RWorksheet #6

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```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.2.2
```

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

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

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

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.2.2
```

```
data(mpg)

mpg_df <- as.data.frame(mpg)
mpg_df
```

```
##     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
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## 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
## 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
```

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## 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
## 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
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## 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
```

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## 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
```

1. How many columns are in mpg dataset? How about the number of rows? Show the codes and its result.

```
mpg_data <- glimpse(mpg_df)
```

```
## Rows: 234
## Columns: 11
## $ manufacturer <chr> "audi", "audi", "audi", "audi", "audi", "audi", "audi", "~
## $ model        <chr> "a4", "a4", "a4", "a4", "a4", "a4", "a4", "a4 quattro", "~
## $ displ        <dbl> 1.8, 1.8, 2.0, 2.0, 2.8, 2.8, 3.1, 1.8, 1.8, 2.0, 2.0, 2.~
## $ year         <int> 1999, 1999, 2008, 2008, 1999, 1999, 2008, 1999, 1999, 200~
## $ cyl          <int> 4, 4, 4, 4, 6, 6, 6, 4, 4, 4, 4, 6, 6, 6, 6, 6, 6, 8, 8, ~
## $ trans        <chr> "auto(l5)", "manual(m5)", "manual(m6)", "auto(av)", "auto~
## $ drv          <chr> "f", "f", "f", "f", "f", "f", "f", "4", "4", "4", "4", "4~
## $ cty          <int> 18, 21, 20, 21, 16, 18, 18, 18, 16, 20, 19, 15, 17, 17, 1~
## $ hwy          <int> 29, 29, 31, 30, 26, 26, 27, 26, 25, 28, 27, 25, 25, 25, 2~
## $ fl           <chr> "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p", "p~
## $ class        <chr> "compact", "compact", "compact", "compact", "compact", "c~
```

```
#There are 234 rows and 11 columns.
```

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

```
#Dodge, it has 37 models. While the most variations for model are the caravan2wd
```

```
man_count <- mpg_data %>% group_by(manufacturer,model) %>% count()
colnames(man_count) <- list("Manufacturer","Model","Counts")

man_count
```

```
## # A tibble: 38 x 3
## # Groups:   Manufacturer, Model [38]
##    Manufacturer Model              Counts
##    <chr>        <chr>               <int>
##  1 audi         a4                      7
##  2 audi         a4 quattro              8
##  3 audi         a6 quattro              3
##  4 chevrolet    c1500 suburban 2wd      5
##  5 chevrolet    corvette                5
##  6 chevrolet    k1500 tahoe 4wd         4
##  7 chevrolet    malibu                  5
##  8 dodge        caravan 2wd            11
##  9 dodge        dakota pickup 4wd       9
## 10 dodge        durango 4wd             7
## # ... with 28 more rows
```

a. Group the manufacturers and find the unique models. Copy the codes and result.

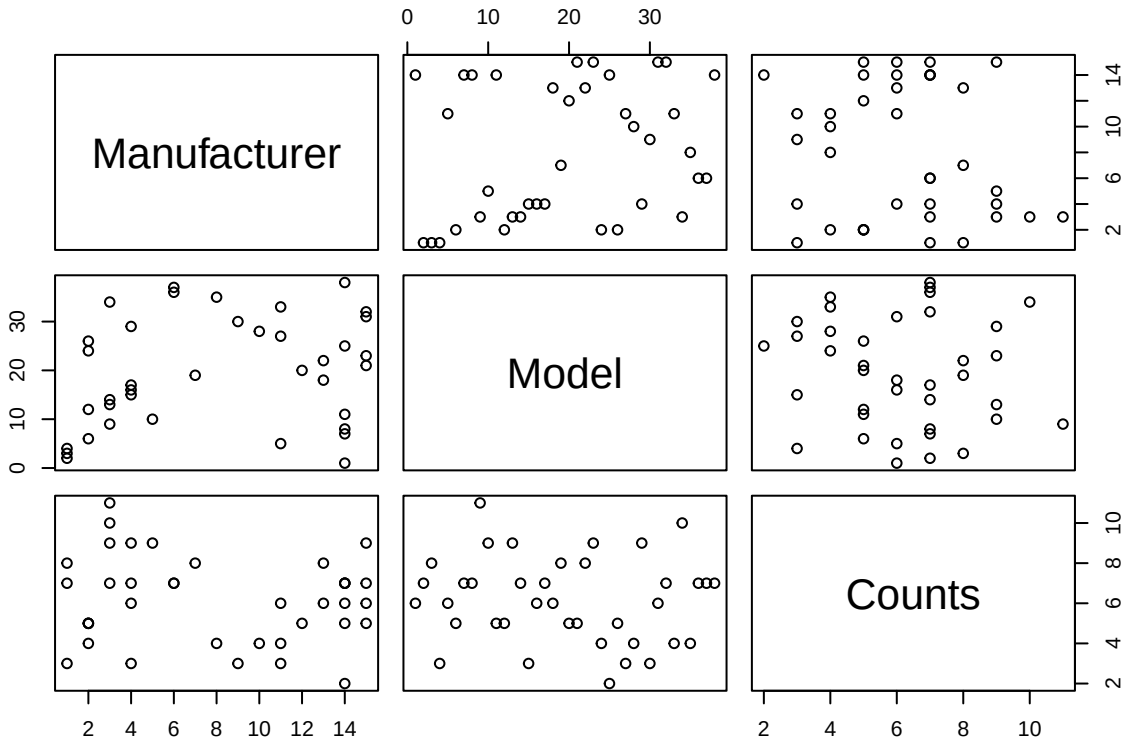
```
grp_unique <- mpg_data %>% group_by(manufacturer, model) %>% distinct() %>% count()
colnames(grp_unique) <- list("Manufacturer", "Model","Counts")

grp_unique
```

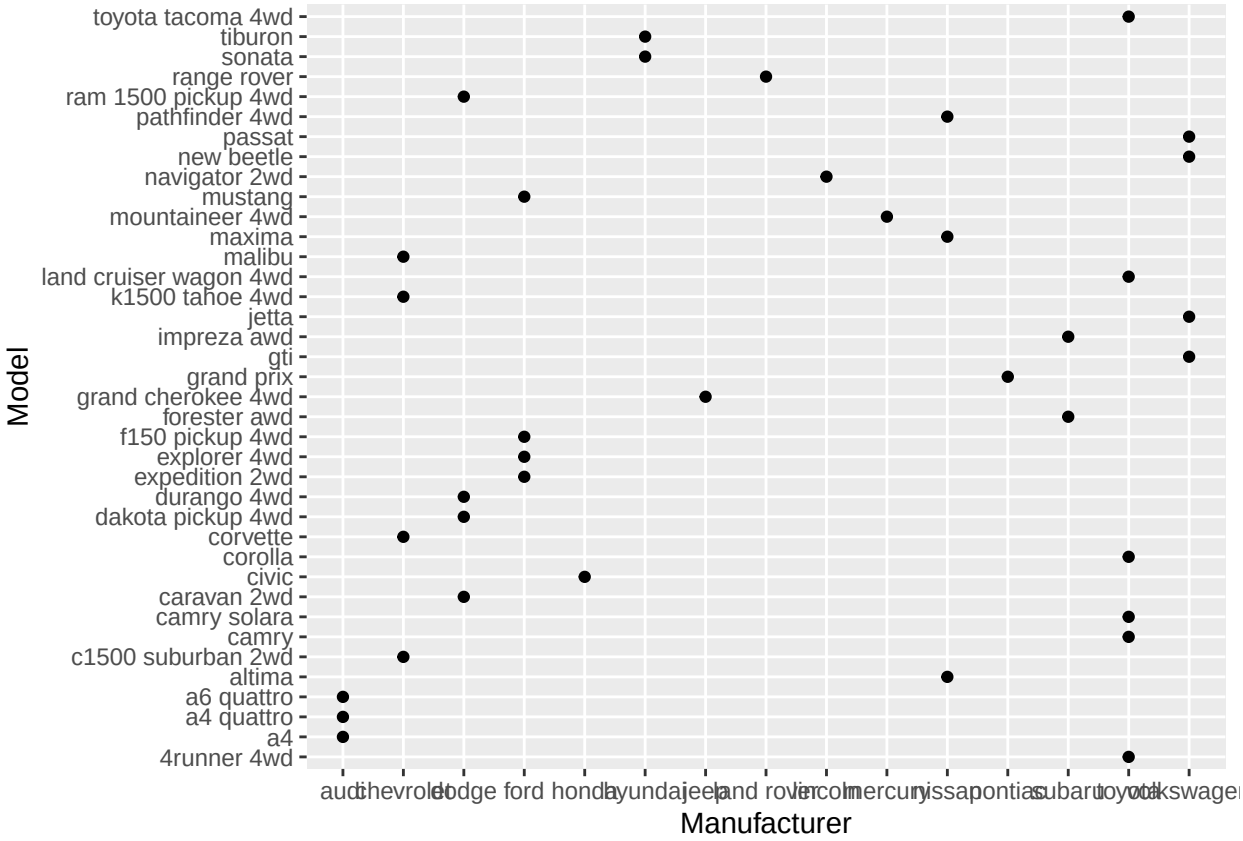
```
## # A tibble: 38 x 3
## # Groups:   Manufacturer, Model [38]
##    Manufacturer Model              Counts
##    <chr>        <chr>               <int>
##  1 audi         a4                      7
##  2 audi         a4 quattro              8
##  3 audi         a6 quattro              3
##  4 chevrolet    c1500 suburban 2wd      4
##  5 chevrolet    corvette                5
##  6 chevrolet    k1500 tahoe 4wd         4
##  7 chevrolet    malibu                  5
##  8 dodge        caravan 2wd             9
##  9 dodge        dakota pickup 4wd       8
## 10 dodge        durango 4wd             6
## # ... with 28 more rows
```

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

```
#Plot
plot(man_count)
```



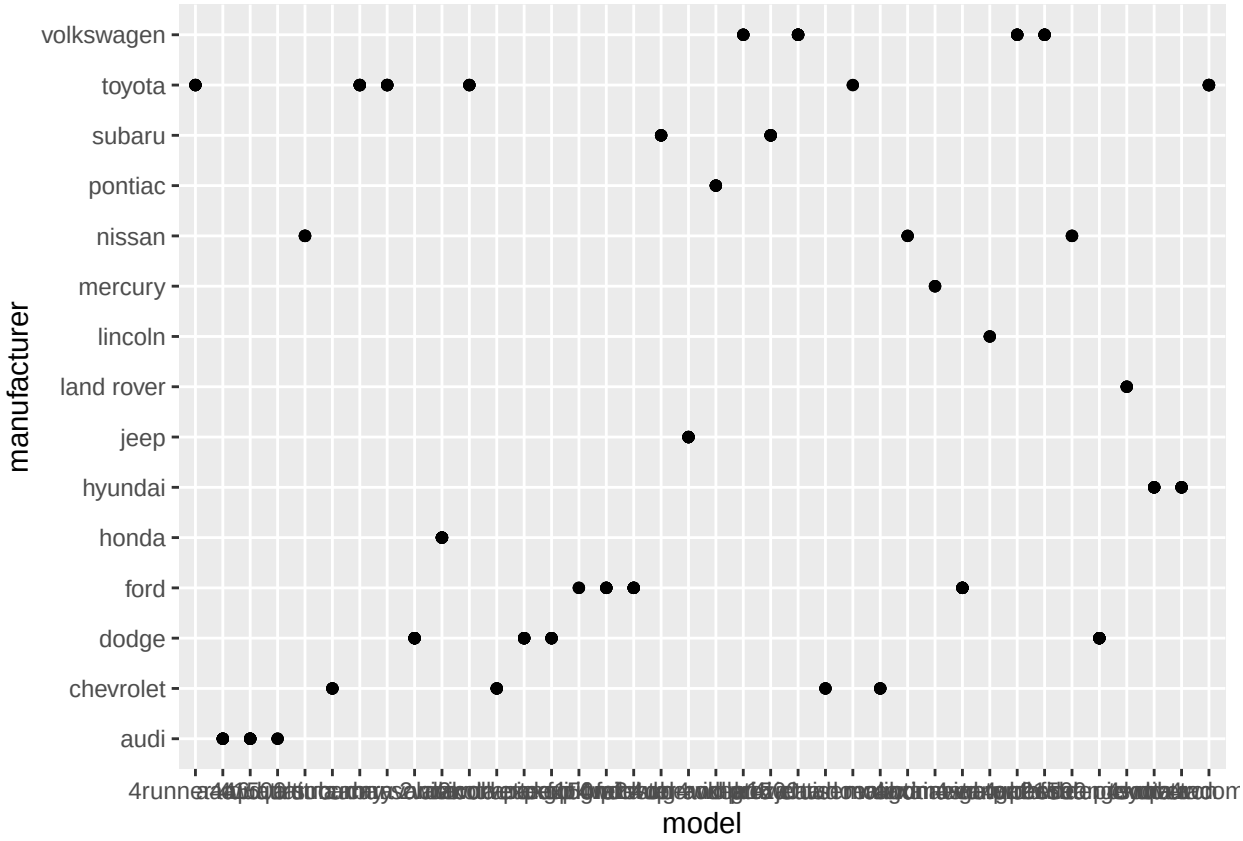

```
#GGPlot
ggplot(man_count, aes(Manufacturer, Model)) + geom_point()
```



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

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

```
#It shows in the point graph what is the manufacturer of the said model. It helps
#the user to analyze the data easily and informative.
ggplot(mpg_df, aes(model, manufacturer)) + geom_point()
```



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

```
#The data is very useful. It is simple and easy to analyze.
```

4. Using the pipe (%>%), group the model and get the number of cars per model. Show codes and its result.

```
grp_data <- mpg_data %>% group_by(model) %>% count()
colnames(grp_data) <- c("Model","Counts")

grp_data
```

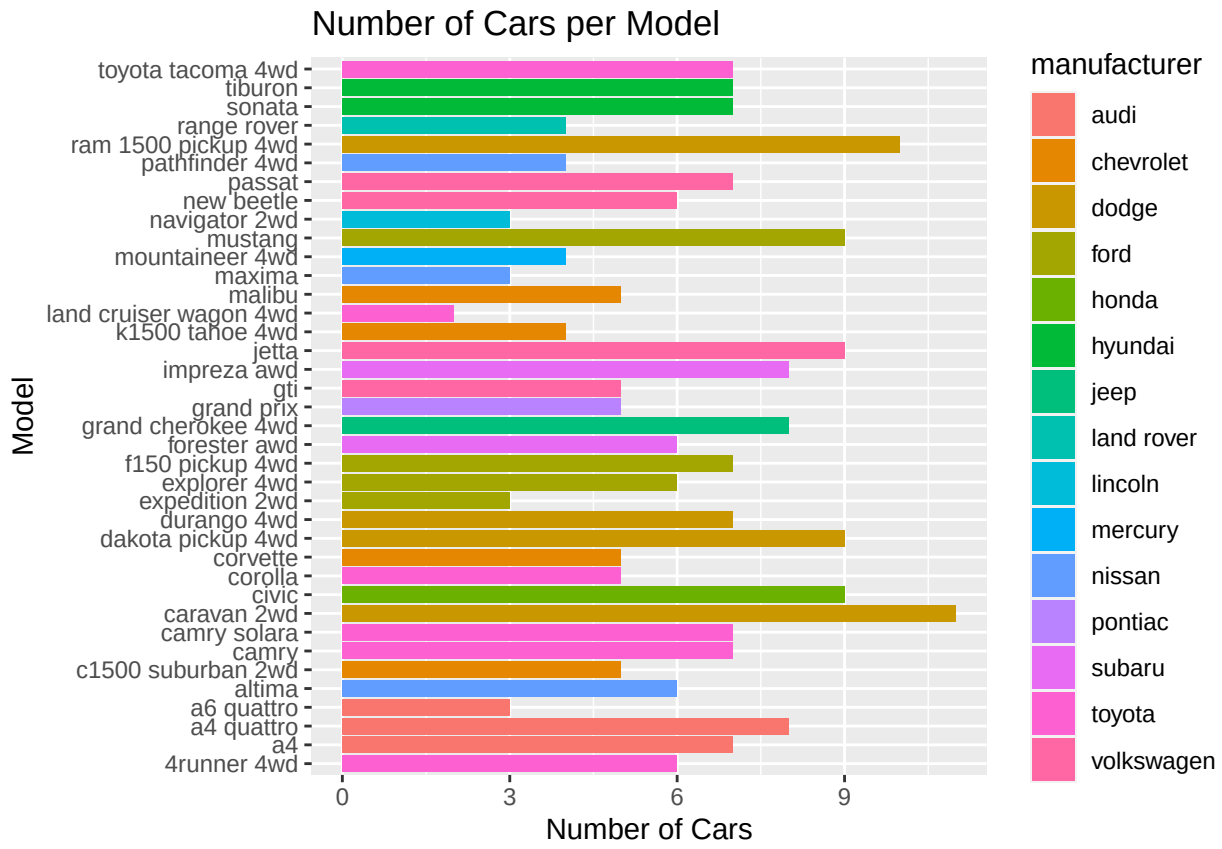
```
## # A tibble: 38 x 2
## # Groups:   Model [38]
##    Model              Counts
##    <chr>               <int>
##  1 4runner 4wd             6
##  2 a4                      7
##  3 a4 quattro              8
##  4 a6 quattro              3
##  5 altima                  6
##  6 c1500 suburban 2wd      5
##  7 camry                   7
##  8 camry solara            7
##  9 caravan 2wd            11
```

```
## 10 civic                    9
## # ... with 28 more rows
```

a. Plot using the geom_bar() + coord_flip() just like what is shown below. Show codes and its result.

```
qplot(model,data = mpg_df,
      main = "Number of Cars per Model",
      xlab = "Model",
      ylab = "Number of Cars", geom = "bar", fill = manufacturer) + coord_flip()
```

```
## Warning: `qplot()` was deprecated in ggplot2 3.4.0.
```



b. Use only the top 20 observations. Show code and results.

```
top_20 <- grp_data[1:20,] %>% top_n(2)
```

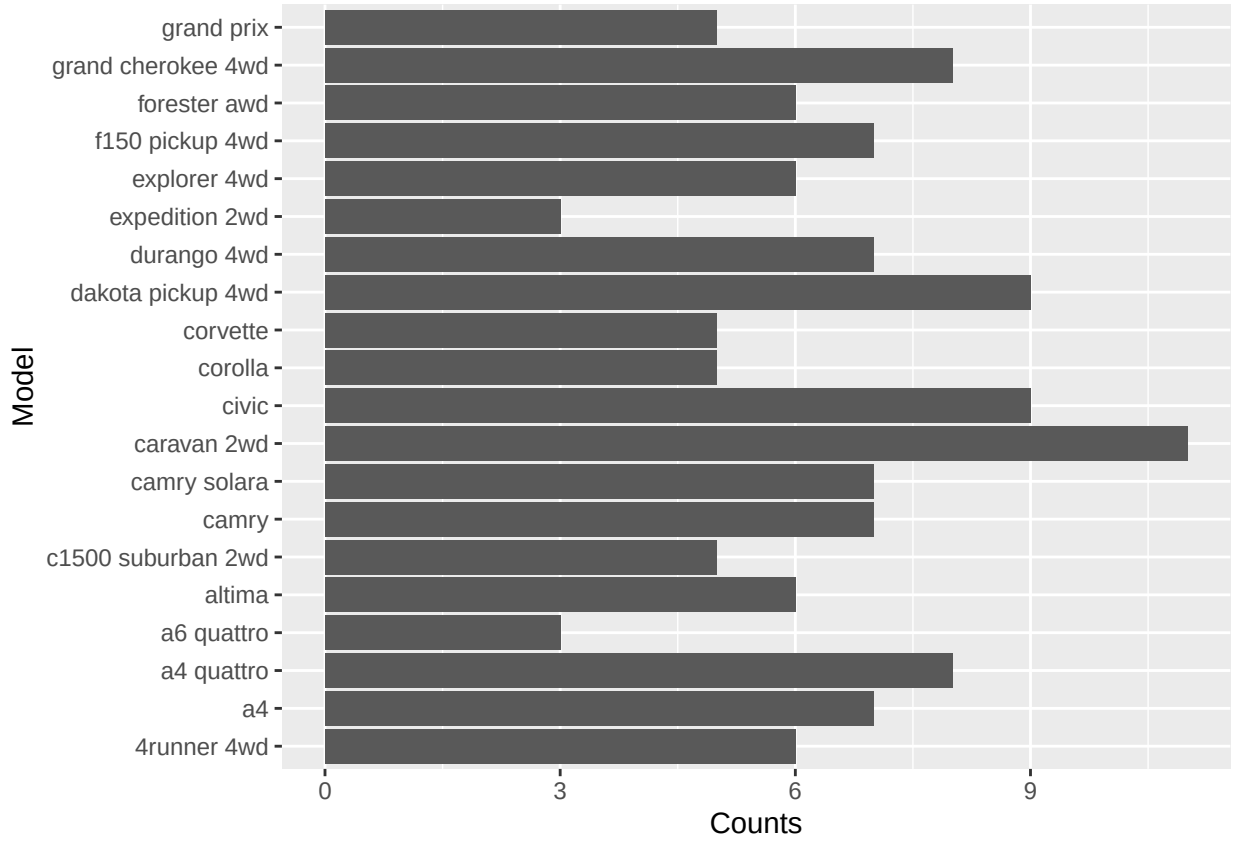
```
## Selecting by Counts
```

```r
colnames(top_20) <- c("Model","Counts")

top_20
```

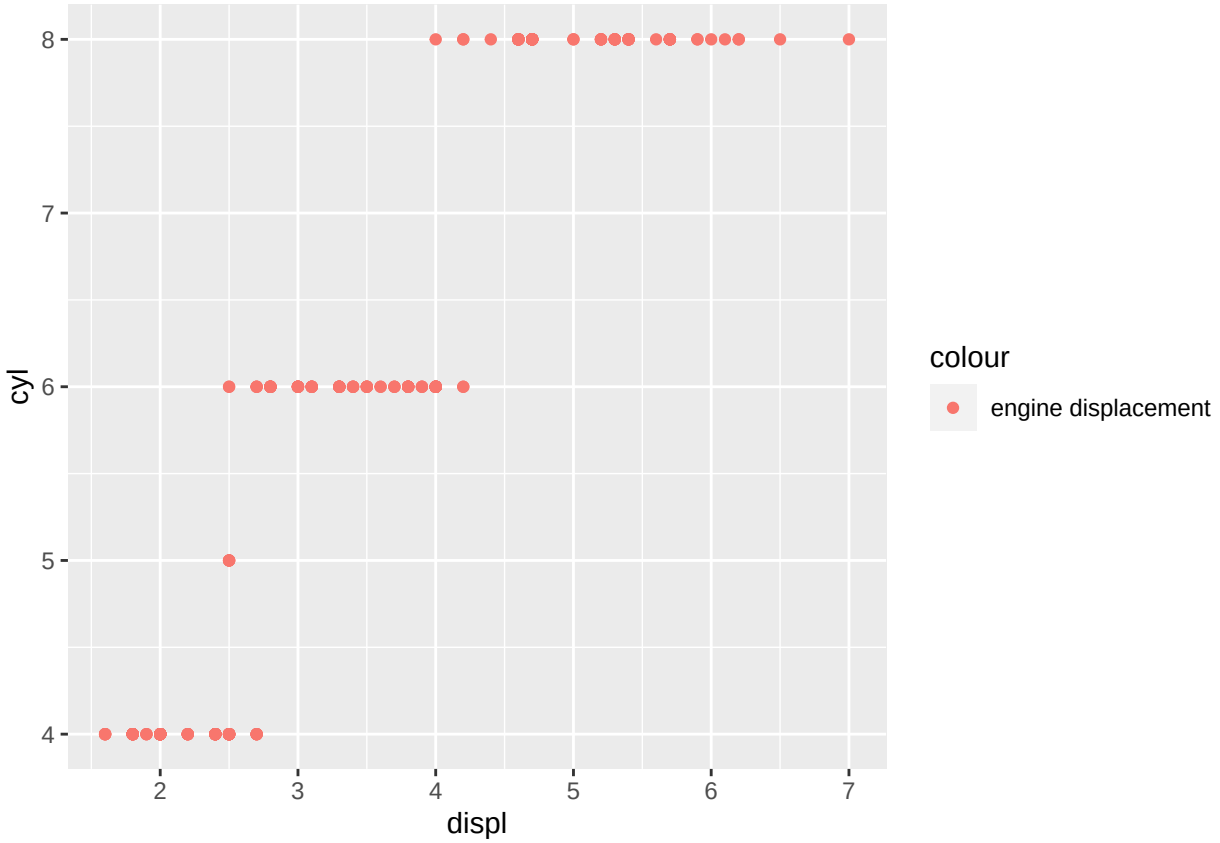
```
## # A tibble: 20 x 2
## # Groups:   Model [20]
##    Model              Counts
##    <chr>               <int>
##  1 4runner 4wd             6
##  2 a4                      7
##  3 a4 quattro              8
##  4 a6 quattro              3
##  5 altima                  6
##  6 c1500 suburban 2wd      5
##  7 camry                   7
##  8 camry solara            7
##  9 caravan 2wd            11
## 10 civic                   9
## 11 corolla                 5
## 12 corvette                5
## 13 dakota pickup 4wd       9
## 14 durango 4wd             7
## 15 expedition 2wd          3
## 16 explorer 4wd            6
## 17 f150 pickup 4wd         7
## 18 forester awd            6
## 19 grand cherokee 4wd      8
## 20 grand prix              5
```

```r
ggplot(top_20,aes(x = Model, y = Counts)) +
  geom_bar(stat = "Identity") +coord_flip()
```



5. Plot the relationship between cyl - number of cylinders and displ - engine displacement using geom_point with aesthetic colour = engine displacement. Title should be "Relationship between No. of Cylinders and Engine Displacement".
a. Show the codes and its result

```
ggplot(data = mpg_data , mapping = aes(x = displ, y = cyl, main = "Relationship
between No. of Cylinders and Engine Displacement")) +
  geom_point(mapping=aes(colour = "engine displacement"))
```

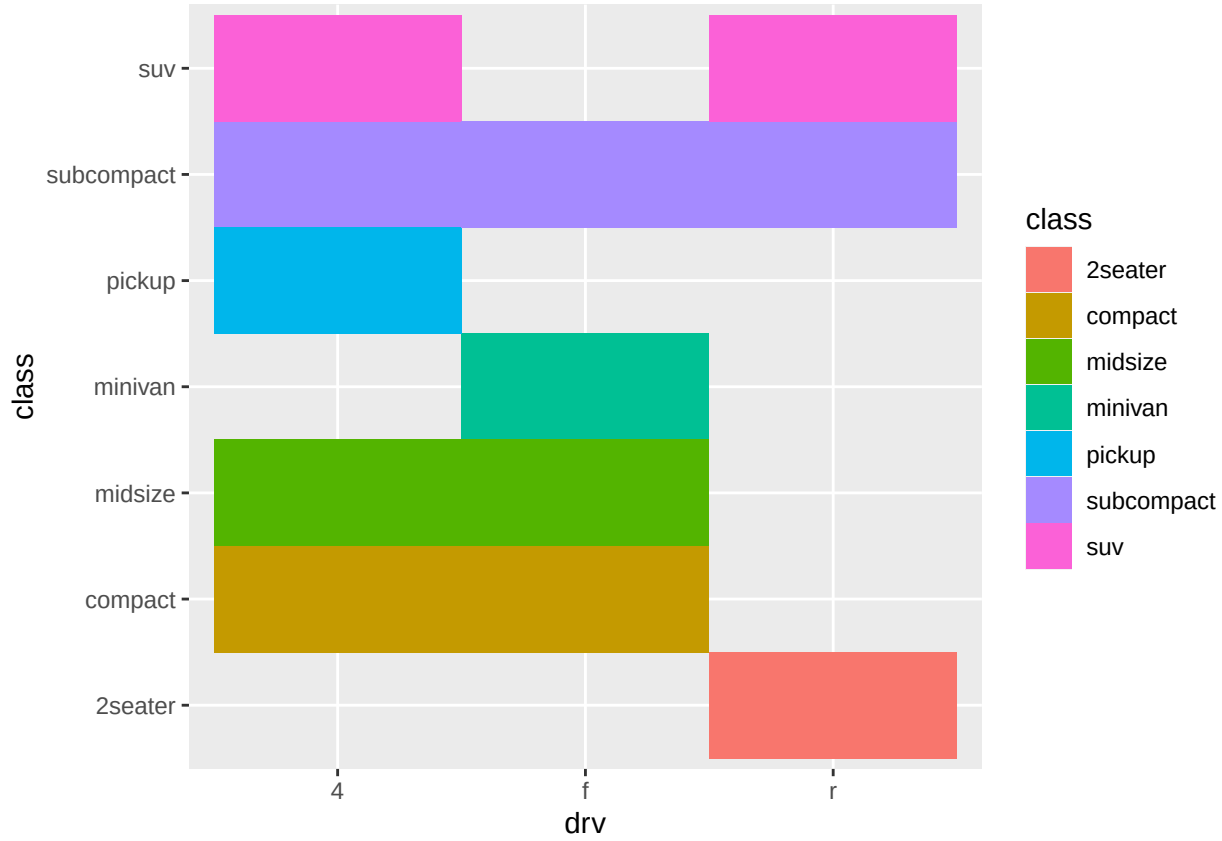


b. How would you describe its relationship?

```
#The scatter plot shows that the cyl is in y axis and the displ are in the x axis
#to easily distinguish the clustered data, which indicate the engine displacement.
```

6. Get the total number of observations for drv - type of drive train (f = front-wheel drive, r = rear wheel drive, 4 = 4wd) and class - type of class (Example: suv, 2seater, etc.). Plot using the geom_tile() where the number of observations for class be used as a fill for aesthetics.
a. Show the codes and its result for the narrative in #6

```
ggplot(data = mpg_data, mapping = aes(x = drv, y = class)) +
  geom_tile(aes(fill=class))
```

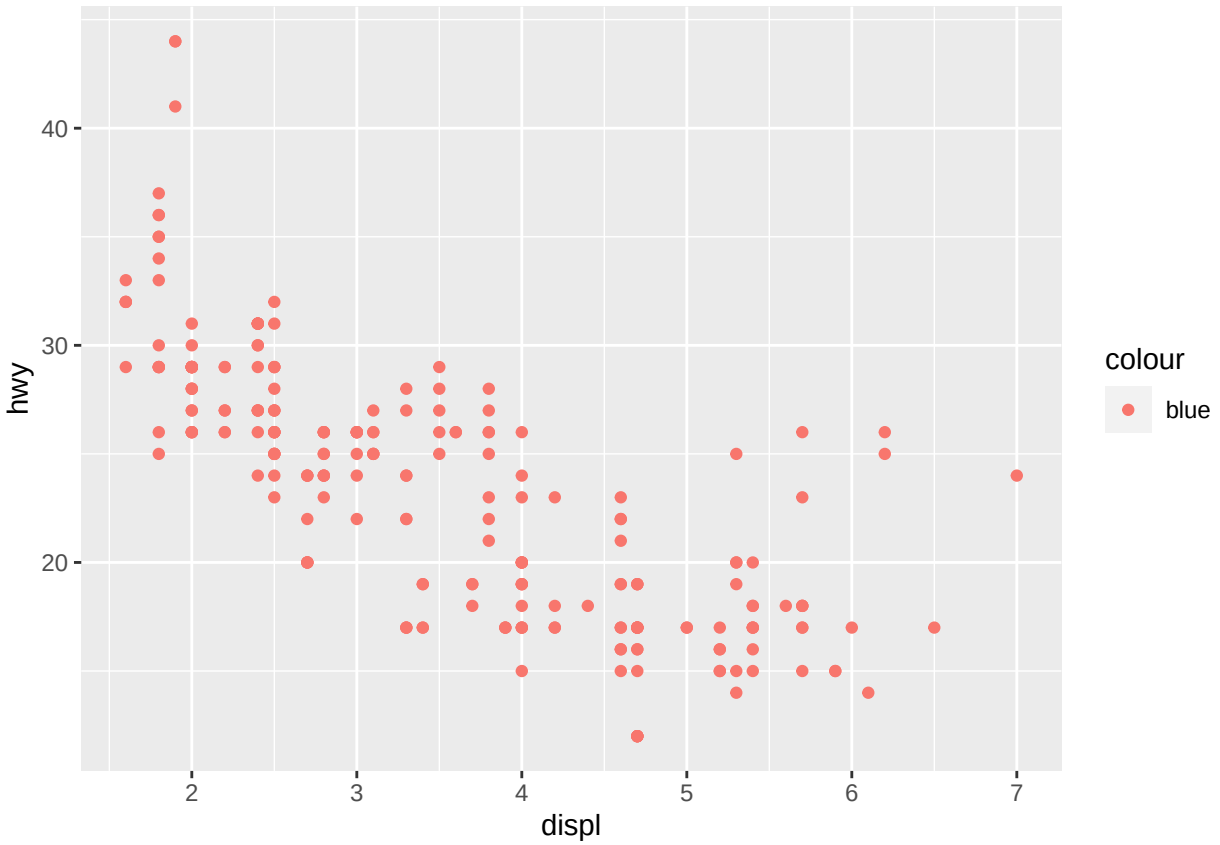


b. Interpret the result.

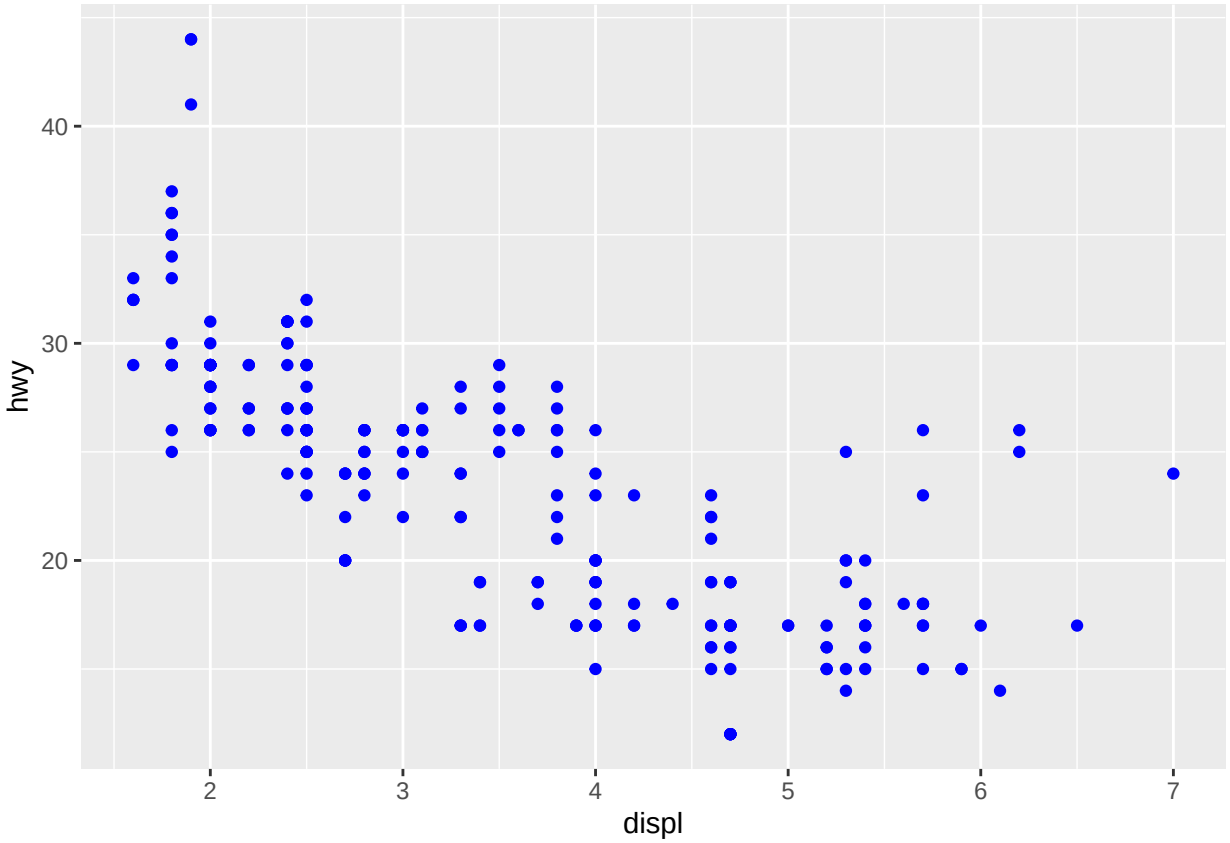
```
#By mapping a geometric tile, it graph the data in a tile graph that was shown in
#different colors.The data shows the drv of each class.
```

7. Discuss the difference between these codes. Its outputs for each are shown below.

```
# Code #1
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy, colour = "blue"))
```




```
#+ Code #2
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy), colour = "blue")
```




```
#The difference between these two codes are they have the same color value which is blue
#but in the output in the code #1 it has a color red dots while the code #2 has
#a color blue dots. It is because the value of the color in code #1 is belong in
#the aes function, thats why the value of the color don't matter. Unlike in the code #2
#whereas the value of the color are outside is the value of function aes.
```

8. Try to run the command ?mpg. What is the result of this command?

```
?mpg
```

```
## starting httpd help server ... done
```

```
#The result of this command is it shows the description of the data set mpg.
#In other terms the "?" command is also known as help.
```

a. Which variables from mpg dataset are categorical?

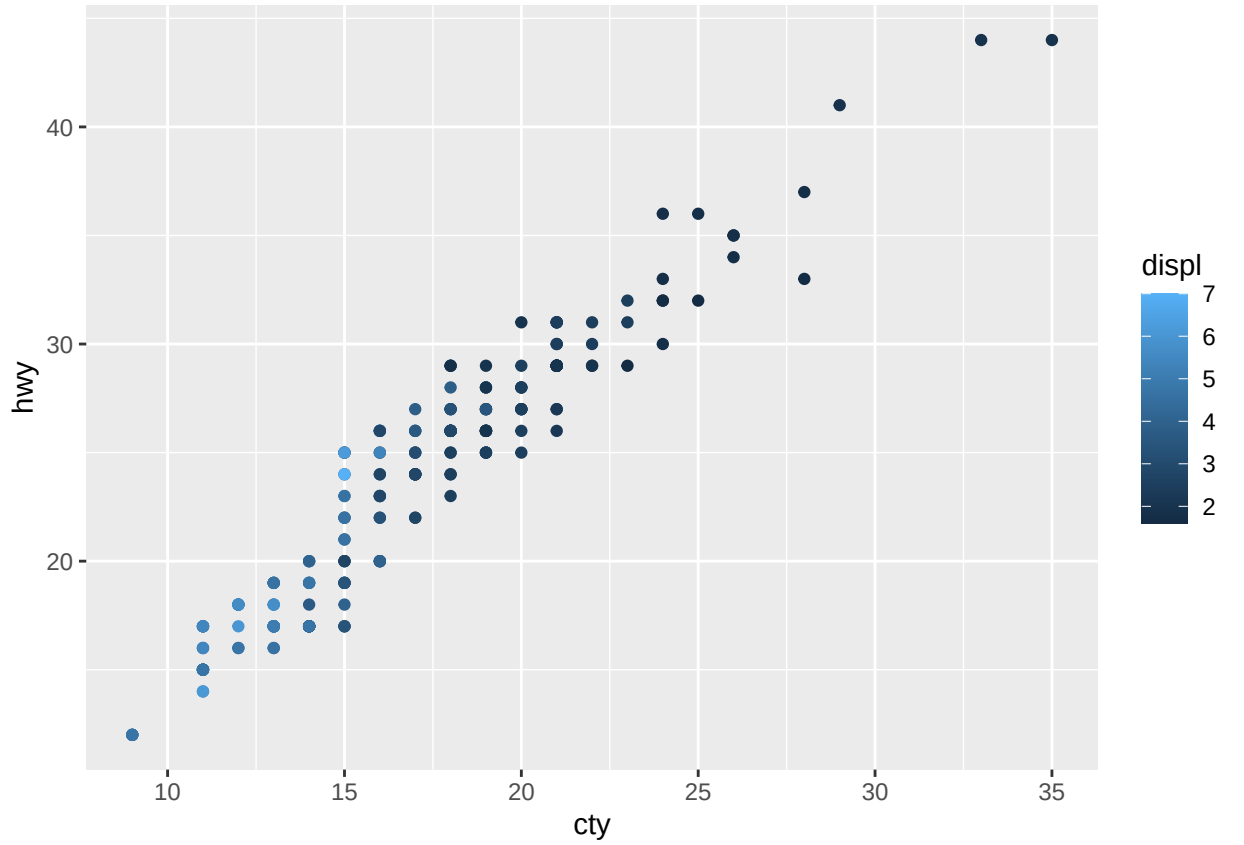
```
#The variables that are categoral in mpg dataset are the manufacturer, model,
#trans, drv, fl, class are the categorical variables from the data-set of mpg.
```

b. Which are continuous variables?

```
#The continuous variable of the mpg data-set are the dsipl, year,
#cyl, cty, and hwy.
```

c. Plot the relationship between displ (engine displacement) and hwy(highway miles per gallon). Mapped it with a continuous variable you have identified in #5-b. What is its result? Why it produced such output?

```
ggplot(mpg, aes(x = cty, y = hwy, colour = displ)) + geom_point()
```

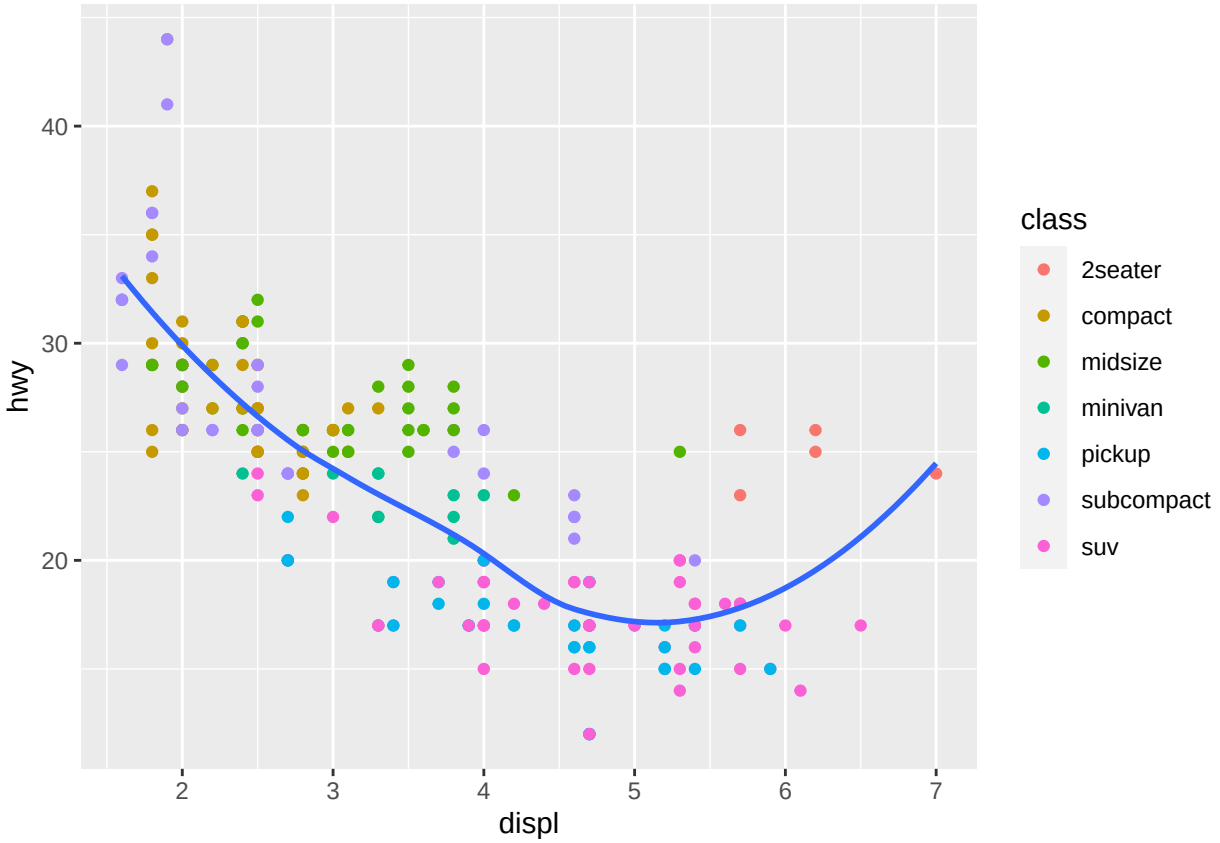



```
#The data that have been graph shows that they are in the positive rate using the
#displ for hwy and cty scattered plot. The data tracks the cty by placing cty at
#color that having a variations of color blue.
```

9. Plot the relationship between displ (engine displacement) and hwy(highway miles per gallon) using geom_point(). Add a trend line over the existing plot using geom_smooth() with se = FALSE. Default method is "loess".

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy)) +
  geom_point(mapping=aes(color=class)) +
  geom_smooth(se = FALSE)
```

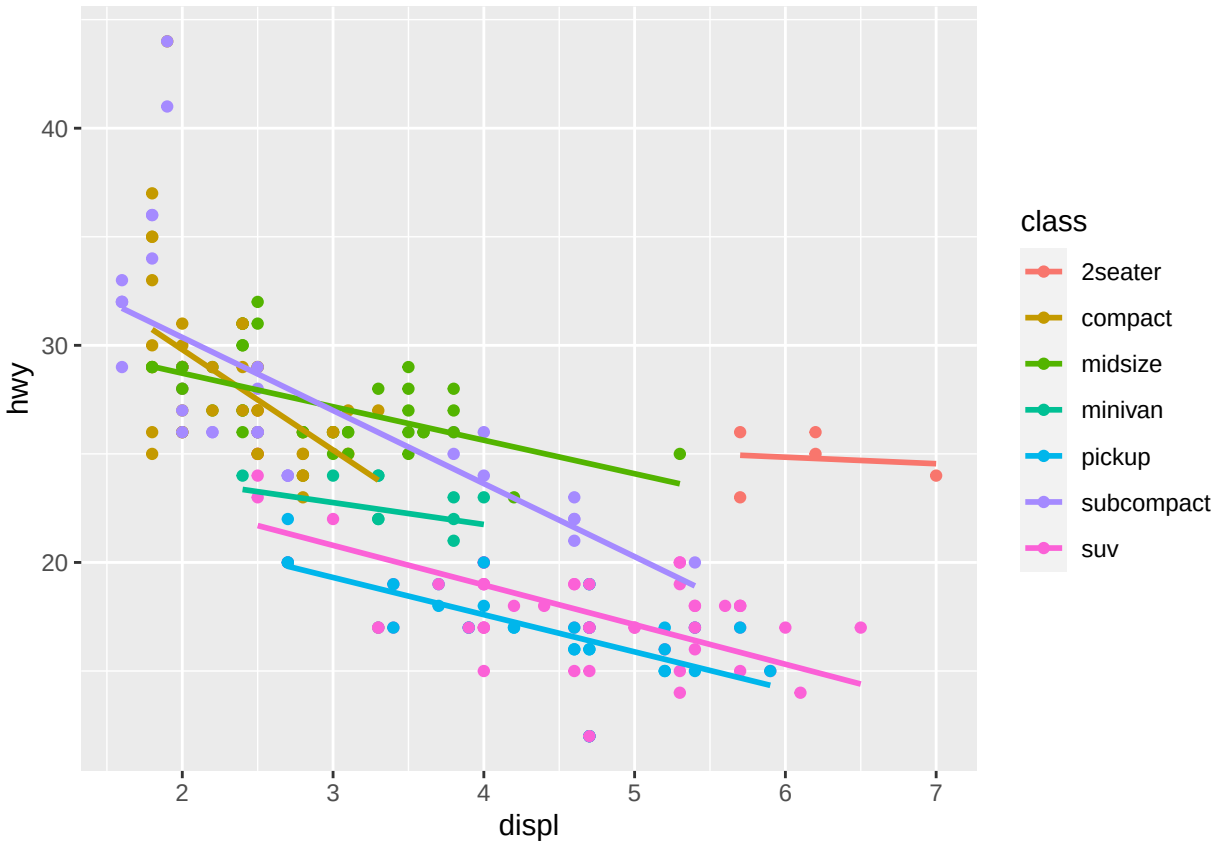
```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



10. Using the relationship of displ and hwy, add a trend line over existing plot. Set the se = FALSE to remove the confidence interval and method = lm to check for linear modeling.

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy, color = class)) +
  geom_point() +
  geom_smooth(se = FALSE, method = lm)
```

```
## `geom_smooth()` using formula = 'y ~ x'
```


hwy
40
30
20
2
3
4
5
6
7
displ
class
2seater
compact
midsize
minivan
pickup
subcompact
suv