Lab 10

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NOT DUE

Load up the Boston Housing Data and separate into `X` and `y`.

```
pacman::p_load(MASS)
y=Boston$medv
X=Boston[,1:13]
```

Similar to lab 1, write a function that takes a matrix and punches holes (i.e. sets entries equal to `NA`) randomly with an argument `prob_missing`.

```
punch_hole= function(X, prob_missing){
  nr = nrow(X)
  nc = ncol(X)
  M = matrix(rbinom(nr*nc,1,prob_missing),nrow=nr,ncol=nc)
  X[M==1] = NA
  X
}
```

Create a matrix `Xmiss` which is `X` but has missingness with probability of 10% using the previous function.

```
Xmiss = punch_hole(X, 0.10)
Xmiss
```

```
##         crim    zn indus chas    nox    rm   age     dis rad tax ptratio  black
## 1    0.00632  18.0  2.31    0 0.5380 6.575  65.2  4.0900   1 296    15.3     NA
## 2    0.02731   0.0  7.07    0 0.4690    NA  78.9      NA   2 242    17.8 396.90
## 3    0.02729   0.0  7.07    0 0.4690 7.185  61.1  4.9671   2 242    17.8     NA
## 4    0.03237   0.0  2.18    0 0.4580    NA    NA  6.0622   3 222    18.7     NA
## 5    0.06905   0.0  2.18    0 0.4580 7.147  54.2  6.0622   3 222    18.7 396.90
## 6    0.02985   0.0  2.18    0 0.4580 6.430  58.7  6.0622   3 222    18.7 394.12
## 7    0.08829  12.5  7.87   NA 0.5240 6.012  66.6  5.5605   5 311    15.2 395.60
## 8    0.14455  12.5  7.87    0 0.5240 6.172    NA  5.9505   5 311    15.2 396.90
## 9    0.21124    NA  7.87    0 0.5240 5.631 100.0  6.0821   5 311    15.2 386.63
## 10   0.17004    NA  7.87    0 0.5240 6.004  85.9      NA   5 311    15.2 386.71
## 11   0.22489  12.5  7.87    0 0.5240 6.377  94.3  6.3467   5 311    15.2 392.52
## 12   0.11747  12.5  7.87    0     NA 6.009  82.9  6.2267   5  NA    15.2 396.90
## 13   0.09378  12.5  7.87    0     NA 5.889  39.0  5.4509   5 311    15.2 390.50
## 14         NA   0.0    NA    0 0.5380 5.949  61.8  4.7075   4 307    21.0 396.90
## 15         NA   0.0  8.14   NA 0.5380 6.096  84.5  4.4619   4 307    21.0 380.02
## 16   0.62739   0.0  8.14    0 0.5380 5.834  56.5  4.4986   4 307    21.0 395.62
## 17   1.05393   0.0  8.14    0 0.5380 5.935  29.3  4.4986  NA 307      NA 386.85
## 18   0.78420   0.0  8.14    0 0.5380 5.990  81.7  4.2579   4 307    21.0 386.75
## 19   0.80271   0.0  8.14    0 0.5380 5.456  36.6  3.7965   4  NA    21.0     NA
## 20   0.72580   0.0  8.14    0     NA 5.727  69.5  3.7965   4 307    21.0 390.95
## 21   1.25179   0.0  8.14    0 0.5380 5.570  98.1  3.7979   4 307    21.0 376.57
## 22   0.85204   0.0  8.14    0 0.5380 5.965  89.2  4.0123  NA 307    21.0 392.53
```

```
## 23   1.23247   0.0  8.14    0 0.5380 6.142    NA  3.9769  NA  NA    21.0 396.90
## 24        NA   0.0  8.14    0     NA    NA 100.0      NA   4 307    21.0 394.54
## 25   0.75026   0.0  8.14    0 0.5380 5.924  94.1  4.3996   4 307    21.0 394.33
## 26   0.84054    NA  8.14    0 0.5380 5.599  85.7  4.4546   4 307    21.0 303.42
## 27   0.67191   0.0  8.14    0 0.5380 5.813  90.3  4.6820   4 307    21.0 376.88
## 28   0.95577    NA  8.14    0 0.5380 6.047  88.8  4.4534   4 307    21.0 306.38
## 29   0.77299   0.0  8.14    0 0.5380 6.495  94.4  4.4547   4  NA    21.0 387.94
## 30   1.00245   0.0  8.14   NA 0.5380 6.674  87.3  4.2390   4 307    21.0 380.23
## 31   1.13081    NA  8.14    0 0.5380 5.713  94.1  4.2330   4 307    21.0 360.17
## 32   1.35472   0.0  8.14    0 0.5380 6.072 100.0  4.1750   4 307    21.0 376.73
## 33   1.38799   0.0  8.14    0 0.5380 5.950  82.0  3.9900   4 307    21.0 232.60
## 34   1.15172   0.0  8.14    0 0.5380 5.701  95.0  3.7872   4 307    21.0     NA
## 35        NA   0.0  8.14    0 0.5380 6.096    NA  3.7598   4 307    21.0 248.31
## 36   0.06417   0.0  5.96    0 0.4990 5.933    NA  3.3603   5 279    19.2 396.90
## 37   0.09744   0.0  5.96    0     NA 5.841  61.4  3.3779  NA 279    19.2 377.56
## 38   0.08014   0.0  5.96    0 0.4990 5.850  41.5  3.9342   5 279    19.2 396.90
## 39        NA   0.0    NA    0 0.4990 5.966  30.2  3.8473   5 279    19.2 393.43
## 40   0.02763  75.0  2.95    0 0.4280 6.595  21.8  5.4011   3 252    18.3 395.63
## 41   0.03359  75.0  2.95    0 0.4280 7.024  15.8  5.4011   3  NA    18.3     NA
## 42   0.12744   0.0  6.91    0 0.4480    NA   2.9      NA   3 233    17.9 385.41
## 43   0.14150   0.0  6.91    0 0.4480 6.169   6.6  5.7209  NA 233    17.9 383.37
## 44   0.15936   0.0  6.91    0 0.4480 6.211   6.5  5.7209   3 233    17.9 394.46
## 45   0.12269   0.0  6.91   NA 0.4480 6.069  40.0  5.7209   3 233    17.9 389.39
## 46   0.17142   0.0  6.91    0 0.4480 5.682  33.8      NA   3  NA    17.9 396.90
## 47   0.18836   0.0  6.91    0 0.4480 5.786  33.3      NA   3 233    17.9 396.90
## 48   0.22927   0.0  6.91   NA 0.4480 6.030  85.5  5.6894   3 233    17.9 392.74
## 49        NA   0.0  6.91    0 0.4480    NA    NA  5.8700   3 233      NA 396.90
## 50   0.21977   0.0  6.91    0 0.4480 5.602  62.0  6.0877   3 233    17.9 396.90
## 51   0.08873  21.0    NA    0 0.4390    NA  45.7  6.8147   4 243    16.8 395.56
## 52   0.04337  21.0  5.64    0 0.4390 6.115  63.0  6.8147   4 243    16.8 393.97
## 53   0.05360  21.0  5.64    0 0.4390 6.511    NA      NA   4 243    16.8 396.90
## 54   0.04981  21.0  5.64    0 0.4390 5.998  21.4  6.8147   4 243    16.8 396.90
## 55   0.01360  75.0  4.00    0 0.4100 5.888  47.6  7.3197   3 469    21.1 396.90
## 56   0.01311  90.0  1.22    0 0.4030 7.249  21.9  8.6966   5 226    17.9     NA
## 57        NA  85.0  0.74    0 0.4100 6.383  35.7      NA   2 313    17.3 396.90
## 58        NA 100.0  1.32    0 0.4110    NA  40.5  8.3248   5 256    15.1 392.90
## 59        NA  25.0  5.13    0     NA    NA  29.2      NA   8 284      NA     NA
## 60   0.10328  25.0  5.13    0 0.4530 5.927    NA  6.9320  NA 284    19.7 396.90
## 61        NA  25.0  5.13    0     NA 5.741  66.2  7.2254   8 284    19.7 395.11
## 62   0.17171  25.0  5.13    0 0.4530 5.966  93.4      NA   8 284      NA     NA
## 63   0.11027  25.0  5.13    0 0.4530 6.456  67.8  7.2255   8 284    19.7 396.90
## 64   0.12650  25.0    NA    0 0.4530 6.762    NA  7.9809   8 284      NA     NA
## 65   0.01951  17.5  1.38    0     NA    NA  59.5  9.2229   3 216    18.6 393.24
## 66   0.03584  80.0  3.37    0     NA 6.290  17.8  6.6115   4 337    16.1 396.90
## 67   0.04379  80.0  3.37    0 0.3980 5.787  31.1  6.6115   4 337      NA 396.90
## 68   0.05789    NA  6.07    0 0.4090    NA  21.4  6.4980   4 345    18.9 396.21
## 69   0.13554  12.5    NA    0 0.4090 5.594  36.8  6.4980   4 345    18.9 396.90
## 70   0.12816  12.5  6.07    0 0.4090    NA  33.0  6.4980   4 345    18.9 396.90
## 71   0.08826   0.0 10.81    0     NA 6.417   6.6  5.2873   4 305    19.2 383.73
## 72   0.15876   0.0 10.81    0 0.4130 5.961  17.5  5.2873   4 305    19.2 376.94
## 73   0.09164   0.0 10.81    0     NA 6.065   7.8  5.2873   4 305    19.2 390.91
## 74   0.19539   0.0 10.81    0 0.4130 6.245   6.2  5.2873   4 305    19.2 377.17
## 75   0.07896   0.0 12.83    0 0.4370 6.273   6.0  4.2515   5  NA    18.7 394.92
## 76   0.09512   0.0 12.83    0 0.4370 6.286  45.0  4.5026   5 398    18.7     NA
```

```
## 77   0.10153   0.0 12.83    0 0.4370 6.279  74.5  4.0522   5 398    18.7 373.66
## 78   0.08707   0.0 12.83   NA 0.4370 6.140  45.8      NA   5 398    18.7 386.96
## 79   0.05646   0.0    NA    0 0.4370 6.232  53.7  5.0141   5 398    18.7 386.40
## 80   0.08387    NA 12.83    0 0.4370    NA  36.6  4.5026   5 398    18.7 396.06
## 81   0.04113  25.0    NA    0 0.4260 6.727  33.5      NA   4 281    19.0 396.90
## 82   0.04462  25.0  4.86    0 0.4260 6.619  70.4  5.4007   4 281    19.0 395.63
## 83        NA  25.0  4.86    0 0.4260 6.302    NA  5.4007  NA  NA    19.0 396.90
## 84   0.03551  25.0  4.86    0 0.4260 6.167  46.7  5.4007   4 281    19.0 390.64
## 85   0.05059   0.0    NA   NA     NA 6.389  48.0  4.7794   3 247    18.5     NA
## 86   0.05735   0.0  4.49    0 0.4490 6.630    NA  4.4377   3 247      NA 392.30
## 87   0.05188   0.0  4.49   NA 0.4490 6.015    NA  4.4272   3 247    18.5 395.99
## 88   0.07151    NA  4.49    0     NA 6.121  56.8  3.7476   3 247    18.5 395.15
## 89   0.05660   0.0  3.41    0 0.4890 7.007    NA  3.4217   2 270    17.8 396.90
## 90   0.05302   0.0  3.41   NA 0.4890 7.079  63.1  3.4145   2 270    17.8     NA
## 91   0.04684   0.0  3.41    0 0.4890 6.417  66.1  3.0923  NA 270    17.8 392.18
## 92   0.03932   0.0  3.41    0 0.4890 6.405  73.9  3.0921   2 270    17.8     NA
## 93   0.04203  28.0 15.04    0 0.4640 6.442    NA  3.6659   4 270    18.2 395.01
## 94   0.02875  28.0 15.04    0 0.4640 6.211  28.9  3.6659   4 270    18.2 396.33
## 95   0.04294  28.0    NA    0 0.4640 6.249  77.3  3.6150   4 270    18.2 396.90
## 96   0.12204   0.0  2.89    0 0.4450 6.625  57.8  3.4952  NA 276    18.0     NA
## 97   0.11504   0.0  2.89    0     NA 6.163  69.6  3.4952   2 276    18.0 391.83
## 98   0.12083   0.0  2.89    0 0.4450 8.069  76.0  3.4952   2 276    18.0 396.90
## 99   0.08187   0.0  2.89    0 0.4450    NA    NA  3.4952   2 276    18.0 393.53
## 100  0.06860   0.0  2.89    0 0.4450 7.416  62.5  3.4952   2 276      NA 396.90
## 101  0.14866   0.0  8.56    0 0.5200 6.727  79.9  2.7778   5 384    20.9 394.76
## 102  0.11432   0.0  8.56    0 0.5200 6.781  71.3  2.8561   5 384    20.9     NA
## 103       NA   0.0  8.56    0     NA 6.405  85.4  2.7147   5  NA    20.9  70.80
## 104       NA   0.0  8.56    0 0.5200 6.137    NA  2.7147   5 384    20.9 394.47
## 105  0.13960   0.0  8.56    0 0.5200 6.167  90.0  2.4210   5 384    20.9 392.69
## 106  0.13262   0.0  8.56    0 0.5200 5.851  96.7  2.1069   5  NA    20.9     NA
## 107  0.17120   0.0  8.56    0 0.5200 5.836  91.9  2.2110   5 384    20.9 395.67
## 108  0.13117   0.0  8.56    0 0.5200 6.127  85.2  2.1224   5 384    20.9     NA
## 109  0.12802   0.0  8.56    0 0.5200 6.474  97.1  2.4329   5 384    20.9 395.24
## 110  0.26363    NA  8.56    0 0.5200 6.229  91.2      NA   5 384    20.9 391.23
## 111  0.10793   0.0  8.56    0 0.5200 6.195    NA      NA   5 384    20.9 393.49
## 112  0.10084   0.0 10.01    0 0.5470 6.715  81.6  2.6775   6 432    17.8 395.59
## 113       NA    NA 10.01    0 0.5470 5.913  92.9  2.3534   6 432    17.8 394.95
## 114  0.22212   0.0    NA    0 0.5470 6.092  95.4  2.5480  NA  NA      NA 396.90
## 115  0.14231   0.0 10.01   NA 0.5470    NA  84.2  2.2565   6 432    17.8     NA
## 116  0.17134   0.0 10.01    0 0.5470 5.928  88.2  2.4631   6 432    17.8 344.91
## 117  0.13158    NA 10.01    0 0.5470 6.176  72.5  2.7301   6 432    17.8 393.30
## 118  0.15098   0.0 10.01   NA 0.5470 6.021  82.6  2.7474   6 432    17.8 394.51
## 119  0.13058   0.0 10.01    0 0.5470 5.872  73.1      NA   6 432    17.8     NA
## 120  0.14476   0.0 10.01    0 0.5470 5.731  65.2  2.7592  NA 432    17.8 391.50
## 121  0.06899   0.0 25.65    0 0.5810 5.870  69.7  2.2577  NA  NA    19.1 389.15
## 122  0.07165   0.0 25.65    0 0.5810 6.004  84.1  2.1974   2 188    19.1 377.67
## 123  0.09299   0.0 25.65    0 0.5810    NA  92.9  2.0869   2 188      NA 378.09
## 124  0.15038   0.0 25.65    0 0.5810 5.856  97.0  1.9444   2 188    19.1 370.31
## 125  0.09849   0.0 25.65    0 0.5810 5.879  95.8  2.0063   2  NA    19.1 379.38
## 126  0.16902   0.0 25.65    0 0.5810    NA  88.4  1.9929   2 188    19.1     NA
## 127  0.38735   0.0    NA    0 0.5810 5.613  95.6  1.7572   2 188      NA 359.29
## 128  0.25915   0.0 21.89    0 0.6240 5.693  96.0  1.7883   4 437    21.2 392.11
## 129  0.32543   0.0 21.89    0 0.6240 6.431  98.8  1.8125   4 437    21.2 396.90
## 130  0.88125    NA    NA    0 0.6240    NA    NA      NA   4 437    21.2 396.90
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## 131  0.34006   0.0 21.89   NA 0.6240 6.458  98.9  2.1185   4 437    21.2     NA
## 132  1.19294   0.0 21.89    0     NA 6.326    NA  2.2710   4 437    21.2 396.90
## 133       NA   0.0 21.89    0 0.6240 6.372    NA  2.3274  NA 437    21.2 385.76
## 134  0.32982   0.0 21.89    0 0.6240 5.822  95.4  2.4699   4 437    21.2 388.69
## 135  0.97617    NA    NA    0 0.6240 5.757  98.4  2.3460  NA 437    21.2 262.76
## 136  0.55778   0.0    NA    0 0.6240 6.335    NA  2.1107   4 437    21.2 394.67
## 137  0.32264   0.0 21.89    0 0.6240 5.942  93.5      NA   4 437    21.2 378.25
## 138  0.35233   0.0 21.89    0 0.6240    NA  98.4  1.8498   4 437    21.2 394.08
## 139  0.24980   0.0 21.89    0 0.6240 5.857  98.2  1.6686   4 437    21.2 392.04
## 140  0.54452   0.0 21.89    0 0.6240    NA  97.9  1.6687   4 437    21.2 396.90
## 141  0.29090    NA 21.89    0 0.6240 6.174  93.6  1.6119   4 437    21.2 388.08
## 142  1.62864   0.0 21.89    0 0.6240 5.019 100.0  1.4394  NA 437    21.2 396.90
## 143  3.32105   0.0 19.58    1     NA 5.403 100.0  1.3216   5 403    14.7 396.90
## 144  4.09740   0.0 19.58    0 0.8710 5.468 100.0  1.4118   5 403    14.7 396.90
## 145  2.77974   0.0 19.58    0 0.8710 4.903  97.8  1.3459   5 403    14.7 396.90
## 146  2.37934   0.0    NA    0 0.8710    NA 100.0      NA   5 403    14.7 172.91
## 147  2.15505   0.0 19.58    0 0.8710 5.628 100.0  1.5166   5 403    14.7 169.27
## 148  2.36862    NA 19.58    0 0.8710 4.926  95.7  1.4608   5 403    14.7 391.71
## 149  2.33099   0.0 19.58    0 0.8710 5.186  93.8      NA   5 403    14.7 356.99
## 150  2.73397   0.0 19.58    0 0.8710 5.597  94.9  1.5257   5  NA    14.7 351.85
## 151  1.65660   0.0 19.58    0 0.8710    NA  97.3  1.6180   5 403    14.7 372.80
## 152  1.49632    NA 19.58    0 0.8710 5.404 100.0  1.5916   5  NA    14.7 341.60
## 153  1.12658   0.0 19.58    1 0.8710 5.012  88.0  1.6102   5 403    14.7 343.28
## 154  2.14918   0.0 19.58    0 0.8710 5.709  98.5  1.6232   5  NA    14.7 261.95
## 155  1.41385   0.0 19.58    1 0.8710    NA  96.0  1.7494   5 403    14.7 321.02
## 156  3.53501   0.0 19.58    1 0.8710 6.152  82.6      NA   5 403    14.7  88.01
## 157  2.44668   0.0 19.58    0 0.8710 5.272  94.0  1.7364   5 403    14.7  88.63
## 158  1.22358   0.0 19.58    0 0.6050 6.943  97.4  1.8773   5 403    14.7 363.43
## 159  1.34284   0.0 19.58    0 0.6050 6.066 100.0  1.7573   5  NA    14.7 353.89
## 160       NA   0.0 19.58    0 0.8710 6.510 100.0  1.7659   5 403    14.7 364.31
## 161  1.27346   0.0 19.58    1 0.6050 6.250    NA      NA   5 403    14.7 338.92
## 162  1.46336   0.0 19.58    0 0.6050 7.489  90.8  1.9709   5 403    14.7 374.43
## 163  1.83377   0.0 19.58    1 0.6050 7.802  98.2  2.0407   5  NA    14.7 389.61
## 164  1.51902   0.0 19.58    1 0.6050 8.375  93.9  2.1620   5  NA    14.7 388.45
## 165  2.24236   0.0 19.58    0 0.6050 5.854  91.8  2.4220   5 403    14.7 395.11
## 166  2.92400   0.0 19.58    0 0.6050 6.101  93.0      NA   5 403    14.7 240.16
## 167  2.01019    NA 19.58    0 0.6050 7.929  96.2  2.0459   5 403    14.7 369.30
## 168  1.80028   0.0 19.58    0 0.6050 5.877  79.2  2.4259   5 403    14.7 227.61
## 169       NA   0.0 19.58    0 0.6050 6.319  96.1  2.1000   5 403    14.7 297.09
## 170  2.44953   0.0 19.58    0 0.6050 6.402  95.2  2.2625   5 403    14.7 330.04
## 171       NA   0.0 19.58    0 0.6050 5.875  94.6  2.4259   5 403      NA 292.29
## 172  2.31390   0.0 19.58    0 0.6050 5.880  97.3  2.3887   5 403    14.7     NA
## 173  0.13914   0.0  4.05    0 0.5100    NA  88.5  2.5961   5 296    16.6 396.90
## 174  0.09178   0.0  4.05    0 0.5100 6.416  84.1  2.6463   5 296    16.6 395.50
## 175  0.08447   0.0  4.05    0 0.5100 5.859  68.7  2.7019   5 296    16.6     NA
## 176  0.06664   0.0  4.05   NA 0.5100 6.546  33.1  3.1323   5 296    16.6 390.96
## 177       NA   0.0  4.05    0 0.5100 6.020  47.2  3.5549  NA 296    16.6 393.23
## 178  0.05425    NA  4.05    0 0.5100 6.315  73.4  3.3175  NA 296    16.6 395.60
## 179  0.06642   0.0  4.05    0 0.5100 6.860    NA  2.9153   5 296    16.6 391.27
## 180  0.05780   0.0  2.46    0     NA 6.980    NA  2.8290   3 193      NA 396.90
## 181  0.06588    NA  2.46    0 0.4880 7.765  83.3  2.7410   3  NA    17.8 395.56
## 182       NA   0.0    NA    0     NA 6.144  62.2  2.5979   3 193    17.8 396.90
## 183  0.09103   0.0    NA    0 0.4880 7.155  92.2  2.7006   3 193    17.8     NA
## 184  0.10008   0.0  2.46    0 0.4880 6.563  95.6      NA   3 193    17.8 396.90
```

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## 185  0.08308   0.0    NA    0 0.4880 5.604  89.8      NA   3 193      NA 391.00
## 186  0.06047   0.0  2.46    0 0.4880 6.153  68.8  3.2797   3 193    17.8 387.11
## 187  0.05602   0.0  2.46    0 0.4880 7.831  53.6  3.1992   3 193    17.8 392.63
## 188  0.07875  45.0  3.44    0 0.4370 6.782  41.1  3.7886   5  NA    15.2 393.87
## 189  0.12579  45.0  3.44    0 0.4370 6.556    NA  4.5667  NA 398    15.2 382.84
## 190       NA  45.0  3.44    0 0.4370 7.185  38.9  4.5667   5 398    15.2 396.90
## 191  0.09068  45.0  3.44   NA     NA 6.951  21.5  6.4798   5 398    15.2 377.68
## 192  0.06911  45.0  3.44    0 0.4370 6.739  30.8  6.4798   5 398    15.2 389.71
## 193  0.08664  45.0  3.44    0 0.4370 7.178  26.3  6.4798   5 398    15.2     NA
## 194  0.02187  60.0  2.93    0 0.4010    NA   9.9  6.2196   1 265    15.6 393.37
## 195  0.01439  60.0  2.93    0 0.4010    NA  18.8  6.2196   1  NA    15.6 376.70
## 196  0.01381  80.0  0.46    0 0.4220    NA  32.0  5.6484   4 255      NA 394.23
## 197  0.04011  80.0  1.52    0 0.4040 7.287  34.1  7.3090   2 329    12.6     NA
## 198  0.04666  80.0  1.52   NA 0.4040 7.107  36.6  7.3090   2 329      NA 354.31
## 199  0.03768  80.0  1.52    0     NA    NA  38.3  7.3090   2 329    12.6 392.20
## 200  0.03150  95.0  1.47    0 0.4030 6.975  15.3  7.6534   3 402    17.0 396.90
## 201  0.01778  95.0  1.47    0 0.4030 7.135  13.9  7.6534  NA 402    17.0 384.30
## 202       NA  82.5  2.03   NA 0.4150 6.162  38.4      NA   2 348    14.7 393.77
## 203  0.02177  82.5  2.03    0 0.4150 7.610  15.7  6.2700   2 348    14.7 395.38
## 204  0.03510  95.0  2.68    0 0.4161 7.853  33.2  5.1180   4 224    14.7 392.78
## 205  0.02009  95.0  2.68    0     NA 8.034    NA      NA   4  NA    14.7 390.55
## 206  0.13642   0.0 10.59    0 0.4890    NA  22.3  3.9454   4 277    18.6 396.90
## 207  0.22969   0.0    NA    0 0.4890 6.326  52.5  4.3549   4 277      NA 394.87
## 208       NA   0.0 10.59    0 0.4890 5.783  72.7  4.3549   4 277    18.6 389.43
## 209  0.13587   0.0 10.59    1 0.4890 6.064    NA  4.2392   4 277    18.6 381.32
## 210  0.43571   0.0 10.59    1 0.4890 5.344 100.0  3.8750   4 277    18.6 396.90
## 211  0.17446   0.0 10.59    1 0.4890 5.960  92.1  3.8771   4 277    18.6     NA
## 212  0.37578   0.0    NA    1 0.4890 5.404  88.6  3.6650   4 277    18.6     NA
## 213  0.21719   0.0 10.59    1 0.4890 5.807  53.8  3.6526   4 277    18.6 390.94
## 214  0.14052   0.0 10.59    0 0.4890 6.375  32.3  3.9454   4 277      NA     NA
## 215  0.28955    NA 10.59    0 0.4890 5.412   9.8  3.5875   4 277    18.6 348.93
## 216  0.19802   0.0 10.59    0 0.4890 6.182  42.4  3.9454   4 277    18.6 393.63
## 217       NA   0.0 13.89    1     NA 5.888  56.0  3.1121   5 276    16.4 392.80
## 218  0.07013   0.0 13.89    0 0.5500 6.642  85.1  3.4211   5  NA    16.4 392.78
## 219  0.11069   0.0 13.89    1 0.5500 5.951  93.8  2.8893   5 276    16.4 396.90
## 220  0.11425   0.0 13.89    1 0.5500 6.373  92.4  3.3633   5 276    16.4 393.74
## 221  0.35809   0.0  6.20    1 0.5070 6.951  88.5      NA   8 307      NA 391.70
## 222  0.40771   0.0  6.20    1 0.5070 6.164  91.3      NA   8 307    17.4 395.24
## 223  0.62356   0.0  6.20    1 0.5070 6.879  77.7  3.2721   8 307    17.4     NA
## 224  0.61470   0.0  6.20    0 0.5070 6.618  80.8  3.2721   8 307    17.4 396.90
## 225  0.31533   0.0  6.20    0     NA 8.266  78.3  2.8944   8 307    17.4     NA
## 226  0.52693   0.0    NA    0 0.5040 8.725  83.0  2.8944   8 307    17.4 382.00
## 227  0.38214   0.0  6.20    0 0.5040    NA    NA  3.2157   8 307    17.4 387.38
## 228  0.41238   0.0  6.20    0 0.5040 7.163  79.9      NA  NA 307    17.4 372.08
## 229  0.29819   0.0  6.20    0 0.5040 7.686  17.0  3.3751   8 307    17.4 377.51
## 230  0.44178   0.0  6.20    0 0.5040 6.552  21.4  3.3751   8 307    17.4 380.34
## 231  0.53700   0.0  6.20    0 0.5040 5.981  68.1      NA   8 307    17.4 378.35
## 232  0.46296   0.0  6.20    0 0.5040 7.412  76.9  3.6715   8 307    17.4 376.14
## 233  0.57529   0.0  6.20    0 0.5070 8.337  73.3  3.8384   8 307    17.4 385.91
## 234  0.33147   0.0  6.20    0 0.5070 8.247  70.4  3.6519   8 307    17.4 378.95
## 235  0.44791   0.0  6.20    1 0.5070 6.726  66.5  3.6519   8 307    17.4 360.20
## 236       NA   0.0  6.20    0 0.5070 6.086  61.5  3.6519   8 307      NA 376.75
## 237  0.52058   0.0  6.20    1 0.5070 6.631  76.5  4.1480   8 307    17.4 388.45
## 238  0.51183   0.0    NA    0 0.5070 7.358  71.6  4.1480   8 307    17.4 390.07
```

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## 239  0.08244  30.0  4.93    0 0.4280    NA  18.5  6.1899   6 300    16.6 379.41
## 240  0.09252    NA  4.93    0 0.4280 6.606  42.2  6.1899   6 300    16.6 383.78
## 241  0.11329  30.0  4.93    0 0.4280 6.897  54.3  6.3361   6 300      NA 391.25
## 242  0.10612  30.0  4.93    0 0.4280 6.095  65.1      NA   6 300    16.6     NA
## 243  0.10290    NA  4.93    0 0.4280 6.358    NA  7.0355   6 300    16.6 372.75
## 244  0.12757  30.0  4.93   NA 0.4280 6.393   7.8  7.0355   6  NA    16.6 374.71
## 245  0.20608  22.0  5.86    0 0.4310 5.593  76.5  7.9549   7 330    19.1 372.49
## 246  0.19133  22.0  5.86    0 0.4310    NA  70.2  7.9549   7 330    19.1 389.13
## 247  0.33983  22.0  5.86    0     NA 6.108  34.9  8.0555   7 330    19.1 390.18
## 248  0.19657  22.0  5.86    0 0.4310 6.226    NA  8.0555   7  NA      NA 376.14
## 249  0.16439  22.0  5.86    0 0.4310 6.433  49.1  7.8265   7 330    19.1 374.71
## 250  0.19073    NA  5.86    0 0.4310 6.718    NA  7.8265   7 330    19.1 393.74
## 251  0.14030    NA  5.86    0     NA 6.487  13.0  7.3967   7 330    19.1 396.28
## 252  0.21409  22.0  5.86    0 0.4310 6.438   8.9  7.3967   7 330    19.1     NA
## 253  0.08221  22.0  5.86    0 0.4310 6.957   6.8  8.9067   7 330    19.1 386.09
## 254  0.36894    NA  5.86    0     NA 8.259   8.4  8.9067   7 330    19.1 396.90
## 255  0.04819  80.0  3.64    0 0.3920 6.108  32.0      NA   1  NA    16.4 392.89
## 256  0.03548  80.0  3.64   NA 0.3920 5.876  19.1  9.2203   1 315    16.4 395.18
## 257  0.01538  90.0  3.75    0 0.3940 7.454  34.2  6.3361   3 244    15.9 386.34
## 258  0.61154  20.0    NA    0 0.6470 8.704  86.9  1.8010   5 264    13.0     NA
## 259  0.66351  20.0  3.97    0 0.6470    NA 100.0  1.8946   5 264    13.0 383.29
## 260  0.65665  20.0  3.97    0 0.6470 6.842 100.0  2.0107   5 264    13.0 391.93
## 261  0.54011  20.0  3.97    0 0.6470 7.203  81.8  2.1121  NA 264    13.0 392.80
## 262  0.53412  20.0  3.97    0 0.6470 7.520  89.4  2.1398   5 264    13.0 388.37
## 263  0.52014  20.0    NA    0 0.6470 8.398    NA  2.2885   5  NA    13.0 386.86
## 264  0.82526  20.0  3.97    0 0.6470 7.327  94.5  2.0788   5 264      NA 393.42
## 265  0.55007  20.0  3.97    0 0.6470    NA  91.6  1.9301   5 264    13.0     NA
## 266  0.76162  20.0  3.97    0 0.6470 5.560  62.8  1.9865   5 264    13.0 392.40
## 267  0.78570  20.0  3.97    0 0.6470 7.014  84.6  2.1329   5 264    13.0 384.07
## 268  0.57834  20.0  3.97    0 0.5750    NA  67.0  2.4216  NA 264    13.0 384.54
## 269  0.54050  20.0  3.97    0 0.5750 7.470  52.6  2.8720   5 264    13.0 390.30
## 270  0.09065  20.0  6.96   NA 0.4640 5.920  61.5  3.9175   3 223    18.6     NA
## 271  0.29916  20.0  6.96    0 0.4640 5.856  42.1  4.4290  NA 223    18.6 388.65
## 272  0.16211  20.0  6.96    0 0.4640 6.240  16.3  4.4290   3 223    18.6 396.90
## 273  0.11460  20.0  6.96    0 0.4640 6.538  58.7  3.9175   3 223    18.6 394.96
## 274  0.22188    NA  6.96   NA 0.4640 7.691  51.8  4.3665   3 223    18.6 390.77
## 275       NA    NA  6.41    1 0.4470 6.758  32.9  4.0776   4 254    17.6 396.90
## 276       NA    NA  6.41    0 0.4470 6.854  42.8  4.2673   4 254    17.6     NA
## 277  0.10469  40.0  6.41    1 0.4470 7.267  49.0  4.7872   4  NA    17.6 389.25
## 278  0.06127  40.0  6.41   NA     NA 6.826  27.6  4.8628   4 254    17.6 393.45
## 279       NA  40.0  6.41    0 0.4470 6.482  32.1  4.1403   4 254    17.6 396.90
## 280  0.21038  20.0  3.33   NA 0.4429 6.812  32.2  4.1007   5 216    14.9 396.90
## 281  0.03578  20.0  3.33    0 0.4429 7.820  64.5      NA   5 216    14.9     NA
## 282  0.03705  20.0    NA    0 0.4429 6.968  37.2  5.2447  NA 216    14.9 392.23
## 283  0.06129  20.0    NA    1 0.4429 7.645  49.7  5.2119   5 216    14.9 377.07
## 284  0.01501  90.0  1.21    1 0.4010 7.923  24.8      NA   1 198    13.6 395.52
## 285  0.00906  90.0  2.97    0 0.4000 7.088  20.8  7.3073   1 285    15.3 394.72
## 286       NA  55.0  2.25    0 0.3890    NA  31.9  7.3073   1 300    15.3 394.72
## 287  0.01965  80.0  1.76    0 0.3850 6.230  31.5  9.0892   1 241    18.2 341.60
## 288  0.03871  52.5  5.32   NA 0.4050 6.209  31.3      NA   6  NA    16.6 396.90
## 289  0.04590  52.5  5.32    0 0.4050 6.315  45.6  7.3172   6 293    16.6 396.90
## 290  0.04297  52.5  5.32    0 0.4050 6.565  22.9  7.3172   6 293    16.6 371.72
## 291  0.03502  80.0  4.95    0     NA 6.861    NA  5.1167   4 245    19.2 396.90
## 292       NA  80.0  4.95    0 0.4110 7.148  27.7  5.1167   4 245    19.2 396.90
```

```
## 293       NA  80.0  4.95    0 0.4110 6.630  23.4  5.1167   4 245    19.2 396.90
## 294  0.08265   0.0 13.92   NA     NA    NA  18.4  5.5027   4 289    16.0 396.90
## 295  0.08199   0.0 13.92    0 0.4370 6.009  42.3  5.5027  NA  NA    16.0 396.90
## 296  0.12932   0.0 13.92    0 0.4370 6.678    NA  5.9604   4 289    16.0 396.90
## 297  0.05372   0.0 13.92    0 0.4370 6.549    NA  5.9604   4 289    16.0 392.85
## 298  0.14103    NA 13.92    0 0.4370 5.790  58.0  6.3200   4 289    16.0 396.90
## 299  0.06466  70.0  2.24    0 0.4000 6.345  20.1  7.8278   5 358    14.8     NA
## 300  0.05561    NA  2.24    0 0.4000 7.041  10.0  7.8278  NA  NA    14.8 371.58
## 301  0.04417  70.0  2.24    0     NA 6.871  47.4  7.8278  NA 358    14.8 390.86
## 302  0.03537  34.0  6.09    0 0.4330 6.590    NA  5.4917   7 329    16.1 395.75
## 303  0.09266  34.0  6.09    0 0.4330 6.495  18.4  5.4917   7 329    16.1 383.61
## 304  0.10000  34.0  6.09    0 0.4330 6.982  17.7  5.4917   7 329    16.1 390.43
## 305  0.05515    NA  2.18    0 0.4720 7.236  41.1  4.0220   7 222    18.4 393.68
## 306  0.05479  33.0  2.18    0 0.4720 6.616  58.1  3.3700   7 222    18.4 393.36
## 307  0.07503  33.0  2.18   NA 0.4720 7.420  71.9  3.0992   7 222      NA     NA
## 308  0.04932  33.0  2.18    0 0.4720 6.849  70.3  3.1827   7 222    18.4 396.90
## 309  0.49298   0.0    NA    0 0.5440 6.635  82.5      NA   4 304    18.4 396.90
## 310  0.34940   0.0  9.90    0 0.5440 5.972  76.7  3.1025   4 304    18.4 396.24
## 311  2.63548   0.0  9.90    0 0.5440 4.973  37.8  2.5194   4 304    18.4 350.45
## 312  0.79041   0.0  9.90    0 0.5440    NA  52.8  2.6403   4 304    18.4 396.90
## 313  0.26169   0.0  9.90    0 0.5440 6.023  90.4  2.8340   4 304    18.4 396.30
## 314  0.26938    NA  9.90    0 0.5440 6.266    NA  3.2628  NA 304    18.4 393.39
## 315  0.36920   0.0  9.90    0 0.5440    NA  87.3  3.6023   4 304    18.4 395.69
## 316  0.25356   0.0  9.90    0 0.5440 5.705  77.7      NA   4 304    18.4 396.42
## 317  0.31827    NA  9.90    0 0.5440 5.914  83.2  3.9986   4 304    18.4 390.70
## 318  0.24522   0.0  9.90    0     NA 5.782  71.7  4.0317   4 304    18.4 396.90
## 319  0.40202   0.0  9.90   NA 0.5440 6.382  67.2  3.5325   4 304    18.4 395.21
## 320       NA   0.0  9.90    0 0.5440 6.113  58.8  4.0019  NA 304    18.4 396.23
## 321  0.16760   0.0  7.38    0 0.4930 6.426  52.3      NA   5 287    19.6     NA
## 322  0.18159   0.0  7.38    0 0.4930 6.376  54.3  4.5404   5 287      NA 396.90
## 323  0.35114   0.0  7.38    0 0.4930 6.041  49.9  4.7211   5 287    19.6 396.90
## 324  0.28392   0.0  7.38    0 0.4930 5.708  74.3  4.7211   5 287    19.6     NA
## 325  0.34109   0.0  7.38    0 0.4930 6.415  40.1  4.7211   5  NA    19.6 396.90
## 326  0.19186   0.0  7.38   NA 0.4930 6.431  14.7  5.4159  NA 287      NA 393.68
## 327  0.30347   0.0  7.38    0     NA 6.312  28.9  5.4159   5 287    19.6 396.90
## 328       NA   0.0  7.38    0 0.4930 6.083  43.7  5.4159   5 287    19.6 396.90
## 329  0.06617   0.0  3.24    0 0.4600 5.868  25.8  5.2146   4 430    16.9 382.44
## 330  0.06724   0.0  3.24    0 0.4600 6.333  17.2  5.2146   4 430    16.9 375.21
## 331  0.04544   0.0  3.24    0 0.4600 6.144  32.2  5.8736   4 430    16.9 368.57
## 332  0.05023  35.0  6.06    0 0.4379    NA  28.4  6.6407   1 304    16.9 394.02
## 333       NA  35.0  6.06    0 0.4379 6.031    NA  6.6407   1 304    16.9 362.25
## 334  0.05083   0.0  5.19    0     NA    NA    NA  6.4584   5 224    20.2 389.71
## 335  0.03738   0.0  5.19    0     NA 6.310  38.5  6.4584   5 224    20.2 389.40
## 336  0.03961   0.0  5.19    0 0.5150    NA  34.5  5.9853   5 224    20.2 396.90
## 337  0.03427   0.0  5.19    0 0.5150    NA  46.3  5.2311  NA 224    20.2 396.90
## 338  0.03041   0.0  5.19    0 0.5150 5.895    NA  5.6150   5  NA    20.2 394.81
## 339  0.03306   0.0  5.19    0 0.5150 6.059  37.3  4.8122   5 224    20.2 396.14
## 340  0.05497   0.0  5.19    0 0.5150 5.985  45.4  4.8122   5 224    20.2 396.90
## 341  0.06151   0.0  5.19    0     NA 5.968  58.5  4.8122   5 224    20.2 396.90
## 342       NA  35.0  1.52    0 0.4420 7.241  49.3  7.0379   1 284    15.5 394.74
## 343  0.02498   0.0  1.89    0 0.5180 6.540  59.7  6.2669   1 422    15.9 389.96
## 344  0.02543  55.0  3.78    0 0.4840 6.696    NA  5.7321   5 370    17.6 396.90
## 345  0.03049  55.0  3.78    0 0.4840 6.874  28.1  6.4654   5 370    17.6     NA
## 346       NA   0.0  4.39    0     NA 6.014  48.5  8.0136   3 352    18.8 385.64
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## 347  0.06162   0.0  4.39   NA 0.4420 5.898  52.3      NA  NA 352    18.8 364.61
## 348       NA  85.0  4.15   NA 0.4290 6.516  27.7  8.5353   4 351    17.9     NA
## 349  0.01501    NA  2.01    0 0.4350 6.635  29.7  8.3440   4 280    17.0     NA
## 350       NA  40.0  1.25    0 0.4290 6.939  34.5  8.7921   1 335    19.7 389.85
## 351  0.06211  40.0  1.25    0 0.4290 6.490  44.4  8.7921   1 335    19.7 396.90
## 352  0.07950  60.0  1.69    0 0.4110 6.579  35.9 10.7103   4 411    18.3 370.78
## 353  0.07244  60.0  1.69    0 0.4110 5.884    NA 10.7103   4 411    18.3 392.33
## 354  0.01709  90.0  2.02    0 0.4100 6.728  36.1 12.1265   5 187    17.0 384.46
## 355  0.04301  80.0    NA    0 0.4130 5.663  21.9 10.5857   4 334    22.0 382.80
## 356  0.10659  80.0  1.91    0 0.4130 5.936  19.5 10.5857   4 334    22.0 376.04
## 357       NA   0.0 18.10    1 0.7700 6.212  97.4  2.1222  24 666      NA 377.73
## 358  3.84970   0.0 18.10    1     NA 6.395  91.0  2.5052  24 666    20.2     NA
## 359  5.20177   0.0 18.10    1 0.7700 6.127  83.4  2.7227  24 666      NA 395.43
## 360  4.26131   0.0 18.10    0 0.7700 6.112  81.3  2.5091  24 666    20.2 390.74
## 361  4.54192   0.0 18.10    0     NA 6.398  88.0  2.5182  NA 666    20.2 374.56
## 362  3.83684   0.0 18.10    0 0.7700 6.251  91.1  2.2955  24 666    20.2 350.65
## 363  3.67822   0.0 18.10    0     NA 5.362  96.2      NA  NA 666    20.2 380.79
## 364  4.22239   0.0 18.10    1 0.7700 5.803  89.0  1.9047  24 666    20.2 353.04
## 365  3.47428   0.0 18.10   NA 0.7180 8.780  82.9  1.9047  24 666    20.2 354.55
## 366  4.55587   0.0 18.10    0 0.7180 3.561  87.9  1.6132  24 666      NA 354.70
## 367  3.69695   0.0 18.10    0     NA 4.963  91.4  1.7523  24 666      NA 316.03
## 368 13.52220   0.0 18.10    0     NA 3.863 100.0  1.5106  24 666    20.2 131.42
## 369  4.89822   0.0 18.10    0 0.6310 4.970    NA  1.3325  24 666    20.2 375.52
## 370  5.66998   0.0    NA    1 0.6310 6.683  96.8  1.3567  24 666    20.2 375.33
## 371  6.53876   0.0 18.10    1 0.6310 7.016  97.5  1.2024  24 666    20.2 392.05
## 372  9.23230   0.0 18.10    0 0.6310 6.216 100.0  1.1691  24 666    20.2 366.15
## 373  8.26725   0.0 18.10    1 0.6680 5.875  89.6  1.1296  24 666    20.2 347.88
## 374 11.10810   0.0 18.10    0 0.6680 4.906 100.0  1.1742  24 666    20.2 396.90
## 375       NA    NA 18.10    0 0.6680 4.138 100.0  1.1370  NA 666    20.2 396.90
## 376 19.60910   0.0 18.10    0 0.6710 7.313  97.9  1.3163  24 666    20.2 396.90
## 377 15.28800   0.0 18.10   NA 0.6710 6.649  93.3  1.3449  24 666    20.2 363.02
## 378  9.82349    NA 18.10    0 0.6710    NA  98.8      NA  24 666    20.2 396.90
## 379 23.64820   0.0 18.10    0 0.6710 6.380  96.2  1.3861  24 666    20.2 396.90
## 380 17.86670   0.0 18.10    0 0.6710 6.223 100.0  1.3861  24 666    20.2 393.74
## 381 88.97620   0.0 18.10    0     NA 6.968  91.9  1.4165  24  NA    20.2 396.90
## 382 15.87440    NA 18.10    0 0.6710 6.545  99.1  1.5192  24  NA    20.2 396.90
## 383       NA   0.0 18.10   NA 0.7000 5.536    NA  1.5804  24  NA    20.2 396.90
## 384       NA   0.0 18.10   NA     NA 5.520 100.0      NA  24 666      NA 396.90
## 385 20.08490    NA 18.10    0 0.7000    NA  91.2  1.4395  NA 666    20.2     NA
## 386       NA   0.0 18.10    0     NA 5.277  98.1  1.4261  24 666    20.2 396.90
## 387 24.39380   0.0 18.10    0 0.7000 4.652 100.0  1.4672  24 666      NA 396.90
## 388 22.59710   0.0 18.10    0 0.7000    NA  89.5  1.5184  24 666    20.2 396.90
## 389 14.33370   0.0 18.10    0 0.7000 4.880 100.0  1.5895  24 666    20.2 372.92
## 390  8.15174   0.0 18.10    0 0.7000 5.390  98.9  1.7281  24 666    20.2 396.90
## 391  6.96215   0.0 18.10    0 0.7000 5.713  97.0  1.9265  24  NA      NA 394.43
## 392  5.29305   0.0    NA    0 0.7000 6.051  82.5      NA  24 666    20.2 378.38
## 393 11.57790    NA 18.10    0 0.7000 5.036  97.0  1.7700  24 666      NA 396.90
## 394  8.64476   0.0 18.10    0 0.6930 6.193  92.6  1.7912  24 666    20.2 396.90
## 395 13.35980   0.0 18.10    0 0.6930 5.887  94.7      NA  24 666    20.2 396.90
## 396  8.71675   0.0 18.10    0 0.6930 6.471  98.8  1.7257  24 666    20.2 391.98
## 397  5.87205   0.0 18.10    0 0.6930 6.405  96.0  1.6768  24 666    20.2 396.90
## 398  7.67202   0.0 18.10    0 0.6930 5.747  98.9  1.6334  24  NA    20.2 393.10
## 399 38.35180   0.0 18.10    0 0.6930 5.453 100.0  1.4896  24 666    20.2     NA
## 400  9.91655   0.0 18.10    0 0.6930    NA  77.8  1.5004  24 666    20.2     NA
```

```
## 401 25.04610   0.0    NA    0 0.6930 5.987 100.0  1.5888  24 666    20.2 396.90
## 402       NA   0.0 18.10    0 0.6930 6.343 100.0  1.5741  24 666    20.2 396.90
## 403  9.59571   0.0 18.10   NA     NA 6.404 100.0  1.6390  24 666    20.2 376.11
## 404 24.80170   0.0 18.10    0 0.6930 5.349  96.0  1.7028  24 666    20.2 396.90
## 405 41.52920   0.0 18.10    0     NA 5.531    NA  1.6074  24 666    20.2 329.46
## 406       NA   0.0 18.10    0 0.6930 5.683 100.0  1.4254  24 666    20.2 384.97
## 407 20.71620   0.0 18.10   NA 0.6590 4.138 100.0  1.1781  24 666    20.2 370.22
## 408 11.95110    NA    NA    0 0.6590 5.608 100.0  1.2852  24 666    20.2     NA
## 409  7.40389   0.0    NA    0 0.5970 5.617  97.9  1.4547  NA 666    20.2 314.64
## 410 14.43830   0.0 18.10    0 0.5970    NA 100.0  1.4655  24 666    20.2 179.36
## 411 51.13580   0.0 18.10   NA 0.5970 5.757    NA  1.4130  24 666    20.2   2.60
## 412 14.05070   0.0    NA    0 0.5970 6.657 100.0  1.5275  NA 666    20.2  35.05
## 413 18.81100   0.0 18.10    0 0.5970 4.628 100.0  1.5539  24 666    20.2     NA
## 414 28.65580   0.0 18.10    0 0.5970 5.155 100.0  1.5894  24 666    20.2     NA
## 415 45.74610   0.0 18.10    0 0.6930 4.519 100.0  1.6582  NA 666    20.2  88.27
## 416 18.08460   0.0 18.10    0     NA 6.434 100.0      NA  24 666    20.2  27.25
## 417 10.83420   0.0 18.10    0 0.6790 6.782  90.8  1.8195  24 666      NA  21.57
## 418 25.94060   0.0 18.10    0 0.6790 5.304  89.1  1.6475  24 666    20.2 127.36
## 419 73.53410   0.0 18.10    0 0.6790 5.957 100.0  1.8026  NA 666    20.2  16.45
## 420 11.81230   0.0    NA   NA 0.7180 6.824  76.5      NA  24 666    20.2  48.45
## 421 11.08740   0.0 18.10    0 0.7180 6.411 100.0  1.8589  24 666      NA 318.75
## 422  7.02259   0.0 18.10   NA 0.7180 6.006    NA  1.8746  NA 666    20.2 319.98
## 423 12.04820   0.0 18.10    0 0.6140 5.648  87.6  1.9512  24 666      NA 291.55
## 424  7.05042   0.0 18.10    0 0.6140 6.103  85.1  2.0218  24 666    20.2   2.52
## 425  8.79212   0.0 18.10   NA 0.5840 5.565  70.6  2.0635  24 666    20.2   3.65
## 426 15.86030   0.0 18.10    0     NA 5.896  95.4  1.9096  24  NA    20.2   7.68
## 427 12.24720    NA 18.10    0 0.5840 5.837  59.7      NA  24 666    20.2  24.65
## 428 37.66190   0.0 18.10    0 0.6790 6.202  78.7  1.8629  24 666    20.2  18.82
## 429  7.36711   0.0 18.10    0 0.6790 6.193  78.1  1.9356  24 666    20.2  96.73
## 430  9.33889   0.0 18.10    0 0.6790 6.380  95.6  1.9682  24 666    20.2     NA
## 431  8.49213   0.0 18.10    0 0.5840 6.348  86.1  2.0527  24 666    20.2  83.45
## 432       NA   0.0 18.10    0     NA    NA  94.3  2.0882  24 666    20.2     NA
## 433  6.44405   0.0 18.10    0 0.5840    NA  74.8  2.2004  24 666    20.2  97.95
## 434  5.58107   0.0 18.10    0 0.7130 6.436  87.9      NA  24 666    20.2     NA
## 435 13.91340   0.0 18.10   NA     NA 6.208  95.0  2.2222  24 666    20.2 100.63
## 436 11.16040   0.0 18.10    0 0.7400 6.629  94.6  2.1247  24  NA    20.2 109.85
## 437 14.42080    NA 18.10    0     NA 6.461  93.3  2.0026  24  NA    20.2     NA
## 438 15.17720   0.0 18.10    0 0.7400 6.152 100.0  1.9142  24 666      NA   9.32
## 439 13.67810   0.0 18.10   NA 0.7400 5.935  87.9  1.8206  24 666    20.2  68.95
## 440  9.39063   0.0 18.10    0 0.7400 5.627    NA  1.8172  NA 666    20.2 396.90
## 441 22.05110   0.0    NA    0 0.7400 5.818  92.4  1.8662  24 666    20.2 391.45
## 442  9.72418   0.0 18.10    0 0.7400 6.406    NA  2.0651  24 666    20.2 385.96
## 443       NA   0.0    NA    0 0.7400 6.219 100.0  2.0048  24 666    20.2 395.69
## 444  9.96654   0.0 18.10    0 0.7400 6.485 100.0  1.9784  24 666    20.2 386.73
## 445 12.80230   0.0    NA    0 0.7400 5.854  96.6  1.8956  24 666    20.2 240.52
## 446 10.67180   0.0 18.10    0 0.7400 6.459  94.8  1.9879  24 666    20.2  43.06
## 447       NA    NA 18.10    0 0.7400 6.341  96.4  2.0720  NA  NA    20.2 318.01
## 448       NA   0.0 18.10    0 0.7400 6.251  96.6  2.1980  24 666      NA     NA
## 449  9.32909   0.0 18.10    0 0.7130 6.185  98.7  2.2616  24 666    20.2 396.90
## 450       NA   0.0 18.10    0 0.7130 6.417  98.3  2.1850  24 666    20.2 304.21
## 451  6.71772   0.0 18.10    0 0.7130 6.749    NA  2.3236  24 666    20.2   0.32
## 452  5.44114    NA 18.10    0 0.7130 6.655  98.2  2.3552  24 666    20.2 355.29
## 453       NA   0.0 18.10    0     NA 6.297  91.8  2.3682  24 666    20.2 385.09
## 454  8.24809   0.0 18.10    0 0.7130 7.393  99.3  2.4527  24 666    20.2 375.87
```

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## 455  9.51363   0.0 18.10    0 0.7130 6.728  94.1  2.4961  24  NA    20.2   6.68
## 456  4.75237   0.0 18.10    0 0.7130 6.525  86.5      NA  24  NA    20.2  50.92
## 457  4.66883   0.0 18.10    0 0.7130 5.976  87.9  2.5806  24 666    20.2  10.48
## 458  8.20058   0.0 18.10    0 0.7130 5.936  80.3  2.7792  24 666    20.2   3.50
## 459  7.75223   0.0 18.10    0 0.7130 6.301  83.7  2.7831  24 666    20.2 272.21
## 460  6.80117   0.0 18.10    0 0.7130    NA    NA  2.7175  24 666    20.2 396.90
## 461  4.81213   0.0 18.10    0 0.7130 6.701  90.0  2.5975  24 666    20.2     NA
## 462       NA   0.0 18.10    0 0.7130 6.376  88.4  2.5671  24 666    20.2 391.43
## 463  6.65492   0.0 18.10    0 0.7130 6.317  83.0  2.7344  24 666    20.2 396.90
## 464  5.82115   0.0    NA    0 0.7130 6.513    NA  2.8016  NA 666    20.2 393.82
## 465  7.83932   0.0 18.10    0 0.6550 6.209  65.4  2.9634  24 666    20.2 396.90
## 466  3.16360   0.0 18.10    0 0.6550 5.759  48.2  3.0665  24 666    20.2 334.40
## 467  3.77498   0.0 18.10    0 0.6550 5.952  84.7  2.8715  24 666    20.2     NA
## 468  4.42228   0.0 18.10    0 0.5840 6.003    NA      NA  NA  NA    20.2 331.29
## 469 15.57570   0.0 18.10    0 0.5800 5.926  71.0  2.9084  24 666    20.2 368.74
## 470 13.07510   0.0 18.10    0     NA 5.713    NA  2.8237  24 666    20.2 396.90
## 471       NA   0.0 18.10    0     NA    NA    NA  3.0334  24 666    20.2 396.90
## 472  4.03841   0.0 18.10   NA 0.5320 6.229  90.7      NA  24 666    20.2 395.33
## 473  3.56868    NA    NA    0 0.5800 6.437    NA      NA  24 666    20.2 393.37
## 474  4.64689   0.0 18.10    0 0.6140 6.980  67.6  2.5329  24 666    20.2 374.68
## 475  8.05579   0.0 18.10    0 0.5840 5.427  95.4  2.4298  24 666    20.2     NA
## 476  6.39312    NA 18.10    0 0.5840 6.162    NA      NA  24 666    20.2     NA
## 477  4.87141   0.0 18.10    0 0.6140 6.484  93.6  2.3053  24 666    20.2 396.21
## 478       NA   0.0 18.10    0 0.6140 5.304  97.3  2.1007  24  NA      NA 349.48
## 479 10.23300   0.0 18.10    0 0.6140 6.185  96.7      NA  24 666      NA     NA
## 480 14.33370   0.0 18.10    0 0.6140 6.229  88.0  1.9512  24 666      NA 383.32
## 481  5.82401   0.0 18.10    0 0.5320 6.242  64.7  3.4242  24 666    20.2 396.90
## 482       NA   0.0 18.10   NA 0.5320 6.750  74.9  3.3317  24 666    20.2     NA
## 483  5.73116   0.0    NA    0 0.5320 7.061    NA  3.4106  24 666    20.2 395.28
## 484  2.81838    NA 18.10    0 0.5320 5.762  40.3  4.0983  24 666    20.2 392.92
## 485  2.37857   0.0 18.10    0 0.5830 5.871  41.9  3.7240  24 666    20.2 370.73
## 486  3.67367   0.0 18.10    0 0.5830 6.312  51.9  3.9917  24  NA    20.2 388.62
## 487  5.69175   0.0 18.10    0     NA 6.114  79.8  3.5459  24 666    20.2 392.68
## 488  4.83567   0.0 18.10    0 0.5830 5.905  53.2  3.1523  24 666    20.2     NA
## 489  0.15086   0.0 27.74    0 0.6090 5.454  92.7  1.8209   4 711    20.1 395.09
## 490  0.18337   0.0 27.74    0 0.6090 5.414  98.3  1.7554   4 711    20.1 344.05
## 491       NA    NA 27.74    0 0.6090    NA  98.0  1.8226   4 711    20.1 318.43
## 492  0.10574   0.0 27.74    0 0.6090 5.983  98.8  1.8681   4 711    20.1 390.11
## 493  0.11132   0.0 27.74    0 0.6090 5.983  83.5  2.1099   4 711    20.1 396.90
## 494  0.17331   0.0  9.69    0 0.5850    NA  54.0  2.3817   6 391    19.2 396.90
## 495  0.27957   0.0    NA   NA 0.5850 5.926  42.6  2.3817   6  NA    19.2 396.90
## 496  0.17899   0.0  9.69   NA 0.5850 5.670  28.8  2.7986   6  NA    19.2 393.29
## 497  0.28960   0.0  9.69    0 0.5850 5.390  72.9  2.7986   6 391    19.2 396.90
## 498  0.26838   0.0  9.69   NA 0.5850 5.794  70.6  2.8927   6  NA    19.2 396.90
## 499  0.23912   0.0  9.69    0 0.5850 6.019  65.3      NA   6 391    19.2 396.90
## 500  0.17783   0.0  9.69    0 0.5850 5.569    NA  2.3999   6 391    19.2     NA
## 501  0.22438    NA  9.69    0 0.5850 6.027  79.7  2.4982  NA 391    19.2     NA
## 502  0.06263   0.0 11.93    0 0.5730 6.593  69.1  2.4786  NA  NA    21.0 391.99
## 503  0.04527   0.0 11.93    0 0.5730 6.120  76.7  2.2875   1 273    21.0 396.90
## 504  0.06076   0.0 11.93    0 0.5730 6.976  91.0  2.1675   1 273    21.0 396.90
## 505  0.10959   0.0 11.93    0 0.5730 6.794  89.3  2.3889   1  NA    21.0 393.45
## 506  0.04741   0.0    NA    0 0.5730 6.030  80.8  2.5050   1 273    21.0 396.90
##     lstat
## 1      NA
```

```
## 2    9.14
## 3    4.03
## 4    2.94
## 5    5.33
## 6    5.21
## 7   12.43
## 8   19.15
## 9   29.93
## 10  17.10
## 11  20.45
## 12  13.27
## 13  15.71
## 14   8.26
## 15     NA
## 16   8.47
## 17   6.58
## 18  14.67
## 19  11.69
## 20  11.28
## 21  21.02
## 22     NA
## 23  18.72
## 24  19.88
## 25  16.30
## 26  16.51
## 27     NA
## 28  17.28
## 29  12.80
## 30  11.98
## 31  22.60
## 32  13.04
## 33  27.71
## 34  18.35
## 35  20.34
## 36     NA
## 37  11.41
## 38   8.77
## 39  10.13
## 40   4.32
## 41     NA
## 42     NA
## 43     NA
## 44   7.44
## 45   9.55
## 46  10.21
## 47  14.15
## 48  18.80
## 49  30.81
## 50     NA
## 51  13.45
## 52   9.43
## 53   5.28
## 54   8.43
## 55  14.80
```

```
## 56   4.81
## 57     NA
## 58   3.95
## 59   6.86
## 60   9.22
## 61  13.15
## 62  14.44
## 63   6.73
## 64   9.50
## 65   8.05
## 66   4.67
## 67  10.24
## 68   8.10
## 69  13.09
## 70     NA
## 71   6.72
## 72     NA
## 73   5.52
## 74   7.54
## 75   6.78
## 76   8.94
## 77     NA
## 78  10.27
## 79     NA
## 80   9.10
## 81   5.29
## 82   7.22
## 83   6.72
## 84   7.51
## 85   9.62
## 86   6.53
## 87     NA
## 88   8.44
## 89   5.50
## 90   5.70
## 91   8.81
## 92   8.20
## 93     NA
## 94   6.21
## 95  10.59
## 96   6.65
## 97  11.34
## 98   4.21
## 99   3.57
## 100  6.19
## 101  9.42
## 102  7.67
## 103 10.63
## 104    NA
## 105 12.33
## 106 16.47
## 107 18.66
## 108 14.09
## 109 12.27
```

```
## 110 15.55
## 111 13.00
## 112 10.16
## 113 16.21
## 114 17.09
## 115 10.45
## 116 15.76
## 117 12.04
## 118 10.30
## 119 15.37
## 120 13.61
## 121 14.37
## 122 14.27
## 123 17.93
## 124 25.41
## 125 17.58
## 126 14.81
## 127 27.26
## 128 17.19
## 129 15.39
## 130 18.34
## 131 12.60
## 132 12.26
## 133 11.12
## 134 15.03
## 135 17.31
## 136 16.96
## 137 16.90
## 138 14.59
## 139    NA
## 140 18.46
## 141 24.16
## 142 34.41
## 143 26.82
## 144 26.42
## 145 29.29
## 146    NA
## 147 16.65
## 148 29.53
## 149 28.32
## 150 21.45
## 151 14.10
## 152 13.28
## 153 12.12
## 154 15.79
## 155 15.12
## 156 15.02
## 157 16.14
## 158  4.59
## 159  6.43
## 160  7.39
## 161    NA
## 162    NA
## 163  1.92
```

```
## 164  3.32
## 165 11.64
## 166  9.81
## 167  3.70
## 168 12.14
## 169 11.10
## 170 11.32
## 171    NA
## 172 12.03
## 173 14.69
## 174  9.04
## 175  9.64
## 176  5.33
## 177 10.11
## 178  6.29
## 179  6.92
## 180  5.04
## 181  7.56
## 182  9.45
## 183  4.82
## 184  5.68
## 185 13.98
## 186 13.15
## 187  4.45
## 188  6.68
## 189  4.56
## 190  5.39
## 191  5.10
## 192  4.69
## 193  2.87
## 194  5.03
## 195  4.38
## 196  2.97
## 197  4.08
## 198  8.61
## 199  6.62
## 200  4.56
## 201    NA
## 202  7.43
## 203  3.11
## 204  3.81
## 205  2.88
## 206 10.87
## 207 10.97
## 208 18.06
## 209 14.66
## 210 23.09
## 211 17.27
## 212 23.98
## 213 16.03
## 214    NA
## 215 29.55
## 216  9.47
## 217 13.51
```

```
## 218  9.69
## 219    NA
## 220    NA
## 221  9.71
## 222 21.46
## 223  9.93
## 224    NA
## 225    NA
## 226  4.63
## 227  3.13
## 228  6.36
## 229  3.92
## 230  3.76
## 231 11.65
## 232  5.25
## 233  2.47
## 234  3.95
## 235  8.05
## 236 10.88
## 237  9.54
## 238  4.73
## 239  6.36
## 240  7.37
## 241 11.38
## 242    NA
## 243 11.22
## 244  5.19
## 245 12.50
## 246 18.46
## 247  9.16
## 248 10.15
## 249  9.52
## 250  6.56
## 251  5.90
## 252  3.59
## 253  3.53
## 254  3.54
## 255  6.57
## 256  9.25
## 257  3.11
## 258  5.12
## 259  7.79
## 260  6.90
## 261  9.59
## 262  7.26
## 263    NA
## 264 11.25
## 265  8.10
## 266 10.45
## 267 14.79
## 268  7.44
## 269  3.16
## 270 13.65
## 271 13.00
```

```
## 272  6.59
## 273  7.73
## 274  6.58
## 275  3.53
## 276  2.98
## 277  6.05
## 278  4.16
## 279  7.19
## 280  4.85
## 281  3.76
## 282  4.59
## 283    NA
## 284  3.16
## 285  7.85
## 286  8.23
## 287 12.93
## 288  7.14
## 289  7.60
## 290  9.51
## 291  3.33
## 292  3.56
## 293  4.70
## 294  8.58
## 295 10.40
## 296  6.27
## 297  7.39
## 298 15.84
## 299    NA
## 300  4.74
## 301  6.07
## 302  9.50
## 303  8.67
## 304  4.86
## 305    NA
## 306  8.93
## 307  6.47
## 308  7.53
## 309  4.54
## 310  9.97
## 311 12.64
## 312  5.98
## 313 11.72
## 314  7.90
## 315  9.28
## 316 11.50
## 317 18.33
## 318 15.94
## 319 10.36
## 320 12.73
## 321  7.20
## 322  6.87
## 323    NA
## 324 11.74
## 325  6.12
```

```
## 326  5.08
## 327  6.15
## 328 12.79
## 329  9.97
## 330    NA
## 331  9.09
## 332 12.43
## 333  7.83
## 334  5.68
## 335  6.75
## 336  8.01
## 337  9.80
## 338    NA
## 339  8.51
## 340    NA
## 341  9.29
## 342  5.49
## 343  8.65
## 344  7.18
## 345  4.61
## 346    NA
## 347    NA
## 348  6.36
## 349  5.99
## 350  5.89
## 351  5.98
## 352  5.49
## 353  7.79
## 354  4.50
## 355  8.05
## 356    NA
## 357 17.60
## 358 13.27
## 359 11.48
## 360 12.67
## 361  7.79
## 362 14.19
## 363 10.19
## 364 14.64
## 365  5.29
## 366  7.12
## 367 14.00
## 368 13.33
## 369  3.26
## 370  3.73
## 371  2.96
## 372  9.53
## 373  8.88
## 374 34.77
## 375 37.97
## 376 13.44
## 377 23.24
## 378 21.24
## 379 23.69
```

```
## 380 21.78
## 381    NA
## 382 21.08
## 383 23.60
## 384    NA
## 385    NA
## 386 30.81
## 387 28.28
## 388 31.99
## 389 30.62
## 390 20.85
## 391 17.11
## 392 18.76
## 393 25.68
## 394 15.17
## 395    NA
## 396 17.12
## 397 19.37
## 398 19.92
## 399 30.59
## 400 29.97
## 401 26.77
## 402 20.32
## 403 20.31
## 404 19.77
## 405 27.38
## 406 22.98
## 407 23.34
## 408 12.13
## 409    NA
## 410 19.78
## 411 10.11
## 412 21.22
## 413 34.37
## 414 20.08
## 415 36.98
## 416 29.05
## 417 25.79
## 418 26.64
## 419 20.62
## 420    NA
## 421 15.02
## 422 15.70
## 423 14.10
## 424 23.29
## 425 17.16
## 426 24.39
## 427 15.69
## 428 14.52
## 429 21.52
## 430 24.08
## 431 17.64
## 432 19.69
## 433 12.03
```

```
## 434 16.22
## 435    NA
## 436 23.27
## 437 18.05
## 438 26.45
## 439 34.02
## 440 22.88
## 441 22.11
## 442 19.52
## 443 16.59
## 444 18.85
## 445    NA
## 446    NA
## 447 17.79
## 448 16.44
## 449 18.13
## 450 19.31
## 451 17.44
## 452 17.73
## 453 17.27
## 454 16.74
## 455 18.71
## 456 18.13
## 457 19.01
## 458 16.94
## 459 16.23
## 460 14.70
## 461 16.42
## 462 14.65
## 463 13.99
## 464 10.29
## 465 13.22
## 466 14.13
## 467    NA
## 468 21.32
## 469 18.13
## 470 14.76
## 471 16.29
## 472 12.87
## 473 14.36
## 474 11.66
## 475    NA
## 476 24.10
## 477 18.68
## 478 24.91
## 479 18.03
## 480 13.11
## 481 10.74
## 482  7.74
## 483  7.01
## 484 10.42
## 485 13.34
## 486 10.58
## 487    NA
```

```
## 488 11.45
## 489 18.06
## 490 23.97
## 491 29.68
## 492 18.07
## 493 13.35
## 494 12.01
## 495 13.59
## 496 17.60
## 497 21.14
## 498 14.10
## 499 12.92
## 500 15.10
## 501 14.33
## 502  9.67
## 503  9.08
## 504  5.64
## 505  6.48
## 506  7.88
```

What type of missing data mechanism created the missingness in `Xmiss`?

MCAR

Impute using the feature averages to create a matrix `Ximpnaive`.

```
Ximpnaive = Xmiss
Xj_bars = colMeans(Xmiss, na.rm=TRUE)
Xj_bars
```

```
##        crim          zn       indus        chas         nox          rm
##   3.5520635  11.6050328  11.0623110   0.0673913   0.5552944   6.2802826
##         age         dis         rad         tax     ptratio       black
##  68.5765101   3.7918663   9.5250545 408.0905077  18.4334052 358.1459226
##       lstat
##  12.6952643
```

```
for(j in 1:ncol(X)){
  for(i in 1:nrow(X)){
    if(is.na(Xmiss[i,j]))
    Ximpnaive[i,j]=Xj_bars[j]
  }
}
Ximpnaive
```

```
##          crim        zn    indus      chas       nox       rm       age
## 1    0.006320  18.00000  2.31000 0.0000000 0.5380000 6.575000  65.20000
## 2    0.027310   0.00000  7.07000 0.0000000 0.4690000 6.280283  78.90000
## 3    0.027290   0.00000  7.07000 0.0000000 0.4690000 7.185000  61.10000
## 4    0.032370   0.00000  2.18000 0.0000000 0.4580000 6.280283  68.57651
## 5    0.069050   0.00000  2.18000 0.0000000 0.4580000 7.147000  54.20000
## 6    0.029850   0.00000  2.18000 0.0000000 0.4580000 6.430000  58.70000
## 7    0.088290  12.50000  7.87000 0.0673913 0.5240000 6.012000  66.60000
## 8    0.144550  12.50000  7.87000 0.0000000 0.5240000 6.172000  68.57651
## 9    0.211240  11.60503  7.87000 0.0000000 0.5240000 5.631000 100.00000
## 10   0.170040  11.60503  7.87000 0.0000000 0.5240000 6.004000  85.90000
## 11   0.224890  12.50000  7.87000 0.0000000 0.5240000 6.377000  94.30000
```

```
## 12   0.117470  12.50000  7.87000 0.0000000 0.5552944 6.009000  82.90000
## 13   0.093780  12.50000  7.87000 0.0000000 0.5552944 5.889000  39.00000
## 14   3.552063   0.00000 11.06231 0.0000000 0.5380000 5.949000  61.80000
## 15   3.552063   0.00000  8.14000 0.0673913 0.5380000 6.096000  84.50000
## 16   0.627390   0.00000  8.14000 0.0000000 0.5380000 5.834000  56.50000
## 17   1.053930   0.00000  8.14000 0.0000000 0.5380000 5.935000  29.30000
## 18   0.784200   0.00000  8.14000 0.0000000 0.5380000 5.990000  81.70000
## 19   0.802710   0.00000  8.14000 0.0000000 0.5380000 5.456000  36.60000
## 20   0.725800   0.00000  8.14000 0.0000000 0.5552944 5.727000  69.50000
## 21   1.251790   0.00000  8.14000 0.0000000 0.5380000 5.570000  98.10000
## 22   0.852040   0.00000  8.14000 0.0000000 0.5380000 5.965000  89.20000
## 23   1.232470   0.00000  8.14000 0.0000000 0.5380000 6.142000  68.57651
## 24   3.552063   0.00000  8.14000 0.0000000 0.5552944 6.280283 100.00000
## 25   0.750260   0.00000  8.14000 0.0000000 0.5380000 5.924000  94.10000
## 26   0.840540  11.60503  8.14000 0.0000000 0.5380000 5.599000  85.70000
## 27   0.671910   0.00000  8.14000 0.0000000 0.5380000 5.813000  90.30000
## 28   0.955770  11.60503  8.14000 0.0000000 0.5380000 6.047000  88.80000
## 29   0.772990   0.00000  8.14000 0.0000000 0.5380000 6.495000  94.40000
## 30   1.002450   0.00000  8.14000 0.0673913 0.5380000 6.674000  87.30000
## 31   1.130810  11.60503  8.14000 0.0000000 0.5380000 5.713000  94.10000
## 32   1.354720   0.00000  8.14000 0.0000000 0.5380000 6.072000 100.00000
## 33   1.387990   0.00000  8.14000 0.0000000 0.5380000 5.950000  82.00000
## 34   1.151720   0.00000  8.14000 0.0000000 0.5380000 5.701000  95.00000
## 35   3.552063   0.00000  8.14000 0.0000000 0.5380000 6.096000  68.57651
## 36   0.064170   0.00000  5.96000 0.0000000 0.4990000 5.933000  68.57651
## 37   0.097440   0.00000  5.96000 0.0000000 0.5552944 5.841000  61.40000
## 38   0.080140   0.00000  5.96000 0.0000000 0.4990000 5.850000  41.50000
## 39   3.552063   0.00000 11.06231 0.0000000 0.4990000 5.966000  30.20000
## 40   0.027630  75.00000  2.95000 0.0000000 0.4280000 6.595000  21.80000
## 41   0.033590  75.00000  2.95000 0.0000000 0.4280000 7.024000  15.80000
## 42   0.127440   0.00000  6.91000 0.0000000 0.4480000 6.280283   2.90000
## 43   0.141500   0.00000  6.91000 0.0000000 0.4480000 6.169000   6.60000
## 44   0.159360   0.00000  6.91000 0.0000000 0.4480000 6.211000   6.50000
## 45   0.122690   0.00000  6.91000 0.0673913 0.4480000 6.069000  40.00000
## 46   0.171420   0.00000  6.91000 0.0000000 0.4480000 5.682000  33.80000
## 47   0.188360   0.00000  6.91000 0.0000000 0.4480000 5.786000  33.30000
## 48   0.229270   0.00000  6.91000 0.0673913 0.4480000 6.030000  85.50000
## 49   3.552063   0.00000  6.91000 0.0000000 0.4480000 6.280283  68.57651
## 50   0.219770   0.00000  6.91000 0.0000000 0.4480000 5.602000  62.00000
## 51   0.088730  21.00000 11.06231 0.0000000 0.4390000 6.280283  45.70000
## 52   0.043370  21.00000  5.64000 0.0000000 0.4390000 6.115000  63.00000
## 53   0.053600  21.00000  5.64000 0.0000000 0.4390000 6.511000  68.57651
## 54   0.049810  21.00000  5.64000 0.0000000 0.4390000 5.998000  21.40000
## 55   0.013600  75.00000  4.00000 0.0000000 0.4100000 5.888000  47.60000
## 56   0.013110  90.00000  1.22000 0.0000000 0.4030000 7.249000  21.90000
## 57   3.552063  85.00000  0.74000 0.0000000 0.4100000 6.383000  35.70000
## 58   3.552063 100.00000  1.32000 0.0000000 0.4110000 6.280283  40.50000
## 59   3.552063  25.00000  5.13000 0.0000000 0.5552944 6.280283  29.20000
## 60   0.103280  25.00000  5.13000 0.0000000 0.4530000 5.927000  68.57651
## 61   3.552063  25.00000  5.13000 0.0000000 0.5552944 5.741000  66.20000
## 62   0.171710  25.00000  5.13000 0.0000000 0.4530000 5.966000  93.40000
## 63   0.110270  25.00000  5.13000 0.0000000 0.4530000 6.456000  67.80000
## 64   0.126500  25.00000 11.06231 0.0000000 0.4530000 6.762000  68.57651
## 65   0.019510  17.50000  1.38000 0.0000000 0.5552944 6.280283  59.50000
```

```
## 66   0.035840  80.00000  3.37000 0.0000000 0.5552944 6.290000  17.80000
## 67   0.043790  80.00000  3.37000 0.0000000 0.3980000 5.787000  31.10000
## 68   0.057890  11.60503  6.07000 0.0000000 0.4090000 6.280283  21.40000
## 69   0.135540  12.50000 11.06231 0.0000000 0.4090000 5.594000  36.80000
## 70   0.128160  12.50000  6.07000 0.0000000 0.4090000 6.280283  33.00000
## 71   0.088260   0.00000 10.81000 0.0000000 0.5552944 6.417000   6.60000
## 72   0.158760   0.00000 10.81000 0.0000000 0.4130000 5.961000  17.50000
## 73   0.091640   0.00000 10.81000 0.0000000 0.5552944 6.065000   7.80000
## 74   0.195390   0.00000 10.81000 0.0000000 0.4130000 6.245000   6.20000
## 75   0.078960   0.00000 12.83000 0.0000000 0.4370000 6.273000   6.00000
## 76   0.095120   0.00000 12.83000 0.0000000 0.4370000 6.286000  45.00000
## 77   0.101530   0.00000 12.83000 0.0000000 0.4370000 6.279000  74.50000
## 78   0.087070   0.00000 12.83000 0.0673913 0.4370000 6.140000  45.80000
## 79   0.056460   0.00000 11.06231 0.0000000 0.4370000 6.232000  53.70000
## 80   0.083870  11.60503 12.83000 0.0000000 0.4370000 6.280283  36.60000
## 81   0.041130  25.00000 11.06231 0.0000000 0.4260000 6.727000  33.50000
## 82   0.044620  25.00000  4.86000 0.0000000 0.4260000 6.619000  70.40000
## 83   3.552063  25.00000  4.86000 0.0000000 0.4260000 6.302000  68.57651
## 84   0.035510  25.00000  4.86000 0.0000000 0.4260000 6.167000  46.70000
## 85   0.050590   0.00000 11.06231 0.0673913 0.5552944 6.389000  48.00000
## 86   0.057350   0.00000  4.49000 0.0000000 0.4490000 6.630000  68.57651
## 87   0.051880   0.00000  4.49000 0.0673913 0.4490000 6.015000  68.57651
## 88   0.071510  11.60503  4.49000 0.0000000 0.5552944 6.121000  56.80000
## 89   0.056600   0.00000  3.41000 0.0000000 0.4890000 7.007000  68.57651
## 90   0.053020   0.00000  3.41000 0.0673913 0.4890000 7.079000  63.10000
## 91   0.046840   0.00000  3.41000 0.0000000 0.4890000 6.417000  66.10000
## 92   0.039320   0.00000  3.41000 0.0000000 0.4890000 6.405000  73.90000
## 93   0.042030  28.00000 15.04000 0.0000000 0.4640000 6.442000  68.57651
## 94   0.028750  28.00000 15.04000 0.0000000 0.4640000 6.211000  28.90000
## 95   0.042940  28.00000 11.06231 0.0000000 0.4640000 6.249000  77.30000
## 96   0.122040   0.00000  2.89000 0.0000000 0.4450000 6.625000  57.80000
## 97   0.115040   0.00000  2.89000 0.0000000 0.5552944 6.163000  69.60000
## 98   0.120830   0.00000  2.89000 0.0000000 0.4450000 8.069000  76.00000
## 99   0.081870   0.00000  2.89000 0.0000000 0.4450000 6.280283  68.57651
## 100  0.068600   0.00000  2.89000 0.0000000 0.4450000 7.416000  62.50000
## 101  0.148660   0.00000  8.56000 0.0000000 0.5200000 6.727000  79.90000
## 102  0.114320   0.00000  8.56000 0.0000000 0.5200000 6.781000  71.30000
## 103  3.552063   0.00000  8.56000 0.0000000 0.5552944 6.405000  85.40000
## 104  3.552063   0.00000  8.56000 0.0000000 0.5200000 6.137000  68.57651
## 105  0.139600   0.00000  8.56000 0.0000000 0.5200000 6.167000  90.00000
## 106  0.132620   0.00000  8.56000 0.0000000 0.5200000 5.851000  96.70000
## 107  0.171200   0.00000  8.56000 0.0000000 0.5200000 5.836000  91.90000
## 108  0.131170   0.00000  8.56000 0.0000000 0.5200000 6.127000  85.20000
## 109  0.128020   0.00000  8.56000 0.0000000 0.5200000 6.474000  97.10000
## 110  0.263630  11.60503  8.56000 0.0000000 0.5200000 6.229000  91.20000
## 111  0.107930   0.00000  8.56000 0.0000000 0.5200000 6.195000  68.57651
## 112  0.100840   0.00000 10.01000 0.0000000 0.5470000 6.715000  81.60000
## 113  3.552063  11.60503 10.01000 0.0000000 0.5470000 5.913000  92.90000
## 114  0.222120   0.00000 11.06231 0.0000000 0.5470000 6.092000  95.40000
## 115  0.142310   0.00000 10.01000 0.0673913 0.5470000 6.280283  84.20000
## 116  0.171340   0.00000 10.01000 0.0000000 0.5470000 5.928000  88.20000
## 117  0.131580  11.60503 10.01000 0.0000000 0.5470000 6.176000  72.50000
## 118  0.150980   0.00000 10.01000 0.0673913 0.5470000 6.021000  82.60000
## 119  0.130580   0.00000 10.01000 0.0000000 0.5470000 5.872000  73.10000
```

```
## 120  0.144760   0.00000 10.01000 0.0000000 0.5470000 5.731000  65.20000
## 121  0.068990   0.00000 25.65000 0.0000000 0.5810000 5.870000  69.70000
## 122  0.071650   0.00000 25.65000 0.0000000 0.5810000 6.004000  84.10000
## 123  0.092990   0.00000 25.65000 0.0000000 0.5810000 6.280283  92.90000
## 124  0.150380   0.00000 25.65000 0.0000000 0.5810000 5.856000  97.00000
## 125  0.098490   0.00000 25.65000 0.0000000 0.5810000 5.879000  95.80000
## 126  0.169020   0.00000 25.65000 0.0000000 0.5810000 6.280283  88.40000
## 127  0.387350   0.00000 11.06231 0.0000000 0.5810000 5.613000  95.60000
## 128  0.259150   0.00000 21.89000 0.0000000 0.6240000 5.693000  96.00000
## 129  0.325430   0.00000 21.89000 0.0000000 0.6240000 6.431000  98.80000
## 130  0.881250  11.60503 11.06231 0.0000000 0.6240000 6.280283  68.57651
## 131  0.340060   0.00000 21.89000 0.0673913 0.6240000 6.458000  98.90000
## 132  1.192940   0.00000 21.89000 0.0000000 0.5552944 6.326000  68.57651
## 133  3.552063   0.00000 21.89000 0.0000000 0.6240000 6.372000  68.57651
## 134  0.329820   0.00000 21.89000 0.0000000 0.6240000 5.822000  95.40000
## 135  0.976170  11.60503 11.06231 0.0000000 0.6240000 5.757000  98.40000
## 136  0.557780   0.00000 11.06231 0.0000000 0.6240000 6.335000  68.57651
## 137  0.322640   0.00000 21.89000 0.0000000 0.6240000 5.942000  93.50000
## 138  0.352330   0.00000 21.89000 0.0000000 0.6240000 6.280283  98.40000
## 139  0.249800   0.00000 21.89000 0.0000000 0.6240000 5.857000  98.20000
## 140  0.544520   0.00000 21.89000 0.0000000 0.6240000 6.280283  97.90000
## 141  0.290900  11.60503 21.89000 0.0000000 0.6240000 6.174000  93.60000
## 142  1.628640   0.00000 21.89000 0.0000000 0.6240000 5.019000 100.00000
## 143  3.321050   0.00000 19.58000 1.0000000 0.5552944 5.403000 100.00000
## 144  4.097400   0.00000 19.58000 0.0000000 0.8710000 5.468000 100.00000
## 145  2.779740   0.00000 19.58000 0.0000000 0.8710000 4.903000  97.80000
## 146  2.379340   0.00000 11.06231 0.0000000 0.8710000 6.280283 100.00000
## 147  2.155050   0.00000 19.58000 0.0000000 0.8710000 5.628000 100.00000
## 148  2.368620  11.60503 19.58000 0.0000000 0.8710000 4.926000  95.70000
## 149  2.330990   0.00000 19.58000 0.0000000 0.8710000 5.186000  93.80000
## 150  2.733970   0.00000 19.58000 0.0000000 0.8710000 5.597000  94.90000
## 151  1.656600   0.00000 19.58000 0.0000000 0.8710000 6.280283  97.30000
## 152  1.496320  11.60503 19.58000 0.0000000 0.8710000 5.404000 100.00000
## 153  1.126580   0.00000 19.58000 1.0000000 0.8710000 5.012000  88.00000
## 154  2.149180   0.00000 19.58000 0.0000000 0.8710000 5.709000  98.50000
## 155  1.413850   0.00000 19.58000 1.0000000 0.8710000 6.280283  96.00000
## 156  3.535010   0.00000 19.58000 1.0000000 0.8710000 6.152000  82.60000
## 157  2.446680   0.00000 19.58000 0.0000000 0.8710000 5.272000  94.00000
## 158  1.223580   0.00000 19.58000 0.0000000 0.6050000 6.943000  97.40000
## 159  1.342840   0.00000 19.58000 0.0000000 0.6050000 6.066000 100.00000
## 160  3.552063   0.00000 19.58000 0.0000000 0.8710000 6.510000 100.00000
## 161  1.273460   0.00000 19.58000 1.0000000 0.6050000 6.250000  68.57651
## 162  1.463360   0.00000 19.58000 0.0000000 0.6050000 7.489000  90.80000
## 163  1.833770   0.00000 19.58000 1.0000000 0.6050000 7.802000  98.20000
## 164  1.519020   0.00000 19.58000 1.0000000 0.6050000 8.375000  93.90000
## 165  2.242360   0.00000 19.58000 0.0000000 0.6050000 5.854000  91.80000
## 166  2.924000   0.00000 19.58000 0.0000000 0.6050000 6.101000  93.00000
## 167  2.010190  11.60503 19.58000 0.0000000 0.6050000 7.929000  96.20000
## 168  1.800280   0.00000 19.58000 0.0000000 0.6050000 5.877000  79.20000
## 169  3.552063   0.00000 19.58000 0.0000000 0.6050000 6.319000  96.10000
## 170  2.449530   0.00000 19.58000 0.0000000 0.6050000 6.402000  95.20000
## 171  3.552063   0.00000 19.58000 0.0000000 0.6050000 5.875000  94.60000
## 172  2.313900   0.00000 19.58000 0.0000000 0.6050000 5.880000  97.30000
## 173  0.139140   0.00000  4.05000 0.0000000 0.5100000 6.280283  88.50000
```

```
## 174  0.091780   0.00000  4.05000 0.0000000 0.5100000 6.416000  84.10000
## 175  0.084470   0.00000  4.05000 0.0000000 0.5100000 5.859000  68.70000
## 176  0.066640   0.00000  4.05000 0.0673913 0.5100000 6.546000  33.10000
## 177  3.552063   0.00000  4.05000 0.0000000 0.5100000 6.020000  47.20000
## 178  0.054250  11.60503  4.05000 0.0000000 0.5100000 6.315000  73.40000
## 179  0.066420   0.00000  4.05000 0.0000000 0.5100000 6.860000  68.57651
## 180  0.057800   0.00000  2.46000 0.0000000 0.5552944 6.980000  68.57651
## 181  0.065880  11.60503  2.46000 0.0000000 0.4880000 7.765000  83.30000
## 182  3.552063   0.00000 11.06231 0.0000000 0.5552944 6.144000  62.20000
## 183  0.091030   0.00000 11.06231 0.0000000 0.4880000 7.155000  92.20000
## 184  0.100080   0.00000  2.46000 0.0000000 0.4880000 6.563000  95.60000
## 185  0.083080   0.00000 11.06231 0.0000000 0.4880000 5.604000  89.80000
## 186  0.060470   0.00000  2.46000 0.0000000 0.4880000 6.153000  68.80000
## 187  0.056020   0.00000  2.46000 0.0000000 0.4880000 7.831000  53.60000
## 188  0.078750  45.00000  3.44000 0.0000000 0.4370000 6.782000  41.10000
## 189  0.125790  45.00000  3.44000 0.0000000 0.4370000 6.556000  68.57651
## 190  3.552063  45.00000  3.44000 0.0000000 0.4370000 7.185000  38.90000
## 191  0.090680  45.00000  3.44000 0.0673913 0.5552944 6.951000  21.50000
## 192  0.069110  45.00000  3.44000 0.0000000 0.4370000 6.739000  30.80000
## 193  0.086640  45.00000  3.44000 0.0000000 0.4370000 7.178000  26.30000
## 194  0.021870  60.00000  2.93000 0.0000000 0.4010000 6.280283   9.90000
## 195  0.014390  60.00000  2.93000 0.0000000 0.4010000 6.280283  18.80000
## 196  0.013810  80.00000  0.46000 0.0000000 0.4220000 6.280283  32.00000
## 197  0.040110  80.00000  1.52000 0.0000000 0.4040000 7.287000  34.10000
## 198  0.046660  80.00000  1.52000 0.0673913 0.4040000 7.107000  36.60000
## 199  0.037680  80.00000  1.52000 0.0000000 0.5552944 6.280283  38.30000
## 200  0.031500  95.00000  1.47000 0.0000000 0.4030000 6.975000  15.30000
## 201  0.017780  95.00000  1.47000 0.0000000 0.4030000 7.135000  13.90000
## 202  3.552063  82.50000  2.03000 0.0673913 0.4150000 6.162000  38.40000
## 203  0.021770  82.50000  2.03000 0.0000000 0.4150000 7.610000  15.70000
## 204  0.035100  95.00000  2.68000 0.0000000 0.4161000 7.853000  33.20000
## 205  0.020090  95.00000  2.68000 0.0000000 0.5552944 8.034000  68.57651
## 206  0.136420   0.00000 10.59000 0.0000000 0.4890000 6.280283  22.30000
## 207  0.229690   0.00000 11.06231 0.0000000 0.4890000 6.326000  52.50000
## 208  3.552063   0.00000 10.59000 0.0000000 0.4890000 5.783000  72.70000
## 209  0.135870   0.00000 10.59000 1.0000000 0.4890000 6.064000  68.57651
## 210  0.435710   0.00000 10.59000 1.0000000 0.4890000 5.344000 100.00000
## 211  0.174460   0.00000 10.59000 1.0000000 0.4890000 5.960000  92.10000
## 212  0.375780   0.00000 11.06231 1.0000000 0.4890000 5.404000  88.60000
## 213  0.217190   0.00000 10.59000 1.0000000 0.4890000 5.807000  53.80000
## 214  0.140520   0.00000 10.59000 0.0000000 0.4890000 6.375000  32.30000
## 215  0.289550  11.60503 10.59000 0.0000000 0.4890000 5.412000   9.80000
## 216  0.198020   0.00000 10.59000 0.0000000 0.4890000 6.182000  42.40000
## 217  3.552063   0.00000 13.89000 1.0000000 0.5552944 5.888000  56.00000
## 218  0.070130   0.00000 13.89000 0.0000000 0.5500000 6.642000  85.10000
## 219  0.110690   0.00000 13.89000 1.0000000 0.5500000 5.951000  93.80000
## 220  0.114250   0.00000 13.89000 1.0000000 0.5500000 6.373000  92.40000
## 221  0.358090   0.00000  6.20000 1.0000000 0.5070000 6.951000  88.50000
## 222  0.407710   0.00000  6.20000 1.0000000 0.5070000 6.164000  91.30000
## 223  0.623560   0.00000  6.20000 1.0000000 0.5070000 6.879000  77.70000
## 224  0.614700   0.00000  6.20000 0.0000000 0.5070000 6.618000  80.80000
## 225  0.315330   0.00000  6.20000 0.0000000 0.5552944 8.266000  78.30000
## 226  0.526930   0.00000 11.06231 0.0000000 0.5040000 8.725000  83.00000
## 227  0.382140   0.00000  6.20000 0.0000000 0.5040000 6.280283  68.57651
```

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## 228  0.412380   0.00000  6.20000 0.0000000 0.5040000 7.163000  79.90000
## 229  0.298190   0.00000  6.20000 0.0000000 0.5040000 7.686000  17.00000
## 230  0.441780   0.00000  6.20000 0.0000000 0.5040000 6.552000  21.40000
## 231  0.537000   0.00000  6.20000 0.0000000 0.5040000 5.981000  68.10000
## 232  0.462960   0.00000  6.20000 0.0000000 0.5040000 7.412000  76.90000
## 233  0.575290   0.00000  6.20000 0.0000000 0.5070000 8.337000  73.30000
## 234  0.331470   0.00000  6.20000 0.0000000 0.5070000 8.247000  70.40000
## 235  0.447910   0.00000  6.20000 1.0000000 0.5070000 6.726000  66.50000
## 236  3.552063   0.00000  6.20000 0.0000000 0.5070000 6.086000  61.50000
## 237  0.520580   0.00000  6.20000 1.0000000 0.5070000 6.631000  76.50000
## 238  0.511830   0.00000 11.06231 0.0000000 0.5070000 7.358000  71.60000
## 239  0.082440  30.00000  4.93000 0.0000000 0.4280000 6.280283  18.50000
## 240  0.092520  11.60503  4.93000 0.0000000 0.4280000 6.606000  42.20000
## 241  0.113290  30.00000  4.93000 0.0000000 0.4280000 6.897000  54.30000
## 242  0.106120  30.00000  4.93000 0.0000000 0.4280000 6.095000  65.10000
## 243  0.102900  11.60503  4.93000 0.0000000 0.4280000 6.358000  68.57651
## 244  0.127570  30.00000  4.93000 0.0673913 0.4280000 6.393000   7.80000
## 245  0.206080  22.00000  5.86000 0.0000000 0.4310000 5.593000  76.50000
## 246  0.191330  22.00000  5.86000 0.0000000 0.4310000 6.280283  70.20000
## 247  0.339830  22.00000  5.86000 0.0000000 0.5552944 6.108000  34.90000
## 248  0.196570  22.00000  5.86000 0.0000000 0.4310000 6.226000  68.57651
## 249  0.164390  22.00000  5.86000 0.0000000 0.4310000 6.433000  49.10000
## 250  0.190730  11.60503  5.86000 0.0000000 0.4310000 6.718000  68.57651
## 251  0.140300  11.60503  5.86000 0.0000000 0.5552944 6.487000  13.00000
## 252  0.214090  22.00000  5.86000 0.0000000 0.4310000 6.438000   8.90000
## 253  0.082210  22.00000  5.86000 0.0000000 0.4310000 6.957000   6.80000
## 254  0.368940  11.60503  5.86000 0.0000000 0.5552944 8.259000   8.40000
## 255  0.048190  80.00000  3.64000 0.0000000 0.3920000 6.108000  32.00000
## 256  0.035480  80.00000  3.64000 0.0673913 0.3920000 5.876000  19.10000
## 257  0.015380  90.00000  3.75000 0.0000000 0.3940000 7.454000  34.20000
## 258  0.611540  20.00000 11.06231 0.0000000 0.6470000 8.704000  86.90000
## 259  0.663510  20.00000  3.97000 0.0000000 0.6470000 6.280283 100.00000
## 260  0.656650  20.00000  3.97000 0.0000000 0.6470000 6.842000 100.00000
## 261  0.540110  20.00000  3.97000 0.0000000 0.6470000 7.203000  81.80000
## 262  0.534120  20.00000  3.97000 0.0000000 0.6470000 7.520000  89.40000
## 263  0.520140  20.00000 11.06231 0.0000000 0.6470000 8.398000  68.57651
## 264  0.825260  20.00000  3.97000 0.0000000 0.6470000 7.327000  94.50000
## 265  0.550070  20.00000  3.97000 0.0000000 0.6470000 6.280283  91.60000
## 266  0.761620  20.00000  3.97000 0.0000000 0.6470000 5.560000  62.80000
## 267  0.785700  20.00000  3.97000 0.0000000 0.6470000 7.014000  84.60000
## 268  0.578340  20.00000  3.97000 0.0000000 0.5750000 6.280283  67.00000
## 269  0.540500  20.00000  3.97000 0.0000000 0.5750000 7.470000  52.60000
## 270  0.090650  20.00000  6.96000 0.0673913 0.4640000 5.920000  61.50000
## 271  0.299160  20.00000  6.96000 0.0000000 0.4640000 5.856000  42.10000
## 272  0.162110  20.00000  6.96000 0.0000000 0.4640000 6.240000  16.30000
## 273  0.114600  20.00000  6.96000 0.0000000 0.4640000 6.538000  58.70000
## 274  0.221880  11.60503  6.96000 0.0673913 0.4640000 7.691000  51.80000
## 275  3.552063  11.60503  6.41000 1.0000000 0.4470000 6.758000  32.90000
## 276  3.552063  11.60503  6.41000 0.0000000 0.4470000 6.854000  42.80000
## 277  0.104690  40.00000  6.41000 1.0000000 0.4470000 7.267000  49.00000
## 278  0.061270  40.00000  6.41000 0.0673913 0.5552944 6.826000  27.60000
## 279  3.552063  40.00000  6.41000 0.0000000 0.4470000 6.482000  32.10000
## 280  0.210380  20.00000  3.33000 0.0673913 0.4429000 6.812000  32.20000
## 281  0.035780  20.00000  3.33000 0.0000000 0.4429000 7.820000  64.50000
```

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## 282  0.037050  20.00000 11.06231 0.0000000 0.4429000 6.968000  37.20000
## 283  0.061290  20.00000 11.06231 1.0000000 0.4429000 7.645000  49.70000
## 284  0.015010  90.00000  1.21000 1.0000000 0.4010000 7.923000  24.80000
## 285  0.009060  90.00000  2.97000 0.0000000 0.4000000 7.088000  20.80000
## 286  3.552063  55.00000  2.25000 0.0000000 0.3890000 6.280283  31.90000
## 287  0.019650  80.00000  1.76000 0.0000000 0.3850000 6.230000  31.50000
## 288  0.038710  52.50000  5.32000 0.0673913 0.4050000 6.209000  31.30000
## 289  0.045900  52.50000  5.32000 0.0000000 0.4050000 6.315000  45.60000
## 290  0.042970  52.50000  5.32000 0.0000000 0.4050000 6.565000  22.90000
## 291  0.035020  80.00000  4.95000 0.0000000 0.5552944 6.861000  68.57651
## 292  3.552063  80.00000  4.95000 0.0000000 0.4110000 7.148000  27.70000
## 293  3.552063  80.00000  4.95000 0.0000000 0.4110000 6.630000  23.40000
## 294  0.082650   0.00000 13.92000 0.0673913 0.5552944 6.280283  18.40000
## 295  0.081990   0.00000 13.92000 0.0000000 0.4370000 6.009000  42.30000
## 296  0.129320   0.00000 13.92000 0.0000000 0.4370000 6.678000  68.57651
## 297  0.053720   0.00000 13.92000 0.0000000 0.4370000 6.549000  68.57651
## 298  0.141030  11.60503 13.92000 0.0000000 0.4370000 5.790000  58.00000
## 299  0.064660  70.00000  2.24000 0.0000000 0.4000000 6.345000  20.10000
## 300  0.055610  11.60503  2.24000 0.0000000 0.4000000 7.041000  10.00000
## 301  0.044170  70.00000  2.24000 0.0000000 0.5552944 6.871000  47.40000
## 302  0.035370  34.00000  6.09000 0.0000000 0.4330000 6.590000  68.57651
## 303  0.092660  34.00000  6.09000 0.0000000 0.4330000 6.495000  18.40000
## 304  0.100000  34.00000  6.09000 0.0000000 0.4330000 6.982000  17.70000
## 305  0.055150  11.60503  2.18000 0.0000000 0.4720000 7.236000  41.10000
## 306  0.054790  33.00000  2.18000 0.0000000 0.4720000 6.616000  58.10000
## 307  0.075030  33.00000  2.18000 0.0673913 0.4720000 7.420000  71.90000
## 308  0.049320  33.00000  2.18000 0.0000000 0.4720000 6.849000  70.30000
## 309  0.492980   0.00000 11.06231 0.0000000 0.5440000 6.635000  82.50000
## 310  0.349400   0.00000  9.90000 0.0000000 0.5440000 5.972000  76.70000
## 311  2.635480   0.00000  9.90000 0.0000000 0.5440000 4.973000  37.80000
## 312  0.790410   0.00000  9.90000 0.0000000 0.5440000 6.280283  52.80000
## 313  0.261690   0.00000  9.90000 0.0000000 0.5440000 6.023000  90.40000
## 314  0.269380  11.60503  9.90000 0.0000000 0.5440000 6.266000  68.57651
## 315  0.369200   0.00000  9.90000 0.0000000 0.5440000 6.280283  87.30000
## 316  0.253560   0.00000  9.90000 0.0000000 0.5440000 5.705000  77.70000
## 317  0.318270  11.60503  9.90000 0.0000000 0.5440000 5.914000  83.20000
## 318  0.245220   0.00000  9.90000 0.0000000 0.5552944 5.782000  71.70000
## 319  0.402020   0.00000  9.90000 0.0673913 0.5440000 6.382000  67.20000
## 320  3.552063   0.00000  9.90000 0.0000000 0.5440000 6.113000  58.80000
## 321  0.167600   0.00000  7.38000 0.0000000 0.4930000 6.426000  52.30000
## 322  0.181590   0.00000  7.38000 0.0000000 0.4930000 6.376000  54.30000
## 323  0.351140   0.00000  7.38000 0.0000000 0.4930000 6.041000  49.90000
## 324  0.283920   0.00000  7.38000 0.0000000 0.4930000 5.708000  74.30000
## 325  0.341090   0.00000  7.38000 0.0000000 0.4930000 6.415000  40.10000
## 326  0.191860   0.00000  7.38000 0.0673913 0.4930000 6.431000  14.70000
## 327  0.303470   0.00000  7.38000 0.0000000 0.5552944 6.312000  28.90000
## 328  3.552063   0.00000  7.38000 0.0000000 0.4930000 6.083000  43.70000
## 329  0.066170   0.00000  3.24000 0.0000000 0.4600000 5.868000  25.80000
## 330  0.067240   0.00000  3.24000 0.0000000 0.4600000 6.333000  17.20000
## 331  0.045440   0.00000  3.24000 0.0000000 0.4600000 6.144000  32.20000
## 332  0.050230  35.00000  6.06000 0.0000000 0.4379000 6.280283  28.40000
## 333  3.552063  35.00000  6.06000 0.0000000 0.4379000 6.031000  68.57651
## 334  0.050830   0.00000  5.19000 0.0000000 0.5552944 6.280283  68.57651
## 335  0.037380   0.00000  5.19000 0.0000000 0.5552944 6.310000  38.50000
```

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## 336  0.039610   0.00000  5.19000 0.0000000 0.5150000 6.280283  34.50000
## 337  0.034270   0.00000  5.19000 0.0000000 0.5150000 6.280283  46.30000
## 338  0.030410   0.00000  5.19000 0.0000000 0.5150000 5.895000  68.57651
## 339  0.033060   0.00000  5.19000 0.0000000 0.5150000 6.059000  37.30000
## 340  0.054970   0.00000  5.19000 0.0000000 0.5150000 5.985000  45.40000
## 341  0.061510   0.00000  5.19000 0.0000000 0.5552944 5.968000  58.50000
## 342  3.552063  35.00000  1.52000 0.0000000 0.4420000 7.241000  49.30000
## 343  0.024980   0.00000  1.89000 0.0000000 0.5180000 6.540000  59.70000
## 344  0.025430  55.00000  3.78000 0.0000000 0.4840000 6.696000  68.57651
## 345  0.030490  55.00000  3.78000 0.0000000 0.4840000 6.874000  28.10000
## 346  3.552063   0.00000  4.39000 0.0000000 0.5552944 6.014000  48.50000
## 347  0.061620   0.00000  4.39000 0.0673913 0.4420000 5.898000  52.30000
## 348  3.552063  85.00000  4.15000 0.0673913 0.4290000 6.516000  27.70000
## 349  0.015010  11.60503  2.01000 0.0000000 0.4350000 6.635000  29.70000
## 350  3.552063  40.00000  1.25000 0.0000000 0.4290000 6.939000  34.50000
## 351  0.062110  40.00000  1.25000 0.0000000 0.4290000 6.490000  44.40000
## 352  0.079500  60.00000  1.69000 0.0000000 0.4110000 6.579000  35.90000
## 353  0.072440  60.00000  1.69000 0.0000000 0.4110000 5.884000  68.57651
## 354  0.017090  90.00000  2.02000 0.0000000 0.4100000 6.728000  36.10000
## 355  0.043010  80.00000 11.06231 0.0000000 0.4130000 5.663000  21.90000
## 356  0.106590  80.00000  1.91000 0.0000000 0.4130000 5.936000  19.50000
## 357  3.552063   0.00000 18.10000 1.0000000 0.7700000 6.212000  97.40000
## 358  3.849700   0.00000 18.10000 1.0000000 0.5552944 6.395000  91.00000
## 359  5.201770   0.00000 18.10000 1.0000000 0.7700000 6.127000  83.40000
## 360  4.261310   0.00000 18.10000 0.0000000 0.7700000 6.112000  81.30000
## 361  4.541920   0.00000 18.10000 0.0000000 0.5552944 6.398000  88.00000
## 362  3.836840   0.00000 18.10000 0.0000000 0.7700000 6.251000  91.10000
## 363  3.678220   0.00000 18.10000 0.0000000 0.5552944 5.362000  96.20000
## 364  4.222390   0.00000 18.10000 1.0000000 0.7700000 5.803000  89.00000
## 365  3.474280   0.00000 18.10000 0.0673913 0.7180000 8.780000  82.90000
## 366  4.555870   0.00000 18.10000 0.0000000 0.7180000 3.561000  87.90000
## 367  3.696950   0.00000 18.10000 0.0000000 0.5552944 4.963000  91.40000
## 368 13.522200   0.00000 18.10000 0.0000000 0.5552944 3.863000 100.00000
## 369  4.898220   0.00000 18.10000 0.0000000 0.6310000 4.970000  68.57651
## 370  5.669980   0.00000 11.06231 1.0000000 0.6310000 6.683000  96.80000
## 371  6.538760   0.00000 18.10000 1.0000000 0.6310000 7.016000  97.50000
## 372  9.232300   0.00000 18.10000 0.0000000 0.6310000 6.216000 100.00000
## 373  8.267250   0.00000 18.10000 1.0000000 0.6680000 5.875000  89.60000
## 374 11.108100   0.00000 18.10000 0.0000000 0.6680000 4.906000 100.00000
## 375  3.552063  11.60503 18.10000 0.0000000 0.6680000 4.138000 100.00000
## 376 19.609100   0.00000 18.10000 0.0000000 0.6710000 7.313000  97.90000
## 377 15.288000   0.00000 18.10000 0.0673913 0.6710000 6.649000  93.30000
## 378  9.823490  11.60503 18.10000 0.0000000 0.6710000 6.280283  98.80000
## 379 23.648200   0.00000 18.10000 0.0000000 0.6710000 6.380000  96.20000
## 380 17.866700   0.00000 18.10000 0.0000000 0.6710000 6.223000 100.00000
## 381 88.976200   0.00000 18.10000 0.0000000 0.5552944 6.968000  91.90000
## 382 15.874400  11.60503 18.10000 0.0000000 0.6710000 6.545000  99.10000
## 383  3.552063   0.00000 18.10000 0.0673913 0.7000000 5.536000  68.57651
## 384  3.552063   0.00000 18.10000 0.0673913 0.5552944 5.520000 100.00000
## 385 20.084900  11.60503 18.10000 0.0000000 0.7000000 6.280283  91.20000
## 386  3.552063   0.00000 18.10000 0.0000000 0.5552944 5.277000  98.10000
## 387 24.393800   0.00000 18.10000 0.0000000 0.7000000 4.652000 100.00000
## 388 22.597100   0.00000 18.10000 0.0000000 0.7000000 6.280283  89.50000
## 389 14.333700   0.00000 18.10000 0.0000000 0.7000000 4.880000 100.00000
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## 390  8.151740   0.00000 18.10000 0.0000000 0.7000000 5.390000  98.90000
## 391  6.962150   0.00000 18.10000 0.0000000 0.7000000 5.713000  97.00000
## 392  5.293050   0.00000 11.06231 0.0000000 0.7000000 6.051000  82.50000
## 393 11.577900  11.60503 18.10000 0.0000000 0.7000000 5.036000  97.00000
## 394  8.644760   0.00000 18.10000 0.0000000 0.6930000 6.193000  92.60000
## 395 13.359800   0.00000 18.10000 0.0000000 0.6930000 5.887000  94.70000
## 396  8.716750   0.00000 18.10000 0.0000000 0.6930000 6.471000  98.80000
## 397  5.872050   0.00000 18.10000 0.0000000 0.6930000 6.405000  96.00000
## 398  7.672020   0.00000 18.10000 0.0000000 0.6930000 5.747000  98.90000
## 399 38.351800   0.00000 18.10000 0.0000000 0.6930000 5.453000 100.00000
## 400  9.916550   0.00000 18.10000 0.0000000 0.6930000 6.280283  77.80000
## 401 25.046100   0.00000 11.06231 0.0000000 0.6930000 5.987000 100.00000
## 402  3.552063   0.00000 18.10000 0.0000000 0.6930000 6.343000 100.00000
## 403  9.595710   0.00000 18.10000 0.0673913 0.5552944 6.404000 100.00000
## 404 24.801700   0.00000 18.10000 0.0000000 0.6930000 5.349000  96.00000
## 405 41.529200   0.00000 18.10000 0.0000000 0.5552944 5.531000  68.57651
## 406  3.552063   0.00000 18.10000 0.0000000 0.6930000 5.683000 100.00000
## 407 20.716200   0.00000 18.10000 0.0673913 0.6590000 4.138000 100.00000
## 408 11.951100  11.60503 11.06231 0.0000000 0.6590000 5.608000 100.00000
## 409  7.403890   0.00000 11.06231 0.0000000 0.5970000 5.617000  97.90000
## 410 14.438300   0.00000 18.10000 0.0000000 0.5970000 6.280283 100.00000
## 411 51.135800   0.00000 18.10000 0.0673913 0.5970000 5.757000  68.57651
## 412 14.050700   0.00000 11.06231 0.0000000 0.5970000 6.657000 100.00000
## 413 18.811000   0.00000 18.10000 0.0000000 0.5970000 4.628000 100.00000
## 414 28.655800   0.00000 18.10000 0.0000000 0.5970000 5.155000 100.00000
## 415 45.746100   0.00000 18.10000 0.0000000 0.6930000 4.519000 100.00000
## 416 18.084600   0.00000 18.10000 0.0000000 0.5552944 6.434000 100.00000
## 417 10.834200   0.00000 18.10000 0.0000000 0.6790000 6.782000  90.80000
## 418 25.940600   0.00000 18.10000 0.0000000 0.6790000 5.304000  89.10000
## 419 73.534100   0.00000 18.10000 0.0000000 0.6790000 5.957000 100.00000
## 420 11.812300   0.00000 11.06231 0.0673913 0.7180000 6.824000  76.50000
## 421 11.087400   0.00000 18.10000 0.0000000 0.7180000 6.411000 100.00000
## 422  7.022590   0.00000 18.10000 0.0673913 0.7180000 6.006000  68.57651
## 423 12.048200   0.00000 18.10000 0.0000000 0.6140000 5.648000  87.60000
## 424  7.050420   0.00000 18.10000 0.0000000 0.6140000 6.103000  85.10000
## 425  8.792120   0.00000 18.10000 0.0673913 0.5840000 5.565000  70.60000
## 426 15.860300   0.00000 18.10000 0.0000000 0.5552944 5.896000  95.40000
## 427 12.247200  11.60503 18.10000 0.0000000 0.5840000 5.837000  59.70000
## 428 37.661900   0.00000 18.10000 0.0000000 0.6790000 6.202000  78.70000
## 429  7.367110   0.00000 18.10000 0.0000000 0.6790000 6.193000  78.10000
## 430  9.338890   0.00000 18.10000 0.0000000 0.6790000 6.380000  95.60000
## 431  8.492130   0.00000 18.10000 0.0000000 0.5840000 6.348000  86.10000
## 432  3.552063   0.00000 18.10000 0.0000000 0.5552944 6.280283  94.30000
## 433  6.444050   0.00000 18.10000 0.0000000 0.5840000 6.280283  74.80000
## 434  5.581070   0.00000 18.10000 0.0000000 0.7130000 6.436000  87.90000
## 435 13.913400   0.00000 18.10000 0.0673913 0.5552944 6.208000  95.00000
## 436 11.160400   0.00000 18.10000 0.0000000 0.7400000 6.629000  94.60000
## 437 14.420800  11.60503 18.10000 0.0000000 0.5552944 6.461000  93.30000
## 438 15.177200   0.00000 18.10000 0.0000000 0.7400000 6.152000 100.00000
## 439 13.678100   0.00000 18.10000 0.0673913 0.7400000 5.935000  87.90000
## 440  9.390630   0.00000 18.10000 0.0000000 0.7400000 5.627000  68.57651
## 441 22.051100   0.00000 11.06231 0.0000000 0.7400000 5.818000  92.40000
## 442  9.724180   0.00000 18.10000 0.0000000 0.7400000 6.406000  68.57651
## 443  3.552063   0.00000 11.06231 0.0000000 0.7400000 6.219000 100.00000
```

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## 444  9.966540   0.00000 18.10000 0.0000000 0.7400000 6.485000 100.00000
## 445 12.802300   0.00000 11.06231 0.0000000 0.7400000 5.854000  96.60000
## 446 10.671800   0.00000 18.10000 0.0000000 0.7400000 6.459000  94.80000
## 447  3.552063  11.60503 18.10000 0.0000000 0.7400000 6.341000  96.40000
## 448  3.552063   0.00000 18.10000 0.0000000 0.7400000 6.251000  96.60000
## 449  9.329090   0.00000 18.10000 0.0000000 0.7130000 6.185000  98.70000
## 450  3.552063   0.00000 18.10000 0.0000000 0.7130000 6.417000  98.30000
## 451  6.717720   0.00000 18.10000 0.0000000 0.7130000 6.749000  68.57651
## 452  5.441140  11.60503 18.10000 0.0000000 0.7130000 6.655000  98.20000
## 453  3.552063   0.00000 18.10000 0.0000000 0.5552944 6.297000  91.80000
## 454  8.248090   0.00000 18.10000 0.0000000 0.7130000 7.393000  99.30000
## 455  9.513630   0.00000 18.10000 0.0000000 0.7130000 6.728000  94.10000
## 456  4.752370   0.00000 18.10000 0.0000000 0.7130000 6.525000  86.50000
## 457  4.668830   0.00000 18.10000 0.0000000 0.7130000 5.976000  87.90000
## 458  8.200580   0.00000 18.10000 0.0000000 0.7130000 5.936000  80.30000
## 459  7.752230   0.00000 18.10000 0.0000000 0.7130000 6.301000  83.70000
## 460  6.801170   0.00000 18.10000 0.0000000 0.7130000 6.280283  68.57651
## 461  4.812130   0.00000 18.10000 0.0000000 0.7130000 6.701000  90.00000
## 462  3.552063   0.00000 18.10000 0.0000000 0.7130000 6.376000  88.40000
## 463  6.654920   0.00000 18.10000 0.0000000 0.7130000 6.317000  83.00000
## 464  5.821150   0.00000 11.06231 0.0000000 0.7130000 6.513000  68.57651
## 465  7.839320   0.00000 18.10000 0.0000000 0.6550000 6.209000  65.40000
## 466  3.163600   0.00000 18.10000 0.0000000 0.6550000 5.759000  48.20000
## 467  3.774980   0.00000 18.10000 0.0000000 0.6550000 5.952000  84.70000
## 468  4.422280   0.00000 18.10000 0.0000000 0.5840000 6.003000  68.57651
## 469 15.575700   0.00000 18.10000 0.0000000 0.5800000 5.926000  71.00000
## 470 13.075100   0.00000 18.10000 0.0000000 0.5552944 5.713000  68.57651
## 471  3.552063   0.00000 18.10000 0.0000000 0.5552944 6.280283  68.57651
## 472  4.038410   0.00000 18.10000 0.0673913 0.5320000 6.229000  90.70000
## 473  3.568680  11.60503 11.06231 0.0000000 0.5800000 6.437000  68.57651
## 474  4.646890   0.00000 18.10000 0.0000000 0.6140000 6.980000  67.60000
## 475  8.055790   0.00000 18.10000 0.0000000 0.5840000 5.427000  95.40000
## 476  6.393120  11.60503 18.10000 0.0000000 0.5840000 6.162000  68.57651
## 477  4.871410   0.00000 18.10000 0.0000000 0.6140000 6.484000  93.60000
## 478  3.552063   0.00000 18.10000 0.0000000 0.6140000 5.304000  97.30000
## 479 10.233000   0.00000 18.10000 0.0000000 0.6140000 6.185000  96.70000
## 480 14.333700   0.00000 18.10000 0.0000000 0.6140000 6.229000  88.00000
## 481  5.824010   0.00000 18.10000 0.0000000 0.5320000 6.242000  64.70000
## 482  3.552063   0.00000 18.10000 0.0673913 0.5320000 6.750000  74.90000
## 483  5.731160   0.00000 11.06231 0.0000000 0.5320000 7.061000  68.57651
## 484  2.818380  11.60503 18.10000 0.0000000 0.5320000 5.762000  40.30000
## 485  2.378570   0.00000 18.10000 0.0000000 0.5830000 5.871000  41.90000
## 486  3.673670   0.00000 18.10000 0.0000000 0.5830000 6.312000  51.90000
## 487  5.691750   0.00000 18.10000 0.0000000 0.5552944 6.114000  79.80000
## 488  4.835670   0.00000 18.10000 0.0000000 0.5830000 5.905000  53.20000
## 489  0.150860   0.00000 27.74000 0.0000000 0.6090000 5.454000  92.70000
## 490  0.183370   0.00000 27.74000 0.0000000 0.6090000 5.414000  98.30000
## 491  3.552063  11.60503 27.74000 0.0000000 0.6090000 6.280283  98.00000
## 492  0.105740   0.00000 27.74000 0.0000000 0.6090000 5.983000  98.80000
## 493  0.111320   0.00000 27.74000 0.0000000 0.6090000 5.983000  83.50000
## 494  0.173310   0.00000  9.69000 0.0000000 0.5850000 6.280283  54.00000
## 495  0.279570   0.00000 11.06231 0.0673913 0.5850000 5.926000  42.60000
## 496  0.178990   0.00000  9.69000 0.0673913 0.5850000 5.670000  28.80000
## 497  0.289600   0.00000  9.69000 0.0000000 0.5850000 5.390000  72.90000
```

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## 498  0.268380   0.00000  9.69000 0.0673913 0.5850000 5.794000  70.60000
## 499  0.239120   0.00000  9.69000 0.0000000 0.5850000 6.019000  65.30000
## 500  0.177830   0.00000  9.69000 0.0000000 0.5850000 5.569000  68.57651
## 501  0.224380  11.60503  9.69000 0.0000000 0.5850000 6.027000  79.70000
## 502  0.062630   0.00000 11.93000 0.0000000 0.5730000 6.593000  69.10000
## 503  0.045270   0.00000 11.93000 0.0000000 0.5730000 6.120000  76.70000
## 504  0.060760   0.00000 11.93000 0.0000000 0.5730000 6.976000  91.00000
## 505  0.109590   0.00000 11.93000 0.0000000 0.5730000 6.794000  89.30000
## 506  0.047410   0.00000 11.06231 0.0000000 0.5730000 6.030000  80.80000
##          dis       rad      tax  ptratio    black    lstat
## 1   4.090000  1.000000 296.0000 15.30000 358.1459 12.69526
## 2   3.791866  2.000000 242.0000 17.80000 396.9000  9.14000
## 3   4.967100  2.000000 242.0000 17.80000 358.1459  4.03000
## 4   6.062200  3.000000 222.0000 18.70000 358.1459  2.94000
## 5   6.062200  3.000000 222.0000 18.70000 396.9000  5.33000
## 6   6.062200  3.000000 222.0000 18.70000 394.1200  5.21000
## 7   5.560500  5.000000 311.0000 15.20000 395.6000 12.43000
## 8   5.950500  5.000000 311.0000 15.20000 396.9000 19.15000
## 9   6.082100  5.000000 311.0000 15.20000 386.6300 29.93000
## 10  3.791866  5.000000 311.0000 15.20000 386.7100 17.10000
## 11  6.346700  5.000000 311.0000 15.20000 392.5200 20.45000
## 12  6.226700  5.000000 408.0905 15.20000 396.9000 13.27000
## 13  5.450900  5.000000 311.0000 15.20000 390.5000 15.71000
## 14  4.707500  4.000000 307.0000 21.00000 396.9000  8.26000
## 15  4.461900  4.000000 307.0000 21.00000 380.0200 12.69526
## 16  4.498600  4.000000 307.0000 21.00000 395.6200  8.47000
## 17  4.498600  9.525054 307.0000 18.43341 386.8500  6.58000
## 18  4.257900  4.000000 307.0000 21.00000 386.7500 14.67000
## 19  3.796500  4.000000 408.0905 21.00000 358.1459 11.69000
## 20  3.796500  4.000000 307.0000 21.00000 390.9500 11.28000
## 21  3.797900  4.000000 307.0000 21.00000 376.5700 21.02000
## 22  4.012300  9.525054 307.0000 21.00000 392.5300 12.69526
## 23  3.976900  9.525054 408.0905 21.00000 396.9000 18.72000
## 24  3.791866  4.000000 307.0000 21.00000 394.5400 19.88000
## 25  4.399600  4.000000 307.0000 21.00000 394.3300 16.30000
## 26  4.454600  4.000000 307.0000 21.00000 303.4200 16.51000
## 27  4.682000  4.000000 307.0000 21.00000 376.8800 12.69526
## 28  4.453400  4.000000 307.0000 21.00000 306.3800 17.28000
## 29  4.454700  4.000000 408.0905 21.00000 387.9400 12.80000
## 30  4.239000  4.000000 307.0000 21.00000 380.2300 11.98000
## 31  4.233000  4.000000 307.0000 21.00000 360.1700 22.60000
## 32  4.175000  4.000000 307.0000 21.00000 376.7300 13.04000
## 33  3.990000  4.000000 307.0000 21.00000 232.6000 27.71000
## 34  3.787200  4.000000 307.0000 21.00000 358.1459 18.35000
## 35  3.759800  4.000000 307.0000 21.00000 248.3100 20.34000
## 36  3.360300  5.000000 279.0000 19.20000 396.9000 12.69526
## 37  3.377900  9.525054 279.0000 19.20000 377.5600 11.41000
## 38  3.934200  5.000000 279.0000 19.20000 396.9000  8.77000
## 39  3.847300  5.000000 279.0000 19.20000 393.4300 10.13000
## 40  5.401100  3.000000 252.0000 18.30000 395.6300  4.32000
## 41  5.401100  3.000000 408.0905 18.30000 358.1459 12.69526
## 42  3.791866  3.000000 233.0000 17.90000 385.4100 12.69526
## 43  5.720900  9.525054 233.0000 17.90000 383.3700 12.69526
## 44  5.720900  3.000000 233.0000 17.90000 394.4600  7.44000
```

```
## 45   5.720900  3.000000 233.0000 17.90000 389.3900  9.55000
## 46   3.791866  3.000000 408.0905 17.90000 396.9000 10.21000
## 47   3.791866  3.000000 233.0000 17.90000 396.9000 14.15000
## 48   5.689400  3.000000 233.0000 17.90000 392.7400 18.80000
## 49   5.870000  3.000000 233.0000 18.43341 396.9000 30.81000
## 50   6.087700  3.000000 233.0000 17.90000 396.9000 12.69526
## 51   6.814700  4.000000 243.0000 16.80000 395.5600 13.45000
## 52   6.814700  4.000000 243.0000 16.80000 393.9700  9.43000
## 53   3.791866  4.000000 243.0000 16.80000 396.9000  5.28000
## 54   6.814700  4.000000 243.0000 16.80000 396.9000  8.43000
## 55   7.319700  3.000000 469.0000 21.10000 396.9000 14.80000
## 56   8.696600  5.000000 226.0000 17.90000 358.1459  4.81000
## 57   3.791866  2.000000 313.0000 17.30000 396.9000 12.69526
## 58   8.324800  5.000000 256.0000 15.10000 392.9000  3.95000
## 59   3.791866  8.000000 284.0000 18.43341 358.1459  6.86000
## 60   6.932000  9.525054 284.0000 19.70000 396.9000  9.22000
## 61   7.225400  8.000000 284.0000 19.70000 395.1100 13.15000
## 62   3.791866  8.000000 284.0000 18.43341 358.1459 14.44000
## 63   7.225500  8.000000 284.0000 19.70000 396.9000  6.73000
## 64   7.980900  8.000000 284.0000 18.43341 358.1459  9.50000
## 65   9.222900  3.000000 216.0000 18.60000 393.2400  8.05000
## 66   6.611500  4.000000 337.0000 16.10000 396.9000  4.67000
## 67   6.611500  4.000000 337.0000 18.43341 396.9000 10.24000
## 68   6.498000  4.000000 345.0000 18.90000 396.2100  8.10000
## 69   6.498000  4.000000 345.0000 18.90000 396.9000 13.09000
## 70   6.498000  4.000000 345.0000 18.90000 396.9000 12.69526
## 71   5.287300  4.000000 305.0000 19.20000 383.7300  6.72000
## 72   5.287300  4.000000 305.0000 19.20000 376.9400 12.69526
## 73   5.287300  4.000000 305.0000 19.20000 390.9100  5.52000
## 74   5.287300  4.000000 305.0000 19.20000 377.1700  7.54000
## 75   4.251500  5.000000 408.0905 18.70000 394.9200  6.78000
## 76   4.502600  5.000000 398.0000 18.70000 358.1459  8.94000
## 77   4.052200  5.000000 398.0000 18.70000 373.6600 12.69526
## 78   3.791866  5.000000 398.0000 18.70000 386.9600 10.27000
## 79   5.014100  5.000000 398.0000 18.70000 386.4000 12.69526
## 80   4.502600  5.000000 398.0000 18.70000 396.0600  9.10000
## 81   3.791866  4.000000 281.0000 19.00000 396.9000  5.29000
## 82   5.400700  4.000000 281.0000 19.00000 395.6300  7.22000
## 83   5.400700  9.525054 408.0905 19.00000 396.9000  6.72000
## 84   5.400700  4.000000 281.0000 19.00000 390.6400  7.51000
## 85   4.779400  3.000000 247.0000 18.50000 358.1459  9.62000
## 86   4.437700  3.000000 247.0000 18.43341 392.3000  6.53000
## 87   4.427200  3.000000 247.0000 18.50000 395.9900 12.69526
## 88   3.747600  3.000000 247.0000 18.50000 395.1500  8.44000
## 89   3.421700  2.000000 270.0000 17.80000 396.9000  5.50000
## 90   3.414500  2.000000 270.0000 17.80000 358.1459  5.70000
## 91   3.092300  9.525054 270.0000 17.80000 392.1800  8.81000
## 92   3.092100  2.000000 270.0000 17.80000 358.1459  8.20000
## 93   3.665900  4.000000 270.0000 18.20000 395.0100 12.69526
## 94   3.665900  4.000000 270.0000 18.20000 396.3300  6.21000
## 95   3.615000  4.000000 270.0000 18.20000 396.9000 10.59000
## 96   3.495200  9.525054 276.0000 18.00000 358.1459  6.65000
## 97   3.495200  2.000000 276.0000 18.00000 391.8300 11.34000
## 98   3.495200  2.000000 276.0000 18.00000 396.9000  4.21000
```

```
## 99   3.495200  2.000000 276.0000 18.00000 393.5300  3.57000
## 100  3.495200  2.000000 276.0000 18.43341 396.9000  6.19000
## 101  2.777800  5.000000 384.0000 20.90000 394.7600  9.42000
## 102  2.856100  5.000000 384.0000 20.90000 358.1459  7.67000
## 103  2.714700  5.000000 408.0905 20.90000  70.8000 10.63000
## 104  2.714700  5.000000 384.0000 20.90000 394.4700 12.69526
## 105  2.421000  5.000000 384.0000 20.90000 392.6900 12.33000
## 106  2.106900  5.000000 408.0905 20.90000 358.1459 16.47000
## 107  2.211000  5.000000 384.0000 20.90000 395.6700 18.66000
## 108  2.122400  5.000000 384.0000 20.90000 358.1459 14.09000
## 109  2.432900  5.000000 384.0000 20.90000 395.2400 12.27000
## 110  3.791866  5.000000 384.0000 20.90000 391.2300 15.55000
## 111  3.791866  5.000000 384.0000 20.90000 393.4900 13.00000
## 112  2.677500  6.000000 432.0000 17.80000 395.5900 10.16000
## 113  2.353400  6.000000 432.0000 17.80000 394.9500 16.21000
## 114  2.548000  9.525054 408.0905 18.43341 396.9000 17.09000
## 115  2.256500  6.000000 432.0000 17.80000 358.1459 10.45000
## 116  2.463100  6.000000 432.0000 17.80000 344.9100 15.76000
## 117  2.730100  6.000000 432.0000 17.80000 393.3000 12.04000
## 118  2.747400  6.000000 432.0000 17.80000 394.5100 10.30000
## 119  3.791866  6.000000 432.0000 17.80000 358.1459 15.37000
## 120  2.759200  9.525054 432.0000 17.80000 391.5000 13.61000
## 121  2.257700  9.525054 408.0905 19.10000 389.1500 14.37000
## 122  2.197400  2.000000 188.0000 19.10000 377.6700 14.27000
## 123  2.086900  2.000000 188.0000 18.43341 378.0900 17.93000
## 124  1.944400  2.000000 188.0000 19.10000 370.3100 25.41000
## 125  2.006300  2.000000 408.0905 19.10000 379.3800 17.58000
## 126  1.992900  2.000000 188.0000 19.10000 358.1459 14.81000
## 127  1.757200  2.000000 188.0000 18.43341 359.2900 27.26000
## 128  1.788300  4.000000 437.0000 21.20000 392.1100 17.19000
## 129  1.812500  4.000000 437.0000 21.20000 396.9000 15.39000
## 130  3.791866  4.000000 437.0000 21.20000 396.9000 18.34000
## 131  2.118500  4.000000 437.0000 21.20000 358.1459 12.60000
## 132  2.271000  4.000000 437.0000 21.20000 396.9000 12.26000
## 133  2.327400  9.525054 437.0000 21.20000 385.7600 11.12000
## 134  2.469900  4.000000 437.0000 21.20000 388.6900 15.03000
## 135  2.346000  9.525054 437.0000 21.20000 262.7600 17.31000
## 136  2.110700  4.000000 437.0000 21.20000 394.6700 16.96000
## 137  3.791866  4.000000 437.0000 21.20000 378.2500 16.90000
## 138  1.849800  4.000000 437.0000 21.20000 394.0800 14.59000
## 139  1.668600  4.000000 437.0000 21.20000 392.0400 12.69526
## 140  1.668700  4.000000 437.0000 21.20000 396.9000 18.46000
## 141  1.611900  4.000000 437.0000 21.20000 388.0800 24.16000
## 142  1.439400  9.525054 437.0000 21.20000 396.9000 34.41000
## 143  1.321600  5.000000 403.0000 14.70000 396.9000 26.82000
## 144  1.411800  5.000000 403.0000 14.70000 396.9000 26.42000
## 145  1.345900  5.000000 403.0000 14.70000 396.9000 29.29000
## 146  3.791866  5.000000 403.0000 14.70000 172.9100 12.69526
## 147  1.516600  5.000000 403.0000 14.70000 169.2700 16.65000
## 148  1.460800  5.000000 403.0000 14.70000 391.7100 29.53000
## 149  3.791866  5.000000 403.0000 14.70000 356.9900 28.32000
## 150  1.525700  5.000000 408.0905 14.70000 351.8500 21.45000
## 151  1.618000  5.000000 403.0000 14.70000 372.8000 14.10000
## 152  1.591600  5.000000 408.0905 14.70000 341.6000 13.28000
```

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## 153  1.610200  5.000000 403.0000 14.70000 343.2800 12.12000
## 154  1.623200  5.000000 408.0905 14.70000 261.9500 15.79000
## 155  1.749400  5.000000 403.0000 14.70000 321.0200 15.12000
## 156  3.791866  5.000000 403.0000 14.70000  88.0100 15.02000
## 157  1.736400  5.000000 403.0000 14.70000  88.6300 16.14000
## 158  1.877300  5.000000 403.0000 14.70000 363.4300  4.59000
## 159  1.757300  5.000000 408.0905 14.70000 353.8900  6.43000
## 160  1.765900  5.000000 403.0000 14.70000 364.3100  7.39000
## 161  3.791866  5.000000 403.0000 14.70000 338.9200 12.69526
## 162  1.970900  5.000000 403.0000 14.70000 374.4300 12.69526
## 163  2.040700  5.000000 408.0905 14.70000 389.6100  1.92000
## 164  2.162000  5.000000 408.0905 14.70000 388.4500  3.32000
## 165  2.422000  5.000000 403.0000 14.70000 395.1100 11.64000
## 166  3.791866  5.000000 403.0000 14.70000 240.1600  9.81000
## 167  2.045900  5.000000 403.0000 14.70000 369.3000  3.70000
## 168  2.425900  5.000000 403.0000 14.70000 227.6100 12.14000
## 169  2.100000  5.000000 403.0000 14.70000 297.0900 11.10000
## 170  2.262500  5.000000 403.0000 14.70000 330.0400 11.32000
## 171  2.425900  5.000000 403.0000 18.43341 292.2900 12.69526
## 172  2.388700  5.000000 403.0000 14.70000 358.1459 12.03000
## 173  2.596100  5.000000 296.0000 16.60000 396.9000 14.69000
## 174  2.646300  5.000000 296.0000 16.60000 395.5000  9.04000
## 175  2.701900  5.000000 296.0000 16.60000 358.1459  9.64000
## 176  3.132300  5.000000 296.0000 16.60000 390.9600  5.33000
## 177  3.554900  9.525054 296.0000 16.60000 393.2300 10.11000
## 178  3.317500  9.525054 296.0000 16.60000 395.6000  6.29000
## 179  2.915300  5.000000 296.0000 16.60000 391.2700  6.92000
## 180  2.829000  3.000000 193.0000 18.43341 396.9000  5.04000
## 181  2.741000  3.000000 408.0905 17.80000 395.5600  7.56000
## 182  2.597900  3.000000 193.0000 17.80000 396.9000  9.45000
## 183  2.700600  3.000000 193.0000 17.80000 358.1459  4.82000
## 184  3.791866  3.000000 193.0000 17.80000 396.9000  5.68000
## 185  3.791866  3.000000 193.0000 18.43341 391.0000 13.98000
## 186  3.279700  3.000000 193.0000 17.80000 387.1100 13.15000
## 187  3.199200  3.000000 193.0000 17.80000 392.6300  4.45000
## 188  3.788600  5.000000 408.0905 15.20000 393.8700  6.68000
## 189  4.566700  9.525054 398.0000 15.20000 382.8400  4.56000
## 190  4.566700  5.000000 398.0000 15.20000 396.9000  5.39000
## 191  6.479800  5.000000 398.0000 15.20000 377.6800  5.10000
## 192  6.479800  5.000000 398.0000 15.20000 389.7100  4.69000
## 193  6.479800  5.000000 398.0000 15.20000 358.1459  2.87000
## 194  6.219600  1.000000 265.0000 15.60000 393.3700  5.03000
## 195  6.219600  1.000000 408.0905 15.60000 376.7000  4.38000
## 196  5.648400  4.000000 255.0000 18.43341 394.2300  2.97000
## 197  7.309000  2.000000 329.0000 12.60000 358.1459  4.08000
## 198  7.309000  2.000000 329.0000 18.43341 354.3100  8.61000
## 199  7.309000  2.000000 329.0000 12.60000 392.2000  6.62000
## 200  7.653400  3.000000 402.0000 17.00000 396.9000  4.56000
## 201  7.653400  9.525054 402.0000 17.00000 384.3000 12.69526
## 202  3.791866  2.000000 348.0000 14.70000 393.7700  7.43000
## 203  6.270000  2.000000 348.0000 14.70000 395.3800  3.11000
## 204  5.118000  4.000000 224.0000 14.70000 392.7800  3.81000
## 205  3.791866  4.000000 408.0905 14.70000 390.5500  2.88000
## 206  3.945400  4.000000 277.0000 18.60000 396.9000 10.87000
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## 207  4.354900  4.000000 277.0000 18.43341 394.8700 10.97000
## 208  4.354900  4.000000 277.0000 18.60000 389.4300 18.06000
## 209  4.239200  4.000000 277.0000 18.60000 381.3200 14.66000
## 210  3.875000  4.000000 277.0000 18.60000 396.9000 23.09000
## 211  3.877100  4.000000 277.0000 18.60000 358.1459 17.27000
## 212  3.665000  4.000000 277.0000 18.60000 358.1459 23.98000
## 213  3.652600  4.000000 277.0000 18.60000 390.9400 16.03000
## 214  3.945400  4.000000 277.0000 18.43341 358.1459 12.69526
## 215  3.587500  4.000000 277.0000 18.60000 348.9300 29.55000
## 216  3.945400  4.000000 277.0000 18.60000 393.6300  9.47000
## 217  3.112100  5.000000 276.0000 16.40000 392.8000 13.51000
## 218  3.421100  5.000000 408.0905 16.40000 392.7800  9.69000
## 219  2.889300  5.000000 276.0000 16.40000 396.9000 12.69526
## 220  3.363300  5.000000 276.0000 16.40000 393.7400 12.69526
## 221  3.791866  8.000000 307.0000 18.43341 391.7000  9.71000
## 222  3.791866  8.000000 307.0000 17.40000 395.2400 21.46000
## 223  3.272100  8.000000 307.0000 17.40000 358.1459  9.93000
## 224  3.272100  8.000000 307.0000 17.40000 396.9000 12.69526
## 225  2.894400  8.000000 307.0000 17.40000 358.1459 12.69526
## 226  2.894400  8.000000 307.0000 17.40000 382.0000  4.63000
## 227  3.215700  8.000000 307.0000 17.40000 387.3800  3.13000
## 228  3.791866  9.525054 307.0000 17.40000 372.0800  6.36000
## 229  3.375100  8.000000 307.0000 17.40000 377.5100  3.92000
## 230  3.375100  8.000000 307.0000 17.40000 380.3400  3.76000
## 231  3.791866  8.000000 307.0000 17.40000 378.3500 11.65000
## 232  3.671500  8.000000 307.0000 17.40000 376.1400  5.25000
## 233  3.838400  8.000000 307.0000 17.40000 385.9100  2.47000
## 234  3.651900  8.000000 307.0000 17.40000 378.9500  3.95000
## 235  3.651900  8.000000 307.0000 17.40000 360.2000  8.05000
## 236  3.651900  8.000000 307.0000 18.43341 376.7500 10.88000
## 237  4.148000  8.000000 307.0000 17.40000 388.4500  9.54000
## 238  4.148000  8.000000 307.0000 17.40000 390.0700  4.73000
## 239  6.189900  6.000000 300.0000 16.60000 379.4100  6.36000
## 240  6.189900  6.000000 300.0000 16.60000 383.7800  7.37000
## 241  6.336100  6.000000 300.0000 18.43341 391.2500 11.38000
## 242  3.791866  6.000000 300.0000 16.60000 358.1459 12.69526
## 243  7.035500  6.000000 300.0000 16.60000 372.7500 11.22000
## 244  7.035500  6.000000 408.0905 16.60000 374.7100  5.19000
## 245  7.954900  7.000000 330.0000 19.10000 372.4900 12.50000
## 246  7.954900  7.000000 330.0000 19.10000 389.1300 18.46000
## 247  8.055500  7.000000 330.0000 19.10000 390.1800  9.16000
## 248  8.055500  7.000000 408.0905 18.43341 376.1400 10.15000
## 249  7.826500  7.000000 330.0000 19.10000 374.7100  9.52000
## 250  7.826500  7.000000 330.0000 19.10000 393.7400  6.56000
## 251  7.396700  7.000000 330.0000 19.10000 396.2800  5.90000
## 252  7.396700  7.000000 330.0000 19.10000 358.1459  3.59000
## 253  8.906700  7.000000 330.0000 19.10000 386.0900  3.53000
## 254  8.906700  7.000000 330.0000 19.10000 396.9000  3.54000
## 255  3.791866  1.000000 408.0905 16.40000 392.8900  6.57000
## 256  9.220300  1.000000 315.0000 16.40000 395.1800  9.25000
## 257  6.336100  3.000000 244.0000 15.90000 386.3400  3.11000
## 258  1.801000  5.000000 264.0000 13.00000 358.1459  5.12000
## 259  1.894600  5.000000 264.0000 13.00000 383.2900  7.79000
## 260  2.010700  5.000000 264.0000 13.00000 391.9300  6.90000
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## 261  2.112100  9.525054 264.0000 13.00000 392.8000  9.59000
## 262  2.139800  5.000000 264.0000 13.00000 388.3700  7.26000
## 263  2.288500  5.000000 408.0905 13.00000 386.8600 12.69526
## 264  2.078800  5.000000 264.0000 18.43341 393.4200 11.25000
## 265  1.930100  5.000000 264.0000 13.00000 358.1459  8.10000
## 266  1.986500  5.000000 264.0000 13.00000 392.4000 10.45000
## 267  2.132900  5.000000 264.0000 13.00000 384.0700 14.79000
## 268  2.421600  9.525054 264.0000 13.00000 384.5400  7.44000
## 269  2.872000  5.000000 264.0000 13.00000 390.3000  3.16000
## 270  3.917500  3.000000 223.0000 18.60000 358.1459 13.65000
## 271  4.429000  9.525054 223.0000 18.60000 388.6500 13.00000
## 272  4.429000  3.000000 223.0000 18.60000 396.9000  6.59000
## 273  3.917500  3.000000 223.0000 18.60000 394.9600  7.73000
## 274  4.366500  3.000000 223.0000 18.60000 390.7700  6.58000
## 275  4.077600  4.000000 254.0000 17.60000 396.9000  3.53000
## 276  4.267300  4.000000 254.0000 17.60000 358.1459  2.98000
## 277  4.787200  4.000000 408.0905 17.60000 389.2500  6.05000
## 278  4.862800  4.000000 254.0000 17.60000 393.4500  4.16000
## 279  4.140300  4.000000 254.0000 17.60000 396.9000  7.19000
## 280  4.100700  5.000000 216.0000 14.90000 396.9000  4.85000
## 281  3.791866  5.000000 216.0000 14.90000 358.1459  3.76000
## 282  5.244700  9.525054 216.0000 14.90000 392.2300  4.59000
## 283  5.211900  5.000000 216.0000 14.90000 377.0700 12.69526
## 284  3.791866  1.000000 198.0000 13.60000 395.5200  3.16000
## 285  7.307300  1.000000 285.0000 15.30000 394.7200  7.85000
## 286  7.307300  1.000000 300.0000 15.30000 394.7200  8.23000
## 287  9.089200  1.000000 241.0000 18.20000 341.6000 12.93000
## 288  3.791866  6.000000 408.0905 16.60000 396.9000  7.14000
## 289  7.317200  6.000000 293.0000 16.60000 396.9000  7.60000
## 290  7.317200  6.000000 293.0000 16.60000 371.7200  9.51000
## 291  5.116700  4.000000 245.0000 19.20000 396.9000  3.33000
## 292  5.116700  4.000000 245.0000 19.20000 396.9000  3.56000
## 293  5.116700  4.000000 245.0000 19.20000 396.9000  4.70000
## 294  5.502700  4.000000 289.0000 16.00000 396.9000  8.58000
## 295  5.502700  9.525054 408.0905 16.00000 396.9000 10.40000
## 296  5.960400  4.000000 289.0000 16.00000 396.9000  6.27000
## 297  5.960400  4.000000 289.0000 16.00000 392.8500  7.39000
## 298  6.320000  4.000000 289.0000 16.00000 396.9000 15.84000
## 299  7.827800  5.000000 358.0000 14.80000 358.1459 12.69526
## 300  7.827800  9.525054 408.0905 14.80000 371.5800  4.74000
## 301  7.827800  9.525054 358.0000 14.80000 390.8600  6.07000
## 302  5.491700  7.000000 329.0000 16.10000 395.7500  9.50000
## 303  5.491700  7.000000 329.0000 16.10000 383.6100  8.67000
## 304  5.491700  7.000000 329.0000 16.10000 390.4300  4.86000
## 305  4.022000  7.000000 222.0000 18.40000 393.6800 12.69526
## 306  3.370000  7.000000 222.0000 18.40000 393.3600  8.93000
## 307  3.099200  7.000000 222.0000 18.43341 358.1459  6.47000
## 308  3.182700  7.000000 222.0000 18.40000 396.9000  7.53000
## 309  3.791866  4.000000 304.0000 18.40000 396.9000  4.54000
## 310  3.102500  4.000000 304.0000 18.40000 396.2400  9.97000
## 311  2.519400  4.000000 304.0000 18.40000 350.4500 12.64000
## 312  2.640300  4.000000 304.0000 18.40000 396.9000  5.98000
## 313  2.834000  4.000000 304.0000 18.40000 396.3000 11.72000
## 314  3.262800  9.525054 304.0000 18.40000 393.3900  7.90000
```

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## 315  3.602300  4.000000 304.0000 18.40000 395.6900  9.28000
## 316  3.791866  4.000000 304.0000 18.40000 396.4200 11.50000
## 317  3.998600  4.000000 304.0000 18.40000 390.7000 18.33000
## 318  4.031700  4.000000 304.0000 18.40000 396.9000 15.94000
## 319  3.532500  4.000000 304.0000 18.40000 395.2100 10.36000
## 320  4.001900  9.525054 304.0000 18.40000 396.2300 12.73000
## 321  3.791866  5.000000 287.0000 19.60000 358.1459  7.20000
## 322  4.540400  5.000000 287.0000 18.43341 396.9000  6.87000
## 323  4.721100  5.000000 287.0000 19.60000 396.9000 12.69526
## 324  4.721100  5.000000 287.0000 19.60000 358.1459 11.74000
## 325  4.721100  5.000000 408.0905 19.60000 396.9000  6.12000
## 326  5.415900  9.525054 287.0000 18.43341 393.6800  5.08000
## 327  5.415900  5.000000 287.0000 19.60000 396.9000  6.15000
## 328  5.415900  5.000000 287.0000 19.60000 396.9000 12.79000
## 329  5.214600  4.000000 430.0000 16.90000 382.4400  9.97000
## 330  5.214600  4.000000 430.0000 16.90000 375.2100 12.69526
## 331  5.873600  4.000000 430.0000 16.90000 368.5700  9.09000
## 332  6.640700  1.000000 304.0000 16.90000 394.0200 12.43000
## 333  6.640700  1.000000 304.0000 16.90000 362.2500  7.83000
## 334  6.458400  5.000000 224.0000 20.20000 389.7100  5.68000
## 335  6.458400  5.000000 224.0000 20.20000 389.4000  6.75000
## 336  5.985300  5.000000 224.0000 20.20000 396.9000  8.01000
## 337  5.231100  9.525054 224.0000 20.20000 396.9000  9.80000
## 338  5.615000  5.000000 408.0905 20.20000 394.8100 12.69526
## 339  4.812200  5.000000 224.0000 20.20000 396.1400  8.51000
## 340  4.812200  5.000000 224.0000 20.20000 396.9000 12.69526
## 341  4.812200  5.000000 224.0000 20.20000 396.9000  9.29000
## 342  7.037900  1.000000 284.0000 15.50000 394.7400  5.49000
## 343  6.266900  1.000000 422.0000 15.90000 389.9600  8.65000
## 344  5.732100  5.000000 370.0000 17.60000 396.9000  7.18000
## 345  6.465400  5.000000 370.0000 17.60000 358.1459  4.61000
## 346  8.013600  3.000000 352.0000 18.80000 385.6400 12.69526
## 347  3.791866  9.525054 352.0000 18.80000 364.6100 12.69526
## 348  8.535300  4.000000 351.0000 17.90000 358.1459  6.36000
## 349  8.344000  4.000000 280.0000 17.00000 358.1459  5.99000
## 350  8.792100  1.000000 335.0000 19.70000 389.8500  5.89000
## 351  8.792100  1.000000 335.0000 19.70000 396.9000  5.98000
## 352 10.710300  4.000000 411.0000 18.30000 370.7800  5.49000
## 353 10.710300  4.000000 411.0000 18.30000 392.3300  7.79000
## 354 12.126500  5.000000 187.0000 17.00000 384.4600  4.50000
## 355 10.585700  4.000000 334.0000 22.00000 382.8000  8.05000
## 356 10.585700  4.000000 334.0000 22.00000 376.0400 12.69526
## 357  2.122200 24.000000 666.0000 18.43341 377.7300 17.60000
## 358  2.505200 24.000000 666.0000 20.20000 358.1459 13.27000
## 359  2.722700 24.000000 666.0000 18.43341 395.4300 11.48000
## 360  2.509100 24.000000 666.0000 20.20000 390.7400 12.67000
## 361  2.518200  9.525054 666.0000 20.20000 374.5600  7.79000
## 362  2.295500 24.000000 666.0000 20.20000 350.6500 14.19000
## 363  3.791866  9.525054 666.0000 20.20000 380.7900 10.19000
## 364  1.904700 24.000000 666.0000 20.20000 353.0400 14.64000
## 365  1.904700 24.000000 666.0000 20.20000 354.5500  5.29000
## 366  1.613200 24.000000 666.0000 18.43341 354.7000  7.12000
## 367  1.752300 24.000000 666.0000 18.43341 316.0300 14.00000
## 368  1.510600 24.000000 666.0000 20.20000 131.4200 13.33000
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## 369  1.332500 24.000000 666.0000 20.20000 375.5200  3.26000
## 370  1.356700 24.000000 666.0000 20.20000 375.3300  3.73000
## 371  1.202400 24.000000 666.0000 20.20000 392.0500  2.96000
## 372  1.169100 24.000000 666.0000 20.20000 366.1500  9.53000
## 373  1.129600 24.000000 666.0000 20.20000 347.8800  8.88000
## 374  1.174200 24.000000 666.0000 20.20000 396.9000 34.77000
## 375  1.137000  9.525054 666.0000 20.20000 396.9000 37.97000
## 376  1.316300 24.000000 666.0000 20.20000 396.9000 13.44000
## 377  1.344900 24.000000 666.0000 20.20000 363.0200 23.24000
## 378  3.791866 24.000000 666.0000 20.20000 396.9000 21.24000
## 379  1.386100 24.000000 666.0000 20.20000 396.9000 23.69000
## 380  1.386100 24.000000 666.0000 20.20000 393.7400 21.78000
## 381  1.416500 24.000000 408.0905 20.20000 396.9000 12.69526
## 382  1.519200 24.000000 408.0905 20.20000 396.9000 21.08000
## 383  1.580400 24.000000 408.0905 20.20000 396.9000 23.60000
## 384  3.791866 24.000000 666.0000 18.43341 396.9000 12.69526
## 385  1.439500  9.525054 666.0000 20.20000 358.1459 12.69526
## 386  1.426100 24.000000 666.0000 20.20000 396.9000 30.81000
## 387  1.467200 24.000000 666.0000 18.43341 396.9000 28.28000
## 388  1.518400 24.000000 666.0000 20.20000 396.9000 31.99000
## 389  1.589500 24.000000 666.0000 20.20000 372.9200 30.62000
## 390  1.728100 24.000000 666.0000 20.20000 396.9000 20.85000
## 391  1.926500 24.000000 408.0905 18.43341 394.4300 17.11000
## 392  3.791866 24.000000 666.0000 20.20000 378.3800 18.76000
## 393  1.770000 24.000000 666.0000 18.43341 396.9000 25.68000
## 394  1.791200 24.000000 666.0000 20.20000 396.9000 15.17000
## 395  3.791866 24.000000 666.0000 20.20000 396.9000 12.69526
## 396  1.725700 24.000000 666.0000 20.20000 391.9800 17.12000
## 397  1.676800 24.000000 666.0000 20.20000 396.9000 19.37000
## 398  1.633400 24.000000 408.0905 20.20000 393.1000 19.92000
## 399  1.489600 24.000000 666.0000 20.20000 358.1459 30.59000
## 400  1.500400 24.000000 666.0000 20.20000 358.1459 29.97000
## 401  1.588800 24.000000 666.0000 20.20000 396.9000 26.77000
## 402  1.574100 24.000000 666.0000 20.20000 396.9000 20.32000
## 403  1.639000 24.000000 666.0000 20.20000 376.1100 20.31000
## 404  1.702800 24.000000 666.0000 20.20000 396.9000 19.77000
## 405  1.607400 24.000000 666.0000 20.20000 329.4600 27.38000
## 406  1.425400 24.000000 666.0000 20.20000 384.9700 22.98000
## 407  1.178100 24.000000 666.0000 20.20000 370.2200 23.34000
## 408  1.285200 24.000000 666.0000 20.20000 358.1459 12.13000
## 409  1.454700  9.525054 666.0000 20.20000 314.6400 12.69526
## 410  1.465500 24.000000 666.0000 20.20000 179.3600 19.78000
## 411  1.413000 24.000000 666.0000 20.20000   2.6000 10.11000
## 412  1.527500  9.525054 666.0000 20.20000  35.0500 21.22000
## 413  1.553900 24.000000 666.0000 20.20000 358.1459 34.37000
## 414  1.589400 24.000000 666.0000 20.20000 358.1459 20.08000
## 415  1.658200  9.525054 666.0000 20.20000  88.2700 36.98000
## 416  3.791866 24.000000 666.0000 20.20000  27.2500 29.05000
## 417  1.819500 24.000000 666.0000 18.43341  21.5700 25.79000
## 418  1.647500 24.000000 666.0000 20.20000 127.3600 26.64000
## 419  1.802600  9.525054 666.0000 20.20000  16.4500 20.62000
## 420  3.791866 24.000000 666.0000 20.20000  48.4500 12.69526
## 421  1.858900 24.000000 666.0000 18.43341 318.7500 15.02000
## 422  1.874600  9.525054 666.0000 20.20000 319.9800 15.70000
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## 423  1.951200 24.000000 666.0000 18.43341 291.5500 14.10000
## 424  2.021800 24.000000 666.0000 20.20000   2.5200 23.29000
## 425  2.063500 24.000000 666.0000 20.20000   3.6500 17.16000
## 426  1.909600 24.000000 408.0905 20.20000   7.6800 24.39000
## 427  3.791866 24.000000 666.0000 20.20000  24.6500 15.69000
## 428  1.862900 24.000000 666.0000 20.20000  18.8200 14.52000
## 429  1.935600 24.000000 666.0000 20.20000  96.7300 21.52000
## 430  1.968200 24.000000 666.0000 20.20000 358.1459 24.08000
## 431  2.052700 24.000000 666.0000 20.20000  83.4500 17.64000
## 432  2.088200 24.000000 666.0000 20.20000 358.1459 19.69000
## 433  2.200400 24.000000 666.0000 20.20000  97.9500 12.03000
## 434  3.791866 24.000000 666.0000 20.20000 358.1459 16.22000
## 435  2.222200 24.000000 666.0000 20.20000 100.6300 12.69526
## 436  2.124700 24.000000 408.0905 20.20000 109.8500 23.27000
## 437  2.002600 24.000000 408.0905 20.20000 358.1459 18.05000
## 438  1.914200 24.000000 666.0000 18.43341   9.3200 26.45000
## 439  1.820600 24.000000 666.0000 20.20000  68.9500 34.02000
## 440  1.817200  9.525054 666.0000 20.20000 396.9000 22.88000
## 441  1.866200 24.000000 666.0000 20.20000 391.4500 22.11000
## 442  2.065100 24.000000 666.0000 20.20000 385.9600 19.52000
## 443  2.004800 24.000000 666.0000 20.20000 395.6900 16.59000
## 444  1.978400 24.000000 666.0000 20.20000 386.7300 18.85000
## 445  1.895600 24.000000 666.0000 20.20000 240.5200 12.69526
## 446  1.987900 24.000000 666.0000 20.20000  43.0600 12.69526
## 447  2.072000  9.525054 408.0905 20.20000 318.0100 17.79000
## 448  2.198000 24.000000 666.0000 18.43341 358.1459 16.44000
## 449  2.261600 24.000000 666.0000 20.20000 396.9000 18.13000
## 450  2.185000 24.000000 666.0000 20.20000 304.2100 19.31000
## 451  2.323600 24.000000 666.0000 20.20000   0.3200 17.44000
## 452  2.355200 24.000000 666.0000 20.20000 355.2900 17.73000
## 453  2.368200 24.000000 666.0000 20.20000 385.0900 17.27000
## 454  2.452700 24.000000 666.0000 20.20000 375.8700 16.74000
## 455  2.496100 24.000000 408.0905 20.20000   6.6800 18.71000
## 456  3.791866 24.000000 408.0905 20.20000  50.9200 18.13000
## 457  2.580600 24.000000 666.0000 20.20000  10.4800 19.01000
## 458  2.779200 24.000000 666.0000 20.20000   3.5000 16.94000
## 459  2.783100 24.000000 666.0000 20.20000 272.2100 16.23000
## 460  2.717500 24.000000 666.0000 20.20000 396.9000 14.70000
## 461  2.597500 24.000000 666.0000 20.20000 358.1459 16.42000
## 462  2.567100 24.000000 666.0000 20.20000 391.4300 14.65000
## 463  2.734400 24.000000 666.0000 20.20000 396.9000 13.99000
## 464  2.801600  9.525054 666.0000 20.20000 393.8200 10.29000
## 465  2.963400 24.000000 666.0000 20.20000 396.9000 13.22000
## 466  3.066500 24.000000 666.0000 20.20000 334.4000 14.13000
## 467  2.871500 24.000000 666.0000 20.20000 358.1459 12.69526
## 468  3.791866  9.525054 408.0905 20.20000 331.2900 21.32000
## 469  2.908400 24.000000 666.0000 20.20000 368.7400 18.13000
## 470  2.823700 24.000000 666.0000 20.20000 396.9000 14.76000
## 471  3.033400 24.000000 666.0000 20.20000 396.9000 16.29000
## 472  3.791866 24.000000 666.0000 20.20000 395.3300 12.87000
## 473  3.791866 24.000000 666.0000 20.20000 393.3700 14.36000
## 474  2.532900 24.000000 666.0000 20.20000 374.6800 11.66000
## 475  2.429800 24.000000 666.0000 20.20000 358.1459 12.69526
## 476  3.791866 24.000000 666.0000 20.20000 358.1459 24.10000
```

```
## 477  2.305300 24.000000 666.0000 20.20000 396.2100 18.68000
## 478  2.100700 24.000000 408.0905 18.43341 349.4800 24.91000
## 479  3.791866 24.000000 666.0000 18.43341 358.1459 18.03000
## 480  1.951200 24.000000 666.0000 18.43341 383.3200 13.11000
## 481  3.424200 24.000000 666.0000 20.20000 396.9000 10.74000
## 482  3.331700 24.000000 666.0000 20.20000 358.1459  7.74000
## 483  3.410600 24.000000 666.0000 20.20000 395.2800  7.01000
## 484  4.098300 24.000000 666.0000 20.20000 392.9200 10.42000
## 485  3.724000 24.000000 666.0000 20.20000 370.7300 13.34000
## 486  3.991700 24.000000 408.0905 20.20000 388.6200 10.58000
## 487  3.545900 24.000000 666.0000 20.20000 392.6800 12.69526
## 488  3.152300 24.000000 666.0000 20.20000 358.1459 11.45000
## 489  1.820900  4.000000 711.0000 20.10000 395.0900 18.06000
## 490  1.755400  4.000000 711.0000 20.10000 344.0500 23.97000
## 491  1.822600  4.000000 711.0000 20.10000 318.4300 29.68000
## 492  1.868100  4.000000 711.0000 20.10000 390.1100 18.07000
## 493  2.109900  4.000000 711.0000 20.10000 396.9000 13.35000
## 494  2.381700  6.000000 391.0000 19.20000 396.9000 12.01000
## 495  2.381700  6.000000 408.0905 19.20000 396.9000 13.59000
## 496  2.798600  6.000000 408.0905 19.20000 393.2900 17.60000
## 497  2.798600  6.000000 391.0000 19.20000 396.9000 21.14000
## 498  2.892700  6.000000 408.0905 19.20000 396.9000 14.10000
## 499  3.791866  6.000000 391.0000 19.20000 396.9000 12.92000
## 500  2.399900  6.000000 391.0000 19.20000 358.1459 15.10000
## 501  2.498200  9.525054 391.0000 19.20000 358.1459 14.33000
## 502  2.478600  9.525054 408.0905 21.00000 391.9900  9.67000
## 503  2.287500  1.000000 273.0000 21.00000 396.9000  9.08000
## 504  2.167500  1.000000 273.0000 21.00000 396.9000  5.64000
## 505  2.388900  1.000000 408.0905 21.00000 393.4500  6.48000
## 506  2.505000  1.000000 273.0000 21.00000 396.9000  7.88000
```

Use `missForest` to impute the missing entries to create a matrix `XimpMF`.

```
pacman::p_load(missForest)
XimpMF = missForest(data.frame(Xmiss))$ximp
```

```
##   missForest iteration 1 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
##   missForest iteration 2 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
##   missForest iteration 3 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
##   missForest iteration 4 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
```

What is the s_e of the error for both the naive imputation with feature averages and the intelligent imputation with missForest?

```
sd(c((as.matrix(X[is.na(Xmiss)]) - as.matrix(Ximpnaive[is.na(Xmiss)]))))
```

```
## [1] 56.74858
```

```
sd(c((as.matrix(X[is.na(Xmiss)]) - as.matrix(XimpMF[is.na(Xmiss)]))))
```

```
## [1] 24.5238
```

Create a function that creates missingness in the feature `rm` that is a MAR missing data mechanism.

```
MakeMar = function(x_i,gamma){
  if(x_i$chas==1 & runif(1)<gamma){
    x_i$rm=NA
  }
  x_i
}
```

Create a function that creates missingness in the feature `rm` that is a NMAR missing data mechanism.

```
MakeNMar = function(x_i,gamma){
  if(x_i$rm>6.2 & runif(1)<gamma){
    x_i$rm=NA
  }
  x_i
}
```

Run an OLS model on the diamonds dataset using only the features `carat` and `table`. Print out the coefficients.

```
pacman::p_load(ggplot2)
lm(price~carat+table, diamonds)
```

```
##
## Call:
## lm(formula = price ~ carat + table, data = diamonds)
##
## Coefficients:
## (Intercept)        carat        table
##      1962.0       7820.0        -74.3
```

Interpret the coefficient for `carat`

Lecture 26 Notes

Run a logistic regression probability estimation model on the adult dataset using only the features `age` and `education_num`. Print out the coefficients.

```
pacman::p_load_gh("coatless/ucidata")
data(adult)
adult = na.omit(adult) #kill any observations with missingness
glm(income~age+education_num,adult, family="binomial")
```

```
##
```

```
## Call:  glm(formula = income ~ age + education_num, family = "binomial",
##     data = adult)
##
## Coefficients:
##   (Intercept)            age  education_num
##      -6.80849        0.04639        0.36132
##
## Degrees of Freedom: 30160 Total (i.e. Null);  30158 Residual
## Null Deviance:       33850
## Residual Deviance: 28450     AIC: 28450
```

Interpret the coefficient for `education_num`

Lecture 26 notes

Let y = the binary category which is 1 if the income is >50K and 0 if not and x = education_num. Let z = one of the causal variables that influences y directly. Is this an example of causal scenario A, B or C. Explain.

B or C

In a matrix X, generate n = 200 observations each with p = 200000 features which are all realizations from an iid N(0, 1) r.v. Then generate responses y, a vector of length n also from an iid N(0, 1) r.v.

```
n=200
p=200000
X = matrix(rnorm(n*p), nrow=n, ncol=p)
y = rnorm(n)
```

Scan through each of the 200000 features looking for the maximum R^2 between x_j and y among only the first 100 observations. Plot the x_j and y that has the highest R^2 for the first 30 observations.

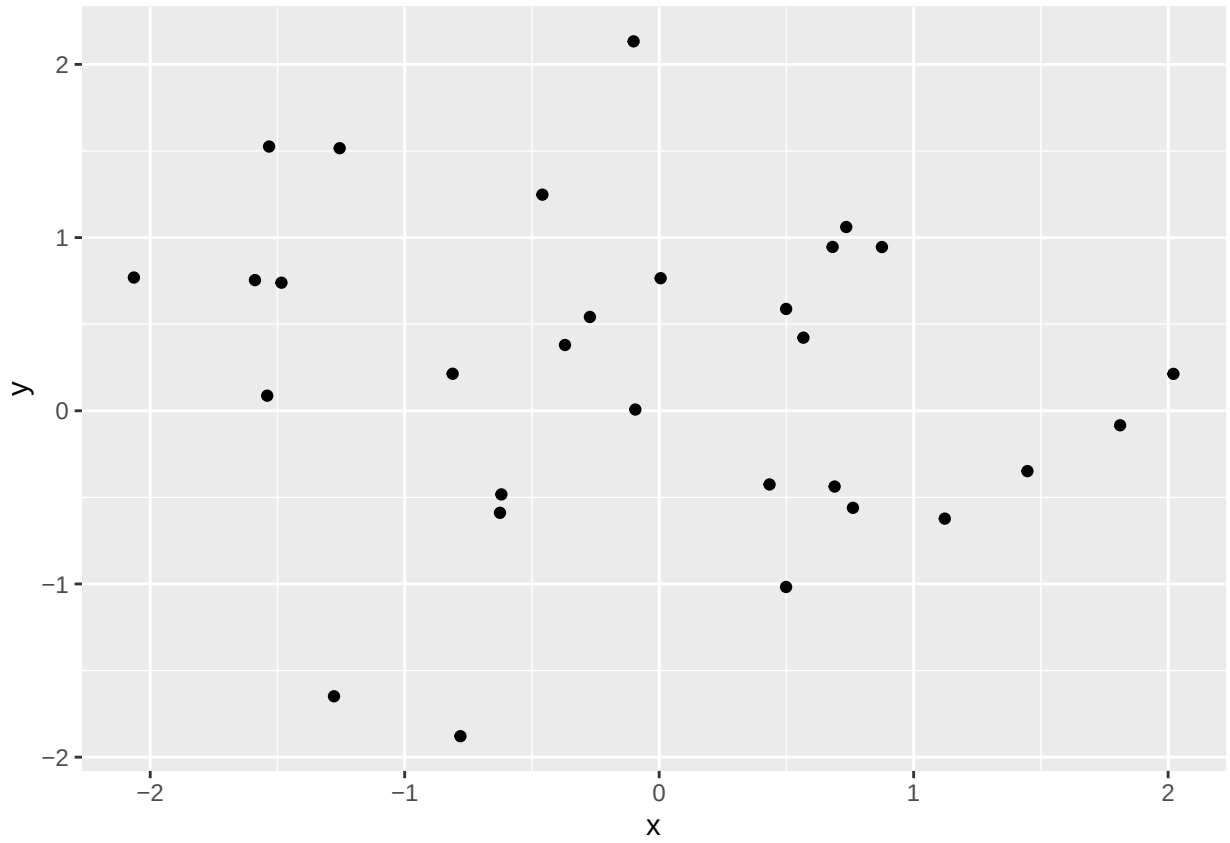
```
pacman::p_load(ggplot2)
Rsqs = array(NA, dim=p)
for (j in 1:p){
  Rsqs[j]=cor(X[1:30],y[1:30])^2
}
j_star=which.max(Rsqs)
j_star
```

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

```
Rsqs[j_star]
```

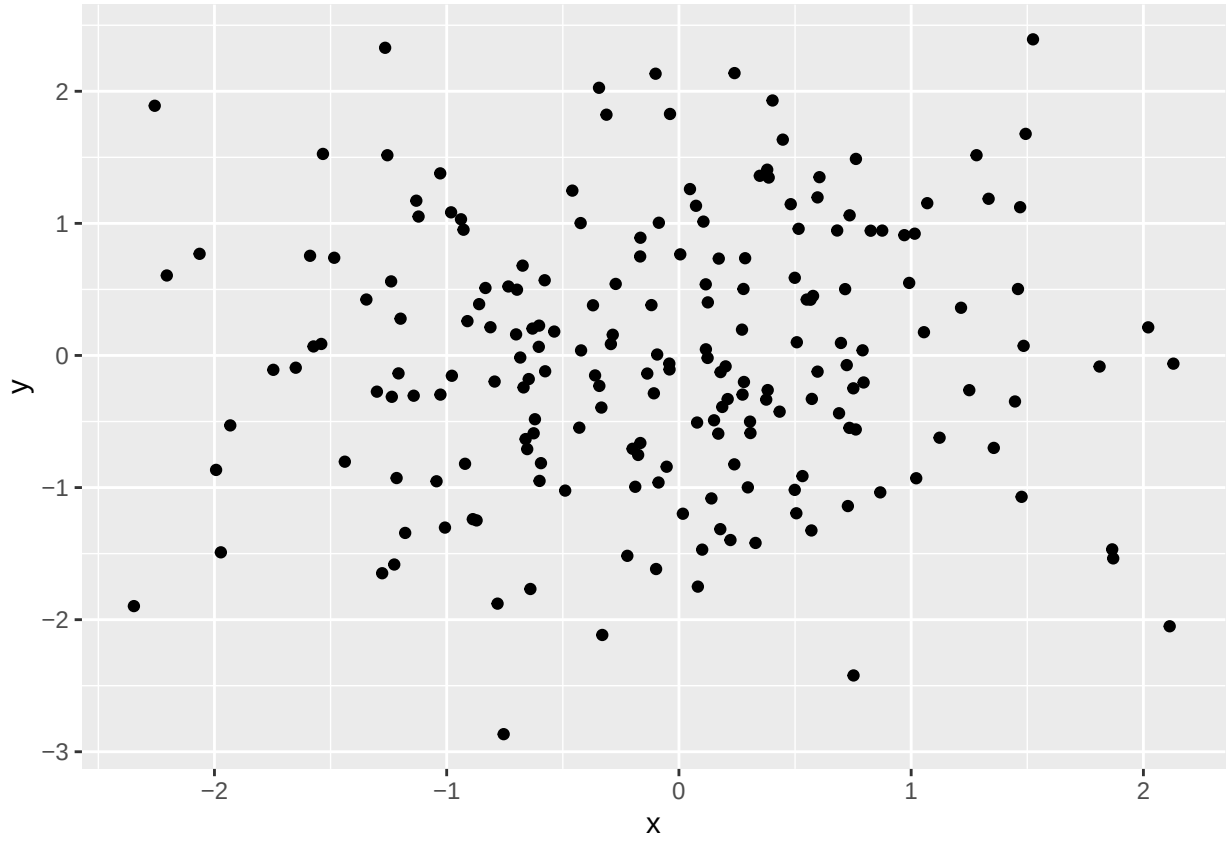
```
## [1] 0.02140744
```

```
ggplot(data.frame(x=X[1:30, j_star], y=y[1:30]))+
  aes(x=x, y=y)+
  geom_point()
```



Now plot this x_j and y for all 200 observations.

```
ggplot(data.frame(x=X[, j_star], y=y))+
  aes(x=x, y=y)+
  geom_point()
```



Is this an example of a "spurious correlation"? Yes/no and explain.

Yes, correlated by chance.

Run the following code to create a dataset but don't read it:

```
rm(list = ls())
set.seed(1)
n = 200
salary_data = rbind(
  data.frame(
    is_male = rep(1, n / 2),
    height_in_inches = rnorm(n / 2, 70, 3),
    salary_in_thou = rnorm(n / 2, 60, 15)
  ),
  data.frame(
    is_male = rep(0, n / 2),
    height_in_inches = rnorm(n / 2, 64, 3),
    salary_in_thou = rnorm(n / 2, 50, 15)
  )
)
```

Using the `salary_data` data frame, run an OLS model predicting `salary_in_thou` using `height_in_inches`.

```
summary(lm(salary_in_thou ~ height_in_inches, salary_data))
```

```
##
## Call:
## lm(formula = salary_in_thou ~ height_in_inches, data = salary_data)
```

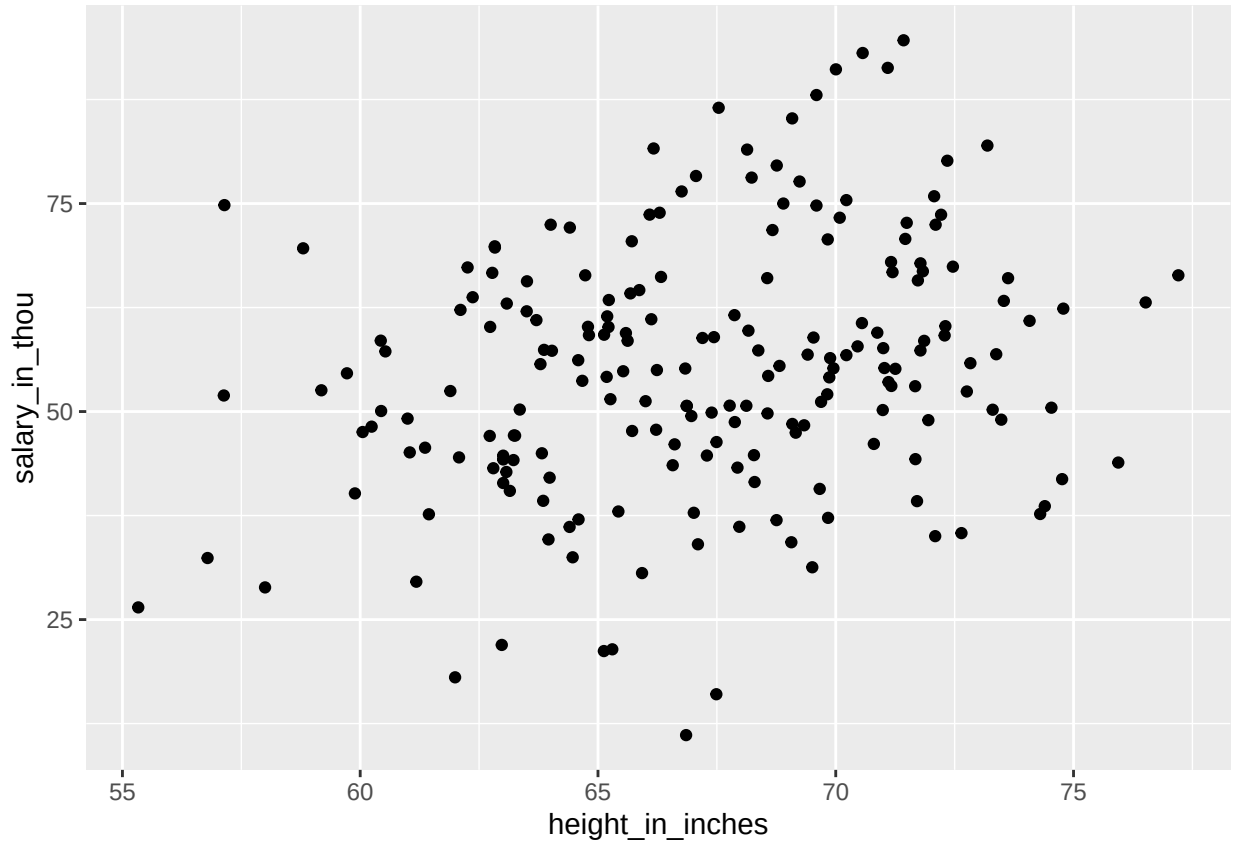
```
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -43.674  -8.655  -0.591   9.379  35.781
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       -4.4047    16.5495  -0.266 0.790400
## height_in_inches   0.8854     0.2458   3.603 0.000398 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.78 on 198 degrees of freedom
## Multiple R-squared:  0.06153,    Adjusted R-squared:  0.05679
## F-statistic: 12.98 on 1 and 198 DF,  p-value: 0.0003979
```

Interpret the coefficient of `height_in_inches`.

Lecture 26 Notes

Plot `salary_in_thou` vs `height_in_inches`.

```
ggplot(salary_data)+
  aes(x=height_in_inches, y=salary_in_thou)+
  geom_point()
```



Now run an OLS model predicting `salary_in_thou` using both `height_in_inches` and `is_male`.

```
summary(lm(salary_in_thou ~ height_in_inches + is_male, salary_data))
```

```
##
## Call:
## lm(formula = salary_in_thou ~ height_in_inches + is_male, data = salary_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -40.489  -8.775  -1.414   9.734  34.856
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       31.5168    22.9849   1.371    0.172
## height_in_inches   0.3005     0.3579   0.840    0.402
## is_male            6.7846     3.0443   2.229    0.027 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.63 on 197 degrees of freedom
## Multiple R-squared:  0.08461,    Adjusted R-squared:  0.07531
## F-statistic: 9.104 on 2 and 197 DF,  p-value: 0.0001653
```

Interpret the coefficient of `height_in_inches`.

#TO-DO

Although we didn't discuss this in class, the *'s in the summary of a linear model indicates there is evidence that this OLS slope coefficient is nonzero. In the first model, there was evidence that the OLS slope coefficient for `height_in_inches` was nonzero but in the second model there is no longer any evidence that the OLS slope coefficient for `height_in_inches`is nonzero. This may indicate that `is_male` is what type of variable?

The lurking variable.

Of the three causal scenarios we discussed in class (A, B and C), what is the likely scenario here?

B

Are we sure that `is_male` is a causal variable with respect to the phenomenon `salary_in_thou`? Yes/no and explain.

In the `diamonds` data, consider the OLS model where the features are all second-order interactions. Use a cross-validated lasso (via the `glmnet.cv` function in the `glmnet` package) to select variables that are useful in predicting the dimaonds' prices. Print out a list of the selected variables. If this takes too long, subsample the data so there is n=2000 observations.

```
rm(list = ls())
pacman::p_load(glmnet)
#TO-DO
```

In the `adult` data, consider the logistic regression model of all second-order interactions. Use a cross-validated lasso (via the `glmnet.cv` function in the `glmnet` package) to select variables that are useful in predicting the binary income level. We never discussed lasso for logistic regression, but it is the same as regular logistic regression where you minimize the likelihood but now add the regularization penalty to the optimization problem. This is all handled for us by merely passing the `family = "binomial"` argument into the `glmnet.cv` function. Print out a list of the selected variables. If this takes too long, subsample the data so there is n=2000 observations.

```
rm(list = ls())
#TO-DO
```

Returning to the diamonds dataset, leave a 10% holdout and compare the oos performance of the linear model of all second-order interactions among the following three algorithms: a cross-validated ridge, a cross-validated lasso and a cross-validated elastic net (where alpha = 1/2).

```
rm(list = ls())
#TO-DO
```