STAT 33B Workbook 2

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This workbook is due **Sep 10, 2020** by 11:59pm PT.

The workbook is organized into sections that correspond to the lecture videos for the week. Watch a video, then do the corresponding exercises *before* moving on to the next video.

Workbooks are graded for completeness, so as long as you make a clear effort to solve each problem, you'll get full credit. That said, make sure you understand the concepts here, because they're likely to reappear in homeworks, quizzes, and later lectures.

As you work, write your answers in this notebook. Answer questions with complete sentences, and put code in code chunks. You can make as many new code chunks as you like.

In the notebook, you can run the line of code where the cursor is by pressing `Ctrl` + `Enter` on Windows or `Cmd` + `Enter` on Mac OS X. You can run an entire code chunk by clicking on the green arrow in the upper right corner of the code chunk.

Please do not delete the exercises already in this notebook, because it may interfere with our grading tools.

You need to submit your work in two places:

- Submit this Rmd file with your edits on bCourses.
- Knit and submit the generated PDF file on Gradescope.

File Systems

Watch the "File Systems" lecture video.

Exercise 1

For each of the following paths, say whether the path is absolute or relative, and explain how you can tell.

1. `"./documents"`
2. `"/Users/Jun/doggos_to_pet.md"`
3. `"TODO.md"`

YOUR ANSWER GOES HERE:

The first and third paths is relative path since it starts from a directory not the home directory. The second path is an absolute path as it starts from a home directory.

The R Working Directory

Watch the "The R Working Directory" lecture video.

Exercise 2

1. What's the root directory called on your computer?
2. What's the absolute path to the home directory on your computer?
3. Use R to count the total number of files in your home directory. Your code should return the result as a number.

YOUR ANSWER GOES HERE:

```
# the name of my home directory is called "yuanruizhu"
normalizePath("~") # the name of my home directory
```

```
## [1] "/Users/yuanruizhu"
```

```
length(list.files("~")) # find the number of files in the directory
```

```
## [1] 11
```

Data Frames

Watch the "Data Frames" lecture video.

Exercise 3

1. Load the dogs data set `dogs.rds` into R (this one has more than 10 rows).
2. What's the mean weight of the dogs? You can use the `na.rm` parameter in the `mean()` function to make the function ignore missing values.
3. The `which.min()` function returns the index of the minimum element of a vector. Which breed of dog has the shortest height?
4. Which breed of dog has the longest lifespan?

YOUR ANSWER GOES HERE:

```
dogs = readRDS("dogs.rds")
mean(dogs$weight, na.rm = TRUE)
```

```
## [1] 44.97093
```

```
which.min(dogs$height)
```

```
## [1] 16
```

```r
which.max(dogs$longevity)
```

```
## [1] 16
```

```r
dogs
```

```
##                                breed        group datadog popularity_all
## 1                       Border Collie      herding    3.64             45
## 2                     Border Terrier      terrier    3.61             80
## 3                           Brittany     sporting    3.54             30
## 4                      Cairn Terrier      terrier    3.53             59
## 5              Welsh Springer Spaniel     sporting    3.34            130
## 6              English Cocker Spaniel     sporting    3.33             63
## 7                      Cocker Spaniel     sporting    3.30             27
## 8                            Papillon          toy    3.26             38
## 9              Australian Cattle Dog      herding    3.25             60
## 10                 Shetland Sheepdog      herding    3.22             20
## 11                    Siberian Husky      working    3.22             16
## 12                        Lhasa Apso non-sporting    3.21             62
## 13                      Affenpinscher          toy    3.20            139
## 14                         Dachshund        hound    3.19              9
## 15               Miniature Schnauzer      terrier    3.19             12
## 16                         Chihuahua          toy    3.15             14
## 17               Australian Terrier      terrier    3.11            121
## 18                           Whippet        hound    3.11             57
## 19          English Springer Spaniel     sporting    3.09             29
## 20       West Highland White Terrier      terrier    3.08             35
## 21                 Bedlington Terrier      terrier    3.07            134
## 22                             Poodle non-sporting    3.04              8
## 23                      Bichon Frise non-sporting    3.03             39
## 24       German Shorthaired Pointer     sporting    3.03             15
## 25                           Pointer     sporting    3.03            115
## 26                  Tibetan Spaniel non-sporting    3.02            114
## 27                 Labrador Retriever     sporting    2.97              1
## 28                           Maltese          toy    2.93             23
## 29                        Pomeranian          toy    2.93             17
## 30                          Shih Tzu          toy    2.93             11
## 31               Australian Shepherd      herding    2.91             24
## 32                 Yorkshire Terrier          toy    2.85              5
## 33                       Irish Setter     sporting    2.84             70
## 34                     Pharaoh Hound        hound    2.81            151
## 35                   Brussels Griffon          toy    2.80             77
## 36                   Golden Retriever     sporting    2.80              4
## 37                           Samoyed      working    2.80             69
## 38                            Beagle        hound    2.79              3
## 39          Chesapeake Bay Retriever     sporting    2.78             46
## 40                   Tibetan Terrier non-sporting    2.75             86
## 41                     Gordon Setter     sporting    2.73             94
## 42                     English Setter     sporting    2.72             87
## 43                                Pug          toy    2.72             26
## 44                             Briard      herding    2.71            125
## 45                   Norfolk Terrier      terrier    2.71            120
```

```
## 46              Flat-Coated Retriever     sporting    2.70            90
## 47                     Boston Terrier non-sporting    2.61            22
## 48                  Doberman Pinscher      working    2.59            13
## 49                English Toy Spaniel          toy    2.59           129
## 50                   Belgian Tervuren      herding    2.57           108
## 51       Cavalier King Charles Spaniel          toy    2.57            21
## 52                           Dalmatian non-sporting    2.57            73
## 53                       Basset Hound        hound    2.54            41
## 54                             Basenji        hound    2.51            93
## 55                  Italian Greyhound          toy    2.49            65
## 56          Staffordshire Bull Terrier      terrier    2.48            76
## 57                Bouvier des Flandres      herding    2.47            83
## 58                Pembroke Welsh Corgi      herding    2.45            25
## 59                     Clumber Spaniel     sporting    2.44           133
## 60               Dandie Dinmont Terrier      terrier    2.42           160
## 61                               Saluki        hound    2.41           117
## 62                     Giant Schnauzer      working    2.38            95
## 63                           Greyhound        hound    2.29           140
## 64                     Scottish Terrier      terrier    2.27            54
## 65                           Rottweiler      working    2.24            10
## 66                   Kerry Blue Terrier      terrier    2.13           124
## 67                         Afghan Hound        hound    2.08            88
## 68                         Newfoundland      working    2.07            43
## 69                      German Shepherd      herding    2.06             2
## 70                             Pekingese          toy    2.05            64
## 71                  Old English Sheepdog      herding    2.04            84
## 72                                 Akita      working    1.95            47
## 73                   Rhodesian Ridgeback        hound    1.91            44
## 74                        French Bulldog non-sporting    1.90            18
## 75                               Borzoi        hound    1.89           102
## 76                 Bernese Mountain Dog      working    1.85            34
## 77                         Bull Terrier      terrier    1.85            51
## 78                                Boxer      working    1.83             7
## 79                    Alaskan Malamute      working    1.82            58
## 80                           Chow Chow non-sporting    1.76            68
## 81                          Bloodhound        hound    1.66            48
## 82                       Irish Wolfhound        hound    1.66            79
## 83                           Bullmastiff      working    1.64            40
## 84                              Mastiff      working    1.57            28
## 85                           Great Dane      working    1.53            19
## 86                         Saint Bernard      working    1.42            49
## 87                               Bulldog non-sporting    0.99             6
## 88                     Airedale Terrier      terrier      NA            55
## 89            American English Coonhound        hound      NA            33
## 90                  American Eskimo Dog non-sporting      NA           116
## 91                    American Foxhound        hound      NA           173
## 92         American Staffordshire Terrier      terrier      NA            72
## 93                 American Water Spaniel     sporting      NA           157
## 94                Anatolian Shepherd Dog      working      NA           111
## 95                       Bearded Collie      herding      NA           112
## 96                            Beauceron      herding      NA           144
## 97                     Belgian Malinois      herding      NA            74
## 98                     Belgian Sheepdog      herding      NA           118
## 99               Black and Tan Coonhound        hound      NA           109
```

```
## 100              Black Russian Terrier      working      NA            128
## 101                 Bluetick Coonhound        hound      NA            136
## 102                     Boykin Spaniel     sporting      NA            138
## 103                        Canaan Dog      herding      NA            168
## 104                        Cane Corso      working      NA             67
## 105               Cardigan Welsh Corgi      herding      NA             81
## 106                     Cesky Terrier      terrier      NA            106
## 107                   Chinese Crested          toy      NA             61
## 108                  Chinese Shar Pei non-sporting      NA             50
## 109                            Collie      herding      NA             36
## 110            Curly Coated Retriever     sporting      NA            154
## 111                  English Foxhound        hound      NA            171
## 112          Entlebucher Mountain Dog      herding      NA            146
## 113                     Field Spaniel     sporting      NA            141
## 114                  Finnish Lapphund      herding      NA            104
## 115                     Finnish Spitz non-sporting      NA            167
## 116                   German Pinscher      working      NA            137
## 117         German Wirehaired Pointer     sporting      NA             75
## 118              Glen of Imaal Terrier      terrier      NA            158
## 119                   Great Pyrenees      working      NA             71
## 120        Greater Swiss Mountain Dog      working      NA             82
## 121                           Harrier        hound      NA            172
## 122                          Havanese          toy      NA             31
## 123                       Ibizan Hound        hound      NA            149
## 124               Icelandic Sheepdog      herding      NA            143
## 125        Irish Red and White Setter     sporting      NA            147
## 126                     Irish Terrier      terrier      NA            132
## 127               Irish Water Spaniel     sporting      NA            150
## 128                     Japanese Chin          toy      NA             78
## 129                          Keeshond non-sporting      NA             98
## 130                          Komondor      working      NA            166
## 131                            Kuvasz      working      NA            148
## 132                 Lakeland Terrier      terrier      NA            135
## 133                       Leonberger      working      NA            103
## 134                         Löwchen non-sporting      NA            152
## 135               Manchester Terrier      terrier      NA            119
## 136            Miniature Bull Terrier      terrier      NA            127
## 137                Miniature Pinscher          toy      NA             42
## 138                Neapolitan Mastiff      working      NA            110
## 139                  Norwegian Buhund      herding      NA            165
## 140                Norwegian Elkhound        hound      NA             96
## 141               Norwegian Lundehund non-sporting      NA            170
## 142                   Norwich Terrier      terrier      NA             89
## 143 Nova Scotia Duck Tolling Retriever     sporting      NA            107
## 144                         Otterhound        hound      NA            169
## 145             Parson Russell Terrier      terrier      NA             97
## 146       Petit Basset Griffon Vendeen        hound      NA            131
## 147                             Plott        hound      NA            145
## 148           Polish Lowland Sheepdog      herding      NA            159
## 149              Portuguese Water Dog      working      NA             56
## 150                              Puli      herding      NA            156
## 151                Pyrenean Shepherd      herding      NA            162
## 152                Redbone Coonhound        hound      NA            126
## 153                       Schipperke non-sporting      NA            105
```

```
## 154                 Scottish Deerhound        hound      NA            142
## 155                   Sealyham Terrier      terrier      NA            163
## 156                          Shiba Inu non-sporting      NA             53
## 157                      Silky Terrier          toy      NA             85
## 158                       Skye Terrier      terrier      NA            164
## 159                 Smooth Fox Terrier      terrier      NA            113
## 160        Soft-Coated Wheaten Terrier      terrier      NA             52
## 161                  Spinone Italiano     sporting      NA            123
## 162                 Standard Schnauzer      working      NA             91
## 163                     Sussex Spaniel     sporting      NA            161
## 164                  Swedish Vallhund      herding      NA            153
## 165                   Tibetan Mastiff      working      NA            122
## 166                   Toy Fox Terrier          toy      NA            101
## 167                           Vizsla     sporting      NA             37
## 168                        Weimaraner     sporting      NA             32
## 169                     Welsh Terrier      terrier      NA             99
## 170                   Wire Fox Terrier      terrier      NA            100
## 171        Wirehaired Pointing Griffon     sporting      NA             92
## 172                     Xoloitzcuintli non-sporting      NA            155
##     popularity lifetime_cost intelligence_rank longevity ailments price
## 1           39         20143                 1     12.52        2   623
## 2           61         22638                30     14.00        0   833
## 3           30         22589                19     12.92        0   618
## 4           48         21992                35     13.84        2   435
## 5           81         20224                31     12.49        1   750
## 6           51         18993                18     11.66        0   800
## 7           27         24330                20     12.50        2   465
## 8           33         21001                 8     13.00        5   740
## 9           49         20395                10     11.67        1   530
## 10          20         21006                 6     12.53        5   465
## 11          16         22049                45     12.58        0   650
## 12          50         22031                68     13.92        1   350
## 13          84         18333                37     11.42        0   510
## 14           9         20113                49     12.63        2   423
## 15          12         20087                12     11.81        2   715
## 16          14         26250                67     16.50        1   588
## 17          77         17892                34     11.05        0   640
## 18          46         20976                51     12.87        0   915
## 19          29         21946                13     12.54        4   615
## 20          32         20490                47     12.80        3   538
## 21          83         22107                40     13.51        2  1058
## 22           8         21237                 2     11.95        2   900
## 23          34         19735                45     12.21        0   693
## 24          15         25842                17     11.46        1   545
## 25          74         24445                43     12.42        1   294
## 26          73         25549                46     14.42        0  1050
## 27           1         21299                 7     12.04        3   810
## 28          23         19084                59     12.25        1   650
## 29          17         15792                23      9.67        1   670
## 30          11         21152                70     13.20        1   583
## 31          24         21458                42     12.28        2   565
## 32           5         20701                27     12.60        4  1057
## 33          56         20323                35     11.63        2   525
## 34          86         21047                37     11.83        0   913
```

```
## 35          59          19551          59     12.00        0   833
## 36           4          21447           4     12.04        4   958
## 37          55          25352          33     12.44        1  1162
## 38           3          19468          73     12.30        1   288
## 39          40          16697          27      9.48        1   522
## 40          64          20336          62     12.31        0  1140
## 41          69          19605          34     11.10        1   700
## 42          65          20312          37     11.57        2   615
## 43          26          18527          57     11.00        1   469
## 44          79          19673          30     11.17        1   650
## 45          76          24308          56     13.07        0  2083
## 46          67          16000          18      9.02        0   600
## 47          22          17741          54     10.92        1   690
## 48          13          18397           5     10.33        4   790
## 49          80          17521          45     10.10        0   925
## 50          72          19132          14     10.60        2  1070
## 51          21          18639          44     11.29        2  1017
## 52          57          19886          39     11.27        2   695
## 53          36          18328          71     11.43        2   490
## 54          68          22096          79     13.58        3   940
## 55          53          16463          60     10.02        0   800
## 56          58          21650          49     12.05        1  1145
## 57          62          18959          29     10.34        1  1335
## 58          25          23978          11     12.25        9   587
## 59          82          18084          37     10.00        0  1033
## 60          87          21633          62     12.17        0   925
## 61          75          24866          43     12.00        0  1525
## 62          70          26686          28     10.00        1   810
## 63          85          15819          46      9.36        1  1175
## 64          45          17525          65     10.69        1   829
## 65          10          18886           9      9.11        3  1118
## 66          78          17240          35      9.40        1  1200
## 67          66          24077          80     11.92        0   890
## 68          37          19351          34      9.32        2  1178
## 69           2          17416           3      9.73        8   820
## 70          52          20565          74     11.56        1   885
## 71          63          22611          63     11.19        1   832
## 72          41          20994          54     10.16        1  1202
## 73          38          16530          52      9.10        2   995
## 74          18          17266          58      9.00        0  1900
## 75          71          16176          76      9.08        0   675
## 76          31          16099          22      7.56        4  1320
## 77          44          18490          66     10.21        2  1085
## 78           7          15746          48      8.81        4   700
## 79          47          21986          50     10.67        2  1210
## 80          54          15898          77      9.01        2   515
## 81          42          13824          75      6.75        2   608
## 82          60          18435          41      6.94        3  1333
## 83          35          13936          69      7.57        2   980
## 84          28          13581          72      6.50        2   900
## 85          19          14662          48      6.96        4  1040
## 86          43          20022          65      7.78        3   875
## 87           6          13479          78      6.29        5  2680
## 88          NA             NA          29     11.45        1   733
```

```
## 89          NA            NA                NA     11.50       NA   283
## 90          NA            NA                NA        NA        0   560
## 91          NA            NA                46        NA       NA   757
## 92          NA            NA                34        NA        1  1043
## 93          NA            NA                44        NA        0   730
## 94          NA            NA                NA     10.75       NA    NA
## 95          NA            NA                34     12.77        0    NA
## 96          NA            NA                NA        NA       NA   967
## 97          NA            NA                22        NA        0  1080
## 98          NA            NA                15        NA        4    NA
## 99          NA            NA                44        NA        0   325
## 100         NA            NA                NA        NA        0  2833
## 101         NA            NA                NA        NA        0   370
## 102         NA            NA                NA        NA       NA   531
## 103         NA            NA                NA     14.67        0    NA
## 104         NA            NA                NA        NA       NA  1070
## 105         NA            NA                26     12.70        0   828
## 106         NA            NA                NA      8.42       NA    NA
## 107         NA            NA                61     10.08       NA   538
## 108         NA            NA                51        NA        4   840
## 109         NA            NA                16        NA        2   650
## 110         NA            NA                41     10.75        0    NA
## 111         NA            NA                46        NA        0    NA
## 112         NA            NA                NA        NA       NA  1167
## 113         NA            NA                34      9.90        0    NA
## 114         NA            NA                NA      7.33       NA    NA
## 115         NA            NA                43     11.17        0    NA
## 116         NA            NA                NA     11.42       NA  1500
## 117         NA            NA                44     10.00        1   655
## 118         NA            NA                NA     10.42       NA    NA
## 119         NA            NA                64     10.00        1   503
## 120         NA            NA                NA      6.80        1  1605
## 121         NA            NA                NA        NA        0    NA
## 122         NA            NA                NA     10.25        0   830
## 123         NA            NA                53        NA        0  1500
## 124         NA            NA                NA        NA       NA    NA
## 125         NA            NA                NA     11.57       NA  1000
## 126         NA            NA                53        NA        0   588
## 127         NA            NA                24      9.33        1    NA
## 128         NA            NA                62      9.25        0   513
## 129         NA            NA                16     12.17        1   610
## 130         NA            NA                NA      9.17        1   656
## 131         NA            NA                42        NA        1    NA
## 132         NA            NA                62        NA        0  1093
## 133         NA         15141                NA      6.98       NA  1480
## 134         NA            NA                NA     10.00        0    NA
## 135         NA            NA                32      9.32        0   720
## 136         NA            NA                NA      6.60        0  1740
## 137         NA            NA                37        NA        0   535
## 138         NA            NA                NA        NA        1  1760
## 139         NA            NA                NA     12.67       NA    NA
## 140         NA            NA                36        NA        1   448
## 141         NA            NA                NA        NA       NA    NA
## 142         NA            NA                38        NA        0  1245
```

```
## 143         NA         12653                NA      6.50        1  1500
## 144         NA            NA                46     10.80        1    NA
## 145         NA            NA                NA        NA        0   528
## 146         NA            NA                62     12.70        0   400
## 147         NA            NA                NA        NA        0    NA
## 148         NA            NA                NA     10.80       NA    NA
## 149         NA            NA                NA     11.42        0    NA
## 150         NA            NA                27        NA        0   913
## 151         NA            NA                NA        NA       NA    NA
## 152         NA            NA                NA        NA        0   425
## 153         NA            NA                15     13.00        4   658
## 154         NA            NA                47      8.70        2    NA
## 155         NA            NA                56     12.25        1    NA
## 156         NA            NA                NA      7.00        1   890
## 157         NA            NA                37     14.25        0   448
## 158         NA            NA                55     11.00        0   550
## 159         NA            NA                40     13.17        0   575
## 160         NA            NA                40     12.16        0   832
## 161         NA            NA                NA      9.00       NA  1725
## 162         NA            NA                18        NA        1   855
## 163         NA            NA                NA     11.17        0    NA
## 164         NA         22839                NA     14.17       NA   772
## 165         NA         23747                NA     11.92       NA  3460
## 166         NA            NA                NA        NA       NA   460
## 167         NA            NA                25     12.50        0   935
## 168         NA            NA                21        NA        1   562
## 169         NA            NA                53        NA        0   843
## 170         NA            NA                51     13.17        0   668
## 171         NA            NA                46      8.80        0   755
## 172         NA            NA                NA        NA       NA   717
##     food_cost grooming   kids megarank_kids megarank   size weight height
## 1         324   weekly    low             1       29 medium     NA  20.00
## 2         324   weekly   high             2        1  small   13.5     NA
## 3         466   weekly medium             3       11 medium   35.0  19.00
## 4         324   weekly   high             4        2  small   14.0  10.00
## 5         324   weekly   high             5        4 medium     NA  18.00
## 6         324   weekly   high             6        5 medium   30.0  16.00
## 7         674   weekly   high             7        6  small   25.0  14.50
## 8         324   weekly medium             8       22  small     NA   9.50
## 9         466   weekly    low             9       52 medium     NA  18.50
## 10        405    daily   high            11        8  small   22.0  14.50
## 11        466  monthly   high            10        3 medium   47.5  21.75
## 12        324   weekly   high            12        7  small   15.0  10.50
## 13        324   weekly medium            13       26  small     NA  10.25
## 14        324   weekly    low            14       54  small   24.0     NA
## 15        405   weekly medium            14       27  small   15.5  13.00
## 16        324   weekly    low            16       55  small    5.5   5.00
## 17        324   weekly medium            17       30  small     NA  10.50
## 18        324   weekly medium            17       30 medium     NA  20.00
## 19        466   weekly   high            19        9 medium   45.0  19.50
## 20        324   weekly   high            20       10  small     NA  10.50
## 21        324   weekly medium            21       35  small   20.0     NA
## 22        466   weekly medium            22       39 medium     NA  16.00
## 23        324    daily   high            25       16  small     NA  10.50
```

```
## 24        971   weekly   high          23       12  large   62.5  24.00
## 25        710   weekly   high          24       13  large   59.5  25.50
## 26        466   weekly   high          26       14  small   12.0  10.00
## 27        466   weekly   high          27       15 medium   67.5  23.00
## 28        270    daily    low          29       65  small    5.0   9.00
## 29        324   weekly medium          28       45  small    5.0     NA
## 30        324    daily   high          29       19  small   12.5   9.75
## 31        466   weekly medium          31       46 medium     NA  20.50
## 32        324    daily    low          32       69  small    5.5     NA
## 33        466   weekly   high          33       17  large   65.0  26.00
## 34        466   weekly medium          34       47 medium     NA  23.00
## 35        324   weekly    low          36       66  small    9.0     NA
## 36        466   weekly   high          37       20 medium   60.0  22.75
## 37        710   weekly   high          35       18 medium     NA  21.25
## 38        324    daily   high          38       28  small     NA  14.00
## 39        466   weekly   high          39       21  large   67.5  23.50
## 40        324   weekly medium          40       51  small   24.0  15.50
## 41        466   weekly   high          41       23  large   62.5  25.00
## 42        466   weekly   high          43       25  large     NA  24.50
## 43        405   weekly   high          42       24 medium   16.0  16.00
## 44        466    daily   high          44       33  large     NA  24.50
## 45        466   weekly medium          45       53  small   12.0   9.50
## 46        466    daily   high          46       34 medium     NA  23.25
## 47        324   weekly   high          47       32 medium     NA     NA
## 48        466   weekly medium          49       57  large     NA  26.00
## 49        405   weekly medium          48       56  small   11.0  10.00
## 50        466   weekly   high          52       38  large     NA  24.00
## 51        324   weekly   high          50       35  small   15.5  12.50
## 52        466   weekly   high          50       35 medium     NA  21.00
## 53        324   weekly   high          53       39  small     NA  14.00
## 54        324   weekly medium          54       59 medium   23.0  16.50
## 55        324   weekly    low          55       77  small     NA  14.00
## 56        466   weekly   high          56       41 medium   31.0  15.00
## 57        466   weekly   high          57       42  large     NA  25.50
## 58        674   weekly   high          58       43  small   26.0  11.00
## 59        466   weekly   high          59       44 medium   70.0  18.50
## 60        466    daily   high          60       49  small   21.0   9.00
## 61        710    daily   high          61       50 medium     NA  23.00
## 62       1349    daily medium          62       67  large   77.5  25.50
## 63        324   weekly   high          63       48  large   65.0     NA
## 64        324    daily medium          64       71  small   20.0  10.00
## 65        710   weekly medium          65       68  large     NA  24.50
## 66        466    daily medium          66       76 medium   36.5  18.50
## 67        710    daily   high          67       60  large   55.0  26.00
## 68        710   weekly   high          68       58  large  125.0  27.00
## 69        466   weekly medium          69       74  large     NA  24.00
## 70        466    daily medium          70       78  small   13.0     NA
## 71        710    daily   high          71       61 medium     NA  22.00
## 72        710   weekly    low          72       86  large     NA  26.00
## 73        466   weekly medium          73       79  large   77.5  25.50
## 74        466   weekly   high          74       62 medium   27.0     NA
## 75        466    daily medium          75       82  large   82.5  28.00
## 76        710   weekly   high          76       63  large     NA  25.25
## 77        466   weekly medium          77       80 medium   60.0  21.50
```

```
## 78        466   weekly   high          78       64 medium     NA  23.25
## 79        710    daily medium          79       83  large   80.0  24.00
## 80        466    daily medium          80       85 medium     NA  18.50
## 81        710   weekly medium          81       84  large   85.0  25.00
## 82       1217   weekly   high          82       70  large     NA  32.00
## 83        466   weekly   high          83       72  large  115.0  25.50
## 84        701   weekly   high          84       73  large  175.0  30.00
## 85        710   weekly   high          85       75  large     NA  30.00
## 86       1217    daily   high          86       81  large  155.0  26.50
## 87        466   weekly medium          87       87 medium   45.0     NA
## 88         NA     <NA>   <NA>          NA       NA medium     NA  23.00
## 89         NA     <NA>   <NA>          NA       NA  large     NA  24.50
## 90         NA     <NA>   <NA>          NA       NA  small     NA  14.00
## 91         NA     <NA>   <NA>          NA       NA medium     NA  23.00
## 92         NA     <NA>   <NA>          NA       NA medium     NA  18.00
## 93         NA     <NA>   <NA>          NA       NA medium   35.0  16.50
## 94         NA   weekly medium          NA       NA  large  115.0  28.00
## 95         NA    daily   high          NA       NA medium     NA  21.00
## 96         NA     <NA>   <NA>          NA       NA  large     NA  25.75
## 97         NA   weekly   high          NA       NA  large     NA  24.00
## 98         NA     <NA>   <NA>          NA       NA  large     NA  24.00
## 99         NA     <NA>   <NA>          NA       NA  large     NA  25.00
## 100        NA     <NA>   <NA>          NA       NA  large     NA  28.00
## 101        NA     <NA>   <NA>          NA       NA  large   62.5  24.00
## 102        NA     <NA>   <NA>          NA       NA medium     NA  16.00
## 103        NA   weekly   high          NA       NA medium   45.0  21.50
## 104        NA     <NA>   <NA>          NA       NA  large     NA  25.00
## 105        NA     <NA>   <NA>          NA       NA  small   31.5  11.50
## 106        NA   weekly   high          NA       NA  small   19.0  11.50
## 107        NA     <NA>   <NA>          NA       NA  small     NA  12.00
## 108        NA     <NA>   <NA>          NA       NA medium   52.5  19.00
## 109        NA     <NA>   <NA>          NA       NA  large   62.5  24.00
## 110        NA   weekly medium          NA       NA  large     NA  25.00
## 111        NA     <NA>   <NA>          NA       NA  large     NA  24.00
## 112        NA     <NA>   <NA>          NA       NA medium     NA  18.50
## 113        NA    daily medium          NA       NA medium     NA  17.50
## 114        NA    daily   high          NA       NA medium     NA  18.50
## 115        NA   weekly   high          NA       NA medium     NA  17.75
## 116        NA     <NA>   <NA>          NA       NA medium     NA  18.50
## 117        NA     <NA>   <NA>          NA       NA  large     NA  24.00
## 118        NA     <NA>   <NA>          NA       NA  small   35.0  13.25
## 119        NA     <NA>   <NA>          NA       NA  large     NA  28.50
## 120        NA     <NA>   <NA>          NA       NA  large     NA  26.00
## 121        NA     <NA>   <NA>          NA       NA medium     NA  20.00
## 122        NA     <NA>   <NA>          NA       NA  small     NA   9.75
## 123        NA   weekly   high          NA       NA  large     NA  25.00
## 124        NA     <NA>   <NA>          NA       NA medium     NA  17.25
## 125        NA     <NA>   <NA>          NA       NA  large     NA  24.25
## 126        NA   weekly   high          NA       NA medium   26.0  18.00
## 127        NA   weekly   high          NA       NA medium   55.0  22.50
## 128        NA     <NA>   <NA>          NA       NA  small     NA   9.50
## 129        NA     <NA>   <NA>          NA       NA medium     NA  17.50
## 130        NA     <NA>   <NA>          NA       NA  large  100.0  27.50
## 131        NA     <NA>   <NA>          NA       NA  large   92.5  28.00
```

```
## 132        NA   weekly   high           NA       NA  small   17.0  14.50
## 133        NA   weekly   high           NA       NA  large     NA  28.50
## 134        NA     <NA>   <NA>           NA       NA  small     NA  13.00
## 135        NA     <NA>   <NA>           NA       NA  small   17.0     NA
## 136        NA     <NA>   <NA>           NA       NA  small     NA  12.00
## 137        NA     <NA>   <NA>           NA       NA  small     NA  11.25
## 138        NA   weekly   high           NA       NA  large  130.0  27.50
## 139        NA     <NA>   <NA>           NA       NA medium   33.0  17.25
## 140        NA     <NA>   <NA>           NA       NA medium   51.5  20.00
## 141        NA     <NA>   <NA>           NA       NA  small     NA  13.50
## 142        NA   weekly medium           NA       NA  small   12.0  10.00
## 143        NA   weekly   high           NA       NA medium     NA  19.00
## 144        NA   weekly   high           NA       NA  large   97.5  25.50
## 145        NA   weekly medium           NA       NA  small   15.0  13.50
## 146        NA     <NA>   <NA>           NA       NA  small     NA  14.00
## 147        NA     <NA>   <NA>           NA       NA medium   50.0  22.50
## 148        NA   weekly medium           NA       NA medium     NA  18.50
## 149        NA     <NA>   <NA>           NA       NA medium   47.5  20.00
## 150        NA     <NA>   <NA>           NA       NA medium     NA  16.50
## 151        NA     <NA>   <NA>           NA       NA medium     NA  18.00
## 152        NA     <NA>   <NA>           NA       NA  large     NA  24.00
## 153        NA     <NA>   <NA>           NA       NA  small     NA  11.50
## 154        NA     <NA>   <NA>           NA       NA  large   92.5     NA
## 155        NA     <NA>   <NA>           NA       NA  small   24.0  10.50
## 156        NA     <NA>   <NA>           NA       NA  small   20.0  15.00
## 157        NA     <NA>   <NA>           NA       NA  small   10.0   9.50
## 158        NA     <NA>   <NA>           NA       NA  small   40.0   9.75
## 159        NA     <NA>   <NA>           NA       NA  small   17.5  15.00
## 160        NA     <NA>   <NA>           NA       NA medium   35.0  18.00
## 161        NA     <NA>   <NA>           NA       NA  large     NA  24.50
## 162        NA     <NA>   <NA>           NA       NA medium     NA  18.50
## 163        NA   weekly    low           NA       NA  small   40.0  14.00
## 164        NA   weekly   high           NA       NA  small     NA  12.50
## 165        NA   weekly   high           NA       NA  large     NA  25.00
## 166        NA     <NA>   <NA>           NA       NA  small     NA  10.00
## 167        NA     <NA>   <NA>           NA       NA medium     NA  22.50
## 168        NA   weekly   high           NA       NA  large     NA  25.00
## 169        NA   weekly   high           NA       NA  small   20.0  15.00
## 170        NA     <NA>   <NA>           NA       NA  small   17.5  15.00
## 171        NA     <NA>   <NA>           NA       NA medium     NA  22.00
## 172        NA     <NA>   <NA>           NA       NA medium     NA  16.50
```

Factors

Watch the "Factors" lecture video.

No exercises for this video. Get up, stretch, and take a break! :)

File Formats

Watch the "File Formats" lecture video.

Exercise 4

1. Load the volcano data set into R.
2. What are the column names? Use R to get these rather than typing them out yourself.
3. How many volcano eruptions are recorded in the data set?
4. What are the classes/types of the columns? *Hint: an earlier lecture mentioned a function that summarizes of this information.*
5. Are there any columns that contain categorical data? Are these columns factors? If not, what are their classes?

YOUR ANSWER GOES HERE:

```
vol = read.delim("volerup.txt") # read in the tables
names(vol) # the column names
```

```
##  [1] "Year"                                "Month"
##  [3] "Day"                                 "TSU"
##  [5] "EQ"                                  "Name"
##  [7] "Location"                            "Country"
##  [9] "Latitude"                            "Longitude"
## [11] "Elevation"                           "Type"
## [13] "Status"                              "Time"
## [15] "VEI"                                 "Agent"
## [17] "DEATHS"                              "DEATHS_DESCRIPTION"
## [19] "MISSING"                             "MISSING_DESCRIPTION"
## [21] "INJURIES"                            "INJURIES_DESCRIPTION"
## [23] "DAMAGE_MILLIONS_DOLLARS"             "DAMAGE_DESCRIPTION"
## [25] "HOUSES_DESTROYED"                    "HOUSES_DESTROYED_DESCRIPTION"
## [27] "TOTAL_DEATHS"                        "TOTAL_DEATHS_DESCRIPTION"
## [29] "TOTAL_MISSING"                       "TOTAL_MISSING_DESCRIPTION"
## [31] "TOTAL_INJURIES"                      "TOTAL_INJURIES_DESCRIPTION"
## [33] "TOTAL_DAMAGE_MILLIONS_DOLLARS"       "TOTAL_DAMAGE_DESCRIPTION"
## [35] "TOTAL_HOUSES_DESTROYED"              "TOTAL_HOUSES_DESTROYED_DESCRIPTION"
```

```
nrow(vol) # the number of volcano eruptions
```

```
## [1] 835
```

```
str(vol) # the class the types of the columns
```

```
## 'data.frame':    835 obs. of  36 variables:
##  $ Year                            : int  -4360 -4350 -4050 -4000 -3580 -3550 -2420 -2040 -1900 -18
##  $ Month                           : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Day                             : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TSU                             : chr  "" "" "" "" ...
##  $ EQ                              : chr  "" "" "" "" ...
##  $ Name                            : chr  "Macauley Island" "Kikai" "Masaya" "Pago" ...
##  $ Location                        : chr  "Kermadec Is" "Ryukyu Is" "Nicaragua" "New Britain-SW Pa
##  $ Country                         : chr  "New Zealand" "Japan" "Nicaragua" "Papua New Guinea" ...
##  $ Latitude                        : num  -30.2 30.78 11.98 -5.58 14 ...
##  $ Longitude                       : num  -178.5 130.3 -86.2 150.5 121 ...
##  $ Elevation                       : int  238 717 635 742 400 1486 1281 1280 1032 1905 ...
```

```
##  $ Type                                : chr  "Caldera" "Caldera" "Caldera" "Caldera" ...
##  $ Status                              : chr  "Holocene" "Historical" "Historical" "Historical" ...
##  $ Time                                : chr  "U" "D1" "D1" "D2" ...
##  $ VEI                                 : int  6 7 6 6 6 6 5 6 6 6 ...
##  $ Agent                               : chr  "" "P" "" "T" ...
##  $ DEATHS                              : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ DEATHS_DESCRIPTION                  : int  NA 3 NA 1 NA NA NA NA NA NA ...
##  $ MISSING                             : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ MISSING_DESCRIPTION                 : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ INJURIES                            : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ INJURIES_DESCRIPTION                : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ DAMAGE_MILLIONS_DOLLARS             : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ DAMAGE_DESCRIPTION                  : int  NA 3 NA 1 NA NA NA NA NA NA ...
##  $ HOUSES_DESTROYED                    : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ HOUSES_DESTROYED_DESCRIPTION        : int  NA 3 NA NA NA NA NA NA NA NA ...
##  $ TOTAL_DEATHS                        : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_DEATHS_DESCRIPTION            : int  NA 3 NA 1 NA NA NA NA NA NA ...
##  $ TOTAL_MISSING                       : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_MISSING_DESCRIPTION           : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_INJURIES                      : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_INJURIES_DESCRIPTION          : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_DAMAGE_MILLIONS_DOLLARS       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_DAMAGE_DESCRIPTION            : int  NA 3 NA 1 NA NA NA NA NA NA ...
##  $ TOTAL_HOUSES_DESTROYED              : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TOTAL_HOUSES_DESTROYED_DESCRIPTION: int  NA 3 NA NA NA NA NA NA NA NA ...
```

```
# For instance, "Status" column contains categorical data, its type is "chr" or "character".
```