Work Sheet 4c

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```
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)
```

###1.

```
data(mpg)

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

```
#1A.
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
```

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## 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
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## 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
## 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
```

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## 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
## 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
```

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## 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
```

```
#1B.
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 characters and factors are categorical
```

```
#1C.
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
```

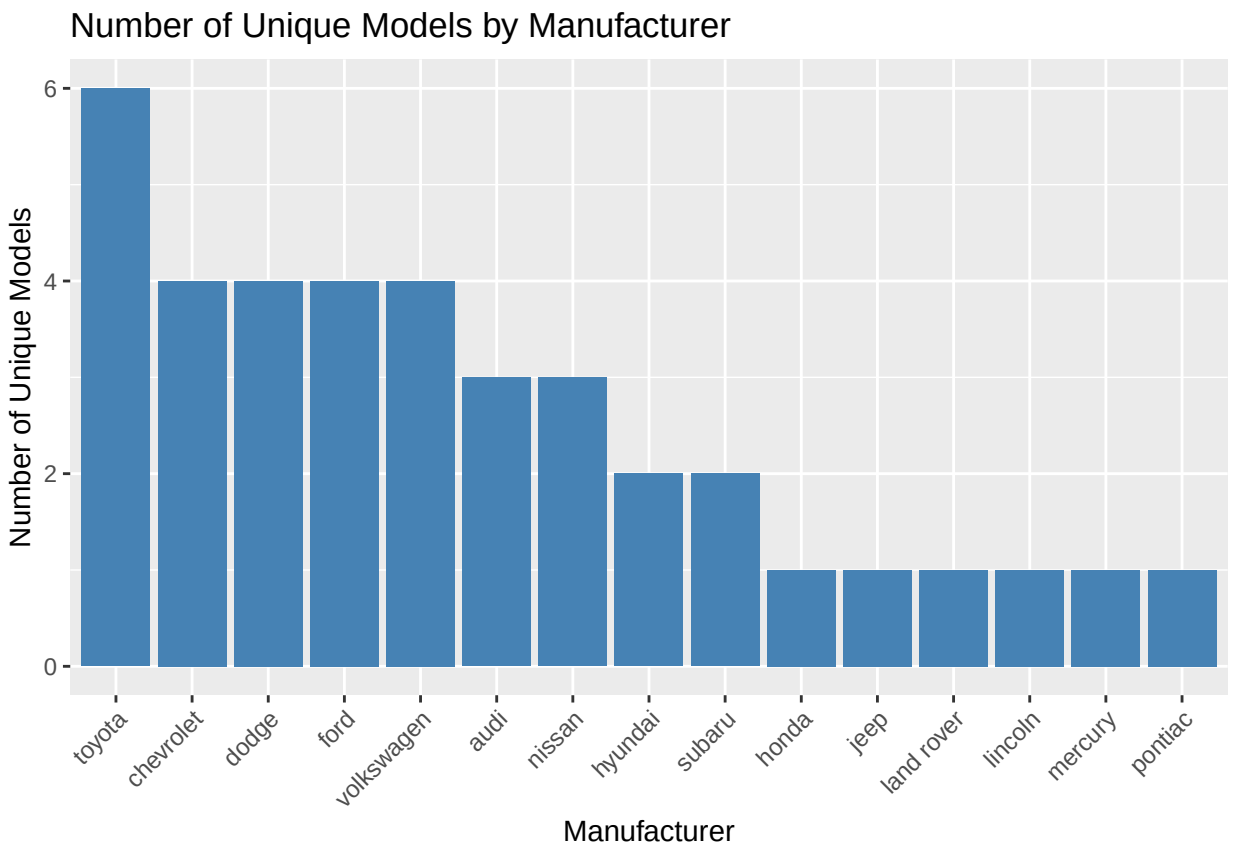
```
#2A.
unique_models <- mpg %>%
  group_by(manufacturer) %>%
  summarise(unique_models = n_distinct(model)) %>%
  arrange(desc(unique_models))

unique_models
```

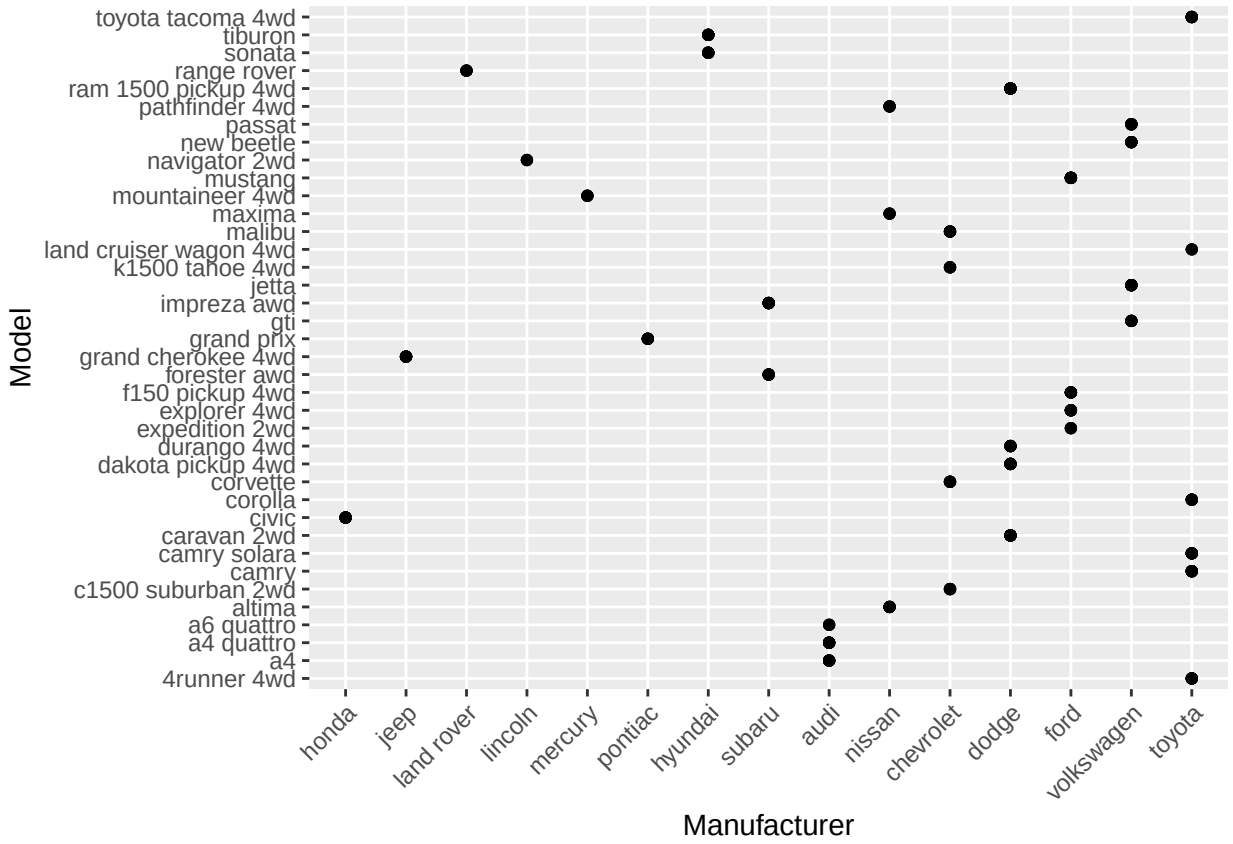
```
## # A tibble: 15 x 2
##    manufacturer unique_models
##    <chr>                <int>
##  1 toyota                   6
##  2 chevrolet                4
##  3 dodge                    4
##  4 ford                     4
##  5 volkswagen               4
##  6 audi                     3
##  7 nissan                   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
```

```
#2B.
```

```r
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))
```

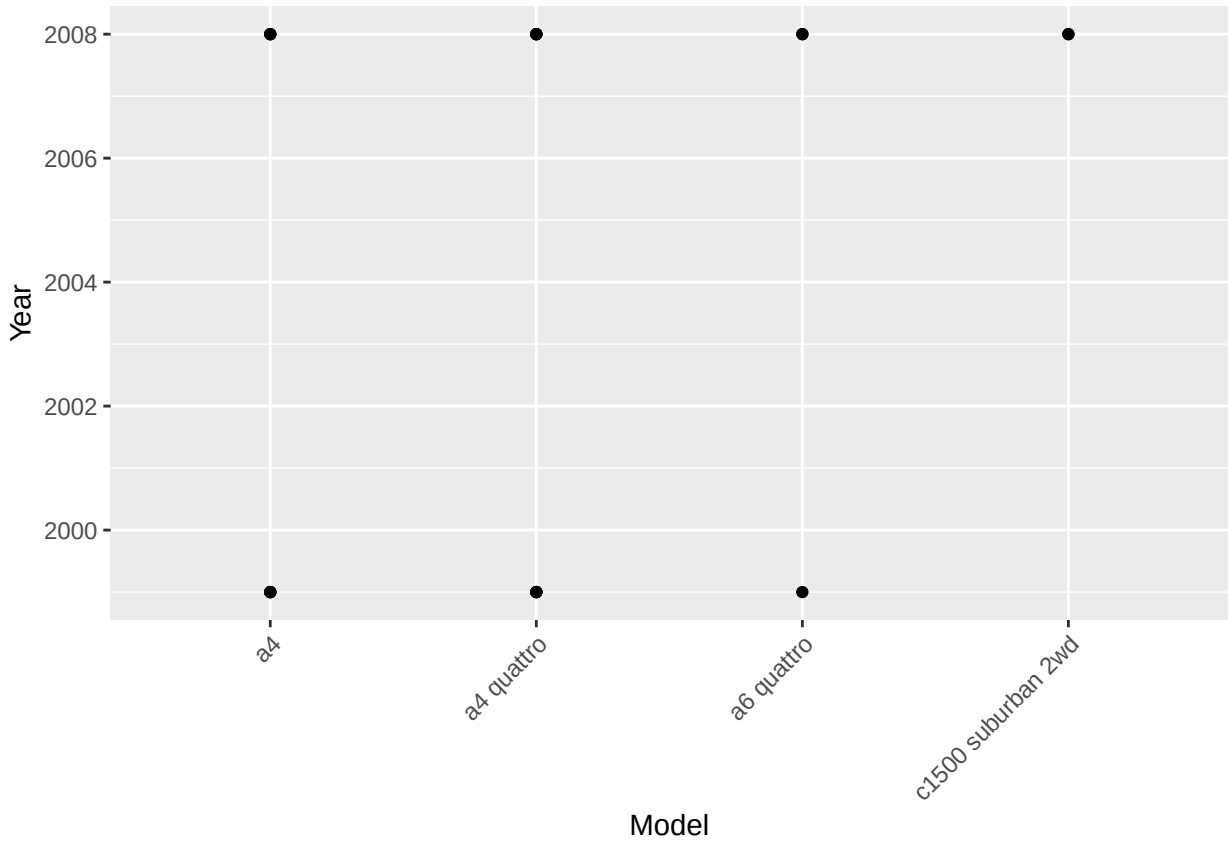



```r
#2A.

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))
```




```
#2B.

#For me, no. Barplot is more useless and easy to understand.
```

```
#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))
```

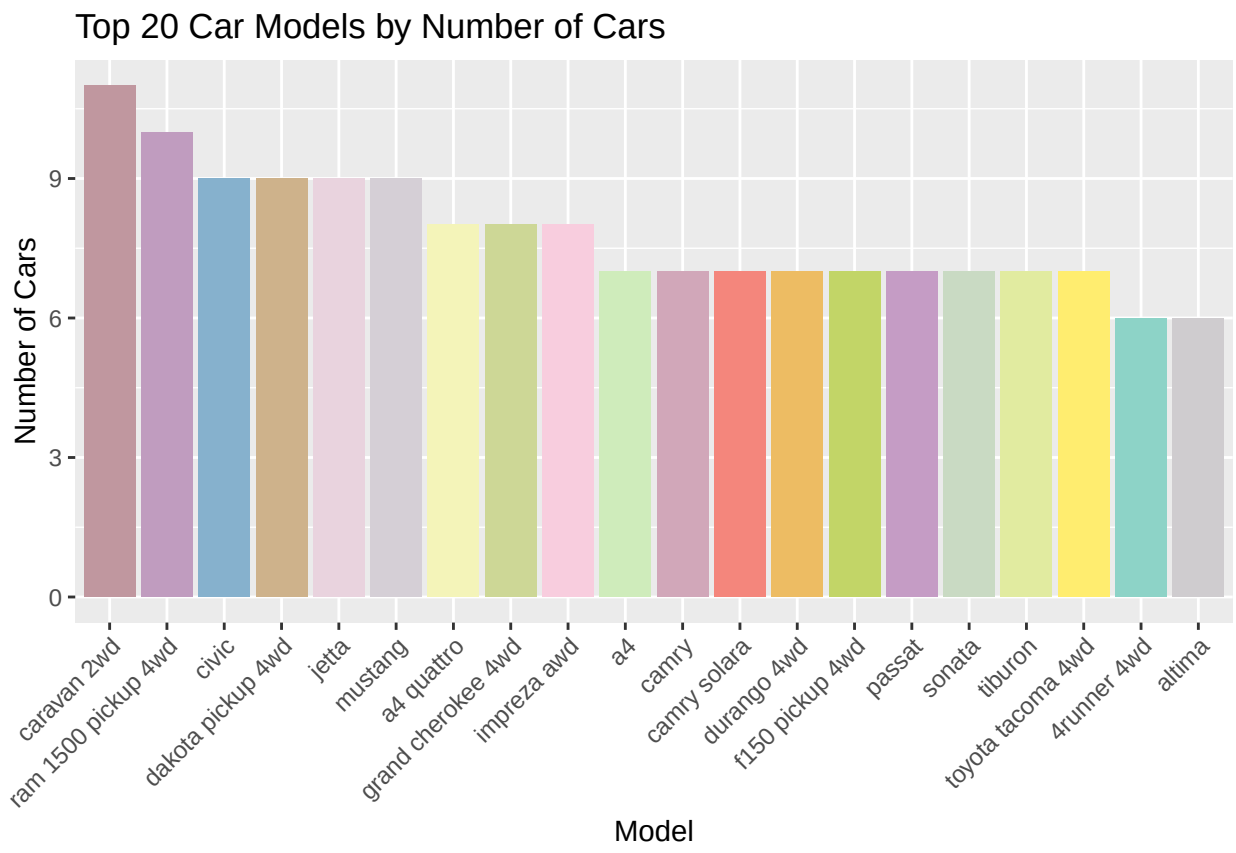



```
#4.

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

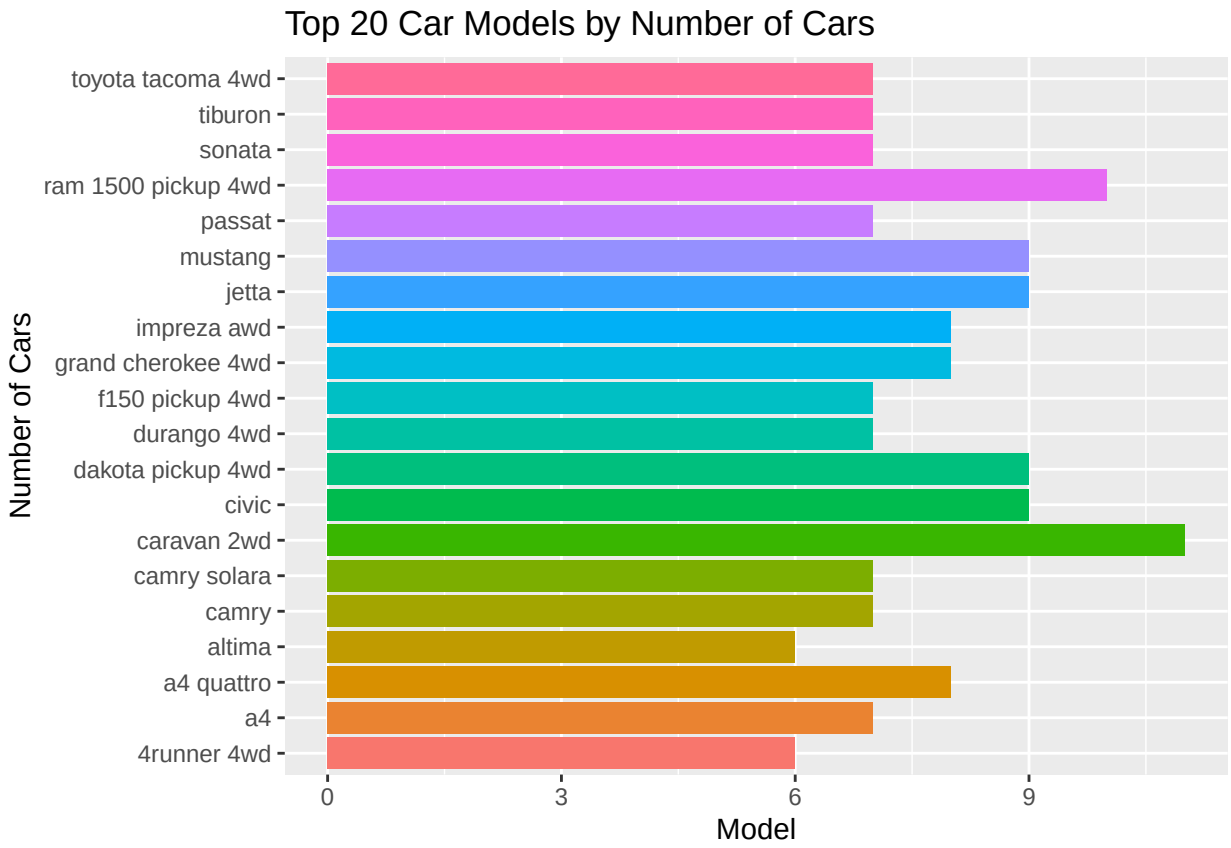
```
## # A tibble: 38 x 2
##    model               count
##    <chr>               <int>
##  1 caravan 2wd            11
##  2 ram 1500 pickup 4wd    10
##  3 civic                   9
##  4 dakota pickup 4wd       9
##  5 jetta                   9
##  6 mustang                 9
##  7 a4 quattro              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)) %>%
```

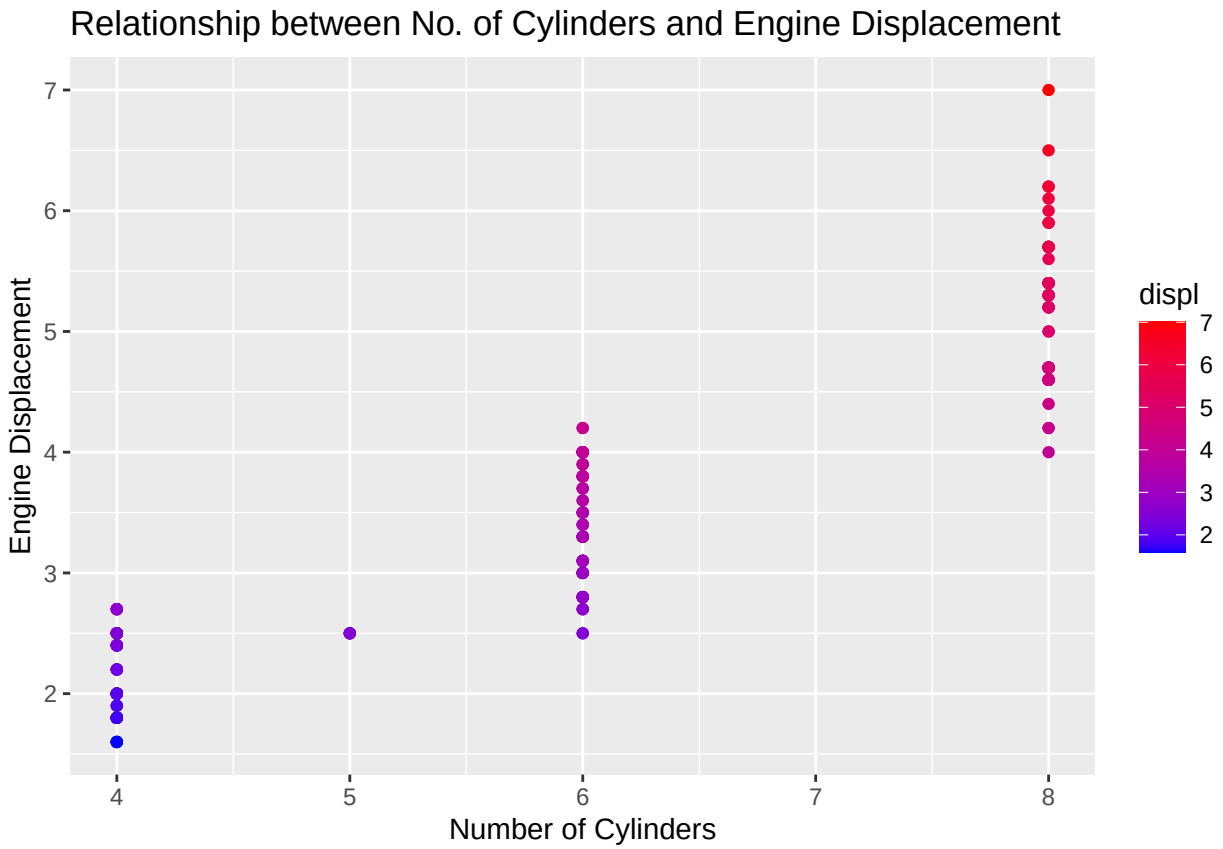
```
  head(20)

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))
```




```
#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")
```

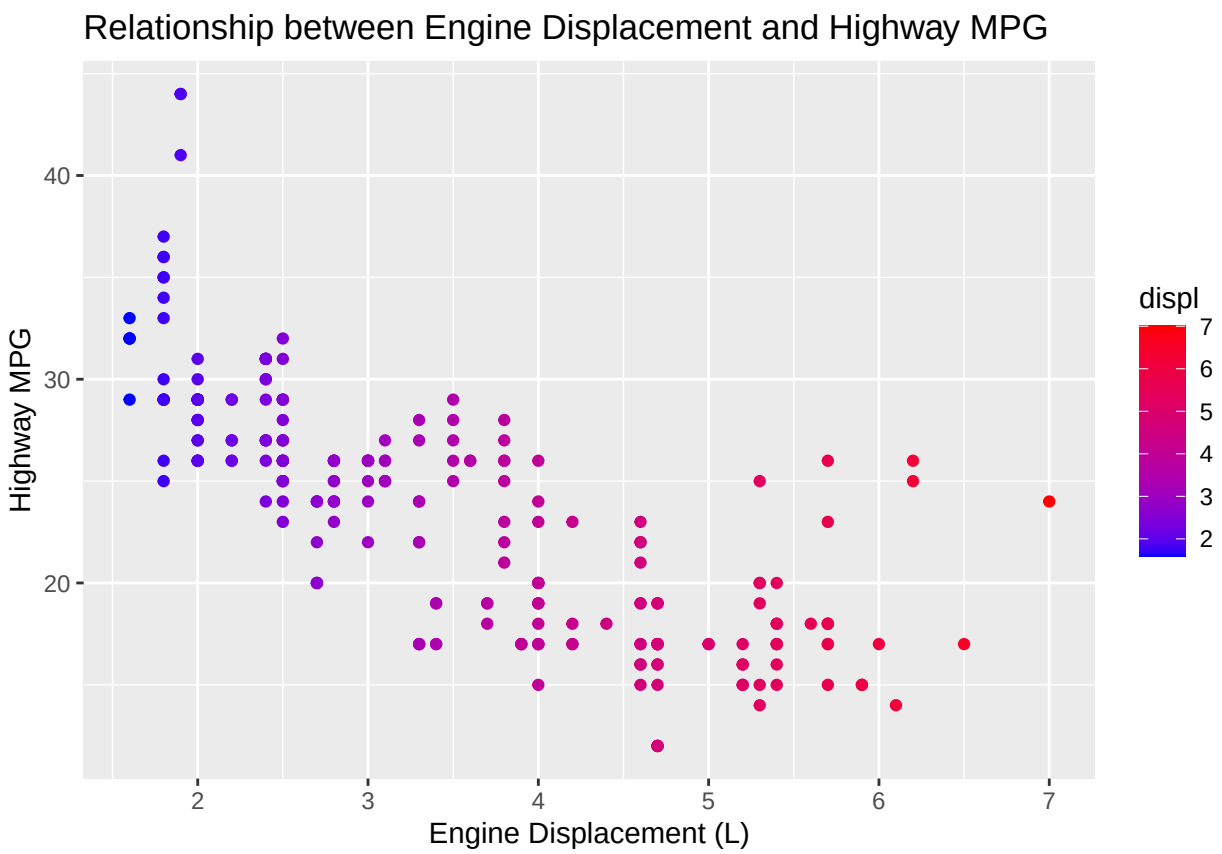



```r
#5.

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")
```




```
#5A.

#Is strong and positive, engines with more cylinders generally have larger 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")
```




```
#6. I AM NOT SURE MAAM IF THE TRAFFIC DATA SET IS CORRECT, I HAVE NO IDEA WHERE TO GET THE DATA

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)
```

```
#6A.

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
```

```
#6B.

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

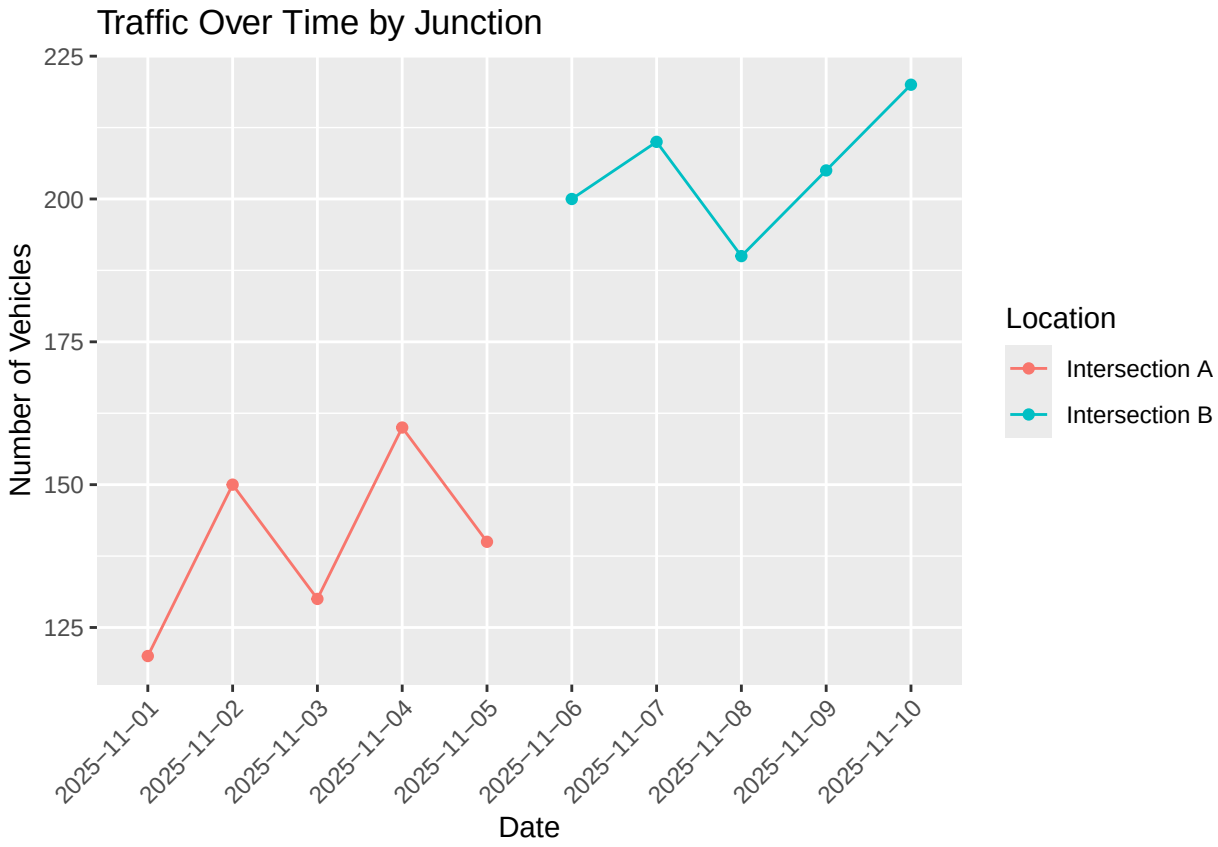
```r
print(intersection_a)
```

```
##         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
```

```r
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
```

```r
#6C.

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))
```



```r
#7.

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

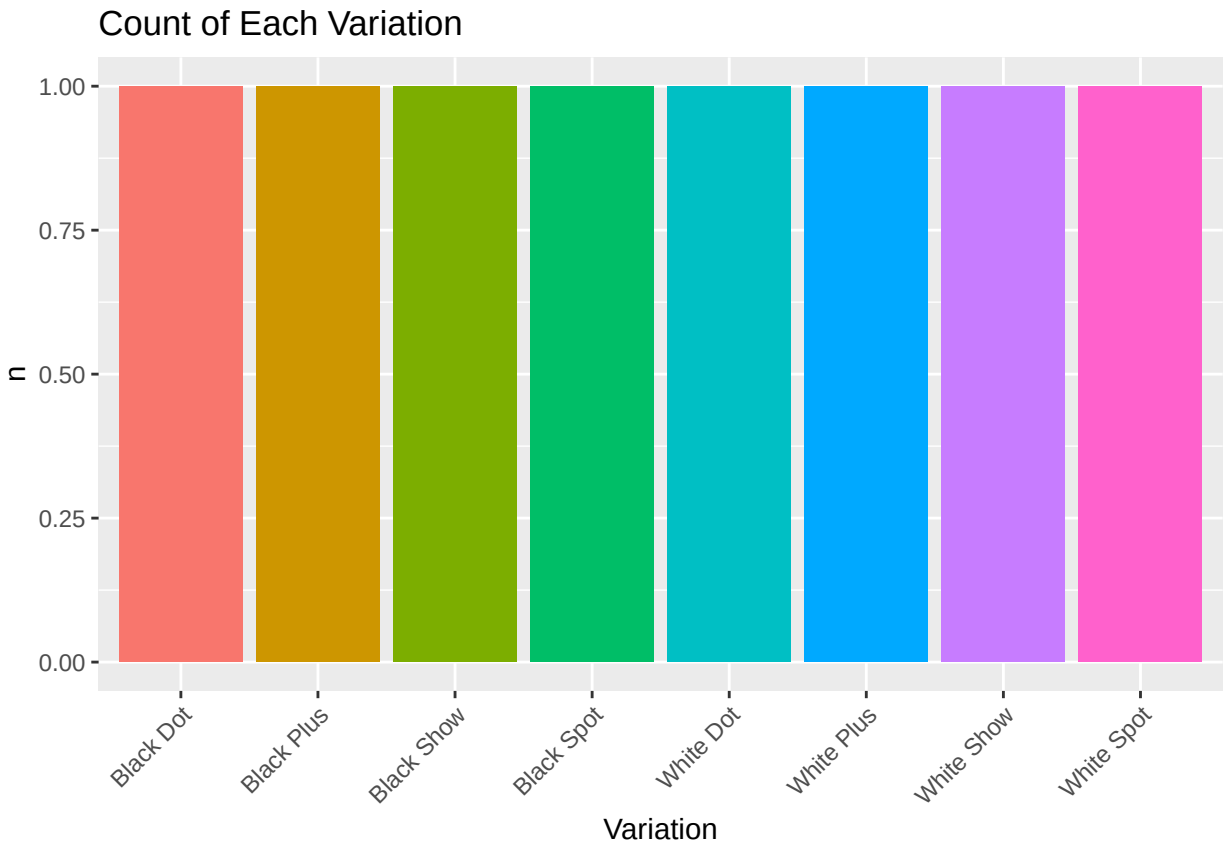
```r
#7A.

str(alexa)
```

```
## tibble [8 x 5] (S3: tbl_df/tbl/data.frame)
##  $ rating          : num [1:8] 5 5 4 3 5 4 5 4
##  $ date            : chr [1:8] "2018-07-30" "2018-07-30" "2018-07-30" "2018-07-30" ...
##  $ variation       : chr [1:8] "Black Dot" "Black Plus" "Black Show" "Black Spot" ...
##  $ verified_reviews: chr [1:8] "It works great!!" "PHENOMENAL" "I used it to control my smart devices
##  $ feedback        : num [1:8] 1 1 1 1 1 1 1 1
```

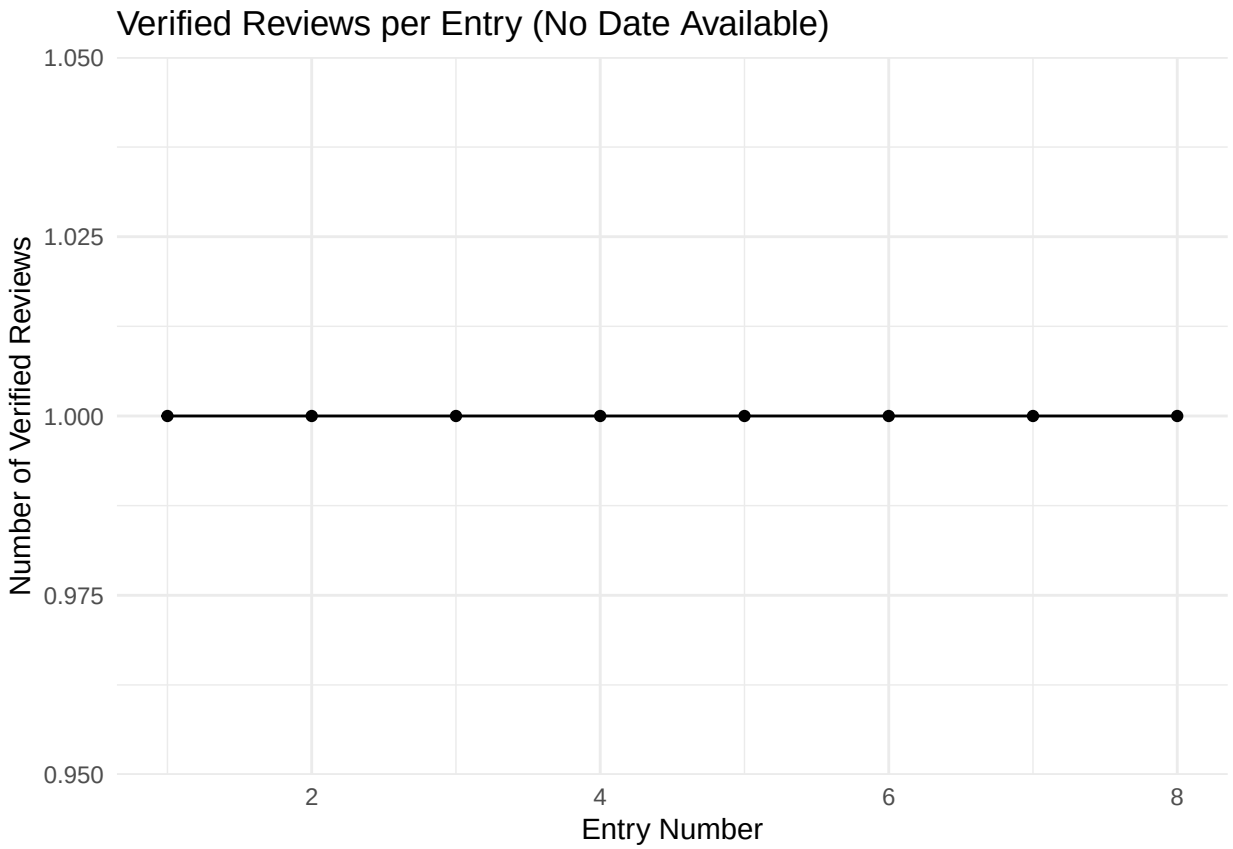
```r
#7B.
load("variations.RData")

numeric_col <- names(variations)[sapply(variations, is.numeric)][1]

variations %>%
  group_by(variation) %>%
  summarise(total = sum(.data[[numeric_col]]))
```

```
## # A tibble: 8 x 2
##   variation  total
##   <chr>      <int>
## 1 Black Dot      1
## 2 Black Plus     1
## 3 Black Show     1
## 4 Black Spot     1
## 5 White Dot      1
## 6 White Plus     1
## 7 White Show     1
## 8 White Spot     1
```

```r
#7C.
num_col <- names(variations)[sapply(variations, is.numeric)][1]

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




```
#7D.
num_col <- names(variations)[sapply(variations, is.numeric)][1]

variations$index <- 1:nrow(variations)

ggplot(variations, aes(x = index, y = .data[[num_col]])) +
  geom_line() +
  geom_point() +
  xlab("Entry Number") +
  ylab("Number of Verified Reviews") +
  ggtitle("Verified Reviews per Entry (No Date Available)") +
  theme_minimal()
```

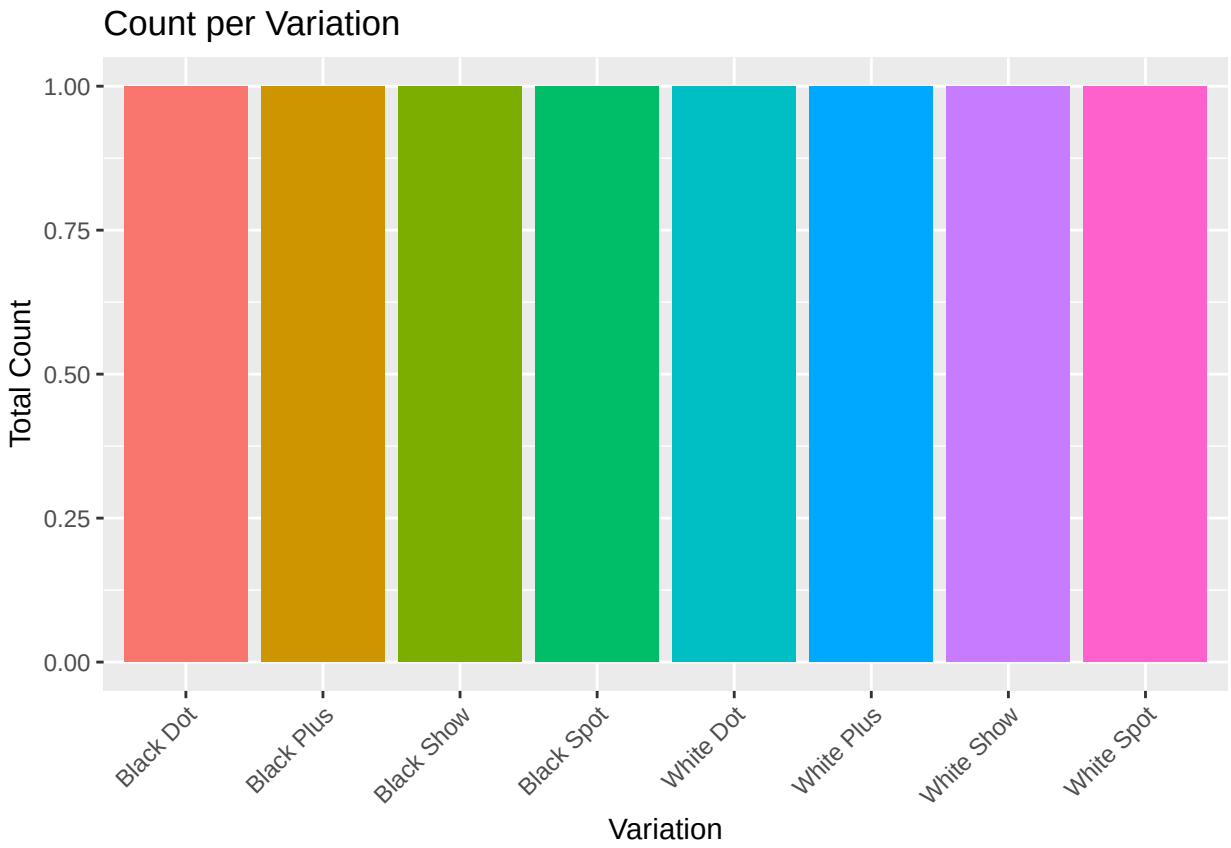



```
#My variations dataset has no date, so I used the entry number as a substitute to create the line plot.
```

```
#7E.
variation_col <- names(variations)[sapply(variations, is.character) | sapply(variations, is.factor)][1]
num_col <- names(variations)[sapply(variations, is.numeric)][1]

variation_summary <- variations %>%
  group_by(.data[[variation_col]]) %>%
  summarise(total = sum(.data[[num_col]], na.rm = TRUE))

variation_summary %>% arrange(desc(total)) %>% head(1)
```

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

```
ggplot(variation_summary,
       aes(x = .data[[variation_col]], y = total, fill = .data[[variation_col]])) +
  geom_col() +
  xlab("Variation") +
  ylab("Total Count") +
  ggtitle("Count per Variation") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1),
        legend.position = "none")
```




```
#My variations dataset has no ratings, so I used the count values instead to identify which variation h
```