Class Activity 8

Courtney Hodge

2024-07-25

Multicollinearity

```
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✓ dplyr     1.1.3     ✓ readr     2.1.4
## ✓ forcats   1.0.0     ✓ stringr   1.5.0
## ✓ ggplot2   3.4.4     ✓ tibble    3.2.1
## ✓ lubridate 1.9.3     ✓ tidyr     1.3.0
## ✓ purrr     1.0.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becom
e errors
```

```
data <- read.csv("C:\\Users\\hodge\\Downloads\\credit_data.csv")

data
```

```
##      ID  Income Limit Rating Cards Age Education Gender Student Married
## 1     1  14.891  3606    283     2  34        11   Male      No     Yes
## 2     2 106.025  6645    483     3  82        15 Female     Yes     Yes
## 3     3 104.593  7075    514     4  71        11   Male      No      No
## 4     4 148.924  9504    681     3  36        11 Female      No      No
## 5     5  55.882  4897    357     2  68        16   Male      No     Yes
## 6     6  80.180  8047    569     4  77        10   Male      No      No
## 7     7  20.996  3388    259     2  37        12 Female      No      No
## 8     8  71.408  7114    512     2  87         9   Male      No      No
## 9     9  15.125  3300    266     5  66        13 Female      No      No
## 10   10  71.061  6819    491     3  41        19 Female     Yes     Yes
## 11   11  63.095  8117    589     4  30        14   Male      No     Yes
## 12   12  15.045  1311    138     3  64        16   Male      No      No
## 13   13  80.616  5308    394     1  57         7 Female      No     Yes
## 14   14  43.682  6922    511     1  49         9   Male      No     Yes
## 15   15  19.144  3291    269     2  75        13 Female      No      No
## 16   16  20.089  2525    200     3  57        15 Female      No     Yes
## 17   17  53.598  3714    286     3  73        17 Female      No     Yes
## 18   18  36.496  4378    339     3  69        15 Female      No     Yes
## 19   19  49.570  6384    448     1  28         9 Female      No     Yes
## 20   20  42.079  6626    479     2  44         9   Male      No      No
## 21   21  17.700  2860    235     4  63        16 Female      No      No
## 22   22  37.348  6378    458     1  72        17 Female      No      No
## 23   23  20.103  2631    213     3  61        10   Male      No     Yes
## 24   24  64.027  5179    398     5  48         8   Male      No     Yes
## 25   25  10.742  1757    156     3  57        15 Female      No      No
## 26   26  14.090  4323    326     5  25        16 Female      No     Yes
## 27   27  42.471  3625    289     6  44        12 Female     Yes      No
## 28   28  32.793  4534    333     2  44        16   Male      No      No
## 29   29 186.634 13414    949     2  41        14 Female      No     Yes
## 30   30  26.813  5611    411     4  55        16 Female      No      No
## 31   31  34.142  5666    413     4  47         5 Female      No     Yes
## 32   32  28.941  2733    210     5  43        16   Male      No     Yes
## 33   33 134.181  7838    563     2  48        13 Female      No      No
## 34   34  31.367  1829    162     4  30        10   Male      No     Yes
## 35   35  20.150  2646    199     2  25        14 Female      No     Yes
## 36   36  23.350  2558    220     3  49        12 Female     Yes      No
## 37   37  62.413  6457    455     2  71        11 Female      No     Yes
## 38   38  30.007  6481    462     2  69         9 Female      No     Yes
## 39   39  11.795  3899    300     4  25        10 Female      No      No
## 40   40  13.647  3461    264     4  47        14   Male      No     Yes
## 41   41  34.950  3327    253     3  54        14 Female      No      No
## 42   42 113.659  7659    538     2  66        15   Male     Yes     Yes
## 43   43  44.158  4763    351     2  66        13 Female      No     Yes
## 44   44  36.929  6257    445     1  24        14 Female      No     Yes
## 45   45  31.861  6375    469     3  25        16 Female      No     Yes
## 46   46  77.380  7569    564     3  50        12 Female      No     Yes
## 47   47  19.531  5043    376     2  64        16 Female     Yes     Yes
## 48   48  44.646  4431    320     2  49        15   Male     Yes     Yes
## 49   49  44.522  2252    205     6  72        15   Male      No     Yes
## 50   50  43.479  4569    354     4  49        13   Male     Yes     Yes
## 51   51  36.362  5183    376     3  49        15   Male      No     Yes
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## 52   52  39.705  3969    301     2  27        20   Male      No     Yes
## 53   53  44.205  5441    394     1  32        12   Male      No     Yes
## 54   54  16.304  5466    413     4  66        10   Male      No     Yes
## 55   55  15.333  1499    138     2  47         9 Female      No     Yes
## 56   56  32.916  1786    154     2  60         8 Female      No     Yes
## 57   57  57.100  4742    372     7  79        18 Female      No     Yes
## 58   58  76.273  4779    367     4  65        14 Female      No     Yes
## 59   59  10.354  3480    281     2  70        17   Male      No     Yes
## 60   60  51.872  5294    390     4  81        17 Female      No      No
## 61   61  35.510  5198    364     2  35        20 Female      No      No
## 62   62  21.238  3089    254     3  59        10 Female      No      No
## 63   63  30.682  1671    160     2  77         7 Female      No      No
## 64   64  14.132  2998    251     4  75        17   Male      No      No
## 65   65  32.164  2937    223     2  79        15 Female      No     Yes
## 66   66  12.000  4160    320     4  28        14 Female      No     Yes
## 67   67 113.829  9704    694     4  38        13 Female      No     Yes
## 68   68  11.187  5099    380     4  69        16 Female      No      No
## 69   69  27.847  5619    418     2  78        15 Female      No     Yes
## 70   70  49.502  6819    505     4  55        14   Male      No     Yes
## 71   71  24.889  3954    318     4  75        12   Male      No     Yes
## 72   72  58.781  7402    538     2  81        12 Female      No     Yes
## 73   73  22.939  4923    355     1  47        18 Female      No     Yes
## 74   74  23.989  4523    338     4  31        15   Male      No      No
## 75   75  16.103  5390    418     4  45        10 Female      No     Yes
## 76   76  33.017  3180    224     2  28        16   Male      No     Yes
## 77   77  30.622  3293    251     1  68        16   Male     Yes      No
## 78   78  20.936  3254    253     1  30        15 Female      No      No
## 79   79 110.968  6662    468     3  45        11 Female      No     Yes
## 80   80  15.354  2101    171     2  65        14   Male      No      No
## 81   81  27.369  3449    288     3  40         9 Female      No     Yes
## 82   82  53.480  4263    317     1  83        15   Male      No      No
## 83   83  23.672  4433    344     3  63        11   Male      No      No
## 84   84  19.225  1433    122     3  38        14 Female      No      No
## 85   85  43.540  2906    232     4  69        11   Male      No      No
## 86   86 152.298 12066    828     4  41        12 Female      No     Yes
## 87   87  55.367  6340    448     1  33        15   Male      No     Yes
## 88   88  11.741  2271    182     4  59        12 Female      No      No
## 89   89  15.560  4307    352     4  57         8   Male      No     Yes
## 90   90  59.530  7518    543     3  52         9 Female      No      No
## 91   91  20.191  5767    431     4  42        16   Male      No     Yes
## 92   92  48.498  6040    456     3  47        16   Male      No     Yes
## 93   93  30.733  2832    249     4  51        13   Male      No      No
## 94   94  16.479  5435    388     2  26        16   Male      No      No
## 95   95  38.009  3075    245     3  45        15 Female      No      No
## 96   96  14.084   855    120     5  46        17 Female      No     Yes
## 97   97  14.312  5382    367     1  59        17   Male     Yes      No
## 98   98  26.067  3388    266     4  74        17 Female      No     Yes
## 99   99  36.295  2963    241     2  68        14 Female     Yes      No
## 100 100  83.851  8494    607     5  47        18   Male      No      No
## 101 101  21.153  3736    256     1  41        11   Male      No      No
## 102 102  17.976  2433    190     3  70        16 Female     Yes      No
## 103 103  68.713  7582    531     2  56        16   Male     Yes      No
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## 104 104 146.183  9540    682     6  66        15   Male      No      No
## 105 105  15.846  4768    365     4  53        12 Female      No      No
## 106 106  12.031  3182    259     2  58        18 Female      No     Yes
## 107 107  16.819  1337    115     2  74        15   Male      No     Yes
## 108 108  39.110  3189    263     3  72        12   Male      No      No
## 109 109 107.986  6033    449     4  64        14   Male      No     Yes
## 110 110  13.561  3261    279     5  37        19   Male      No     Yes
## 111 111  34.537  3271    250     3  57        17 Female      No     Yes
## 112 112  28.575  2959    231     2  60        11 Female      No      No
## 113 113  46.007  6637    491     4  42        14   Male      No     Yes
## 114 114  69.251  6386    474     4  30        12 Female      No     Yes
## 115 115  16.482  3326    268     4  41        15   Male      No      No
## 116 116  40.442  4828    369     5  81         8 Female      No      No
## 117 117  35.177  2117    186     3  62        16 Female      No      No
## 118 118  91.362  9113    626     1  47        17   Male      No     Yes
## 119 119  27.039  2161    173     3  40        17 Female      No      No
## 120 120  23.012  1410    137     3  81        16   Male      No      No
## 121 121  27.241  1402    128     2  67        15 Female      No     Yes
## 122 122 148.080  8157    599     2  83        13   Male      No     Yes
## 123 123  62.602  7056    481     1  84        11 Female      No      No
## 124 124  11.808  1300    117     3  77        14 Female      No      No
## 125 125  29.564  2529    192     1  30        12 Female      No     Yes
## 126 126  27.578  2531    195     1  34        15 Female      No     Yes
## 127 127  26.427  5533    433     5  50        15 Female     Yes     Yes
## 128 128  57.202  3411    259     3  72        11 Female      No      No
## 129 129 123.299  8376    610     2  89        17   Male     Yes      No
## 130 130  18.145  3461    279     3  56        15   Male      No     Yes
## 131 131  23.793  3821    281     4  56        12 Female     Yes     Yes
## 132 132  10.726  1568    162     5  46        19   Male      No     Yes
## 133 133  23.283  5443    407     4  49        13   Male      No     Yes
## 134 134  21.455  5829    427     4  80        12 Female      No     Yes
## 135 135  34.664  5835    452     3  77        15 Female      No     Yes
## 136 136  44.473  3500    257     3  81        16 Female      No      No
## 137 137  54.663  4116    314     2  70         8 Female      No      No
## 138 138  36.355  3613    278     4  35         9   Male      No     Yes
## 139 139  21.374  2073    175     2  74        11 Female      No     Yes
## 140 140 107.841 10384    728     3  87         7   Male      No      No
## 141 141  39.831  6045    459     3  32        12 Female     Yes     Yes
## 142 142  91.876  6754    483     2  33        10   Male      No     Yes
## 143 143 103.893  7416    549     3  84        17   Male      No      No
## 144 144  19.636  4896    387     3  64        10 Female      No      No
## 145 145  17.392  2748    228     3  32        14   Male      No     Yes
## 146 146  19.529  4673    341     2  51        14   Male      No      No
## 147 147  17.055  5110    371     3  55        15 Female      No     Yes
## 148 148  23.857  1501    150     3  56        16   Male      No     Yes
## 149 149  15.184  2420    192     2  69        11 Female      No     Yes
## 150 150  13.444   886    121     5  44        10   Male      No     Yes
## 151 151  63.931  5728    435     3  28        14 Female      No     Yes
## 152 152  35.864  4831    353     3  66        13 Female      No     Yes
## 153 153  41.419  2120    184     4  24        11 Female     Yes      No
## 154 154  92.112  4612    344     3  32        17   Male      No      No
## 155 155  55.056  3155    235     2  31        16   Male      No     Yes
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## 156 156  19.537  1362    143     4  34         9 Female      No     Yes
## 157 157  31.811  4284    338     5  75        13 Female      No     Yes
## 158 158  56.256  5521    406     2  72        16 Female     Yes     Yes
## 159 159  42.357  5550    406     2  83        12 Female      No     Yes
## 160 160  53.319  3000    235     3  53        13   Male      No      No
## 161 161  12.238  4865    381     5  67        11 Female      No      No
## 162 162  31.353  1705    160     3  81        14   Male      No     Yes
## 163 163  63.809  7530    515     1  56        12   Male      No     Yes
## 164 164  13.676  2330    203     5  80        16 Female      No      No
## 165 165  76.782  5977    429     4  44        12   Male      No     Yes
## 166 166  25.383  4527    367     4  46        11   Male      No     Yes
## 167 167  35.691  2880    214     2  35        15   Male      No      No
## 168 168  29.403  2327    178     1  37        14 Female      No     Yes
## 169 169  27.470  2820    219     1  32        11 Female      No     Yes
## 170 170  27.330  6179    459     4  36        12 Female      No     Yes
## 171 171  34.772  2021    167     3  57         9   Male      No      No
## 172 172  36.934  4270    299     1  63         9 Female      No     Yes
## 173 173  76.348  4697    344     4  60        18   Male      No      No
## 174 174  14.887  4745    339     3  58        12   Male      No     Yes
## 175 175 121.834 10673    750     3  54        16   Male      No      No
## 176 176  30.132  2168    206     3  52        17   Male      No      No
## 177 177  24.050  2607    221     4  32        18   Male      No     Yes
## 178 178  22.379  3965    292     2  34        14 Female      No     Yes
## 179 179  28.316  4391    316     2  29        10 Female      No      No
## 180 180  58.026  7499    560     5  67        11 Female      No      No
## 181 181  10.635  3584    294     5  69        16   Male      No     Yes
## 182 182  46.102  5180    382     3  81        12   Male      No     Yes
## 183 183  58.929  6420    459     2  66         9 Female      No     Yes
## 184 184  80.861  4090    335     3  29        15 Female      No     Yes
## 185 185 158.889 11589    805     1  62        17 Female      No     Yes
## 186 186  30.420  4442    316     1  30        14 Female      No      No
## 187 187  36.472  3806    309     2  52        13   Male      No      No
## 188 188  23.365  2179    167     2  75        15   Male      No      No
## 189 189  83.869  7667    554     2  83        11   Male      No      No
## 190 190  58.351  4411    326     2  85        16 Female      No     Yes
## 191 191  55.187  5352    385     4  50        17 Female      No     Yes
## 192 192 124.290  9560    701     3  52        17 Female     Yes      No
## 193 193  28.508  3933    287     4  56        14   Male      No     Yes
## 194 194 130.209 10088    730     7  39        19 Female      No     Yes
## 195 195  30.406  2120    181     2  79        14   Male      No     Yes
## 196 196  23.883  5384    398     2  73        16 Female      No     Yes
## 197 197  93.039  7398    517     1  67        12   Male      No     Yes
## 198 198  50.699  3977    304     2  84        17 Female      No      No
## 199 199  27.349  2000    169     4  51        16 Female      No     Yes
## 200 200  10.403  4159    310     3  43         7   Male      No     Yes
## 201 201  23.949  5343    383     2  40        18   Male      No     Yes
## 202 202  73.914  7333    529     6  67        15 Female      No     Yes
## 203 203  21.038  1448    145     2  58        13 Female      No     Yes
## 204 204  68.206  6784    499     5  40        16 Female     Yes      No
## 205 205  57.337  5310    392     2  45         7 Female      No      No
## 206 206  10.793  3878    321     8  29        13   Male      No      No
## 207 207  23.450  2450    180     2  78        13   Male      No      No
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## 208 208  10.842  4391    358     5  37        10 Female     Yes     Yes
## 209 209  51.345  4327    320     3  46        15   Male      No      No
## 210 210 151.947  9156    642     2  91        11 Female      No     Yes
## 211 211  24.543  3206    243     2  62        12 Female      No     Yes
## 212 212  29.567  5309    397     3  25        15   Male      No      No
## 213 213  39.145  4351    323     2  66        13   Male      No     Yes
## 214 214  39.422  5245    383     2  44        19   Male      No      No
## 215 215  34.909  5289    410     2  62        16 Female      No     Yes
## 216 216  41.025  4229    337     3  79        19 Female      No     Yes
## 217 217  15.476  2762    215     3  60        18   Male      No      No
## 218 218  12.456  5395    392     3  65        14   Male      No     Yes
## 219 219  10.627  1647    149     2  71        10 Female     Yes     Yes
## 220 220  38.954  5222    370     4  76        13 Female      No      No
## 221 221  44.847  5765    437     3  53        13 Female     Yes      No
## 222 222  98.515  8760    633     5  78        11 Female      No      No
## 223 223  33.437  6207    451     4  44         9   Male     Yes      No
## 224 224  27.512  4613    344     5  72        17   Male      No     Yes
## 225 225 121.709  7818    584     4  50         6   Male      No     Yes
## 226 226  15.079  5673    411     4  28        15 Female      No     Yes
## 227 227  59.879  6906    527     6  78        15 Female      No      No
## 228 228  66.989  5614    430     3  47        14 Female      No     Yes
## 229 229  69.165  4668    341     2  34        11 Female      No      No
## 230 230  69.943  7555    547     3  76         9   Male      No     Yes
## 231 231  33.214  5137    387     3  59         9   Male      No      No
## 232 232  25.124  4776    378     4  29        12   Male      No     Yes
## 233 233  15.741  4788    360     1  39        14   Male      No     Yes
## 234 234  11.603  2278    187     3  71        11   Male      No     Yes
## 235 235  69.656  8244    579     3  41        14   Male      No     Yes
## 236 236  10.503  2923    232     3  25        18 Female      No     Yes
## 237 237  42.529  4986    369     2  37        11   Male      No     Yes
## 238 238  60.579  5149    388     5  38        15   Male      No     Yes
## 239 239  26.532  2910    236     6  58        19 Female      No     Yes
## 240 240  27.952  3557    263     1  35        13 Female      No     Yes
## 241 241  29.705  3351    262     5  71        14 Female      No     Yes
## 242 242  15.602   906    103     2  36        11   Male      No     Yes
## 243 243  20.918  1233    128     3  47        18 Female     Yes     Yes
## 244 244  58.165  6617    460     1  56        12 Female      No     Yes
## 245 245  22.561  1787    147     4  66        15 Female      No      No
## 246 246  34.509  2001    189     5  80        18 Female      No     Yes
## 247 247  19.588  3211    265     4  59        14 Female      No      No
## 248 248  36.364  2220    188     3  50        19   Male      No      No
## 249 249  15.717   905     93     1  38        16   Male     Yes     Yes
## 250 250  22.574  1551    134     3  43        13 Female     Yes     Yes
## 251 251  10.363  2430    191     2  47        18 Female      No     Yes
## 252 252  28.474  3202    267     5  66        12   Male      No     Yes
## 253 253  72.945  8603    621     3  64         8 Female      No      No
## 254 254  85.425  5182    402     6  60        12   Male      No     Yes
## 255 255  36.508  6386    469     4  79         6 Female      No     Yes
## 256 256  58.063  4221    304     3  50         8   Male      No      No
## 257 257  25.936  1774    135     2  71        14 Female      No      No
## 258 258  15.629  2493    186     1  60        14   Male      No     Yes
## 259 259  41.400  2561    215     2  36        14   Male      No     Yes
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## 260 260  33.657  6196    450     6  55         9 Female      No      No
## 261 261  67.937  5184    383     4  63        12   Male      No     Yes
## 262 262 180.379  9310    665     3  67         8 Female     Yes     Yes
## 263 263  10.588  4049    296     1  66        13 Female      No     Yes
## 264 264  29.725  3536    270     2  52        15 Female      No      No
## 265 265  27.999  5107    380     1  55        10   Male      No     Yes
## 266 266  40.885  5013    379     3  46        13 Female      No     Yes
## 267 267  88.830  4952    360     4  86        16 Female      No     Yes
## 268 268  29.638  5833    433     3  29        15 Female      No     Yes
## 269 269  25.988  1349    142     4  82        12   Male      No      No
## 270 270  39.055  5565    410     4  48        18 Female      No     Yes
## 271 271  15.866  3085    217     1  39        13   Male      No      No
## 272 272  44.978  4866    347     1  30        10 Female      No      No
## 273 273  30.413  3690    299     2  25        15 Female     Yes      No
## 274 274  16.751  4706    353     6  48        14   Male     Yes      No
## 275 275  30.550  5869    439     5  81         9 Female      No      No
## 276 276 163.329  8732    636     3  50        14   Male      No     Yes
## 277 277  23.106  3476    257     2  50        15 Female      No      No
## 278 278  41.532  5000    353     2  50        12   Male      No     Yes
## 279 279 128.040  6982    518     2  78        11 Female      No     Yes
## 280 280  54.319  3063    248     3  59         8 Female     Yes      No
## 281 281  53.401  5319    377     3  35        12 Female      No      No
## 282 282  36.142  1852    183     3  33        13 Female      No      No
## 283 283  63.534  8100    581     2  50        17 Female      No     Yes
## 284 284  49.927  6396    485     3  75        17 Female      No     Yes
## 285 285  14.711  2047    167     2  67         6   Male      No     Yes
## 286 286  18.967  1626    156     2  41        11 Female      No     Yes
## 287 287  18.036  1552    142     2  48        15 Female      No      No
## 288 288  60.449  3098    272     4  69         8   Male      No     Yes
## 289 289  16.711  5274    387     3  42        16 Female      No     Yes
## 290 290  10.852  3907    296     2  30         9   Male      No      No
## 291 291  26.370  3235    268     5  78        11   Male      No     Yes
## 292 292  24.088  3665    287     4  56        13 Female      No     Yes
## 293 293  51.532  5096    380     2  31        15   Male      No     Yes
## 294 294 140.672 11200    817     7  46         9   Male      No     Yes
## 295 295  42.915  2532    205     4  42        13   Male      No     Yes
## 296 296  27.272  1389    149     5  67        10 Female      No     Yes
## 297 297  65.896  5140    370     1  49        17 Female      No     Yes
## 298 298  55.054  4381    321     3  74        17   Male      No     Yes
## 299 299  20.791  2672    204     1  70        18 Female      No      No
## 300 300  24.919  5051    372     3  76        11 Female      No     Yes
## 301 301  21.786  4632    355     1  50        17   Male      No     Yes
## 302 302  31.335  3526    289     3  38         7 Female      No      No
## 303 303  59.855  4964    365     1  46        13 Female      No     Yes
## 304 304  44.061  4970    352     1  79        11   Male      No     Yes
## 305 305  82.706  7506    536     2  64        13 Female      No     Yes
## 306 306  24.460  1924    165     2  50        14 Female      No     Yes
## 307 307  45.120  3762    287     3  80         8   Male      No     Yes
## 308 308  75.406  3874    298     3  41        14 Female      No     Yes
## 309 309  14.956  4640    332     2  33         6   Male      No      No
## 310 310  75.257  7010    494     3  34        18 Female      No     Yes
## 311 311  33.694  4891    369     1  52        16   Male     Yes      No
```

```
## 312 312  23.375  5429    396     3  57        15 Female      No     Yes
## 313 313  27.825  5227    386     6  63        11   Male      No     Yes
## 314 314  92.386  7685    534     2  75        18 Female      No     Yes
## 315 315 115.520  9272    656     2  69        14   Male      No      No
## 316 316  14.479  3907    296     3  43        16   Male      No     Yes
## 317 317  52.179  7306    522     2  57        14   Male      No      No
## 318 318  68.462  4712    340     2  71        16   Male      No     Yes
## 319 319  18.951  1485    129     3  82        13 Female      No      No
## 320 320  27.590  2586    229     5  54        16   Male      No     Yes
## 321 321  16.279  1160    126     3  78        13   Male     Yes     Yes
## 322 322  25.078  3096    236     2  27        15 Female      No     Yes
## 323 323  27.229  3484    282     6  51        11   Male      No      No
## 324 324 182.728 13913    982     4  98        17   Male      No     Yes
## 325 325  31.029  2863    223     2  66        17   Male     Yes     Yes
## 326 326  17.765  5072    364     1  66        12 Female      No     Yes
## 327 327 125.480 10230    721     3  82        16   Male      No     Yes
## 328 328  49.166  6662    508     3  68        14 Female      No      No
## 329 329  41.192  3673    297     3  54        16 Female      No     Yes
## 330 330  94.193  7576    527     2  44        16 Female      No     Yes
## 331 331  20.405  4543    329     2  72        17   Male     Yes      No
## 332 332  12.581  3976    291     2  48        16   Male      No     Yes
## 333 333  62.328  5228    377     3  83        15   Male      No      No
## 334 334  21.011  3402    261     2  68        17   Male      No     Yes
## 335 335  24.230  4756    351     2  64        15 Female      No     Yes
## 336 336  24.314  3409    270     2  23         7 Female      No     Yes
## 337 337  32.856  5884    438     4  68        13   Male      No      No
## 338 338  12.414   855    119     3  32        12   Male      No     Yes
## 339 339  41.365  5303    377     1  45        14   Male      No      No
## 340 340 149.316 10278    707     1  80        16   Male      No      No
## 341 341  27.794  3807    301     4  35         8 Female      No     Yes
## 342 342  13.234  3922    299     2  77        17 Female      No     Yes
## 343 343  14.595  2955    260     5  37         9   Male      No     Yes
## 344 344  10.735  3746    280     2  44        17 Female      No     Yes
## 345 345  48.218  5199    401     7  39        10   Male      No     Yes
## 346 346  30.012  1511    137     2  33        17   Male      No     Yes
## 347 347  21.551  5380    420     5  51        18   Male      No     Yes
## 348 348 160.231 10748    754     2  69        17   Male      No      No
## 349 349  13.433  1134    112     3  70        14   Male      No     Yes
## 350 350  48.577  5145    389     3  71        13 Female      No     Yes
## 351 351  30.002  1561    155     4  70        13 Female      No     Yes
## 352 352  61.620  5140    374     1  71         9   Male      No     Yes
## 353 353 104.483  7140    507     2  41        14   Male      No     Yes
## 354 354  41.868  4716    342     2  47        18   Male      No      No
## 355 355  12.068  3873    292     1  44        18 Female      No     Yes
## 356 356 180.682 11966    832     2  58         8 Female      No     Yes
## 357 357  34.480  6090    442     3  36        14   Male      No      No
## 358 358  39.609  2539    188     1  40        14   Male      No     Yes
## 359 359  30.111  4336    339     1  81        18   Male      No     Yes
## 360 360  12.335  4471    344     3  79        12   Male      No     Yes
## 361 361  53.566  5891    434     4  82        10 Female      No      No
## 362 362  53.217  4943    362     2  46        16 Female      No     Yes
## 363 363  26.162  5101    382     3  62        19 Female      No      No
```

```
## 364 364  64.173  6127    433     1  80        10   Male      No     Yes
## 365 365 128.669  9824    685     3  67        16   Male      No     Yes
## 366 366 113.772  6442    489     4  69        15   Male     Yes     Yes
## 367 367  61.069  7871    564     3  56        14   Male      No     Yes
## 368 368  23.793  3615    263     2  70        14   Male      No      No
## 369 369  89.000  5759    440     3  37         6 Female      No      No
## 370 370  71.682  8028    599     3  57        16   Male      No     Yes
## 371 371  35.610  6135    466     4  40        12   Male      No      No
## 372 372  39.116  2150    173     4  75        15   Male      No      No
## 373 373  19.782  3782    293     2  46        16 Female     Yes      No
## 374 374  55.412  5354    383     2  37        16 Female     Yes     Yes
## 375 375  29.400  4840    368     3  76        18 Female      No     Yes
## 376 376  20.974  5673    413     5  44        16 Female      No     Yes
## 377 377  87.625  7167    515     2  46        10 Female      No      No
## 378 378  28.144  1567    142     3  51        10   Male      No     Yes
## 379 379  19.349  4941    366     1  33        19   Male      No     Yes
## 380 380  53.308  2860    214     1  84        10   Male      No     Yes
## 381 381 115.123  7760    538     3  83        14 Female      No      No
## 382 382 101.788  8029    574     2  84        11   Male      No     Yes
## 383 383  24.824  5495    409     1  33         9   Male     Yes      No
## 384 384  14.292  3274    282     9  64         9   Male      No     Yes
## 385 385  20.088  1870    180     3  76        16   Male      No      No
## 386 386  26.400  5640    398     3  58        15 Female      No      No
## 387 387  19.253  3683    287     4  57        10   Male      No      No
## 388 388  16.529  1357    126     3  62         9   Male      No      No
## 389 389  37.878  6827    482     2  80        13 Female      No      No
## 390 390  83.948  7100    503     2  44        18   Male      No      No
## 391 391 135.118 10578    747     3  81        15 Female      No     Yes
## 392 392  73.327  6555    472     2  43        15 Female      No      No
## 393 393  25.974  2308    196     2  24        10   Male      No      No
## 394 394  17.316  1335    138     2  65        13   Male      No      No
## 395 395  49.794  5758    410     4  40         8   Male      No      No
## 396 396  12.096  4100    307     3  32        13   Male      No     Yes
## 397 397  13.364  3838    296     5  65        17   Male      No      No
## 398 398  57.872  4171    321     5  67        12 Female      No     Yes
## 399 399  37.728  2525    192     1  44        13   Male      No     Yes
## 400 400  18.701  5524    415     5  64         7 Female      No      No
##            Ethnicity Balance
## 1          Caucasian     333
## 2              Asian     903
## 3              Asian     580
## 4              Asian     964
## 5          Caucasian     331
## 6          Caucasian    1151
## 7   African American     203
## 8              Asian     872
## 9          Caucasian     279
## 10  African American    1350
## 11         Caucasian    1407
## 12         Caucasian       0
## 13             Asian     204
## 14         Caucasian    1081
```

```
## 15  African American     148
## 16  African American       0
## 17  African American       0
## 18             Asian     368
## 19             Asian     891
## 20             Asian    1048
## 21             Asian      89
## 22         Caucasian     968
## 23  African American       0
## 24  African American     411
## 25         Caucasian       0
## 26  African American     671
## 27         Caucasian     654
## 28  African American     467
## 29  African American    1809
## 30         Caucasian     915
## 31         Caucasian     863
## 32             Asian       0
## 33         Caucasian     526
## 34         Caucasian       0
## 35             Asian       0
## 36         Caucasian     419
## 37         Caucasian     762
## 38         Caucasian    1093
## 39         Caucasian     531
## 40         Caucasian     344
## 41  African American      50
## 42  African American    1155
## 43             Asian     385
## 44             Asian     976
## 45         Caucasian    1120
## 46         Caucasian     997
## 47             Asian    1241
## 48         Caucasian     797
## 49             Asian       0
## 50  African American     902
## 51  African American     654
## 52  African American     211
## 53         Caucasian     607
## 54             Asian     957
## 55             Asian       0
## 56             Asian       0
## 57             Asian     379
## 58         Caucasian     133
## 59         Caucasian     333
## 60         Caucasian     531
## 61             Asian     631
## 62         Caucasian     108
## 63         Caucasian       0
## 64         Caucasian     133
## 65  African American       0
## 66         Caucasian     602
```

```
## 67             Asian    1388
## 68  African American     889
## 69         Caucasian     822
## 70         Caucasian    1084
## 71         Caucasian     357
## 72             Asian    1103
## 73             Asian     663
## 74         Caucasian     601
## 75         Caucasian     945
## 76  African American      29
## 77         Caucasian     532
## 78             Asian     145
## 79         Caucasian     391
## 80             Asian       0
## 81         Caucasian     162
## 82         Caucasian      99
## 83         Caucasian     503
## 84         Caucasian       0
## 85         Caucasian       0
## 86             Asian    1779
## 87         Caucasian     815
## 88             Asian       0
## 89  African American     579
## 90  African American    1176
## 91  African American    1023
## 92         Caucasian     812
## 93         Caucasian       0
## 94  African American     937
## 95  African American       0
## 96  African American       0
## 97             Asian    1380
## 98  African American     155
## 99  African American     375
## 100        Caucasian    1311
## 101        Caucasian     298
## 102        Caucasian     431
## 103        Caucasian    1587
## 104        Caucasian    1050
## 105        Caucasian     745
## 106        Caucasian     210
## 107            Asian       0
## 108            Asian       0
## 109        Caucasian     227
## 110            Asian     297
## 111            Asian      47
## 112 African American       0
## 113        Caucasian    1046
## 114            Asian     768
## 115        Caucasian     271
## 116 African American     510
## 117        Caucasian       0
## 118            Asian    1341
```

```
## 119        Caucasian       0
## 120        Caucasian       0
## 121            Asian       0
## 122        Caucasian     454
## 123        Caucasian     904
## 124 African American       0
## 125        Caucasian       0
## 126        Caucasian       0
## 127            Asian    1404
## 128        Caucasian       0
## 129 African American    1259
## 130 African American     255
## 131 African American     868
## 132            Asian       0
## 133 African American     912
## 134 African American    1018
## 135 African American     835
## 136 African American       8
## 137 African American      75
## 138            Asian     187
## 139        Caucasian       0
## 140 African American    1597
## 141 African American    1425
## 142        Caucasian     605
## 143            Asian     669
## 144 African American     710
## 145        Caucasian      68
## 146            Asian     642
## 147        Caucasian     805
## 148        Caucasian       0
## 149        Caucasian       0
## 150            Asian       0
## 151 African American     581
## 152        Caucasian     534
## 153        Caucasian     156
## 154        Caucasian       0
## 155 African American       0
## 156            Asian       0
## 157        Caucasian     429
## 158        Caucasian    1020
## 159            Asian     653
## 160            Asian       0
## 161        Caucasian     836
## 162        Caucasian       0
## 163        Caucasian    1086
## 164 African American       0
## 165            Asian     548
## 166        Caucasian     570
## 167 African American       0
## 168        Caucasian       0
## 169            Asian       0
## 170        Caucasian    1099
```

```
## 171            Asian       0
## 172        Caucasian     283
## 173            Asian     108
## 174 African American     724
## 175 African American    1573
## 176        Caucasian       0
## 177        Caucasian       0
## 178            Asian     384
## 179        Caucasian     453
## 180        Caucasian    1237
## 181            Asian     423
## 182 African American     516
## 183 African American     789
## 184            Asian       0
## 185        Caucasian    1448
## 186 African American     450
## 187 African American     188
## 188            Asian       0
## 189 African American     930
## 190        Caucasian     126
## 191        Caucasian     538
## 192            Asian    1687
## 193            Asian     336
## 194        Caucasian    1426
## 195 African American       0
## 196 African American     802
## 197 African American     749
## 198 African American      69
## 199 African American       0
## 200            Asian     571
## 201 African American     829
## 202        Caucasian    1048
## 203        Caucasian       0
## 204 African American    1411
## 205        Caucasian     456
## 206        Caucasian     638
## 207        Caucasian       0
## 208        Caucasian    1216
## 209 African American     230
## 210 African American     732
## 211        Caucasian      95
## 212        Caucasian     799
## 213        Caucasian     308
## 214 African American     637
## 215        Caucasian     681
## 216        Caucasian     246
## 217            Asian      52
## 218        Caucasian     955
## 219            Asian     195
## 220        Caucasian     653
## 221            Asian    1246
## 222 African American    1230
```

```
## 223        Caucasian    1549
## 224            Asian     573
## 225        Caucasian     701
## 226            Asian    1075
## 227        Caucasian    1032
## 228        Caucasian     482
## 229 African American     156
## 230            Asian    1058
## 231 African American     661
## 232        Caucasian     657
## 233            Asian     689
## 234        Caucasian       0
## 235 African American    1329
## 236 African American     191
## 237            Asian     489
## 238            Asian     443
## 239        Caucasian      52
## 240            Asian     163
## 241            Asian     148
## 242 African American       0
## 243            Asian      16
## 244        Caucasian     856
## 245        Caucasian       0
## 246 African American       0
## 247            Asian     199
## 248        Caucasian       0
## 249        Caucasian       0
## 250        Caucasian      98
## 251            Asian       0
## 252        Caucasian     132
## 253        Caucasian    1355
## 254 African American     218
## 255        Caucasian    1048
## 256 African American     118
## 257            Asian       0
## 258            Asian       0
## 259        Caucasian       0
## 260        Caucasian    1092
## 261            Asian     345
## 262            Asian    1050
## 263        Caucasian     465
## 264 African American     133
## 265        Caucasian     651
## 266 African American     549
## 267        Caucasian      15
## 268            Asian     942
## 269        Caucasian       0
## 270        Caucasian     772
## 271        Caucasian     136
## 272        Caucasian     436
## 273            Asian     728
## 274            Asian    1255
```

```
## 275 African American     967
## 276        Caucasian     529
## 277        Caucasian     209
## 278        Caucasian     531
## 279        Caucasian     250
## 280        Caucasian     269
## 281 African American     541
## 282 African American       0
## 283        Caucasian    1298
## 284        Caucasian     890
## 285        Caucasian       0
## 286            Asian       0
## 287        Caucasian       0
## 288        Caucasian       0
## 289            Asian     863
## 290        Caucasian     485
## 291            Asian     159
## 292        Caucasian     309
## 293        Caucasian     481
## 294 African American    1677
## 295            Asian       0
## 296        Caucasian       0
## 297        Caucasian     293
## 298            Asian     188
## 299 African American       0
## 300 African American     711
## 301        Caucasian     580
## 302        Caucasian     172
## 303        Caucasian     295
## 304 African American     414
## 305            Asian     905
## 306            Asian       0
## 307        Caucasian      70
## 308            Asian       0
## 309            Asian     681
## 310        Caucasian     885
## 311 African American    1036
## 312        Caucasian     844
## 313        Caucasian     823
## 314            Asian     843
## 315 African American    1140
## 316        Caucasian     463
## 317            Asian    1142
## 318        Caucasian     136
## 319        Caucasian       0
## 320 African American       0
## 321 African American       5
## 322        Caucasian      81
## 323        Caucasian     265
## 324        Caucasian    1999
## 325            Asian     415
## 326        Caucasian     732
```

```
## 327        Caucasian    1361
## 328            Asian     984
## 329        Caucasian     121
## 330        Caucasian     846
## 331            Asian    1054
## 332        Caucasian     474
## 333        Caucasian     380
## 334 African American     182
## 335        Caucasian     594
## 336        Caucasian     194
## 337        Caucasian     926
## 338 African American       0
## 339        Caucasian     606
## 340 African American    1107
## 341 African American     320
## 342        Caucasian     426
## 343 African American     204
## 344        Caucasian     410
## 345            Asian     633
## 346        Caucasian       0
## 347            Asian     907
## 348        Caucasian    1192
## 349        Caucasian       0
## 350            Asian     503
## 351        Caucasian       0
## 352        Caucasian     302
## 353 African American     583
## 354        Caucasian     425
## 355            Asian     413
## 356 African American    1405
## 357        Caucasian     962
## 358            Asian       0
## 359        Caucasian     347
## 360 African American     611
## 361        Caucasian     712
## 362            Asian     382
## 363 African American     710
## 364        Caucasian     578
## 365            Asian    1243
## 366        Caucasian     790
## 367        Caucasian    1264
## 368 African American     216
## 369        Caucasian     345
## 370        Caucasian    1208
## 371        Caucasian     992
## 372        Caucasian       0
## 373        Caucasian     840
## 374        Caucasian    1003
## 375        Caucasian     588
## 376        Caucasian    1000
## 377 African American     767
## 378        Caucasian       0
```

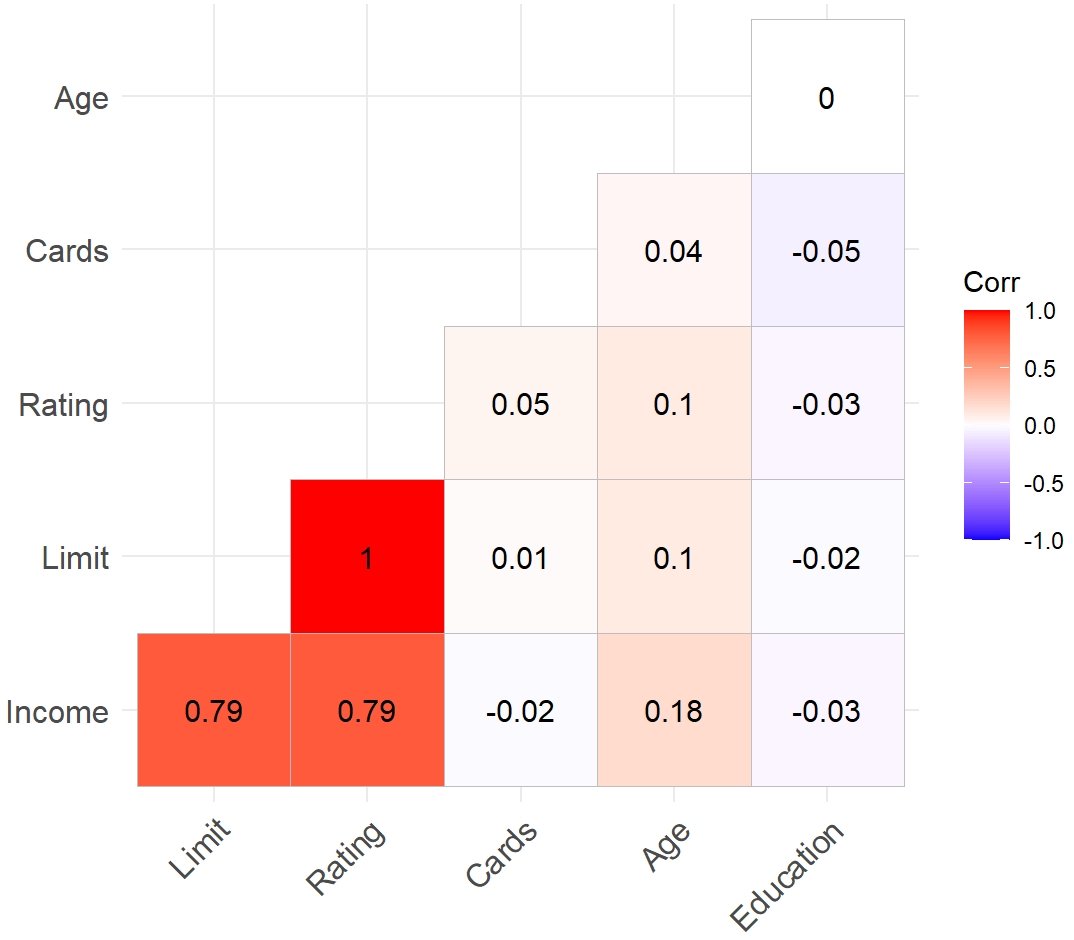
```
## 379        Caucasian     717
## 380        Caucasian       0
## 381 African American     661
## 382        Caucasian     849
## 383        Caucasian    1352
## 384        Caucasian     382
## 385 African American       0
## 386            Asian     905
## 387 African American     371
## 388            Asian       0
## 389        Caucasian    1129
## 390        Caucasian     806
## 391            Asian    1393
## 392        Caucasian     721
## 393            Asian       0
## 394 African American       0
## 395        Caucasian     734
## 396        Caucasian     560
## 397 African American     480
## 398        Caucasian     138
## 399        Caucasian       0
## 400            Asian     966
```

1

```
data <- data.frame(data)
data2 <- data[2:7]
cor_matrix <-round(cor(data2),2)
cor_matrix
```

```
##           Income Limit Rating Cards  Age Education
## Income      1.00  0.79   0.79 -0.02 0.18     -0.03
## Limit       0.79  1.00   1.00  0.01 0.10     -0.02
## Rating      0.79  1.00   1.00  0.05 0.10     -0.03
## Cards      -0.02  0.01   0.05  1.00 0.04     -0.05
## Age         0.18  0.10   0.10  0.04 1.00      0.00
## Education  -0.03 -0.02  -0.03 -0.05 0.00      1.00
```

```
library(ggcorrplot)
ggcorrplot(cor_matrix, lab = T, type = "lower")
```



There are issues with multicollinearity between Limit and Rating because their because correlation coefficients for pairwise comparisons between predictors ashould ideally be below 0.80

2

```
library(car)
```

```
## Loading required package: carData
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
## The following object is masked from 'package:purrr':
##
##     some
```

```
model1 <- lm(Balance~Income + Limit + Rating + Cards + Age + Education, data = data)

vif(model1)
```

```
##     Income      Limit     Rating      Cards        Age  Education
##   2.773276 228.848290 230.612596   1.433932   1.038541   1.008043
```

> After further investigation, Limit and Rating still have multicollinearity issues based on their VIF values.

```
model2 <- lm(Balance~Income + Rating + Cards + Age + Education, data = data)
```

```
vif(model2)
```

```
##    Income    Rating     Cards       Age Education
##  2.772528  2.720585  1.018348  1.038468  1.003614
```

> After eliminating Limit, the vif values have decreased for all predictors and there are no further multicollinearity.

3

```
model3 <- lm(Balance~Income + Rating + Cards + Age + Education, data = data)

coef(model3)
```

```
##  (Intercept)       Income       Rating        Cards          Age    Education
## -525.9182542   -7.5431353    3.9366411    2.5641756   -0.9018958    2.4071949
```

```
new_dat <- data.frame(Income = c(-7.5431353), Rating = c(3.9366411), Cards = c(2.5641756), Age =
c(-0.9018958), Education = c(2.4071949))

predict(model3, newdata = new_dat)
```

```
##         1
## -440.3392
```

```
predict(model3, newdata = new_dat, interval = "prediction", level = 0.95)
```

```
##         fit       lwr       upr
## 1 -440.3392 -771.5115 -109.1669
```

We are 95% confident that a specific individual would have a predicted balance values fall between -771.5115 and -109.1669

```
predict(model3, newdata = new_dat, interval = "confidence", level = 0.95)
```

```
##         fit       lwr       upr
## 1 -440.3392 -526.9088 -353.7696
```

We are 95% confident that the mean predicted balance values would fall between -536.9088 and -353.7696