

FishR 101 – Functions Part 2

Homework

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First, load your libraries!

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

Questions:

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

1 Functions

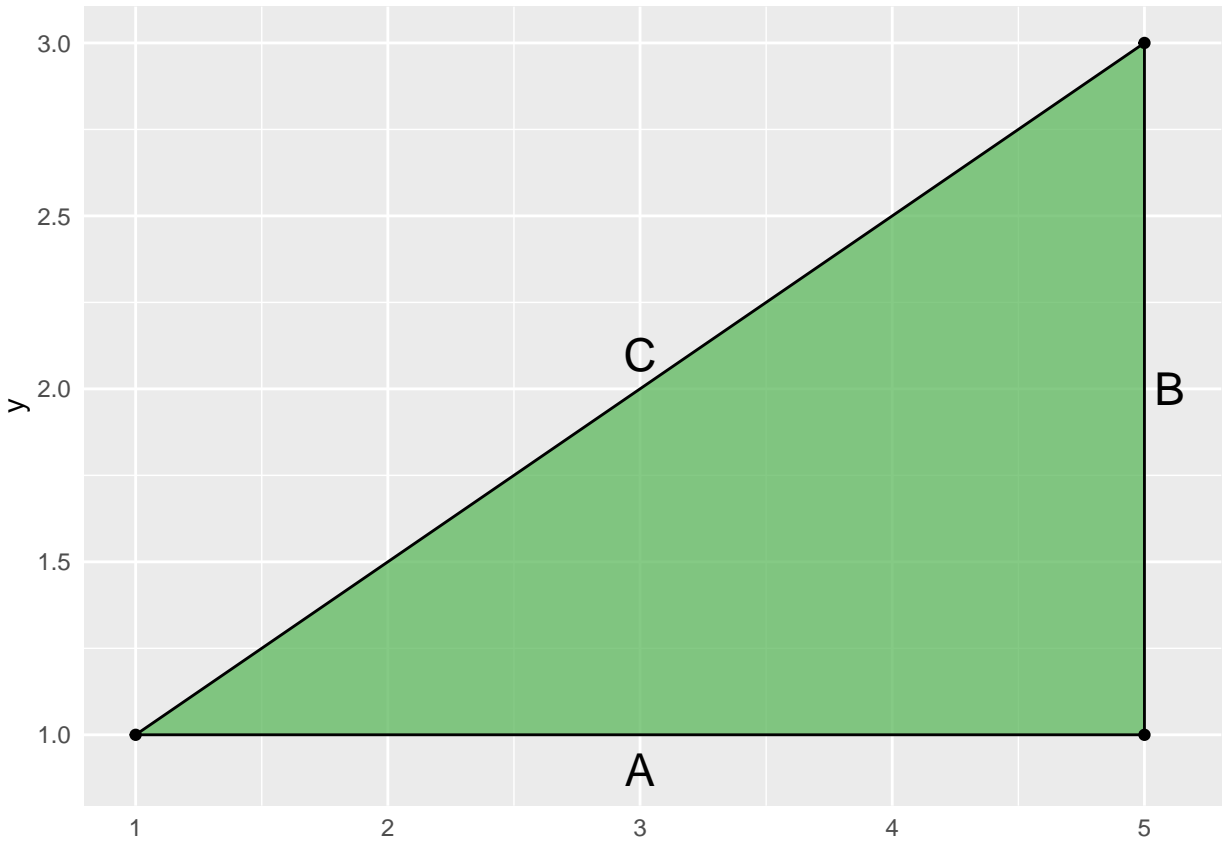
Though you can use functions to automate processes like we did in the coursework, I am going to take a slightly different take here and focus on using functions for, well, mathematical functions!

1.1 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



Solve for c and include {roxygen2} skeletons!

Let:

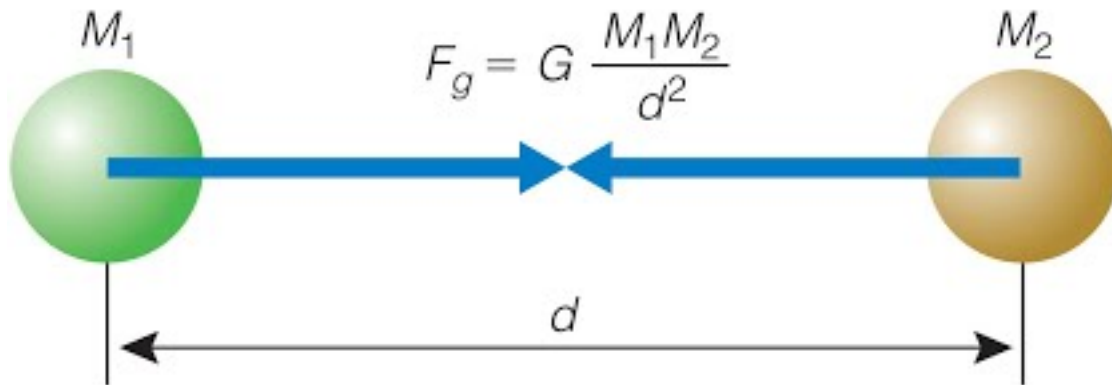
- $a = c(5, 3, 10, 4)$
- $b = c(3, 5, 10, 20)$

1.2 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



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Figure 1: Newton's Universal Law of Gravitation

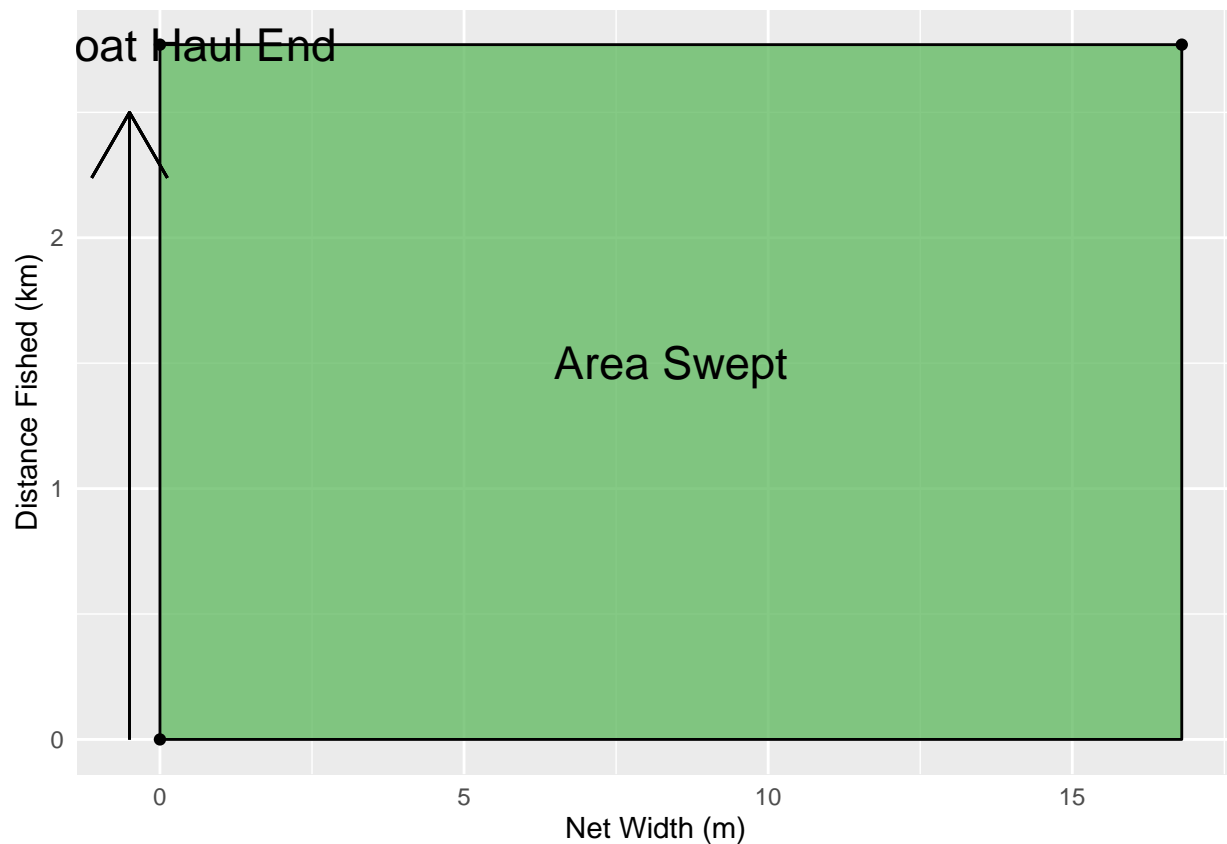
1.2.1 Solve for force (F) and include {roxygen2} skeletons:

Let:

- the mass of object 1 (m_1) = 5,
- the mass of object 2 (m_2) = 3, and
- distance between the two masses (d) = 2.

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

1.3 Area Swept (from our surveys!)



This is the area sampled for each observation when we survey. Here I'll write without variables to make it easier to read:

$$AreaSwept_{haul}(ha) = \frac{DistanceFished_{haul}(km) * NetWidth_{haul}(m)}{10(\frac{m*km}{ha})}$$

1.3.1 Write a function for this equation and solve for $AreaSwept(km^2)$.

Let:

- dist_fish = Distance Fished (2.77 km)
- net_width = Net Width (16.8 m)

Solve for Area and include {roxygen2} skeletons.

1.3.2 Now we will apply this function to some real data! Here I've combined two datasets, *haul* and *catch* for Eastern Bering Sea data (people familiar with the survey data on Oracle will know what this means).

```
EBS<-read_csv(file = here("data", "haul_catch.csv"))
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
EBS<-janitor::clean_names(EBS)
```

```
EBS_summary <- EBS %>%
```

```
  dplyr::filter(year == 2017) %>%
```

```
  dplyr::select(hauljoin, distance_fished, net_width) %>%
```

```
  # Now notice that this equation is calculated by haul.
```

```
  # Right now the data includes species data so each haul number is
```

```
  # listed multiple times in the haul column. We'll need to find the
```

```
  # unique rows of the data so there is one row per haul.
```

```
  dplyr::distinct(hauljoin, distance_fished, net_width)
```

```
head(EBS_summary)
```

hauljoin	distance_fished	net_width
-16940	2.768	16.811
-16941	2.734	16.248
-16520	2.872	16.505
-16533	2.916	17.834
-16345	2.824	16.007
-16551	2.838	16.745

```
str(EBS_summary)
```

```
## tibble [376 x 3] (S3: tbl_df/tbl/data.frame)
```

```
## $ hauljoin      : num [1:376] -16940 -16941 -16520 -16533 -16345 ...
```

```
## $ distance_fished: num [1:376] 2.77 2.73 2.87 2.92 2.82 ...
```

```
## $ net_width      : num [1:376] 16.8 16.2 16.5 17.8 16 ...
```

Let:

- `dist_fish = EBS_summary$distance_fished`
- `net_width = EBS_summary$net_width`

Add a new column called `area_swept` to our `EBS_summary` data frame.

1.4 Catch Per Unit Effort (CPUE)

CPUE is calculated by dividing the catch weight of each fishing trip by the area swept (from the last equation!). This gives CPUE in units of kilograms per hectare.

$$CPUE_{haul}(kg/ha) = \frac{FishWeight_{haul}(kg)}{(DistanceFished_{haul}(km) * NetWidth_{haul}(m))/10(\frac{m*km}{ha})} = \frac{FishWeight_{haul}(kg)}{AreaSwept_{haul}(ha)}$$

Write a function for the above CPUE equation and solve for *CPUE* using the below data and using your function for area swept from the last question.

```
# EBS<-read_csv(file = here("data", "haul_catch.csv"))
# EBS<-janitor::clean_names(EBS)
EBS_summary <- EBS %>%
  dplyr::select(year, hauljoin, distance_fished, net_width, weight) %>%
  dplyr::group_by(year, hauljoin, distance_fished, net_width) %>%
  dplyr::summarise(sum_weight = sum(weight, na.rm = TRUE))

head(EBS_summary)
```

year	hauljoin	distance_fished	net_width	sum_weight
1982	857	2.667	16.055	392.992
1982	858	2.889	16.055	2195.443
1982	859	2.667	16.440	2547.919
1982	860	2.889	16.440	2264.883
1982	862	2.685	16.454	988.244
1982	863	2.519	16.440	1283.893

Let:

- catch = catch from the survey (catch = EBS_summary\$number_fish),
- time = time in hours from the survey (EBS_summary\$duration),
- trips = number of trips taken during survey (EBS_summary\$haul).

Solve for CPUE (CPUE) and include {roxygen2} skeleton.