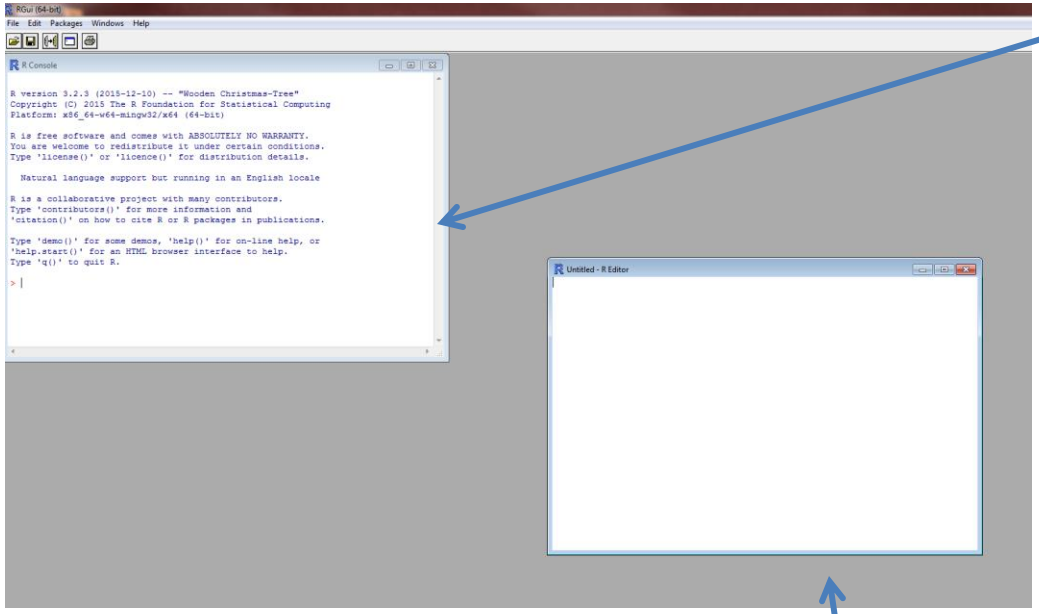
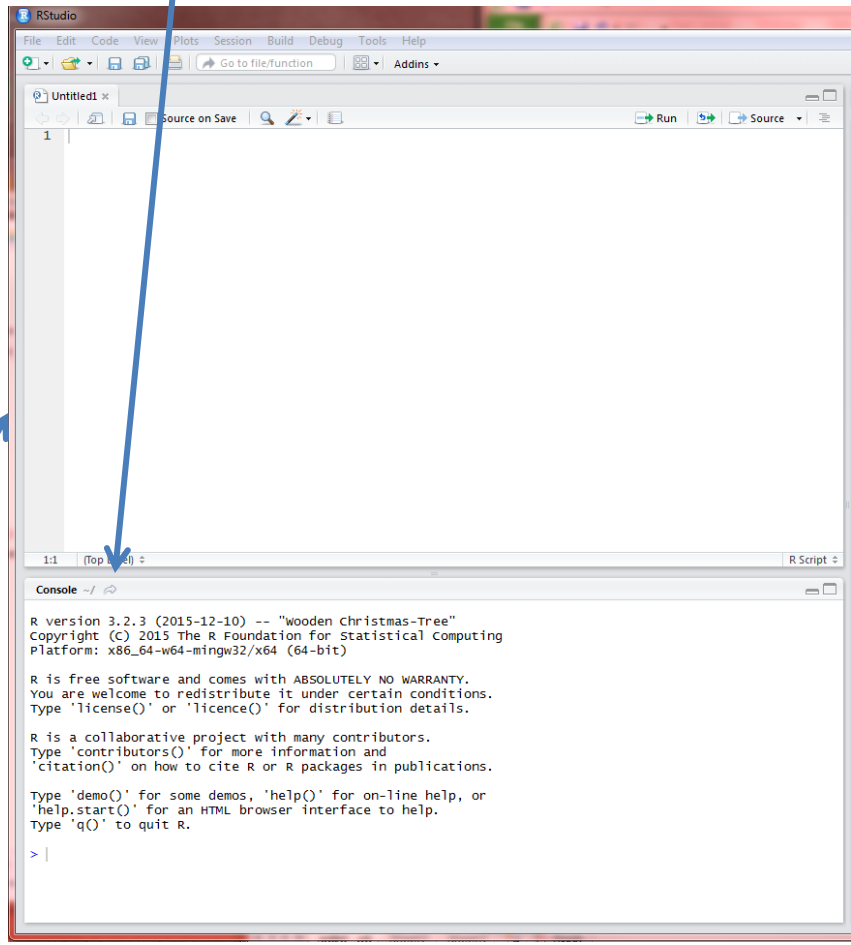
Intro to R

R

Console



R studio



There is a large number of applications for interfacing with R. Here is an example of two ways to work with R.

Blank script

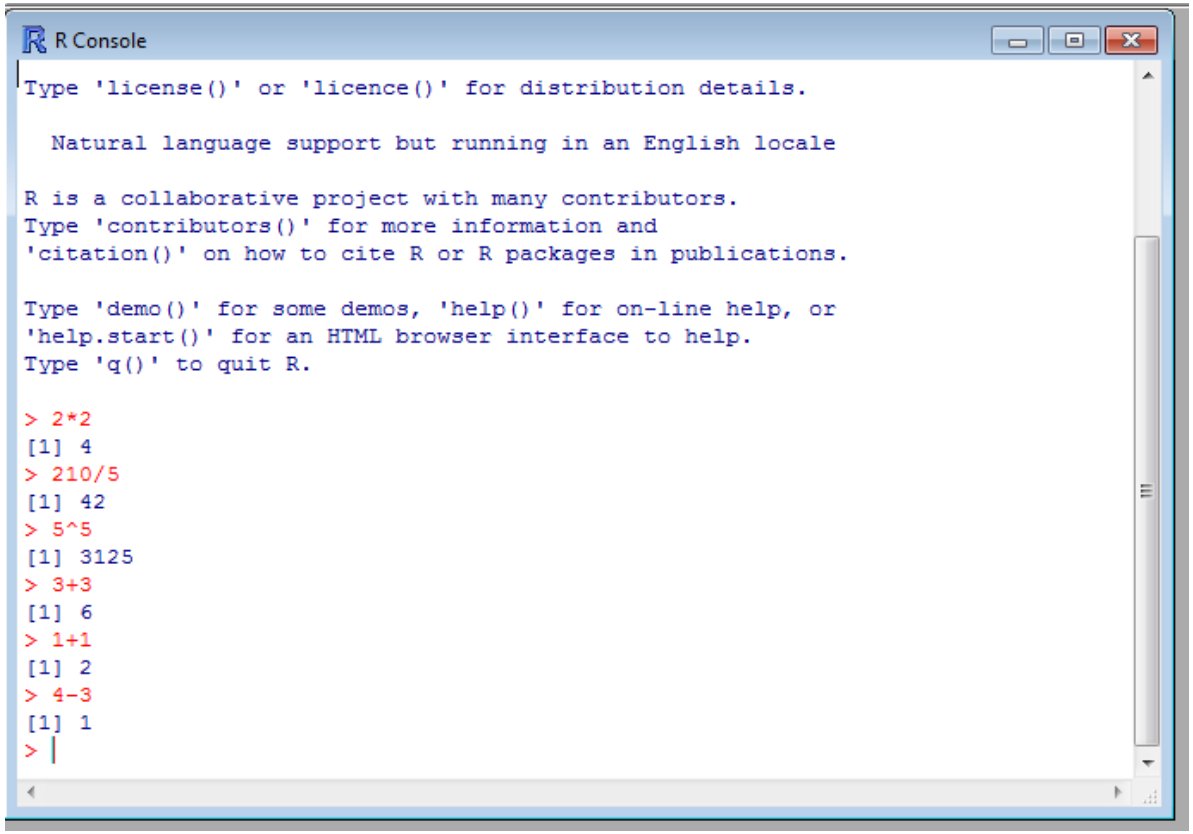
Using R

- The **console** is the main component of R. It is where you run all of your commands and functions.
- The **script** is where you write all of your commands to run in R. This file is saved (usually .R format) and a good script can be run at any time.

Working with numbers in R

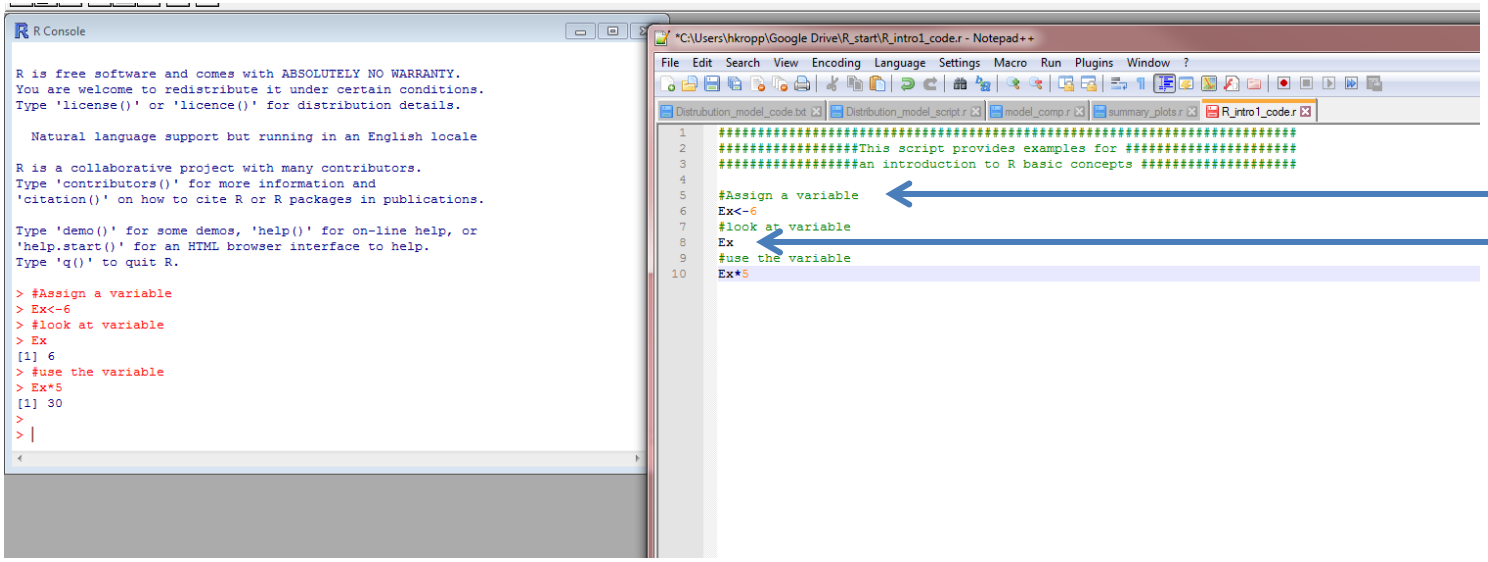
- R acts like a calculator:

Red=inputs from your script
Blue= output from R



Assigning variables in R

- Give an item a name using the <- followed by the item
  - This allows you to refer back to items without having to remember them or write huge amounts of code
- Comment your code using # in front of the line
  - Commenting allows you to keep track of what you are doing and provide reminders for later



comments

variable

Vectors and matrix in R

- R automatically treats inputs like they are vectors.
- Create a vector using c()

```
#set up a vector
Vec<-c(3,4,5,2,10,4,6)
```

- Set up a matrix using matrix()

```
> Vec<-c(3,4,5,2,10,4,6)
> Mat<-matrix(c(1,2,3,4,5,6), ncol=2, byrow=TRUE)
> Mat
     [,1] [,2]
[1,]    1    2
[2,]    3    4
[3,]    5    6
> #set up a matrix that fills in by columns
> Mat.bycol<-matrix(c(1,2,3,4,5,6), ncol=2, byrow=FALSE)
> Mat.bycol
     [,1] [,2]
[1,]    1    4
[2,]    2    5
[3,]    3    6
>
```

```
Ex*5

#set up a vector
Vec<-c(3,4,5,2,10,4,6)

#set up a matrix
Mat<-matrix(c(1,2,3,4,5,6), ncol=2, byrow=TRUE)
Mat
#set up a matrix that fills in by columns
Mat.bycol<-matrix(c(1,2,3,4,5,6), ncol=2, byrow=FALSE)
Mat.bycol
```

Functions in R

- Using matrix() is an example of a function in R
- There are a lot of “built in” functions in R that make it easier to work with data or statistics
- For example, calculating an average using mean():

```
> mean(Vec)
[1] 4.857143
>
```

```
21
22  #calculate the average value of Vec
23  mean(Vec)
24
```

Functions in R

- A **function** typically gives you an **output** based on the inputs you give it
- The inputs needed for a function are often called **arguments**
- R will have a description of the arguments and output for its function
  - google the *function.name*
  - type help(*function.name*) in the console

mean {base} ← *function.name*

R Documentation

Arithmetic Mean

Description

Generic function for the (trimmed) arithmetic mean.

Usage

```
mean(x, ...)

## Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)
```

Way that the function gets used and the arguments that have some default assumptions

Arguments

`x`
: An R object. Currently there are methods for numeric/logical vectors and date, date-time and time interval objects. Complex vectors are allowed for `trim = 0`, only.

`trim`
: the fraction (0 to 0.5) of observations to be trimmed from each end of `x` before the mean is computed. Values of trim outside that range are taken as the nearest endpoint.

`na.rm`
: a logical value indicating whether `NA` values should be stripped before the computation proceeds.

`...`
: further arguments passed to or from other methods.

Detailed description

- Here *x*, *trim*, and *na.rm* are the names of arguments
- The order here is important because if the names of the arguments aren't used, then they are assumed to be in this default order.
- If the default arguments are sufficient there is no need to include them in the function
- If you don't want to use the default order than you can specify the order using the argument names:

```
[1] 4.857143
> mean(na.rm=TRUE,x=Vec)
[1] 4.857143
```

```
#specify arguments by name and not order
mean(na.rm=TRUE,x=Vec)
```

Working with vectors and matrices:

- Keep in mind that R automatically does vector/matrix math:

```
[3,]   15   18
> #multiply vector by 5
> Vec*5
[1] 15 20 25 10 50 20 30
>
```

```
#multiply vector by 5
Vec*5
```

```
> #set multiply matrix by vector
> Mat.scale<-matrix(c(2,2,2,3,3,3), ncol=2,byrow=TRUE)
> Mat*Mat.scale
     [,1] [,2]
[1,]    2    4
[2,]    6   12
[3,]   15   18
>
```

```
# multiply matrix by vector
Mat.scale<-matrix(c(2,2,2,3,3,3), ncol=2,byrow=TRUE)
Mat*Mat.scale
```

Packages in R

- People have created thousands of **packages** to add more functions to R
- Packages allow you to download only the ones you want to use (it would take up a lot of space)
- Some functions may have the same name in different packages so be sure to note potential overlap in packages
  - only load the ones you are going to use

Data Types

- Numeric: number can have any number of decimals
- Character: text
- Factor: text but a short identifying category name

```
> N.ex
[1] 0.9333333
> C.ex<-c("December")
> C.ex
[1] "December"
> F.ex<-as.factor("a")
> F.ex<-as.factor("a")
> F.ex
[1] a
Levels: a
>
```

```
#data types
#numeric
N.ex<-14/15
N.ex
#character
C.ex<-c("December")
C.ex
#Factor
F.ex<-as.factor("a")
F.ex
```

Reading in Data

- The easiest and most consistent way to read in data in R is through a comma separated text file (.csv)
- You need to tell R where to find the data
  - Set a working directory to always get files from one folder
  - Or specify the file path with the csv name
- File/File paths always need to be in quotes and file paths always have \\ between folders

```
> #set working directory
> setwd("c:\\Users\\hkropp\\Google Drive\\data_to_do\\Example_dataR")
> #check what your working directory is set at
> getwd()
[1] "c:/Users/hkropp/Google Drive/data_to_do/Example_dataR"
>
```

```
#set working directory
setwd("c:\\Users\\hkropp\\Google Drive\\data_to_do\\Example_dataR")
#check what your working directory is set at
getwd()
```

R programming language | length : 1050 lines : 48

```
#read in data file
datM<-read.csv("mountain_data.csv")
#check out data
datM
```

- Always think about your names
  - Length
  - Clarity
- Capitalization matters!

```
> datM
   Rank                        Name           Region Elev.m Prom.m Elev.ft Prom.ft
1     1                   Mt Everest      Nepal Tibet   8848   8848   29028   29028
2     2                    Aconcagua        Argentina   6962   6962   22841   22841
3     3            Mt McKinley Denali               US   6194   6138   20320   20138
4     4                  Kilimanjaro         Tanzania   5895   5885   19340   19308
5     5                Cristobal Colon         Colombia   5700   5509   18701   18074
6     6                     Mt Logan           Canada   5959   5250   19550   17224
7     7  Pico de Orizaba Citlaltepetl           Mexico   5636   4922   18491   16148
8     8                 Vinson Massif       Antarctica   4892   4892   16050   16050
9     9                   Puncak Jaya        Indonesia   4884   4884   16023   16023
10   10                   Gora Elbrus           Russia   5642   4741   18510   15554
11   11                    Mont Blanc     France Italy   4809   4696   15777   15406
12   12                      Damavand             Iran   5610   4667   18405   15311
13   13         Klyuchevskaya Volcano           Russia   4750   4649   15584   15252
14   14                  Nanga Parbat         Pakistan   8125   4608   26657   15118
15   15                     Mauna Kea               US   4205   4205   13796   13796
16   16 Jengish Chokusu ex Pik Pobedy Kyrgyzstan China   7439   4148   24406   13609
17   17                    Chimborazo          Ecuador   6267   4122   20561   13523
18   18                    Bogda Shan            China   5445   4122   17864   13523
19   19                  Namcha Barwa            China   7782   4106   25531   13471
20   20                      Kinabalu         Malaysia   4095   4095   13435   13435
21   21                    Mt Rainier               US   4393   4023   14411   13196
22   22                            K2   Pakistan China   8611   4017   28251   13179
23   23                     Ras Dejen         Ethiopia   4533   3980   15092   13090
24   24               Volcan Tajumulco        Guatemala   4220   3980   13845   13058
25   25                  Pico Bolivar        Venezuela   4981   3957   16341   12982
>
```

Properties of a data frame

- Typically the columns have names
- All columns are the same length
- There can be different types of data in each column

Basic Info about a data frame

- Get dimensions

```
> dim(datM)
[1] 25  7
> Mdim<-dim(datM)
>
```

```
#get dimensions of the dataset
dim(datM)
#Note output is a vector of 2 values
#we can name this and refer to later
Mdim<-dim(datM)
```

- Names of columns

```
> names(datM)
[1] "Rank"    "Name"    "Region"  "Elev.m"  "Prom.m"  "Elev.ft" "Prom.ft"
>
```

```
#get the column names
names(datM)
```

- See what it looks like

```
> head(datM)
  Rank               Name      Region Elev.m Prom.m Elev.ft Prom.ft
1    1         Mt Everest Nepal Tibet   8848   8848   29028   29028
2    2          Aconcagua   Argentina   6962   6962   22841   22841
3    3 Mt McKinley Denali          US   6194   6138   20320   20138
4    4        Kilimanjaro    Tanzania   5895   5885   19340   19308
5    5    Cristobal Colon    Colombia   5700   5509   18701   18074
6    6           Mt Logan      Canada   5959   5250   19550   17224
>
```

```
#look at the names and first 5 rows
head(datM)
```

Referring to data in data frames

- A column can be used by: *data.frame$column*

```
#look at only the name columne
datM$Name
```

- Data frames can also be refered to like matrix where [rows,columns] notation is used
  - Refer to a column without calling its name:

```
#look at name in second column
datM[,2]
```

  - Multiple columns

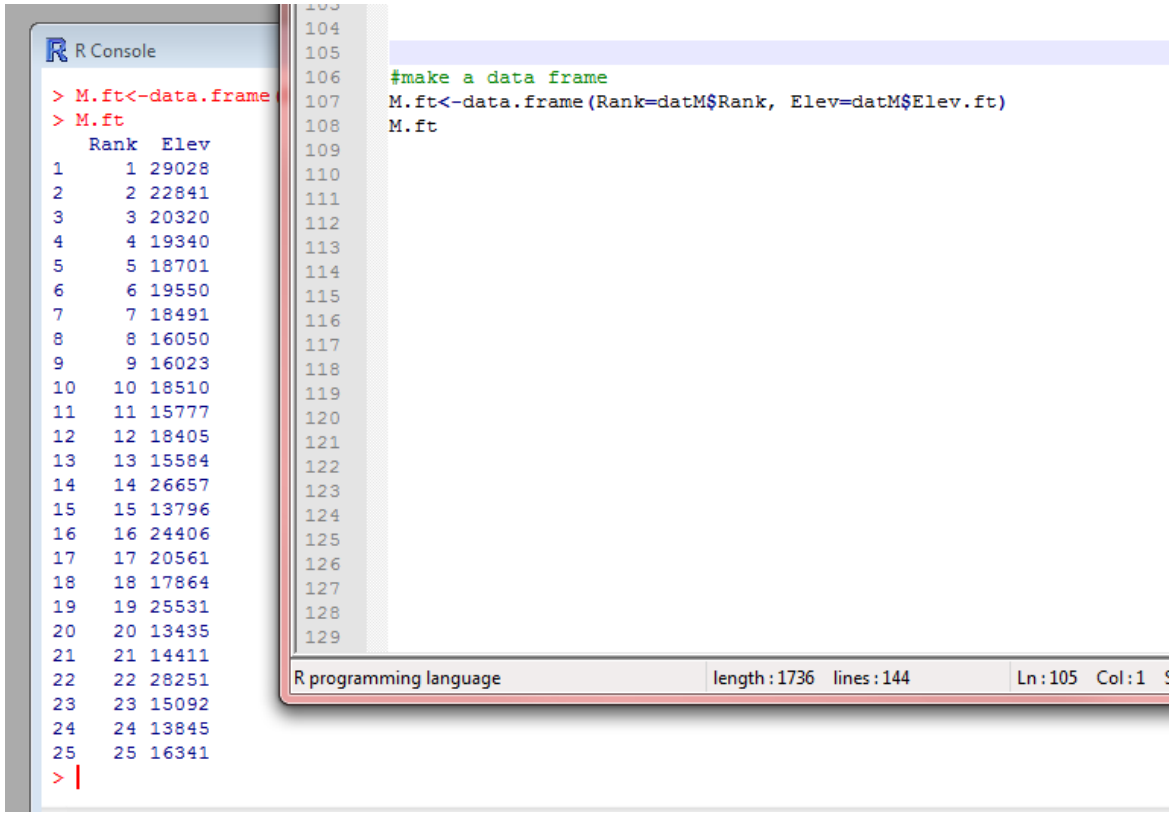
```
#refer to multiple columns
datM[,2:4]
```

  - Rows:

```
#refer to several rows
datM[1:3,]
```

Creating a data frame

- Use the function data.frame
  - Note: all vectors must be equal lengths



Subset data

- Data can be subset by a characteristic
- This is done using logical expressions (see R's guide for logical expressions.
  - https://www.r-bloggers.com/logical-operators-in-r/
- Subset with brackets:
  - Mountains in the US

```
> US.M
   Rank               Name Region Elev.m Prom.m Elev.ft Prom.ft
3     3 Mt McKinley Denali     US   6194   6138   20320   20138
15   15          Mauna Kea     US   4205   4205   13796   13796
21   21         Mt Rainier     US   4393   4023   14411   13196
>
```

```
M.ft

#subset all of the tallest mountains in the US
US.M<-datM[datM$Region=="US",]
```

  - Mountains above 20000 ft

```
> High.M<-datM[datM$Elev.ft>20000,]
> High.M
   Rank                          Name           Region Elev.m Prom.m Elev.ft Prom.ft
1     1                     Mt Everest      Nepal Tibet   8848   8848   29028   29028
2     2                      Aconcagua        Argentina   6962   6962   22841   22841
3     3             Mt McKinley Denali               US   6194   6138   20320   20138
14   14                   Nanga Parbat         Pakistan   8125   4608   26657   15118
16   16 Jengish Chokusu ex Pik Pobedy Kyrgyzstan China   7439   4148   24406   13609
17   17                     Chimborazo          Ecuador   6267   4122   20561   13523
19   19                   Namcha Barwa            China   7782   4106   25531   13471
22   22                             K2   Pakistan China   8611   4017   28251   13179
```

```
#subset by mountains above 20,000 ft
High.M<-datM[datM$Elev.ft>20000,]
High.M
```

Missing data

- NA indicates that the data is missing in R
- If there are blank cells in a data file R will automatically fill them in with NA
- You can also designate what marks an NA if it differs in a data file:

Errors

- Error messages look intimidating at first in R, but they are actually very useful
- Some kinds of examples:
  - Trying to do something where vectors are different lengths

```
> High.M$Elev.ft-US.M$Prom.ft
[1]  8890  9045  7124  6519 10610  7365  5393 14455
Warning message:
In High.M$Elev.ft - US.M$Prom.ft :
  longer object length is not a multiple of shorter object length
>
```

```
#look at difference between prominance and elevation
High.M$Elev.ft-US.M$Prom.ft
```

  - Referring to names incorrectly (capitalization counts!)

```
> mean(High.M$elev.ft)
[1] NA
Warning message:
In mean.default(High.M$elev.ft) :
  argument is not numeric or logical: returning NA
>
```