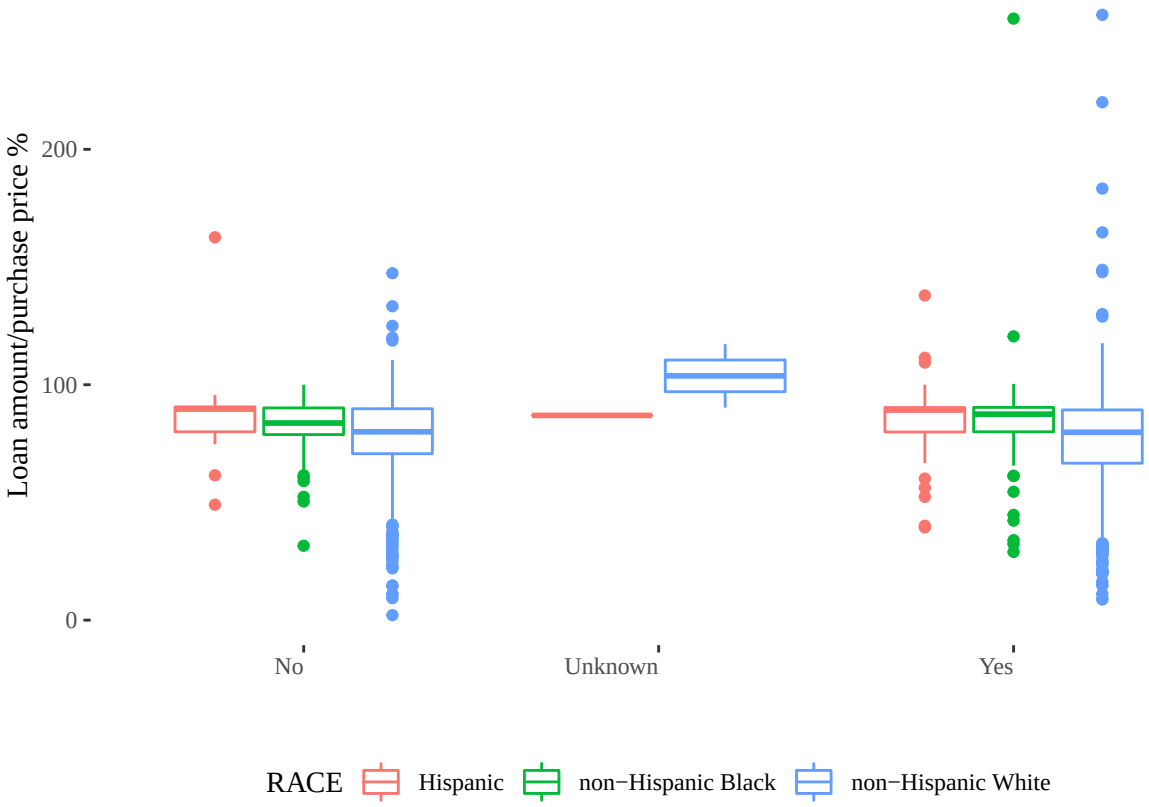

```
##          APPROVE
## MALE        No  Yes
##   No        50  319
##   Unknown    0   15
##   Yes      194 1411
```

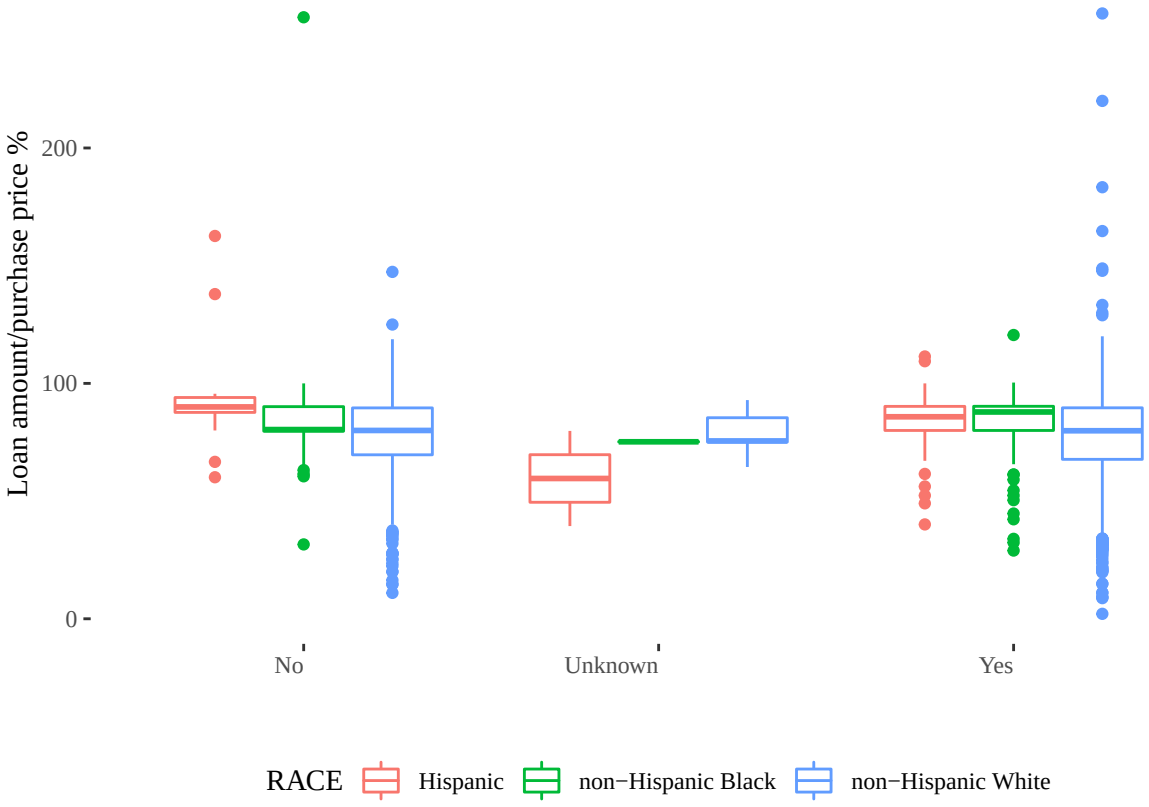


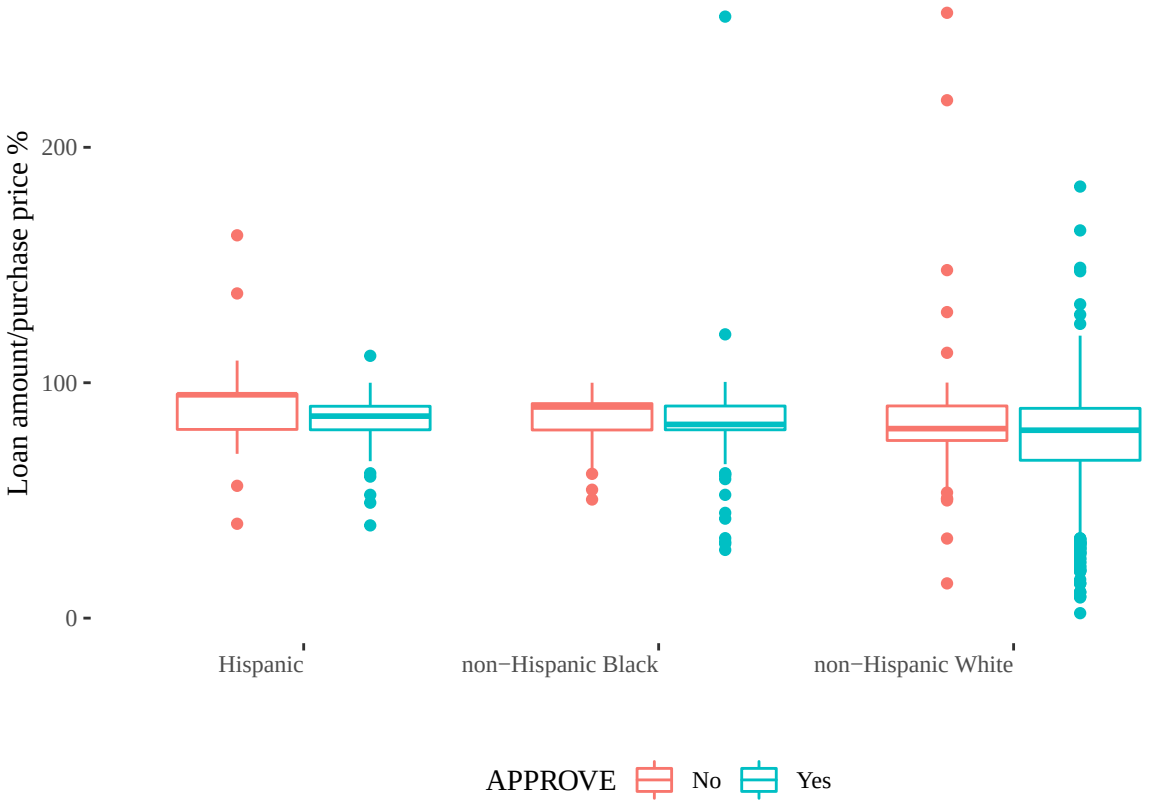

```
## , , RACE = Hispanic
##
##          APPROVE
## MARRIED     No  Yes
##   No         7   24
##   Unknown    0    1
##   Yes       19   60
##
## , , RACE = non-Hispanic Black
##
##          APPROVE
## MARRIED     No  Yes
##   No        27   49
##   Unknown    0    0
##   Yes       37   84
##
## , , RACE = non-Hispanic White
##
##          APPROVE
## MARRIED     No  Yes
##   No        68  503
##   Unknown    0    2
##   Yes       86 1022
```

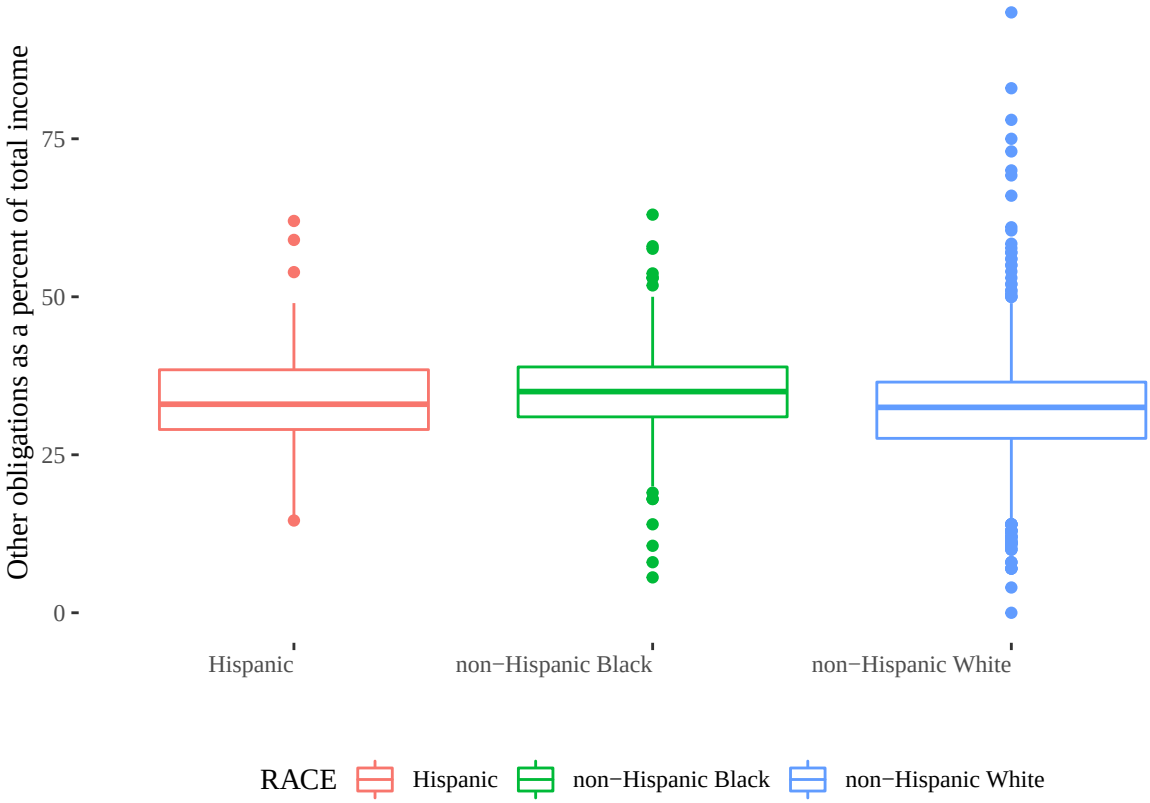

1500
1000
500
0
count
Hispanic
non−Hispanic Black
non−Hispanic White
Race
MALE
No
Unknown
Yes

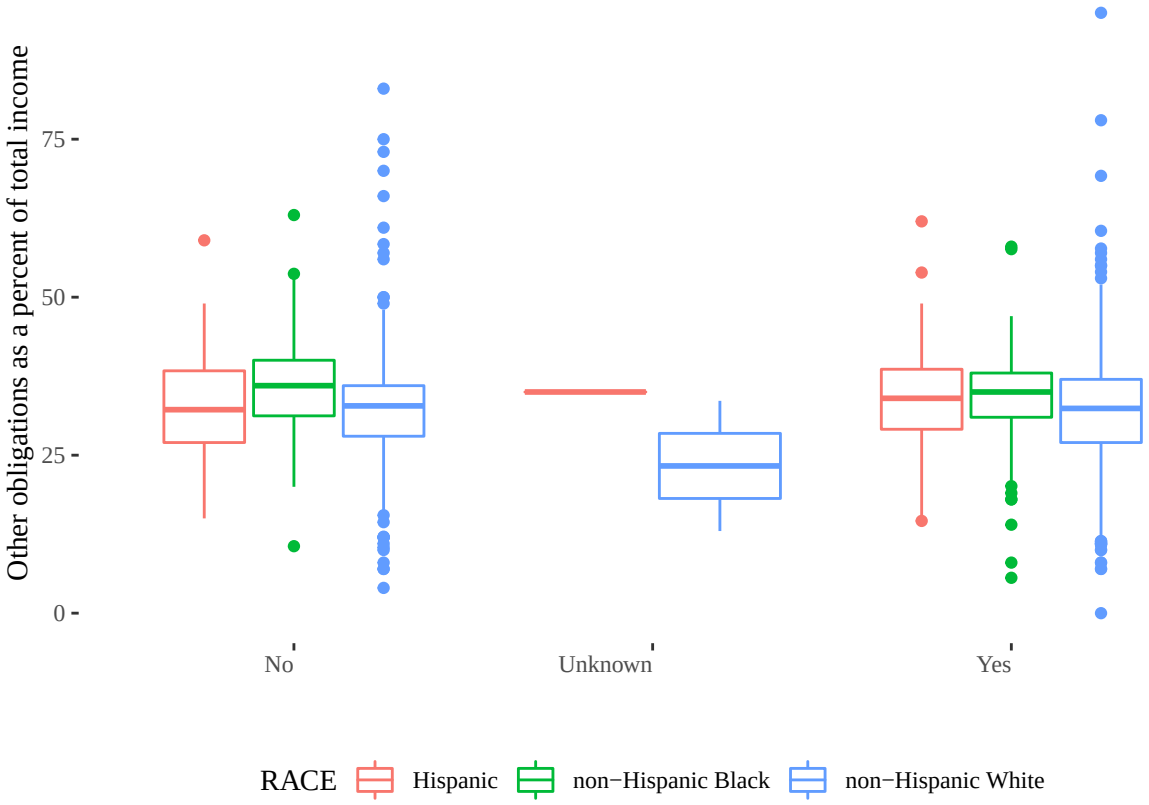

200
100
0
Loan amount/purchase price %
Hispanic
non−Hispanic Black
non−Hispanic White
RACE
Hispanic
non−Hispanic Black
non−Hispanic White

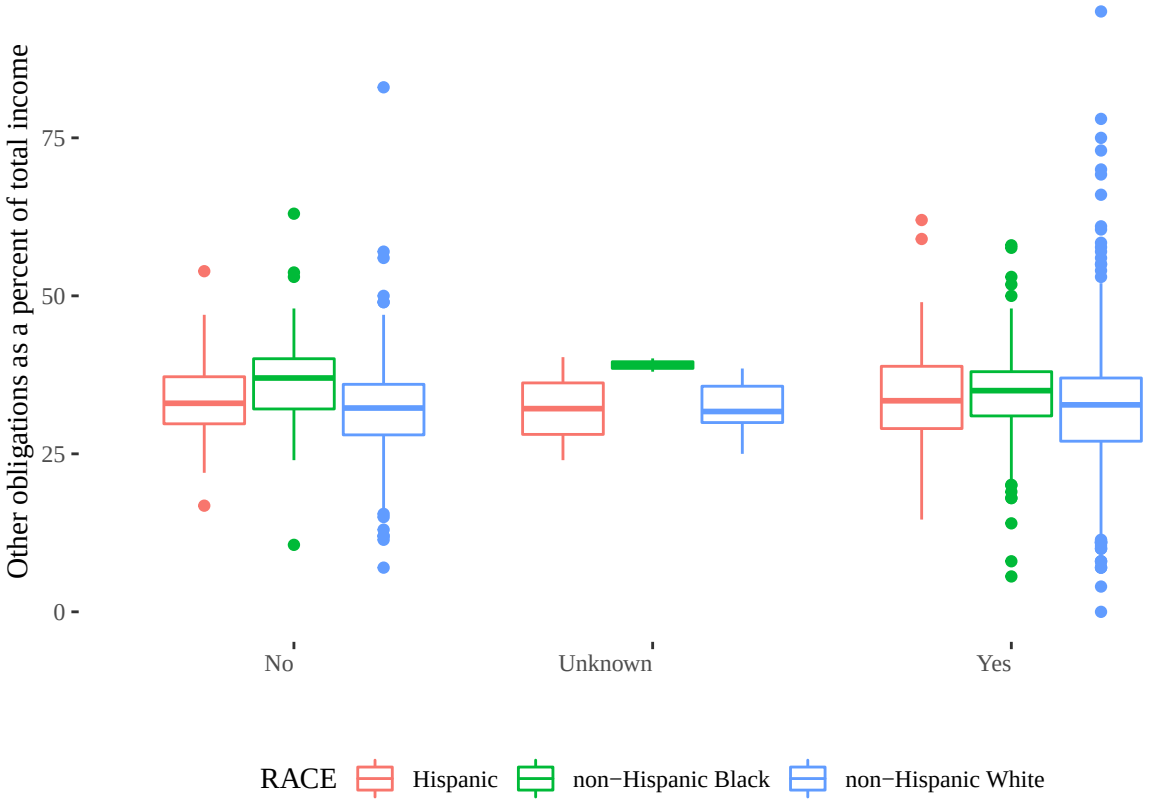

Loan amount/purchase price %
200
100
0
No
Unknown
Yes
RACE
Hispanic
non−Hispanic Black
non−Hispanic White

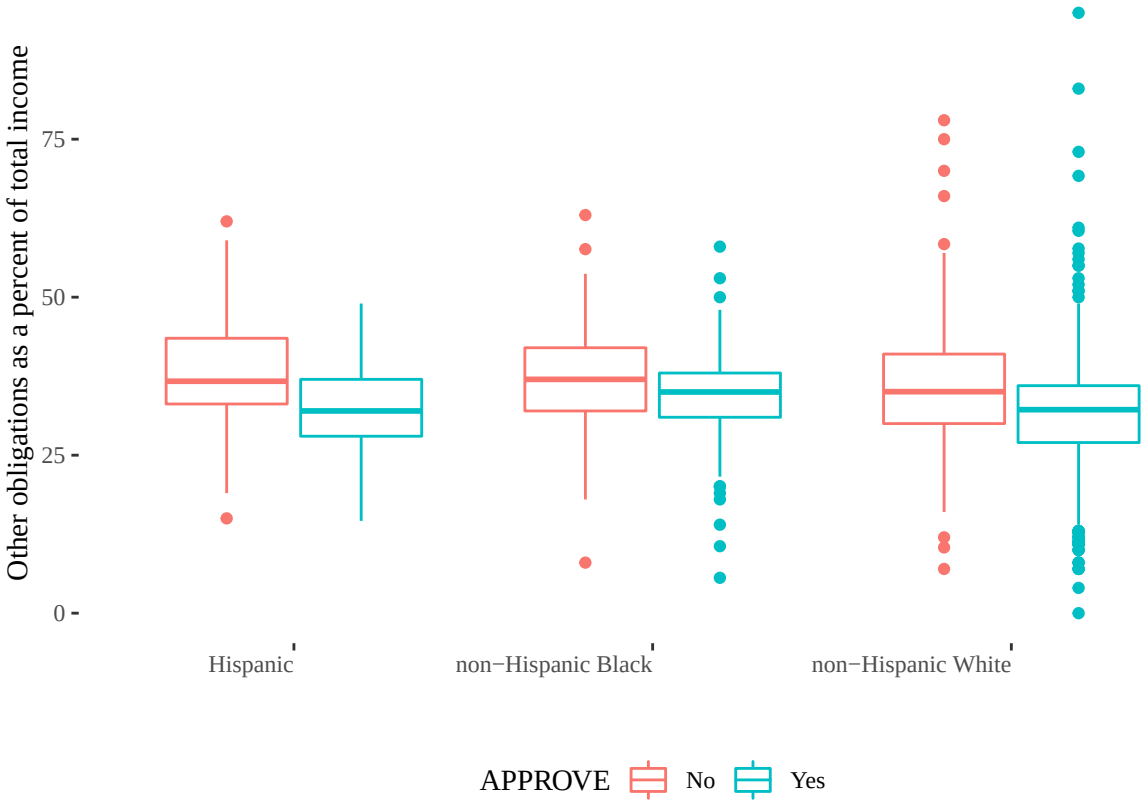

Loan amount/purchase price %
200
100
0
No
Unknown
Yes
RACE
Hispanic
non−Hispanic Black
non−Hispanic White


Loan amount/purchase price %
200
100
0
Hispanic
non−Hispanic Black
non−Hispanic White
APPROVE
No
Yes


Other obligations as a percent of total income
75
50
25
0
Hispanic
non−Hispanic Black
non−Hispanic White
RACE
Hispanic
non−Hispanic Black
non−Hispanic White


Other obligations as a percent of total income
75
50
25
0
No
Unknown
Yes
RACE
Hispanic
non−Hispanic Black
non−Hispanic White


Other obligations as a percent of total income
75
50
25
0
No
Unknown
Yes
RACE
Hispanic
non−Hispanic Black
non−Hispanic White



Data Discription

The data set includes the following variables:

- APPROVE = 1 if mortgage loan was approved, = 0 otherwise
- GDLIN = 1 if credit history meets guidelines, = 0 otherwise
- LOANPRC = loan amount/purchase price
- OBRAT = other obligations as a percent of total income
- MALE = 1 if male, = 0 otherwise
- MARRIED = 1 if married, = 0 otherwise
- BLACK = 1 if black, = 0 otherwise
- HISPAN = 1 if Hispanic, = 0 otherwise

Logistic Regression Full Model

log(p/1-p) = $b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC + b_6 * MARRIED + b_7 * MALE$

```
##
## Call:
## glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.8800   0.2447   0.3079   0.3638   2.3315
```

```
##
## Coefficients:
##              Estimate Std. Error z value             Pr(>|z|)
## (Intercept)  1.208579   0.734473   1.646             0.099866 .
## GDLIN1       3.760690   0.223653  16.815 < 0.0000000000000002 ***
## OBRAT       -0.030396   0.011241  -2.704             0.006850 **
## BLACK1      -0.904717   0.246767  -3.666             0.000246 ***
## HISPAN1     -0.870271   0.324986  -2.678             0.007409 **
## LOANPRC     -0.016424   0.007338  -2.238             0.025202 *
## MARRIED1     0.447570   0.199802   2.240             0.025086 *
## MALE1       -0.031184   0.243816  -0.128             0.898227
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1390.72  on 1885  degrees of freedom
## Residual deviance:  896.72  on 1878  degrees of freedom
## AIC: 912.72
##
## Number of Fisher Scoring iterations: 6
```

For every one unit change in `OBRAT`, the log odds of loan approval (versus non loan approval) decreases by 0.030396.

For every one unit change in `LOANPRC`, the log odds of loan approval (versus non loan approval) decreases by 0.0164238.

The log odds of loan approval for applicants that meet credit guidelines increases by 3.7606898.

The log odds of loan approval for married applicants increases by 0.4475696.

The log odds of loan approval for Black applicants decreases by 0.9047169.

The log odds of loan approval for Hispanic applicants decreases by 0.8702706.

For example, for a black married male whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the log odds of loan approval is 94.47%

Statistical Tests for Individual Predictors

```
##             Overall
## GDLIN1   16.8148657
## OBRAT     2.7040722
## BLACK1    3.6662817
## HISPAN1   2.6778685
## LOANPRC   2.2382875
## MARRIED1  2.2400685
## MALE1     0.1279015

## Wald test for GDLIN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  282.7397  on  1  and  1878  df: p= < 0.000000000000000222

## Wald test for OBRAT
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  7.312006  on  1  and  1878  df: p= 0.0069113
```

```
## Wald test for BLACK
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  13.44162  on  1  and  1878  df: p= 0.00025294

## Wald test for HISPAN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  7.17098  on  1  and  1878  df: p= 0.0074738

## Wald test for MALE
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  0.01635879  on  1  and  1878  df: p= 0.89824

## Wald test for LOANPRC
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  5.009931  on  1  and  1878  df: p= 0.025319

## Wald test for MARRIED
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = "binomial", data = data1)
## F =  5.017907  on  1  and  1878  df: p= 0.025203

##          llh      llhNull           G2     McFadden         r2ML
## -448.3577042 -695.3607456  494.0060828    0.3552157    0.2304376
##         r2CU
##    0.4417558
```

Logistic Regression Reduced Model 1

$\log(\text{p/1-p}) = b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC + b_6 * MARRIED$

```
##
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##     1.18843      3.76189     -0.03039     -0.90261     -0.86897
##     LOANPRC     MARRIED1
##    -0.01644      0.43896
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1879 Residual
## Null Deviance:       1391
## Residual Deviance: 896.7     AIC: 910.7

## Wald test for GDLIN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  283.3964  on  1  and  1879  df: p= < 0.000000000000000222
```

```
## Wald test for OBRAT
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  7.314229  on  1  and  1879  df: p= 0.0069028

## Wald test for BLACK
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  13.43634  on  1  and  1879  df: p= 0.00025365

## Wald test for HISPAN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  7.156744  on  1  and  1879  df: p= 0.0075331

## Wald test for MARRIED
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  5.439062  on  1  and  1879  df: p= 0.019796

## Wald test for LOANPRC
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
## F =  5.020868  on  1  and  1879  df: p= 0.02516
```

For every one unit change in `OBRAT`, the log odds of loan approval (versus non loan approval) decreases by 0.0303945.

For every one unit change in `LOANPRC`, the log odds of loan approval (versus non loan approval) decreases by 0.016437.

The log odds of loan approval for applicants that meet credit guidelines increase by 3.7618942.

The log odds of loan approval for married applicants decreases by 0.4389634.

The log odds of loan approval for non married applicants decreases by NA.

The log odds of loan approval for Black applicants decreases by 0.9026137.

The log odds of loan approval for Hispanic applicants decreases by 0.8689742.

For example, for a black married person whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the log odds of loan approval is 94.5%

CIs using profiled log-likelihood

```
##                    2.5 %       97.5 %
## (Intercept) -0.18806662  2.626546198
## GDLIN1       3.33379631  4.211510283
## OBRAT       -0.05251241 -0.008494145
## BLACK1      -1.37765058 -0.410877648
## HISPAN1     -1.48288996 -0.205867078
## LOANPRC     -0.03136959 -0.002597949
## MARRIED1     0.06852344  0.807760873
```

CIs using standard errors

```
##                   2.5 %       97.5 %
## (Intercept) -0.21740968  2.594276613
## GDLIN1       3.32391091  4.199877410
## OBRAT       -0.05242167 -0.008367323
## BLACK1      -1.38523846 -0.419989031
## HISPAN1     -1.50561899 -0.232329315
## LOANPRC     -0.03081445 -0.002059573
## MARRIED1     0.07005851  0.807868249
```

Odds ratios only

```
## (Intercept)      GDLIN1       OBRAT      BLACK1     HISPAN1     LOANPRC
##   3.2819359  43.0298542   0.9700628   0.4055084   0.4193815   0.9836973
##    MARRIED1
##   1.5510985
```

Odds ratios and 95% CI

```
##                      OR      2.5 %     97.5 %
## (Intercept)  3.2819359  0.8285595 13.8259353
## GDLIN1      43.0298542 28.0446059 67.4583441
## OBRAT        0.9700628  0.9488425  0.9915418
## BLACK1       0.4055084  0.2521703  0.6630681
## HISPAN1      0.4193815  0.2269808  0.8139413
## LOANPRC      0.9836973  0.9691173  0.9974054
## MARRIED1     1.5510985  1.0709257  2.2428803
```

Logistic Regression Reduced Model 2

$\log(\text{p/1-p}) = b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC$

```
##
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##     1.53768      3.73504     -0.03121     -0.91626     -0.83735
##     LOANPRC
##    -0.01676
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1880 Residual
## Null Deviance:       1391
## Residual Deviance: 902.1     AIC: 914.1
```

```
## Wald test for GDLIN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
## F =  284.4088  on  1  and  1880  df: p= < 0.00000000000000222
```

```
## Wald test for OBRAT
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
```

```
##     family = "binomial", data = data1)
## F =  7.714542  on  1  and  1880  df: p= 0.0055322

## Wald test for BLACK
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
## F =  13.89861  on  1  and  1880  df: p= 0.00019865

## Wald test for HISPAN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
## F =  6.678807  on  1  and  1880  df: p= 0.0098314

## Wald test for LOANPRC
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
## F =  5.263613  on  1  and  1880  df: p= 0.021886
```

For every one unit change in `OBRAT`, the log odds of loan approval (versus non loan approval) decreases by 0.0312148.

For every one unit change in `LOANPRC`, the log odds of loan approval (versus non loan approval) decreases by 0.0167577.

The log odds of loan approval for applicants that meet credit guidelines increases by 3.7350414.

The log odds of loan approval for Black applicants decreases by 0.9162564.

The log odds of loan approval for Hispanic applicants decreases by 0.8373507.

For example, for a black person whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the log odds of loan approval is 93.59%

CIs using profiled log-likelihood

```
##                   2.5 %       97.5 %
## (Intercept)  0.19912316  2.942080302
## GDLIN1       3.31054596  4.180450565
## OBRAT       -0.05331854 -0.009309996
## BLACK1      -1.39038556 -0.425483903
## HISPAN1     -1.44932977 -0.175612349
## LOANPRC     -0.03162036 -0.002970753
```

CIs using standard errors

```
##                   2.5 %       97.5 %
## (Intercept)  0.16770811  2.907646603
## GDLIN1       3.30095914  4.169123566
## OBRAT       -0.05324170 -0.009187888
## BLACK1      -1.39795940 -0.434553354
## HISPAN1     -1.47239792 -0.202303437
## LOANPRC     -0.03107369 -0.002441741
```

Odds ratios only

```
## (Intercept)      GDLIN1       OBRAT      BLACK1     HISPAN1     LOANPRC
##   4.6537687  41.8897578   0.9692674   0.4000137   0.4328558   0.9833819
```

Odds ratios and 95% CI

```
##                     OR      2.5 %     97.5 %
## (Intercept)  4.6537687  1.2203323 18.9552380
## GDLIN1      41.8897578 27.4000807 65.3953114
## OBRAT        0.9692674  0.9480780  0.9907332
## BLACK1       0.4000137  0.2489793  0.6534535
## HISPAN1      0.4328558  0.2347276  0.8389431
## LOANPRC      0.9833819  0.9688743  0.9970337
```

Model comparison

```
## Analysis of Deviance Table
##
## Model 1: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED +
##     MALE
## Model 2: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED
## Model 3: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      1878     896.72
## 2      1879     896.73 -1  -0.0164  0.89809
## 3      1880     902.11 -1  -5.3816  0.02035 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Likelihood ratio test
##
## Model 1: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED +
##     MALE
## Model 2: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED
## Model 3: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC
##   #Df  LogLik Df  Chisq Pr(>Chisq)
## 1   8 -448.36
## 2   7 -448.37 -1 0.0164    0.89809
## 3   6 -451.06 -1 5.3816    0.02035 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Probit Regression Full Model

$\text{Probit(approve)} = b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC + b_6 * MARRIED + b_7 * MALE$

```
##
## Call:
## glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.9283   0.2399   0.3074   0.3648   2.2798
##
## Coefficients:
##              Estimate Std. Error z value             Pr(>|z|)
```

```
## (Intercept)  0.428105   0.358878   1.193             0.232909
## GDLIN1       2.168946   0.124753  17.386 < 0.0000000000000002 ***
## OBRAT       -0.014480   0.005729  -2.528             0.011482 *
## BLACK1      -0.468201   0.130076  -3.599             0.000319 ***
## HISPAN1     -0.448923   0.169524  -2.648             0.008094 **
## LOANPRC     -0.007644   0.003423  -2.233             0.025536 *
## MARRIED1     0.225349   0.099408   2.267             0.023395 *
## MALE1       -0.026194   0.121830  -0.215             0.829762
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1390.72  on 1885  degrees of freedom
## Residual deviance:  896.51  on 1878  degrees of freedom
## AIC: 912.51
##
## Number of Fisher Scoring iterations: 6
```

For every one unit change in `OBRAT`, the probit odds of loan approval (versus non loan approval) decreases by 0.0144802.

For every one unit change in `LOANPRC`, the probit odds of loan approval (versus non loan approval) decreases by 0.007644.

The probit odds of loan approval for applicants that meet credit guidelines increases by 2.1689458.

The probit odds of loan approval for married applicants increases by 0.2253492.

The probit odds of loan approval for Black applicants decreases by 0.4682011.

The probit odds of loan approval for Hispanic applicants decreases by 0.4489233.

For example, for a black married male whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the probit odds of loan approval is 94.1%

Statistical Tests for Individual Predictors

```
## Wald test for GDLIN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  302.2684  on  1  and  1878  df: p= < 0.000000000000000222
```

```
## Wald test for OBRAT
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  6.3891  on  1  and  1878  df: p= 0.011564
```

```
## Wald test for BLACK
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  12.95601  on  1  and  1878  df: p= 0.00032716
```

```
## Wald test for HISPAN
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  7.01264  on  1  and  1878  df: p= 0.0081614
```

```
## Wald test for MALE
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  0.04622779  on  1  and  1878  df: p= 0.82979

## Wald test for LOANPRC
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  4.9872  on  1  and  1878  df: p= 0.025653

## Wald test for MARRIED
##  in glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED + MALE, family = binomial(link = "probit"), data = data1)
## F =  5.138901  on  1  and  1878  df: p= 0.023509
```

Probit Regression Reduced Model 1

Probit(approve) = $b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC + b_6 * MARRIED $

```
##
## Call:
## glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = binomial(link = "probit"), data = data1)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.9302   0.2399   0.3074   0.3657   2.2712
##
## Coefficients:
##              Estimate Std. Error z value             Pr(>|z|)
## (Intercept)  0.410225   0.349741   1.173             0.240820
## GDLIN1       2.169978   0.124674  17.405 < 0.0000000000000002 ***
## OBRAT       -0.014482   0.005728  -2.528             0.011467 *
## BLACK1      -0.466005   0.129812  -3.590             0.000331 ***
## HISPAN1     -0.447940   0.169449  -2.644             0.008205 **
## LOANPRC     -0.007644   0.003421  -2.235             0.025444 *
## MARRIED1     0.218202   0.093503   2.334             0.019615 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1390.72  on 1885  degrees of freedom
## Residual deviance:  896.56  on 1879  degrees of freedom
## AIC: 910.56
##
## Number of Fisher Scoring iterations: 6

##            Overall
## GDLIN1   17.405277
## OBRAT     2.528140
## BLACK1    3.589845
## HISPAN1   2.643510
## LOANPRC   2.234599
## MARRIED1  2.333638
```

```
##          llh      llhNull           G2     McFadden         r2ML
## -448.2775981 -695.3607456  494.1662949    0.3553309    0.2305030
##         r2CU
##    0.4418812
```

For every one unit change in `OBRAT`, the probit odds of loan approval (versus non loan approval) decreases by 0.0144821.

For every one unit change in `LOANPRC`, the probit odds of loan approval (versus non loan approval) decreases by 0.0076438.

The probit odds of loan approval for applicants that meet credit guidelines increases by 2.1699783.

The probit odds of loan approval for married applicants increases by 0.2182022.

The probit odds of loan approval for Black applicants decreases by 0.4660055.

The probit odds of loan approval for Hispanic applicants decreases by 0.4479401.

For example, for a black married person whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the probit odds of loan approval is 94.16%

Probit Regression Reduced Model 2

Probit(approve) = $b_0 + b_1 * GDLIN + b_2 * OBRAT + b_3 * BLACK + b_4 * HISPAN + b_5 * LOANPRC $

```
##
## Call:
## glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = binomial(link = "probit"), data = data1)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.8695   0.2495   0.3143   0.3607   2.1663
##
## Coefficients:
##              Estimate Std. Error z value             Pr(>|z|)
## (Intercept)  0.586042   0.341400   1.717             0.086055 .
## GDLIN1       2.160590   0.124167  17.401 < 0.0000000000000002 ***
## OBRAT       -0.014978   0.005719  -2.619             0.008818 **
## BLACK1      -0.473030   0.129367  -3.656             0.000256 ***
## HISPAN1     -0.427703   0.169113  -2.529             0.011436 *
## LOANPRC     -0.007836   0.003405  -2.302             0.021353 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1390.72  on 1885  degrees of freedom
## Residual deviance:  901.95  on 1880  degrees of freedom
## AIC: 913.95
##
## Number of Fisher Scoring iterations: 6
```

```
##           Overall
## GDLIN1  17.400746
```

```
## OBRAT    2.619037
## BLACK1   3.656499
## HISPAN1  2.529089
## LOANPRC  2.301677

##          llh      llhNull           G2     McFadden         r2ML
## -450.9763999 -695.3607456  488.7686914    0.3514497    0.2282976
##         r2CU
##    0.4376533
```

For every one unit change in `OBRAT`, the probit odds of loan approval (versus non loan approval) decreases by 0.0149775.

For every one unit change in `LOANPRC`, the probit odds of loan approval (versus non loan approval) decreases by 0.0078363.

The probit odds of loan approval for applicants that meet credit guidelines increases by 2.1605897.

The probit odds of loan approval for Black applicants decreases by 0.4730296.

The probit odds of loan approval for Hispanic applicants decreases by 0.427703.

For example, for a black person whose credit history meets guidline (GDLIN = 1), loan amount price is 100 (LOANPRC = 100) and other obligations as a percent of total income is none (OBRAT = 0), the probit odds of loan approval is 93.19%

Model comparison

```
## Analysis of Deviance Table
##
## Model 1: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED +
##     MALE
## Model 2: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED
## Model 3: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC
##   Resid. Df Resid. Dev Df Deviance Pr(>Chi)
## 1      1878     896.51
## 2      1879     896.56 -1  -0.0464  0.82944
## 3      1880     901.95 -1  -5.3976  0.02016 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Likelihood ratio test
##
## Model 1: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED +
##     MALE
## Model 2: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC + MARRIED
## Model 3: APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC
##   #Df  LogLik Df  Chisq Pr(>Chisq)
## 1   8 -448.25
## 2   7 -448.28 -1 0.0464    0.82944
## 3   6 -450.98 -1 5.3976    0.02016 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

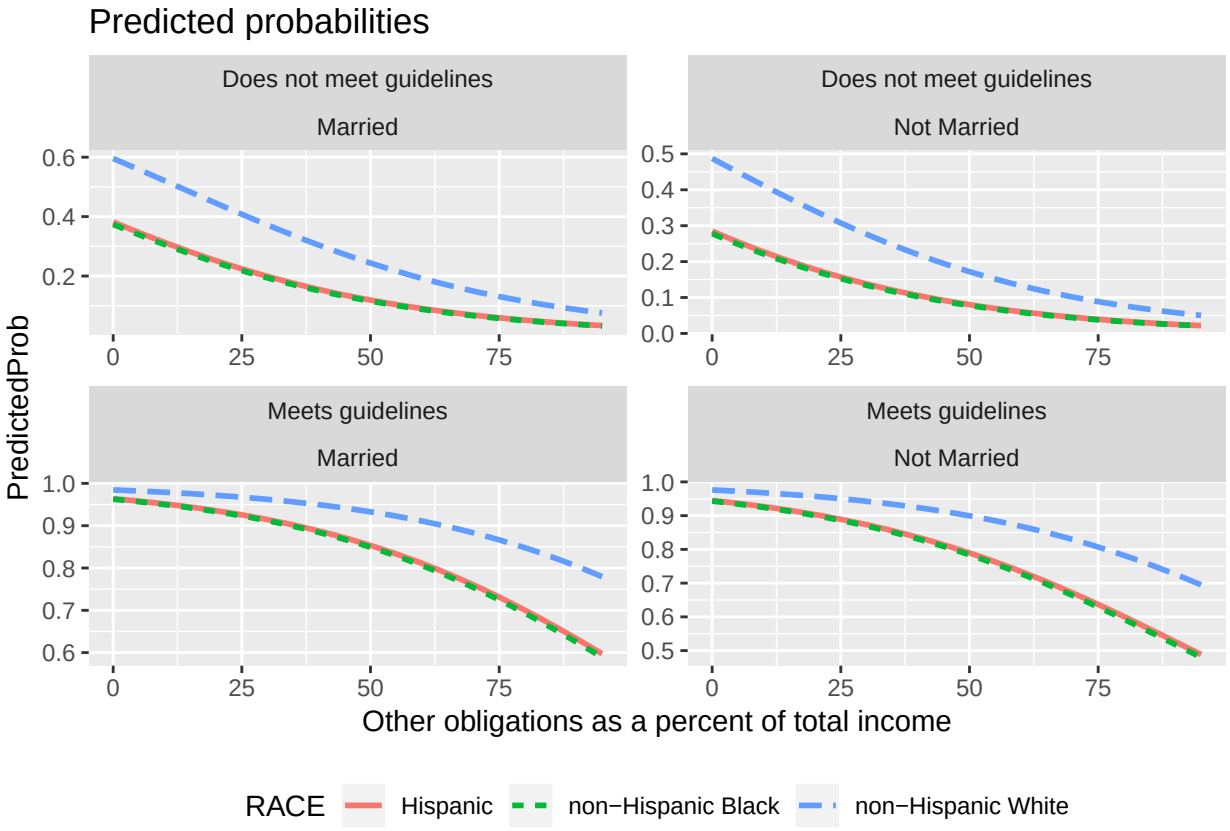
Log Prediction

Logit Model 1

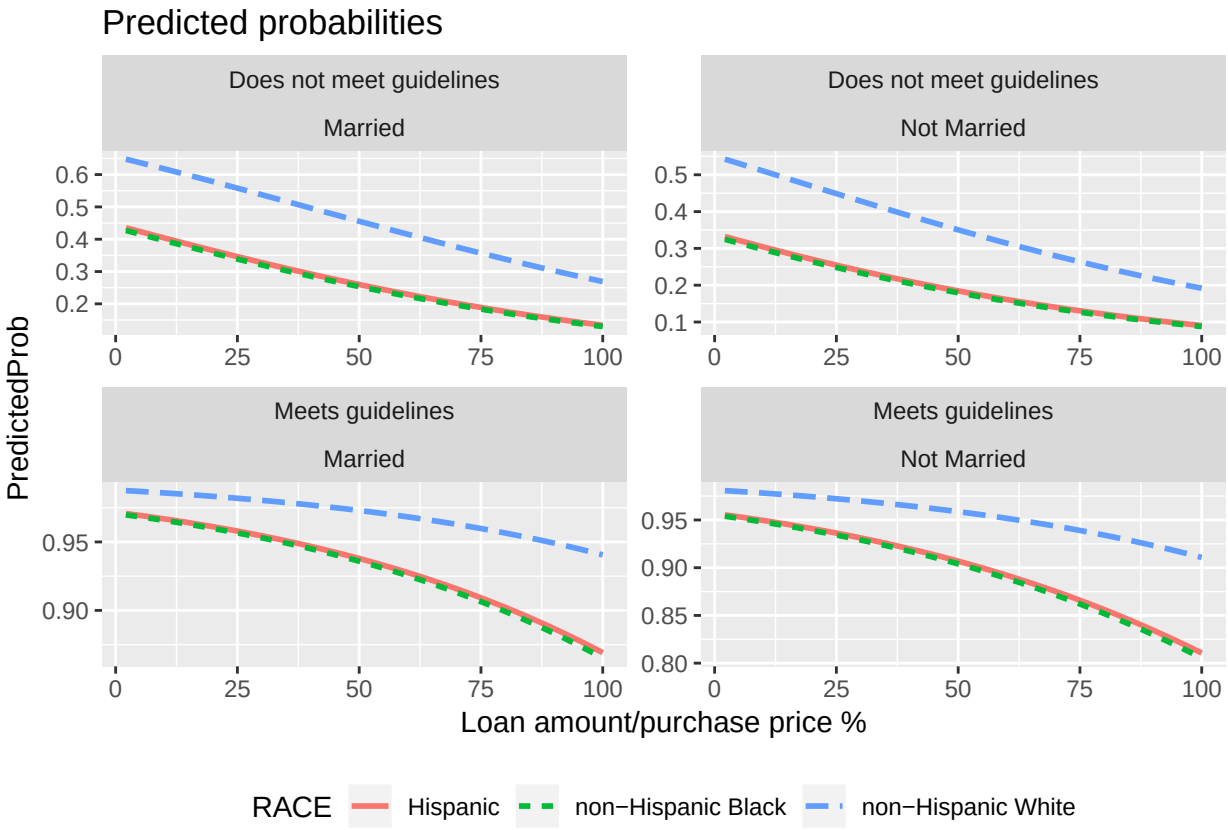
```
##
```

```
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = "binomial", data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##     1.18843      3.76189     -0.03039     -0.90261     -0.86897
##     LOANPRC     MARRIED1
##    -0.01644      0.43896
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1879 Residual
## Null Deviance:       1391
## Residual Deviance: 896.7     AIC: 910.7
```

GDLIN	OBRAT	BLACK	HISPAN	MARRIED	LOANPRC	fit	PredictedProb
0	0	1	0	0	75.44245	-0.9542287	0.2780352
0	1	1	0	0	75.44245	-0.9846232	0.2719754
0	2	1	0	0	75.44245	-1.0150177	0.2659990
0	3	1	0	0	75.44245	-1.0454122	0.2601071
0	4	1	0	0	75.44245	-1.0758067	0.2543004
0	5	1	0	0	75.44245	-1.1062012	0.2485798



GDLIN	OBRAT	BLACK	HISPAN	MARRIED	LOANPRC	fit	PredictedProb
0	32.35767	1	0	0	2.105000	-0.7322754	0.3246956
0	32.35767	1	0	0	3.093838	-0.7485290	0.3211419
0	32.35767	1	0	0	4.082677	-0.7647825	0.3176088
0	32.35767	1	0	0	5.071515	-0.7810361	0.3140966
0	32.35767	1	0	0	6.060353	-0.7972896	0.3106056
0	32.35767	1	0	0	7.049192	-0.8135432	0.3071360

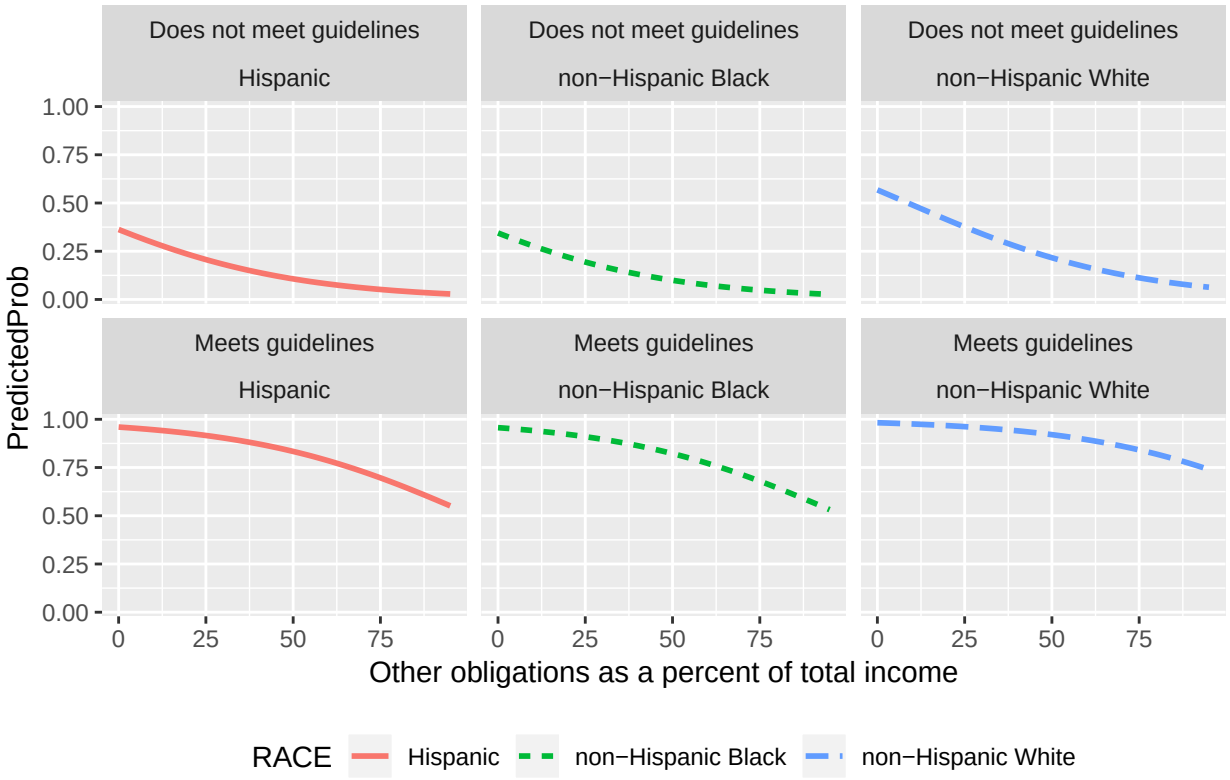


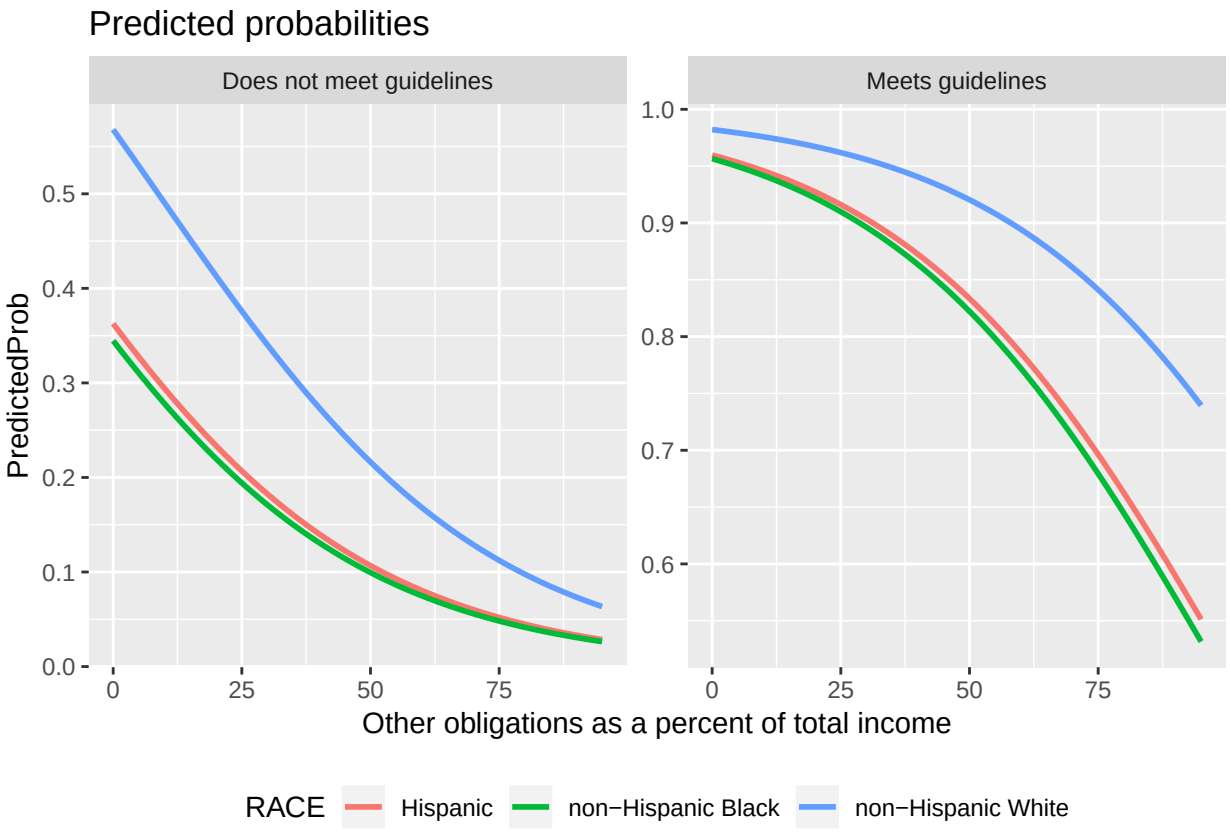
Logit Model 2

```
##
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = "binomial", data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##     1.53768      3.73504     -0.03121     -0.91626     -0.83735
##     LOANPRC
##    -0.01676
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1880 Residual
## Null Deviance:       1391
## Residual Deviance: 902.1     AIC: 914.1
```

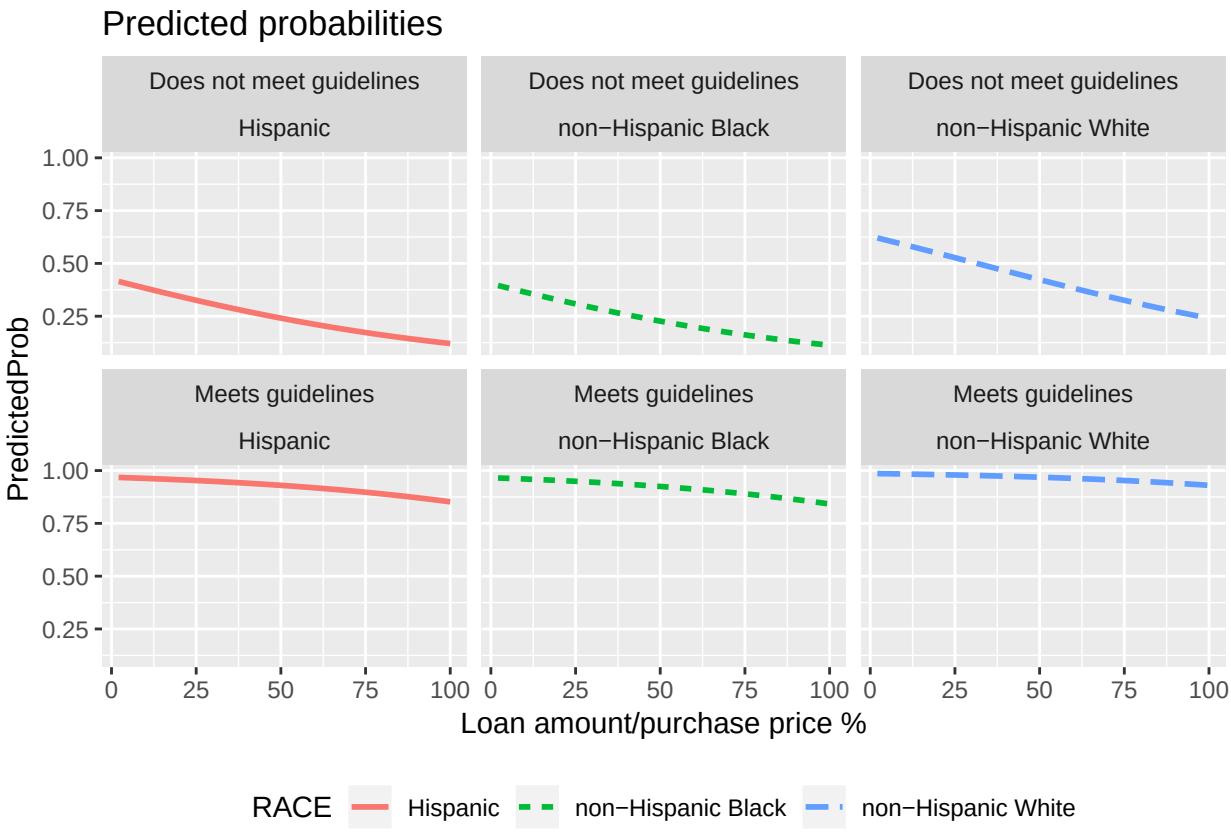
GDLIN	OBRAT	BLACK	HISPAN	LOANPRC	fit	PredictedProb
0	0	1	0	75.44245	-0.6428222	0.3446088
0	1	1	0	75.44245	-0.6740370	0.3375935
0	2	1	0	75.44245	-0.7052518	0.3306489
0	3	1	0	75.44245	-0.7364666	0.3237773
0	4	1	0	75.44245	-0.7676814	0.3169809
0	5	1	0	75.44245	-0.7988962	0.3102617

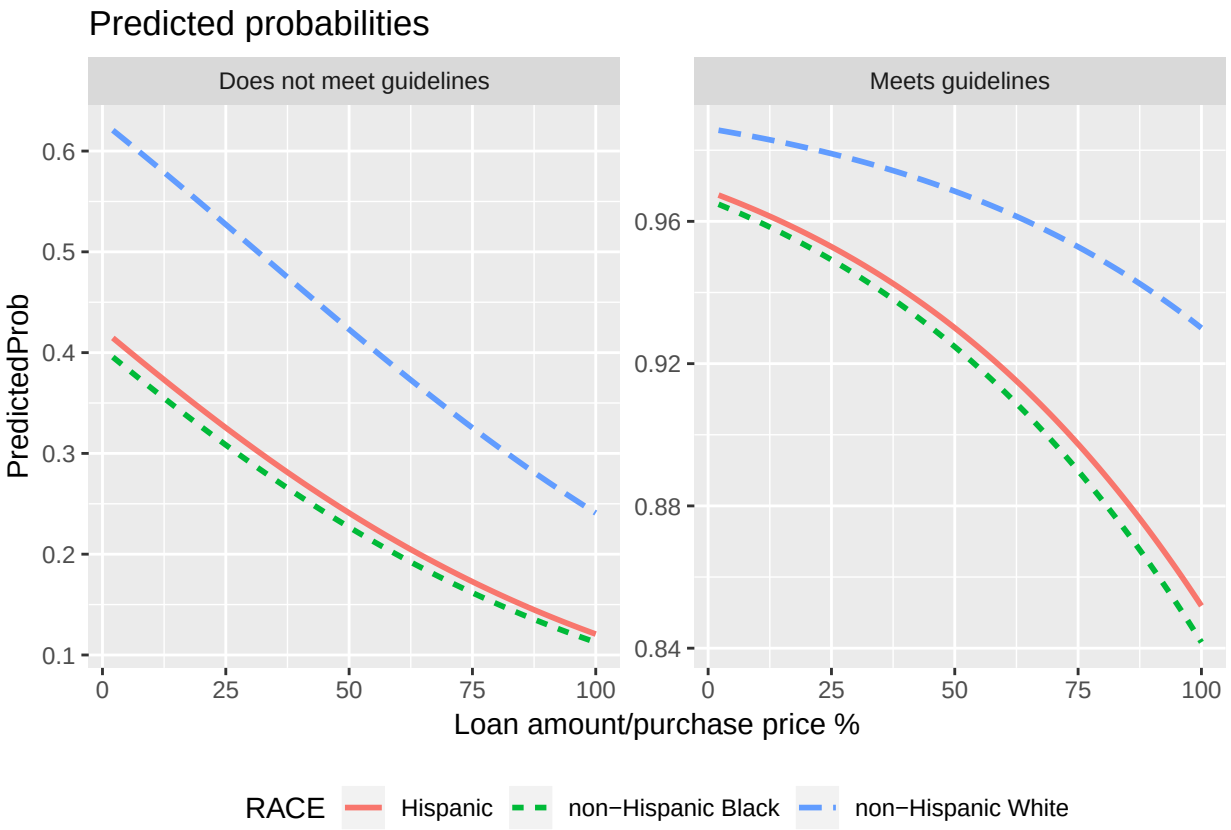
Predicted probabilities





GDLIN	OBRAT	BLACK	HISPAN	LOANPRC	fit	PredictedProb
0	32.35767	1	0	2.105000	-0.4238922	0.3955858
0	32.35767	1	0	3.093838	-0.4404628	0.3916307
0	32.35767	1	0	4.082677	-0.4570335	0.3876898
0	32.35767	1	0	5.071515	-0.4736042	0.3837635
0	32.35767	1	0	6.060353	-0.4901749	0.3798524
0	32.35767	1	0	7.049192	-0.5067455	0.3759568


Predicted probabilities
Does not meet guidelines
Hispanic
Does not meet guidelines
non−Hispanic Black
Does not meet guidelines
non−Hispanic White
Meets guidelines
Hispanic
Meets guidelines
non−Hispanic Black
Meets guidelines
non−Hispanic White
PredictedProb
1.00
0.75
0.50
0.25
0
25
50
75
100
Loan amount/purchase price %
RACE
Hispanic
non−Hispanic Black
non−Hispanic White

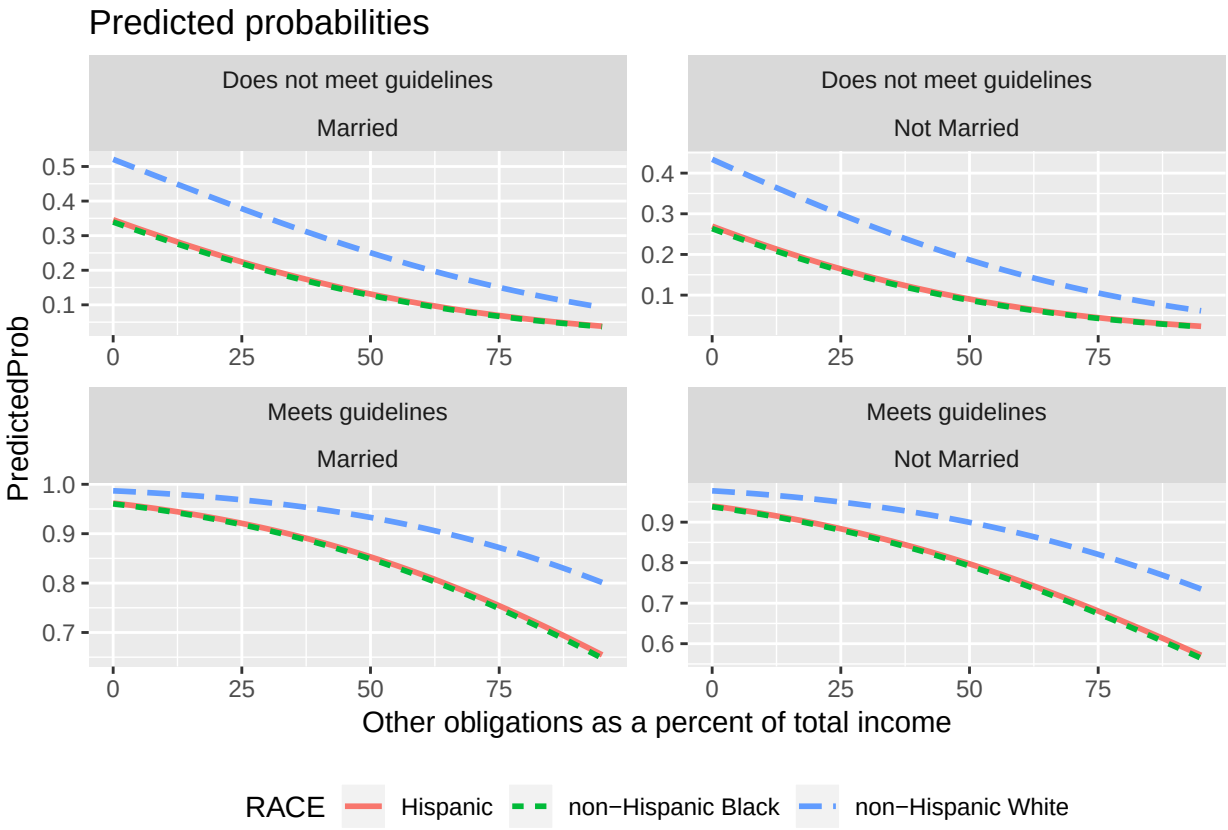

Predicted probabilities
Does not meet guidelines
Meets guidelines
PredictedProb
0.6
0.5
0.4
0.3
0.2
0.1
0.96
0.92
0.88
0.84
0
25
50
75
100
Loan amount/purchase price %
RACE
Hispanic
non−Hispanic Black
non−Hispanic White

Probit Prediction

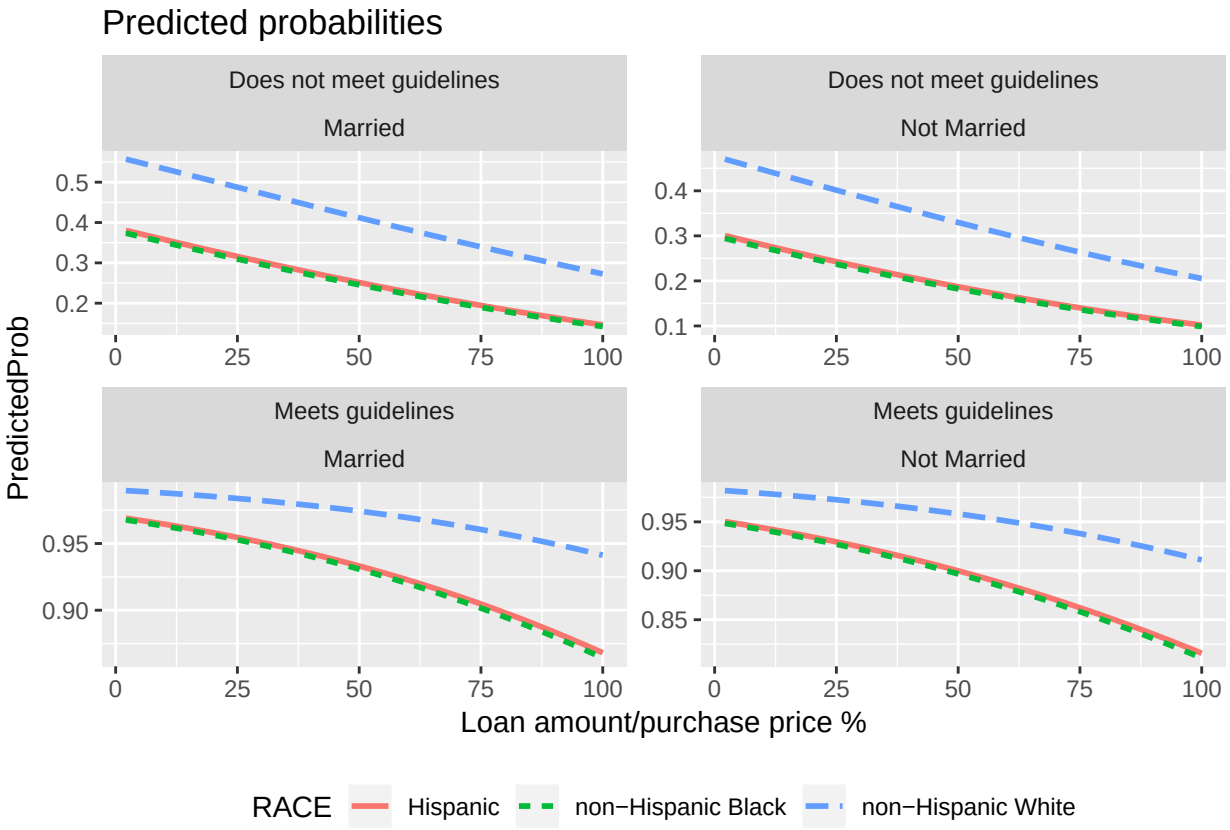
Probit Model 1

```
##
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC +
##     MARRIED, family = binomial(link = "probit"), data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##    0.410225     2.169978    -0.014482    -0.466005    -0.447940
##     LOANPRC     MARRIED1
##   -0.007644     0.218202
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1879 Residual
## Null Deviance:       1391
## Residual Deviance: 896.6     AIC: 910.6
```

GDLIN	OBRAT	BLACK	HISPAN	MARRIED	LOANPRC	fit	se.fit
0	0	1	0	0	75.44245	0.2635483	0.0856403
0	1	1	0	0	75.44245	0.2588398	0.0834016
0	2	1	0	0	75.44245	0.2541751	0.0811961
0	3	1	0	0	75.44245	0.2495550	0.0790251
0	4	1	0	0	75.44245	0.2449799	0.0768898
0	5	1	0	0	75.44245	0.2404502	0.0747916



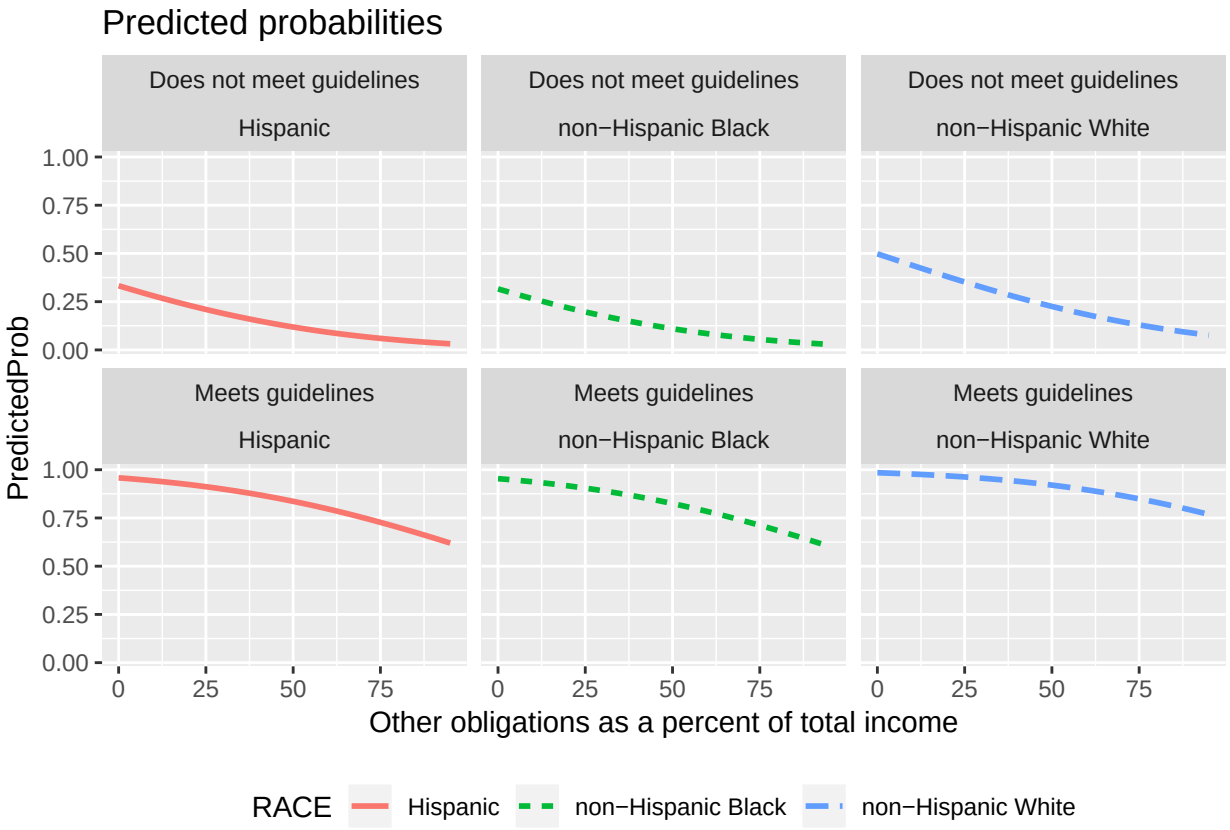
GDLIN	OBRAT	BLACK	HISPAN	MARRIED	LOANPRC
0	32.35767	1	0	0	2.105000
0	32.35767	1	0	0	3.093838
0	32.35767	1	0	0	4.082677
0	32.35767	1	0	0	5.071515
0	32.35767	1	0	0	6.060353
0	32.35767	1	0	0	7.049192

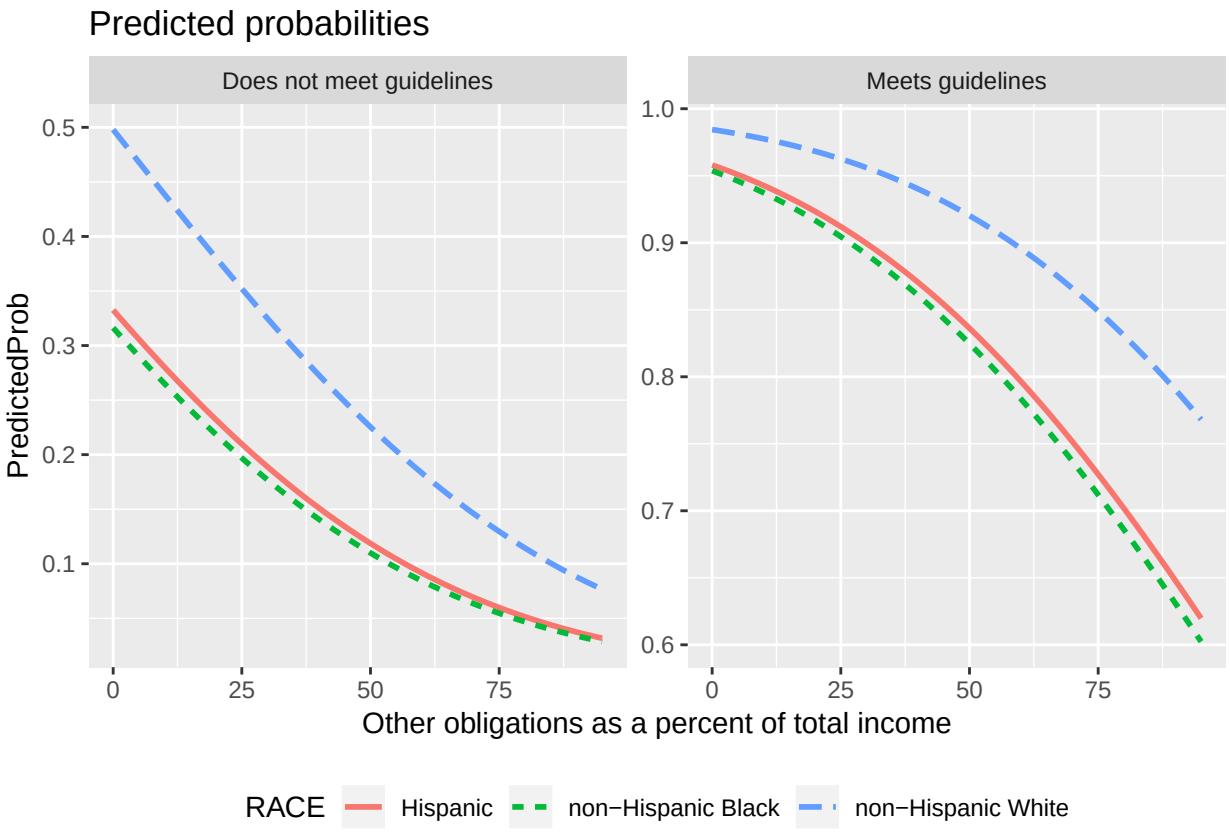


Probit Model 2

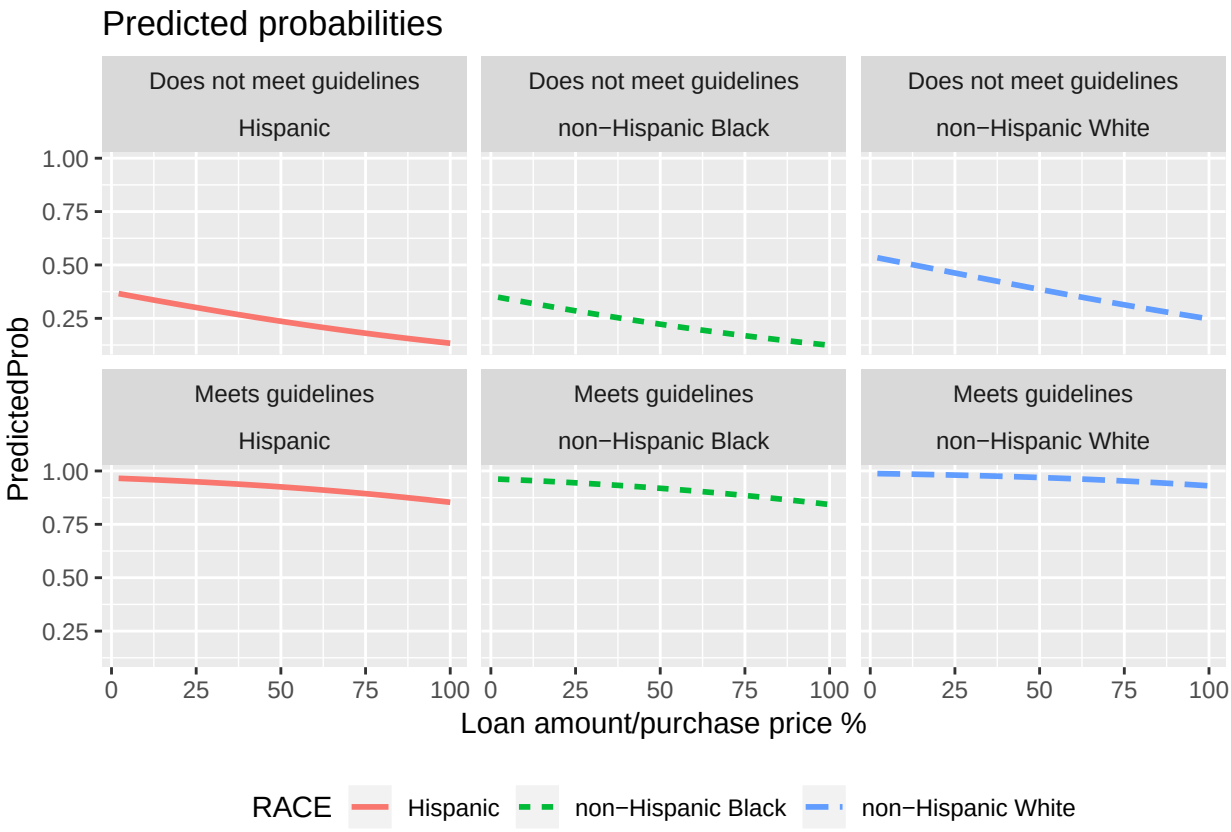
```
##
## Call:  glm(formula = APPROVE ~ GDLIN + OBRAT + BLACK + HISPAN + LOANPRC,
##     family = binomial(link = "probit"), data = data1)
##
## Coefficients:
## (Intercept)       GDLIN1        OBRAT       BLACK1      HISPAN1
##    0.586042     2.160590    -0.014978    -0.473030    -0.427703
##     LOANPRC
##   -0.007836
##
## Degrees of Freedom: 1885 Total (i.e. Null);  1880 Residual
## Null Deviance:       1391
## Residual Deviance: 902   AIC: 914
```

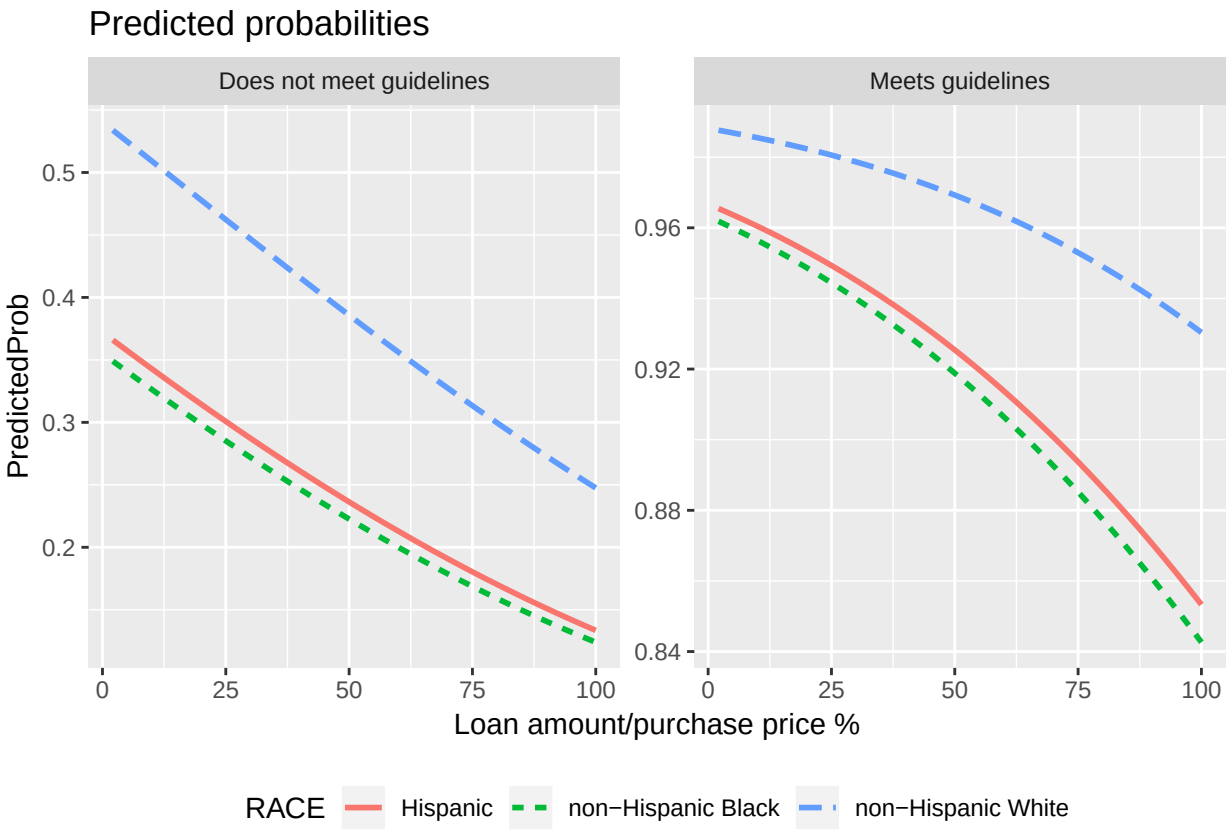
GDLIN	OBRAT	BLACK	HISPAN	LOANPRC	fit
0	0	1	0	75.44245	0.3162608
0	1	1	0	75.44245	0.3109504
0	2	1	0	75.44245	0.3056791
0	3	1	0	75.44245	0.3004477
0	4	1	0	75.44245	0.2952572
0	5	1	0	75.44245	0.2901083





GDLIN	OBRAT	BLACK	HISPAN	LOANPRC	fit
0	32.35767	1	0	2.105000	0.3489630
0	32.35767	1	0	3.093838	0.3461002
0	32.35767	1	0	4.082677	0.3432463
0	32.35767	1	0	5.071515	0.3404012
0	32.35767	1	0	6.060353	0.3375652
0	32.35767	1	0	7.049192	0.3347384


Predicted probabilities
Does not meet guidelines
Hispanic
Does not meet guidelines
non−Hispanic Black
Does not meet guidelines
non−Hispanic White
Meets guidelines
Hispanic
Meets guidelines
non−Hispanic Black
Meets guidelines
non−Hispanic White
PredictedProb
1.00
0.75
0.50
0.25
0
25
50
75
100
Loan amount/purchase price %
RACE
Hispanic
non−Hispanic Black
non−Hispanic White


Predicted probabilities
Does not meet guidelines
Meets guidelines
PredictedProb
0.5
0.4
0.3
0.2
0.96
0.92
0.88
0.84
0
25
50
75
100
Loan amount/purchase price %
RACE
Hispanic
non−Hispanic Black
non−Hispanic White