

# Competition

CSUCI Datathon – Southern California Consortium for Data Science

2025-04-26

## Channel Islands

The **Channel Islands** are a chain of eight islands located off the southern coast of California in the Pacific Ocean. They are known for their stunning natural beauty, ecological richness, and deep cultural history.

### The Eight Channel Islands (North to South)

1. **San Miguel Island**
2. **Santa Rosa Island**
3. **Santa Cruz Island**
4. **Anacapa Island**
5. **Santa Barbara Island**
6. **San Nicolas Island**
7. **San Clemente Island**
8. **Santa Catalina Island**

### Channel Islands National Park

- Includes **five islands**: *San Miguel*, *Santa Rosa*, *Santa Cruz*, *Anacapa*, and *Santa Barbara*.
- Sometimes called the “**Galápagos of North America**” for its rich biodiversity and many **endemic species**.
- Accessible only by **boat or small plane**.
- Ideal for hiking, kayaking, camping, and wildlife observation.

### Cultural and Historical Significance

- Originally inhabited by **Chumash** and **Tongva** indigenous groups for thousands of years.
- Home to important archaeological and cultural heritage sites.

### Island Fox (*Urocyon littoralis*)

The **island fox** is a small, charismatic canid species **endemic** to six of the eight **Channel Islands** off the coast of southern California. It's one of the best examples of **island dwarfism**, having evolved from the mainland gray fox (*Urocyon cinereoargenteus*) to become significantly smaller.

In the **1990s**, several island fox populations faced **near extinction** due to golden eagle predation, canine distemper virus, and habitat degradation. The island fox was listed as endangered in 2004. Recovery efforts of the island fox included removal of golden eagles, vaccination and captive breeding programs, reintroduction of native bald eagles, and habitat restoration.

### Competition

For the competition, you will investigate one of the two sections, **Fox Weight** or **Fox Reproductive Status**. Follow the guidelines in the section of your choice and complete one of the challenges. **You may also analyze the data in any other way or work on the other section, but it is not necessary.** Afterwards, create a presentation using google slides. Share the slides to the lead instructor in the classroom. They will provide their email on the board.

## Analysis

Using the [tutorial](#) and example analysis, complete at least one of the challenges.

## Slides and Presentation

The slides will be used for a presentation, in the last 30 minutes. You should have no more than 5 slides displaying what your findings are. Here is an example of the slides you should submit:

1. Title Slide
  - Come up with a creative title for your analysis.
  - Include the names of all your group members.
  - Include Team Name
  - Provide what you have analyzed
2. Numerical Results
  - Provide information about the results you found.
3. Plots
  - Provide any plots.
4. Conclusions
  - Answer your research question.

An Example can be found [here](#).

## Data and Prep

The data provided is part of an ongoing longitudinal study from 2014 to 2016 of trap monitoring. This resulted in collection of 4,975 recorded trap observations, which may have contained a fox or not. Other information collected from the fox were Sex, Age Class, Weight, Body Condition, Reproductive Status, and Vaccinations. Information of the data collected can be found in the [Databook](#).

You can download the data and script files [here](#). (Password: dolphins\_2025) Download, unzip file, load R project, and select “datathon.R” file to follow datathon document. For more help, watch this [video](#)

## Installing and Loading Packages

```
install.packages("tidyverse")  
library(tidyverse)
```

## Loading Data

We will need to load the data into R using the `read_csv` function.

```
df <- read_csv("data_for_csuci_datathon_2014_2016.csv") # Loads the Data Set into the objects df and
```

## Cleaning Data

### Renaming Categories

Looking at the [Databook](#), the variables `Vaccinations`, `ReproductiveStatus` and `BodyCondition` have interesting ways they are coded. In `Vaccinations`, missing values (NA) are considered as not vaccinated; therefore, changing the missing to “NV” will ensure that they are correctly classified, see data book. In

ReproductiveStatus, the missing values (NA) indicate unknown reproductive status. In BodyCondition, the numerical values 1, 2, 3, 4, and 5, represent a condition. To make the condition easier, we will convert them to the categories. Run the code below to alter them:

```
df <- df |> mutate( # Will change the variables in the df data set
  Vaccinations = case_when(is.na(Vaccinations) ~ "NV", .default = Vaccinations), # Reclassifies Missing
  ReproductiveStatus = case_when(is.na(ReproductiveStatus) ~ "UN", .default = ReproductiveStatus), # Rec
  BodyCondition = case_when( # Begins to modify BodyCondition
    as.character(BodyCondition) == "1" ~ "emaciated", # Changes 1 to emaciated
    as.character(BodyCondition) == "2" ~ "thin", # Changes 2 to thin
    as.character(BodyCondition) == "3" ~ "healthy wild", # Changes 3 to healthy wild
    as.character(BodyCondition) == "4" ~ "extra fat reserves", # Changes 4 to Extra Fat Reserve
    as.character(BodyCondition) == "5" ~ "extreme fat reserves" # Changes 5 to Extreme Fat Reserves
  )
)
```

## Missing Values

Several variables in the data set may have missing values. Using the `summary()`, we can determine which variables have missing values by looking at the “NA’s” category.

```
summary(df)
```

Island	SamplingYear	GridCode	
Length:4975	Min. :2014	Length:4975	
Class :character	1st Qu.:2014	Class :character	
Mode :character	Median :2015	Mode :character	
	Mean :2015		
	3rd Qu.:2016		
	Max. :2016		

TrapDate	NightNumber	TrapNumber	
Min. :2014-07-16 00:00:00.00	Min. :1.000	Min. : 1.00	
1st Qu.:2014-08-24 00:00:00.00	1st Qu.:2.000	1st Qu.: 4.00	
Median :2015-08-12 00:00:00.00	Median :3.000	Median : 8.00	
Mean :2015-08-25 01:31:27.92	Mean :3.392	Mean : 18.87	
3rd Qu.:2016-08-18 00:00:00.00	3rd Qu.:5.000	3rd Qu.: 11.00	
Max. :2016-11-30 00:00:00.00	Max. :6.000	Max. :108.00	

TrapResult	Pittag	CaptureType	Sex
Length:4975	Length:4975	Length:4975	Length:4975
Class :character	Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character	Mode :character

AgeClass	Weight	Weight_units	BodyCondition
Min. :0.000	Min. : 0.72	Length:4975	Length:4975
1st Qu.:1.000	1st Qu.: 1.73	Class :character	Class :character
Median :1.000	Median : 2.02	Mode :character	Mode :character
Mean :1.557	Mean : 49.49		

```

3rd Qu.:3.000    3rd Qu.: 2.30
Max.      :4.000    Max.      :910.00
NA's      :2840    NA's      :2808
ReproductiveStatus Vaccinations
Length:4975      Length:4975
Class :character  Class :character
Mode  :character  Mode  :character

```

We notice that the variables `AgeClass`, `Weight`, and `BodyCondition` have missing values. **For this analysis, we will remove the missing values (NA).**

```
df <- drop_na(df, AgeClass, Weight, BodyCondition) # Removes the missing values (NA) using the variables A
```

After cleaning the data, this should result in 1,967 recorded foxes!

```
nrow(df)
```

```
[1] 1967
```

## Fox Weight Analysis

Imagine you're a field biologist tracking animal health across the remote Santa Rosa and San Miguel Islands. You've noticed that some animals seem heavier in certain years—but is it just your imagination, or is there a real trend?

The `Weight` variable contains information of the Fox's weight in kilograms. Let's start by calculating the mean weight and standard deviation of weight using `mean()` and `sd()` functions:

```

mean_weight<-mean(df$Weight)
sd_weight<-sd(df$Weight)
mean_weight

```

```
[1] 1.940275
```

```
sd_weight #printing the values
```

```
[1] 0.4140872
```

We see that mean weight of fox is about 1.9 kg with standard deviation about .41 kg.

We will use the `table()` and `prop.table()` function to get the frequencies and proportions for the `Sex`.

```

count_df <- table(df$Sex) # Using the 'Sex' variable from the `df` data set, we count the frequencies of e
count_df # Printing out the contents of "rs_df"

```

```

Female   Male
   923    1044

```

Using the `table()` function, we can see that there are 923 female and 1044 male Foxes.

```
prop.table(count_df) # Computing the Proportions of "rs_df"
```

```

Female      Male
0.923      0.1044

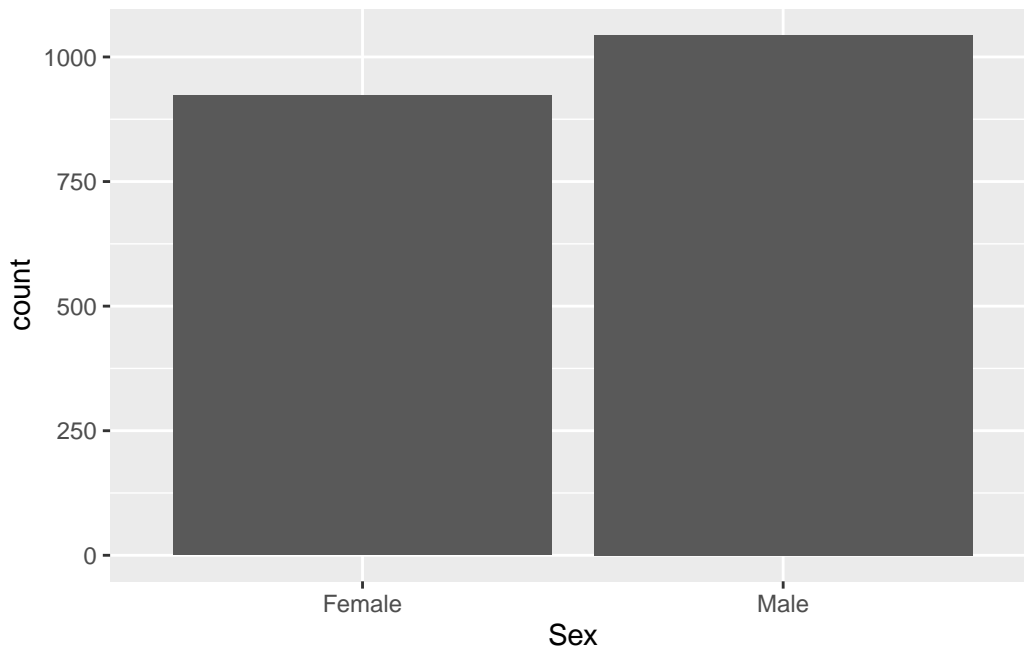
```

0.4692425 0.5307575

Using the `prop.table()` function, we can see that there are slightly more male Foxes (about 53%) vs. female Foxes (about 47%).

We can visualize the data using the `ggplot` functions:

```
ggplot(df) + # Setting up the data to create a plot.  
  geom_bar(aes(Sex)) # Creating a bar chart based on the variable "ReproductiveStatus"
```



The bar plot demonstrates that there are more males than females.

## Weight vs Sex

Let's visualize the variable `Weight` and `Sex` with a box plot using `ggplot`:

```
ggplot(df, aes(x = Sex, y = Weight)) +  
  geom_boxplot() +  
  labs(  
    title = "Boxplot of Weight by Sex",  
    x = "Sex",  
    y = "Weight"  
  )
```



From the box plot we see that male Foxes are slightly heavier than female Foxes.

We can use `group_by()` function to separate male from female population and calculate mean and standard deviation separately:

```
weight_summary <- df %>%
  group_by(Sex) %>%
  summarise(
    mean_weight = mean(Weight),
    sd_weight = sd(Weight),
    .groups = "drop"
  )
weight_summary
```

```
# A tibble: 2 x 3
  Sex    mean_weight sd_weight
<chr>    <dbl>    <dbl>
1 Female      1.88      0.386
2 Male       1.99      0.431
```

This table confirms that male Foxes are slightly heavier, about 1.99 kg, than female Foxes, about 1.88 kg, with standard deviations also slightly higher for male Foxes.

### Weight vs Sex over time

To see weight vs sex trend over time we can use `group_by()` and `ggplot` functions again:

```
weight_summary_yearly <- df %>%
  group_by(Sex, SamplingYear) %>%
  summarise(
    mean_weight = mean(Weight, na.rm = TRUE),
    sd_weight = sd(Weight, na.rm = TRUE),
```

```

    .groups = "drop"
  ) #group the data by Sex and Year and calculate mean and standard deviation of weight
weight_summary_yearly

```

```

# A tibble: 6 x 4
  Sex      SamplingYear mean_weight sd_weight
<chr>      <dbl>      <dbl>    <dbl>
1 Female      2014          1.95     0.362
2 Female      2015          1.85     0.409
3 Female      2016          1.86     0.373
4 Male        2014          2.08     0.405
5 Male        2015          1.95     0.451
6 Male        2016          1.99     0.419

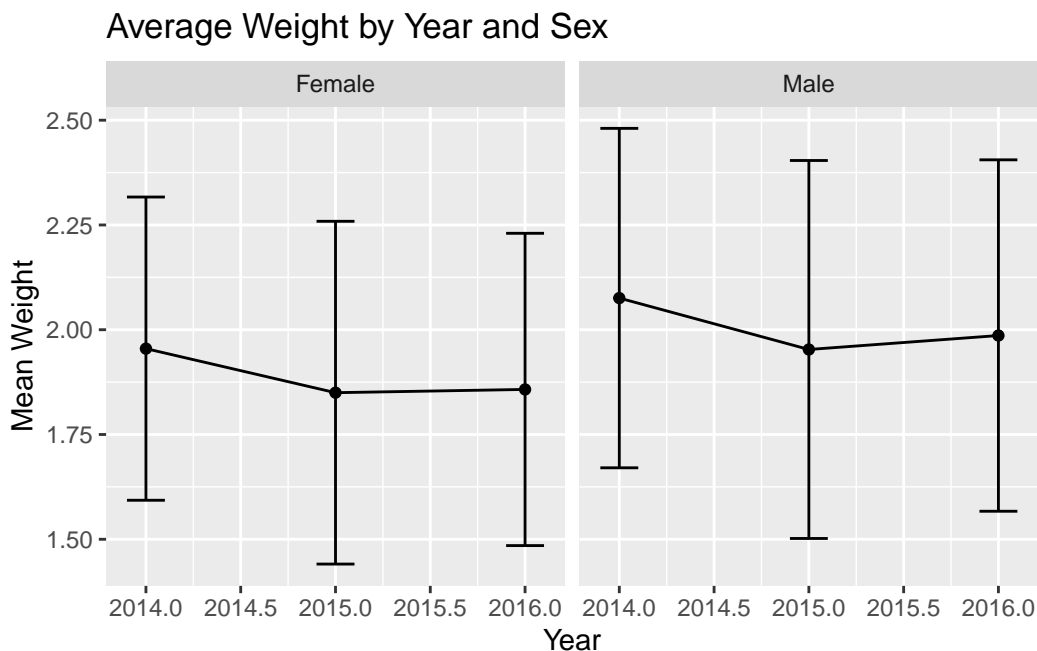
```

From the table we see a downward trend in weight for both females and males. Let's plot it on the graph:

```

ggplot(weight_summary_yearly, aes(x = SamplingYear, y = mean_weight)) +
  geom_line() +
  geom_point() +
  geom_errorbar(aes(ymin = mean_weight - sd_weight,
                    ymax = mean_weight + sd_weight), width = 0.2) +
  facet_wrap(~ Sex) +
  labs(
    title = "Average Weight by Year and Sex",
    y = "Mean Weight",
    x = "Year"
  )

```





### Weight vs Sex over time by Island

Take a moment to conduct the same analysis for different **Islands** separately and comment on the trends you see:

```
#Santa Rosa Fox population
SR_df<-filter(df,Island=="SRI")

#San Miguel Fox population
SM_df<-filter(df,Island=="SMI")
```

## Challenges

### Vaccinations

Analyse the interaction between **Weight** and **Vaccinations**

### Body Condition

Analyse the interaction between **Weight** and **BodyCondition**

## Fox Reproductive Status Analysis

The **ReproductiveStatus** variable contains information of the Fox's reproductive status when captures. This data is recorded as "N" (Not actively reproductive), "L" (Lactating), "SL" (Signs of Lactating), and "TD" (Testes Distended).

## Descriptive Statistics

### Reproductive Status

We will use the `table()` and `prop.table()` function to get the frequencies and proportions for the **ReproductiveStatus**.

```
rs_df <- table(df$ReproductiveStatus) # Using the 'ReproductiveStatus' variable from the `df` data set, we
rs_df # Printing out the contents of "rs_df"
```

```
  L   SL   TD   UN
18  244 1030  675
```

Using the `table()` function, we can see that there are 3 common reproductive statuses by Fox: "L" at 18, "SL" at 244, "TD" at 1030, and "UN" at 675.

```
prop.table(rs_df) # Computing the Proportions of "rs_df"
```

```
      L      SL      TD      UN
0.009150991 0.124046772 0.523640061 0.343162176
```

Using the `prop.table()` function, we can see that the most common status is "TD" at 52.4% and the least common is "L" at the 0.9%. Both "SL" and "UN" represent 12.4% and 34.3% of the data, respectively.

We can visualize the data using the `ggplot` functions:

```
ggplot(df) + # Setting up the data to create a plot.  
  geom_bar(aes(ReproductiveStatus)) # Creating a bar chart based on the variable "ReproductiveStatus"
```



The bar plot demonstrates that “TD” is the most common status in the data, and “L” is the least common status in the data.

#### Analysing Sex

Take a moment to conduct the same analysis with the `Sex` variable.

### Sex and Reproductive Status

Let’s compare the frequencies between the variables `Sex` and `Reproductive Status`. We will be using the same `table()` function:

```
xy_df <- table(df$ReproductiveStatus, df$Sex)  
# Use the variables "ReproductiveStatus" and "Sex" from the "df" data set  
# Use the table function to compute the crosstabs  
# Store the results in the xy_df object  
  
xy_df # Print results out
```

	Female	Male
L	18	0
SL	244	0
TD	0	1030
UN	661	14

The results show that certain categorical combinations between `ReproductiveStatus` and `Sex` are 0, which

is to be expected. The category “UN” is found in both Male and Female foxes. Looking at Female foxes, The most common type is “UN”, followed by “SL”. For Male foxes, the most common type was “TD”.

Let’s find the proportions for each the combination of the variables using the `prop.table()` function.

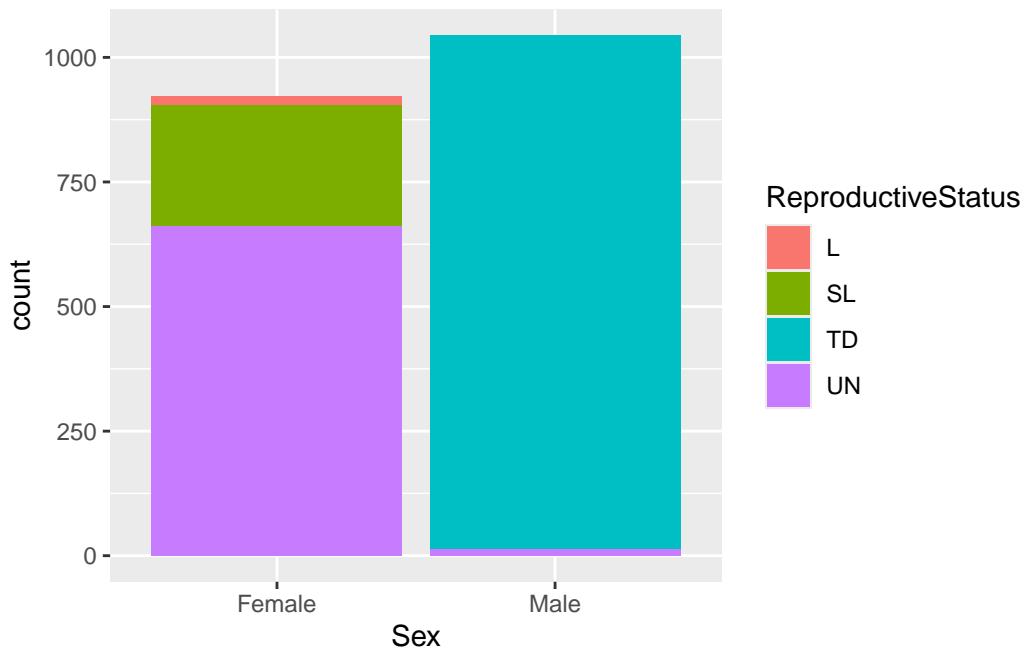
```
prop.table(xy_df)
```

	Female	Male
L	0.009150991	0.000000000
SL	0.124046772	0.000000000
TD	0.000000000	0.523640061
UN	0.336044738	0.007117438

We can see that 52.4% of the data are Male and “TD” foxes, 33.6% of the data are Female and “UN” foxes, and 12.4% of the data are Female and “SL” foxes.

Let’s visualize the variable `ReproductiveStatus` and `Sex` with a stacked bar plot:

```
ggplot(df) +  
  geom_bar(aes(Sex, fill = ReproductiveStatus))
```



The plot indicate which categories are most dominant in each sex. We can see that the most dominant reproductive status in Male foxes is testes distended. For Female foxes, we can see tha tthe most common reproductive status being unknown.

## Challenges

Age Class

Analyse the interaction between `ReproductiveStatus` and `AgeClass`

### Vaccinations

Analyse the interaction between `ReproductiveStatus` and `Vaccinations`

### Capture Type

Analyse the interaction between `ReproductiveStatus` and `Capture Type`