RWorksheet_MAMINTA#4c

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```r
library(ggplot2)
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
library(RColorBrewer)
library(readxl)

#1.
data(mpg)

write.csv(mpg, "mpg.csv", row.names = FALSE)

#A.
mpg <- read.csv("mpg.csv", stringsAsFactors = FALSE)

mpg
```

```
##    manufacturer        model displ year cyl      trans drv cty hwy
## 1          audi           a4   1.8 1999   4   auto(l5)   f  18  29
## 2          audi           a4   1.8 1999   4 manual(m5)   f  21  29
## 3          audi           a4   2.0 2008   4 manual(m6)   f  20  31
## 4          audi           a4   2.0 2008   4   auto(av)   f  21  30
## 5          audi           a4   2.8 1999   6   auto(l5)   f  16  26
## 6          audi           a4   2.8 1999   6 manual(m5)   f  18  26
## 7          audi           a4   3.1 2008   6   auto(av)   f  18  27
## 8          audi   a4 quattro   1.8 1999   4 manual(m5)   4  18  26
## 9          audi   a4 quattro   1.8 1999   4   auto(l5)   4  16  25
## 10         audi   a4 quattro   2.0 2008   4 manual(m6)   4  20  28
## 11         audi   a4 quattro   2.0 2008   4   auto(s6)   4  19  27
## 12         audi   a4 quattro   2.8 1999   6   auto(l5)   4  15  25
```

```
## 13         audi            a4 quattro  2.8 1999  6 manual(m5)  4 17 25
## 14         audi            a4 quattro  3.1 2008  6   auto(s6)  4 17 25
## 15         audi            a4 quattro  3.1 2008  6 manual(m6)  4 15 25
## 16         audi            a6 quattro  2.8 1999  6   auto(l5)  4 15 24
## 17         audi            a6 quattro  3.1 2008  6   auto(s6)  4 17 25
## 18         audi            a6 quattro  4.2 2008  8   auto(s6)  4 16 23
## 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 15
## 21    chevrolet   c1500 suburban 2wd  5.3 2008  8   auto(l4)  r 14 20
## 22    chevrolet   c1500 suburban 2wd  5.7 1999  8   auto(l4)  r 13 17
## 23    chevrolet   c1500 suburban 2wd  6.0 2008  8   auto(l4)  r 12 17
## 24    chevrolet             corvette  5.7 1999  8 manual(m6)  r 16 26
## 25    chevrolet             corvette  5.7 1999  8   auto(l4)  r 15 23
## 26    chevrolet             corvette  6.2 2008  8 manual(m6)  r 16 26
## 27    chevrolet             corvette  6.2 2008  8   auto(s6)  r 15 25
## 28    chevrolet             corvette  7.0 2008  8 manual(m6)  r 15 24
## 29    chevrolet       k1500 tahoe 4wd 5.3 2008  8   auto(l4)  4 14 19
## 30    chevrolet       k1500 tahoe 4wd 5.3 2008  8   auto(l4)  4 11 14
## 31    chevrolet       k1500 tahoe 4wd 5.7 1999  8   auto(l4)  4 11 15
## 32    chevrolet       k1500 tahoe 4wd 6.5 1999  8   auto(l4)  4 14 17
## 33    chevrolet               malibu  2.4 1999  4   auto(l4)  f 19 27
## 34    chevrolet               malibu  2.4 2008  4   auto(l4)  f 22 30
## 35    chevrolet               malibu  3.1 1999  6   auto(l4)  f 18 26
## 36    chevrolet               malibu  3.5 2008  6   auto(l4)  f 18 29
## 37    chevrolet               malibu  3.6 2008  6   auto(s6)  f 17 26
## 38       dodge           caravan 2wd  2.4 1999  4   auto(l3)  f 18 24
## 39       dodge           caravan 2wd  3.0 1999  6   auto(l4)  f 17 24
## 40       dodge           caravan 2wd  3.3 1999  6   auto(l4)  f 16 22
## 41       dodge           caravan 2wd  3.3 1999  6   auto(l4)  f 16 22
## 42       dodge           caravan 2wd  3.3 2008  6   auto(l4)  f 17 24
## 43       dodge           caravan 2wd  3.3 2008  6   auto(l4)  f 17 24
## 44       dodge           caravan 2wd  3.3 2008  6   auto(l4)  f 11 17
## 45       dodge           caravan 2wd  3.8 1999  6   auto(l4)  f 15 22
## 46       dodge           caravan 2wd  3.8 1999  6   auto(l4)  f 15 21
## 47       dodge           caravan 2wd  3.8 2008  6   auto(l6)  f 16 23
## 48       dodge           caravan 2wd  4.0 2008  6   auto(l6)  f 16 23
## 49       dodge      dakota pickup 4wd 3.7 2008  6 manual(m6)  4 15 19
## 50       dodge      dakota pickup 4wd 3.7 2008  6   auto(l4)  4 14 18
## 51       dodge      dakota pickup 4wd 3.9 1999  6   auto(l4)  4 13 17
## 52       dodge      dakota pickup 4wd 3.9 1999  6 manual(m5)  4 14 17
## 53       dodge      dakota pickup 4wd 4.7 2008  8   auto(l5)  4 14 19
## 54       dodge      dakota pickup 4wd 4.7 2008  8   auto(l5)  4 14 19
## 55       dodge      dakota pickup 4wd 4.7 2008  8   auto(l5)  4  9 12
## 56       dodge      dakota pickup 4wd 5.2 1999  8 manual(m5)  4 11 17
## 57       dodge      dakota pickup 4wd 5.2 1999  8   auto(l4)  4 11 15
## 58       dodge           durango 4wd  3.9 1999  6   auto(l4)  4 13 17
## 59       dodge           durango 4wd  4.7 2008  8   auto(l5)  4 13 17
## 60       dodge           durango 4wd  4.7 2008  8   auto(l5)  4  9 12
## 61       dodge           durango 4wd  4.7 2008  8   auto(l5)  4 13 17
## 62       dodge           durango 4wd  5.2 1999  8   auto(l4)  4 11 16
## 63       dodge           durango 4wd  5.7 2008  8   auto(l5)  4 13 18
## 64       dodge           durango 4wd  5.9 1999  8   auto(l4)  4 11 15
## 65       dodge   ram 1500 pickup 4wd  4.7 2008  8 manual(m6)  4 12 16
## 66       dodge   ram 1500 pickup 4wd  4.7 2008  8   auto(l5)  4  9 12
```

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```
## 67         dodge   ram 1500 pickup 4wd   4.7 2008   8   auto(l5)   4   13   17
## 68         dodge   ram 1500 pickup 4wd   4.7 2008   8   auto(l5)   4   13   17
## 69         dodge   ram 1500 pickup 4wd   4.7 2008   8 manual(m6)   4   12   16
## 70         dodge   ram 1500 pickup 4wd   4.7 2008   8 manual(m6)   4    9   12
## 71         dodge   ram 1500 pickup 4wd   5.2 1999   8   auto(l4)   4   11   15
## 72         dodge   ram 1500 pickup 4wd   5.2 1999   8 manual(m5)   4   11   16
## 73         dodge   ram 1500 pickup 4wd   5.7 2008   8   auto(l5)   4   13   17
## 74         dodge   ram 1500 pickup 4wd   5.9 1999   8   auto(l4)   4   11   15
## 75          ford         expedition 2wd   4.6 1999   8   auto(l4)   r   11   17
## 76          ford         expedition 2wd   5.4 1999   8   auto(l4)   r   11   17
## 77          ford         expedition 2wd   5.4 2008   8   auto(l6)   r   12   18
## 78          ford           explorer 4wd   4.0 1999   6   auto(l5)   4   14   17
## 79          ford           explorer 4wd   4.0 1999   6 manual(m5)   4   15   19
## 80          ford           explorer 4wd   4.0 1999   6   auto(l5)   4   14   17
## 81          ford           explorer 4wd   4.0 2008   6   auto(l5)   4   13   19
## 82          ford           explorer 4wd   4.6 2008   8   auto(l6)   4   13   19
## 83          ford           explorer 4wd   5.0 1999   8   auto(l4)   4   13   17
## 84          ford         f150 pickup 4wd   4.2 1999   6   auto(l4)   4   14   17
## 85          ford         f150 pickup 4wd   4.2 1999   6 manual(m5)   4   14   17
## 86          ford         f150 pickup 4wd   4.6 1999   8 manual(m5)   4   13   16
## 87          ford         f150 pickup 4wd   4.6 1999   8   auto(l4)   4   13   16
## 88          ford         f150 pickup 4wd   4.6 2008   8   auto(l4)   4   13   17
## 89          ford         f150 pickup 4wd   5.4 1999   8   auto(l4)   4   11   15
## 90          ford         f150 pickup 4wd   5.4 2008   8   auto(l4)   4   13   17
## 91          ford                mustang   3.8 1999   6 manual(m5)   r   18   26
## 92          ford                mustang   3.8 1999   6   auto(l4)   r   18   25
## 93          ford                mustang   4.0 2008   6 manual(m5)   r   17   26
## 94          ford                mustang   4.0 2008   6   auto(l5)   r   16   24
## 95          ford                mustang   4.6 1999   8   auto(l4)   r   15   21
## 96          ford                mustang   4.6 1999   8 manual(m5)   r   15   22
## 97          ford                mustang   4.6 2008   8 manual(m5)   r   15   23
## 98          ford                mustang   4.6 2008   8   auto(l5)   r   15   22
## 99          ford                mustang   5.4 2008   8 manual(m6)   r   14   20
## 100        honda                  civic   1.6 1999   4 manual(m5)   f   28   33
## 101        honda                  civic   1.6 1999   4   auto(l4)   f   24   32
## 102        honda                  civic   1.6 1999   4 manual(m5)   f   25   32
## 103        honda                  civic   1.6 1999   4 manual(m5)   f   23   29
## 104        honda                  civic   1.6 1999   4   auto(l4)   f   24   32
## 105        honda                  civic   1.8 2008   4 manual(m5)   f   26   34
## 106        honda                  civic   1.8 2008   4   auto(l5)   f   25   36
## 107        honda                  civic   1.8 2008   4   auto(l5)   f   24   36
## 108        honda                  civic   2.0 2008   4 manual(m6)   f   21   29
## 109      hyundai                 sonata   2.4 1999   4   auto(l4)   f   18   26
## 110      hyundai                 sonata   2.4 1999   4 manual(m5)   f   18   27
## 111      hyundai                 sonata   2.4 2008   4   auto(l4)   f   21   30
## 112      hyundai                 sonata   2.4 2008   4 manual(m5)   f   21   31
## 113      hyundai                 sonata   2.5 1999   6   auto(l4)   f   18   26
## 114      hyundai                 sonata   2.5 1999   6 manual(m5)   f   18   26
## 115      hyundai                 sonata   3.3 2008   6   auto(l5)   f   19   28
## 116      hyundai                tiburon   2.0 1999   4   auto(l4)   f   19   26
## 117      hyundai                tiburon   2.0 1999   4 manual(m5)   f   19   29
## 118      hyundai                tiburon   2.0 2008   4 manual(m5)   f   20   28
## 119      hyundai                tiburon   2.0 2008   4   auto(l4)   f   20   27
## 120      hyundai                tiburon   2.7 2008   6   auto(l4)   f   17   24
```

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## 121    hyundai          tiburon  2.7 2008  6 manual(m6)  f  16  24
## 122    hyundai          tiburon  2.7 2008  6 manual(m5)  f  17  24
## 123       jeep  grand cherokee 4wd  3.0 2008  6    auto(15)  4  17  22
## 124       jeep  grand cherokee 4wd  3.7 2008  6    auto(15)  4  15  19
## 125       jeep  grand cherokee 4wd  4.0 1999  6    auto(14)  4  15  20
## 126       jeep  grand cherokee 4wd  4.7 1999  8    auto(14)  4  14  17
## 127       jeep  grand cherokee 4wd  4.7 2008  8    auto(15)  4   9  12
## 128       jeep  grand cherokee 4wd  4.7 2008  8    auto(15)  4  14  19
## 129       jeep  grand cherokee 4wd  5.7 2008  8    auto(15)  4  13  18
## 130       jeep  grand cherokee 4wd  6.1 2008  8    auto(15)  4  11  14
## 131  land rover       range rover  4.0 1999  8    auto(14)  4  11  15
## 132  land rover       range rover  4.2 2008  8    auto(s6)  4  12  18
## 133  land rover       range rover  4.4 2008  8    auto(s6)  4  12  18
## 134  land rover       range rover  4.6 1999  8    auto(14)  4  11  15
## 135    lincoln     navigator 2wd  5.4 1999  8    auto(14)  r  11  17
## 136    lincoln     navigator 2wd  5.4 1999  8    auto(14)  r  11  16
## 137    lincoln     navigator 2wd  5.4 2008  8    auto(16)  r  12  18
## 138    mercury  mountaineer 4wd  4.0 1999  6    auto(15)  4  14  17
## 139    mercury  mountaineer 4wd  4.0 2008  6    auto(15)  4  13  19
## 140    mercury  mountaineer 4wd  4.6 2008  8    auto(16)  4  13  19
## 141    mercury  mountaineer 4wd  5.0 1999  8    auto(14)  4  13  17
## 142     nissan           altima  2.4 1999  4 manual(m5)  f  21  29
## 143     nissan           altima  2.4 1999  4    auto(14)  f  19  27
## 144     nissan           altima  2.5 2008  4    auto(av)  f  23  31
## 145     nissan           altima  2.5 2008  4 manual(m6)  f  23  32
## 146     nissan           altima  3.5 2008  6 manual(m6)  f  19  27
## 147     nissan           altima  3.5 2008  6    auto(av)  f  19  26
## 148     nissan           maxima  3.0 1999  6    auto(14)  f  18  26
## 149     nissan           maxima  3.0 1999  6 manual(m5)  f  19  25
## 150     nissan           maxima  3.5 2008  6    auto(av)  f  19  25
## 151     nissan     pathfinder 4wd  3.3 1999  6    auto(14)  4  14  17
## 152     nissan     pathfinder 4wd  3.3 1999  6 manual(m5)  4  15  17
## 153     nissan     pathfinder 4wd  4.0 2008  6    auto(15)  4  14  20
## 154     nissan     pathfinder 4wd  5.6 2008  8    auto(s5)  4  12  18
## 155    pontiac        grand prix  3.1 1999  6    auto(14)  f  18  26
## 156    pontiac        grand prix  3.8 1999  6    auto(14)  f  16  26
## 157    pontiac        grand prix  3.8 1999  6    auto(14)  f  17  27
## 158    pontiac        grand prix  3.8 2008  6    auto(14)  f  18  28
## 159    pontiac        grand prix  5.3 2008  8    auto(s4)  f  16  25
## 160     subaru      forester awd  2.5 1999  4 manual(m5)  4  18  25
## 161     subaru      forester awd  2.5 1999  4    auto(14)  4  18  24
## 162     subaru      forester awd  2.5 2008  4 manual(m5)  4  20  27
## 163     subaru      forester awd  2.5 2008  4 manual(m5)  4  19  25
## 164     subaru      forester awd  2.5 2008  4    auto(14)  4  20  26
## 165     subaru      forester awd  2.5 2008  4    auto(14)  4  18  23
## 166     subaru       impreza awd  2.2 1999  4    auto(14)  4  21  26
## 167     subaru       impreza awd  2.2 1999  4 manual(m5)  4  19  26
## 168     subaru       impreza awd  2.5 1999  4 manual(m5)  4  19  26
## 169     subaru       impreza awd  2.5 1999  4    auto(14)  4  19  26
## 170     subaru       impreza awd  2.5 2008  4    auto(s4)  4  20  25
## 171     subaru       impreza awd  2.5 2008  4    auto(s4)  4  20  27
## 172     subaru       impreza awd  2.5 2008  4 manual(m5)  4  19  25
## 173     subaru       impreza awd  2.5 2008  4 manual(m5)  4  20  27
## 174     toyota       4runner 4wd  2.7 1999  4 manual(m5)  4  15  20
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## 175       toyota             4runner 4wd 2.7 1999  4   auto(l4)  4 16 20
## 176       toyota             4runner 4wd 3.4 1999  6   auto(l4)  4 15 19
## 177       toyota             4runner 4wd 3.4 1999  6 manual(m5)  4 15 17
## 178       toyota             4runner 4wd 4.0 2008  6   auto(l5)  4 16 20
## 179       toyota             4runner 4wd 4.7 2008  8   auto(l5)  4 14 17
## 180       toyota                   camry 2.2 1999  4 manual(m5)  f 21 29
## 181       toyota                   camry 2.2 1999  4   auto(l4)  f 21 27
## 182       toyota                   camry 2.4 2008  4 manual(m5)  f 21 31
## 183       toyota                   camry 2.4 2008  4   auto(l5)  f 21 31
## 184       toyota                   camry 3.0 1999  6   auto(l4)  f 18 26
## 185       toyota                   camry 3.0 1999  6 manual(m5)  f 18 26
## 186       toyota                   camry 3.5 2008  6   auto(s6)  f 19 28
## 187       toyota             camry solara 2.2 1999  4   auto(l4)  f 21 27
## 188       toyota             camry solara 2.2 1999  4 manual(m5)  f 21 29
## 189       toyota             camry solara 2.4 2008  4 manual(m5)  f 21 31
## 190       toyota             camry solara 2.4 2008  4   auto(s5)  f 22 31
## 191       toyota             camry solara 3.0 1999  6   auto(l4)  f 18 26
## 192       toyota             camry solara 3.0 1999  6 manual(m5)  f 18 26
## 193       toyota             camry solara 3.3 2008  6   auto(s5)  f 18 27
## 194       toyota                 corolla 1.8 1999  4   auto(l3)  f 24 30
## 195       toyota                 corolla 1.8 1999  4   auto(l4)  f 24 33
## 196       toyota                 corolla 1.8 1999  4 manual(m5)  f 26 35
## 197       toyota                 corolla 1.8 2008  4 manual(m5)  f 28 37
## 198       toyota                 corolla 1.8 2008  4   auto(l4)  f 26 35
## 199       toyota land cruiser wagon 4wd 4.7 1999  8   auto(l4)  4 11 15
## 200       toyota land cruiser wagon 4wd 5.7 2008  8   auto(s6)  4 13 18
## 201       toyota       toyota tacoma 4wd 2.7 1999  4 manual(m5)  4 15 20
## 202       toyota       toyota tacoma 4wd 2.7 1999  4   auto(l4)  4 16 20
## 203       toyota       toyota tacoma 4wd 2.7 2008  4 manual(m5)  4 17 22
## 204       toyota       toyota tacoma 4wd 3.4 1999  6 manual(m5)  4 15 17
## 205       toyota       toyota tacoma 4wd 3.4 1999  6   auto(l4)  4 15 19
## 206       toyota       toyota tacoma 4wd 4.0 2008  6 manual(m6)  4 15 18
## 207       toyota       toyota tacoma 4wd 4.0 2008  6   auto(l5)  4 16 20
## 208   volkswagen                     gti 2.0 1999  4 manual(m5)  f 21 29
## 209   volkswagen                     gti 2.0 1999  4   auto(l4)  f 19 26
## 210   volkswagen                     gti 2.0 2008  4 manual(m6)  f 21 29
## 211   volkswagen                     gti 2.0 2008  4   auto(s6)  f 22 29
## 212   volkswagen                     gti 2.8 1999  6 manual(m5)  f 17 24
## 213   volkswagen                   jetta 1.9 1999  4 manual(m5)  f 33 44
## 214   volkswagen                   jetta 2.0 1999  4 manual(m5)  f 21 29
## 215   volkswagen                   jetta 2.0 1999  4   auto(l4)  f 19 26
## 216   volkswagen                   jetta 2.0 2008  4   auto(s6)  f 22 29
## 217   volkswagen                   jetta 2.0 2008  4 manual(m6)  f 21 29
## 218   volkswagen                   jetta 2.5 2008  5   auto(s6)  f 21 29
## 219   volkswagen                   jetta 2.5 2008  5 manual(m5)  f 21 29
## 220   volkswagen                   jetta 2.8 1999  6   auto(l4)  f 16 23
## 221   volkswagen                   jetta 2.8 1999  6 manual(m5)  f 17 24
## 222   volkswagen              new beetle 1.9 1999  4 manual(m5)  f 35 44
## 223   volkswagen              new beetle 1.9 1999  4   auto(l4)  f 29 41
## 224   volkswagen              new beetle 2.0 1999  4 manual(m5)  f 21 29
## 225   volkswagen              new beetle 2.0 1999  4   auto(l4)  f 19 26
## 226   volkswagen              new beetle 2.5 2008  5 manual(m5)  f 20 28
## 227   volkswagen              new beetle 2.5 2008  5   auto(s6)  f 20 29
## 228   volkswagen                  passat 1.8 1999  4 manual(m5)  f 21 29
```

```
## 229     volkswagen                passat  1.8 1999   4    auto(l5)   f  18  29
## 230     volkswagen                passat  2.0 2008   4    auto(s6)   f  19  28
## 231     volkswagen                passat  2.0 2008   4 manual(m6)   f  21  29
## 232     volkswagen                passat  2.8 1999   6    auto(l5)   f  16  26
## 233     volkswagen                passat  2.8 1999   6 manual(m5)   f  18  26
## 234     volkswagen                passat  3.6 2008   6    auto(s6)   f  17  26
##      fl    class
## 1    p   compact
## 2    p   compact
## 3    p   compact
## 4    p   compact
## 5    p   compact
## 6    p   compact
## 7    p   compact
## 8    p   compact
## 9    p   compact
## 10   p   compact
## 11   p   compact
## 12   p   compact
## 13   p   compact
## 14   p   compact
## 15   p   compact
## 16   p   midsize
## 17   p   midsize
## 18   p   midsize
## 19   r       suv
## 20   e       suv
## 21   r       suv
## 22   r       suv
## 23   r       suv
## 24   p   2seater
## 25   p   2seater
## 26   p   2seater
## 27   p   2seater
## 28   p   2seater
## 29   r       suv
## 30   e       suv
## 31   r       suv
## 32   d       suv
## 33   r   midsize
## 34   r   midsize
## 35   r   midsize
## 36   r   midsize
## 37   r   midsize
## 38   r   minivan
## 39   r   minivan
## 40   r   minivan
## 41   r   minivan
## 42   r   minivan
## 43   r   minivan
## 44   e   minivan
## 45   r   minivan
## 46   r   minivan
## 47   r   minivan
```

```
## 48    r    minivan
## 49    r     pickup
## 50    r     pickup
## 51    r     pickup
## 52    r     pickup
## 53    r     pickup
## 54    r     pickup
## 55    e     pickup
## 56    r     pickup
## 57    r     pickup
## 58    r        suv
## 59    r        suv
## 60    e        suv
## 61    r        suv
## 62    r        suv
## 63    r        suv
## 64    r        suv
## 65    r     pickup
## 66    e     pickup
## 67    r     pickup
## 68    r     pickup
## 69    r     pickup
## 70    e     pickup
## 71    r     pickup
## 72    r     pickup
## 73    r     pickup
## 74    r     pickup
## 75    r        suv
## 76    r        suv
## 77    r        suv
## 78    r        suv
## 79    r        suv
## 80    r        suv
## 81    r        suv
## 82    r        suv
## 83    r        suv
## 84    r     pickup
## 85    r     pickup
## 86    r     pickup
## 87    r     pickup
## 88    r     pickup
## 89    r     pickup
## 90    r     pickup
## 91    r subcompact
## 92    r subcompact
## 93    r subcompact
## 94    r subcompact
## 95    r subcompact
## 96    r subcompact
## 97    r subcompact
## 98    r subcompact
## 99    p subcompact
## 100   r subcompact
## 101   r subcompact
```

```
## 102  r subcompact
## 103  p subcompact
## 104  r subcompact
## 105  r subcompact
## 106  r subcompact
## 107  c subcompact
## 108  p subcompact
## 109  r    midsize
## 110  r    midsize
## 111  r    midsize
## 112  r    midsize
## 113  r    midsize
## 114  r    midsize
## 115  r    midsize
## 116  r subcompact
## 117  r subcompact
## 118  r subcompact
## 119  r subcompact
## 120  r subcompact
## 121  r subcompact
## 122  r subcompact
## 123  d        suv
## 124  r        suv
## 125  r        suv
## 126  r        suv
## 127  e        suv
## 128  r        suv
## 129  r        suv
## 130  p        suv
## 131  p        suv
## 132  r        suv
## 133  r        suv
## 134  p        suv
## 135  r        suv
## 136  p        suv
## 137  r        suv
## 138  r        suv
## 139  r        suv
## 140  r        suv
## 141  r        suv
## 142  r    compact
## 143  r    compact
## 144  r    midsize
## 145  r    midsize
## 146  p    midsize
## 147  p    midsize
## 148  r    midsize
## 149  r    midsize
## 150  p    midsize
## 151  r        suv
## 152  r        suv
## 153  p        suv
## 154  p        suv
## 155  r    midsize
```

```
## 156  p    midsize
## 157  r    midsize
## 158  r    midsize
## 159  p    midsize
## 160  r        suv
## 161  r        suv
## 162  r        suv
## 163  p        suv
## 164  r        suv
## 165  p        suv
## 166  r subcompact
## 167  r subcompact
## 168  r subcompact
## 169  r subcompact
## 170  p    compact
## 171  r    compact
## 172  p    compact
## 173  r    compact
## 174  r        suv
## 175  r        suv
## 176  r        suv
## 177  r        suv
## 178  r        suv
## 179  r        suv
## 180  r    midsize
## 181  r    midsize
## 182  r    midsize
## 183  r    midsize
## 184  r    midsize
## 185  r    midsize
## 186  r    midsize
## 187  r    compact
## 188  r    compact
## 189  r    compact
## 190  r    compact
## 191  r    compact
## 192  r    compact
## 193  r    compact
## 194  r    compact
## 195  r    compact
## 196  r    compact
## 197  r    compact
## 198  r    compact
## 199  r        suv
## 200  r        suv
## 201  r     pickup
## 202  r     pickup
## 203  r     pickup
## 204  r     pickup
## 205  r     pickup
## 206  r     pickup
## 207  r     pickup
## 208  r    compact
## 209  r    compact
```

```
## 210  p    compact
## 211  p    compact
## 212  r    compact
## 213  d    compact
## 214  r    compact
## 215  r    compact
## 216  p    compact
## 217  p    compact
## 218  r    compact
## 219  r    compact
## 220  r    compact
## 221  r    compact
## 222  d subcompact
## 223  d subcompact
## 224  r subcompact
## 225  r subcompact
## 226  r subcompact
## 227  r subcompact
## 228  p    midsize
## 229  p    midsize
## 230  p    midsize
## 231  p    midsize
## 232  p    midsize
## 233  p    midsize
## 234  p    midsize
```

```r
#B.
str(mpg)
```

```
## 'data.frame':    234 obs. of  11 variables:
##  $ 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" ...
```

```r
#All characters and factors are categorical

#C.
str(mpg)
```

```
## 'data.frame':    234 obs. of  11 variables:
##  $ 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" ...
```

```
#All numeric are continous
```

```
#2.
mpg %>%
  group_by(manufacturer) %>%
  summarise(models = n_distinct(model))
```

```
## # A tibble: 15 x 2
##    manufacturer models
##    <chr>         <int>
##  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
```

```
#A.
unique_models <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unique_models = n_distinct(model)) %>%
  arrange(desc(unique_models))

unique_models
```

```
## # 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.

ggplot(unique_models, aes(x = reorder(manufacturer, -unique_models), y = unique_models)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  xlab("Manufacturer") + ylab("Number of Unique Models") +
  ggtitle("Number of Unique Models by Manufacturer") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```


Number of Unique Models by Manufacturer
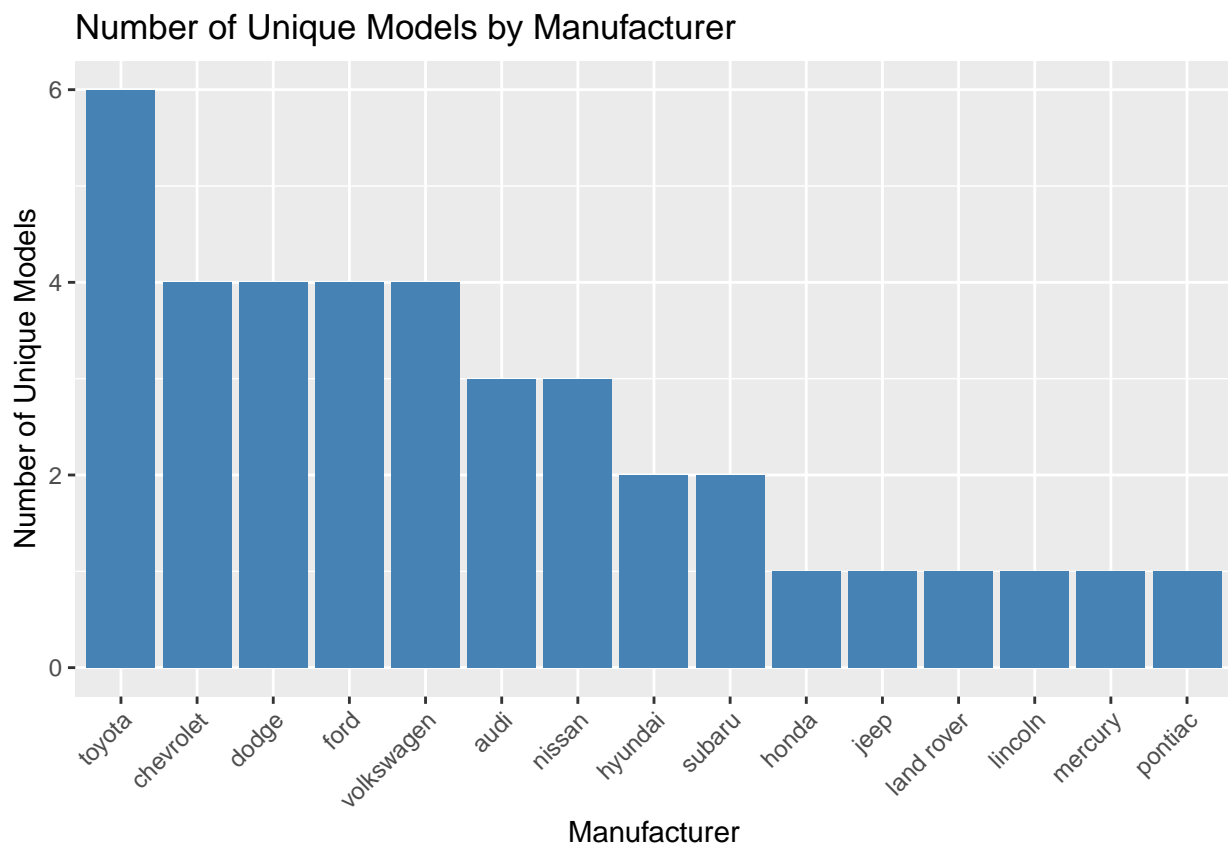
```
ggplot(mpg, aes(x = reorder(manufacturer, model, function(x) length(unique(x))), y = model)) +
  geom_point() +
  xlab("Manufacturer") +
  ylab("Model") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```
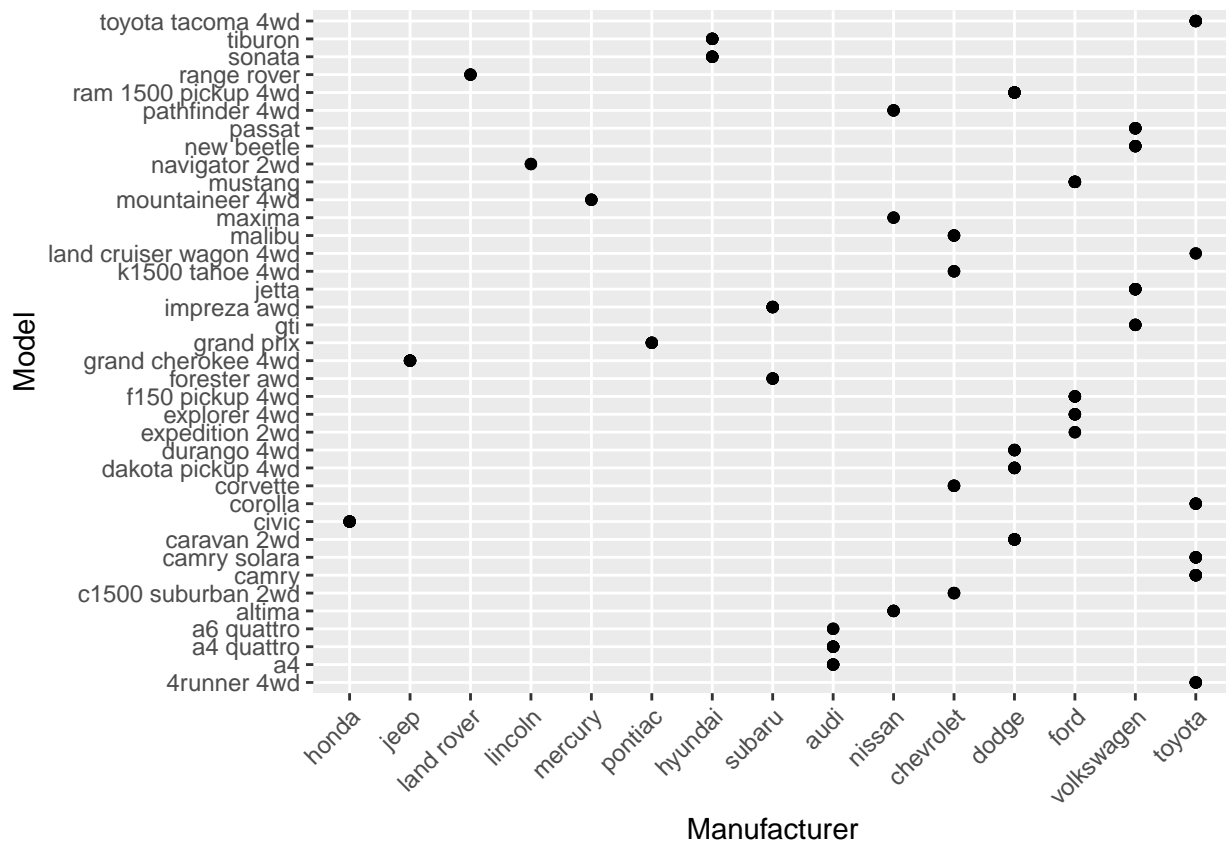
```
#3.

top_20 <- head(mpg, 20)

ggplot(top_20, aes(x = model, y = year)) +
  geom_point() +
  xlab("Model") + ylab("Year") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```
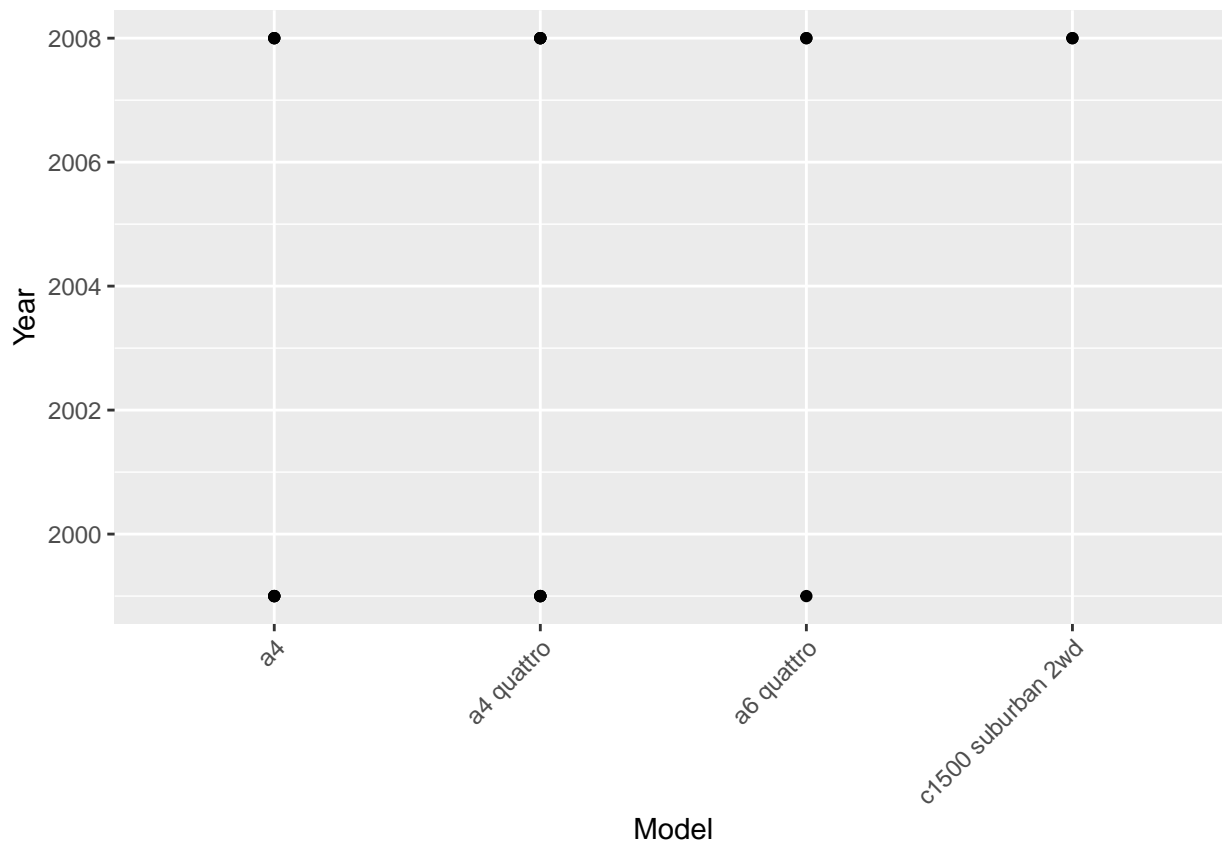
```
#4.

mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count))
```

```
## # A tibble: 38 x 2
##    model             count
##    <chr>             <int>
##  1 caravan 2wd          11
##  2 ram 1500 pickup 4wd  10
##  3 civic                 9
##  4 dakota pickup 4wd     9
##  5 jetta                 9
##  6 mustang               9
##  7 a4 quattro            8
##  8 grand cherokee 4wd    8
##  9 impreza awd           8
## 10 a4                    7
## # i 28 more rows
```

```
#4A.

top_20_models <- mpg %>%
  group_by(model) %>%
```

```
  summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)

ggplot(top_20_models, aes(x = reorder(model, -count), y = count, fill = model)) +
  geom_bar(stat = "identity") +
  xlab("Model") + ylab("Number of Cars") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1), legend.position = "none") +
  scale_fill_manual(values = colorRampPalette(brewer.pal(12, "Set3"))(20))
```

Top 20 Car Models by Number of Cars
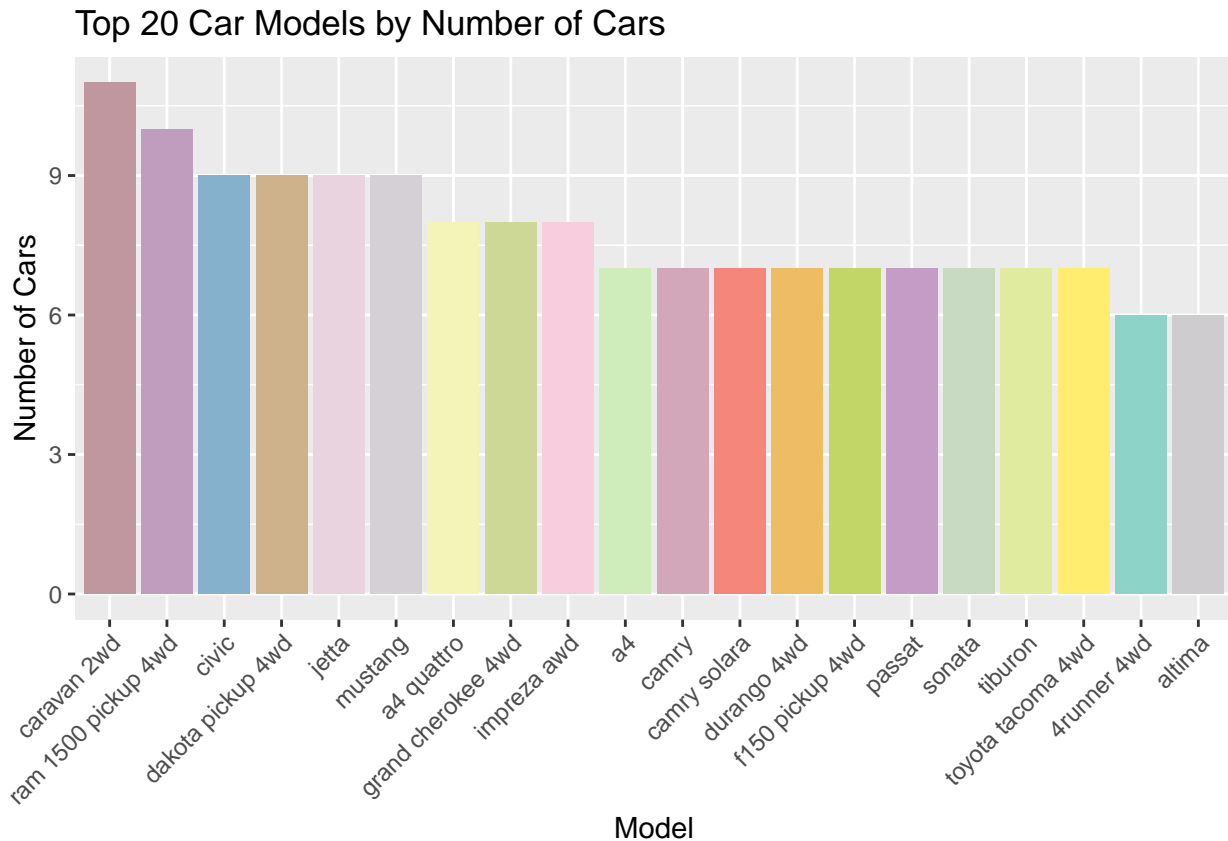

```
#4B.

top_20_models <- mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)

ggplot(top_20_models, aes(x = model, y = count, fill = model)) +
  geom_bar(stat = "identity") +
  coord_flip() +
  xlab("Number of Cars") + ylab("Model") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme(axis.text.y = element_text(size = 9), legend.position = "none")
```

Top 20 Car Models by Number of Cars
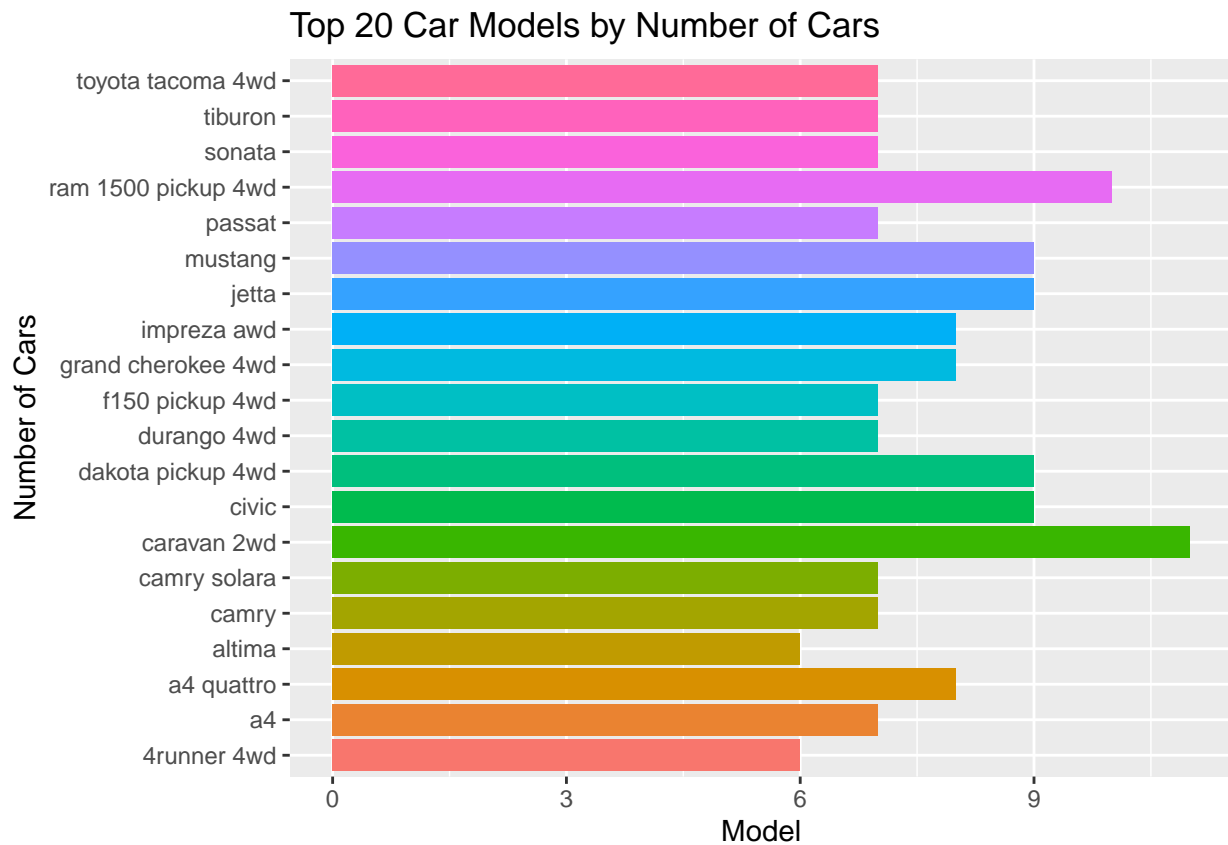

```
#5.

ggplot(mpg, aes(x = cyl, y = displ, color = displ)) +
  geom_point() +
  ggtitle("Relationship between No. of Cylinders and Engine Displacement") +
  xlab("Number of Cylinders") + ylab("Engine Displacement") +
  scale_color_gradient(low = "blue", high = "red")
```

Relationship between No. of Cylinders and Engine Displacement
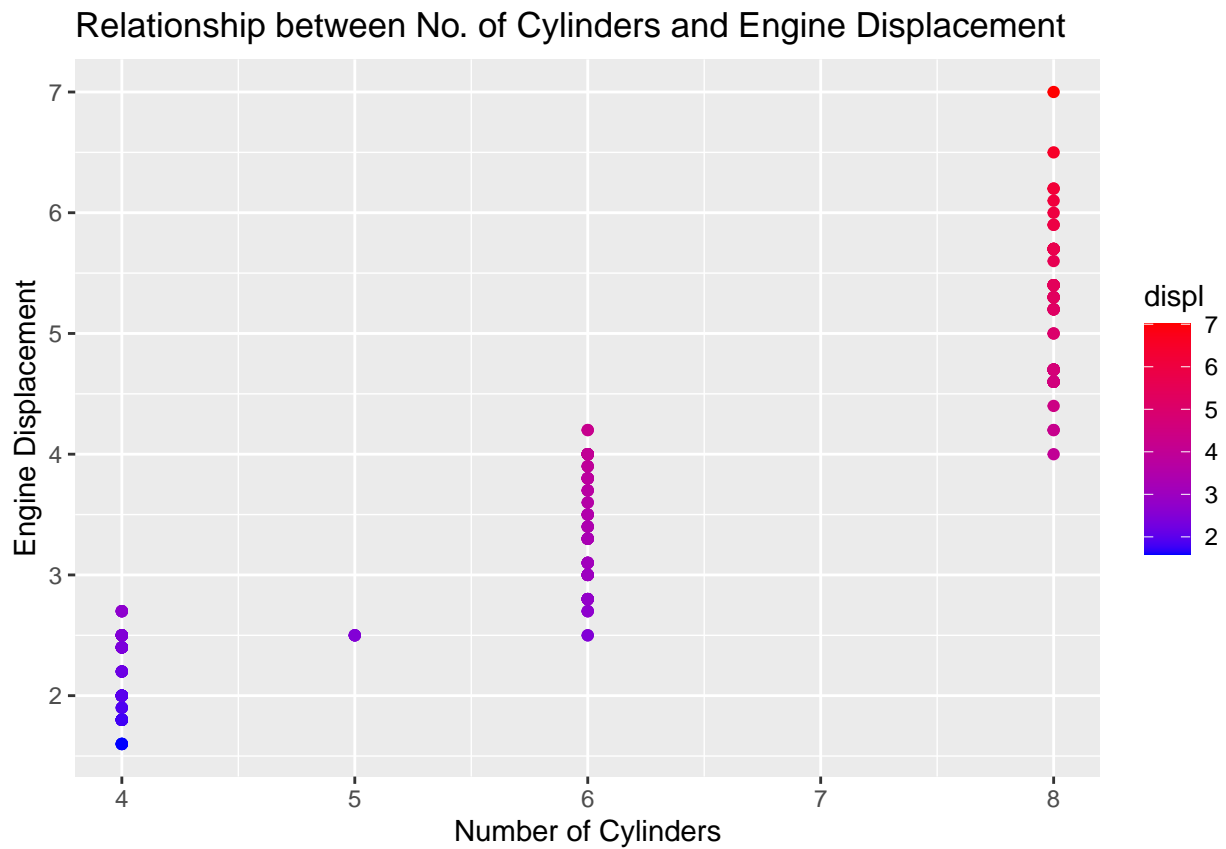
#6.

```
ggplot(mpg, aes(x = displ, y = hwy, color = displ)) +
  geom_point() +
  ggtitle("Relationship between Engine Displacement and Highway MPG") +
  xlab("Engine Displacement (L)") + ylab("Highway MPG") +
  scale_color_gradient(low = "blue", high = "red")
```

Relationship between Engine Displacement and Highway MPG
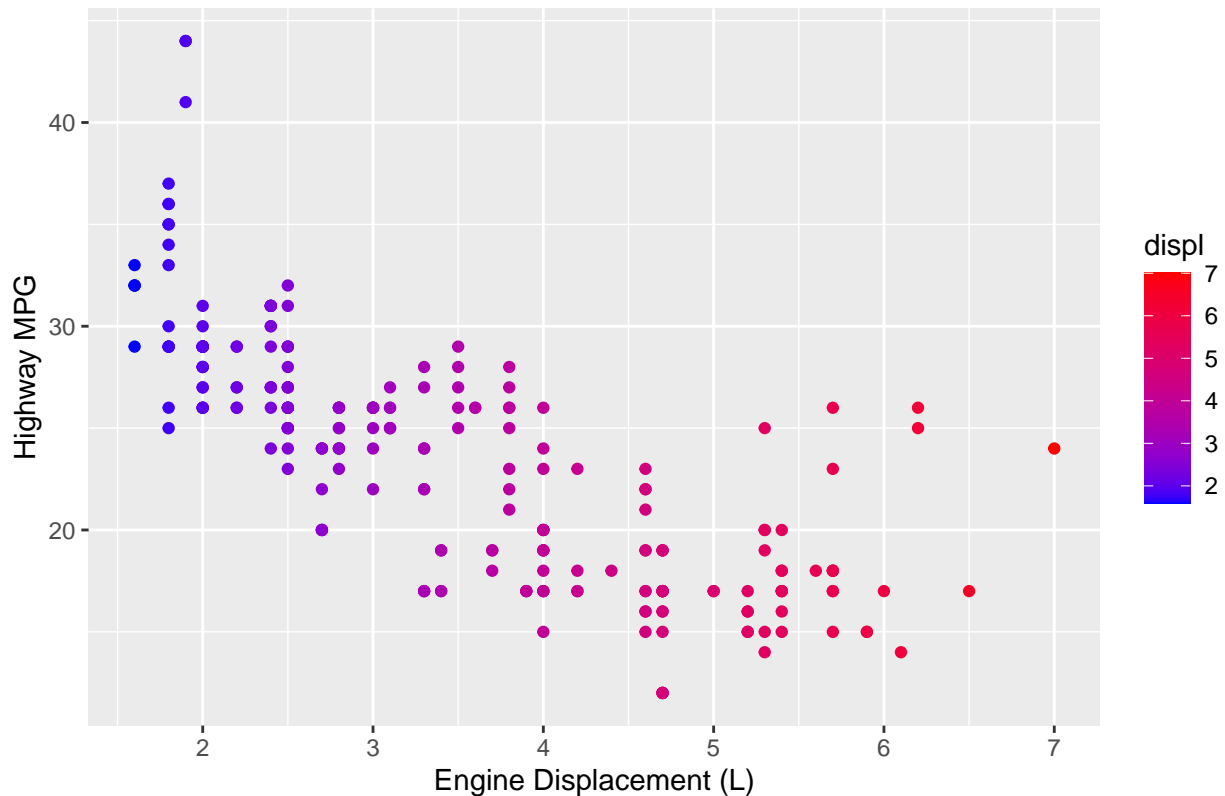
```
#6.

traffic_data <- data.frame(
  Date = as.Date('2025-11-01') + 0:9,
  Location = rep(c("Intersection A", "Intersection B"), each = 5),
  Vehicles = c(120, 150, 130, 160, 140, 200, 210, 190, 205, 220),
  Average_Speed = c(35.5, 34.2, 36.0, 33.8, 34.5, 32.0, 31.5, 33.0, 30.8, 29.5)
)

write.csv(traffic_data, "traffic.csv", row.names = FALSE)

traffic <- read.csv("traffic.csv", stringsAsFactors = FALSE)

str(traffic)
```

```
## 'data.frame':    10 obs. of  4 variables:
##  $ Date         : chr  "2025-11-01" "2025-11-02" "2025-11-03" "2025-11-04" ...
##  $ Location     : chr  "Intersection A" "Intersection A" "Intersection A" "Intersection A" ...
##  $ Vehicles     : int  120 150 130 160 140 200 210 190 205 220
##  $ Average_Speed: num  35.5 34.2 36 33.8 34.5 32 31.5 33 30.8 29.5
```

```
#6

intersection_a <- traffic[traffic$Location == "Intersection A", ]
intersection_b <- traffic[traffic$Location == "Intersection B", ]
```

```
print(intersection_a)
```

```
##         Date       Location Vehicles Average_Speed
## 1 2025-11-01 Intersection A      120          35.5
## 2 2025-11-02 Intersection A      150          34.2
## 3 2025-11-03 Intersection A      130          36.0
## 4 2025-11-04 Intersection A      160          33.8
## 5 2025-11-05 Intersection A      140          34.5
```

```
print(intersection_b)
```

```
##          Date       Location Vehicles Average_Speed
## 6  2025-11-06 Intersection B      200          32.0
## 7  2025-11-07 Intersection B      210          31.5
## 8  2025-11-08 Intersection B      190          33.0
## 9  2025-11-09 Intersection B      205          30.8
## 10 2025-11-10 Intersection B      220          29.5
```

#6

```
ggplot(traffic, aes(x = Date, y = Vehicles, color = Location, group = Location)) +
  geom_line() +
  geom_point() +
  xlab("Date") + ylab("Number of Vehicles") +
  ggtitle("Traffic Over Time by Junction") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```
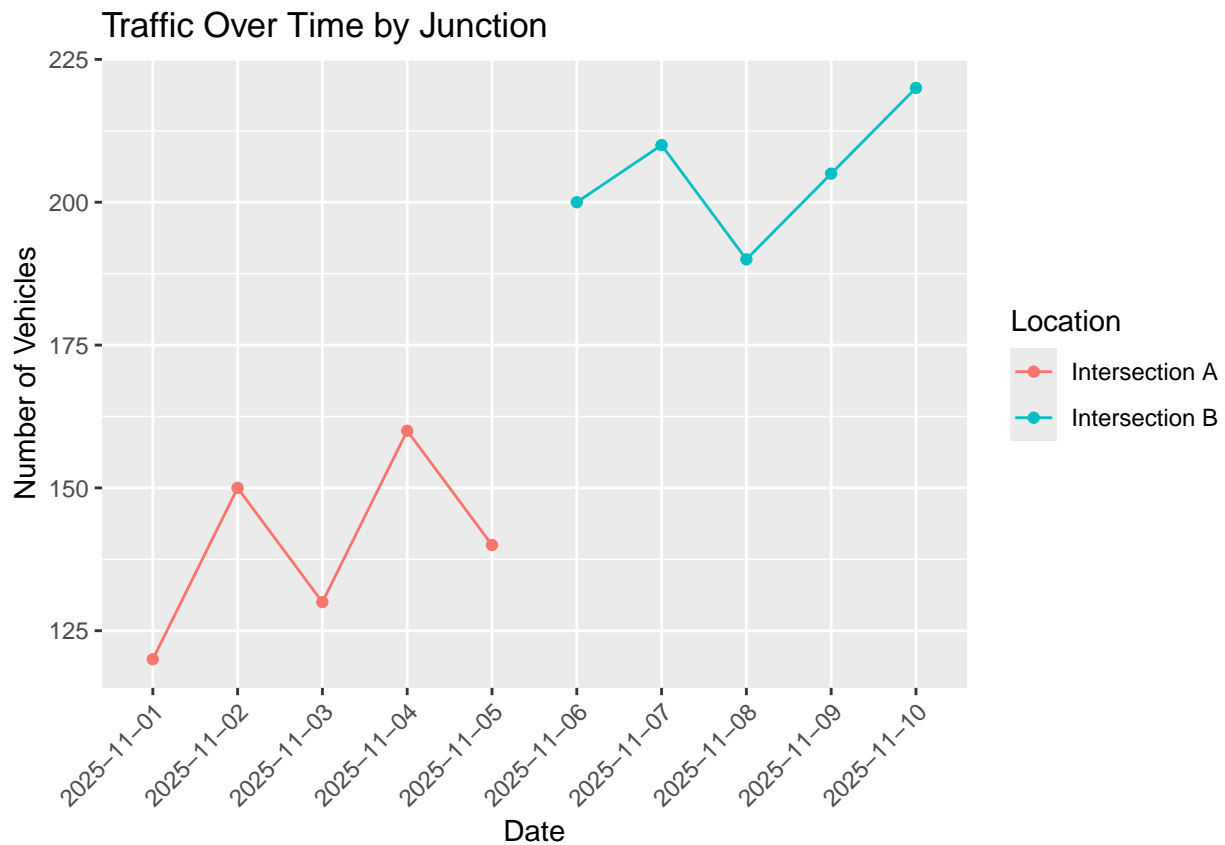
```
#7.

alexa <- read_excel("alexa-file.xlsx")

str(alexa)
```

```
## tibble [5 x 5] (S3: tbl_df/tbl/data.frame)
##  $ rating          : num [1:5] 5 5 5 5 5
##  $ date            : chr [1:5] "2018-07-30" "2018-07-30" "2018-07-30" "2018-07-30" ...
##  $ variation       : chr [1:5] "Black  Dot" "Black Dot" "Black   Dot" "White  Dot" ...
##  $ verified_reviews: chr [1:5] "It works great!!" "PHENOMENAL" "I used it to control my smart home de
##  $ feedback        : num [1:5] 1 1 1 1 1
```

```
load("variations.RData")

variations %>%
  group_by(variation) %>%
  summarise(total = sum(count))
```

```
## # A tibble: 3 x 2
##   variation  total
##   <chr>      <int>
## 1 Black Dot      3
## 2 White Dot      1
## 3 White Plus     1
```

```
ggplot(variations, aes(x = variation, y = count, fill = variation)) +
  geom_bar(stat = "identity") +
  xlab("Variation") + ylab("Count") +
  ggtitle("Count of Each Variation") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1), legend.position = "none")
```

Count of Each Variation