Rworksheet_Rabago#4c

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```r
library(ggplot2)
write.csv(mpg, "mpg.csv", row.names = FALSE)
```

1.a.

```r
mpg <- read.csv("mpg.csv")
mpg
```

```
##    manufacturer              model displ year cyl      trans drv cty hwy
## 1          audi                 a4   1.8 1999   4   auto(l5)   f  18  29
## 2          audi                 a4   1.8 1999   4 manual(m5)   f  21  29
## 3          audi                 a4   2.0 2008   4 manual(m6)   f  20  31
## 4          audi                 a4   2.0 2008   4   auto(av)   f  21  30
## 5          audi                 a4   2.8 1999   6   auto(l5)   f  16  26
## 6          audi                 a4   2.8 1999   6 manual(m5)   f  18  26
## 7          audi                 a4   3.1 2008   6   auto(av)   f  18  27
## 8          audi         a4 quattro   1.8 1999   4 manual(m5)   4  18  26
## 9          audi         a4 quattro   1.8 1999   4   auto(l5)   4  16  25
## 10         audi         a4 quattro   2.0 2008   4 manual(m6)   4  20  28
## 11         audi         a4 quattro   2.0 2008   4   auto(s6)   4  19  27
## 12         audi         a4 quattro   2.8 1999   6   auto(l5)   4  15  25
## 13         audi         a4 quattro   2.8 1999   6 manual(m5)   4  17  25
## 14         audi         a4 quattro   3.1 2008   6   auto(s6)   4  17  25
## 15         audi         a4 quattro   3.1 2008   6 manual(m6)   4  15  25
## 16         audi         a6 quattro   2.8 1999   6   auto(l5)   4  15  24
## 17         audi         a6 quattro   3.1 2008   6   auto(s6)   4  17  25
## 18         audi         a6 quattro   4.2 2008   8   auto(s6)   4  16  23
## 19    chevrolet c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  14  20
## 20    chevrolet c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  11  15
## 21    chevrolet c1500 suburban 2wd   5.3 2008   8   auto(l4)   r  14  20
## 22    chevrolet c1500 suburban 2wd   5.7 1999   8   auto(l4)   r  13  17
## 23    chevrolet c1500 suburban 2wd   6.0 2008   8   auto(l4)   r  12  17
## 24    chevrolet           corvette   5.7 1999   8 manual(m6)   r  16  26
## 25    chevrolet           corvette   5.7 1999   8   auto(l4)   r  15  23
## 26    chevrolet           corvette   6.2 2008   8 manual(m6)   r  16  26
## 27    chevrolet           corvette   6.2 2008   8   auto(s6)   r  15  25
## 28    chevrolet           corvette   7.0 2008   8 manual(m6)   r  15  24
## 29    chevrolet     k1500 tahoe 4wd  5.3 2008   8   auto(l4)   4  14  19
## 30    chevrolet     k1500 tahoe 4wd  5.3 2008   8   auto(l4)   4  11  14
## 31    chevrolet     k1500 tahoe 4wd  5.7 1999   8   auto(l4)   4  11  15
## 32    chevrolet     k1500 tahoe 4wd  6.5 1999   8   auto(l4)   4  14  17
## 33    chevrolet             malibu   2.4 1999   4   auto(l4)   f  19  27
## 34    chevrolet             malibu   2.4 2008   4   auto(l4)   f  22  30
```

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## 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
## 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
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## 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
## 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
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## 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
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## 197         toyota               corolla 1.8 2008   4 manual(m5)  f  28  37
## 198         toyota               corolla 1.8 2008   4   auto(14)  f  26  35
## 199         toyota land cruiser wagon 4wd 4.7 1999   8   auto(14)  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(14)  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(14)  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(15)  4  16  20
## 208     volkswagen                   gti 2.0 1999   4 manual(m5)  f  21  29
## 209     volkswagen                   gti 2.0 1999   4   auto(14)  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(14)  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(14)  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(14)  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(14)  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(15)  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(15)  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.b. -The categorical variables in the mpg dataset are manufacturer, model, trans, drv, fl, and class.

1.c. -The continuous variables in the mpg dataset are displ, cty, and hwy.

2.a.

```r
library(dplyr)
```

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

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

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

```r
manumodel<- mpg %>%
  group_by(manufacturer) %>%
  summarise(num_models = n_distinct(model)) %>%
  arrange(desc(num_models))

manumodel
```

```
## # A tibble: 15 x 2
##    manufacturer num_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
```

2.b.

```r
barplot(manumodel$num_models,
        names.arg = manumodel$manufacturer,
        las = 2,col = "blue",
        main = "Number of Unique Models by Manufacturer",
        xlab = "Manufacturer",
        ylab = "Number of Unique Models")
```

Number of Unique Models by Manufacturer
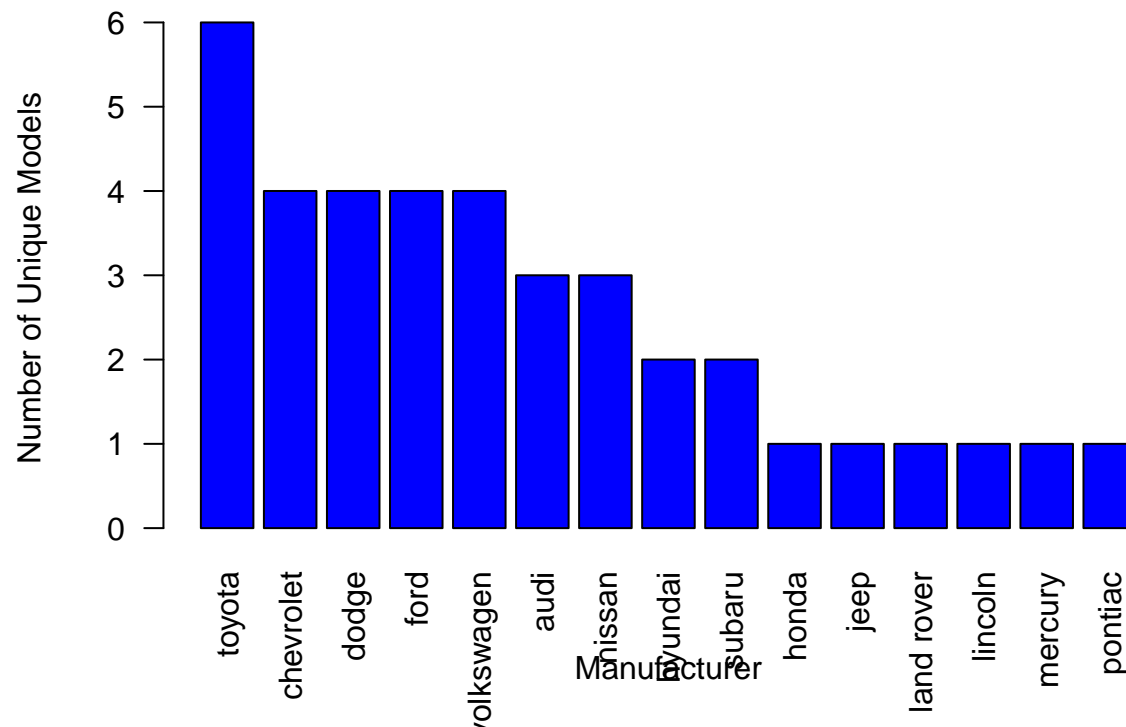

```r
library(ggplot2)


ggplot(manumodel, aes(x = reorder(manufacturer, num_models), y = num_models)) +
  geom_bar(stat = "identity", fill = "lightblue") +
  coord_flip() +  # Flip coordinates for better readability
  labs(title = "Number of Unique Models by Manufacturer",
       x = "Manufacturer",
       y = "Number of Unique Models") +
  theme_minimal()
```

Number of Unique Models by Manufacturer
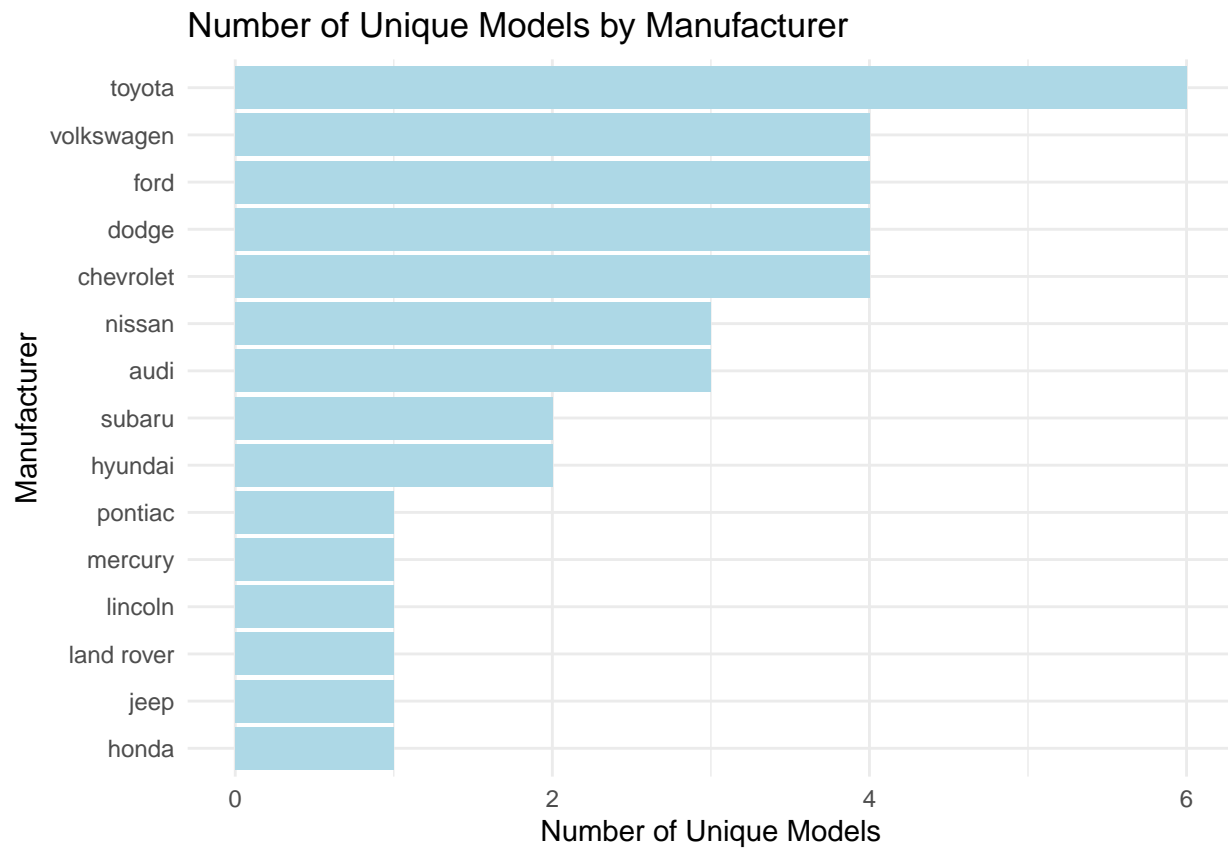
2.a.

```
ggplot(mpg, aes(model, manufacturer)) +
  geom_point()
```
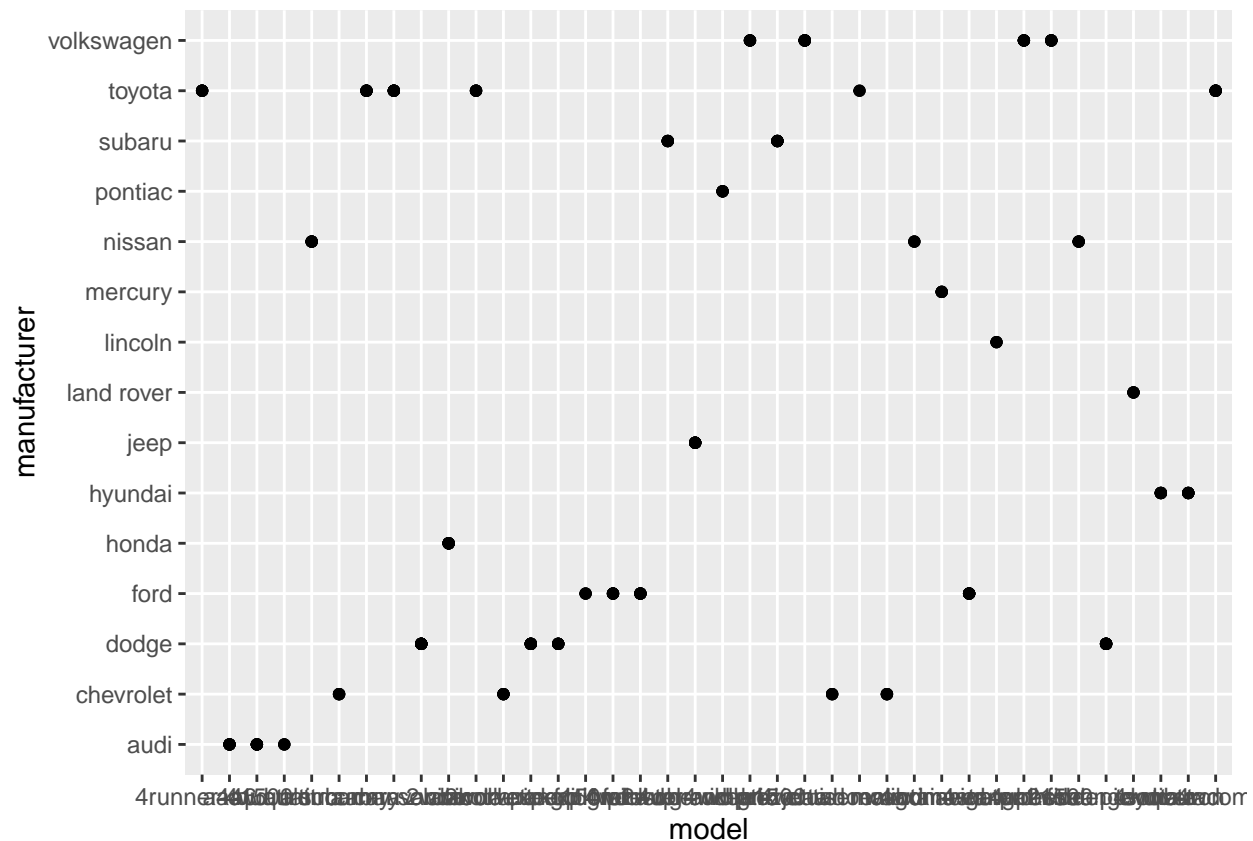
The code creates a scatter plot showing car models and their manufacturers. However, this plot isn't very helpful because many models come from the same manufacturer, causing the points to overlap and making it hard to see individual models. Also, both the x-axis and y-axis use categories, which doesn't work well for showing relationships. To make the data clearer, using bar plots or boxplots would be more effective.

2.b. The plot from `ggplot(mpg, aes(model, manufacturer)) + geom_point()` is not very useful due to overlapping points and categorical axes, making it hard to interpret. To improve it, you could create a bar plot showing how many models each manufacturer has, which highlights those with more variety. Alternatively, using boxplots to compare city or highway mileage by manufacturer would better illustrate fuel efficiency. These changes would make the visualizations more informative.

3.

```
library(ggplot2)
library(dplyr)

top20 <- mpg %>%
  arrange(desc(cty)) %>%
  head(20)

ggplot(top20, aes(x = model, y = year)) +
  geom_point(color = "darkblue", size = 3) +
  coord_flip() +
  labs(title = "Top 20 Models by Year of Manufacture",
       x = "Car Model",
       y = "Year") +
theme_minimal()
```

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Top 20 Models by Year of Manufacture
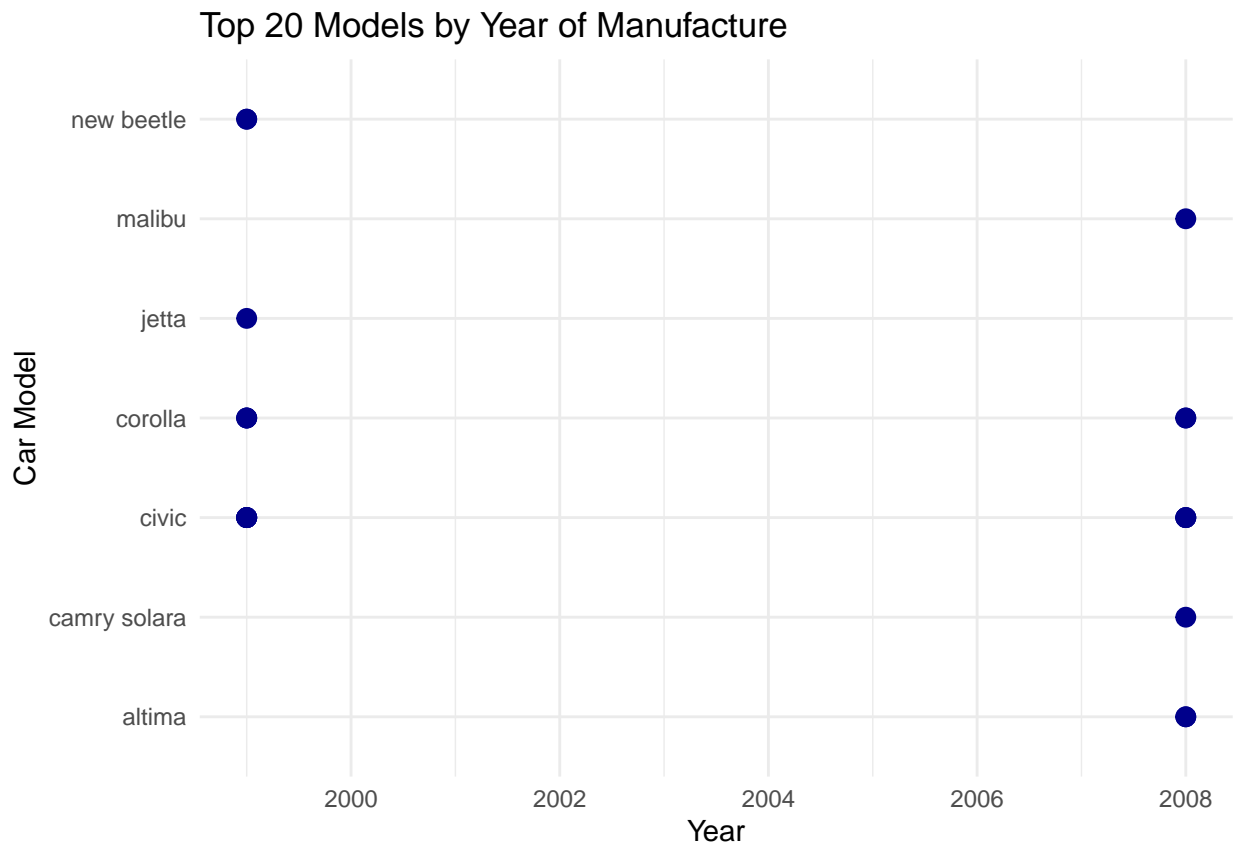
4

```
library(dplyr)
library(ggplot2)


modelcount <- mpg %>%
  group_by(model) %>%
  summarise(num_cars = n()) %>%
  arrange(desc(num_cars))


modelcount
```

```
## # A tibble: 38 x 2
##    model             num_cars
##    <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
```

4.a.

```
top20 <- modelcount %>%
  top_n(20, num_cars)

ggplot(top20, aes(x = reorder(model, num_cars), y = num_cars)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Top 20 Car Models by Number of Cars",
       x = "Car Model",
       y = "Number of Cars") +
  theme_minimal()
```

Top 20 Car Models by Number of Cars
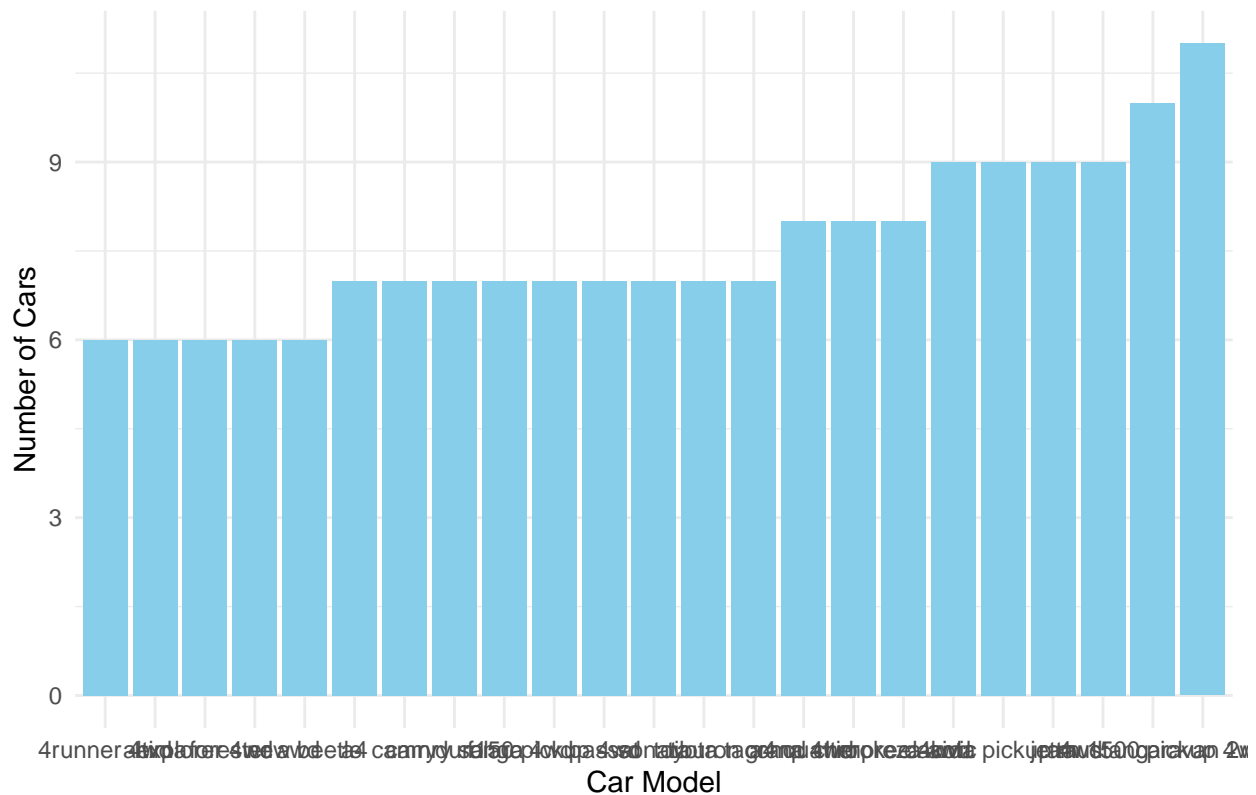
4.b.

```
ggplot(top20, aes(x = reorder(model, num_cars), y = num_cars)) +
  geom_bar(stat = "identity", fill = "red") +
  coord_flip() +
  labs(title = "Top 20 Car Models by Number of Cars (Horizontal)",
       x = "Number of Cars",
       y = "Car Model") +
  theme_minimal()
```

Top 20 Car Models by Number of Cars (Horizontal)

5.
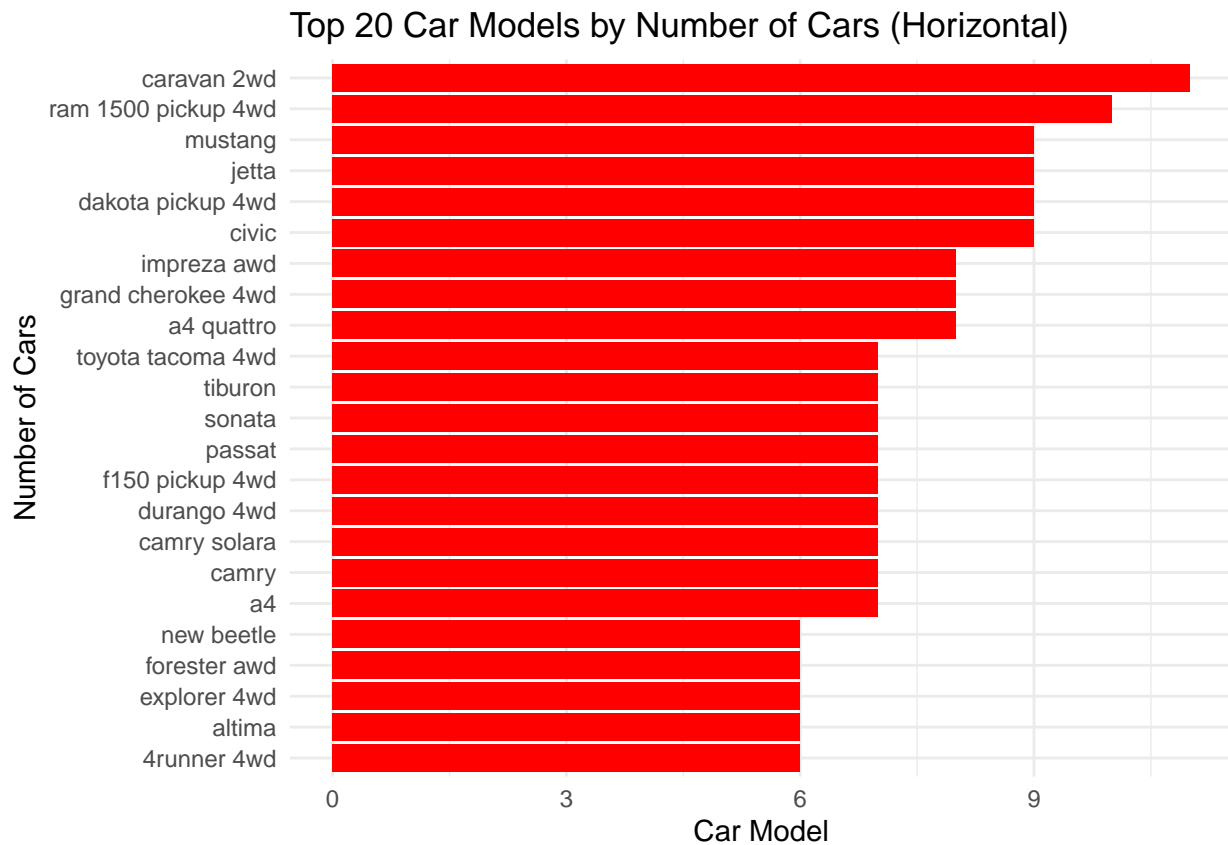
```r
library(ggplot2)

ggplot(mpg, aes(x = cyl, y = displ, color = displ)) +
  geom_point(size = 3) +
  labs(title = "Relationship between No. of Cylinders and Engine Displacement",
       x = "Number of Cylinders",
       y = "Engine Displacement (litres)") +
  theme_minimal() +
  scale_color_gradient(low = "blue", high = "red")
```

Relationship between No. of Cylinders and Engine Displacement
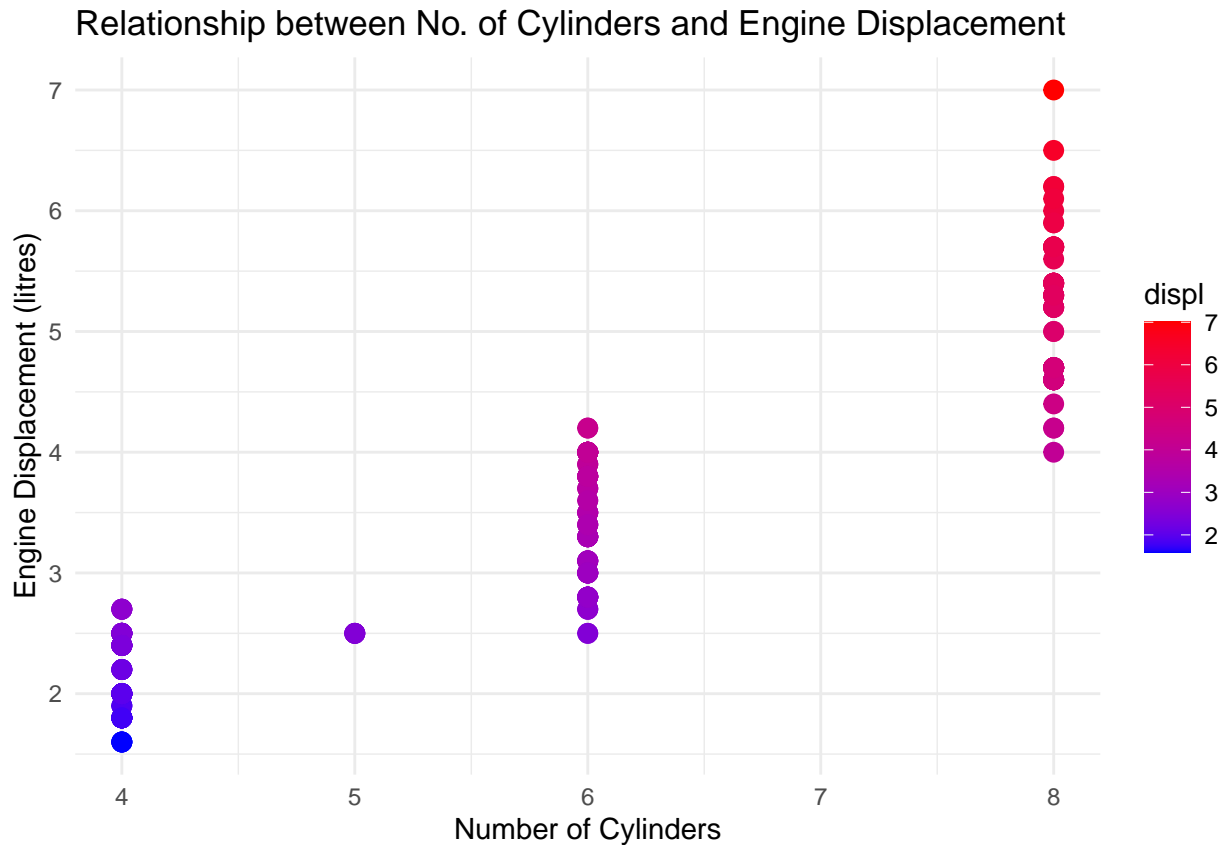
6.1. The scatter plot shows a negative correlation between engine displacement (displ) and highway miles per gallon (hwy), suggesting that as engine displacement increases, highway MPG generally decreases. This relationship occurs because larger engines usually burn more fuel, resulting in reduced fuel efficiency on highways, highlighting the balance between engine size and fuel economy in vehicles.

```
library(ggplot2)


ggplot(mpg, aes(x = displ, y = hwy, color = displ)) +
  geom_point(size = 3, alpha = 0.7) +
  labs(title = "Relationship between Engine Displacement and Highway MPG",
       x = "Engine Displacement (Liters)",
       y = "Highway MPG",
       color = "Engine Displacement") +
  theme_minimal()
```

Relationship between Engine Displacement and Highway MPG

6.2.
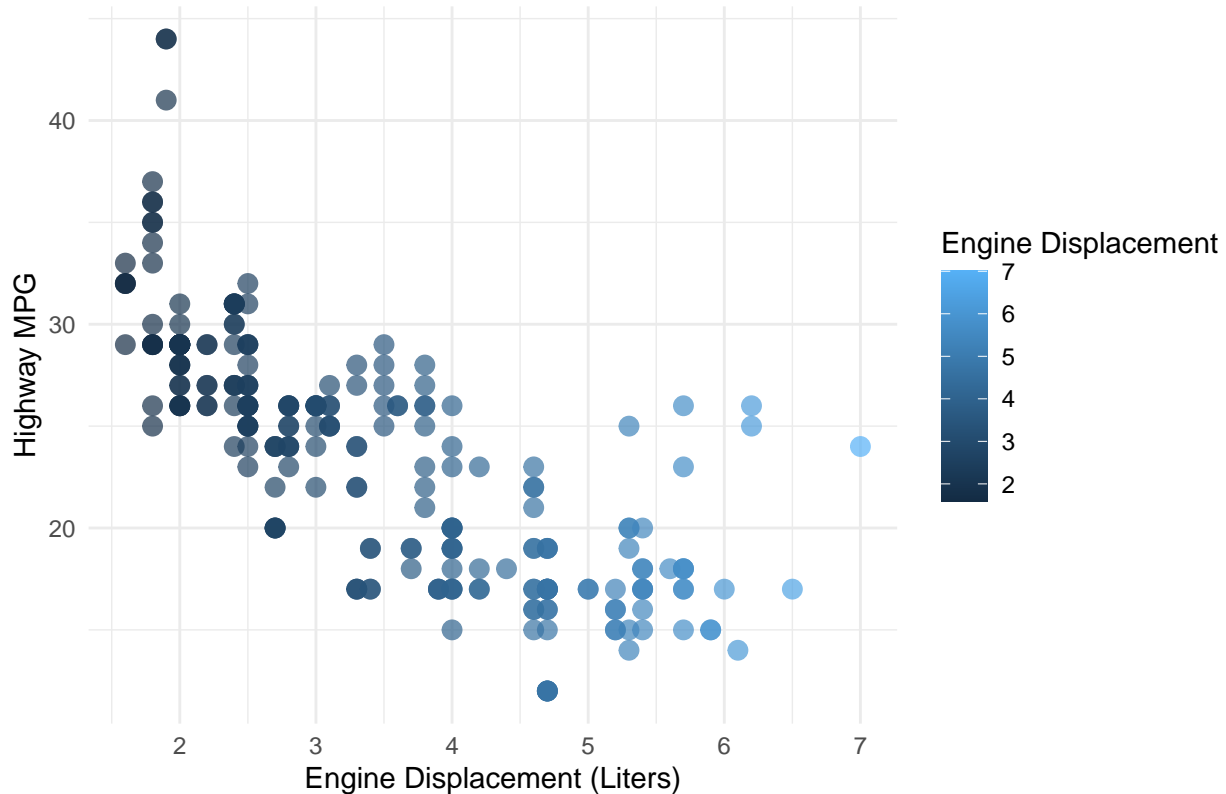
```r
traffic <- read.csv("/cloud/project/Worksheet4/traffic.csv")
```

   a.

```r
num_observations <- nrow(traffic)
print(paste("Number of observations:", num_observations))
```

```
## [1] "Number of observations: 48120"
```

```r
variables <- colnames(traffic)
print("Variables in the dataset:")
```

```
## [1] "Variables in the dataset:"
```

```r
print(variables)
```

```
## [1] "DateTime" "Junction" "Vehicles" "ID"
```

   b.

```r
junction_subsets <- split(traffic, traffic$Junction)
```

   c.

```r
library(ggplot2)
library(dplyr)


traffic$DateTime <- as.POSIXct(traffic$DateTime, format="%Y-%m-%d %H:%M:%S")
```

```
ggplot(traffic, aes(x = DateTime, y = Vehicles, color = factor(Junction))) +
  geom_line() +
  labs(title = "Traffic Volume Over Time by Junction",
       x = "Date and Time",
       y = "Number of Vehicles",
       color = "Junction") +
  theme_minimal() +
  facet_wrap(~ Junction, scales = "free_y")
```

Traffic Volume Over Time by Junction
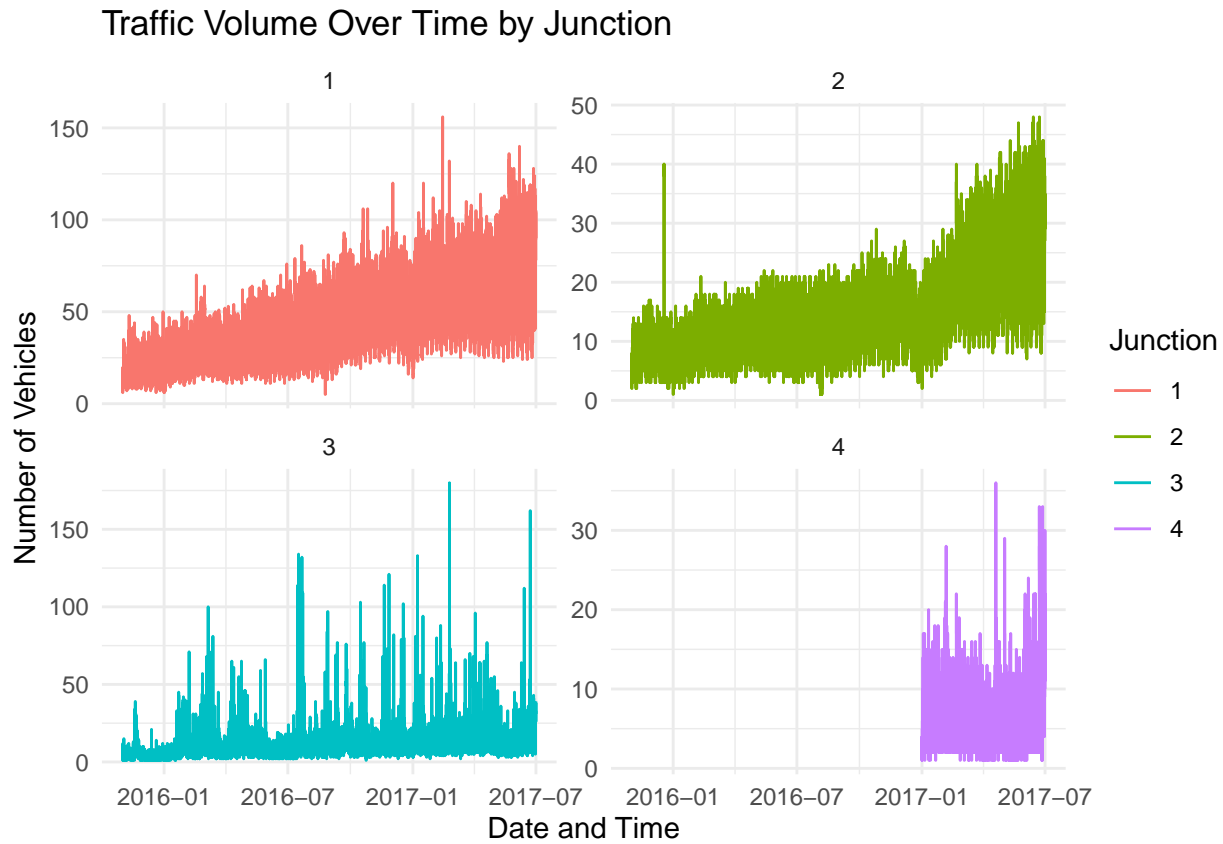
7.

```
library(readxl)

alexa <- read_excel("/cloud/project/Worksheet4/alexa_file.xlsx")
```

   a.

```
n <- nrow(alexa)
print(paste("Number of observations:", n))
```

```
## [1] "Number of observations: 3150"
```

```
v <- colnames(alexa)
print("Variables in the dataset:")
```

```
## [1] "Variables in the dataset:"
```

```
print(variables)
```

```
## [1] "DateTime" "Junction" "Vehicles" "ID"
```

   b.

```
library(dplyr)


variation_counts <- alexa %>%
  group_by(variation) %>%
  summarise(total = n())

print(variation_counts)
```

```
## # 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
```

c.The plot shows which product variations are most popular, with some clearly preferred over others. It highlights what consumers like the most.

```
ggplot(variation_counts, aes(x = reorder(variation, -total), y = total, fill = variation)) +
  geom_bar(stat = "identity") +
  labs(title = "Count of Each Product Variation",
       x = "Product Variation",
       y = "Total Count") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  guides(fill = FALSE)
```

```
## Warning: The `<scale>` argument of `guides()` cannot be `FALSE`. Use "none" instead as
## of ggplot2 3.3.4.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

Count of Each Product Variation
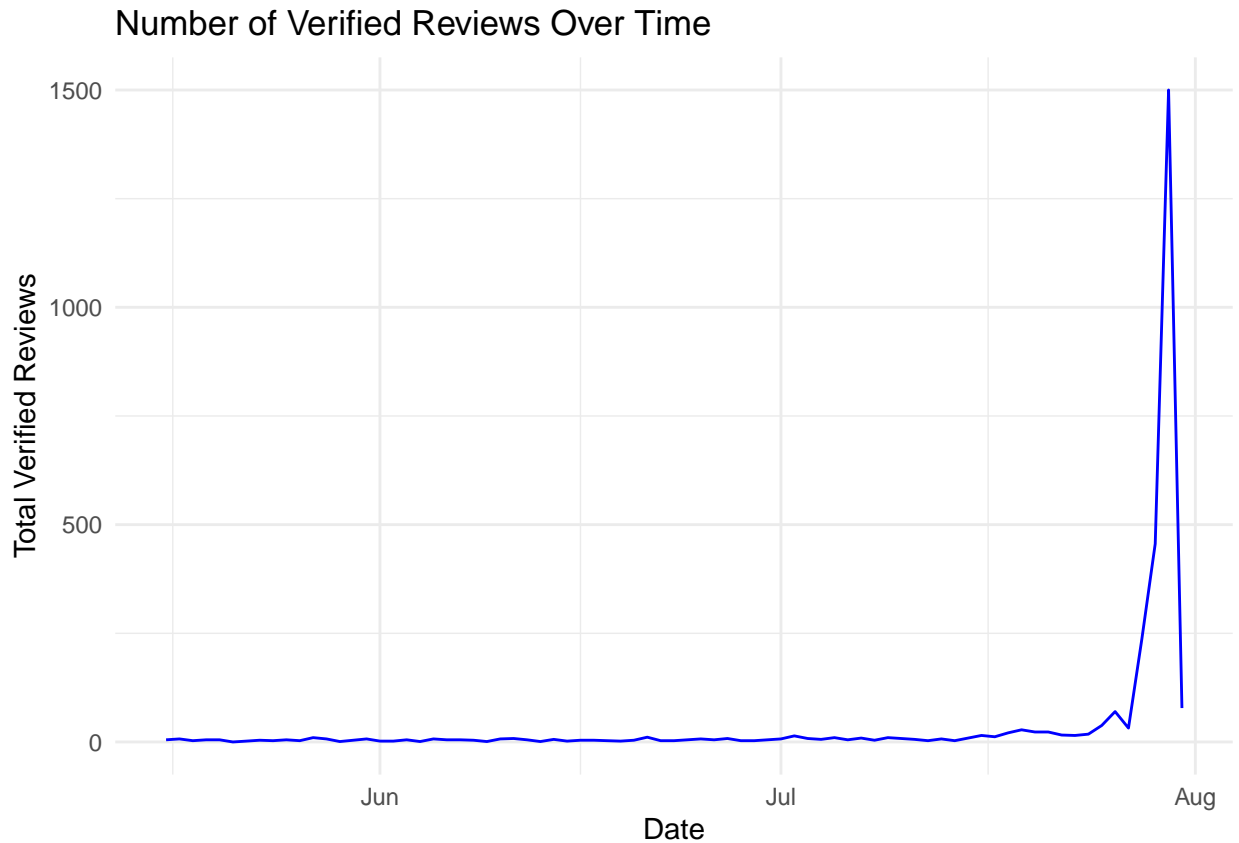

d.
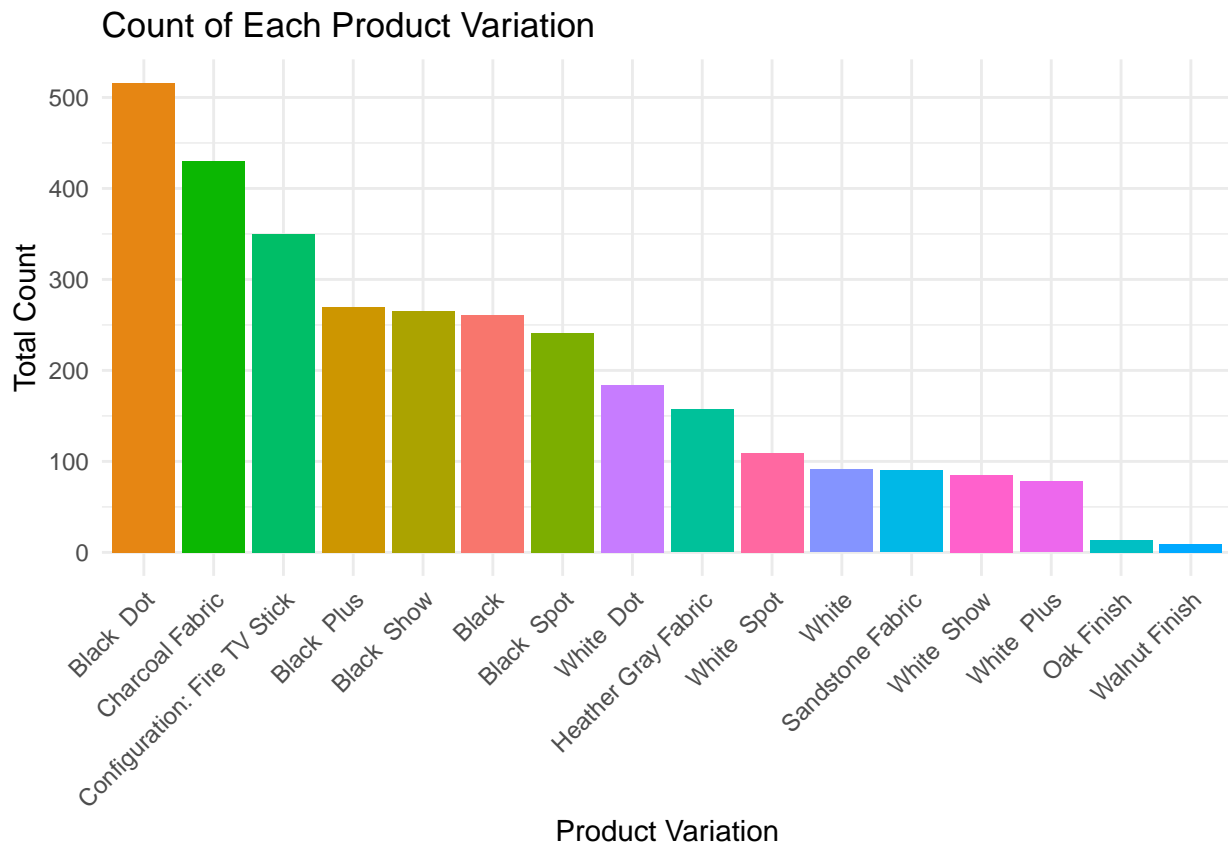
```
alexa$date <- as.Date(alexa$date)

daily_reviews <- alexa %>%
  group_by(date) %>%
  summarise(total_verified_reviews = sum(feedback))

ggplot(daily_reviews, aes(x = date, y = total_verified_reviews)) +
  geom_line(color = "blue") +
  labs(title = "Number of Verified Reviews Over Time",
       x = "Date",
       y = "Total Verified Reviews") +
  theme_minimal()
```

Number of Verified Reviews Over Time

e.

```r
library(dplyr)
library(ggplot2)

variation_ratings <- alexa %>%
  group_by(variation) %>%
  summarise(average_rating = mean(rating, na.rm = TRUE)) %>%

arrange(desc(average_rating))

variation_ratings
```

```
## # A tibble: 16 x 2
##    variation                  average_rating
##    <chr>                               <dbl>
##  1 Walnut Finish                        4.89
##  2 Oak Finish                           4.86
##  3 Charcoal Fabric                      4.73
##  4 Heather Gray Fabric                  4.69
##  5 Configuration: Fire TV Stick         4.59
##  6 Black  Show                          4.49
##  7 Black  Dot                           4.45
##  8 White  Dot                           4.42
##  9 Black  Plus                          4.37
## 10 White  Plus                          4.36
## 11 Sandstone Fabric                     4.36
## 12 White  Spot                          4.31
```

```
## 13 Black  Spot                        4.31
## 14 White  Show                        4.28
## 15 Black                              4.23
## 16 White                              4.14
```

```r
highvar <- variation_ratings %>%
  slice(1)
highvar
```

```
## # A tibble: 1 x 2
##   variation      average_rating
##   <chr>                   <dbl>
## 1 Walnut Finish            4.89
```

```r
ggplot(variation_ratings, aes(x = reorder(variation, -average_rating), y = average_rating, fill = variat
  geom_bar(stat = "identity") +
  labs(title = "Average Rating by Product Variation",
       x = "Product Variation",
       y = "Average Rating") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  guides(fill = FALSE)
```


Average Rating by Product Variation