RWorksheet_Calambro#4c

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#1 #a

```
mpg <- read.csv("/cloud/project/Worksheet4/mpg.csv", header = TRUE, sep = ",")
mpg
```

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##       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
## 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
```

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## 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
## 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
```

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## 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
## 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
```

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## 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
## 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
```

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## 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
## 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
## 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
```

#b #The categorical variables are the Manufacturer, Model, Trans, Drv, fl, and class.

#c #The continuous variables are displ, cty, hwy.

#2 #The manufacturer with the most models in the dataset is Toyota, having 6 different models. The "caravan 2wd" model has the most variations, with 11 different entries.

#a

```
# Load necessary libraries
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
```

```
library(ggplot2)
```

```
##
## Attaching package: 'ggplot2'
```

```
## The following object is masked _by_ '.GlobalEnv':
##
##     mpg
```

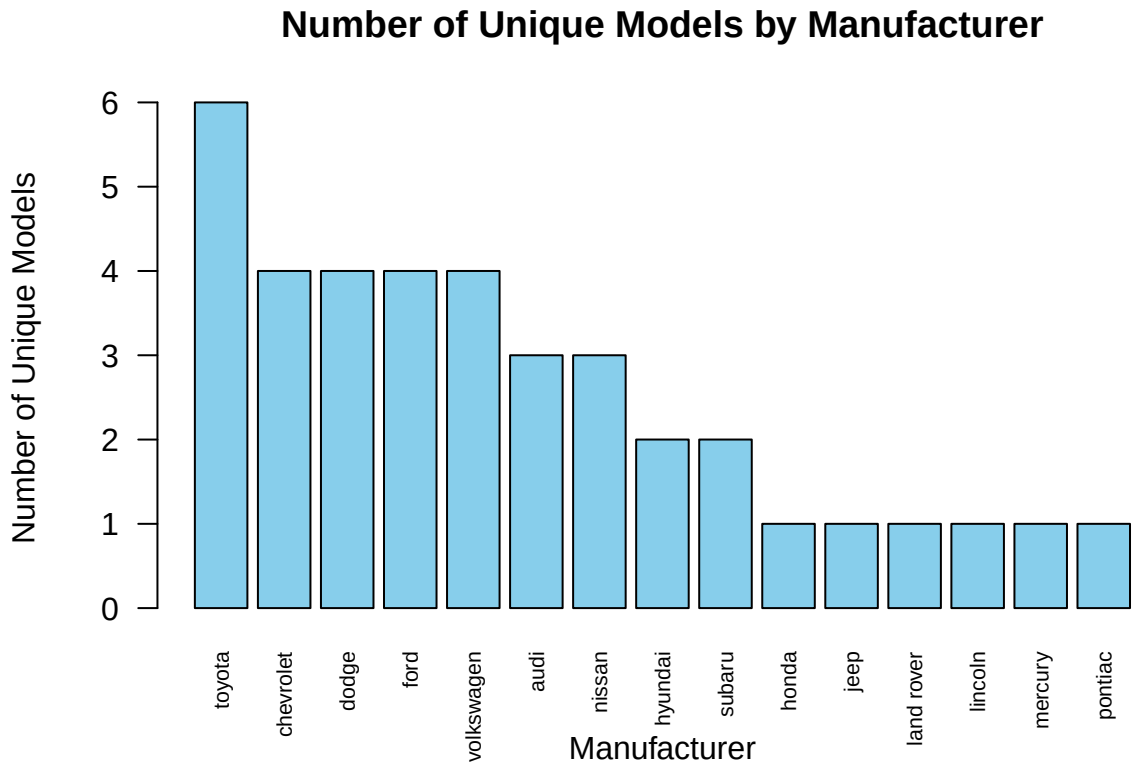
```
# Group by manufacturer and count unique models
mmc <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unique_models = n_distinct(model)) %>%
  arrange(desc(unique_models))

# Print the result
print(mmc)
```

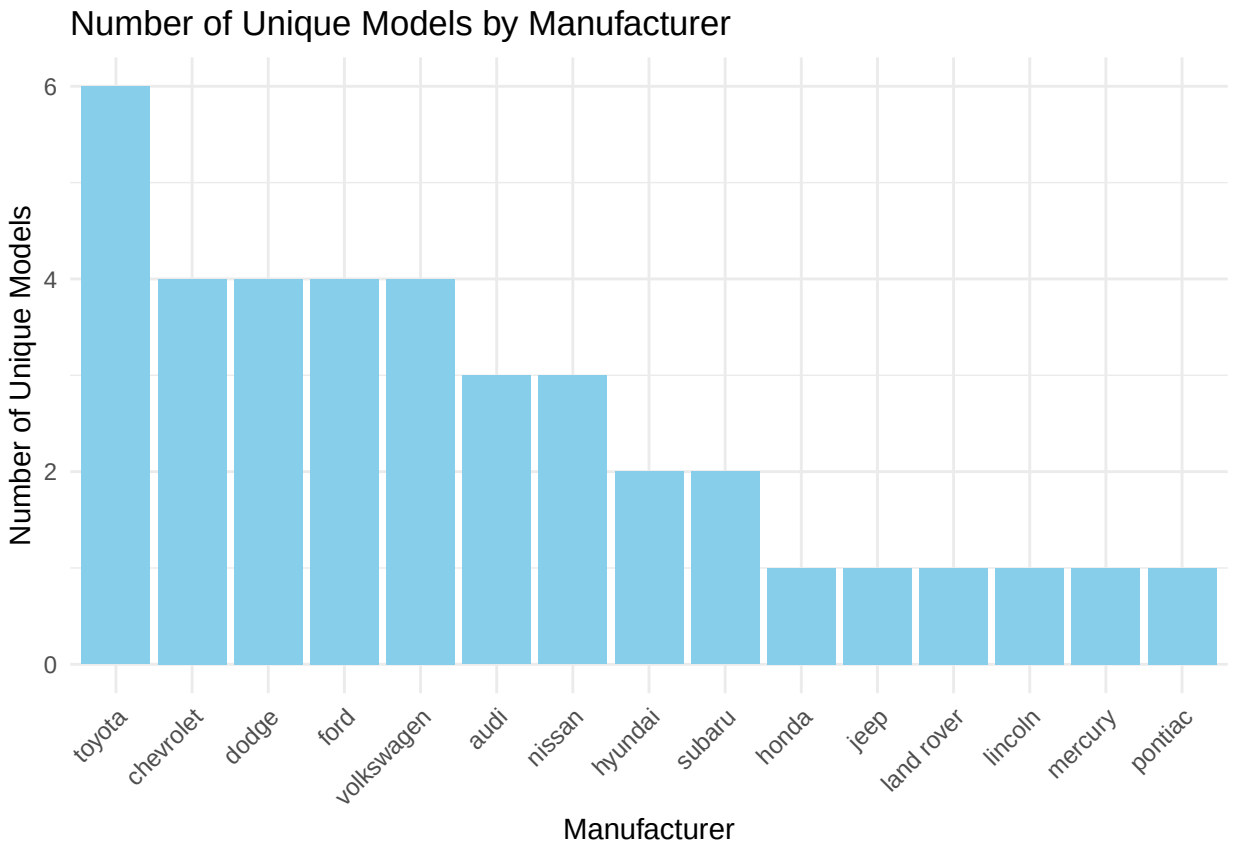
```
## # A tibble: 15 x 2
##    manufacturer unique_models
##    <chr>                <int>
##  1 toyota                   6
##  2 chevrolet                4
##  3 dodge                    4
##  4 ford                     4
##  5 volkswagen               4
##  6 audi                     3
##  7 nissan                   3
##  8 hyundai                  2
##  9 subaru                   2
## 10 honda                    1
## 11 jeep                     1
## 12 land rover               1
## 13 lincoln                  1
## 14 mercury                  1
## 15 pontiac                  1
```

#b

```r
# Base R plotting
barplot(
  mmc$unique_models,
  names.arg = mmc$manufacturer,
  col = "skyblue",
  main = "Number of Unique Models by Manufacturer",
  xlab = "Manufacturer",
  ylab = "Number of Unique Models",
  las = 2,
  cex.names = 0.7
)
```

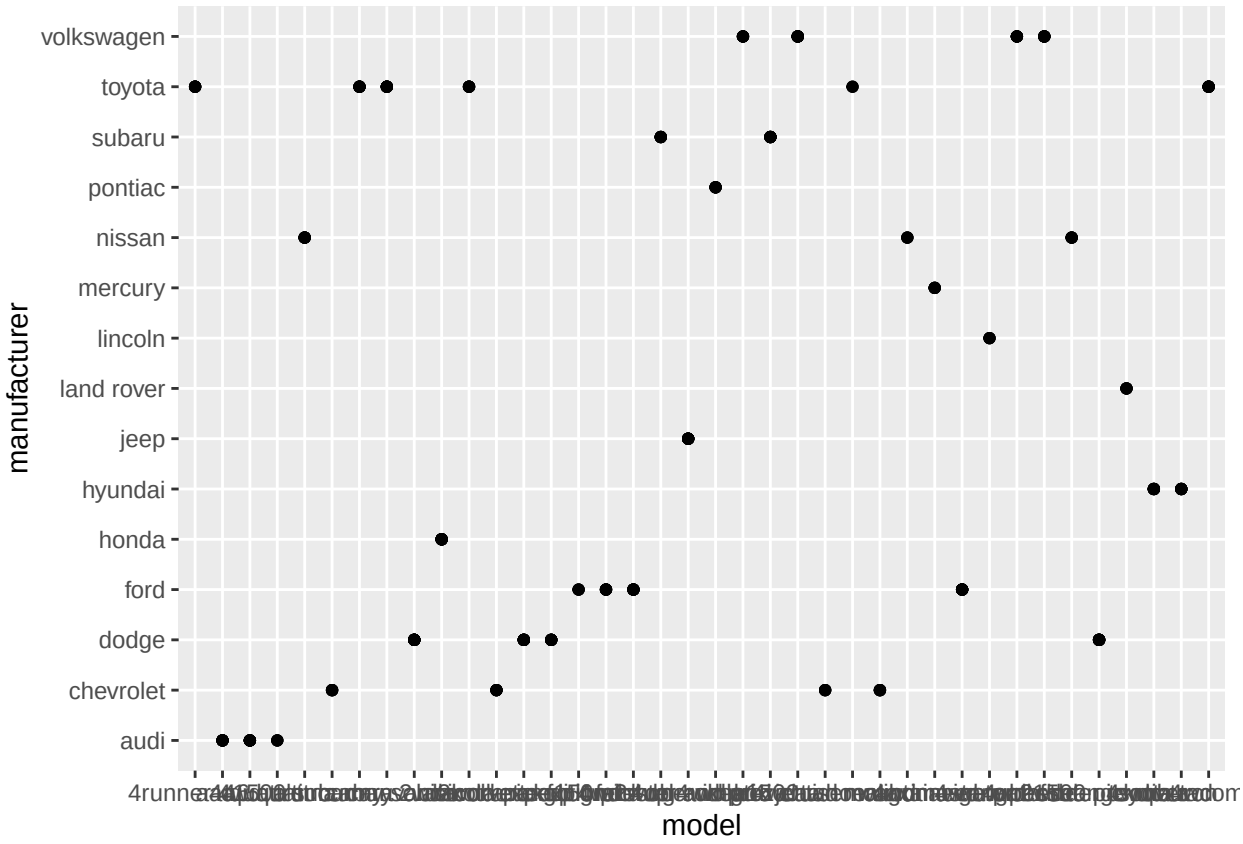



```r
# ggplot2 plotting
ggplot(mmc, aes(x = reorder(manufacturer, -unique_models), y = unique_models)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Number of Unique Models by Manufacturer", x = "Manufacturer", y = "Number of Unique Mode
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



#2a

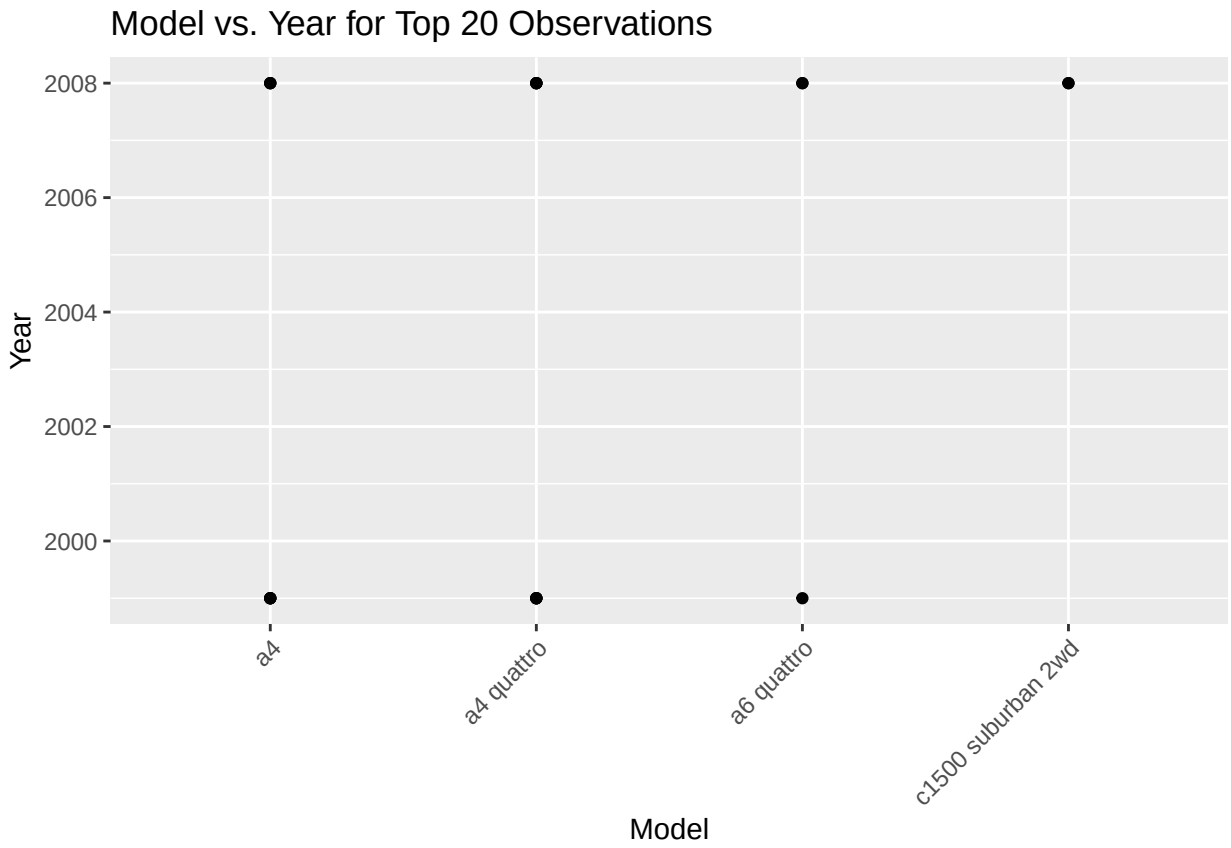
```
ggplot(mpg, aes(model, manufacturer)) + geom_point()
```



#2b #Convert the counts into a heatmap for easier visual analysis.In this plot, darker shades indicate higher counts, making it easy to see popular model-manufacturer combinations at a glance. These modifications offer a clearer view of relationships and trends in the dataset.

#3

```
# Filter the top 20 observations
top_20 <- mpg %>%
  slice(1:20) # Select the first 20 rows

# Plot using ggplot
ggplot(top_20, aes(x = model, y = year)) +
  geom_point() +
  labs(title = "Model vs. Year for Top 20 Observations",
       x = "Model",
       y = "Year") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



#4

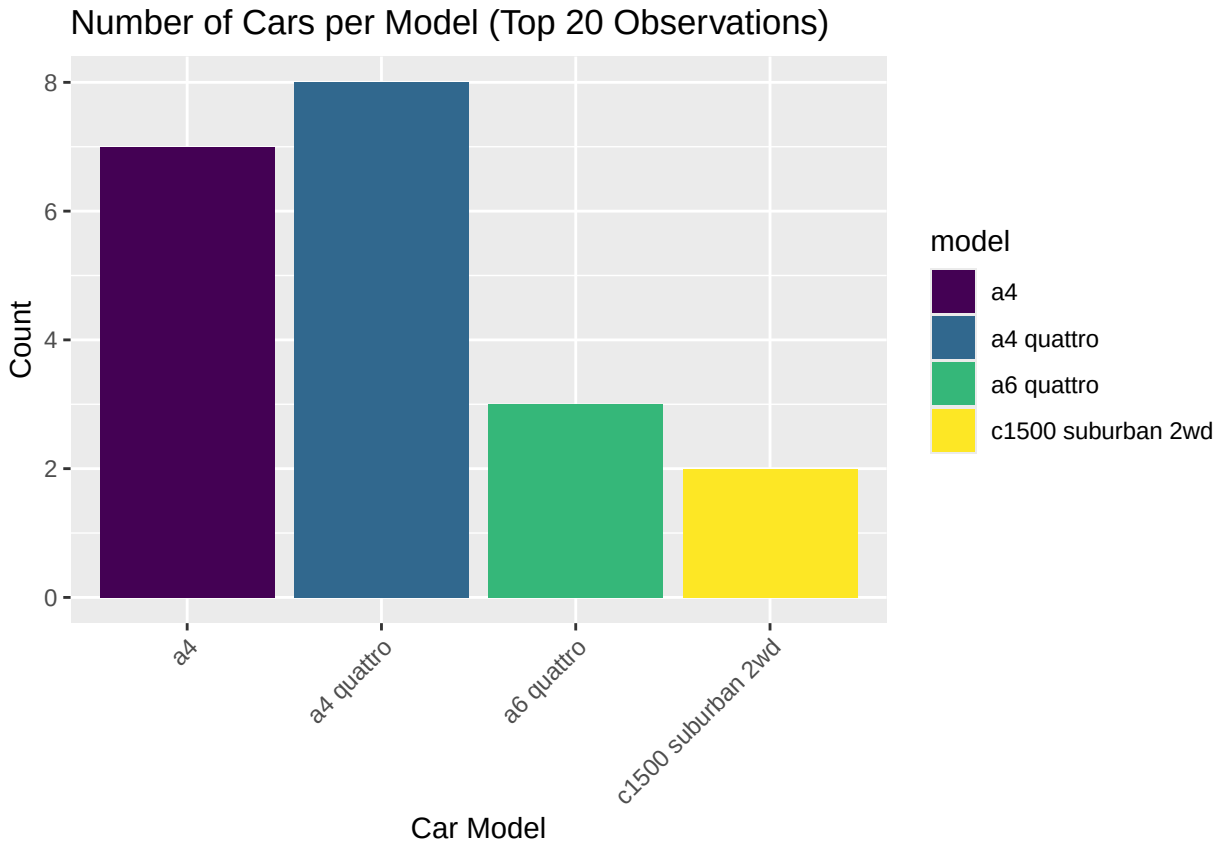
```
# Group by model and count the number of cars per model
model_counts <- mpg %>%
  group_by(model) %>%
  summarise(car_count = n())

# View the result
model_counts
```

```
## # A tibble: 38 x 2
##    model              car_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

```
# Filter the top 20 observations
top_20 <- mpg %>%
```

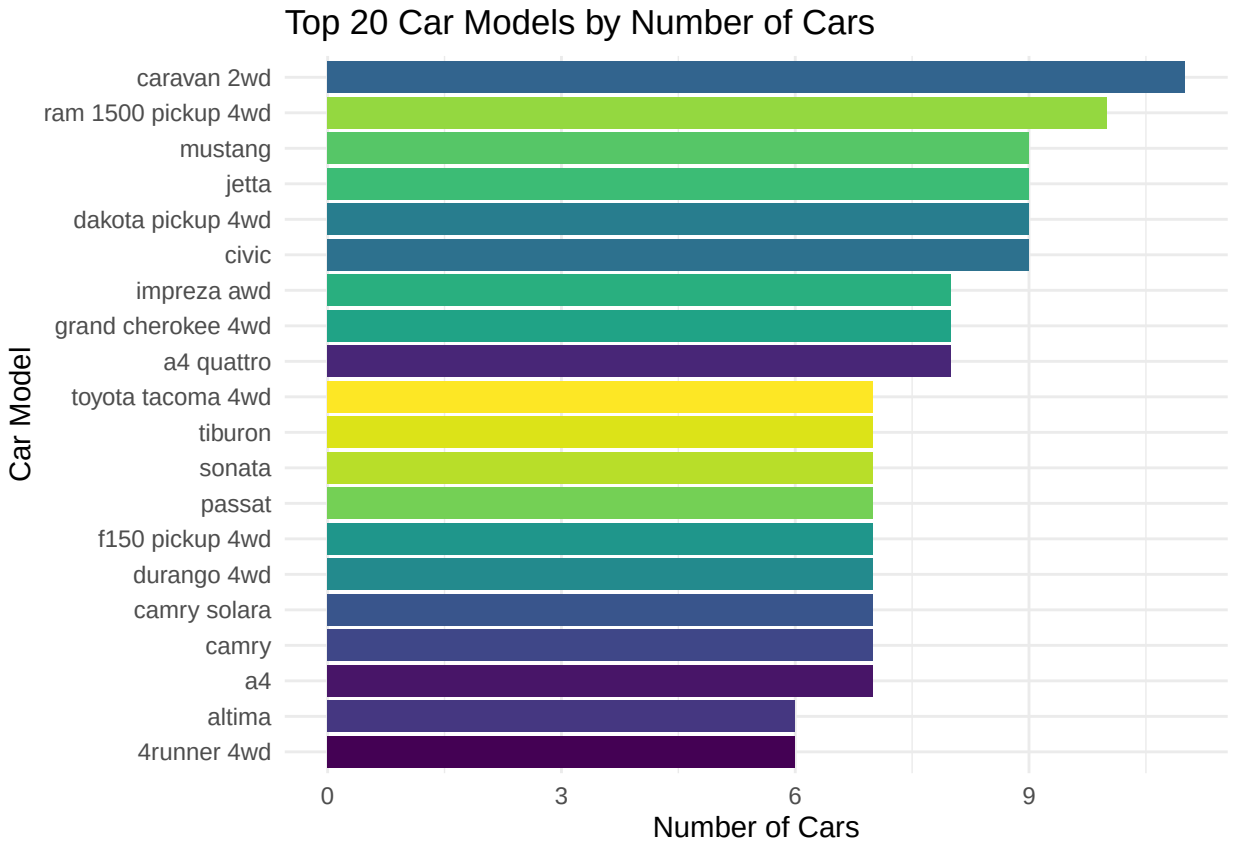
```
  slice(1:20) # Select the first 20 rows

# Plot using ggplot with geom_bar()
ggplot(top_20, aes(x = model, fill = model)) +
  geom_bar() +
  labs(
    title = "Number of Cars per Model (Top 20 Observations)",
    x = "Car Model",
    y = "Count"
  ) +
  scale_fill_viridis_d() +  # Adds color using a color scale
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



#4b

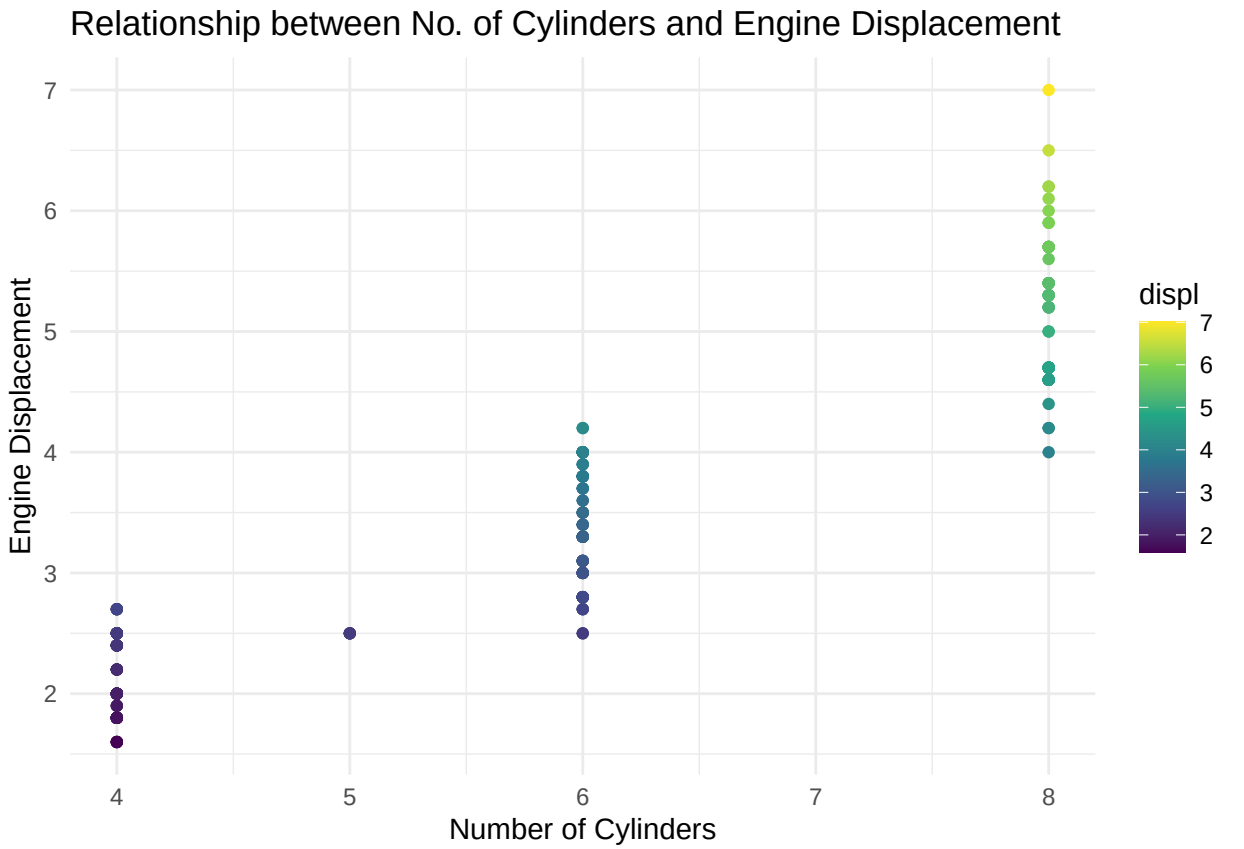
```
# Get the count of cars per model and select the top 20 observations
top_20_models <- mpg %>%
  group_by(model) %>%
  summarise(car_count = n()) %>%
  arrange(desc(car_count)) %>%
  slice(1:20)

# Plot the top 20 models with a horizontal bar chart
ggplot(top_20_models, aes(x = reorder(model, car_count), y = car_count, fill = model)) +
  geom_bar(stat = "identity", show.legend = FALSE) +
  coord_flip() +  # Flip coordinates for horizontal bars
  labs(title = "Top 20 Car Models by Number of Cars",
       x = "Car Model",
```

```
       y = "Number of Cars") +
  theme_minimal() +
  scale_fill_viridis_d()
```



#5

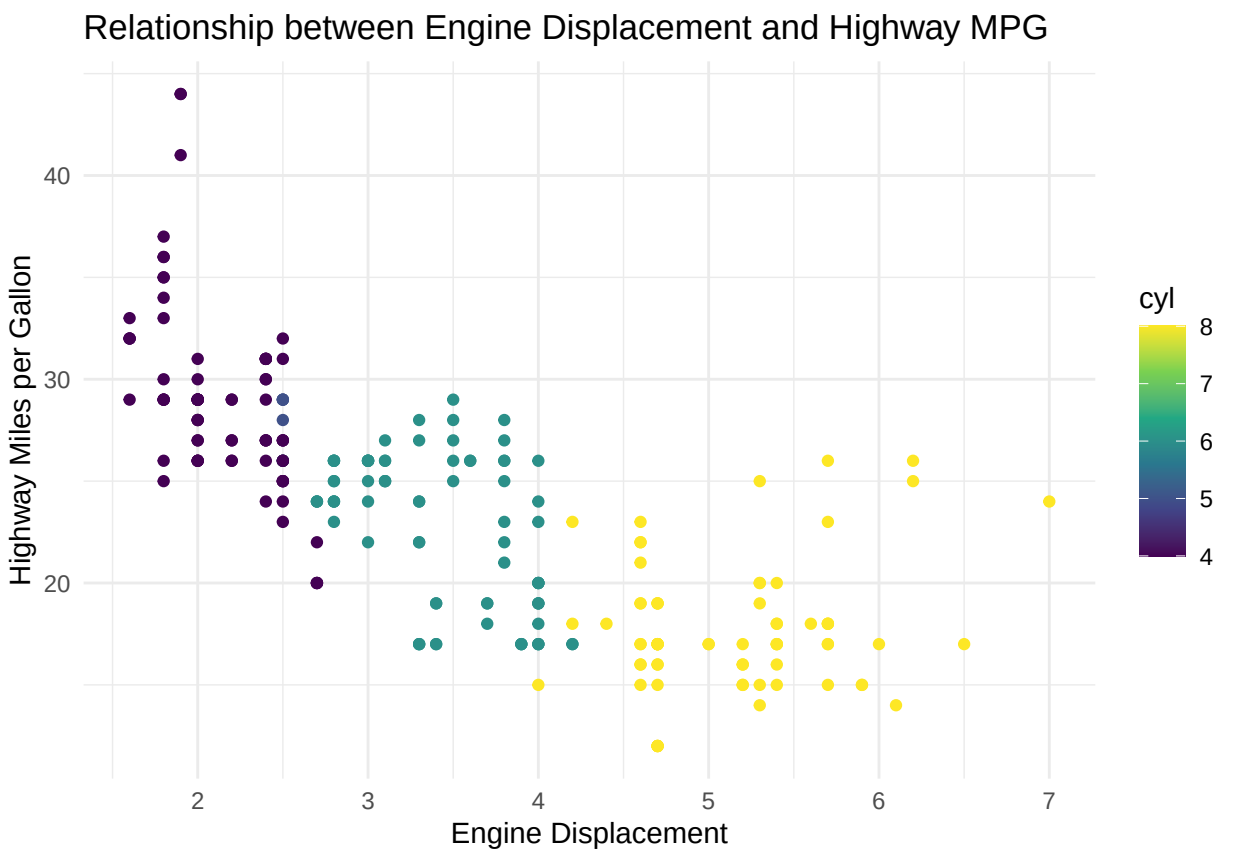
```
# Create the scatter plot
ggplot(mpg, aes(x = cyl, y = displ, color = displ)) +
  geom_point() +
  labs(title = "Relationship between No. of Cylinders and Engine Displacement",
       x = "Number of Cylinders",
       y = "Engine Displacement") +
  scale_color_viridis_c() +  # Use a color scale for continuous variable (engine displacement)
  theme_minimal()
```



#5a #In the plot, as the number of cylinders (cyl) goes up, engine displacement (displ) generally increases too. This means cars with more cylinders tend to have bigger engines. The color intensity also shifts, reinforcing this trend: higher displacement values show up in colors tied to higher cylinder counts.

#6

```
ggplot(mpg, aes(x = displ, y = hwy, color = cyl)) +
  geom_point() +
  labs(title = "Relationship between Engine Displacement and Highway MPG",
       x = "Engine Displacement",
       y = "Highway Miles per Gallon") +
  scale_color_viridis_c() +  # Use a color gradient for continuous variable (number of cylinders)
  theme_minimal()
```



#6

```
# Import the CSV file
traffic_data <- read.csv("/cloud/project/Worksheet4/traffic.csv")

# View the first few rows to confirm
head(traffic_data)
```

```
##              DateTime Junction Vehicles          ID
## 1 2015-11-01 00:00:00        1       15 20151101001
## 2 2015-11-01 01:00:00        1       13 20151101011
## 3 2015-11-01 02:00:00        1       10 20151101021
## 4 2015-11-01 03:00:00        1        7 20151101031
## 5 2015-11-01 04:00:00        1        9 20151101041
## 6 2015-11-01 05:00:00        1        6 20151101051
```

#6a

#The traffic dataset has 48,120 observations and 4 variables: DateTime, the date and time of each observation. Junction, the junction number. Vehicles, the number of vehicles counted. ID, a unique identifier for each observation.

#6b

```
# Subset data by each unique junction
junction_1 <- subset(traffic_data, Junction == 1)
junction_2 <- subset(traffic_data, Junction == 2)
junction_3 <- subset(traffic_data, Junction == 3)
junction_4 <- subset(traffic_data, Junction == 4)
```

```r
# Display the first few rows of each subset to confirm
head(junction_1)
```

```
##              DateTime Junction Vehicles          ID
## 1 2015-11-01 00:00:00        1       15 20151101001
## 2 2015-11-01 01:00:00        1       13 20151101011
## 3 2015-11-01 02:00:00        1       10 20151101021
## 4 2015-11-01 03:00:00        1        7 20151101031
## 5 2015-11-01 04:00:00        1        9 20151101041
## 6 2015-11-01 05:00:00        1        6 20151101051
```

```r
head(junction_2)
```

```
##                  DateTime Junction Vehicles          ID
## 14593 2015-11-01 00:00:00        2        6 20151101002
## 14594 2015-11-01 01:00:00        2        6 20151101012
## 14595 2015-11-01 02:00:00        2        5 20151101022
## 14596 2015-11-01 03:00:00        2        6 20151101032
## 14597 2015-11-01 04:00:00        2        7 20151101042
## 14598 2015-11-01 05:00:00        2        2 20151101052
```

```r
head(junction_3)
```

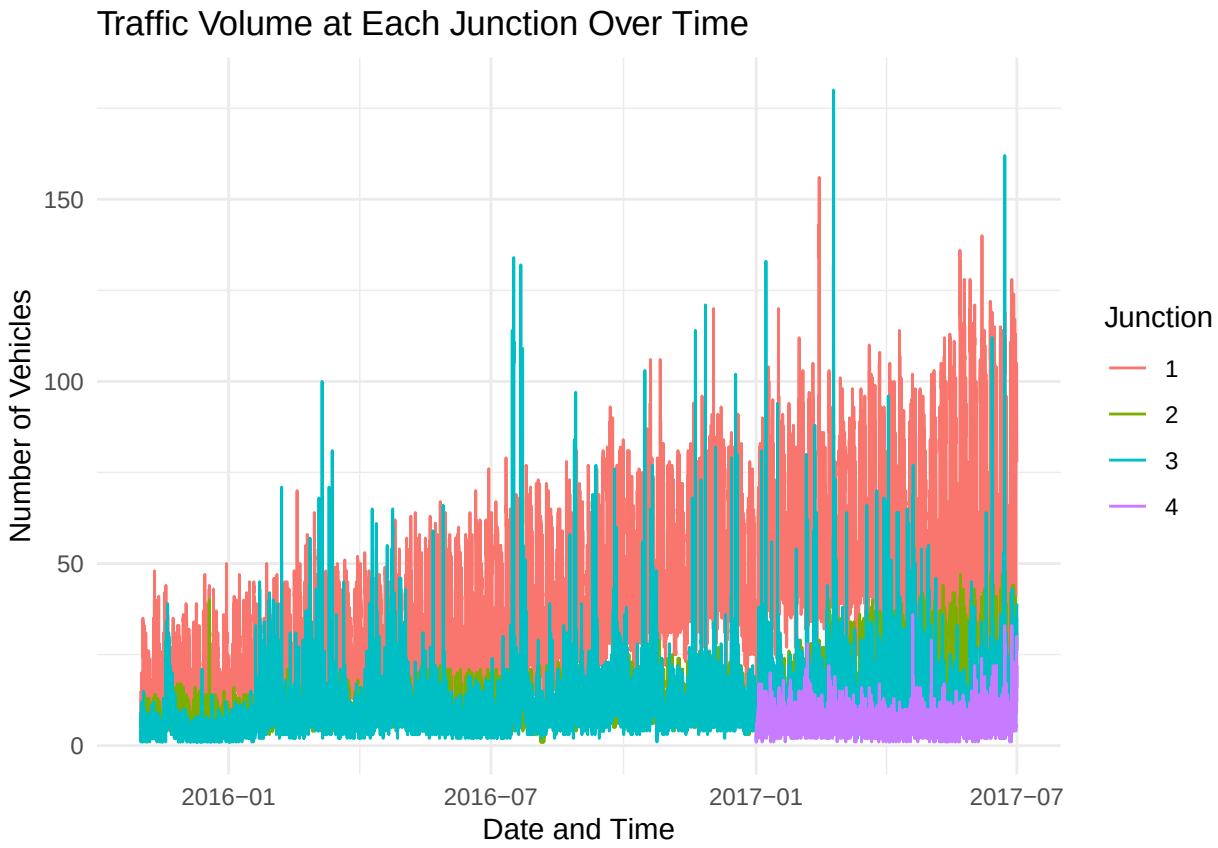
```
##                  DateTime Junction Vehicles          ID
## 29185 2015-11-01 00:00:00        3        9 20151101003
## 29186 2015-11-01 01:00:00        3        7 20151101013
## 29187 2015-11-01 02:00:00        3        5 20151101023
## 29188 2015-11-01 03:00:00        3        1 20151101033
## 29189 2015-11-01 04:00:00        3        2 20151101043
## 29190 2015-11-01 05:00:00        3        2 20151101053
```

```r
head(junction_4)
```

```
##                  DateTime Junction Vehicles          ID
## 43777 2017-01-01 00:00:00        4        3 20170101004
## 43778 2017-01-01 01:00:00        4        1 20170101014
## 43779 2017-01-01 02:00:00        4        4 20170101024
## 43780 2017-01-01 03:00:00        4        4 20170101034
## 43781 2017-01-01 04:00:00        4        2 20170101044
## 43782 2017-01-01 05:00:00        4        1 20170101054
```

#6c

```r
# Convert DateTime to date-time format in R if not already
traffic_data$DateTime <- as.POSIXct(traffic_data$DateTime, format="%Y-%m-%d %H:%M:%S")

# Plotting each junction's data
ggplot(traffic_data, aes(x = DateTime, y = Vehicles, color = factor(Junction))) +
  geom_line() +
  labs(title = "Traffic Volume at Each Junction Over Time",
       x = "Date and Time",
       y = "Number of Vehicles",
       color = "Junction") +
  theme_minimal()
```



#7

```
library(readxl)

# Read the Excel file
alexaExcel <- read_excel("/cloud/project/Worksheet4/alexa_file.xlsx")
```

#7a

```
# Get the number of observations (rows) and columns
num_observations <- nrow(alexaExcel)
num_columns <- ncol(alexaExcel)

# Display the number of observations (rows) and columns clearly
cat("Number of observations:", nrow(alexaExcel), "\n")
```

```
## Number of observations: 3150
```

```
cat("Number of columns:", ncol(alexaExcel), "\n")
```

```
## Number of columns: 5
```

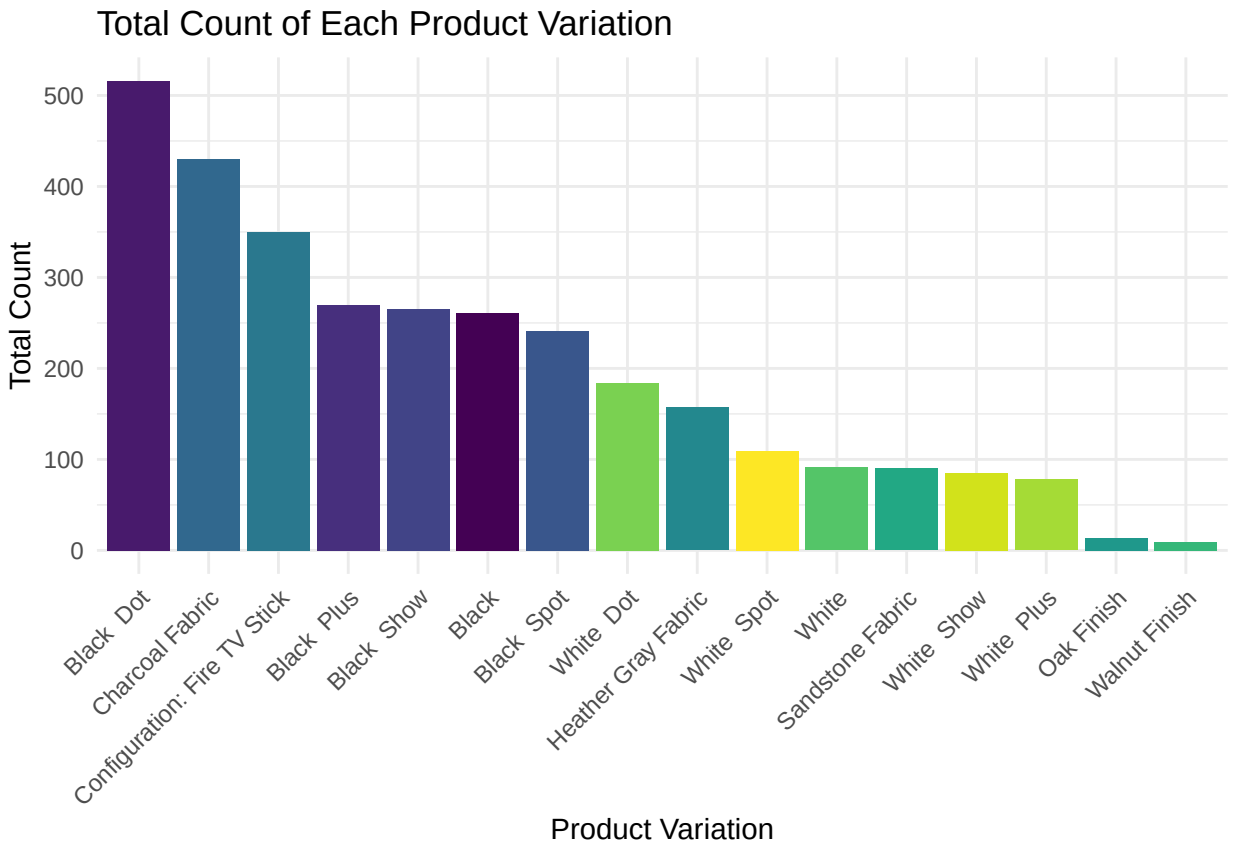
#7b

```
# Group by variation and get the count for each variation
variation_counts <- alexaExcel %>%
  group_by(variation) %>%
  summarise(total_count = n())

# Display the result
variation_counts
```

```
## # A tibble: 16 x 2
##    variation                    total_count
##    <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
```

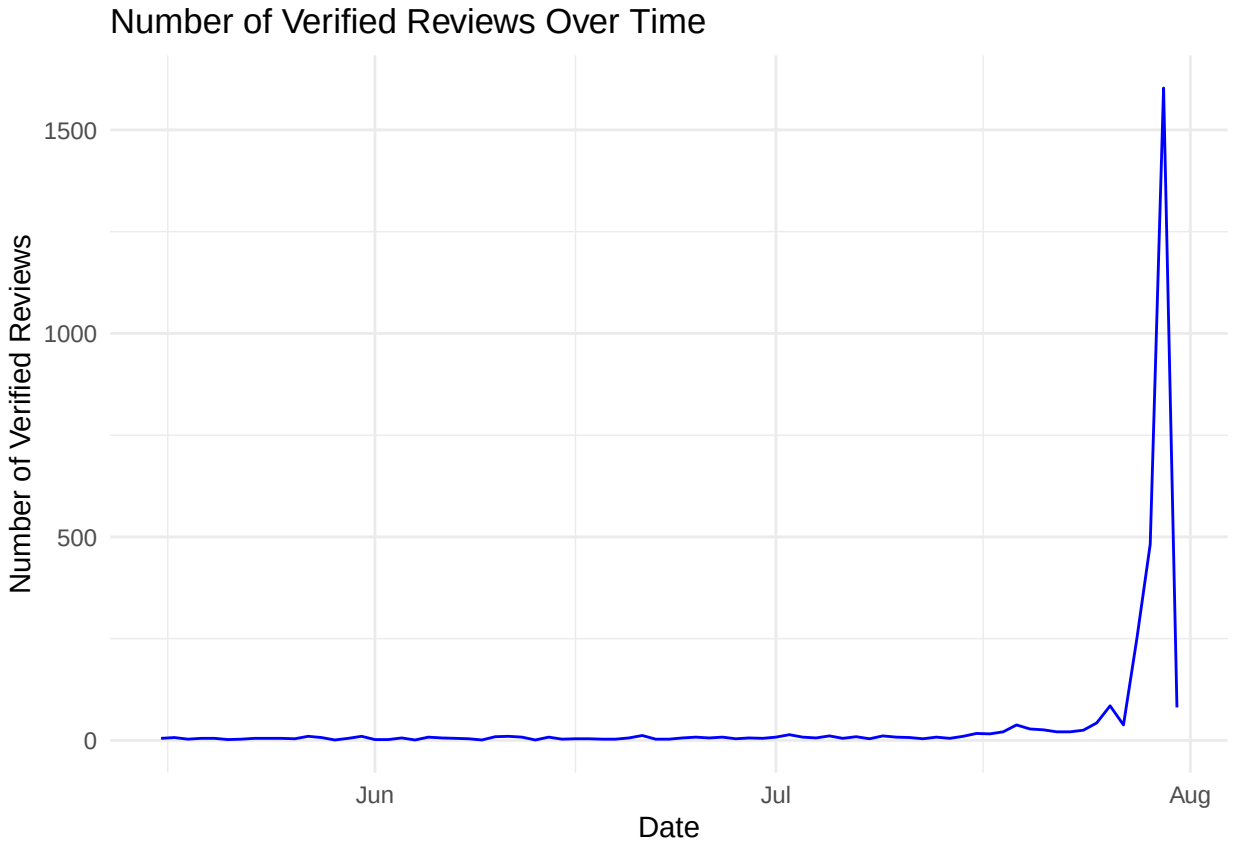
#7c

```
# Plot the variations
ggplot(variation_counts, aes(x = reorder(variation, -total_count), y = total_count, fill = variation)) +
  geom_bar(stat = "identity", show.legend = FALSE) +
  labs(title = "Total Count of Each Product Variation",
       x = "Product Variation",
       y = "Total Count") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  scale_fill_viridis_d()
```



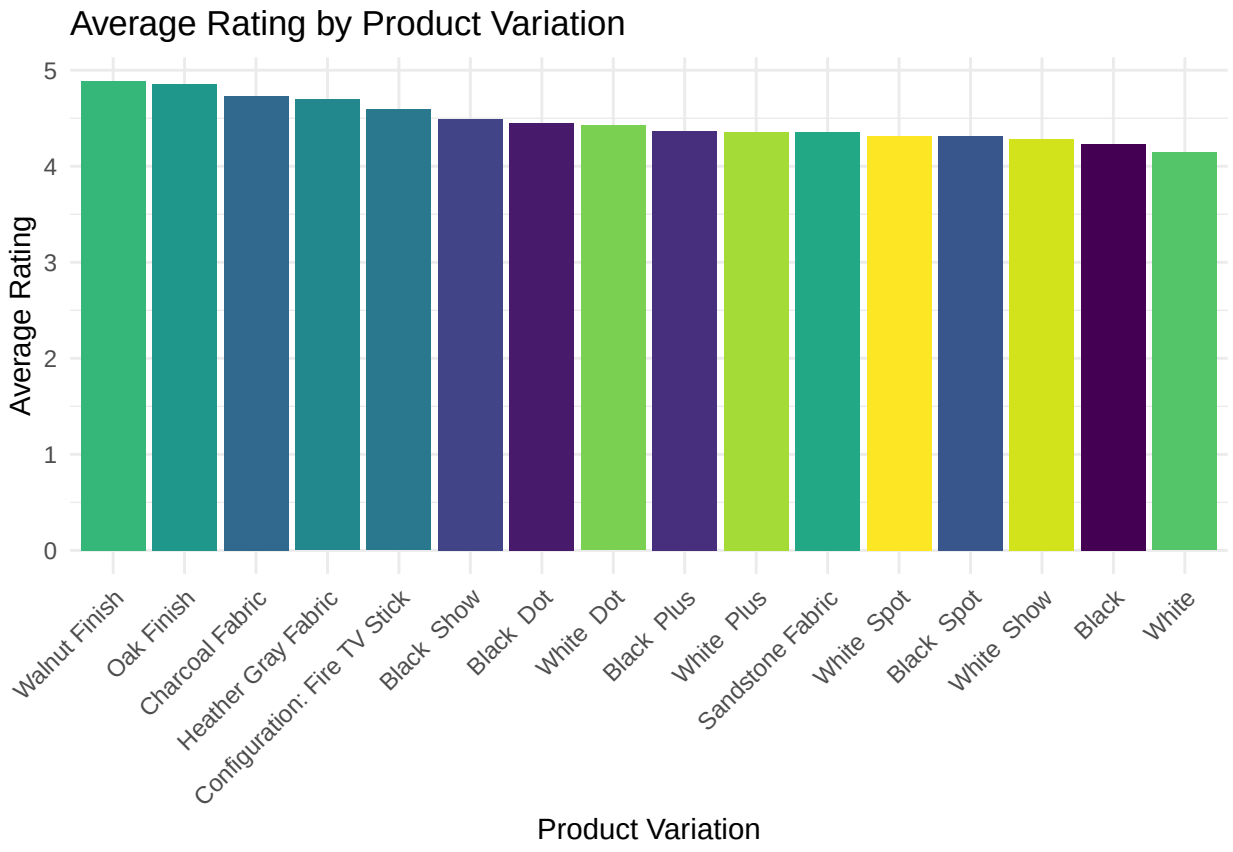
#7d

```
# Prepare data by counting verified reviews per date
reviews_per_date <- alexaExcel %>%
  group_by(date) %>%
  summarise(num_reviews = n())

# Plot the time series of reviews
ggplot(reviews_per_date, aes(x = date, y = num_reviews)) +
  geom_line(color = "blue") +
  labs(title = "Number of Verified Reviews Over Time",
       x = "Date",
       y = "Number of Verified Reviews") +
  theme_minimal()
```



#7e

```
# Calculate average rating for each variation
variation_ratings <- alexaExcel %>%
  group_by(variation) %>%
  summarise(average_rating = mean(rating))

# Plot the average rating for each variation
ggplot(variation_ratings, aes(x = reorder(variation, -average_rating), y = average_rating, fill = varia
  geom_bar(stat = "identity", show.legend = FALSE) +
  labs(title = "Average Rating by Product Variation",
       x = "Product Variation",
       y = "Average Rating") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  scale_fill_viridis_d()
```


Average Rating by Product Variation
Average Rating
0
1
2
3
4
5
Walnut Finish
Oak Finish
Charcoal Fabric
Heather Gray Fabric
Configuration: Fire TV Stick
Black Show
Black Dot
White Dot
Black Plus
White Plus
Sandstone Fabric
White Spot
Black Spot
White Show
Black
White
Product Variation