RWorksheet-4c

```
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
```

```
library(RColorBrewer)
library(readxl)
```

```
data(mpg)
```

#1

```
#a.

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

```
## "x"
## "mpg.csv"
```

```
 read.csv("mpg.csv", stringsAsFactors = FALSE)
```

```
##     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
## 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
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## 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
## 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(l5)   4  17  22
## 124         jeep     grand cherokee 4wd   3.7 2008   6   auto(l5)   4  15  19
## 125         jeep     grand cherokee 4wd   4.0 1999   6   auto(l4)   4  15  20
## 126         jeep     grand cherokee 4wd   4.7 1999   8   auto(l4)   4  14  17
## 127         jeep     grand cherokee 4wd   4.7 2008   8   auto(l5)   4   9  12
```

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## 128         jeep     grand cherokee 4wd   4.7 2008   8   auto(l5)   4  14  19
## 129         jeep     grand cherokee 4wd   5.7 2008   8   auto(l5)   4  13  18
## 130         jeep     grand cherokee 4wd   6.1 2008   8   auto(l5)   4  11  14
## 131   land rover            range rover   4.0 1999   8   auto(l4)   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(l4)   4  11  15
## 135      lincoln          navigator 2wd   5.4 1999   8   auto(l4)   r  11  17
## 136      lincoln          navigator 2wd   5.4 1999   8   auto(l4)   r  11  16
## 137      lincoln          navigator 2wd   5.4 2008   8   auto(l6)   r  12  18
## 138      mercury        mountaineer 4wd   4.0 1999   6   auto(l5)   4  14  17
## 139      mercury        mountaineer 4wd   4.0 2008   6   auto(l5)   4  13  19
## 140      mercury        mountaineer 4wd   4.6 2008   8   auto(l6)   4  13  19
## 141      mercury        mountaineer 4wd   5.0 1999   8   auto(l4)   4  13  17
## 142       nissan                 altima   2.4 1999   4 manual(m5)   f  21  29
## 143       nissan                 altima   2.4 1999   4   auto(l4)   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(l4)   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(l4)   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(l5)   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(l4)   f  18  26
## 156      pontiac              grand prix   3.8 1999   6   auto(l4)   f  16  26
## 157      pontiac              grand prix   3.8 1999   6   auto(l4)   f  17  27
## 158      pontiac              grand prix   3.8 2008   6   auto(l4)   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(l4)   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(l4)   4  20  26
## 165       subaru           forester awd   2.5 2008   4   auto(l4)   4  18  23
## 166       subaru            impreza awd   2.2 1999   4   auto(l4)   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(l4)   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
## 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
```

```
#b.
str(mpg)
```

```
## tibble [234 x 11] (S3: tbl_df/tbl/data.frame)
##  $ manufacturer: chr [1:234] "audi" "audi" "audi" "audi" ...
##  $ model       : chr [1:234] "a4" "a4" "a4" "a4" ...
##  $ displ       : num [1:234] 1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
##  $ year        : int [1:234] 1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
##  $ cyl         : int [1:234] 4 4 4 4 6 6 6 4 4 4 ...
##  $ trans       : chr [1:234] "auto(l5)" "manual(m5)" "manual(m6)" "auto(av)" ...
##  $ drv         : chr [1:234] "f" "f" "f" "f" ...
##  $ cty         : int [1:234] 18 21 20 21 16 18 18 18 16 20 ...
##  $ hwy         : int [1:234] 29 29 31 30 26 26 27 26 25 28 ...
##  $ fl          : chr [1:234] "p" "p" "p" "p" ...
##  $ class       : chr [1:234] "compact" "compact" "compact" "compact" ...
```

All variables are categorical in nature.

```
#c.
str(mpg)
```

```
## tibble [234 x 11] (S3: tbl_df/tbl/data.frame)
##  $ manufacturer: chr [1:234] "audi" "audi" "audi" "audi" ...
##  $ model       : chr [1:234] "a4" "a4" "a4" "a4" ...
##  $ displ       : num [1:234] 1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
##  $ year        : int [1:234] 1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
##  $ cyl         : int [1:234] 4 4 4 4 6 6 6 4 4 4 ...
##  $ trans       : chr [1:234] "auto(l5)" "manual(m5)" "manual(m6)" "auto(av)" ...
##  $ drv         : chr [1:234] "f" "f" "f" "f" ...
##  $ cty         : int [1:234] 18 21 20 21 16 18 18 18 16 20 ...
##  $ hwy         : int [1:234] 29 29 31 30 26 26 27 26 25 28 ...
##  $ fl          : chr [1:234] "p" "p" "p" "p" ...
##  $ class       : chr [1:234] "compact" "compact" "compact" "compact" ...
```

The numeric data consists exclusively of continuous variables.

#2

```r
mpg %>%
  group_by(manufacturer) %>%
  summarise(models = n_distinct(model))
```

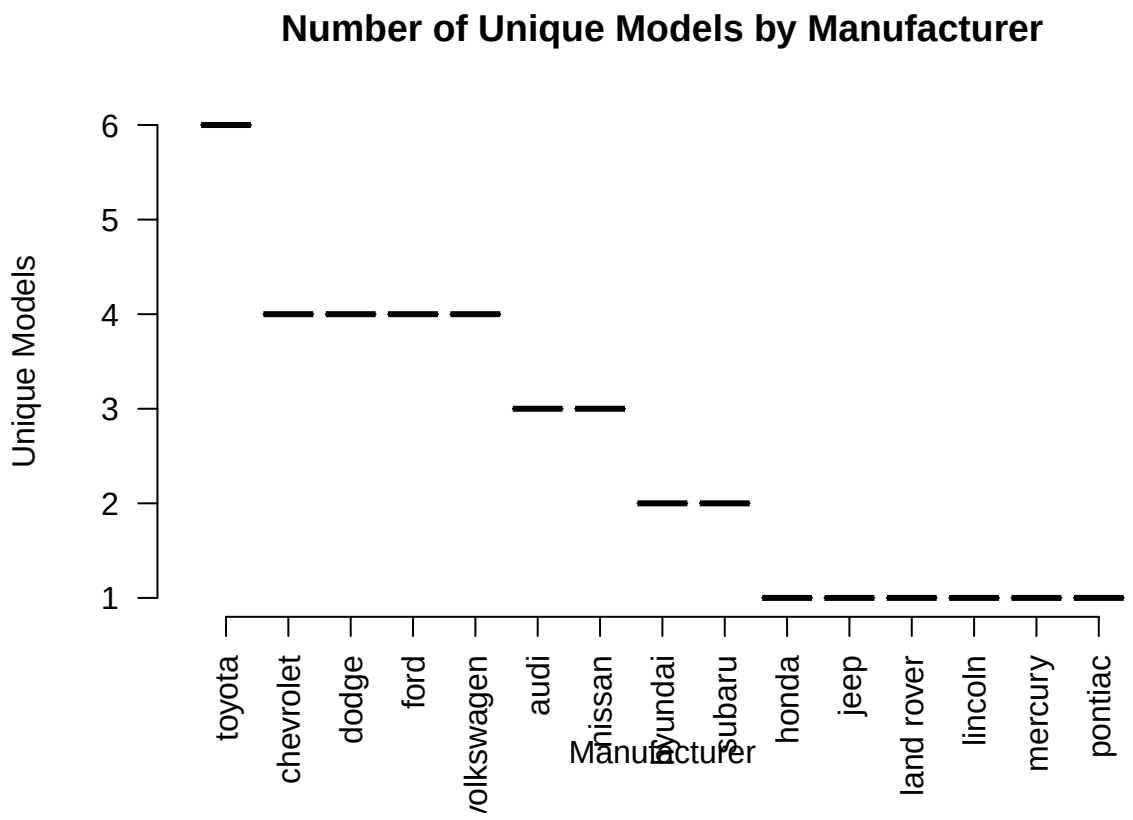
```
## # A tibble: 15 x 2
##    manufacturer models
##    <chr>         <int>
##  1 audi              3
##  2 chevrolet         4
##  3 dodge             4
##  4 ford              4
##  5 honda             1
##  6 hyundai           2
##  7 jeep              1
##  8 land rover        1
##  9 lincoln 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

```r
#a.
unq_mod <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unq_mod = n_distinct(model)) %>%
  arrange(desc(unq_mod))

unq_mod
```

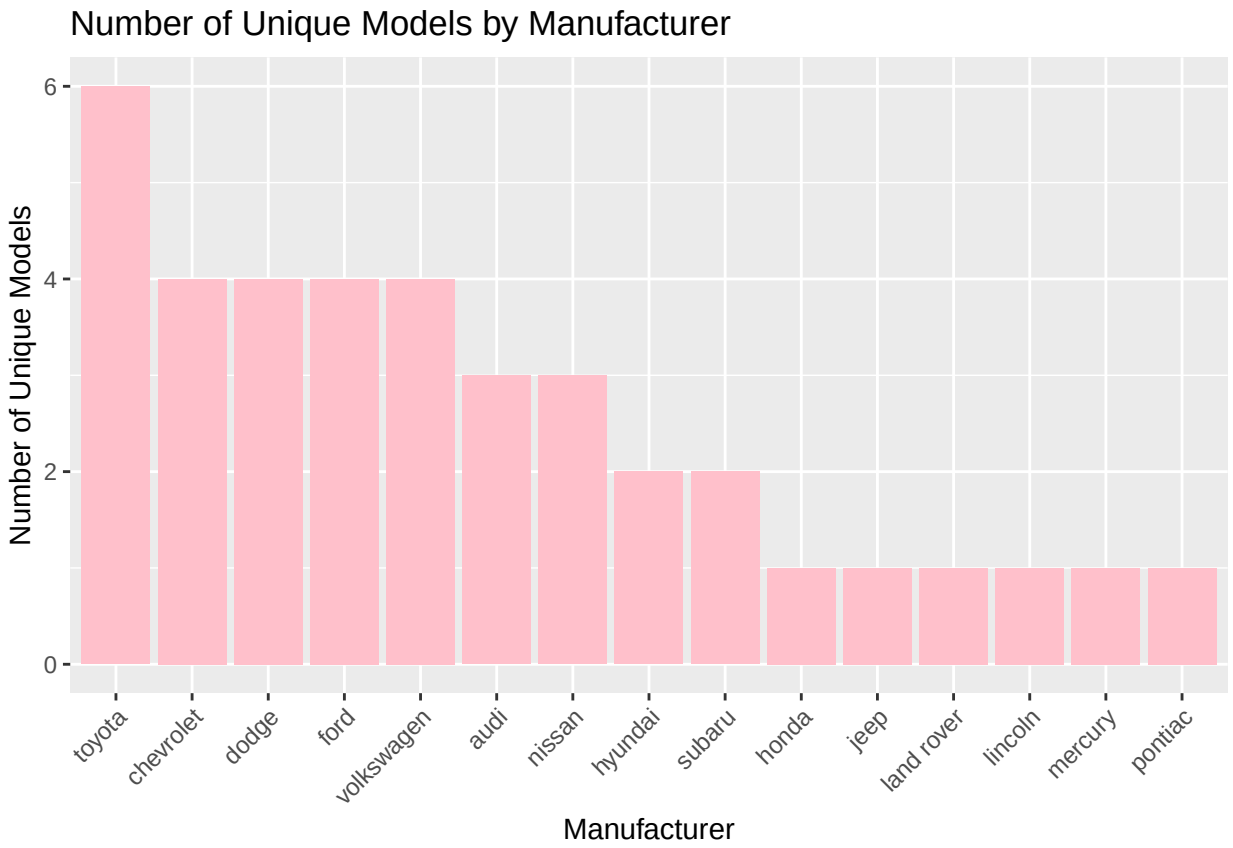
```
## # A tibble: 15 x 2
##    manufacturer unq_mod
##    <chr>          <int>
##  1 toyota             6
##  2 chevrolet          4
##  3 dodge              4
##  4 ford               4
##  5 volkswagen         4
##  6 audi               3
##  7 nissan             3
##  8 hyundai            2
##  9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

```r
#b.
ordered_data <- unq_mod[order(-unq_mod$unq_mod), ]
ordered_data$manufacturer <- factor(ordered_data$manufacturer,
                                    levels = ordered_data$manufacturer)
```

```r
# plot
plot(x = ordered_data$manufacturer,
     y = ordered_data$unq_mod,
     type = "p",  # "p" for points
     main = "Number of Unique Models by Manufacturer",
     xlab = "Manufacturer",
     ylab = "Unique Models",
     col = "black",
     pch = 16,    # Solid circle points
     cex = 1.2,   # Point size
     las = 2,     # Vertical x-axis labels
     frame.plot = FALSE)  # Remove frame
```

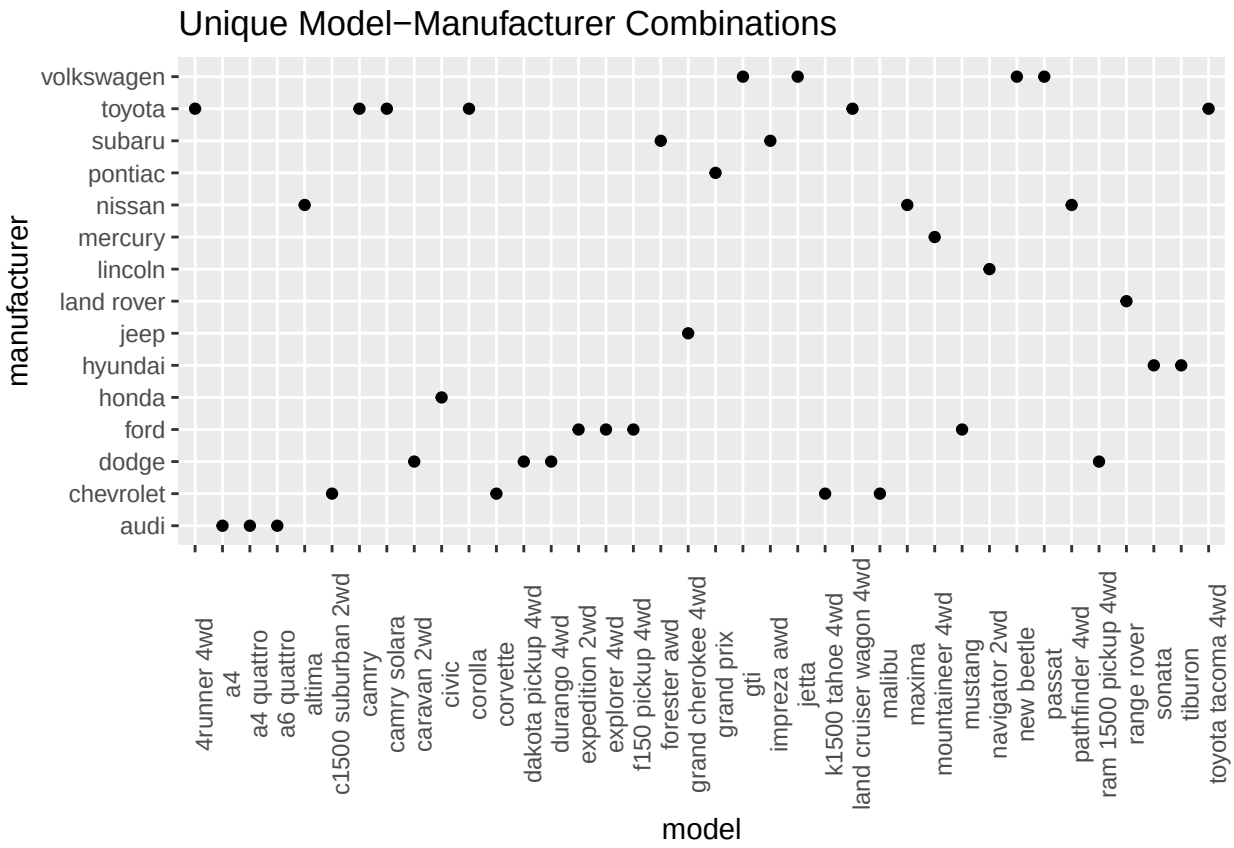



```r
#ggplot
ggplot(unq_mod, aes(x = reorder(manufacturer, -unq_mod), y = unq_mod)) + geom_bar(stat = "identity", fi
  xlab("Manufacturer") + ylab("Number of Unique Models") +
  ggtitle("Number of Unique Models by Manufacturer") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



#2

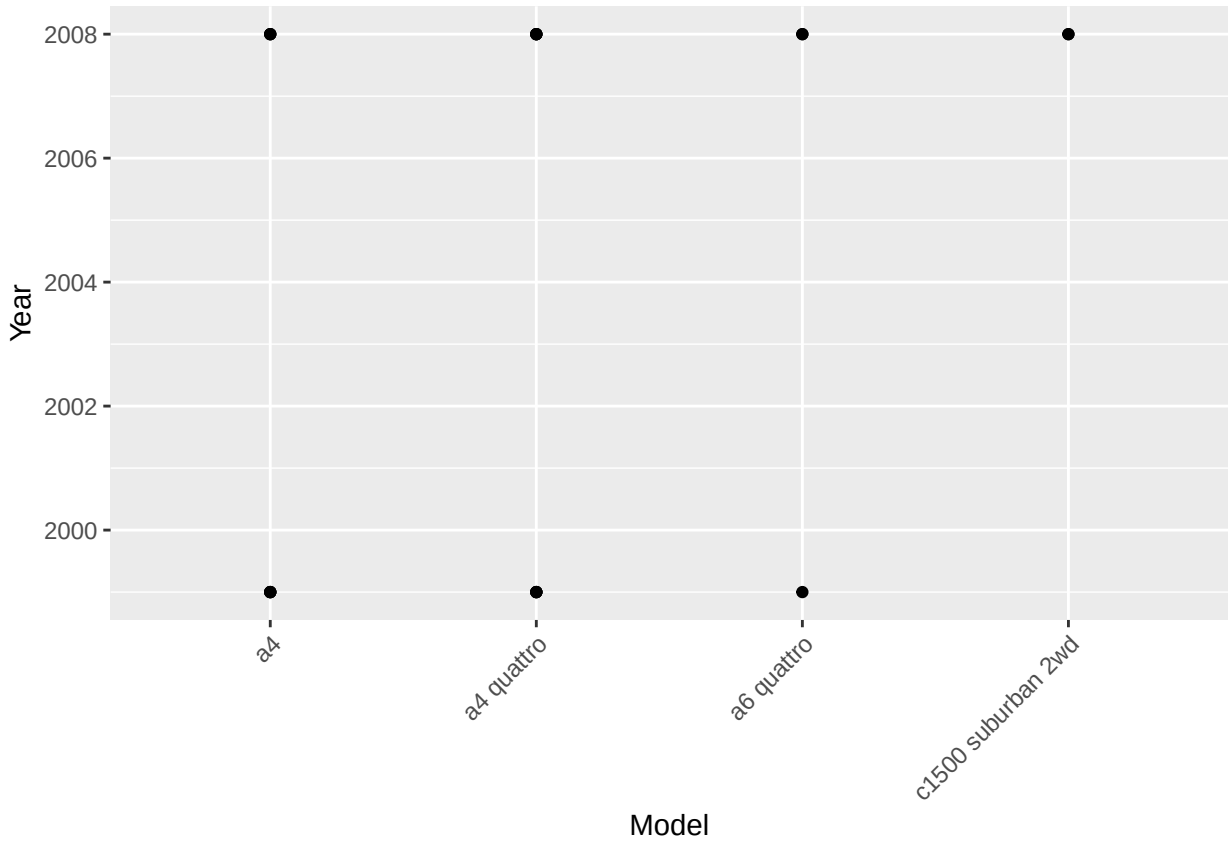
```
#a

mpg_unique <- mpg %>% distinct(model, manufacturer)

ggplot(mpg_unique, aes(model, manufacturer)) +
  geom_point() +
  theme(axis.text.x = element_text(angle=90)) +
  labs(title="Unique Model-Manufacturer Combinations")
```



For this type of comparison, a simple dot plot is not the most effective choice. A bar chart would provide clearer visual comparison between manufacturers and be more intuitive for readers.

#3.

```
top20 <- head(mpg, 20)

ggplot(top20, aes(x = model, y = year)) +
  geom_point() +
  xlab("Model") + ylab("Year") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



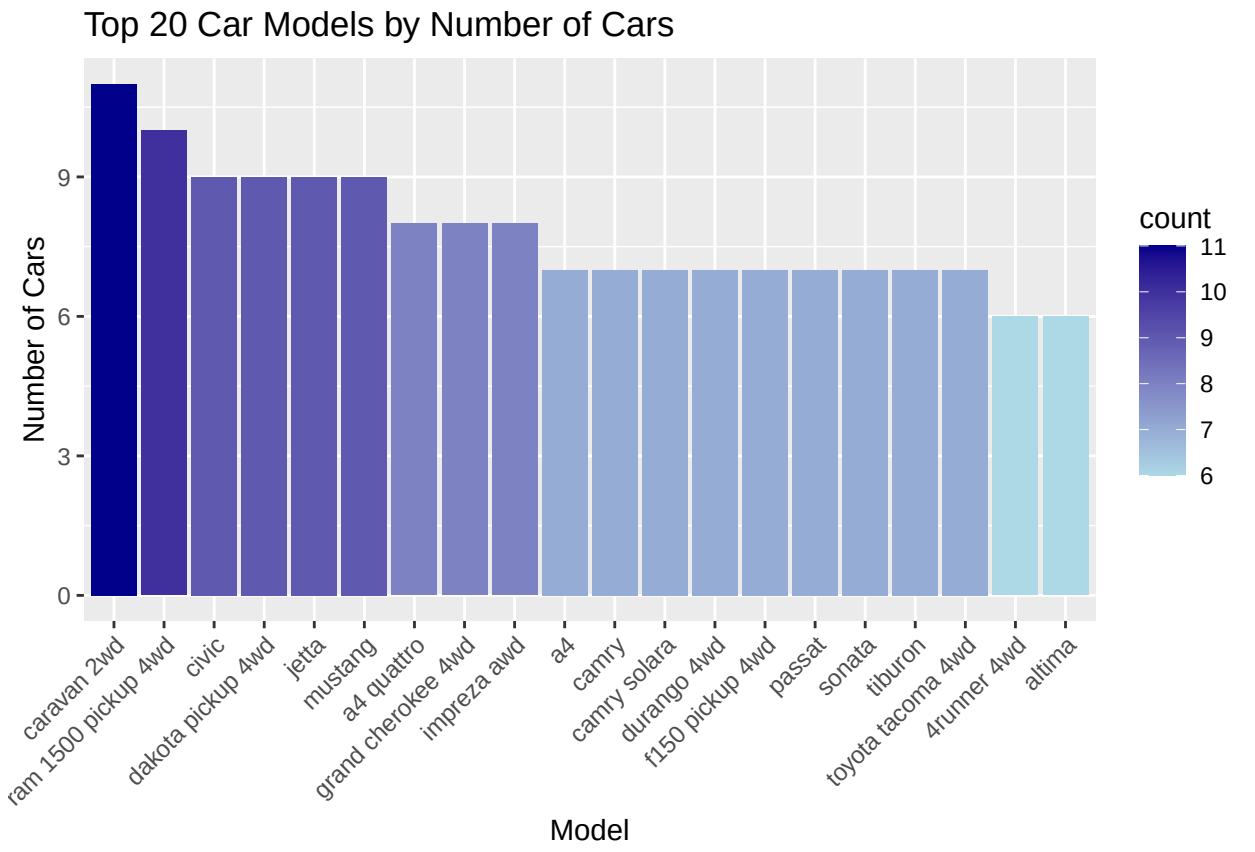
#4

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

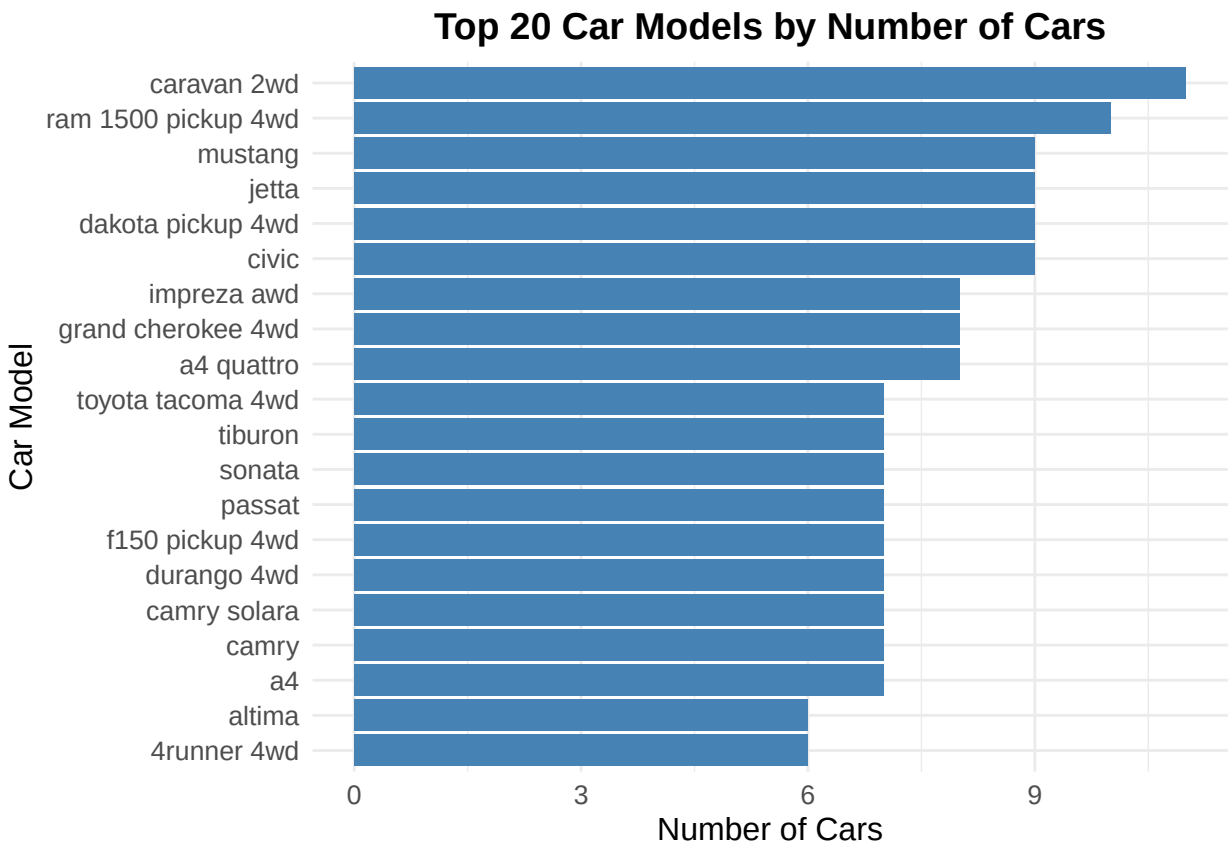
```
## # A tibble: 38 x 2
##    model               count
##    <chr>               <int>
##  1 caravan 2wd            11
##  2 ram 1500 pickup 4wd    10
##  3 civic                   9
##  4 dakota pickup 4wd       9
##  5 jetta                   9
##  6 mustang                 9
##  7 a4 quattro  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

```
#a.
top20_models <- mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)
```

```
ggplot(top20_models, aes(x = reorder(model, -count), y = count, fill = count)) +
  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)) +
  scale_fill_gradient(low = "lightblue", high = "darkblue")
```

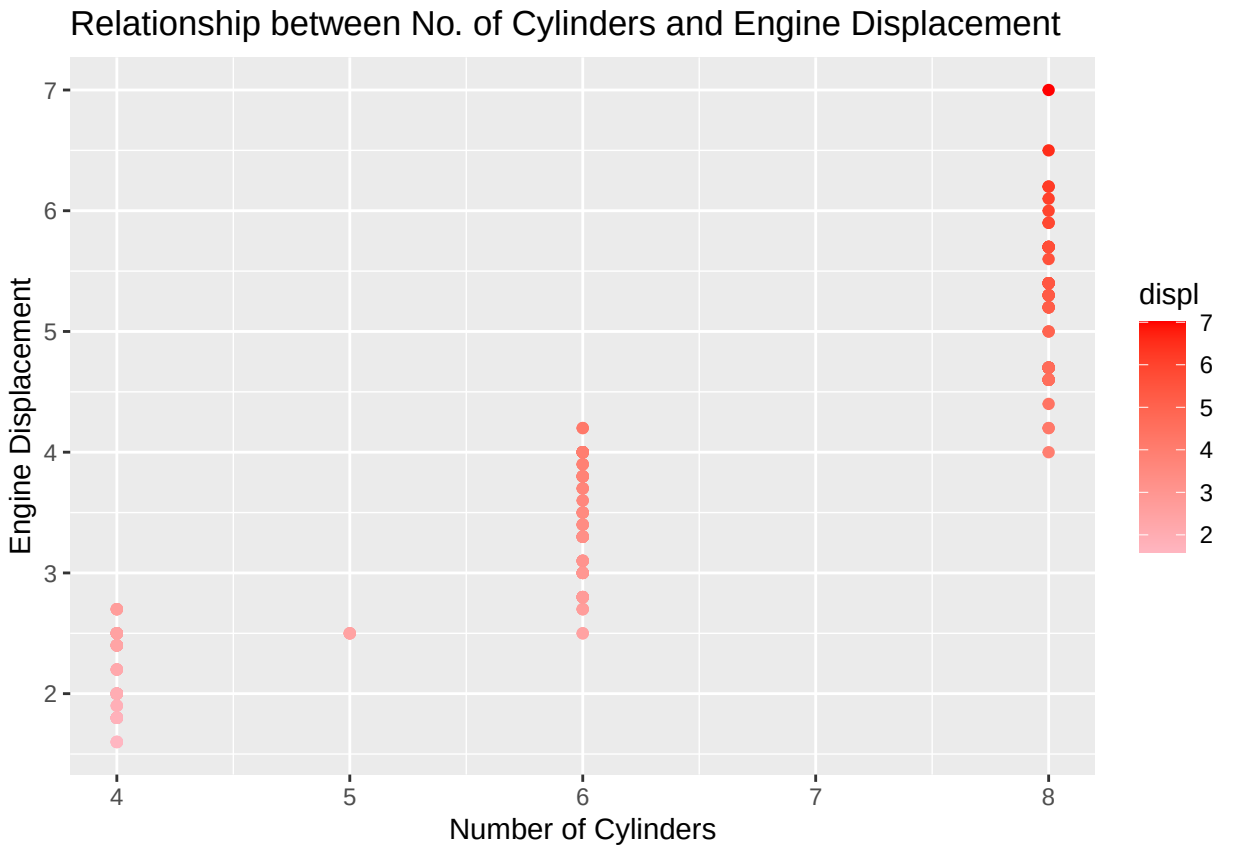



```
#b.

top20_models <- mpg %>%
  group_by(model) %>%
  summarise(count = n()) %>%
  arrange(desc(count)) %>%
  head(20)

ggplot(top20_models, aes(x = reorder(model, count), y = count)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  coord_flip() +  # This makes it horizontal
  xlab("Car Model") +
  ylab("Number of Cars") +
  ggtitle("Top 20 Car Models by Number of Cars") +
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, size = 14, face = "bold"),
    axis.title = element_text(size = 12),
    axis.text = element_text(size = 10)
  )
```



#5

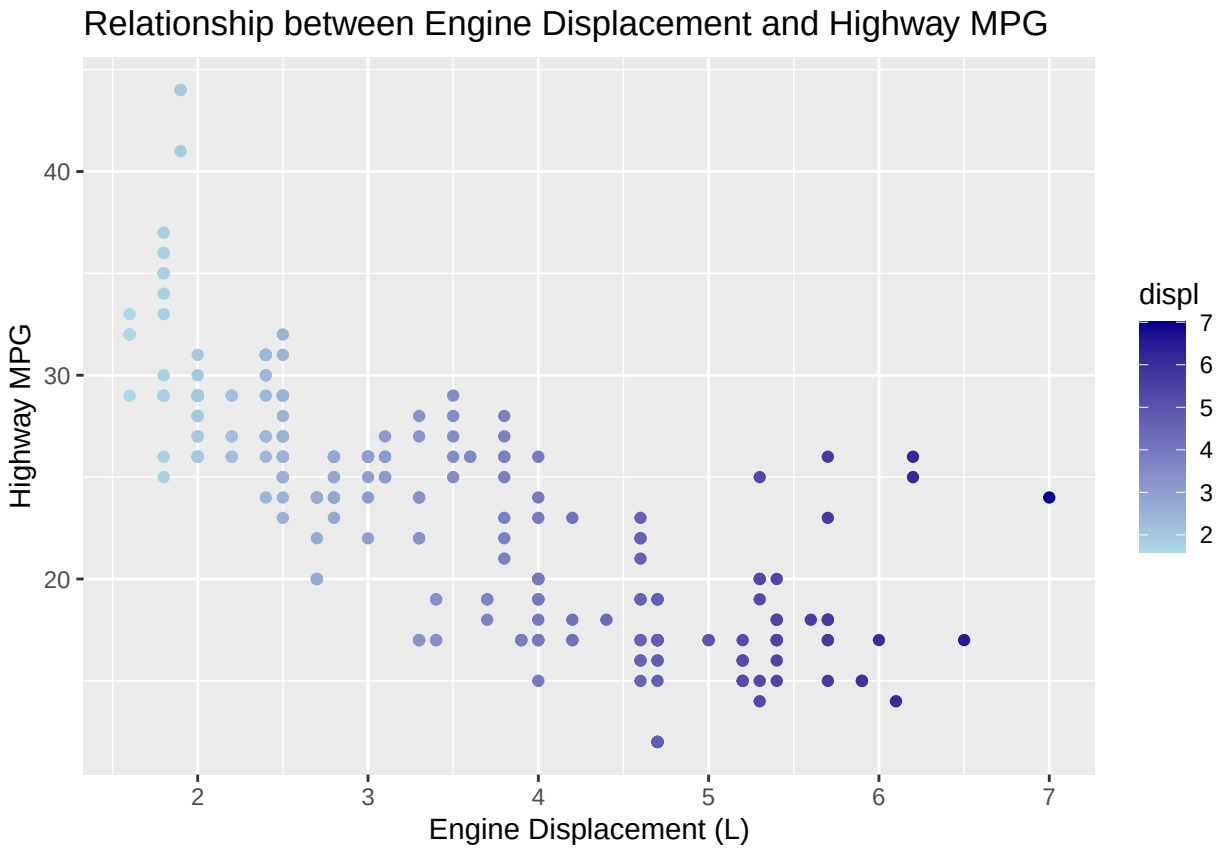
```
ggplot(mpg, aes(x = cyl, y = displ, color = displ)) +
  geom_point() +
  ggtitle("Relationship between No. of Cylinders and Engine Displacement") +
  xlab("Number of Cylinders") + ylab("Engine Displacement") +
  scale_color_gradient(low = "lightpink", high = "red")
```



There is a strong positive correlation between cylinder count and engine displacement, indicating that engines with more cylinders tend to have larger displacement volumes.

#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 = "lightblue", high = "darkblue")
```



#6

```
traffic <- read.csv("traffic.csv")

#a.
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
```

```
#b.
intersect_a <- traffic[traffic$Location == "Intersection A", ]
intersect_b <- traffic[traffic$Location == "Intersection B", ]

print(intersect_a)
```

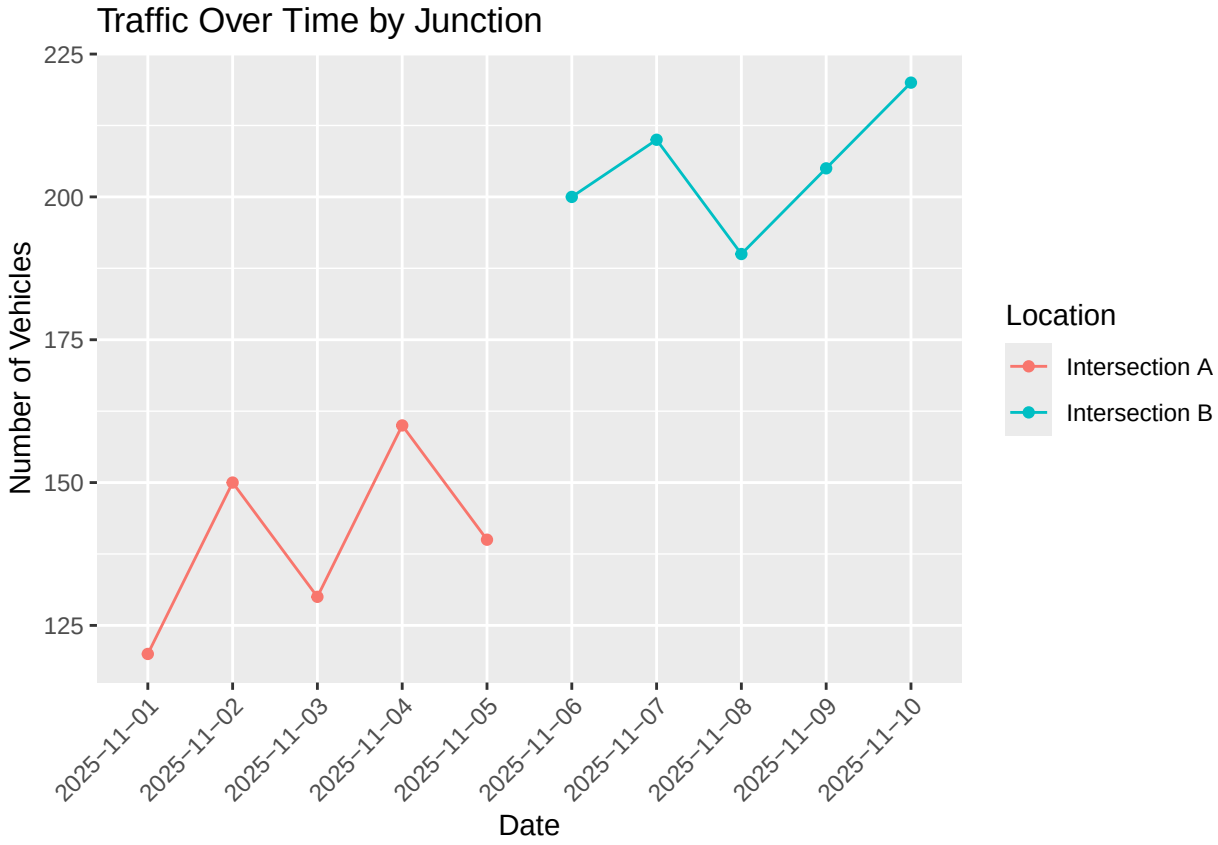
```
##         Date       Location Vehicles Average_Speed
## 1 2025-11-01 Intersection A      120          35.5
## 2 2025-11-02 Intersection A      150          34.2
## 3 2025-11-03 Intersection A      130          36.0
## 4 2025-11-04 Intersection A      160          33.8
## 5 2025-11-05 Intersection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

```
print(intersect_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
```

```
#c.
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

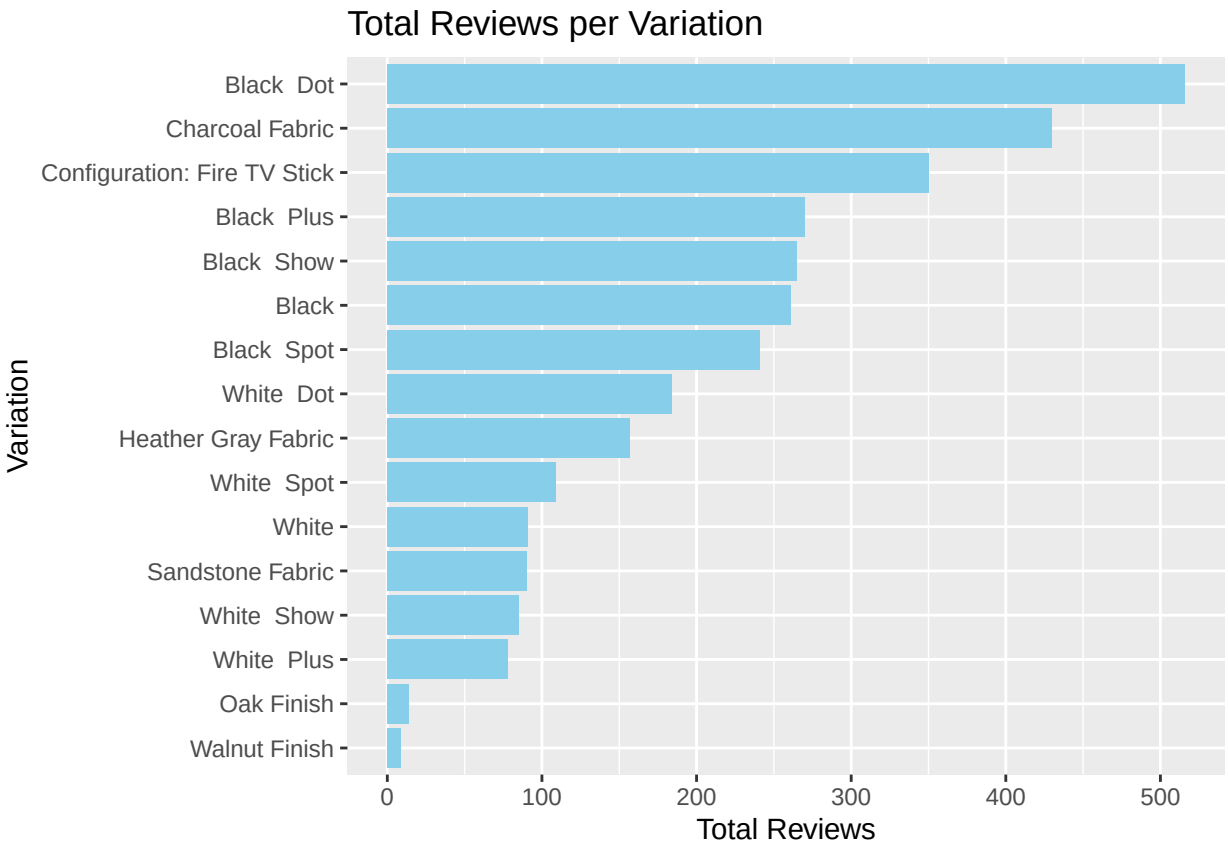
```
alexa <- read_excel("alexa_file.xlsx")

#a.
str(alexa)
```

```
## tibble [3,150 x 5] (S3: tbl_df/tbl/data.frame)
##  $ rating          : num [1:3150] 5 5 4 5 5 5 3 5 5 5 ...
##  $ date            : POSIXct[1:3150], format: "2018-07-31" "2018-07-31" ...
##  $ variation       : chr [1:3150] "Charcoal Fabric" "Charcoal Fabric" "Walnut Finish" "Charcoal Fabri
##  $ verified_reviews: chr [1:3150] "Love my Echo!" "Loved it!" "Sometimes while playing a game, you ca
##  $ feedback        : num [1:3150] 1 1 1 1 1 1 1 1 1 1 ...
```

```r
#b.
total_var <- alexa %>%
  group_by(variation) %>%
  summarise(total = n())

total_var
```

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

```r
#c.
ggplot(total_var, aes(x=reorder(variation, total), y=total)) +
  geom_col(fill="skyblue") +
  coord_flip() +
  labs(title="Total Reviews per Variation",
       x="Variation", y="Total Reviews")
```




```
#d.
ggplot(alexa, aes(x=date, y=verified_reviews)) +
  geom_line() +
  labs(title="Verified Reviews Over Time",
       x="Date", y="Verified Reviews")
```

are some serious flaws, particularly if you are the last one to bed or the first to wake. It doesn't seem like the engineer

expensive alternative option to fill the gap. Ordered the Amazon Fire Stick from Best Buy. Instructions were short and

one of the lights by saying "Alexa, turn off the second light". In the Alexa app, I created a 'Group' with &#34
, but lately I've been getting terrible support. The guy that took my call just rambled off a (completely unhelpful) script a

nting to add this bulb to my Alexa Echo Plus. Everything I tried ended in a Discovery Failed message. I tried to set
igh multiple pages. The one thing that I am not a fan of is the home screen cards do not really rotate that much - they a

```
#e.
rating <- alexa %>%
  group_by(variation) %>%
  summarise(avg_rating = mean(rating, na.rm=TRUE))

ggplot(rating, aes(x=reorder(variation, avg_rating), y=avg_rating)) +
  geom_col(fill="skyblue") +
  coord_flip() +
```

```
  labs(title="Average Rating per Variation",
       x="Variation", y="Average Rating")
```