HW2

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Exercise1

```
## Load the library
library(ggplot2)
## Activate the mpg data.frame provided by ggplot2
data(mpg)
## New versions of ggplot provide a tibble and have all character variables, while ## older were data f
## to show how most data.frames treat character variables.
mpg <- as.data.frame(mpg)
mpg$manufacturer <- factor(mpg$manufacturer)
```

1. Inspect the structure of mpg data.frame. Note the kind of data provided.

```
str(mpg)
```

```
## 'data.frame':    234 obs. of  11 variables:
##  $ manufacturer: Factor w/ 15 levels "audi","chevrolet",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ 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" ...
```

2. Run the summary function to learn more about the variables.

```
summary(mpg)
```

```
##   manufacturer     model               displ            year
##  dodge     :37   Length:234         Min.   :1.600   Min.   :1999
##  toyota    :34   Class :character   1st Qu.:2.400   1st Qu.:1999
##  volkswagen:27   Mode  :character   Median :3.300   Median :2004
##  ford      :25                      Mean   :3.472   Mean   :2004
##  chevrolet :19                      3rd Qu.:4.600   3rd Qu.:2008
##  audi      :18                      Max.   :7.000   Max.   :2008
##  (Other)   :74
##       cyl           trans               drv                 cty
##  Min.   :4.000   Length:234         Length:234         Min.   : 9.00
##  1st Qu.:4.000   Class :character   Class :character   1st Qu.:14.00
##  Median :6.000   Mode  :character   Mode  :character   Median :17.00
##  Mean   :5.889                                         Mean   :16.86
##  3rd Qu.:8.000                                         3rd Qu.:19.00
```

```
##  Max.   :8.000                                    Max.   :35.00
##
##      hwy              fl              class
##  Min.   :12.00   Length:234         Length:234
##  1st Qu.:18.00   Class :character   Class :character
##  Median :24.00   Mode  :character   Mode  :character
##  Mean   :23.44
##  3rd Qu.:27.00
##  Max.   :44.00
##
```

3. Get a subset of the data.frame including all cars that are not ford nor audi.

```
mpgsub <- subset.data.frame(mpg, manufacturer != "ford" & manufacturer != "audi")
mpgsub
```

```
##       manufacturer               model displ year cyl       trans drv cty
## 19       chevrolet   c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  14
## 20       chevrolet   c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  11
## 21       chevrolet   c1500 suburban 2wd   5.3 2008   8    auto(l4)   r  14
## 22       chevrolet   c1500 suburban 2wd   5.7 1999   8    auto(l4)   r  13
## 23       chevrolet   c1500 suburban 2wd   6.0 2008   8    auto(l4)   r  12
## 24       chevrolet            corvette   5.7 1999   8 manual(m6)   r  16
## 25       chevrolet            corvette   5.7 1999   8    auto(l4)   r  15
## 26       chevrolet            corvette   6.2 2008   8 manual(m6)   r  16
## 27       chevrolet            corvette   6.2 2008   8    auto(s6)   r  15
## 28       chevrolet            corvette   7.0 2008   8 manual(m6)   r  15
## 29       chevrolet      k1500 tahoe 4wd   5.3 2008   8    auto(l4)   4  14
## 30       chevrolet      k1500 tahoe 4wd   5.3 2008   8    auto(l4)   4  11
## 31       chevrolet      k1500 tahoe 4wd   5.7 1999   8    auto(l4)   4  11
## 32       chevrolet      k1500 tahoe 4wd   6.5 1999   8    auto(l4)   4  14
## 33       chevrolet              malibu   2.4 1999   4    auto(l4)   f  19
## 34       chevrolet              malibu   2.4 2008   4    auto(l4)   f  22
## 35       chevrolet              malibu   3.1 1999   6    auto(l4)   f  18
## 36       chevrolet              malibu   3.5 2008   6    auto(l4)   f  18
## 37       chevrolet              malibu   3.6 2008   6    auto(s6)   f  17
## 38           dodge         caravan 2wd   2.4 1999   4    auto(l3)   f  18
## 39           dodge         caravan 2wd   3.0 1999   6    auto(l4)   f  17
## 40           dodge         caravan 2wd   3.3 1999   6    auto(l4)   f  16
## 41           dodge         caravan 2wd   3.3 1999   6    auto(l4)   f  16
## 42           dodge         caravan 2wd   3.3 2008   6    auto(l4)   f  17
## 43           dodge         caravan 2wd   3.3 2008   6    auto(l4)   f  17
## 44           dodge         caravan 2wd   3.3 2008   6    auto(l4)   f  11
## 45           dodge         caravan 2wd   3.8 1999   6    auto(l4)   f  15
## 46           dodge         caravan 2wd   3.8 1999   6    auto(l4)   f  15
## 47           dodge         caravan 2wd   3.8 2008   6    auto(l6)   f  16
## 48           dodge         caravan 2wd   4.0 2008   6    auto(l6)   f  16
## 49           dodge     dakota pickup 4wd   3.7 2008   6 manual(m6)   4  15
## 50           dodge     dakota pickup 4wd   3.7 2008   6    auto(l4)   4  14
## 51           dodge     dakota pickup 4wd   3.9 1999   6    auto(l4)   4  13
## 52           dodge     dakota pickup 4wd   3.9 1999   6 manual(m5)   4  14
## 53           dodge     dakota pickup 4wd   4.7 2008   8    auto(l5)   4  14
## 54           dodge     dakota pickup 4wd   4.7 2008   8    auto(l5)   4  14
## 55           dodge     dakota pickup 4wd   4.7 2008   8    auto(l5)   4   9
```

```
## 56        dodge      dakota pickup 4wd 5.2 1999 8 manual(m5) 4 11
## 57        dodge      dakota pickup 4wd 5.2 1999 8   auto(14) 4 11
## 58        dodge            durango 4wd 3.9 1999 6   auto(14) 4 13
## 59        dodge            durango 4wd 4.7 2008 8   auto(15) 4 13
## 60        dodge            durango 4wd 4.7 2008 8   auto(15) 4  9
## 61        dodge            durango 4wd 4.7 2008 8   auto(15) 4 13
## 62        dodge            durango 4wd 5.2 1999 8   auto(14) 4 11
## 63        dodge            durango 4wd 5.7 2008 8   auto(15) 4 13
## 64        dodge            durango 4wd 5.9 1999 8   auto(14) 4 11
## 65        dodge    ram 1500 pickup 4wd 4.7 2008 8 manual(m6) 4 12
## 66        dodge    ram 1500 pickup 4wd 4.7 2008 8   auto(15) 4  9
## 67        dodge    ram 1500 pickup 4wd 4.7 2008 8   auto(15) 4 13
## 68        dodge    ram 1500 pickup 4wd 4.7 2008 8   auto(15) 4 13
## 69        dodge    ram 1500 pickup 4wd 4.7 2008 8 manual(m6) 4 12
## 70        dodge    ram 1500 pickup 4wd 4.7 2008 8 manual(m6) 4  9
## 71        dodge    ram 1500 pickup 4wd 5.2 1999 8   auto(14) 4 11
## 72        dodge    ram 1500 pickup 4wd 5.2 1999 8 manual(m5) 4 11
## 73        dodge    ram 1500 pickup 4wd 5.7 2008 8   auto(15) 4 13
## 74        dodge    ram 1500 pickup 4wd 5.9 1999 8   auto(14) 4 11
## 100       honda                  civic 1.6 1999 4 manual(m5) f 28
## 101       honda                  civic 1.6 1999 4   auto(14) f 24
## 102       honda                  civic 1.6 1999 4 manual(m5) f 25
## 103       honda                  civic 1.6 1999 4 manual(m5) f 23
## 104       honda                  civic 1.6 1999 4   auto(14) f 24
## 105       honda                  civic 1.8 2008 4 manual(m5) f 26
## 106       honda                  civic 1.8 2008 4   auto(15) f 25
## 107       honda                  civic 1.8 2008 4   auto(15) f 24
## 108       honda                  civic 2.0 2008 4 manual(m6) f 21
## 109      hyundai                 sonata 2.4 1999 4   auto(14) f 18
## 110      hyundai                 sonata 2.4 1999 4 manual(m5) f 18
## 111      hyundai                 sonata 2.4 2008 4   auto(14) f 21
## 112      hyundai                 sonata 2.4 2008 4 manual(m5) f 21
## 113      hyundai                 sonata 2.5 1999 6   auto(14) f 18
## 114      hyundai                 sonata 2.5 1999 6 manual(m5) f 18
## 115      hyundai                 sonata 3.3 2008 6   auto(15) f 19
## 116      hyundai                tiburon 2.0 1999 4   auto(14) f 19
## 117      hyundai                tiburon 2.0 1999 4 manual(m5) f 19
## 118      hyundai                tiburon 2.0 2008 4 manual(m5) f 20
## 119      hyundai                tiburon 2.0 2008 4   auto(14) f 20
## 120      hyundai                tiburon 2.7 2008 6   auto(14) f 17
## 121      hyundai                tiburon 2.7 2008 6 manual(m6) f 16
## 122      hyundai                tiburon 2.7 2008 6 manual(m5) f 17
## 123         jeep     grand cherokee 4wd 3.0 2008 6   auto(15) 4 17
## 124         jeep     grand cherokee 4wd 3.7 2008 6   auto(15) 4 15
## 125         jeep     grand cherokee 4wd 4.0 1999 6   auto(14) 4 15
## 126         jeep     grand cherokee 4wd 4.7 1999 8   auto(14) 4 14
## 127         jeep     grand cherokee 4wd 4.7 2008 8   auto(15) 4  9
## 128         jeep     grand cherokee 4wd 4.7 2008 8   auto(15) 4 14
## 129         jeep     grand cherokee 4wd 5.7 2008 8   auto(15) 4 13
## 130         jeep     grand cherokee 4wd 6.1 2008 8   auto(15) 4 11
## 131   land rover            range rover 4.0 1999 8   auto(14) 4 11
## 132   land rover            range rover 4.2 2008 8   auto(s6) 4 12
## 133   land rover            range rover 4.4 2008 8   auto(s6) 4 12
## 134   land rover            range rover 4.6 1999 8   auto(14) 4 11
```

```
## 135     lincoln    navigator 2wd  5.4 1999  8   auto(l4)  r  11
## 136     lincoln    navigator 2wd  5.4 1999  8   auto(l4)  r  11
## 137     lincoln    navigator 2wd  5.4 2008  8   auto(l6)  r  12
## 138     mercury    mountaineer 4wd 4.0 1999 6   auto(l5)  4  14
## 139     mercury    mountaineer 4wd 4.0 2008 6   auto(l5)  4  13
## 140     mercury    mountaineer 4wd 4.6 2008 8   auto(l6)  4  13
## 141     mercury    mountaineer 4wd 5.0 1999 8   auto(l4)  4  13
## 142      nissan          altima  2.4 1999  4 manual(m5)  f  21
## 143      nissan          altima  2.4 1999  4   auto(l4)  f  19
## 144      nissan          altima  2.5 2008  4   auto(av)  f  23
## 145      nissan          altima  2.5 2008  4 manual(m6)  f  23
## 146      nissan          altima  3.5 2008  6 manual(m6)  f  19
## 147      nissan          altima  3.5 2008  6   auto(av)  f  19
## 148      nissan          maxima  3.0 1999  6   auto(l4)  f  18
## 149      nissan          maxima  3.0 1999  6 manual(m5)  f  19
## 150      nissan          maxima  3.5 2008  6   auto(av)  f  19
## 151      nissan    pathfinder 4wd 3.3 1999 6   auto(l4)  4  14
## 152      nissan    pathfinder 4wd 3.3 1999 6 manual(m5)  4  15
## 153      nissan    pathfinder 4wd 4.0 2008 6   auto(l5)  4  14
## 154      nissan    pathfinder 4wd 5.6 2008 8   auto(s5)  4  12
## 155     pontiac      grand prix  3.1 1999  6   auto(l4)  f  18
## 156     pontiac      grand prix  3.8 1999  6   auto(l4)  f  16
## 157     pontiac      grand prix  3.8 1999  6   auto(l4)  f  17
## 158     pontiac      grand prix  3.8 2008  6   auto(l4)  f  18
## 159     pontiac      grand prix  5.3 2008  8   auto(s4)  f  16
## 160      subaru    forester awd  2.5 1999  4 manual(m5)  4  18
## 161      subaru    forester awd  2.5 1999  4   auto(l4)  4  18
## 162      subaru    forester awd  2.5 2008  4 manual(m5)  4  20
## 163      subaru    forester awd  2.5 2008  4 manual(m5)  4  19
## 164      subaru    forester awd  2.5 2008  4   auto(l4)  4  20
## 165      subaru    forester awd  2.5 2008  4   auto(l4)  4  18
## 166      subaru     impreza awd  2.2 1999  4   auto(l4)  4  21
## 167      subaru     impreza awd  2.2 1999  4 manual(m5)  4  19
## 168      subaru     impreza awd  2.5 1999  4 manual(m5)  4  19
## 169      subaru     impreza awd  2.5 1999  4   auto(l4)  4  19
## 170      subaru     impreza awd  2.5 2008  4   auto(s4)  4  20
## 171      subaru     impreza awd  2.5 2008  4   auto(s4)  4  20
## 172      subaru     impreza awd  2.5 2008  4 manual(m5)  4  19
## 173      subaru     impreza awd  2.5 2008  4 manual(m5)  4  20
## 174      toyota      4runner 4wd  2.7 1999 4 manual(m5)  4  15
## 175      toyota      4runner 4wd  2.7 1999 4   auto(l4)  4  16
## 176      toyota      4runner 4wd  3.4 1999 6   auto(l4)  4  15
## 177      toyota      4runner 4wd  3.4 1999 6 manual(m5)  4  15
## 178      toyota      4runner 4wd  4.0 2008 6   auto(l5)  4  16
## 179      toyota      4runner 4wd  4.7 2008 8   auto(l5)  4  14
## 180      toyota           camry  2.2 1999  4 manual(m5)  f  21
## 181      toyota           camry  2.2 1999  4   auto(l4)  f  21
## 182      toyota           camry  2.4 2008  4 manual(m5)  f  21
## 183      toyota           camry  2.4 2008  4   auto(l5)  f  21
## 184      toyota           camry  3.0 1999  6   auto(l4)  f  18
## 185      toyota           camry  3.0 1999  6 manual(m5)  f  18
## 186      toyota           camry  3.5 2008  6   auto(s6)  f  19
## 187      toyota     camry solara  2.2 1999 4   auto(l4)  f  21
## 188      toyota     camry solara  2.2 1999 4 manual(m5)  f  21
```

```
## 189         toyota          camry solara 2.4 2008 4 manual(m5) f 21
## 190         toyota          camry solara 2.4 2008 4   auto(s5) f 22
## 191         toyota          camry solara 3.0 1999 6   auto(l4) f 18
## 192         toyota          camry solara 3.0 1999 6 manual(m5) f 18
## 193         toyota          camry solara 3.3 2008 6   auto(s5) f 18
## 194         toyota               corolla 1.8 1999 4   auto(l3) f 24
## 195         toyota               corolla 1.8 1999 4   auto(l4) f 24
## 196         toyota               corolla 1.8 1999 4 manual(m5) f 26
## 197         toyota               corolla 1.8 2008 4 manual(m5) f 28
## 198         toyota               corolla 1.8 2008 4   auto(l4) f 26
## 199         toyota land cruiser wagon 4wd 4.7 1999 8   auto(l4) 4 11
## 200         toyota land cruiser wagon 4wd 5.7 2008 8   auto(s6) 4 13
## 201         toyota      toyota tacoma 4wd 2.7 1999 4 manual(m5) 4 15
## 202         toyota      toyota tacoma 4wd 2.7 1999 4   auto(l4) 4 16
## 203         toyota      toyota tacoma 4wd 2.7 2008 4 manual(m5) 4 17
## 204         toyota      toyota tacoma 4wd 3.4 1999 6 manual(m5) 4 15
## 205         toyota      toyota tacoma 4wd 3.4 1999 6   auto(l4) 4 15
## 206         toyota      toyota tacoma 4wd 4.0 2008 6 manual(m6) 4 15
## 207         toyota      toyota tacoma 4wd 4.0 2008 6   auto(l5) 4 16
## 208     volkswagen                   gti 2.0 1999 4 manual(m5) f 21
## 209     volkswagen                   gti 2.0 1999 4   auto(l4) f 19
## 210     volkswagen                   gti 2.0 2008 4 manual(m6) f 21
## 211     volkswagen                   gti 2.0 2008 4   auto(s6) f 22
## 212     volkswagen                   gti 2.8 1999 6 manual(m5) f 17
## 213     volkswagen                 jetta 1.9 1999 4 manual(m5) f 33
## 214     volkswagen                 jetta 2.0 1999 4 manual(m5) f 21
## 215     volkswagen                 jetta 2.0 1999 4   auto(l4) f 19
## 216     volkswagen                 jetta 2.0 2008 4   auto(s6) f 22
## 217     volkswagen                 jetta 2.0 2008 4 manual(m6) f 21
## 218     volkswagen                 jetta 2.5 2008 5   auto(s6) f 21
## 219     volkswagen                 jetta 2.5 2008 5 manual(m5) f 21
## 220     volkswagen                 jetta 2.8 1999 6   auto(l4) f 16
## 221     volkswagen                 jetta 2.8 1999 6 manual(m5) f 17
## 222     volkswagen             new beetle 1.9 1999 4 manual(m5) f 35
## 223     volkswagen             new beetle 1.9 1999 4   auto(l4) f 29
## 224     volkswagen             new beetle 2.0 1999 4 manual(m5) f 21
## 225     volkswagen             new beetle 2.0 1999 4   auto(l4) f 19
## 226     volkswagen             new beetle 2.5 2008 5 manual(m5) f 20
## 227     volkswagen             new beetle 2.5 2008 5   auto(s6) f 20
## 228     volkswagen                passat 1.8 1999 4 manual(m5) f 21
## 229     volkswagen                passat 1.8 1999 4   auto(l5) f 18
## 230     volkswagen                passat 2.0 2008 4   auto(s6) f 19
## 231     volkswagen                passat 2.0 2008 4 manual(m6) f 21
## 232     volkswagen                passat 2.8 1999 6   auto(l5) f 16
## 233     volkswagen                passat 2.8 1999 6 manual(m5) f 18
## 234     volkswagen                passat 3.6 2008 6   auto(s6) f 17
##     hwy fl     class
## 19   20 r        suv
## 20   15 e        suv
## 21   20 r        suv
## 22   17 r        suv
## 23   17 r        suv
## 24   26 p     2seater
## 25   23 p     2seater
```

```
## 26     26   p     2seater
## 27     25   p     2seater
## 28     24   p     2seater
## 29     19   r         suv
## 30     14   e         suv
## 31     15   r         suv
## 32     17   d         suv
## 33     27   r     midsize
## 34     30   r     midsize
## 35     26   r     midsize
## 36     29   r     midsize
## 37     26   r     midsize
## 38     24   r     minivan
## 39     24   r     minivan
## 40     22   r     minivan
## 41     22   r     minivan
## 42     24   r     minivan
## 43     24   r     minivan
## 44     17   e     minivan
## 45     22   r     minivan
## 46     21   r     minivan
## 47     23   r     minivan
## 48     23   r     minivan
## 49     19   r      pickup
## 50     18   r      pickup
## 51     17   r      pickup
## 52     17   r      pickup
## 53     19   r      pickup
## 54     19   r      pickup
## 55     12   e      pickup
## 56     17   r      pickup
## 57     15   r      pickup
## 58     17   r         suv
## 59     17   r         suv
## 60     12   e         suv
## 61     17   r         suv
## 62     16   r         suv
## 63     18   r         suv
## 64     15   r         suv
## 65     16   r      pickup
## 66     12   e      pickup
## 67     17   r      pickup
## 68     17   r      pickup
## 69     16   r      pickup
## 70     12   e      pickup
## 71     15   r      pickup
## 72     16   r      pickup
## 73     17   r      pickup
## 74     15   r      pickup
## 100    33   r  subcompact
## 101    32   r  subcompact
## 102    32   r  subcompact
## 103    29   p  subcompact
## 104    32   r  subcompact
```

```
## 105   34   r subcompact
## 106   36   r subcompact
## 107   36   c subcompact
## 108   29   p subcompact
## 109   26   r    midsize
## 110   27   r    midsize
## 111   30   r    midsize
## 112   31   r    midsize
## 113   26   r    midsize
## 114   26   r    midsize
## 115   28   r    midsize
## 116   26   r subcompact
## 117   29   r subcompact
## 118   28   r subcompact
## 119   27   r subcompact
## 120   24   r subcompact
## 121   24   r subcompact
## 122   24   r subcompact
## 123   22   d       suv
## 124   19   r       suv
## 125   20   r       suv
## 126   17   r       suv
## 127   12   e       suv
## 128   19   r       suv
## 129   18   r       suv
## 130   14   p       suv
## 131   15   p       suv
## 132   18   r       suv
## 133   18   r       suv
## 134   15   p       suv
## 135   17   r       suv
## 136   16   p       suv
## 137   18   r       suv
## 138   17   r       suv
## 139   19   r       suv
## 140   19   r       suv
## 141   17   r       suv
## 142   29   r   compact
## 143   27   r   compact
## 144   31   r    midsize
## 145   32   r    midsize
## 146   27   p    midsize
## 147   26   p    midsize
## 148   26   r    midsize
## 149   25   r    midsize
## 150   25   p    midsize
## 151   17   r       suv
## 152   17   r       suv
## 153   20   p       suv
## 154   18   p       suv
## 155   26   r    midsize
## 156   26   p    midsize
## 157   27   r    midsize
## 158   28   r    midsize
```

```
## 159  25  p     midsize
## 160  25  r        suv
## 161  24  r        suv
## 162  27  r        suv
## 163  25  p        suv
## 164  26  r        suv
## 165  23  p        suv
## 166  26  r subcompact
## 167  26  r subcompact
## 168  26  r subcompact
## 169  26  r subcompact
## 170  25  p   compact
## 171  27  r   compact
## 172  25  p   compact
## 173  27  r   compact
## 174  20  r        suv
## 175  20  r        suv
## 176  19  r        suv
## 177  17  r        suv
## 178  20  r        suv
## 179  17  r        suv
## 180  29  r    midsize
## 181  27  r    midsize
## 182  31  r    midsize
## 183  31  r    midsize
## 184  26  r    midsize
## 185  26  r    midsize
## 186  28  r    midsize
## 187  27  r   compact
## 188  29  r   compact
## 189  31  r   compact
## 190  31  r   compact
## 191  26  r   compact
## 192  26  r   compact
## 193  27  r   compact
## 194  30  r   compact
## 195  33  r   compact
## 196  35  r   compact
## 197  37  r   compact
## 198  35  r   compact
## 199  15  r        suv
## 200  18  r        suv
## 201  20  r     pickup
## 202  20  r     pickup
## 203  22  r     pickup
## 204  17  r     pickup
## 205  19  r     pickup
## 206  18  r     pickup
## 207  20  r     pickup
## 208  29  r   compact
## 209  26  r   compact
## 210  29  p   compact
## 211  29  p   compact
## 212  24  r   compact
```

```
## 213  44  d    compact
## 214  29  r    compact
## 215  26  r    compact
## 216  29  p    compact
## 217  29  p    compact
## 218  29  r    compact
## 219  29  r    compact
## 220  23  r    compact
## 221  24  r    compact
## 222  44  d subcompact
## 223  41  d subcompact
## 224  29  r subcompact
## 225  26  r subcompact
## 226  28  r subcompact
## 227  29  r subcompact
## 228  29  p    midsize
## 229  29  p    midsize
## 230  28  p    midsize
## 231  29  p    midsize
## 232  26  p    midsize
## 233  26  p    midsize
## 234  26  p    midsize
```

4. Determine if the manufacturer variable (that is a factor) in your subset has or not dropped the now removed manufacurers audi and ford.

```r
c("audi", "ford") %in% mpgsub$manufacturer
```

```
## [1] FALSE FALSE
```

5. Devise a strategy to assure that the above factor has dropped the levels that have no elements

```r
mpgsub$manufacturer <- droplevels(mpgsub$manufacturer)
levels(mpgsub$manufacturer)
```

```
##  [1] "chevrolet"  "dodge"      "honda"      "hyundai"    "jeep"
##  [6] "land rover" "lincoln"    "mercury"    "nissan"     "pontiac"
## [11] "subaru"     "toyota"     "volkswagen"
```

6. Further subset the data making sure that only front drive midsize cars model 2008 with at least 20 highway or city miles per gallon are included.

```r
mpgsub2 <- subset.data.frame(mpgsub, drv == "f" & class == "midsize" & year == 2008 &
(hwy >= 20 | cty >= 20))
mpgsub2$manufacturer <- droplevels(mpgsub2$manufacturer)
mpgsub2
```

```
##     manufacturer    model displ year cyl      trans drv cty hwy fl
## 34     chevrolet   malibu   2.4 2008   4    auto(14)   f  22  30  r
## 36     chevrolet   malibu   3.5 2008   6    auto(14)   f  18  29  r
## 37     chevrolet   malibu   3.6 2008   6    auto(s6)   f  17  26  r
## 111      hyundai   sonata   2.4 2008   4    auto(14)   f  21  30  r
## 112      hyundai   sonata   2.4 2008   4 manual(m5)   f  21  31  r
```

```
## 115      hyundai      sonata  3.3 2008   6    auto(15)   f  19  28  r
## 144       nissan      altima  2.5 2008   4    auto(av)   f  23  31  r
## 145       nissan      altima  2.5 2008   4 manual(m6)    f  23  32  r
## 146       nissan      altima  3.5 2008   6 manual(m6)    f  19  27  p
## 147       nissan      altima  3.5 2008   6    auto(av)   f  19  26  p
## 150       nissan      maxima  3.5 2008   6    auto(av)   f  19  25  p
## 158      pontiac grand prix   3.8 2008   6    auto(14)   f  18  28  r
## 159      pontiac grand prix   5.3 2008   8    auto(s4)   f  16  25  p
## 182       toyota       camry  2.4 2008   4 manual(m5)    f  21  31  r
## 183       toyota       camry  2.4 2008   4    auto(15)   f  21  31  r
## 186       toyota       camry  3.5 2008   6    auto(s6)   f  19  28  r
## 230   volkswagen      passat  2.0 2008   4    auto(s6)   f  19  28  p
## 231   volkswagen      passat  2.0 2008   4 manual(m6)    f  21  29  p
## 234   volkswagen      passat  3.6 2008   6    auto(s6)   f  17  26  p
##          class
## 34   midsize
## 36   midsize
## 37   midsize
## 111 midsize
## 112 midsize
## 115 midsize
## 144 midsize
## 145 midsize
## 146 midsize
## 147 midsize
## 150 midsize
## 158 midsize
## 159 midsize
## 182 midsize
## 183 midsize
## 186 midsize
## 230 midsize
## 231 midsize
## 234 midsize
```

7. Determine how many cars per manufacturer satisfy these constraints. Only show manufacturers with at least one vehicle.

```
table(mpgsub2$manufacturer)
```

```
##
##   chevrolet      hyundai      nissan      pontiac      toyota volkswagen
##           3            3           5            2           3          3
```

8. Only show the manufacturer(s) with more cars (Note: your solution should also contemplate the possibility of a tie for the first place.)
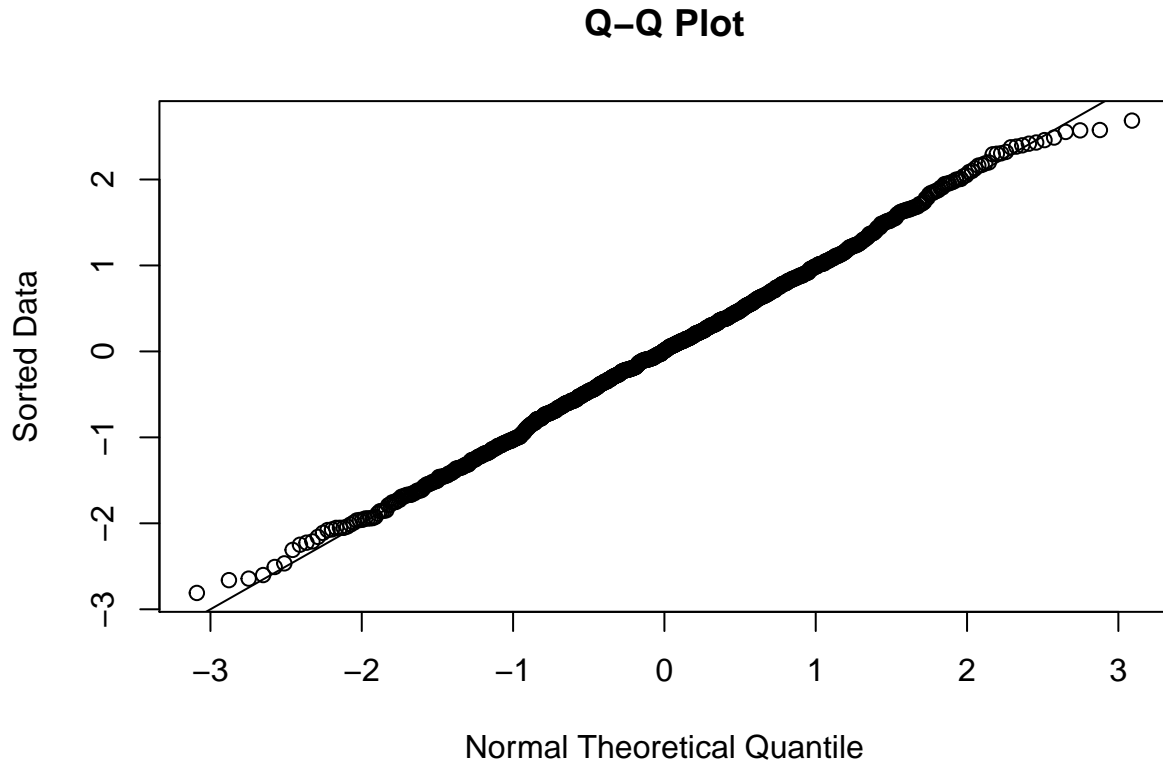
```
total <- table(mpg$manufacturer)
row.names(total)[which(total == max(total))]
```

```
## [1] "dodge"
```

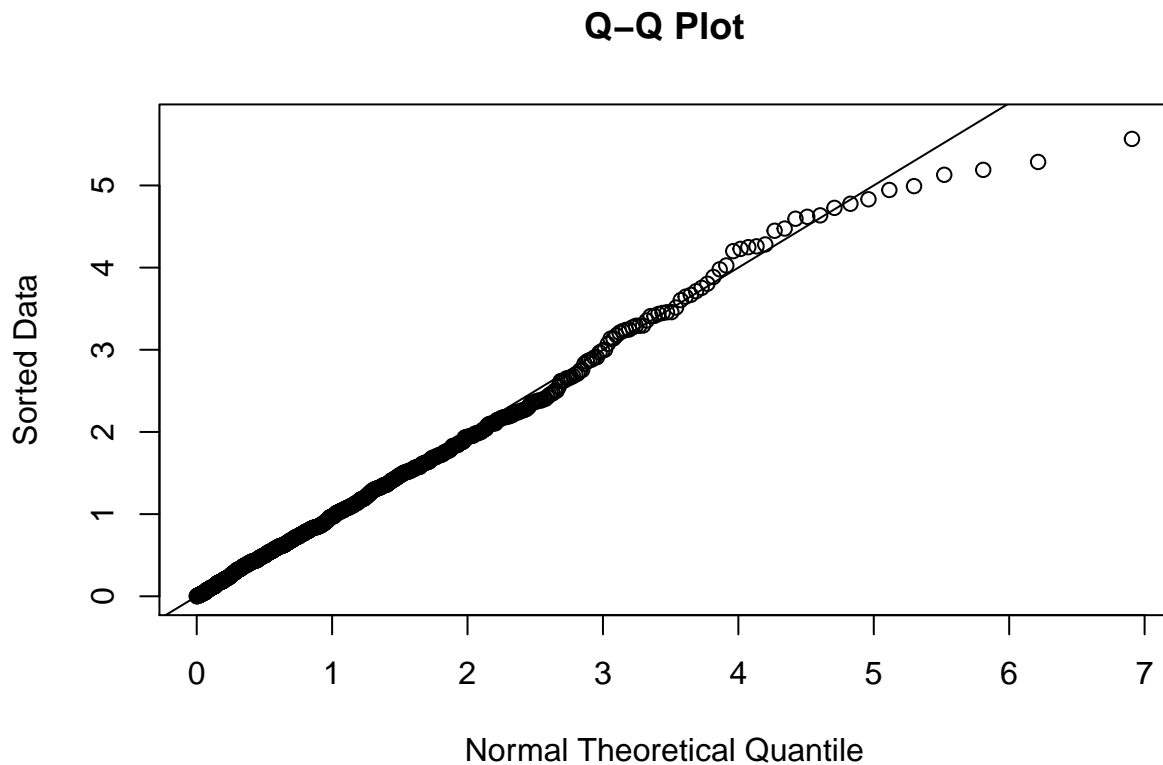10

Exercise2

```r
set.seed(123)
r <- rnorm(1000)

plot(qnorm((1:(length(r)-1))/(length(r)-1)), sort(r[-which.max(r)]),main = "Q-Q Plot",
     xlab = "Normal Theoretical Quantile", ylab = "Sorted Data")
abline(a = 0, b = 1)
```
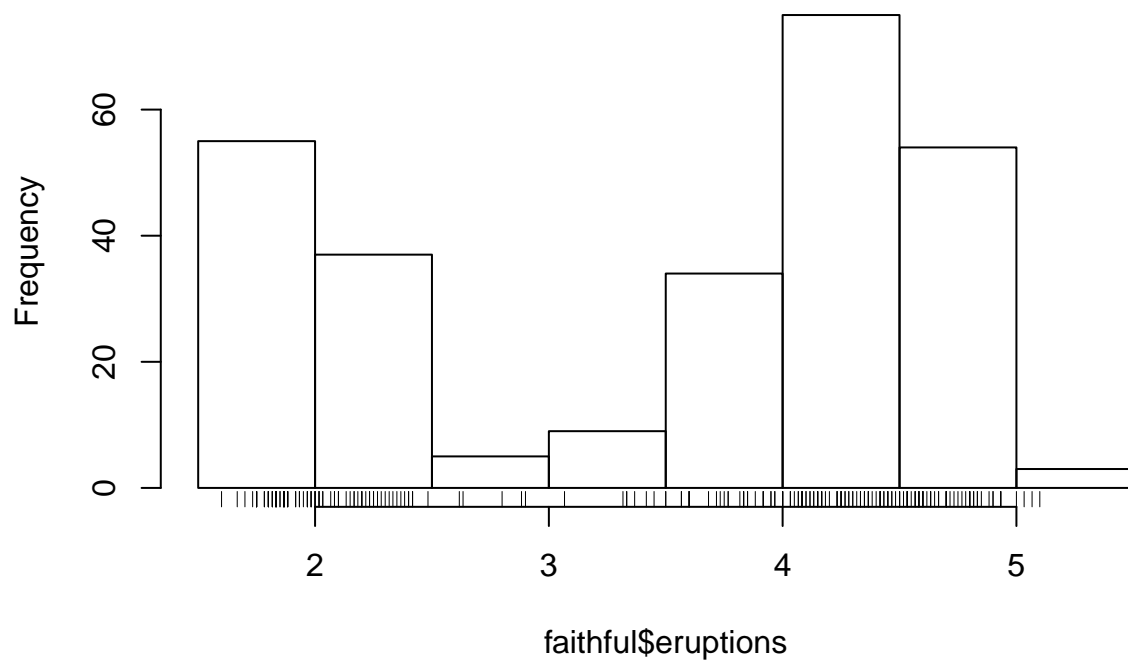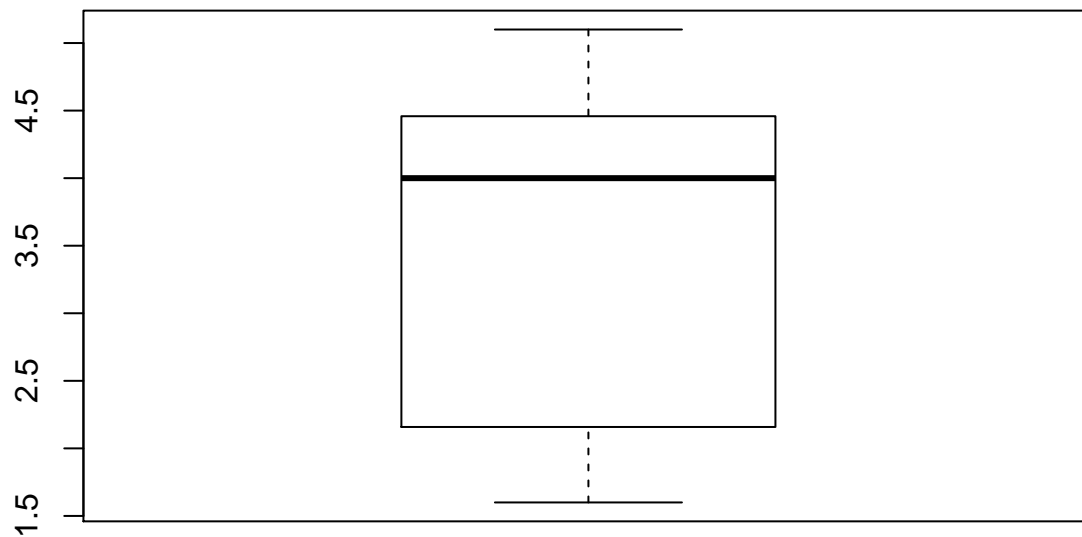
Q–Q Plot

Exercise3

```r
set.seed(123)
r <- rgamma(1000, shape = 1)

plot(qgamma((1:(length(r)-1))/(length(r)-1), shape = 1), sort(r[-which.max(r)]),
     main = "Q-Q Plot", xlab = "Normal Theoretical Quantile", ylab = "Sorted Data")
abline(a = 0, b = 1)
```

Q–Q Plot

Exercise4

```
stem(faithful$eruptions)
```

```
##
##   The decimal point is 1 digit(s) to the left of the |
##
##   16 | 070355555588
##   18 | 0000222333333355777777778888822335777888
##   20 | 00002223378800035778
##   22 | 0002335578023578
##   24 | 00228
##   26 | 23
##   28 | 080
##   30 | 7
##   32 | 2337
##   34 | 250077
##   36 | 0000823577
##   38 | 2333335582225577
##   40 | 000000335778888800223355557778
##   42 | 03335555778800233333555577778
##   44 | 022223355577800000000233333357778888
##   46 | 000023335770000023578
##   48 | 00000022335800333
##   50 | 0370
```

```
hist(faithful$eruptions)
rug(faithful$eruptions)
```

Histogram of faithful$eruptions

faithful$eruptions

```r
boxplot(faithful$eruptions)
```



```r
shapiro.test(faithful$eruptions)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  faithful$eruptions
## W = 0.84592, p-value = 9.036e-16
```

```r
ks.test(faithful$eruptions, pnorm)
```

```
## Warning in ks.test(faithful$eruptions, pnorm): ties should not be present
```

```
## for the Kolmogorov-Smirnov test

##
##   One-sample Kolmogorov-Smirnov test
##
## data:  faithful$eruptions
## D = 0.94857, p-value < 2.2e-16
## alternative hypothesis: two-sided
```

Both p-values are much smaller than 0.5 so eruption is not normally distribution.

Exercise5

```
library(UsingR)
```

```
## Loading required package: MASS
```

```
## Loading required package: HistData
```

```
## Loading required package: Hmisc
```

```
## Loading required package: lattice
```

```
## Loading required package: survival
```

```
## Loading required package: Formula
```

```
##
## Attaching package: 'Hmisc'
```

```
## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
##
## Attaching package: 'UsingR'
```

```
## The following object is masked from 'package:survival':
##
##     cancer
```
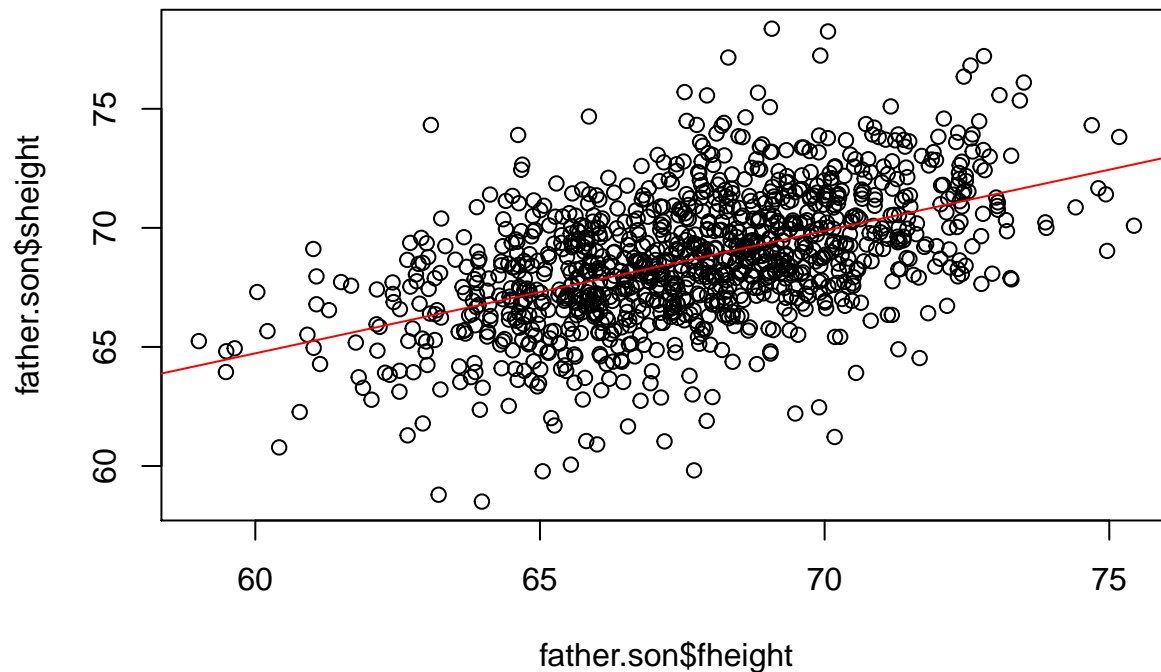
```
data(father.son)

lmfs <- lm(sheight ~ fheight, data = father.son)
slmfs <- summary(lmfs)
anlmfs <- anova(lmfs)
```

1. Extract the coefficients of the regression line from lmfs, and add the regression line (in red) to the scatterplot. Hint: use function abline (see help)
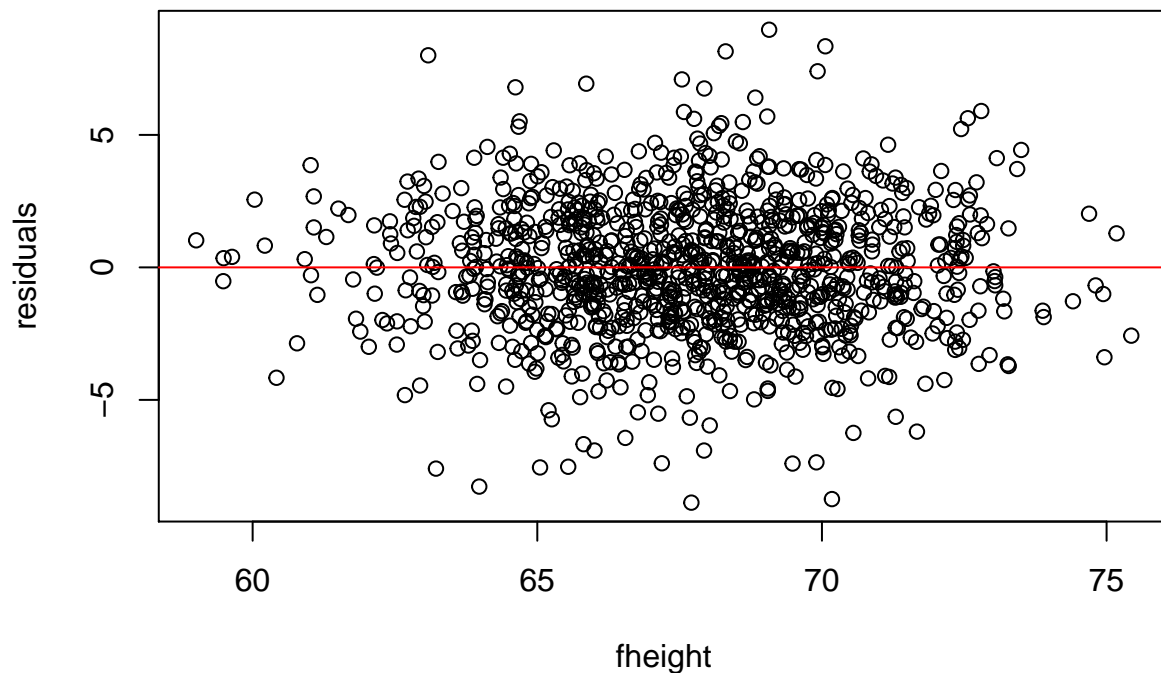
```
coefficients(lmfs)
```

```
## (Intercept)      fheight
##   33.886604     0.514093
```

```
plot(father.son$fheight, father.son$sheight)
abline(reg = lmfs,col = "red")
```

####2. Plot the father heights on x and the residuals in y. Add a horizontal line at 0.

```
plot(father.son$fheight, lmfs$residuals, xlab = "fheight", ylab = "residuals")
abline(0,0, col = "red")
```


3. Extract the fstatistic from slmfs and perform the calculation to obtain the p-value of the anova of the regression (i.e., the line that says: F-statistic: 361.2 on 1 and 1076 DF, p-value: < 2.2e-16. (Hint: use the function pf that gives you the cumulative probability of an F distribution).

```r
pf(slmfs$fstatistic["value"],slmfs$fstatistic["numdf"],slmfs$fstatistic["dendf"],lower.tail = F)
```

```
##        value
## 1.121268e-69
```

4. Extract the p-value directly from anlmfs.

```r
anlmfs$Pr
```

```
## [1] 1.121268e-69          NA
```