RWorksheet_Canonicato#4c

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#1. Use the dataset mpg

```
#1a. Show your solutions on how to import a csv file into the environment.
library(readr)

mpg_data <- read.csv("mpg.csv")
mpg_data
```

```
##      X manufacturer              model displ year cyl       trans drv cty
## 1    1         audi                 a4   1.8 1999   4    auto(l5)   f  18
## 2    2         audi                 a4   1.8 1999   4 manual(m5)   f  21
## 3    3         audi                 a4   2.0 2008   4 manual(m6)   f  20
## 4    4         audi                 a4   2.0 2008   4    auto(av)   f  21
## 5    5         audi                 a4   2.8 1999   6    auto(l5)   f  16
## 6    6         audi                 a4   2.8 1999   6 manual(m5)   f  18
## 7    7         audi                 a4   3.1 2008   6    auto(av)   f  18
## 8    8         audi          a4 quattro   1.8 1999   4 manual(m5)   4  18
## 9    9         audi          a4 quattro   1.8 1999   4    auto(l5)   4  16
## 10  10         audi          a4 quattro   2.0 2008   4 manual(m6)   4  20
## 11  11         audi          a4 quattro   2.0 2008   4    auto(s6)   4  19
## 12  12         audi          a4 quattro   2.8 1999   6    auto(l5)   4  15
## 13  13         audi          a4 quattro   2.8 1999   6 manual(m5)   4  17
## 14  14         audi          a4 quattro   3.1 2008   6    auto(s6)   4  17
## 15  15         audi          a4 quattro   3.1 2008   6 manual(m6)   4  15
## 16  16         audi          a6 quattro   2.8 1999   6    auto(l5)   4  15
## 17  17         audi          a6 quattro   3.1 2008   6    auto(s6)   4  17
## 18  18         audi          a6 quattro   4.2 2008   8    auto(s6)   4  16
## 19  19    chevrolet c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  14
## 20  20    chevrolet c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  11
## 21  21    chevrolet c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  14
## 22  22    chevrolet c1500 suburban 2wd   5.7 1999   8    auto(l4)   r  13
## 23  23    chevrolet c1500 suburban 2wd   6.0 2008   8    auto(l4)   r  12
## 24  24    chevrolet           corvette   5.7 1999   8 manual(m6)   r  16
## 25  25    chevrolet           corvette   5.7 1999   8    auto(l4)   r  15
## 26  26    chevrolet           corvette   6.2 2008   8 manual(m6)   r  16
## 27  27    chevrolet           corvette   6.2 2008   8    auto(s6)   r  15
## 28  28    chevrolet           corvette   7.0 2008   8 manual(m6)   r  15
## 29  29    chevrolet     k1500 tahoe 4wd   5.3 2008   8    auto(l4)   4  14
## 30  30    chevrolet     k1500 tahoe 4wd   5.3 2008   8    auto(l4)   4  11
## 31  31    chevrolet     k1500 tahoe 4wd   5.7 1999   8    auto(l4)   4  11
## 32  32    chevrolet     k1500 tahoe 4wd   6.5 1999   8    auto(l4)   4  14
## 33  33    chevrolet             malibu   2.4 1999   4    auto(l4)   f  19
## 34  34    chevrolet             malibu   2.4 2008   4    auto(l4)   f  22
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## 35   35  chevrolet                malibu  3.1 1999  6   auto(l4)   f  18
## 36   36  chevrolet                malibu  3.5 2008  6   auto(l4)   f  18
## 37   37  chevrolet                malibu  3.6 2008  6   auto(s6)   f  17
## 38   38      dodge           caravan 2wd  2.4 1999  4   auto(l3)   f  18
## 39   39      dodge           caravan 2wd  3.0 1999  6   auto(l4)   f  17
## 40   40      dodge           caravan 2wd  3.3 1999  6   auto(l4)   f  16
## 41   41      dodge           caravan 2wd  3.3 1999  6   auto(l4)   f  16
## 42   42      dodge           caravan 2wd  3.3 2008  6   auto(l4)   f  17
## 43   43      dodge           caravan 2wd  3.3 2008  6   auto(l4)   f  17
## 44   44      dodge           caravan 2wd  3.3 2008  6   auto(l4)   f  11
## 45   45      dodge           caravan 2wd  3.8 1999  6   auto(l4)   f  15
## 46   46      dodge           caravan 2wd  3.8 1999  6   auto(l4)   f  15
## 47   47      dodge           caravan 2wd  3.8 2008  6   auto(l6)   f  16
## 48   48      dodge           caravan 2wd  4.0 2008  6   auto(l6)   f  16
## 49   49      dodge     dakota pickup 4wd  3.7 2008  6 manual(m6)   4  15
## 50   50      dodge     dakota pickup 4wd  3.7 2008  6   auto(l4)   4  14
## 51   51      dodge     dakota pickup 4wd  3.9 1999  6   auto(l4)   4  13
## 52   52      dodge     dakota pickup 4wd  3.9 1999  6 manual(m5)   4  14
## 53   53      dodge     dakota pickup 4wd  4.7 2008  8   auto(l5)   4  14
## 54   54      dodge     dakota pickup 4wd  4.7 2008  8   auto(l5)   4  14
## 55   55      dodge     dakota pickup 4wd  4.7 2008  8   auto(l5)   4   9
## 56   56      dodge     dakota pickup 4wd  5.2 1999  8 manual(m5)   4  11
## 57   57      dodge     dakota pickup 4wd  5.2 1999  8   auto(l4)   4  11
## 58   58      dodge           durango 4wd  3.9 1999  6   auto(l4)   4  13
## 59   59      dodge           durango 4wd  4.7 2008  8   auto(l5)   4  13
## 60   60      dodge           durango 4wd  4.7 2008  8   auto(l5)   4   9
## 61   61      dodge           durango 4wd  4.7 2008  8   auto(l5)   4  13
## 62   62      dodge           durango 4wd  5.2 1999  8   auto(l4)   4  11
## 63   63      dodge           durango 4wd  5.7 2008  8   auto(l5)   4  13
## 64   64      dodge           durango 4wd  5.9 1999  8   auto(l4)   4  11
## 65   65      dodge   ram 1500 pickup 4wd  4.7 2008  8 manual(m6)   4  12
## 66   66      dodge   ram 1500 pickup 4wd  4.7 2008  8   auto(l5)   4   9
## 67   67      dodge   ram 1500 pickup 4wd  4.7 2008  8   auto(l5)   4  13
## 68   68      dodge   ram 1500 pickup 4wd  4.7 2008  8   auto(l5)   4  13
## 69   69      dodge   ram 1500 pickup 4wd  4.7 2008  8 manual(m6)   4  12
## 70   70      dodge   ram 1500 pickup 4wd  4.7 2008  8 manual(m6)   4   9
## 71   71      dodge   ram 1500 pickup 4wd  5.2 1999  8   auto(l4)   4  11
## 72   72      dodge   ram 1500 pickup 4wd  5.2 1999  8 manual(m5)   4  11
## 73   73      dodge   ram 1500 pickup 4wd  5.7 2008  8   auto(l5)   4  13
## 74   74      dodge   ram 1500 pickup 4wd  5.9 1999  8   auto(l4)   4  11
## 75   75       ford        expedition 2wd  4.6 1999  8   auto(l4)   r  11
## 76   76       ford        expedition 2wd  5.4 1999  8   auto(l4)   r  11
## 77   77       ford        expedition 2wd  5.4 2008  8   auto(l6)   r  12
## 78   78       ford          explorer 4wd  4.0 1999  6   auto(l5)   4  14
## 79   79       ford          explorer 4wd  4.0 1999  6 manual(m5)   4  15
## 80   80       ford          explorer 4wd  4.0 1999  6   auto(l5)   4  14
## 81   81       ford          explorer 4wd  4.0 2008  6   auto(l5)   4  13
## 82   82       ford          explorer 4wd  4.6 2008  8   auto(l6)   4  13
## 83   83       ford          explorer 4wd  5.0 1999  8   auto(l4)   4  13
## 84   84       ford       f150 pickup 4wd  4.2 1999  6   auto(l4)   4  14
## 85   85       ford       f150 pickup 4wd  4.2 1999  6 manual(m5)   4  14
## 86   86       ford       f150 pickup 4wd  4.6 1999  8 manual(m5)   4  13
## 87   87       ford       f150 pickup 4wd  4.6 1999  8   auto(l4)   4  13
## 88   88       ford       f150 pickup 4wd  4.6 2008  8   auto(l4)   4  13
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## 89   89        ford       f150 pickup 4wd  5.4 1999  8   auto(l4)  4  11
## 90   90        ford       f150 pickup 4wd  5.4 2008  8   auto(l4)  4  13
## 91   91        ford               mustang  3.8 1999  6 manual(m5)  r  18
## 92   92        ford               mustang  3.8 1999  6   auto(l4)  r  18
## 93   93        ford               mustang  4.0 2008  6 manual(m5)  r  17
## 94   94        ford               mustang  4.0 2008  6   auto(l5)  r  16
## 95   95        ford               mustang  4.6 1999  8   auto(l4)  r  15
## 96   96        ford               mustang  4.6 1999  8 manual(m5)  r  15
## 97   97        ford               mustang  4.6 2008  8 manual(m5)  r  15
## 98   98        ford               mustang  4.6 2008  8   auto(l5)  r  15
## 99   99        ford               mustang  5.4 2008  8 manual(m6)  r  14
## 100 100       honda                 civic  1.6 1999  4 manual(m5)  f  28
## 101 101       honda                 civic  1.6 1999  4   auto(l4)  f  24
## 102 102       honda                 civic  1.6 1999  4 manual(m5)  f  25
## 103 103       honda                 civic  1.6 1999  4 manual(m5)  f  23
## 104 104       honda                 civic  1.6 1999  4   auto(l4)  f  24
## 105 105       honda                 civic  1.8 2008  4 manual(m5)  f  26
## 106 106       honda                 civic  1.8 2008  4   auto(l5)  f  25
## 107 107       honda                 civic  1.8 2008  4   auto(l5)  f  24
## 108 108       honda                 civic  2.0 2008  4 manual(m6)  f  21
## 109 109     hyundai                sonata  2.4 1999  4   auto(l4)  f  18
## 110 110     hyundai                sonata  2.4 1999  4 manual(m5)  f  18
## 111 111     hyundai                sonata  2.4 2008  4   auto(l4)  f  21
## 112 112     hyundai                sonata  2.4 2008  4 manual(m5)  f  21
## 113 113     hyundai                sonata  2.5 1999  6   auto(l4)  f  18
## 114 114     hyundai                sonata  2.5 1999  6 manual(m5)  f  18
## 115 115     hyundai                sonata  3.3 2008  6   auto(l5)  f  19
## 116 116     hyundai               tiburon  2.0 1999  4   auto(l4)  f  19
## 117 117     hyundai               tiburon  2.0 1999  4 manual(m5)  f  19
## 118 118     hyundai               tiburon  2.0 2008  4 manual(m5)  f  20
## 119 119     hyundai               tiburon  2.0 2008  4   auto(l4)  f  20
## 120 120     hyundai               tiburon  2.7 2008  6   auto(l4)  f  17
## 121 121     hyundai               tiburon  2.7 2008  6 manual(m6)  f  16
## 122 122     hyundai               tiburon  2.7 2008  6 manual(m5)  f  17
## 123 123        jeep     grand cherokee 4wd  3.0 2008  6   auto(l5)  4  17
## 124 124        jeep     grand cherokee 4wd  3.7 2008  6   auto(l5)  4  15
## 125 125        jeep     grand cherokee 4wd  4.0 1999  6   auto(l4)  4  15
## 126 126        jeep     grand cherokee 4wd  4.7 1999  8   auto(l4)  4  14
## 127 127        jeep     grand cherokee 4wd  4.7 2008  8   auto(l5)  4   9
## 128 128        jeep     grand cherokee 4wd  4.7 2008  8   auto(l5)  4  14
## 129 129        jeep     grand cherokee 4wd  5.7 2008  8   auto(l5)  4  13
## 130 130        jeep     grand cherokee 4wd  6.1 2008  8   auto(l5)  4  11
## 131 131  land rover            range rover  4.0 1999  8   auto(l4)  4  11
## 132 132  land rover            range rover  4.2 2008  8   auto(s6)  4  12
## 133 133  land rover            range rover  4.4 2008  8   auto(s6)  4  12
## 134 134  land rover            range rover  4.6 1999  8   auto(l4)  4  11
## 135 135     lincoln          navigator 2wd  5.4 1999  8   auto(l4)  r  11
## 136 136     lincoln          navigator 2wd  5.4 1999  8   auto(l4)  r  11
## 137 137     lincoln          navigator 2wd  5.4 2008  8   auto(l6)  r  12
## 138 138     mercury       mountaineer 4wd  4.0 1999  6   auto(l5)  4  14
## 139 139     mercury       mountaineer 4wd  4.0 2008  6   auto(l5)  4  13
## 140 140     mercury       mountaineer 4wd  4.6 2008  8   auto(l6)  4  13
## 141 141     mercury       mountaineer 4wd  5.0 1999  8   auto(l4)  4  13
## 142 142      nissan                altima  2.4 1999  4 manual(m5)  f  21
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## 143 143        nissan          altima 2.4 1999 4   auto(l4) f 19
## 144 144        nissan          altima 2.5 2008 4   auto(av) f 23
## 145 145        nissan          altima 2.5 2008 4 manual(m6) f 23
## 146 146        nissan          altima 3.5 2008 6 manual(m6) f 19
## 147 147        nissan          altima 3.5 2008 6   auto(av) f 19
## 148 148        nissan          maxima 3.0 1999 6   auto(l4) f 18
## 149 149        nissan          maxima 3.0 1999 6 manual(m5) f 19
## 150 150        nissan          maxima 3.5 2008 6   auto(av) f 19
## 151 151        nissan   pathfinder 4wd 3.3 1999 6   auto(l4) 4 14
## 152 152        nissan   pathfinder 4wd 3.3 1999 6 manual(m5) 4 15
## 153 153        nissan   pathfinder 4wd 4.0 2008 6   auto(l5) 4 14
## 154 154        nissan   pathfinder 4wd 5.6 2008 8   auto(s5) 4 12
## 155 155       pontiac      grand prix 3.1 1999 6   auto(l4) f 18
## 156 156       pontiac      grand prix 3.8 1999 6   auto(l4) f 16
## 157 157       pontiac      grand prix 3.8 1999 6   auto(l4) f 17
## 158 158       pontiac      grand prix 3.8 2008 6   auto(l4) f 18
## 159 159       pontiac      grand prix 5.3 2008 8   auto(s4) f 16
## 160 160        subaru    forester awd 2.5 1999 4 manual(m5) 4 18
## 161 161        subaru    forester awd 2.5 1999 4   auto(l4) 4 18
## 162 162        subaru    forester awd 2.5 2008 4 manual(m5) 4 20
## 163 163        subaru    forester awd 2.5 2008 4 manual(m5) 4 19
## 164 164        subaru    forester awd 2.5 2008 4   auto(l4) 4 20
## 165 165        subaru    forester awd 2.5 2008 4   auto(l4) 4 18
## 166 166        subaru     impreza awd 2.2 1999 4   auto(l4) 4 21
## 167 167        subaru     impreza awd 2.2 1999 4 manual(m5) 4 19
## 168 168        subaru     impreza awd 2.5 1999 4 manual(m5) 4 19
## 169 169        subaru     impreza awd 2.5 1999 4   auto(l4) 4 19
## 170 170        subaru     impreza awd 2.5 2008 4   auto(s4) 4 20
## 171 171        subaru     impreza awd 2.5 2008 4   auto(s4) 4 20
## 172 172        subaru     impreza awd 2.5 2008 4 manual(m5) 4 19
## 173 173        subaru     impreza awd 2.5 2008 4 manual(m5) 4 20
## 174 174        toyota     4runner 4wd 2.7 1999 4 manual(m5) 4 15
## 175 175        toyota     4runner 4wd 2.7 1999 4   auto(l4) 4 16
## 176 176        toyota     4runner 4wd 3.4 1999 6   auto(l4) 4 15
## 177 177        toyota     4runner 4wd 3.4 1999 6 manual(m5) 4 15
## 178 178        toyota     4runner 4wd 4.0 2008 6   auto(l5) 4 16
## 179 179        toyota     4runner 4wd 4.7 2008 8   auto(l5) 4 14
## 180 180        toyota           camry 2.2 1999 4 manual(m5) f 21
## 181 181        toyota           camry 2.2 1999 4   auto(l4) f 21
## 182 182        toyota           camry 2.4 2008 4 manual(m5) f 21
## 183 183        toyota           camry 2.4 2008 4   auto(l5) f 21
## 184 184        toyota           camry 3.0 1999 6   auto(l4) f 18
## 185 185        toyota           camry 3.0 1999 6 manual(m5) f 18
## 186 186        toyota           camry 3.5 2008 6   auto(s6) f 19
## 187 187        toyota    camry solara 2.2 1999 4   auto(l4) f 21
## 188 188        toyota    camry solara 2.2 1999 4 manual(m5) f 21
## 189 189        toyota    camry solara 2.4 2008 4 manual(m5) f 21
## 190 190        toyota    camry solara 2.4 2008 4   auto(s5) f 22
## 191 191        toyota    camry solara 3.0 1999 6   auto(l4) f 18
## 192 192        toyota    camry solara 3.0 1999 6 manual(m5) f 18
## 193 193        toyota    camry solara 3.3 2008 6   auto(s5) f 18
## 194 194        toyota         corolla 1.8 1999 4   auto(l3) f 24
## 195 195        toyota         corolla 1.8 1999 4   auto(l4) f 24
## 196 196        toyota         corolla 1.8 1999 4 manual(m5) f 26
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## 197 197        toyota                 corolla 1.8 2008   4 manual(m5)   f 28
## 198 198        toyota                 corolla 1.8 2008   4   auto(l4)   f 26
## 199 199        toyota land cruiser wagon 4wd 4.7 1999   8   auto(l4)   4 11
## 200 200        toyota land cruiser wagon 4wd 5.7 2008   8   auto(s6)   4 13
## 201 201        toyota      toyota tacoma 4wd 2.7 1999   4 manual(m5)   4 15
## 202 202        toyota      toyota tacoma 4wd 2.7 1999   4   auto(l4)   4 16
## 203 203        toyota      toyota tacoma 4wd 2.7 2008   4 manual(m5)   4 17
## 204 204        toyota      toyota tacoma 4wd 3.4 1999   6 manual(m5)   4 15
## 205 205        toyota      toyota tacoma 4wd 3.4 1999   6   auto(l4)   4 15
## 206 206        toyota      toyota tacoma 4wd 4.0 2008   6 manual(m6)   4 15
## 207 207        toyota      toyota tacoma 4wd 4.0 2008   6   auto(l5)   4 16
## 208 208    volkswagen                     gti 2.0 1999   4 manual(m5)   f 21
## 209 209    volkswagen                     gti 2.0 1999   4   auto(l4)   f 19
## 210 210    volkswagen                     gti 2.0 2008   4 manual(m6)   f 21
## 211 211    volkswagen                     gti 2.0 2008   4   auto(s6)   f 22
## 212 212    volkswagen                     gti 2.8 1999   6 manual(m5)   f 17
## 213 213    volkswagen                   jetta 1.9 1999   4 manual(m5)   f 33
## 214 214    volkswagen                   jetta 2.0 1999   4 manual(m5)   f 21
## 215 215    volkswagen                   jetta 2.0 1999   4   auto(l4)   f 19
## 216 216    volkswagen                   jetta 2.0 2008   4   auto(s6)   f 22
## 217 217    volkswagen                   jetta 2.0 2008   4 manual(m6)   f 21
## 218 218    volkswagen                   jetta 2.5 2008   5   auto(s6)   f 21
## 219 219    volkswagen                   jetta 2.5 2008   5 manual(m5)   f 21
## 220 220    volkswagen                   jetta 2.8 1999   6   auto(l4)   f 16
## 221 221    volkswagen                   jetta 2.8 1999   6 manual(m5)   f 17
## 222 222    volkswagen               new beetle 1.9 1999   4 manual(m5)   f 35
## 223 223    volkswagen               new beetle 1.9 1999   4   auto(l4)   f 29
## 224 224    volkswagen               new beetle 2.0 1999   4 manual(m5)   f 21
## 225 225    volkswagen               new beetle 2.0 1999   4   auto(l4)   f 19
## 226 226    volkswagen               new beetle 2.5 2008   5 manual(m5)   f 20
## 227 227    volkswagen               new beetle 2.5 2008   5   auto(s6)   f 20
## 228 228    volkswagen                  passat 1.8 1999   4 manual(m5)   f 21
## 229 229    volkswagen                  passat 1.8 1999   4   auto(l5)   f 18
## 230 230    volkswagen                  passat 2.0 2008   4   auto(s6)   f 19
## 231 231    volkswagen                  passat 2.0 2008   4 manual(m6)   f 21
## 232 232    volkswagen                  passat 2.8 1999   6   auto(l5)   f 16
## 233 233    volkswagen                  passat 2.8 1999   6 manual(m5)   f 18
## 234 234    volkswagen                  passat 3.6 2008   6   auto(s6)   f 17
##     hwy fl    class
## 1    29  p  compact
## 2    29  p  compact
## 3    31  p  compact
## 4    30  p  compact
## 5    26  p  compact
## 6    26  p  compact
## 7    27  p  compact
## 8    26  p  compact
## 9    25  p  compact
## 10   28  p  compact
## 11   27  p  compact
## 12   25  p  compact
## 13   25  p  compact
## 14   25  p  compact
## 15   25  p  compact
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## 16    24   p    midsize
## 17    25   p    midsize
## 18    23   p    midsize
## 19    20   r        suv
## 20    15   e        suv
## 21    20   r        suv
## 22    17   r        suv
## 23    17   r        suv
## 24    26   p    2seater
## 25    23   p    2seater
## 26    26   p    2seater
## 27    25   p    2seater
## 28    24   p    2seater
## 29    19   r        suv
## 30    14   e        suv
## 31    15   r        suv
## 32    17   d        suv
## 33    27   r    midsize
## 34    30   r    midsize
## 35    26   r    midsize
## 36    29   r    midsize
## 37    26   r    midsize
## 38    24   r    minivan
## 39    24   r    minivan
## 40    22   r    minivan
## 41    22   r    minivan
## 42    24   r    minivan
## 43    24   r    minivan
## 44    17   e    minivan
## 45    22   r    minivan
## 46    21   r    minivan
## 47    23   r    minivan
## 48    23   r    minivan
## 49    19   r     pickup
## 50    18   r     pickup
## 51    17   r     pickup
## 52    17   r     pickup
## 53    19   r     pickup
## 54    19   r     pickup
## 55    12   e     pickup
## 56    17   r     pickup
## 57    15   r     pickup
## 58    17   r        suv
## 59    17   r        suv
## 60    12   e        suv
## 61    17   r        suv
## 62    16   r        suv
## 63    18   r        suv
## 64    15   r        suv
## 65    16   r     pickup
## 66    12   e     pickup
## 67    17   r     pickup
## 68    17   r     pickup
## 69    16   r     pickup
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## 70    12  e      pickup
## 71    15  r      pickup
## 72    16  r      pickup
## 73    17  r      pickup
## 74    15  r      pickup
## 75    17  r         suv
## 76    17  r         suv
## 77    18  r         suv
## 78    17  r         suv
## 79    19  r         suv
## 80    17  r         suv
## 81    19  r         suv
## 82    19  r         suv
## 83    17  r         suv
## 84    17  r      pickup
## 85    17  r      pickup
## 86    16  r      pickup
## 87    16  r      pickup
## 88    17  r      pickup
## 89    15  r      pickup
## 90    17  r      pickup
## 91    26  r subcompact
## 92    25  r subcompact
## 93    26  r subcompact
## 94    24  r subcompact
## 95    21  r subcompact
## 96    22  r subcompact
## 97    23  r subcompact
## 98    22  r subcompact
## 99    20  p subcompact
## 100   33  r subcompact
## 101   32  r subcompact
## 102   32  r subcompact
## 103   29  p subcompact
## 104   32  r subcompact
## 105   34  r subcompact
## 106   36  r subcompact
## 107   36  c subcompact
## 108   29  p subcompact
## 109   26  r     midsize
## 110   27  r     midsize
## 111   30  r     midsize
## 112   31  r     midsize
## 113   26  r     midsize
## 114   26  r     midsize
## 115   28  r     midsize
## 116   26  r subcompact
## 117   29  r subcompact
## 118   28  r subcompact
## 119   27  r subcompact
## 120   24  r subcompact
## 121   24  r subcompact
## 122   24  r subcompact
## 123   22  d         suv
```

```
## 124  19  r           suv
## 125  20  r           suv
## 126  17  r           suv
## 127  12  e           suv
## 128  19  r           suv
## 129  18  r           suv
## 130  14  p           suv
## 131  15  p           suv
## 132  18  r           suv
## 133  18  r           suv
## 134  15  p           suv
## 135  17  r           suv
## 136  16  p           suv
## 137  18  r           suv
## 138  17  r           suv
## 139  19  r           suv
## 140  19  r           suv
## 141  17  r           suv
## 142  29  r       compact
## 143  27  r       compact
## 144  31  r       midsize
## 145  32  r       midsize
## 146  27  p       midsize
## 147  26  p       midsize
## 148  26  r       midsize
## 149  25  r       midsize
## 150  25  p       midsize
## 151  17  r           suv
## 152  17  r           suv
## 153  20  p           suv
## 154  18  p           suv
## 155  26  r       midsize
## 156  26  p       midsize
## 157  27  r       midsize
## 158  28  r       midsize
## 159  25  p       midsize
## 160  25  r           suv
## 161  24  r           suv
## 162  27  r           suv
## 163  25  p           suv
## 164  26  r           suv
## 165  23  p           suv
## 166  26  r subcompact
## 167  26  r subcompact
## 168  26  r subcompact
## 169  26  r subcompact
## 170  25  p       compact
## 171  27  r       compact
## 172  25  p       compact
## 173  27  r       compact
## 174  20  r           suv
## 175  20  r           suv
## 176  19  r           suv
## 177  17  r           suv
```

```
## 178    20    r         suv
## 179    17    r         suv
## 180    29    r     midsize
## 181    27    r     midsize
## 182    31    r     midsize
## 183    31    r     midsize
## 184    26    r     midsize
## 185    26    r     midsize
## 186    28    r     midsize
## 187    27    r     compact
## 188    29    r     compact
## 189    31    r     compact
## 190    31    r     compact
## 191    26    r     compact
## 192    26    r     compact
## 193    27    r     compact
## 194    30    r     compact
## 195    33    r     compact
## 196    35    r     compact
## 197    37    r     compact
## 198    35    r     compact
## 199    15    r         suv
## 200    18    r         suv
## 201    20    r      pickup
## 202    20    r      pickup
## 203    22    r      pickup
## 204    17    r      pickup
## 205    19    r      pickup
## 206    18    r      pickup
## 207    20    r      pickup
## 208    29    r     compact
## 209    26    r     compact
## 210    29    p     compact
## 211    29    p     compact
## 212    24    r     compact
## 213    44    d     compact
## 214    29    r     compact
## 215    26    r     compact
## 216    29    p     compact
## 217    29    p     compact
## 218    29    r     compact
## 219    29    r     compact
## 220    23    r     compact
## 221    24    r     compact
## 222    44    d subcompact
## 223    41    d subcompact
## 224    29    r subcompact
## 225    26    r subcompact
## 226    28    r subcompact
## 227    29    r subcompact
## 228    29    p     midsize
## 229    29    p     midsize
## 230    28    p     midsize
## 231    29    p     midsize
```

```
## 232  26  p     midsize
## 233  26  p     midsize
## 234  26  p     midsize
```

#1b. Which variables from mpg dataset are categorical?

```
str(mpg_data)
```

```
## 'data.frame':    234 obs. of  12 variables:
##  $ X           : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ manufacturer: chr  "audi" "audi" "audi" "audi" ...
##  $ model       : chr  "a4" "a4" "a4" "a4" ...
##  $ displ       : num  1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
##  $ year        : int  1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
##  $ cyl         : int  4 4 4 4 6 6 6 4 4 4 ...
##  $ trans       : chr  "auto(l5)" "manual(m5)" "manual(m6)" "auto(av)" ...
##  $ drv         : chr  "f" "f" "f" "f" ...
##  $ cty         : int  18 21 20 21 16 18 18 18 16 20 ...
##  $ hwy         : int  29 29 31 30 26 26 27 26 25 28 ...
##  $ fl          : chr  "p" "p" "p" "p" ...
##  $ class       : chr  "compact" "compact" "compact" "compact" ...
```

```
#ans. manufacturer, model, trans, drv, fl, class variables are categorical
```

#1c. Which are continuous variables?

```
continuous_vars <- c("displ", "year", "cyl", "cty", "hwy")
continuous_vars
```

```
## [1] "displ" "year"  "cyl"   "cty"   "hwy"
```

#2. Which manufacturer has the most models in this data set? Which model has the most variations?

```
manufacturer_counts <- table(mpg_data$manufacturer)



most_models_manufacturer <- as.character(names(manufacturer_counts)[which.max(manufacturer_counts)])


model_counts <- table(mpg_data$model)


most_variations_model <- as.character(names(model_counts)[which.max(model_counts)])


print(paste("The manufacturer with the most models is:", most_models_manufacturer))
```

```
## [1] "The manufacturer with the most models is: dodge"
```

```
print(paste("The model with the most variations is:", most_variations_model))
```

```
## [1] "The model with the most variations is: caravan 2wd"
```

```
#2a. Group the manufacturers and find the unique models. Show your codes and result.
dfmpg <- data.frame(Manufacturer = mpg_data$manufacturer, Model = mpg_data$model)
unique_mpg <- unique(dfmpg)
unique_mpg
```

```
##     Manufacturer              Model
```

```
## 1              audi                     a4
## 8              audi              a4 quattro
## 16             audi              a6 quattro
## 19        chevrolet      c1500 suburban 2wd
## 24        chevrolet                corvette
## 29        chevrolet         k1500 tahoe 4wd
## 33        chevrolet                  malibu
## 38            dodge              caravan 2wd
## 49            dodge        dakota pickup 4wd
## 58            dodge              durango 4wd
## 65            dodge      ram 1500 pickup 4wd
## 75             ford           expedition 2wd
## 78             ford             explorer 4wd
## 84             ford          f150 pickup 4wd
## 91             ford                  mustang
## 100           honda                    civic
## 109         hyundai                   sonata
## 116         hyundai                  tiburon
## 123            jeep       grand cherokee 4wd
## 131      land rover              range rover
## 135         lincoln            navigator 2wd
## 138         mercury          mountaineer 4wd
## 142          nissan                   altima
## 148          nissan                   maxima
## 151          nissan           pathfinder 4wd
## 155         pontiac               grand prix
## 160          subaru            forester awd
## 166          subaru              impreza awd
## 174          toyota             4runner 4wd
## 180          toyota                    camry
## 187          toyota             camry solara
## 194          toyota                  corolla
## 199          toyota land cruiser wagon 4wd
## 201          toyota       toyota tacoma 4wd
## 208      volkswagen                      gti
## 213      volkswagen                    jetta
## 222      volkswagen              new beetle
## 228      volkswagen                   passat
```

#2b. Graph the result by using plot() and ggplot(). Write the codes and its result.

```
library(ggplot2)

factoredManufacturer <- as.factor(unique_mpg$Manufacturer)
manufacturerPlot <- plot(as.factor(factoredManufacturer),
              main = "Unique Model per Manufacturer",
              cex.names = 0.8, las = 2)
```

Unique Model per Manufacturer
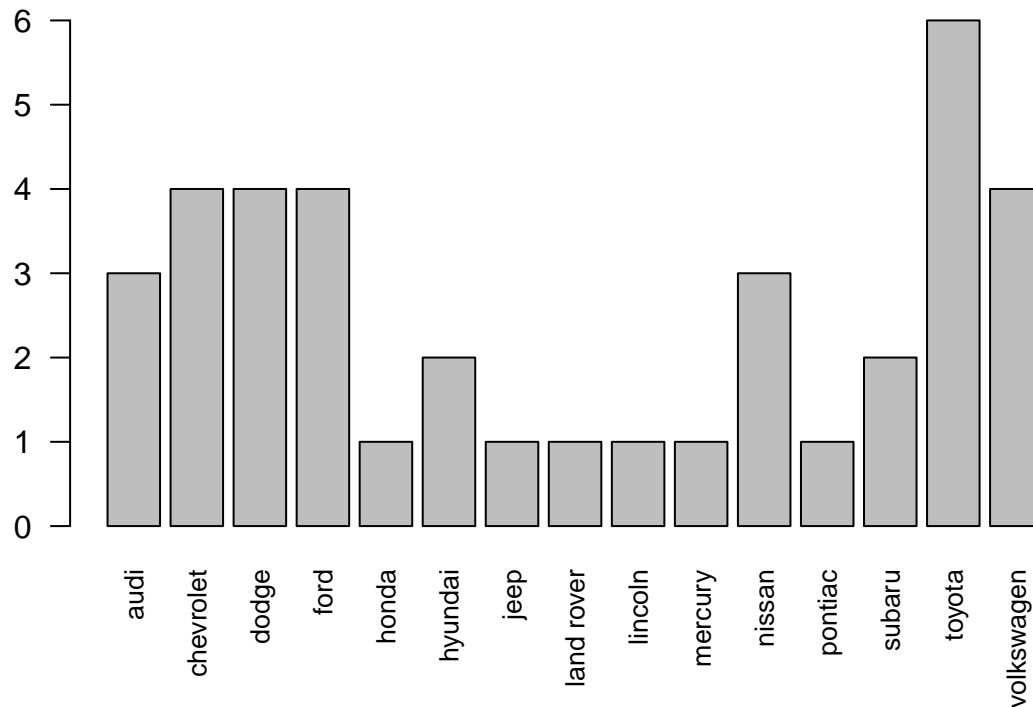

```r
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
unique_count <- unique_mpg %>%
  count(unique_mpg$Manufacturer)
unique_count
```

```
##     unique_mpg$Manufacturer n
## 1                      audi 3
## 2                  chevrolet 4
## 3                      dodge 4
## 4                       ford 4
## 5                      honda 1
## 6                    hyundai 2
## 7                       jeep 1
## 8                 land rover 1
## 9                    lincoln 1
## 10                   mercury 1
## 11                    nissan 3
## 12                   pontiac 1
## 13                    subaru 2
```

```
## 14              toyota 6
## 15          volkswagen 4
```

```
names(unique_count) <- c("Manufacturer", "Number of Models")
unique_count
```

```
##      Manufacturer Number of Models
## 1            audi                3
## 2       chevrolet                4
## 3           dodge                4
## 4            ford                4
## 5           honda                1
## 6         hyundai                2
## 7            jeep                1
## 8      land rover                1
## 9         lincoln                1
## 10        mercury                1
## 11         nissan                3
## 12        pontiac                1
## 13         subaru                2
## 14         toyota                6
## 15     volkswagen                4
```

```
ggplot(unique_count, aes(x = Manufacturer, y = `Number of Models`)) +
geom_bar(stat = "identity", fill = "violet")
```
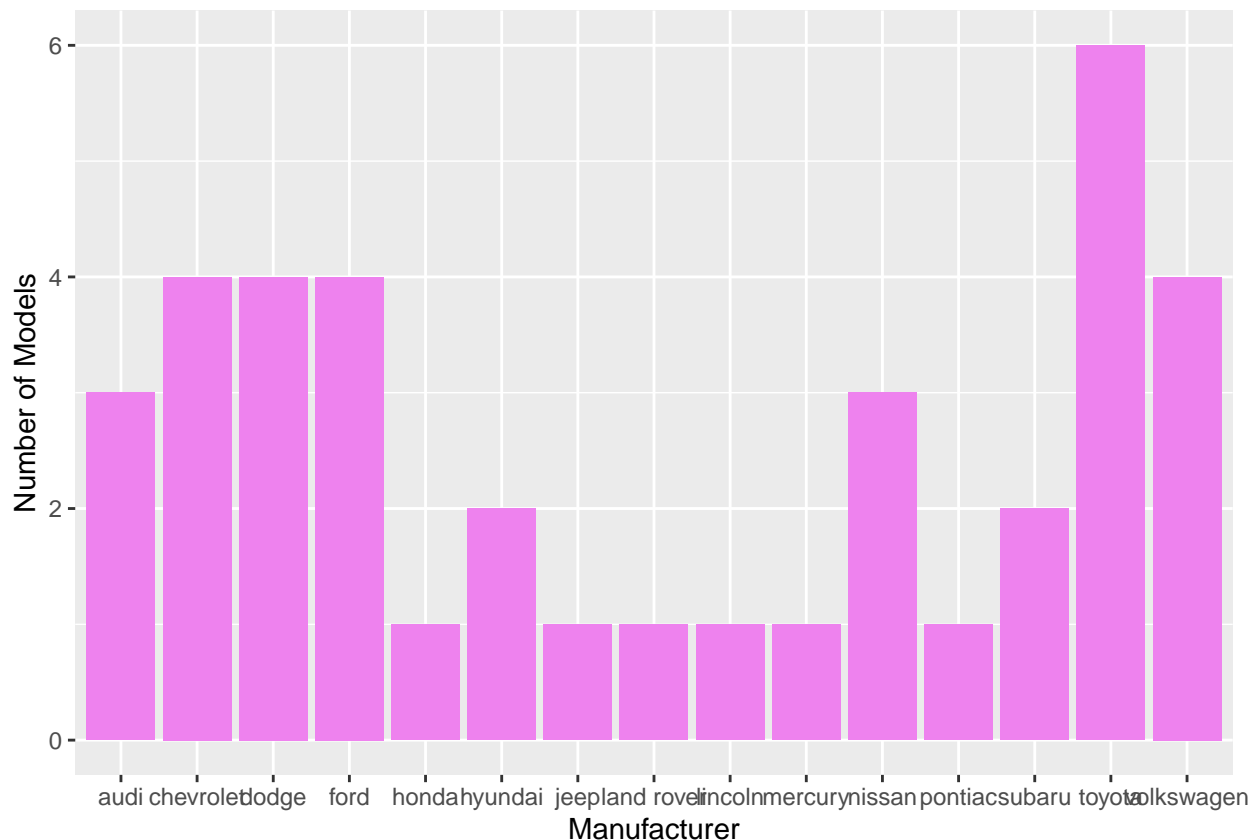

#2. Same dataset will be used. You are going to show the relationship of the model and the manufacturer.

```
#a. What does ggplot(mpg, aes(model, manufacturer)) + geom_point() show?

library(ggplot2)
ggplot(mpg_data, aes(model, manufacturer)) + geom_point()
```
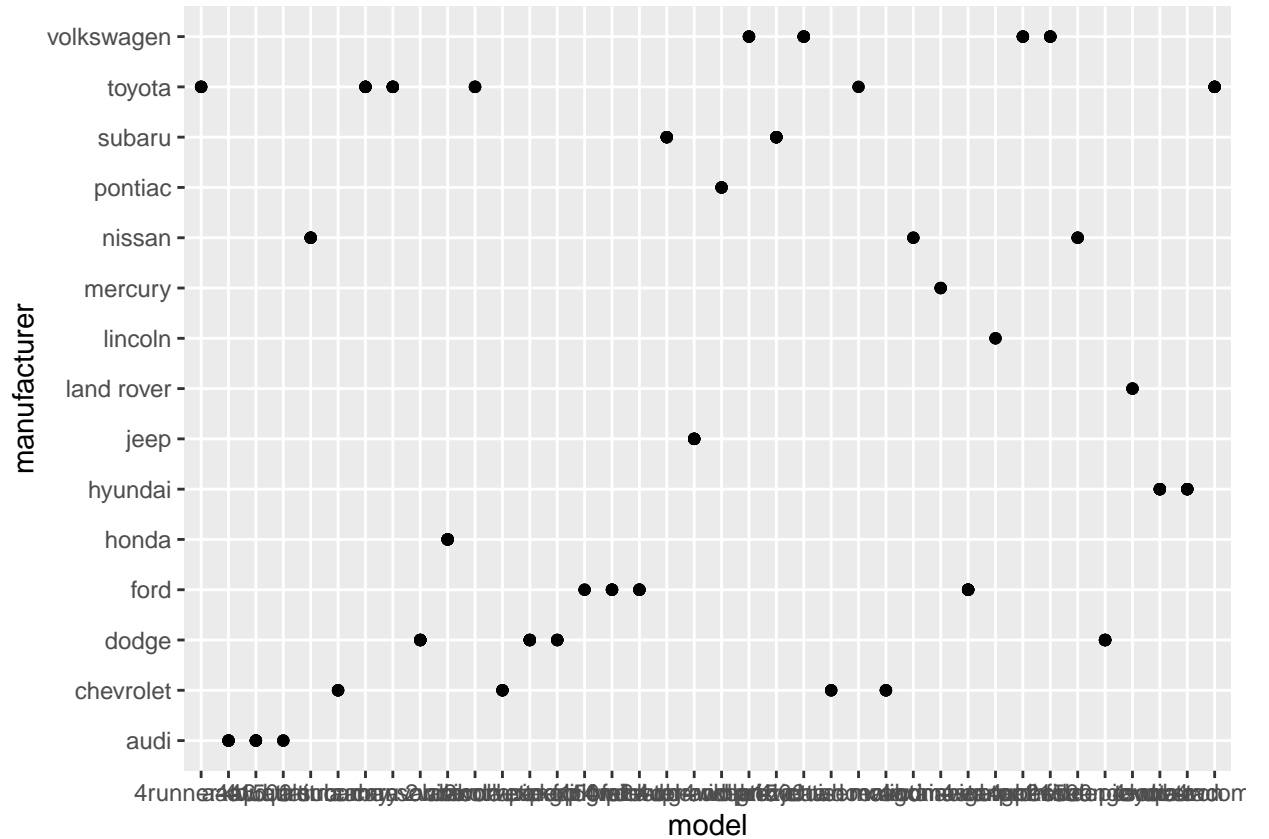


```
#ans. Plots the mpgdataset with model on the x-axis and manufacturer on the y-axis. Each point represen
```

#b. For you, is it useful? If not, how could you modify the data to make it more informative?

```
#The plot shows the relationship between the model and the manufacturer. It can be useful to visualize
```

#3.Plot the model and the year using ggplot(). Use only the top 20 observations. Write the codes and its results.

```
library(ggplot2)

A_obj <-head(mpg_data, 20)
A_obj
```

```
##    X manufacturer       model displ year cyl       trans drv cty hwy fl
## 1  1         audi          a4   1.8 1999   4   auto(l5)   f  18  29  p
## 2  2         audi          a4   1.8 1999   4 manual(m5)   f  21  29  p
## 3  3         audi          a4   2.0 2008   4 manual(m6)   f  20  31  p
## 4  4         audi          a4   2.0 2008   4   auto(av)   f  21  30  p
## 5  5         audi          a4   2.8 1999   6   auto(l5)   f  16  26  p
## 6  6         audi          a4   2.8 1999   6 manual(m5)   f  18  26  p
## 7  7         audi          a4   3.1 2008   6   auto(av)   f  18  27  p
## 8  8         audi   a4 quattro   1.8 1999   4 manual(m5)   4  18  26  p
## 9  9         audi   a4 quattro   1.8 1999   4   auto(l5)   4  16  25  p
```

14

```
## 10 10         audi          a4 quattro   2.0 2008   4 manual(m6)   4  20  28  p
## 11 11         audi          a4 quattro   2.0 2008   4   auto(s6)   4  19  27  p
## 12 12         audi          a4 quattro   2.8 1999   6   auto(l5)   4  15  25  p
## 13 13         audi          a4 quattro   2.8 1999   6 manual(m5)   4  17  25  p
## 14 14         audi          a4 quattro   3.1 2008   6   auto(s6)   4  17  25  p
## 15 15         audi          a4 quattro   3.1 2008   6 manual(m6)   4  15  25  p
## 16 16         audi          a6 quattro   2.8 1999   6   auto(l5)   4  15  24  p
## 17 17         audi          a6 quattro   3.1 2008   6   auto(s6)   4  17  25  p
## 18 18         audi          a6 quattro   4.2 2008   8   auto(s6)   4  16  23  p
## 19 19    chevrolet c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  14  20  r
## 20 20    chevrolet c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  11  15  e
##      class
## 1  compact
## 2  compact
## 3  compact
## 4  compact
## 5  compact
## 6  compact
## 7  compact
## 8  compact
## 9  compact
## 10 compact
## 11 compact
## 12 compact
## 13 compact
## 14 compact
## 15 compact
## 16 midsize
## 17 midsize
## 18 midsize
## 19     suv
## 20     suv
```

```r
ggplot(data = A_obj, aes(x = year, y = model, color = as.factor(model))) +
 geom_point(alpha = 0.7) +
 labs(title = "Relationship between Model, Year, and Manufacturer",
      x = "Year",
      y = "Model",
      color = "Manufacturer") +
 theme_minimal()
```

Relationship between Model, Year, and Manufacturer

Model

c1500 suburban 2wd

a6 quattro

a4 quattro

a4

2000   2002   2004   2006   2008

Year

Manufacturer

- a4
- a4 quattro
- a6 quattro
- c1500 suburban 2wd
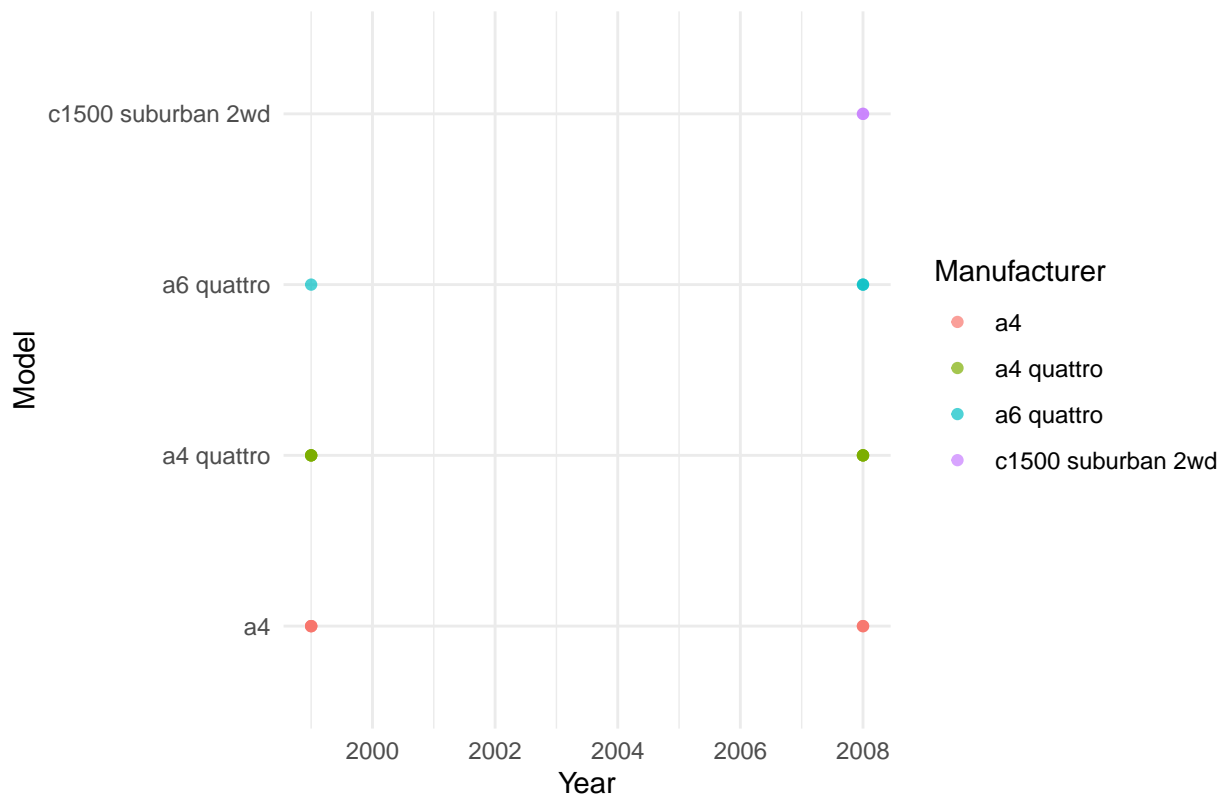
#4. Using the pipe (%>%), group the model and get the number of cars per model. Show codes and its result

```r
library(dplyr)
library(ggplot2)

head(mpg_data, 20)
```

```
##    X manufacturer              model displ year cyl       trans drv cty hwy fl
## 1  1         audi                 a4   1.8 1999   4    auto(l5)   f  18  29  p
## 2  2         audi                 a4   1.8 1999   4 manual(m5)   f  21  29  p
## 3  3         audi                 a4   2.0 2008   4 manual(m6)   f  20  31  p
## 4  4         audi                 a4   2.0 2008   4    auto(av)   f  21  30  p
## 5  5         audi                 a4   2.8 1999   6    auto(l5)   f  16  26  p
## 6  6         audi                 a4   2.8 1999   6 manual(m5)   f  18  26  p
## 7  7         audi                 a4   3.1 2008   6    auto(av)   f  18  27  p
## 8  8         audi          a4 quattro   1.8 1999   4 manual(m5)   4  18  26  p
## 9  9         audi          a4 quattro   1.8 1999   4    auto(l5)   4  16  25  p
## 10 10         audi          a4 quattro   2.0 2008   4 manual(m6)   4  20  28  p
## 11 11         audi          a4 quattro   2.0 2008   4    auto(s6)   4  19  27  p
## 12 12         audi          a4 quattro   2.8 1999   6    auto(l5)   4  15  25  p
## 13 13         audi          a4 quattro   2.8 1999   6 manual(m5)   4  17  25  p
## 14 14         audi          a4 quattro   3.1 2008   6    auto(s6)   4  17  25  p
## 15 15         audi          a4 quattro   3.1 2008   6 manual(m6)   4  15  25  p
## 16 16         audi          a6 quattro   2.8 1999   6    auto(l5)   4  15  24  p
## 17 17         audi          a6 quattro   3.1 2008   6    auto(s6)   4  17  25  p
## 18 18         audi          a6 quattro   4.2 2008   8    auto(s6)   4  16  23  p
## 19 19    chevrolet c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  14  20  r
```

16

```
## 20 20    chevrolet c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  11  15  e
##      class
## 1  compact
## 2  compact
## 3  compact
## 4  compact
## 5  compact
## 6  compact
## 7  compact
## 8  compact
## 9  compact
## 10 compact
## 11 compact
## 12 compact
## 13 compact
## 14 compact
## 15 compact
## 16 midsize
## 17 midsize
## 18 midsize
## 19     suv
## 20     suv
```

```r
mpg_data %>%
  group_by(model) %>%
  summarize(count = n()) -> grouped_open_mpg


grouped_open_mpg
```

```
## # A tibble: 38 x 2
##    model              count
##    <chr>              <int>
##  1 4runner 4wd            6
##  2 a4                     7
##  3 a4 quattro             8
##  4 a6 quattro             3
##  5 altima                 6
##  6 c1500 suburban 2wd     5
##  7 camry                  7
##  8 camry solara           7
##  9 caravan 2wd           11
## 10 civic                  9
## # i 28 more rows
```

#4a. Plot using geom_bar() using the top 20 observations only. The graphs should have a title, labels and colors. Show code and results.

```r
top20_mpg_observation <- head(grouped_open_mpg, 20)


top20_mpg_observation <- ggplot(top20_mpg_observation, aes(x = model, y = count, fill = model)) +
  geom_bar(stat = "identity") +
  labs(title = "Number of Cars per Model",
       x = "Model" ,
       y = "Number of cars")
```
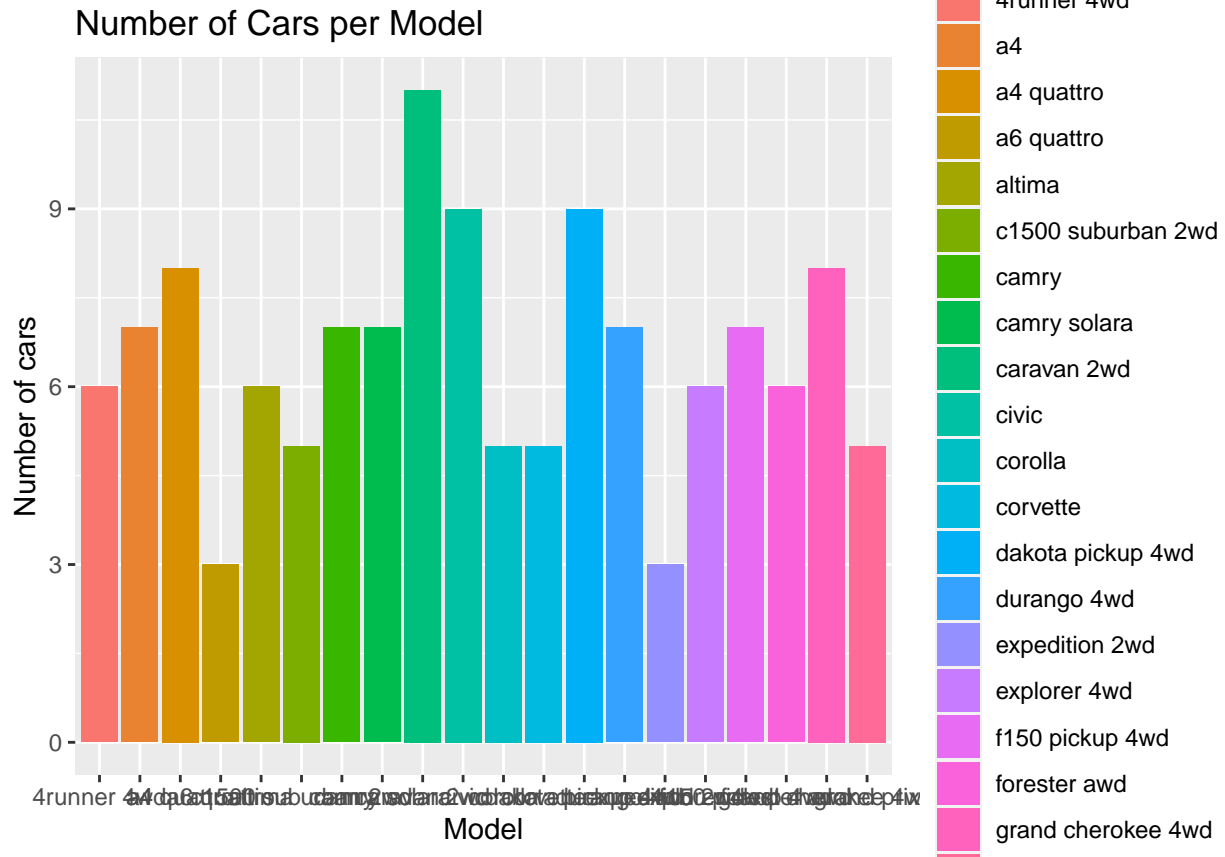
```
library(ggplot2)
mpg_top20 <- ggplot(grouped_open_mpg, aes(x = model, y = count, fill = model)) +
  geom_bar(stat = "identity") +
  labs(title = "Number of Cars per Model",
       x = "Model" ,
       y = "Number of cars") +
  coord_flip()

mpg_top20
```

18

Number of Cars per Model
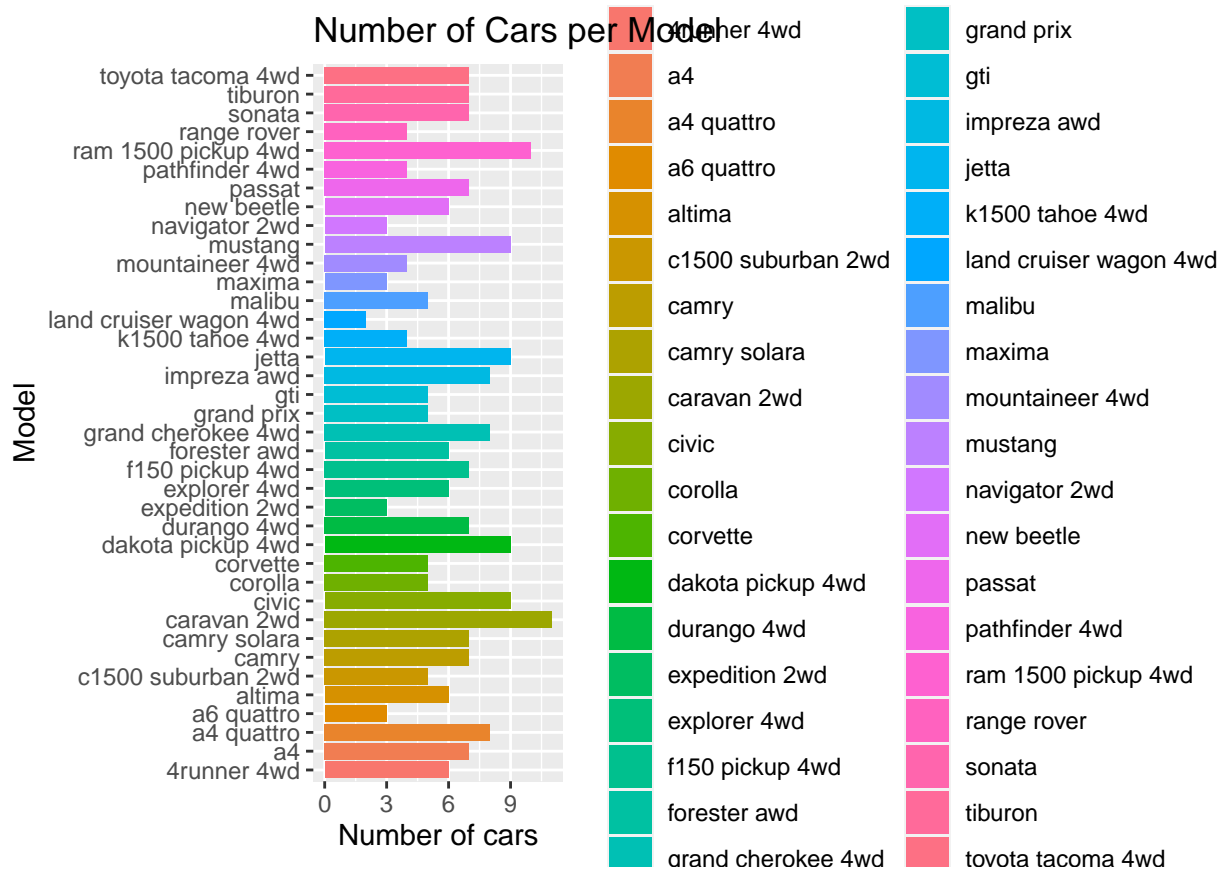
#5. Plot the relationship between cyl - number of cylinders and displ - engine displacement using geom_point with aesthetic color = engine displacement. Title should be "Relationship between No. of Cylinders and Engine Displacement".

```r
relationship_cyl_displ <- ggplot(mpg_data, aes(x = cyl,
                                                y = displ,
                                                color = displ)) +
  geom_point() +
  labs(title = "Relationship between No. of Cylinders and Engine Displacement",
       x = "Number of Cylinders",
       y = "Engine Displacement")

relationship_cyl_displ
```
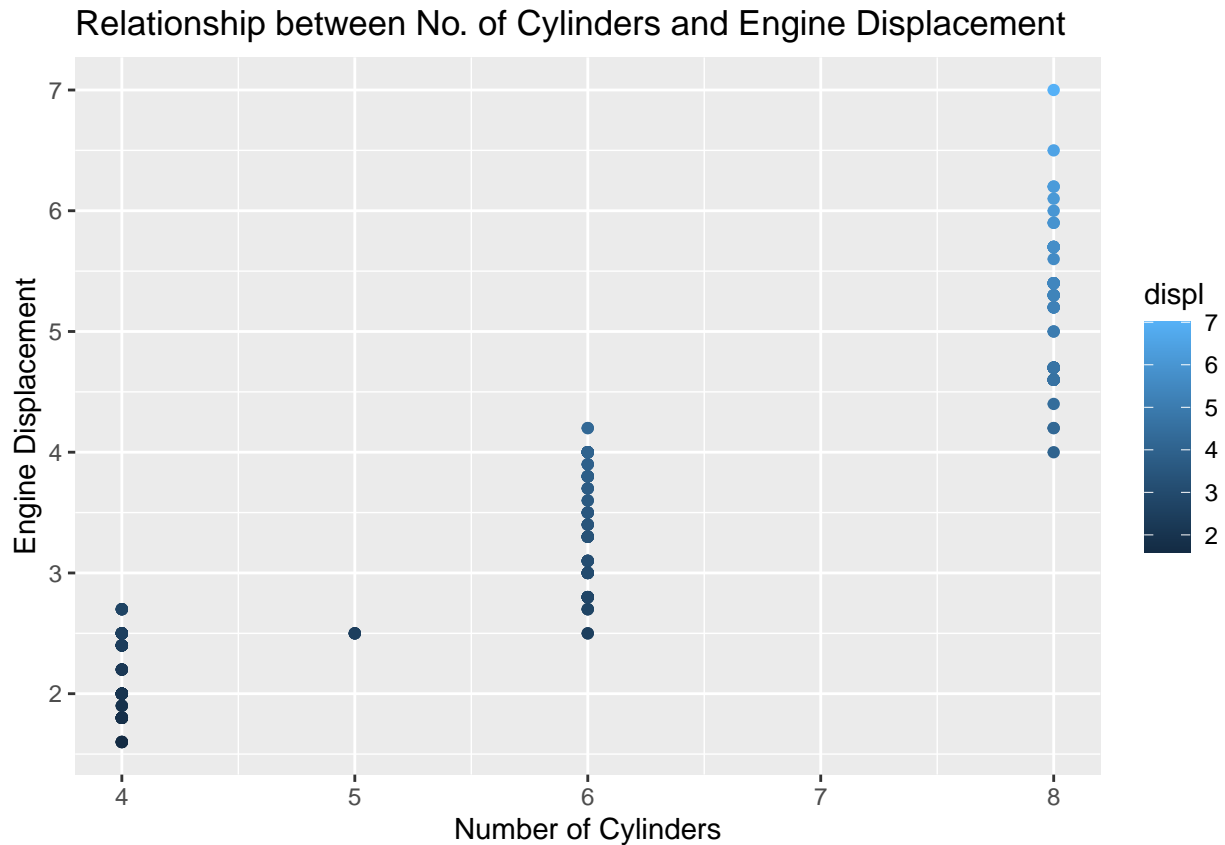
Relationship between No. of Cylinders and Engine Displacement

#6. Plot the relationship between displ (engine displacement) and hwy(highway miles per gallon). Mapped it with a continuous variable you have identified in #1-c. What is its result? Why it produced such output?

```
displ_hwy_relationship <- ggplot(mpg_data, aes(x = displ, y = hwy, color = cty)) +
  geom_point() +
  labs(title = "Relationship between Engine Displacement and Highway MPG",
       x = "Engine Displacement",
       y = "Highway MPG")

displ_hwy_relationship
```

Relationship between Engine Displacement and Highway MPG
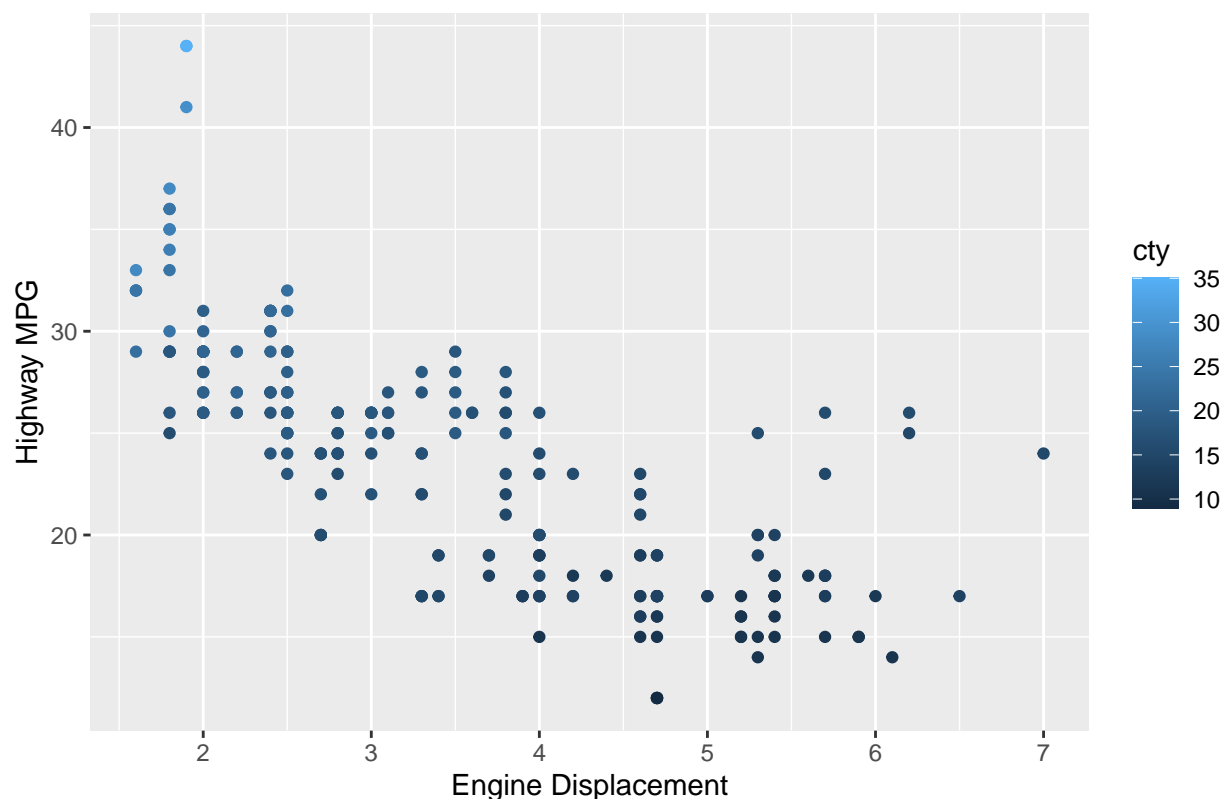

```
#The scatterplot shows the relationship between engine displacement and highway miles per gallon, with
```

```
#6. Import the traffic.csv onto your R environment.
#a. How many numbers of observation does it have? What are the variables of the traffic dataset the Sho
```

```r
library(readr)
traffic <- read.csv("traffic.csv")

num_obs <- nrow(traffic)
num_obs
```

```
## [1] 48120
```

```r
num_vars <- ncol(traffic)
num_vars
```

```
## [1] 4
```

```r
vars <- colnames(traffic)
vars
```

```
## [1] "DateTime" "Junction" "Vehicles" "ID"
```

```
#b. subset the traffic dataset into junctions. What is the R codes and its output?
```

```r
junctions_subset1 <- subset(traffic, Junction == 1)

junctions_subset2 <- subset(traffic, Junction == 2)

junctions_subset3 <- subset(traffic, Junction == 3)
```

```
junctions_subset4 <- subset(traffic, Junction == 4)
```

```
# c. Plot each junction in a using geom_line(). Show your solution and output.

junction_plot_1 <- ggplot(junctions_subset1,
                          aes(x = as.Date(junctions_subset1$DateTime),
                              y = Vehicles)) +
  geom_line() +
  scale_x_date(date_labels = "%b-%Y") + theme(legend.position = "none") +
  labs(title = "Junction 1", x = "Time", y = "Number of Vehicles")

junction_plot_1
```
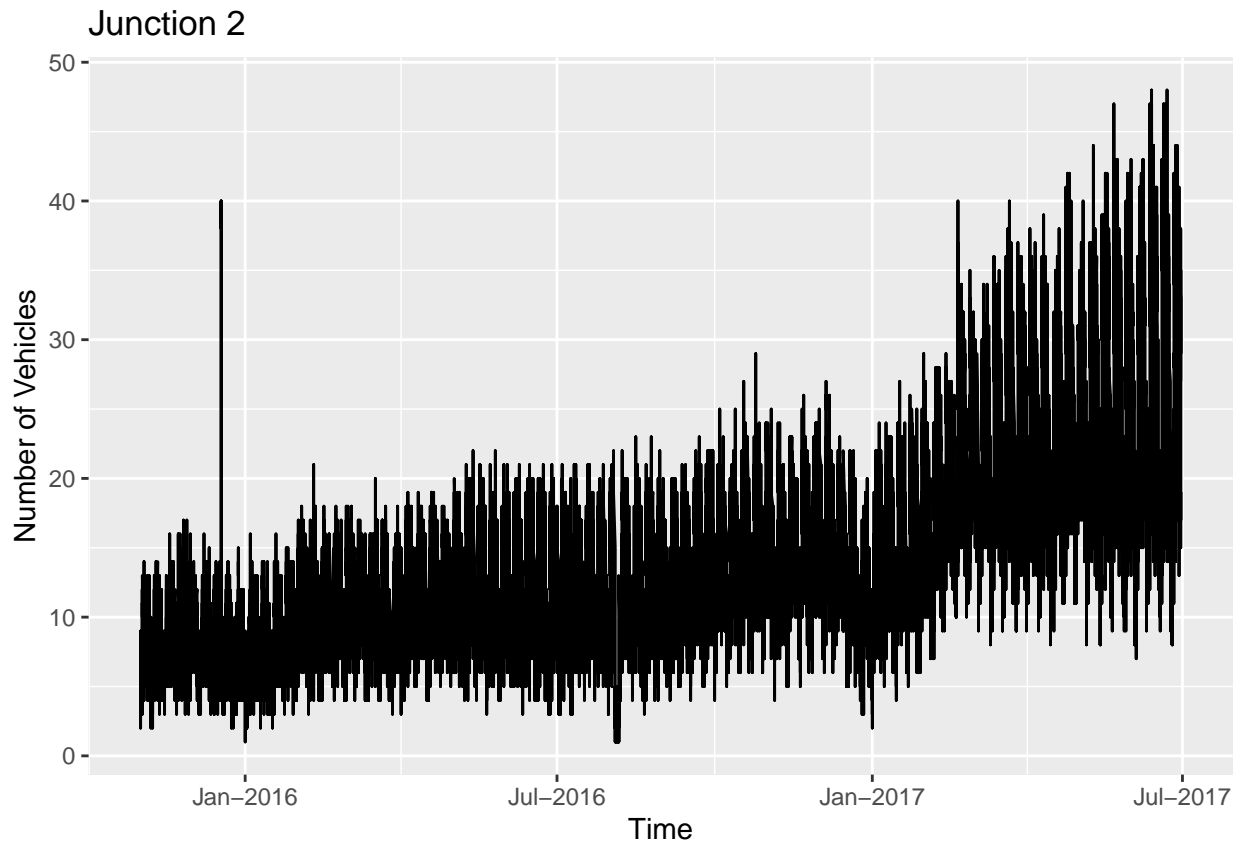
```
## Warning: Use of `junctions_subset1$DateTime` is discouraged.
## i Use `DateTime` instead.
```


Junction 1
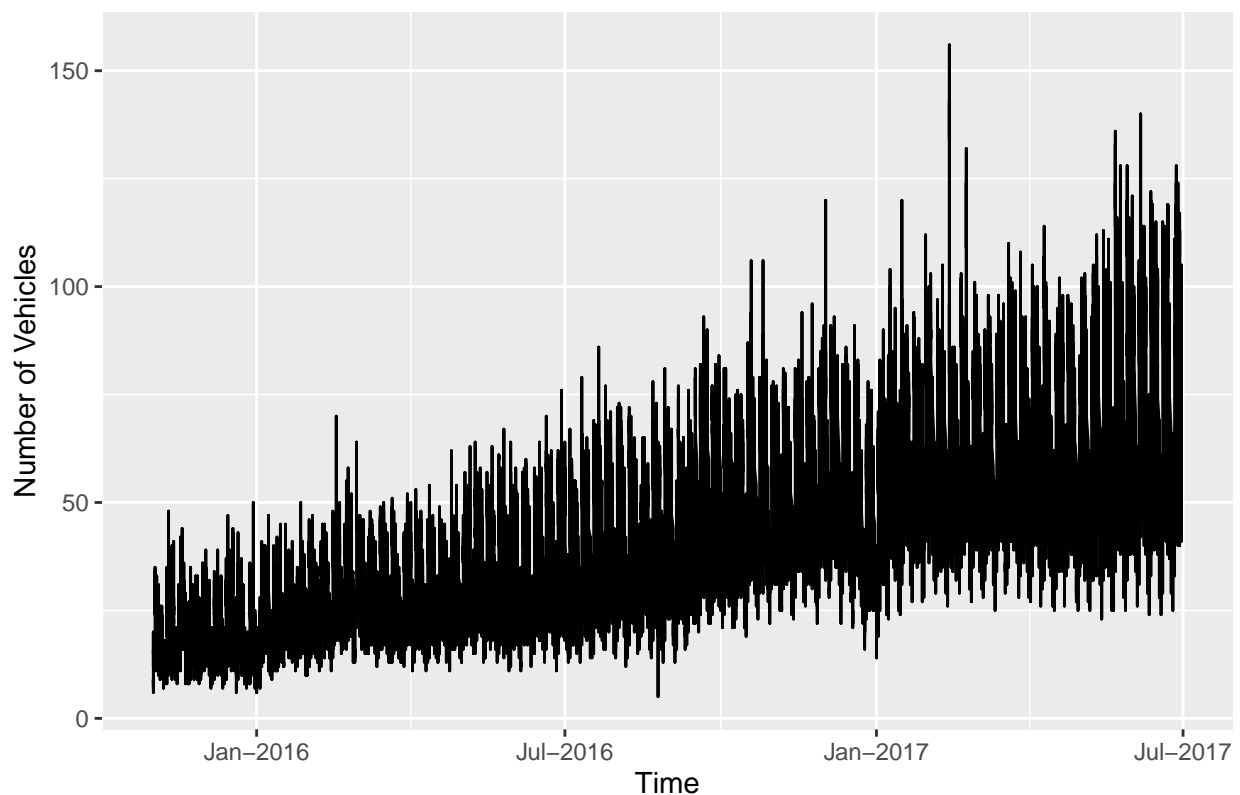
```
junction_plot_2 <- ggplot(junctions_subset2,
                          aes(x = as.Date(junctions_subset2$DateTime),
                              y = Vehicles)) +
  geom_line() +
  scale_x_date(date_labels = "%b-%Y") + theme(legend.position = "none") +
  labs(title = "Junction 2", x = "Time", y = "Number of Vehicles")

junction_plot_2
```

Junction 2


```
junction_plot_3 <- ggplot(junctions_subset3,
                          aes(x = as.Date(junctions_subset3$DateTime),
                              y = Vehicles)) +
  geom_line() +
  scale_x_date(date_labels = "%b-%Y") + theme(legend.position = "none") +
  labs(title = "Junction 3", x = "Time", y = "Number of Vehicles")

junction_plot_3
```

Junction 3
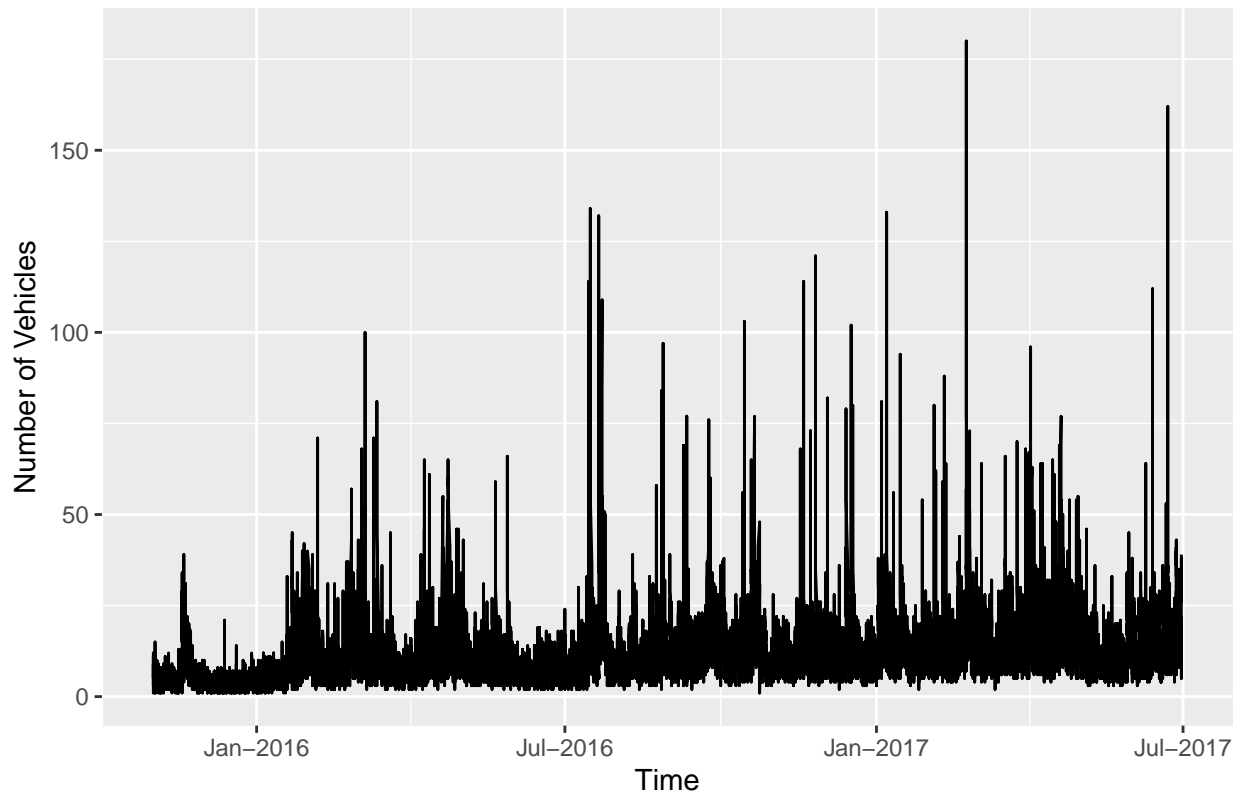

```r
junction_plot_4 <- ggplot(junctions_subset4,
                          aes(x = as.Date(junctions_subset4$DateTime),
                              y = Vehicles)) +
  geom_line() +
  scale_x_date(date_labels = "%b-%Y") + theme(legend.position = "none") +
  labs(title = "Junction 4", x = "Time", y = "Number of Vehicles")

junction_plot_4
```

Junction 4
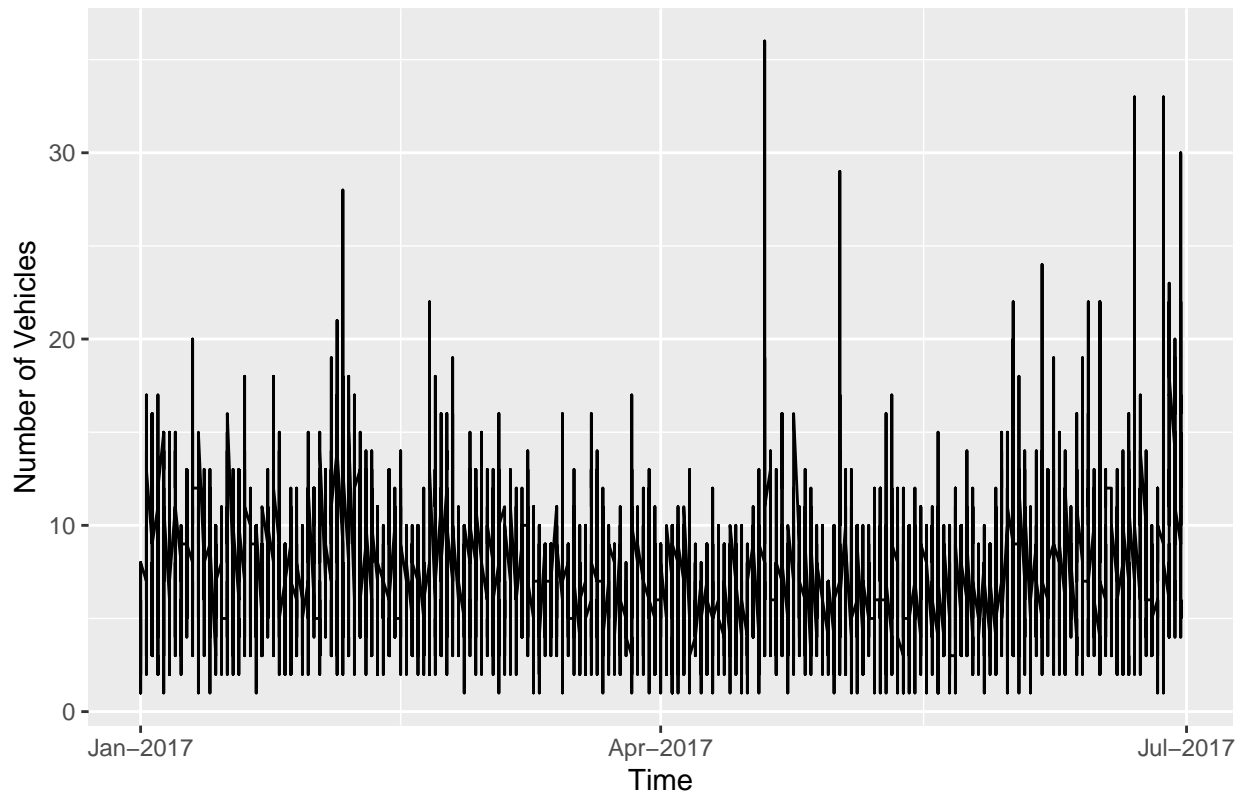
#7. From alexa_file.xlsx, import it to your environment

#a. How many observations does alexa_file has? What about the number of columns? Show your solution and

```
library(readxl)
open_alexa_file <- read_excel("/cloud/project/worksheet#4/Worksheet4c/alexa_file.xlsx")

num_obs <- nrow(open_alexa_file)
num_obs
```

```
## [1] 3150
```

```
num_cols <- ncol(open_alexa_file)
num_cols
```

```
## [1] 5
```

#b. group the variations and get the total of each variations. Use dplyr package. Show solution and ans

```
var_counts <- open_alexa_file %>%
  count(variation)

var_counts
```

```
## # A tibble: 16 x 2
##    variation                 n
##    <chr>                 <int>
##  1 Black                   261
##  2 Black  Dot              516
```

```
##  3 Black   Plus                        270
##  4 Black   Show                        265
##  5 Black   Spot                        241
##  6 Charcoal Fabric                      430
##  7 Configuration: Fire TV Stick        350
##  8 Heather Gray Fabric                 157
##  9 Oak Finish                           14
## 10 Sandstone Fabric                     90
## 11 Walnut Finish                         9
## 12 White                                91
## 13 White   Dot                         184
## 14 White   Plus                         78
## 15 White   Show                         85
## 16 White   Spot                        109
```

#c. Plot the variations using the ggplot() function. What did you observe? Complete the details of the

```r
plot_alexafile <- ggplot(open_alexa_file, aes(x = variation)) +
  geom_bar(fill = "pink") +
  labs(title = "Variations",
       x = "Variation",
       y = "Count")

plot_alexafile
```
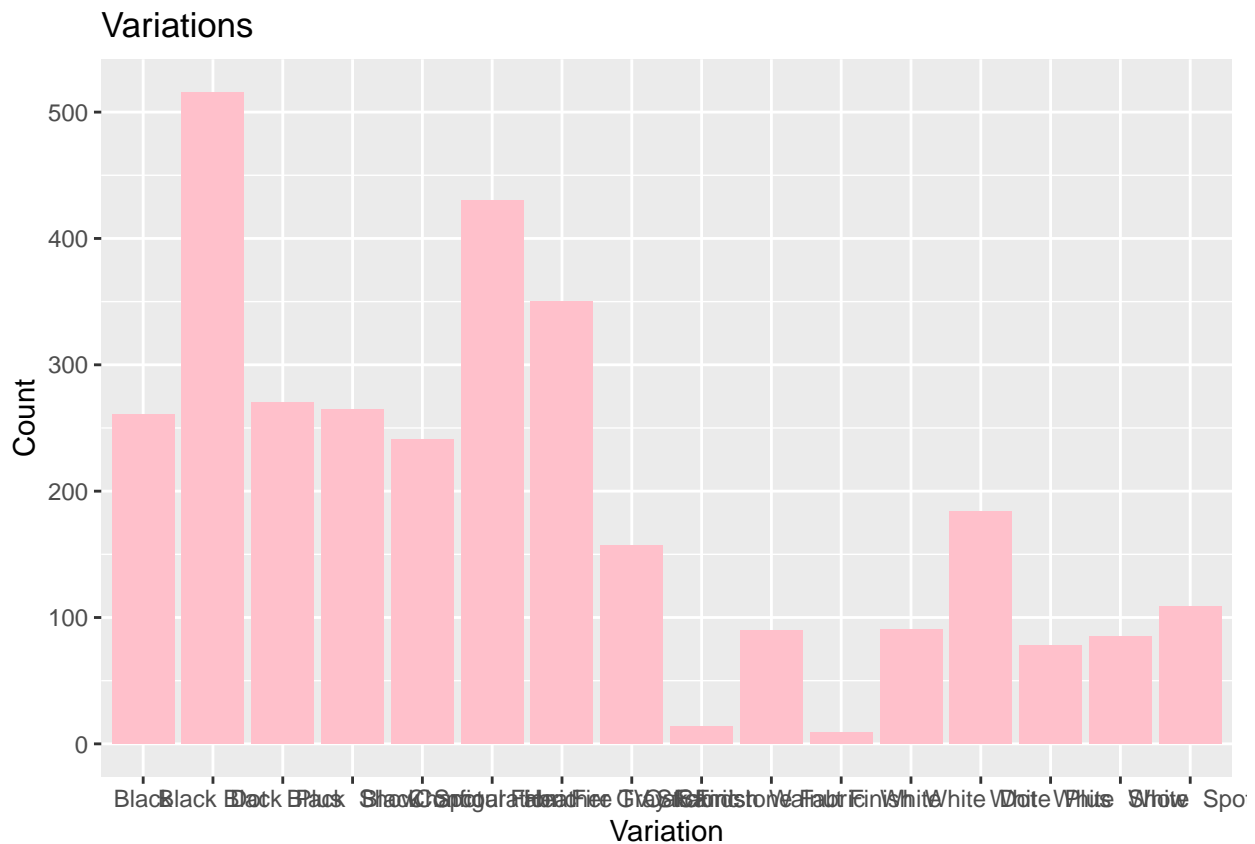

#The graph displays the distribution of variations and their counts, with each bar representing a speci

```r
library(dplyr)

open_alexa_file$date <- as.Date(open_alexa_file$date)

open_alexa_file$month <- format(open_alexa_file$date, "%m")

alexa_Month <-open_alexa_file%>%
  count(month)
alexa_Month
```
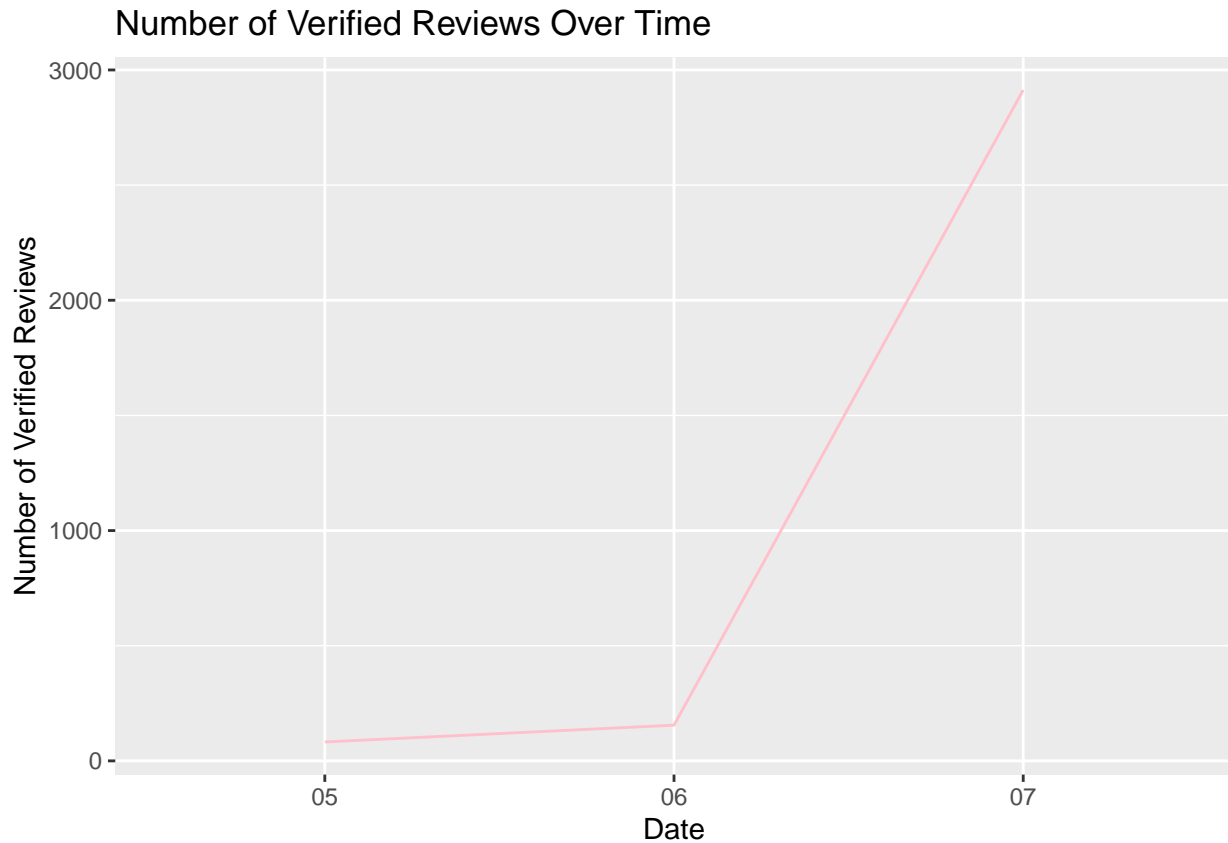
```
## # A tibble: 3 x 2
##   month     n
##   <chr> <int>
## 1 05       82
## 2 06      155
## 3 07     2913
```

```r
alexa_monthly_reviews <- table(alexa_Month)
alexa_monthly_reviews
```

```
##        n
## month 82 155 2913
##    05  1   0    0
##    06  0   1    0
##    07  0   0    1
```

```r
alexa_lineplot <- ggplot(alexa_Month, aes(x = month, y = n, group = 1)) +
  geom_line(color = "pink") +
  labs(title = "Number of Verified Reviews Over Time",
       x = "Date",
       y = "Number of Verified Reviews")

alexa_lineplot
```

Number of Verified Reviews Over Time

```
alexa_variation_ratings <- open_alexa_file %>%
  group_by(variation) %>%
  summarise(avg_rating = mean(rating))

alexa_variation_ratings
```

```
## # A tibble: 16 x 2
##    variation                  avg_rating
##    <chr>                           <dbl>
##  1 Black                            4.23
##  2 Black  Dot                       4.45
##  3 Black  Plus                      4.37
##  4 Black  Show                      4.49
##  5 Black  Spot                      4.31
##  6 Charcoal Fabric                  4.73
##  7 Configuration: Fire TV Stick     4.59
##  8 Heather Gray Fabric              4.69
##  9 Oak Finish                       4.86
## 10 Sandstone Fabric                 4.36
## 11 Walnut Finish                    4.89
## 12 White                            4.14
## 13 White  Dot                       4.42
## 14 White  Plus                      4.36
## 15 White  Show                      4.28
```

```
## 16 White   Spot                          4.31
```

```
highest_ratings <- alexa_variation_ratings %>%
  filter(avg_rating == max(avg_rating))

highest_ratings
```

```
## # A tibble: 1 x 2
##   variation     avg_rating
##   <chr>              <dbl>
## 1 Walnut Finish       4.89
```

```
# The walnut finish variation has the highest rating
```

```
ggplot(alexa_variation_ratings, aes(x = variation, y = avg_rating)) +
  geom_bar(stat = "identity", fill = "purple") +
  labs(title = "Average Ratings by Variation",
       x = "Variation",
       y = "Average Rating")
```

Average Ratings by Variation