FishR 101 – Functions

Homework Answers

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Contents

Answers to Questions:

First, load your libraries!

```
library(tidyverse)
library(here)
```

NOTE: For this homework, also refer to the PDF version. There are helpful graphics included in the PDF version!

1 If-else statements

1.1 Performance: was this a good trawl?

If the weather is `excellent` or `good`, the peformance of the trawl is `0` if the weather is `fair`, the peformance of the trawl is `1` if the weather is `poor`, the peformance of the trawl is `-1`

Write the following as an:

- if() / if()}else{} / if()}else if(){} statement (whichever you see fit),
- in an ifelse() function,
- using dplyr::if_else(), and
- using dplyr::case_when()

Test your scripts whith `weather <- "good"` and solve for the parameter.

Which do you think is the most sensible approach?

> Hint: dplyr depends (and ifelse() can use)) on data.frames (and other types of tables) so you might use this data.frame:

```
dat<-data.frame(weather = c("excellent", "good", "fair", "poor"))
```

```
weather <- "good"
```

```
####  - if() / if()}else{} / if()}else if(){} statement (whichever you see fit),
if (weather %in% c("excellent", "good")) {
  performance <- 0
} else if (weather == "fair") {
  performance <- 1
} else if (weather == "poor") {
  performance <- -1
}
performance
```

```
## [1] 0
```

```r
# alternatively:
if (weather == "excellent" | weather == "good") {
  performance <- 0
} else if (weather == "fair") {
  performance <- 1
} else {
  performance <- -1
}
performance
```

```
## [1] 0
```

```r
#  - in an ifelse() function,

# with one variable
performance<-ifelse(weather %in% c("excellent", "good"), 0,
                    ifelse(weather %in% "fair", 1,
                           ifelse(weather %in% "poor", -1, NA)))
performance
```

```
## [1] 0
```

```r
# alternitively
performance<-ifelse(weather %in% c("excellent", "good"), 0,
                    ifelse(weather %in% "fair", 1, -1))
performance
```

```
## [1] 0
```

```r
# with a data.frame
performance<-ifelse(dat$weather %in% c("excellent", "good"), 0,
                    ifelse(dat$weather %in% "fair", 1,
                           ifelse(dat$weather %in% "poor", -1, NA)))
performance
```

```
## [1]  0  0  1 -1
```

```r
#  - using dplyr::if_else(), and
dat1 <- dat %>%
  dplyr::mutate(performance =
                  dplyr::if_else(weather %in% c("excellent", "good"), 0,
                    dplyr::if_else(weather %in% "fair", 1, -1)))
dat1
```

weather	performance
excellent	0
good	0
fair	1
poor	-1

```r
dat1<-dat %>%
  dplyr::mutate(performance =
                  dplyr::if_else(weather %in% c("excellent", "good"), 0,
                                 dplyr::if_else(weather %in% "fair", 1,
                                                -1)))
dat1
```

weather	performance
excellent	0
good	0
fair	1
poor	-1

```r
#  - using dplyr::case_when()
dat1<-dat %>%
  dplyr::mutate(performance =
                  dplyr::case_when(weather %in% c("excellent", "good") ~ 0,
                                   weather %in% "fair" ~ 1,
                                   weather %in% "poor" ~ -1))
dat1
```

weather	performance
excellent	0
good	0
fair	1
poor	-1

```r
# Which do you think is the most sensible approach?
# I would argue that the dplyr::case_when() is the cleanest solution,
# but as you can see, they all work!
# Whichever one suits your fancy.
```

2 For loops

2.1 Improve the following code by putting it into a for loop!

Let's use a for loop to estimate the average the result of a roll of a die.

```r
nsides = 6
ntrials = 1000
```

A non-loop version of this for the first variable would be:

```r
trials <- c()
j <- 1
trials <- c(trials, sample(1:nsides,1))
trials
```

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

```r
# once you write your loop, you can use the following to calcuale the average the result of a roll of a
mean(trials) # NOTE: because we are taking a random sample (sample()) you will not get the same answer
```

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

```r
for (j in 1:ntrials) {
  trials <- c(trials,
              sample(1:nsides,1))  # We get one sample at a time
}
head(trials)
```

```
## [1] 1 1 5 6 2 5
```

```r
mean(trials) # NOTE: because we are taking a random sample (sample()) you will not get the same answer
```

```
## [1] 3.51049
```

3 Functions

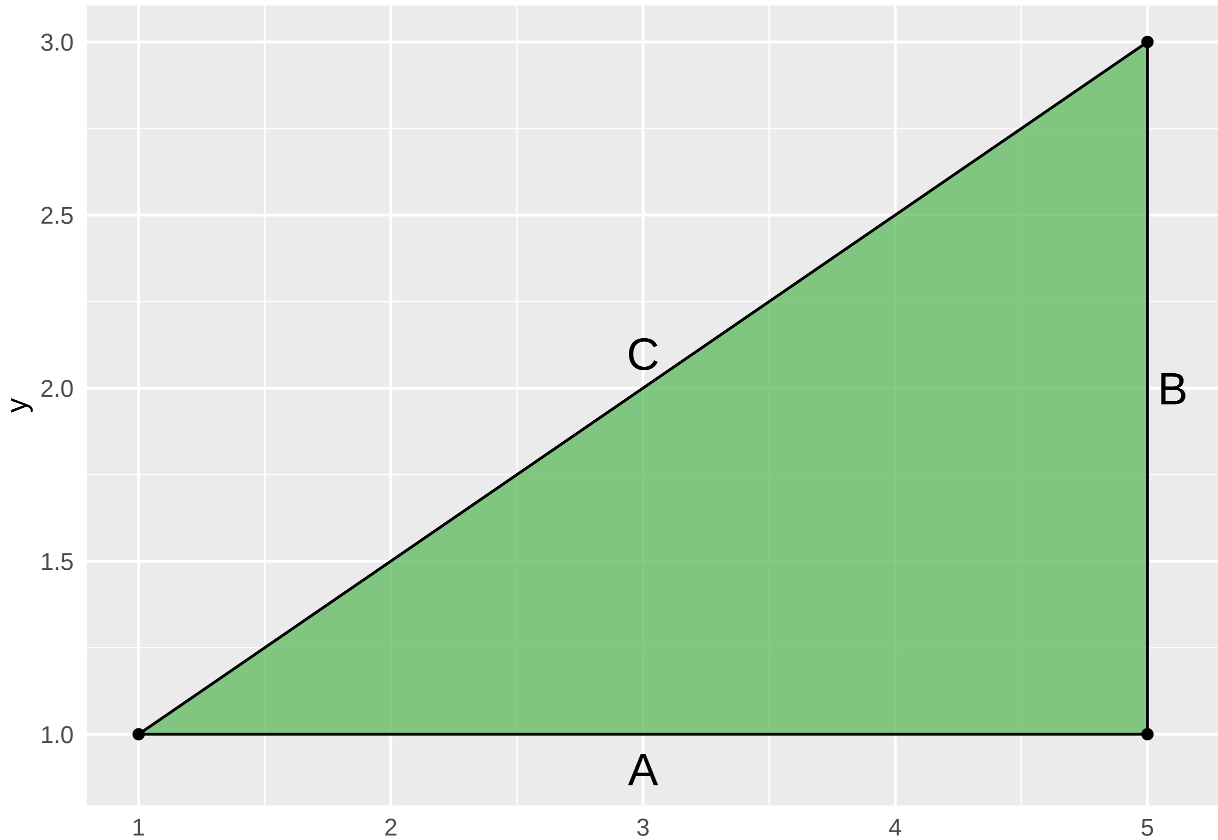
Though you can use funtions to automate processes like we did in the coursework, I am going to take a slightly different take here and focus of using functions for, well, mathimatical functions!

3.1 The Pythagorean Theorem

$$a^2 + b^2 = c^2$$

Where:

- a is the length of leg A
- b is leg length of leg B
- c is the length of leg C, otherwise known as the hypotenuse



If $a = 5$ and $b = 3$, solve for c and include {roxygen2} skeletons!

```r
#' The Pythagorean Theorem
#'
#' @param a1 A numberic. The first leg of a right triangle.
#' @param b1 A numberic. The second leg of a right triangle.
#'
#' @return A numeric. The hypotenuse of the triangle.
#' @export
#'
#' @examples
#' pythagoreanTheorem(a1 = 5, b1 = 3)
pythagoreanTheorem <- function(a1, b1) {

  c2 <- a1^2 + b1^2

  c0 <- c2^(1/2) # could also use sqrt()

  return(c0)
}

pythagoreanTheorem(a1 = 5, b1 = 3)
```

```
## [1] 5.830952
```

3.2 Newton's Universal Law of Gravitation

$$F = G\frac{m_1 m_2}{d^2}$$

Where:

- F = force
- G = gravitational constant $(6.67430 * 10^{-11})$
- m_1 = mass of object 1
- m_2 = mass of object 2
- r = distance between centers of the masses

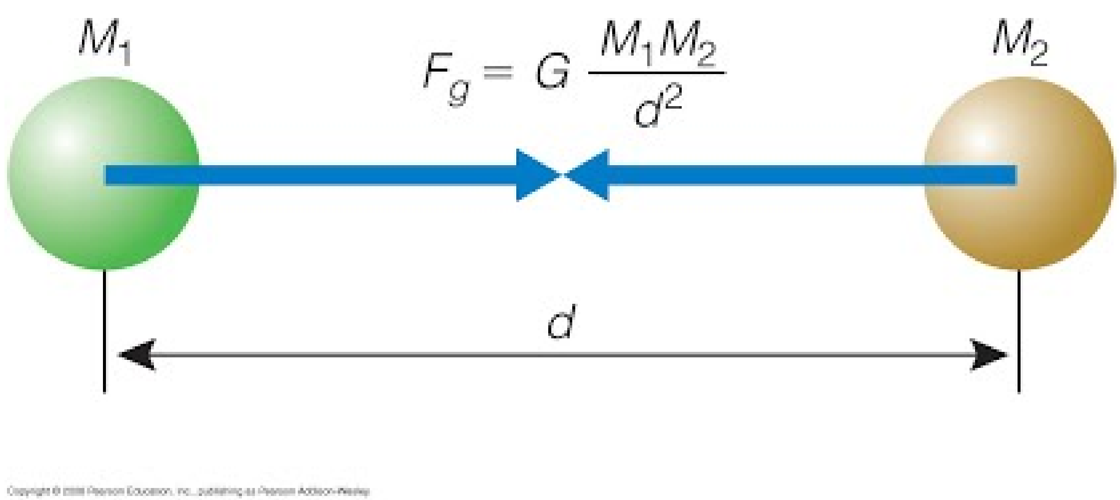


Figure 1: Newton's Universal Law of Gravitation

Let the mass of object 1 (m_1) = 5, mass of object 2 (m_2) = 3, and distance between the two masses (d) = 2. Solve for force (F) and include {roxygen2} skeletons:

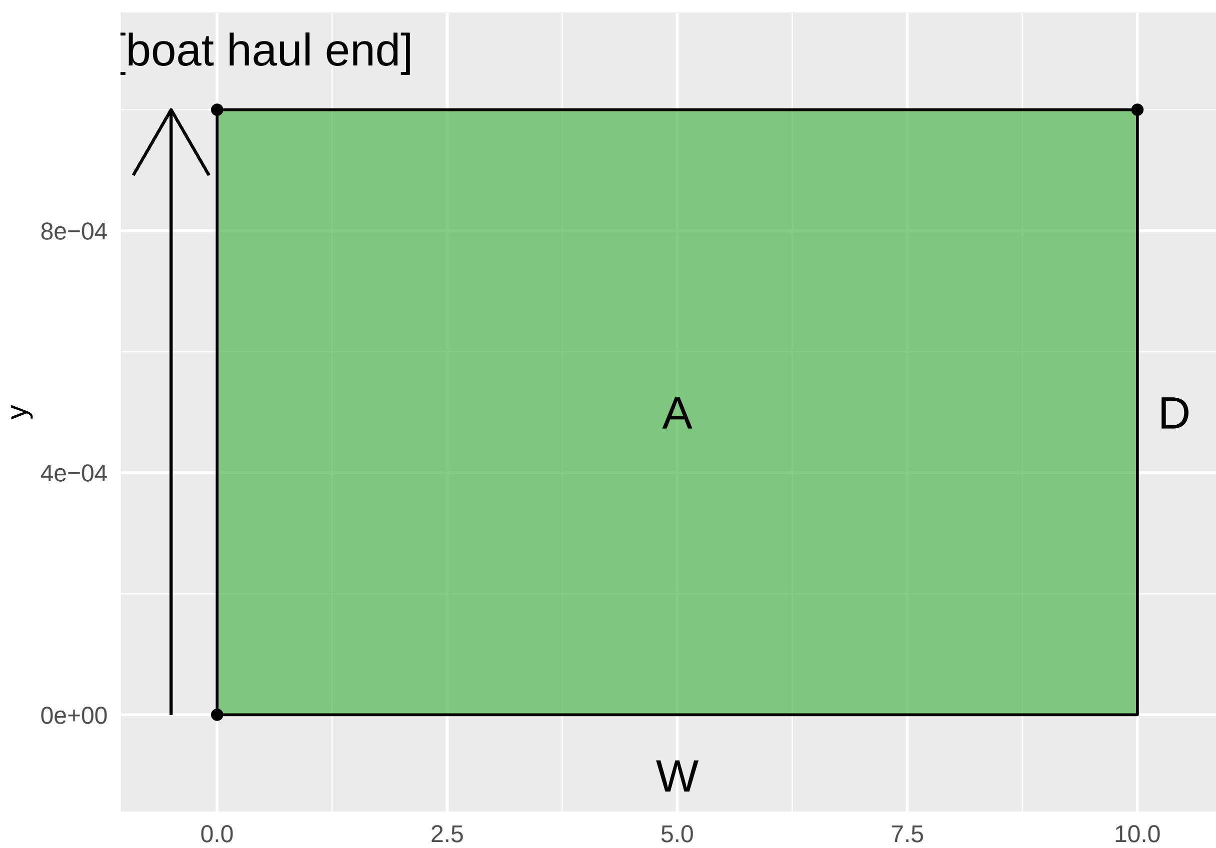
> Hint! The Gravitational Constant Shouldn't change, unless you are testing this out on other planets. To save time, add the gravitational constant to where you call your arguments in your function.

```
#' Calculate Newton's Universal Law of Gravitation
#'
#' @param G0 A numeric. The gravitational constant. The default is 6.67430*10^-11.
#' @param m_1 A numeric. Mass of the first object.
#' @param m_2 A numeric. Mass of the second object.
#' @param d2 A numeric. distance between centers of the masses.
#'
#' @return A numeric. The force.
#' @export
```

```r
#'
#' @examples
#' NewtonGrav(m_1 = 5, m_2 = 3, d2 = 2)
NewtonGrav <- function(G0 = 6.67430*10^-11,
                       m_1,
                       m_2,
                       d2){

  F1 = G0 * (m_1*m_2)/d2

  return(F1)
}

NewtonGrav(m_1 = 5,
           m_2 = 3,
           d2 = 2)
```

```
## [1] 5.005725e-10
```

3.3 Area Swept (from our surveys!)



This is the area sampled for each observation when we survey. Often we can assume this number is low (e.g., 0.001). In our case, we need to add some conversions to make this useful to the survey outputs. Here I'll write without variables to make it easier to read:

$$AreaSwept(km^2) = DistanceFished(hectare) * (NetWidth(m) * 0.001(\frac{km}{m})) * 100(\frac{km}{hectare})$$

But for writing our function, we'll simplify to the core of this equation:

$$area = distance * width$$

3.3.1 Write a function for this equation and solve for $AreaSwept(km^2)$. Use a0 = Area, d0 = Distance (.001), w0 = Width (10). Solve for Area (a0) and include {roxygen2} skeletons.

```
#' Area Swept
#'
#' @param d0 A numeric. distnace of survey.
#' @param w0 A numeric. Width of net.
#'
#' @return
#' @export
#'
#' @examples AreaSwept()
AreaSwept<-function(d0, w0) {
  a0<-d0*(w0*0.001)*100
  return(a0)
}

AreaSwept(d0 = .001, w0 = 10)
```

```
## [1] 0.001
```

3.3.2 Now we will apply this function to some real data! Here I've combined two datasets, *haul* and *catch* for Eastern Bering Sea data.

Here is *catch* and *haul* joined:

```
EBS<-read_csv(file = here("data", "haul_catch.csv"))
EBS <- subset(x = EBS,
              subset = (YEAR == 2017),
              select = c("YEAR", "SPECIES_CODE", "WEIGHT", "NUMBER_FISH",
                         "REGION", "VESSEL", "HAUL",
                         "STRATUM", "PERFORMANCE", "START_TIME",
                         "DURATION", "DISTANCE_FISHED", "NET_WIDTH", "NET_HEIGHT"))
kable(head(EBS))
```

YEAR	SPECIES_CODE	WEIGHT	NUMBER_FISH	REGION	VESSEL	HAUL	STRATUM	PERFORMA
2017	471	129.200	25	BS	162	126	62	
2017	21390	0.060	1	BS	162	127	43	
2017	10285	96.964	99	BS	162	25	31	
2017	10112	4.600	19	BS	162	30	50	
2017	10120	20.972	20	BS	162	6	10	
2017	21368	2.000	1	BS	162	42	31	

```r
EBS$AreaSwept<-AreaSwept(d0 = EBS$DISTANCE_FISHED, w0 = EBS$NET_WIDTH)
summary(EBS)
```

```
##       YEAR       SPECIES_CODE        WEIGHT           NUMBER_FISH          REGION                VESSEL
##  Min.   :2017   Min.   :  320   Min.   :   0.002   Min.   :    1.0   Length:4698          Min.   : 94.0
##  1st Qu.:2017   1st Qu.:10120   1st Qu.:   3.741   1st Qu.:    4.0   Class :character     1st Qu.: 94.0
##  Median :2017   Median :10270   Median :  19.225   Median :   17.0   Mode  :character     Median : 94.0
##  Mean   :2017   Mean   :18154   Mean   : 105.054   Mean   :  318.6                        Mean   :123.9
##  3rd Qu.:2017   3rd Qu.:21438   3rd Qu.:  77.986   3rd Qu.:  134.2                        3rd Qu.:162.0
##  Max.   :2017   Max.   :81742   Max.   :6699.338   Max.   :28160.0                        Max.   :162.0
##                                                    NA's   :2
##   PERFORMANCE         START_TIME                      DURATION       DISTANCE_FISHED    NET_WIDTH        I
##  Min.   :0.00000   Min.   :2017-06-04 07:35:41   Min.   :0.2470   Min.   :1.337   Min.   :13.61   Min
##  1st Qu.:0.00000   1st Qu.:2017-06-20 13:39:02   1st Qu.:0.5120   1st Qu.:2.768   1st Qu.:16.31   1st
##  Median :0.00000   Median :2017-07-03 09:06:40   Median :0.5180   Median :2.827   Median :16.92   Med
##  Mean   :0.07264   Mean   :2017-07-04 09:11:26   Mean   :0.5144   Mean   :2.815   Mean   :16.97   Mea
##  3rd Qu.:0.00000   3rd Qu.:2017-07-20 12:37:52   3rd Qu.:0.5240   3rd Qu.:2.897   3rd Qu.:17.62   3rd
##  Max.   :4.50000   Max.   :2017-07-31 18:29:36   Max.   :0.6090   Max.   :3.439   Max.   :20.12   Max
##
```

3.4 Catch Per Unit Effort (CPUE)

CPUE is calculated by dividing the catch of each fishing trip by the number of hours fished during that trip. This gives CPUE in units of kilograms per hour.

$$CPUE = \frac{Catch_{trips}(kg)}{time_{trips}(hr)}$$

3.4.1 Write a function for this equation and solve for $CPUE$. Use catch = catch from the survey (catch = EBS$NUMBER_{F}ISH), time = timeinhoursfromthesurvey(EBS$DURATION), trips = number of trips taken during survey (EBS$HAUL). Solve for CPUE (CPUE) and include {roxygen2} skeleton.

Hint: This question is meant to challenge you. You'll need to use an for loop to cycle through unique trips.

```r
#' Calculate CPUE of Survey
#'
#' @param catch A numeric or a vector. Catch from the fishing trip.
#' @param time A numeric or a vector. Time in hours. Number of hours fished during that trip.
#' @param trips
#'
#' @return A numeric or a vector of CPUE.
#' @export
#'
#' @examples
#' CPUE0<-CPUE(trips = 3,
#'             time = 100,
#'             catch = 1000)
CPUE <- function(catch, time, trips){
```

```
  trip_unq<-unique(trips)
  CPUE0 <- data.frame(TRIP = trip_unq,
                      CPUE = NA)

  for (i in 1:length(trip_unq)) {
    trip_idx<-which(trips %in% trip_unq[i])
    CPUE0$CPUE[i]<-sum(catch[trip_idx])/sum(time[trip_idx])
  }

  return(CPUE0)
}

CPUE0<-CPUE(trips = EBS$HAUL,
            time = EBS$DURATION,
            catch = EBS$NUMBER_FISH)

head(CPUE0)
```

TRIP	CPUE
126	239.4721
127	277.7416
25	816.5289
30	795.5340
6	785.0103
42	1642.2331