Intelligence of Dogs

Kimberly Cable

05-21-2022

Final Project - Step 2

How to import and clean my data

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

##
## Attaching package: 'purrr'

## The following object is masked from 'package:magrittr':
##
##     set_names
```

Load and read each of the datasets:

- **dog_intelligence.csv**

```
intelligence_df <- read.csv("Final_Project/data/dog_intelligence.csv",
    header = TRUE,
    stringsAsFactors = FALSE)
head(intelligence_df)
```

```
##                Breed Classification obey reps_lower reps_upper
## 1     Border Collie Brightest Dogs  95%          1          4
## 2            Poodle Brightest Dogs  95%          1          4
## 3   German Shepherd Brightest Dogs  95%          1          4
## 4  Golden Retriever Brightest Dogs  95%          1          4
## 5 Doberman Pinscher Brightest Dogs  95%          1          4
## 6 Shetland Sheepdog Brightest Dogs  95%          1          4
```

- **AKC Breed Info.csv**

```
breed_df <- read.csv("Final_Project/data/AKC Breed Info.csv")
head(breed_df)
```

```
##                  Breed height_low_inches height_high_inches weight_low_lbs
## 1                Akita                26                  28             80
## 2   Anatolian Sheepdog                27                  29            100
## 3 Bernese Mountain Dog                23                  27             85
## 4           Bloodhound                24                  26             80
## 5               Borzoi                26                  28             70
## 6          Bullmastiff                25                  27            100
##   weight_high_lbs
## 1             120
## 2             150
## 3             110
## 4             120
## 5             100
## 6             130
```

- **Table_4_Heterozygosity_85_breeds.csv**

```
heterozygosity_4_df <- read.csv("Final_Project/data/Table_4_Heterozygosity_85_breeds.csv")
head(heterozygosity_4_df)
```

```
##                   Population Heterozygosity
## 1         Bedlington Terrier       0.312842
## 2     Miniature Bull Terrier       0.321619
## 3                      Boxer       0.343151
## 4            Clumber Spaniel       0.363595
## 5 Greater Swiss Mountain Dog       0.364943
## 6           Airedale Terrier       0.372793
```

- **Table_5_Expected_Heterozygosity_60_breeds.csv**

```
heterozygosity_5_df <- read.csv("Final_Project/data/Table_5_Expected_Heterozygosity_60_breeds.csv")
colnames(heterozygosity_5_df)[2] <- 'Heterozygosity_x10_4'

head(heterozygosity_5_df)
```

```
##                   Breed Heterozygosity_x10_4
## 1    Scottish Deerhound               2.0683
## 2         Field Spaniel               2.3165
## 3 Flat-coated Retriever               2.6474
## 4  Bernese Mountain Dog               2.8129
## 5    Standard Schnauzer               2.8129
## 6                 Boxer               3.0611
```

Create New Dataframe from the Intelligence data

```
combined_df <- intelligence_df

head(combined_df)
```

```
##               Breed Classification obey reps_lower reps_upper
## 1     Border Collie Brightest Dogs  95%          1          4
## 2            Poodle Brightest Dogs  95%          1          4
## 3   German Shepherd Brightest Dogs  95%          1          4
## 4  Golden Retriever Brightest Dogs  95%          1          4
## 5 Doberman Pinscher Brightest Dogs  95%          1          4
## 6 Shetland Sheepdog Brightest Dogs  95%          1          4
```

Inner Join Breed data to new combined df on key Breed

```
combined_df <- combined_df %>%
    inner_join(breed_df, by = c("Breed" = "Breed"))

head(combined_df)
```

```
##               Breed Classification obey reps_lower reps_upper
## 1      Border Collie Brightest Dogs  95%          1          4
## 2   Golden Retriever Brightest Dogs  95%          1          4
## 3  Doberman Pinscher Brightest Dogs  95%          1          4
## 4 Labrador Retriever Brightest Dogs  95%          1          4
## 5           Papillon Brightest Dogs  95%          1          4
## 6         Rottweiler Brightest Dogs  95%          1          4
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                19                 21             40              40
## 2                21                 24             55              75
## 3                26                 28             60             100
## 4                21                 24             55              80
## 5                 8                 11              5              10
## 6                22                 27             90             110
```

Inner Join Heterozygosity 4 to new combined df on key Breed = Population

```
combined_df <- combined_df %>%
    inner_join(heterozygosity_4_df, by = c("Breed" = "Population"))

head(combined_df)
```

```
##               Breed         Classification obey reps_lower reps_upper
## 1      Border Collie         Brightest Dogs  95%          1          4
## 2   Golden Retriever         Brightest Dogs  95%          1          4
## 3  Doberman Pinscher         Brightest Dogs  95%          1          4
## 4 Labrador Retriever         Brightest Dogs  95%          1          4
## 5         Rottweiler         Brightest Dogs  95%          1          4
## 6         Schipperke Excellent Working Dogs  85%          5         15
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                19                 21             40              40
## 2                21                 24             55              75
## 3                26                 28             60             100
## 4                21                 24             55              80
## 5                22                 27             90             110
## 6                10                 13             12              18
##   Heterozygosity
```

```
## 1       0.549583
## 2       0.517779
## 3       0.383763
## 4       0.560590
## 5       0.456510
## 6       0.445437
```

Inner Join Heterozygosity 5 to new combined df on key Breed

```
combined_df <- combined_df %>%
    inner_join(heterozygosity_5_df, by = c("Breed" = "Breed"))

head(combined_df)
```

```
##                         Breed         Classification obey reps_lower reps_upper
## 1           Golden Retriever         Brightest Dogs  95%          1          4
## 2         Labrador Retriever         Brightest Dogs  95%          1          4
## 3                  Rottweiler         Brightest Dogs  95%          1          4
## 4 German Shorthaired Pointer Excellent Working Dogs  85%          5         15
## 5         Standard Schnauzer Excellent Working Dogs  85%          5         15
## 6       Bernese Mountain Dog Excellent Working Dogs  85%          5         15
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                21                 24             55              75
## 2                21                 24             55              80
## 3                22                 27             90             110
## 4                20                 27             50              80
## 5                17                 19             33              33
## 6                23                 27             85             110
##   Heterozygosity Heterozygosity_x10_4
## 1       0.517779               7.0323
## 2       0.560590               8.4388
## 3       0.456510               4.9640
## 4       0.538761               6.6186
## 5       0.450041               2.8129
## 6       0.399599               2.8129
```

Convert n/a or na to empty cell

```
combined_df[combined_df == 'n/a'] <- ''
combined_df[combined_df == 'na'] <- ''
```

Convert obey to numeric

```
combined_df$obey <- gsub("%", "", as.character(combined_df$obey))

combined_df$obey <- as.numeric(combined_df$obey) / 100
```

Convert height and weight to numeric

```
combined_df$height_low_inches <- as.numeric(combined_df$height_low_inches)
combined_df$height_high_inches <- as.numeric(combined_df$height_high_inches)
combined_df$weight_low_lbs <- as.numeric(combined_df$weight_low_lbs)
combined_df$weight_high_lbs <- as.numeric(combined_df$weight_high_lbs)
```

What does the final data set look like?

```
head(combined_df)
```

```
##                         Breed         Classification obey reps_lower reps_upper
## 1           Golden Retriever         Brightest Dogs 0.95          1          4
## 2         Labrador Retriever         Brightest Dogs 0.95          1          4
## 3                  Rottweiler         Brightest Dogs 0.95          1          4
## 4 German Shorthaired Pointer Excellent Working Dogs 0.85          5         15
## 5         Standard Schnauzer Excellent Working Dogs 0.85          5         15
## 6       Bernese Mountain Dog Excellent Working Dogs 0.85          5         15
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                21                 24             55              75
## 2                21                 24             55              80
## 3                22                 27             90             110
## 4                20                 27             50              80
## 5                17                 19             33              33
## 6                23                 27             85             110
##   Heterozygosity Heterozygosity_x10_4
## 1       0.517779               7.0323
## 2       0.560590               8.4388
## 3       0.456510               4.9640
## 4       0.538761               6.6186
## 5       0.450041               2.8129
## 6       0.399599               2.8129
```

What information is not self-evident?

- Initially I do not know exactly what Heterozygosity and Heterozygosity (x10-4) are and the difference between the two columns.

What are different ways you could look at this data?

One could strictly look at the obey percentage without looking at the number of reps a dog can do. You can also just look at the upper and lower reps versus taking the average number of reps a dog can do. Same problem with height and weight if I were to look at if intelligence is strictly by the weight of a breed or how tall a breed is.

How do you plan to slice and dice the data?

- **Add average weight and height to dataframe**

```
combined_df$avg.weight = rowMeans(
  combined_df[,c('weight_low_lbs', 'weight_high_lbs')], na.rm = TRUE)
combined_df$avg.height = rowMeans(
  combined_df[,c('height_low_inches', 'height_high_inches')], na.rm = TRUE)

head(combined_df)
```

```
##                         Breed         Classification obey reps_lower reps_upper
## 1           Golden Retriever         Brightest Dogs 0.95          1          4
## 2         Labrador Retriever         Brightest Dogs 0.95          1          4
## 3                  Rottweiler         Brightest Dogs 0.95          1          4
## 4 German Shorthaired Pointer Excellent Working Dogs 0.85          5         15
## 5         Standard Schnauzer Excellent Working Dogs 0.85          5         15
## 6       Bernese Mountain Dog Excellent Working Dogs 0.85          5         15
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                21                 24             55              75
## 2                21                 24             55              80
## 3                22                 27             90             110
## 4                20                 27             50              80
## 5                17                 19             33              33
## 6                23                 27             85             110
##   Heterozygosity Heterozygosity_x10_4 avg.weight avg.height
## 1       0.517779               7.0323       65.0       22.5
## 2       0.560590               8.4388       67.5       22.5
## 3       0.456510               4.9640      100.0       24.5
## 4       0.538761               6.6186       65.0       23.5
## 5       0.450041               2.8129       33.0       18.0
## 6       0.399599               2.8129       97.5       25.0
```

How could you summarize your data to answer key questions?

- **Descriptive Statistics on all variables**

```
summary(combined_df)
```

```
##     Breed           Classification          obey        reps_lower
##  Length:29          Length:29          Min.   :0.30   Min.   : 1.00
##  Class :character   Class :character   1st Qu.:0.50   1st Qu.:16.00
##  Mode  :character   Mode  :character   Median :0.50   Median :26.00
##                                        Mean   :0.58   Mean   :30.38
##                                        3rd Qu.:0.70   3rd Qu.:41.00
##                                        Max.   :0.95   Max.   :81.00
##                                        NA's   :4
##    reps_upper     height_low_inches height_high_inches weight_low_lbs
##  Min.   :  4.00   Min.   : 7.00     Min.   :10.00      Min.   :  6.00
##  1st Qu.: 25.00   1st Qu.:14.00     1st Qu.:16.00      1st Qu.: 19.50
##  Median : 40.00   Median :21.00     Median :24.50      Median : 46.00
##  Mean   : 47.31   Mean   :19.05     Mean   :22.12      Mean   : 53.04
##  3rd Qu.: 80.00   3rd Qu.:25.00     3rd Qu.:28.00      3rd Qu.: 72.50
##  Max.   :100.00   Max.   :27.00     Max.   :30.00      Max.   :175.00
##                   NA's   :1         NA's   :1          NA's   :1
##  weight_high_lbs  Heterozygosity   Heterozygosity_x10_4   avg.weight
##  Min.   : 10.00   Min.   :0.3128   Min.   :2.813        Min.   :  8.00
##  1st Qu.: 31.50   1st Qu.:0.4500   1st Qu.:4.550        1st Qu.: 24.75
##  Median : 70.00   Median :0.4879   Median :5.543        Median : 58.75
##  Mean   : 72.64   Mean   :0.4789   Mean   :5.312        Mean   : 62.84
##  3rd Qu.:102.50   3rd Qu.:0.5178   3rd Qu.:6.040        3rd Qu.: 88.12
##  Max.   :190.00   Max.   :0.5630   Max.   :8.439        Max.   :182.50
##  NA's   :1                                              NA's   :1
##    avg.height
```

```
##  Min.   : 8.50
##  1st Qu.:15.25
##  Median :22.75
##  Mean   :20.59
##  3rd Qu.:26.00
##  Max.   :28.50
##  NA's   :1
```

- **Descriptive Statistics on all variables grouped by Classification**

```
combined_df %>%
  split(.$Classification) %>%
  map(summary)
```

```
## $`Above Average Working Dogs`
##     Breed           Classification          obey       reps_lower   reps_upper
##  Length:3           Length:3           Min.   :0.7   Min.   :16   Min.   :25
##  Class :character   Class :character   1st Qu.:0.7   1st Qu.:16   1st Qu.:25
##  Mode  :character   Mode  :character   Median :0.7   Median :16   Median :25
##                                        Mean   :0.7   Mean   :16   Mean   :25
##                                        3rd Qu.:0.7   3rd Qu.:16   3rd Qu.:25
##                                        Max.   :0.7   Max.   :16   Max.   :25
##  height_low_inches height_high_inches weight_low_lbs  weight_high_lbs
##  Min.   :16.00     Min.   :19.00      Min.   : 35.0   Min.   : 45.00
##  1st Qu.:20.50     1st Qu.:23.00      1st Qu.: 47.5   1st Qu.: 57.50
##  Median :25.00     Median :27.00      Median : 60.0   Median : 70.00
##  Mean   :22.33     Mean   :24.67      Mean   : 65.0   Mean   : 88.33
##  3rd Qu.:25.50     3rd Qu.:27.50      3rd Qu.: 80.0   3rd Qu.:110.00
##  Max.   :26.00     Max.   :28.00      Max.   :100.0   Max.   :150.00
##  Heterozygosity   Heterozygosity_x10_4   avg.weight       avg.height
##  Min.   :0.4467   Min.   :5.543        Min.   : 40.00   Min.   :17.50
##  1st Qu.:0.4603   1st Qu.:5.998        1st Qu.: 52.50   1st Qu.:21.75
##  Median :0.4739   Median :6.453        Median : 65.00   Median :26.00
##  Mean   :0.4704   Mean   :6.233        Mean   : 76.67   Mean   :23.50
##  3rd Qu.:0.4823   3rd Qu.:6.577        3rd Qu.: 95.00   3rd Qu.:26.50
##  Max.   :0.4906   Max.   :6.701        Max.   :125.00   Max.   :27.00
##
## $`Average Working/Obedience Intelligence`
##     Breed           Classification          obey       reps_lower   reps_upper
##  Length:11          Length:11          Min.   :0.5   Min.   :26   Min.   :40
##  Class :character   Class :character   1st Qu.:0.5   1st Qu.:26   1st Qu.:40
##  Mode  :character   Mode  :character   Median :0.5   Median :26   Median :40
##                                        Mean   :0.5   Mean   :26   Mean   :40
##                                        3rd Qu.:0.5   3rd Qu.:26   3rd Qu.:40
##                                        Max.   :0.5   Max.   :26   Max.   :40
##
##  height_low_inches height_high_inches weight_low_lbs weight_high_lbs
##  Min.   : 7.00     Min.   :10.00      Min.   :10.0   Min.   : 18.00
##  1st Qu.:11.25     1st Qu.:15.25      1st Qu.:16.5   1st Qu.: 25.25
##  Median :18.00     Median :21.50      Median :30.0   Median : 50.00
##  Mean   :17.55     Mean   :21.05      Mean   :36.6   Mean   : 52.30
##  3rd Qu.:22.75     3rd Qu.:28.00      3rd Qu.:55.5   3rd Qu.: 70.00
##  Max.   :27.00     Max.   :30.00      Max.   :80.0   Max.   :120.00
```

```
##  NA's   :1         NA's   :1          NA's   :1      NA's   :1
##  Heterozygosity   Heterozygosity_x10_4   avg.weight       avg.height
##  Min.   :0.3128   Min.   :3.061        Min.   : 14.00   Min.   : 8.50
##  1st Qu.:0.4557   1st Qu.:4.178        1st Qu.: 21.38   1st Qu.:13.25
##  Median :0.5040   Median :4.716        Median : 41.75   Median :19.75
##  Mean   :0.4742   Mean   :4.941        Mean   : 44.45   Mean   :19.30
##  3rd Qu.:0.5208   3rd Qu.:5.915        3rd Qu.: 61.88   3rd Qu.:25.50
##  Max.   :0.5630   Max.   :6.867        Max.   :100.00   Max.   :28.50
##                                        NA's   :1        NA's   :1
##
## $`Brightest Dogs`
##     Breed           Classification          obey        reps_lower   reps_upper
##  Length:3           Length:3           Min.   :0.95   Min.   :1    Min.   :4
##  Class :character   Class :character   1st Qu.:0.95   1st Qu.:1    1st Qu.:4
##  Mode  :character   Mode  :character   Median :0.95   Median :1    Median :4
##                                        Mean   :0.95   Mean   :1    Mean   :4
##                                        3rd Qu.:0.95   3rd Qu.:1    3rd Qu.:4
##                                        Max.   :0.95   Max.   :1    Max.   :4
##  height_low_inches height_high_inches weight_low_lbs  weight_high_lbs
##  Min.   :21.00     Min.   :24.0       Min.   :55.00   Min.   : 75.00
##  1st Qu.:21.00     1st Qu.:24.0       1st Qu.:55.00   1st Qu.: 77.50
##  Median :21.00     Median :24.0       Median :55.00   Median : 80.00
##  Mean   :21.33     Mean   :25.0       Mean   :66.67   Mean   : 88.33
##  3rd Qu.:21.50     3rd Qu.:25.5       3rd Qu.:72.50   3rd Qu.: 95.00
##  Max.   :22.00     Max.   :27.0       Max.   :90.00   Max.   :110.00
##  Heterozygosity   Heterozygosity_x10_4   avg.weight       avg.height
##  Min.   :0.4565   Min.   :4.964        Min.   : 65.00   Min.   :22.50
##  1st Qu.:0.4871   1st Qu.:5.998        1st Qu.: 66.25   1st Qu.:22.50
##  Median :0.5178   Median :7.032        Median : 67.50   Median :22.50
##  Mean   :0.5116   Mean   :6.812        Mean   : 77.50   Mean   :23.17
##  3rd Qu.:0.5392   3rd Qu.:7.736        3rd Qu.: 83.75   3rd Qu.:23.50
##  Max.   :0.5606   Max.   :8.439        Max.   :100.00   Max.   :24.50
##
## $`Excellent Working Dogs`
##     Breed           Classification          obey        reps_lower   reps_upper
##  Length:3           Length:3           Min.   :0.85   Min.   :5    Min.   :15
##  Class :character   Class :character   1st Qu.:0.85   1st Qu.:5    1st Qu.:15
##  Mode  :character   Mode  :character   Median :0.85   Median :5    Median :15
##                                        Mean   :0.85   Mean   :5    Mean   :15
##                                        3rd Qu.:0.85   3rd Qu.:5    3rd Qu.:15
##                                        Max.   :0.85   Max.   :5    Max.   :15
##  height_low_inches height_high_inches weight_low_lbs weight_high_lbs
##  Min.   :17.0      Min.   :19.00      Min.   :33.0   Min.   : 33.00
##  1st Qu.:18.5      1st Qu.:23.00      1st Qu.:41.5   1st Qu.: 56.50
##  Median :20.0      Median :27.00      Median :50.0   Median : 80.00
##  Mean   :20.0      Mean   :24.33      Mean   :56.0   Mean   : 74.33
##  3rd Qu.:21.5      3rd Qu.:27.00      3rd Qu.:67.5   3rd Qu.: 95.00
##  Max.   :23.0      Max.   :27.00      Max.   :85.0   Max.   :110.00
##  Heterozygosity   Heterozygosity_x10_4   avg.weight      avg.height
##  Min.   :0.3996   Min.   :2.813        Min.   :33.00   Min.   :18.00
##  1st Qu.:0.4248   1st Qu.:2.813        1st Qu.:49.00   1st Qu.:20.75
##  Median :0.4500   Median :2.813        Median :65.00   Median :23.50
##  Mean   :0.4628   Mean   :4.081        Mean   :65.17   Mean   :22.17
##  3rd Qu.:0.4944   3rd Qu.:4.716        3rd Qu.:81.25   3rd Qu.:24.25
```

```
##  Max.   :0.5388   Max.   :6.619        Max.   :97.50   Max.   :25.00
##
## $`Fair Working/Obedience Intelligence`
##     Breed           Classification          obey       reps_lower   reps_upper
##  Length:5           Length:5           Min.   :0.3   Min.   :41   Min.   :80
##  Class :character   Class :character   1st Qu.:0.3   1st Qu.:41   1st Qu.:80
##  Mode  :character   Mode  :character   Median :0.3   Median :41   Median :80
##                                        Mean   :0.3   Mean   :41   Mean   :80
##                                        3rd Qu.:0.3   3rd Qu.:41   3rd Qu.:80
##                                        Max.   :0.3   Max.   :41   Max.   :80
##  height_low_inches height_high_inches weight_low_lbs  weight_high_lbs
##  Min.   :11.0      Min.   :12.0       Min.   :  6.0   Min.   : 10.0
##  1st Qu.:12.0      1st Qu.:15.0       1st Qu.: 17.0   1st Qu.: 28.0
##  Median :14.0      Median :17.0       Median : 20.0   Median : 30.0
##  Mean   :17.4      Mean   :19.8       Mean   : 50.6   Mean   : 77.6
##  3rd Qu.:25.0      3rd Qu.:27.0       3rd Qu.:100.0   3rd Qu.:130.0
##  Max.   :25.0      Max.   :28.0       Max.   :110.0   Max.   :190.0
##  Heterozygosity   Heterozygosity_x10_4   avg.weight      avg.height
##  Min.   :0.4399   Min.   :5.129         Min.   :  8.0   Min.   :11.5
##  1st Qu.:0.4657   1st Qu.:5.543         1st Qu.: 22.5   1st Qu.:13.5
##  Median :0.4688   Median :5.791         Median : 25.0   Median :15.5
##  Mean   :0.4806   Mean   :5.791         Mean   : 64.1   Mean   :18.6
##  3rd Qu.:0.5092   3rd Qu.:6.040         3rd Qu.:115.0   3rd Qu.:26.0
##  Max.   :0.5195   Max.   :6.453         Max.   :150.0   Max.   :26.5
##
## $`Lowest Degree of Working/Obedience Intelligence `
##     Breed           Classification          obey       reps_lower   reps_upper
##  Length:4           Length:4           Min.   : NA   Min.   :81   Min.   :100
##  Class :character   Class :character   1st Qu.: NA   1st Qu.:81   1st Qu.:100
##  Mode  :character   Mode  :character   Median : NA   Median :81   Median :100
##                                        Mean   :NaN   Mean   :81   Mean   :100
##                                        3rd Qu.: NA   3rd Qu.:81   3rd Qu.:100
##                                        Max.   : NA   Max.   :81   Max.   :100
##                                        NA's   :4
##  height_low_inches height_high_inches weight_low_lbs   weight_high_lbs
##  Min.   :13.00     Min.   :14.0       Min.   : 18.00   Min.   : 30.0
##  1st Qu.:13.75     1st Qu.:15.5       1st Qu.: 34.50   1st Qu.: 45.0
##  Median :20.00     Median :22.0       Median : 55.00   Median : 75.0
##  Mean   :20.00     Mean   :22.0       Mean   : 75.75   Mean   : 92.5
##  3rd Qu.:26.25     3rd Qu.:28.5       3rd Qu.: 96.25   3rd Qu.:122.5
##  Max.   :27.00     Max.   :30.0       Max.   :175.00   Max.   :190.0
##
##  Heterozygosity   Heterozygosity_x10_4   avg.weight       avg.height
##  Min.   :0.4412   Min.   :3.806         Min.   : 24.00   Min.   :14.00
##  1st Qu.:0.4516   1st Qu.:4.550         1st Qu.: 39.75   1st Qu.:14.38
##  Median :0.4715   Median :4.881         Median : 65.00   Median :20.75
##  Mean   :0.4833   Mean   :4.840         Mean   : 84.12   Mean   :21.00
##  3rd Qu.:0.5032   3rd Qu.:5.171         3rd Qu.:109.38   3rd Qu.:27.38
##  Max.   :0.5491   Max.   :5.791         Max.   :182.50   Max.   :28.50
##
```

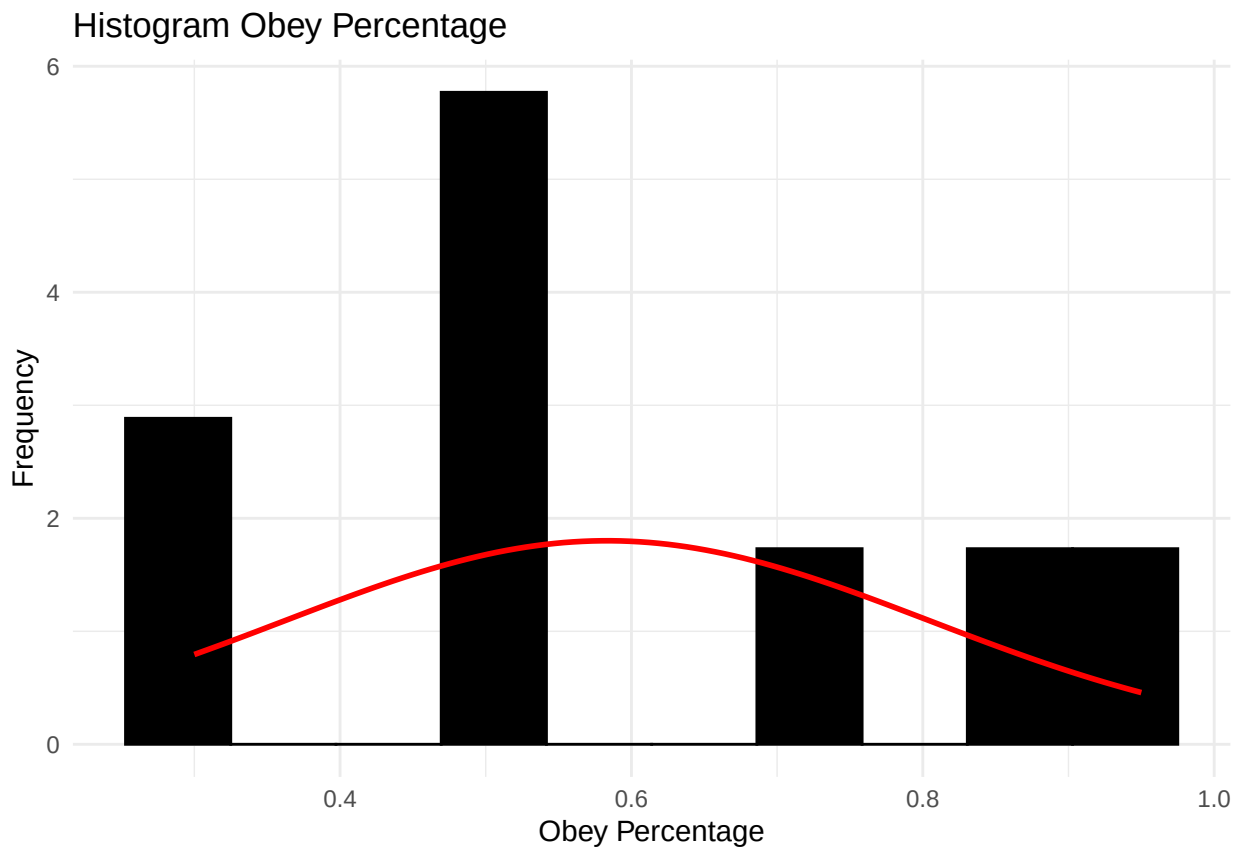
- **Remove empty cells from variables for plots**

```
combined_complete <- combined_df[complete.cases(combined_df), ]
head(combined_complete)
```

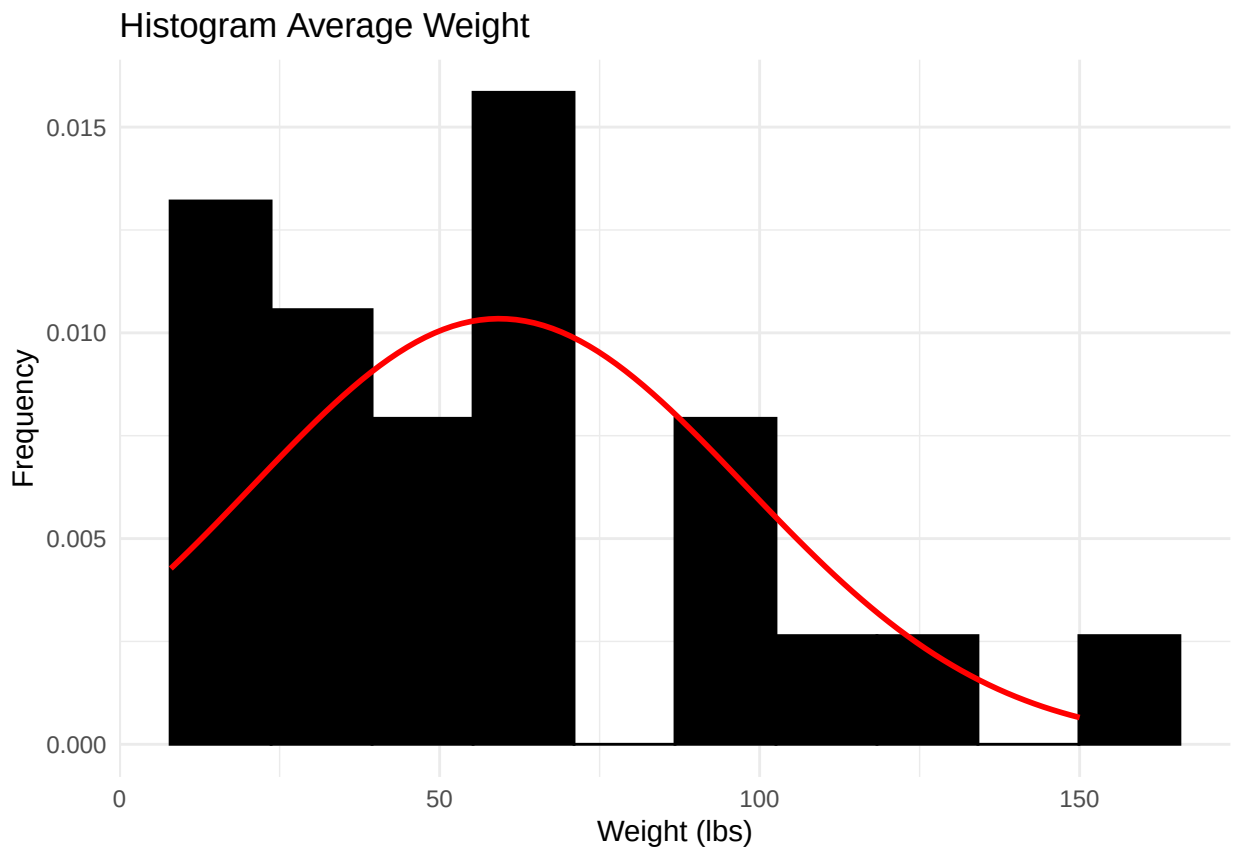
```
##                         Breed         Classification obey reps_lower reps_upper
## 1           Golden Retriever         Brightest Dogs 0.95          1          4
## 2         Labrador Retriever         Brightest Dogs 0.95          1          4
## 3                  Rottweiler         Brightest Dogs 0.95          1          4
## 4 German Shorthaired Pointer Excellent Working Dogs 0.85          5         15
## 5         Standard Schnauzer Excellent Working Dogs 0.85          5         15
## 6       Bernese Mountain Dog Excellent Working Dogs 0.85          5         15
##   height_low_inches height_high_inches weight_low_lbs weight_high_lbs
## 1                21                 24             55              75
## 2                21                 24             55              80
## 3                22                 27             90             110
## 4                20                 27             50              80
## 5                17                 19             33              33
## 6                23                 27             85             110
##   Heterozygosity Heterozygosity_x10_4 avg.weight avg.height
## 1       0.517779               7.0323       65.0       22.5
## 2       0.560590               8.4388       67.5       22.5
## 3       0.456510               4.9640      100.0       24.5
## 4       0.538761               6.6186       65.0       23.5
## 5       0.450041               2.8129       33.0       18.0
## 6       0.399599               2.8129       97.5       25.0
```

What types of plots and tables will help you illustrate the findings to your questions?

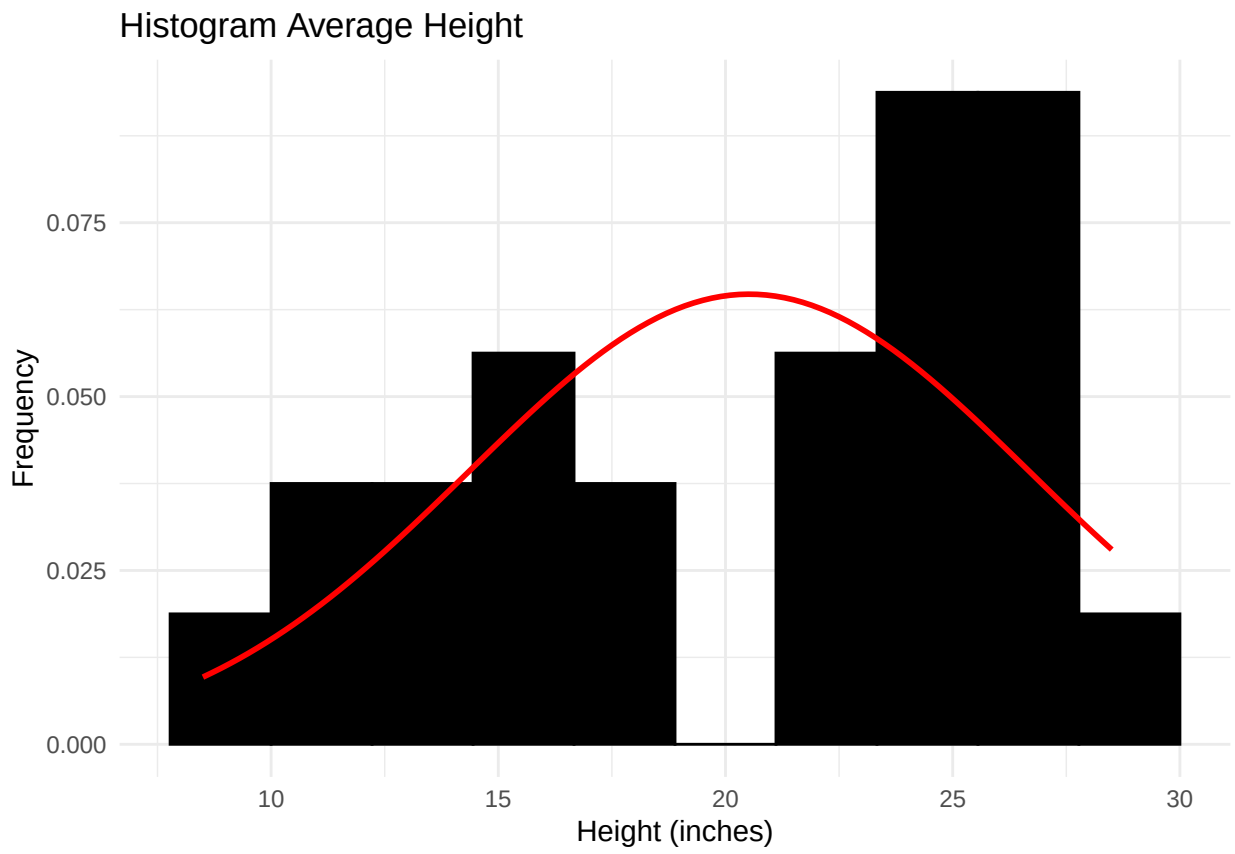
```
ggplot(combined_complete, aes(obey)) +
    labs(title = "Histogram Obey Percentage",
        x = "Obey Percentage", y = "Frequency") +
    geom_histogram(bins = 10, aes(y = ..density..), color = "black", fill = "black") +
    stat_function(fun = dnorm,
                  args = list(mean = mean(combined_complete$obey, na.rm = TRUE),
                              sd = sd(combined_complete$obey, na.rm = TRUE)),
                              color = 'red', size = 1)
```



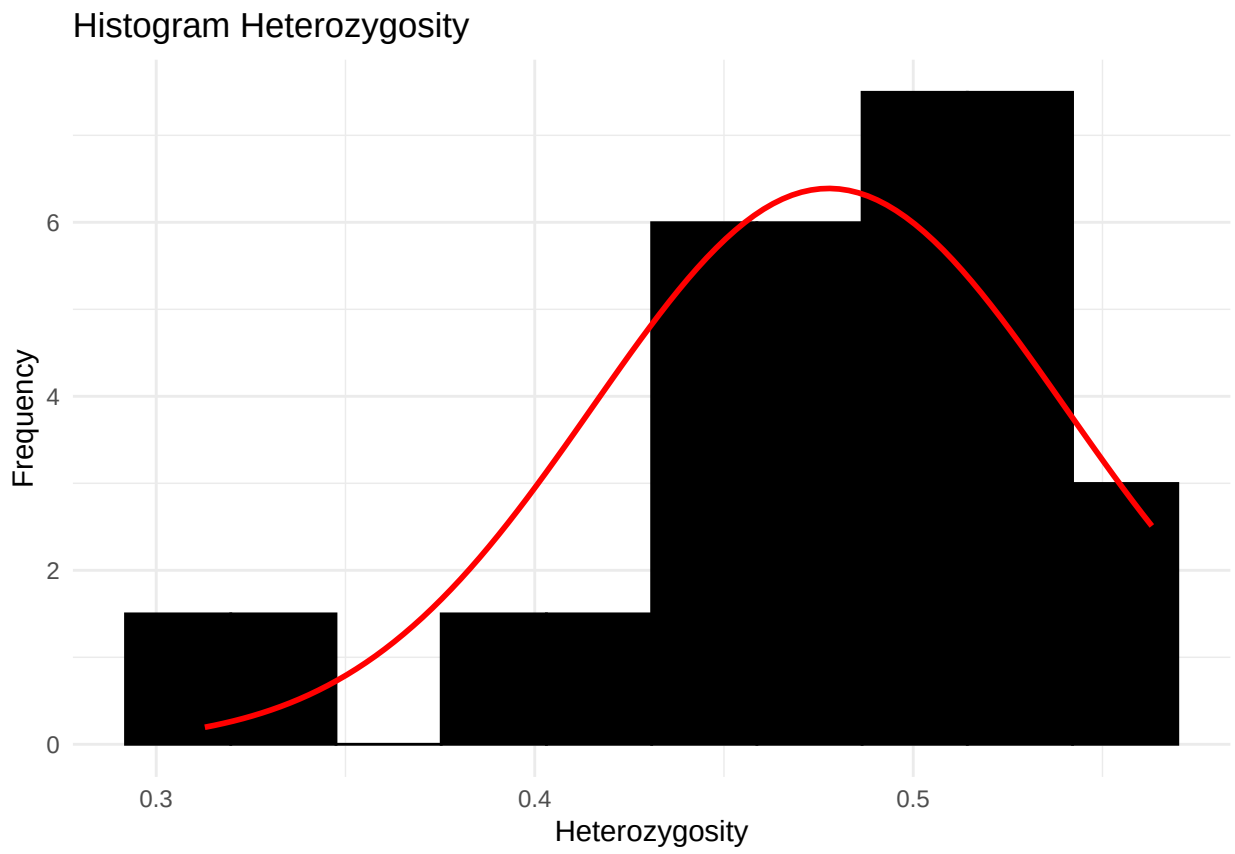

```
ggplot(combined_complete, aes(avg.weight)) +
    labs(title = "Histogram Average Weight",
        x = "Weight (lbs)", y = "Frequency") +
    geom_histogram(bins = 10, aes(y = ..density..), color = "black", fill = "black") +
    stat_function(fun = dnorm,
                  args = list(mean = mean(combined_complete$avg.weight, na.rm = TRUE),
                              sd = sd(combined_complete$avg.weight, na.rm = TRUE)),
                              color = 'red', size = 1)
```



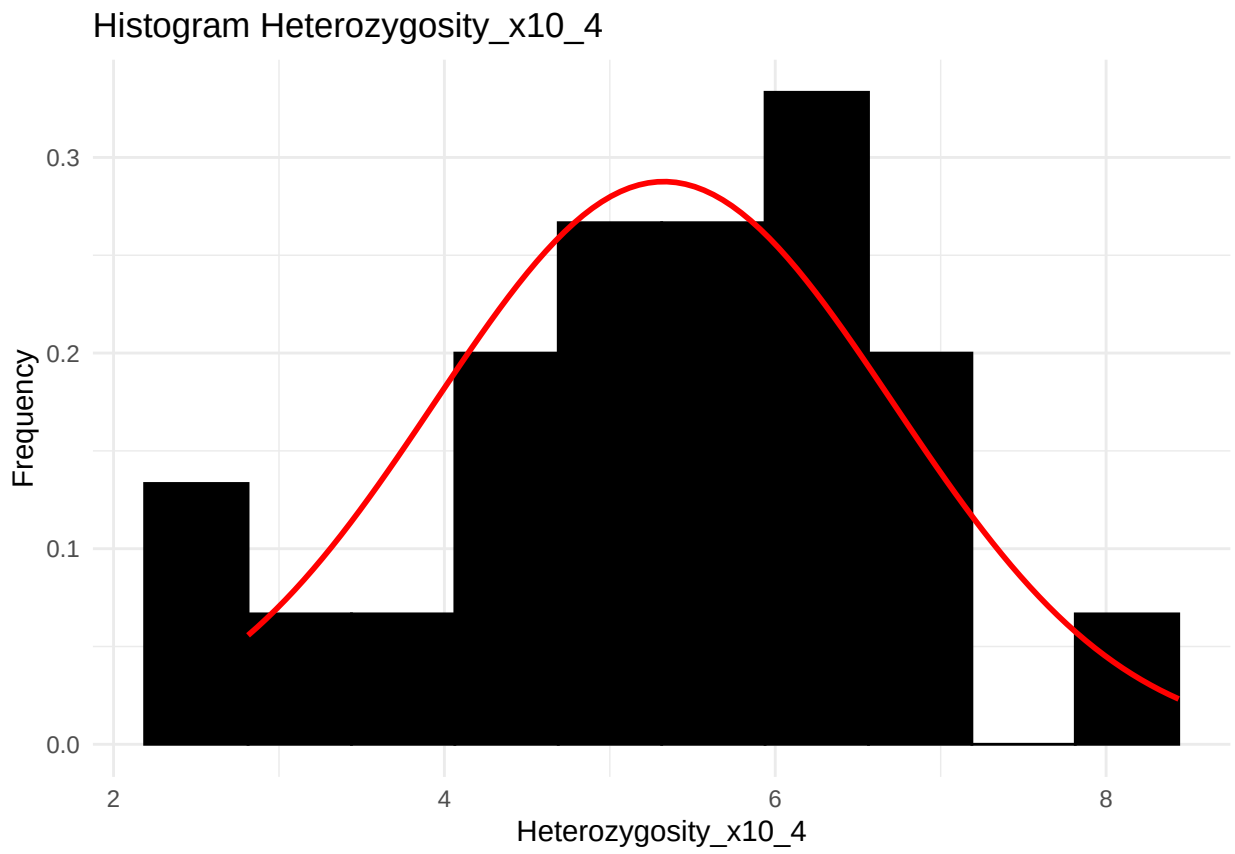

```
ggplot(combined_complete, aes(avg.height)) +
    labs(title = "Histogram Average Height",
        x = "Height (inches)", y = "Frequency") +
    geom_histogram(bins = 10, aes(y = ..density..), color = "black", fill = "black") +
    stat_function(fun = dnorm,
                  args = list(mean = mean(combined_complete$avg.height, na.rm = TRUE),
                              sd = sd(combined_complete$avg.height, na.rm = TRUE)),
                              color = 'red', size = 1)
```




```
ggplot(combined_complete, aes(Heterozygosity)) +
    labs(title = "Histogram Heterozygosity",
        x = "Heterozygosity", y = "Frequency") +
    geom_histogram(bins = 10, aes(y = ..density..), color = "black", fill = "black") +
    stat_function(fun = dnorm,
                  args = list(mean = mean(combined_complete$Heterozygosity, na.rm = TRUE),
                              sd = sd(combined_complete$Heterozygosity, na.rm = TRUE)),
                              color = 'red', size = 1)
```



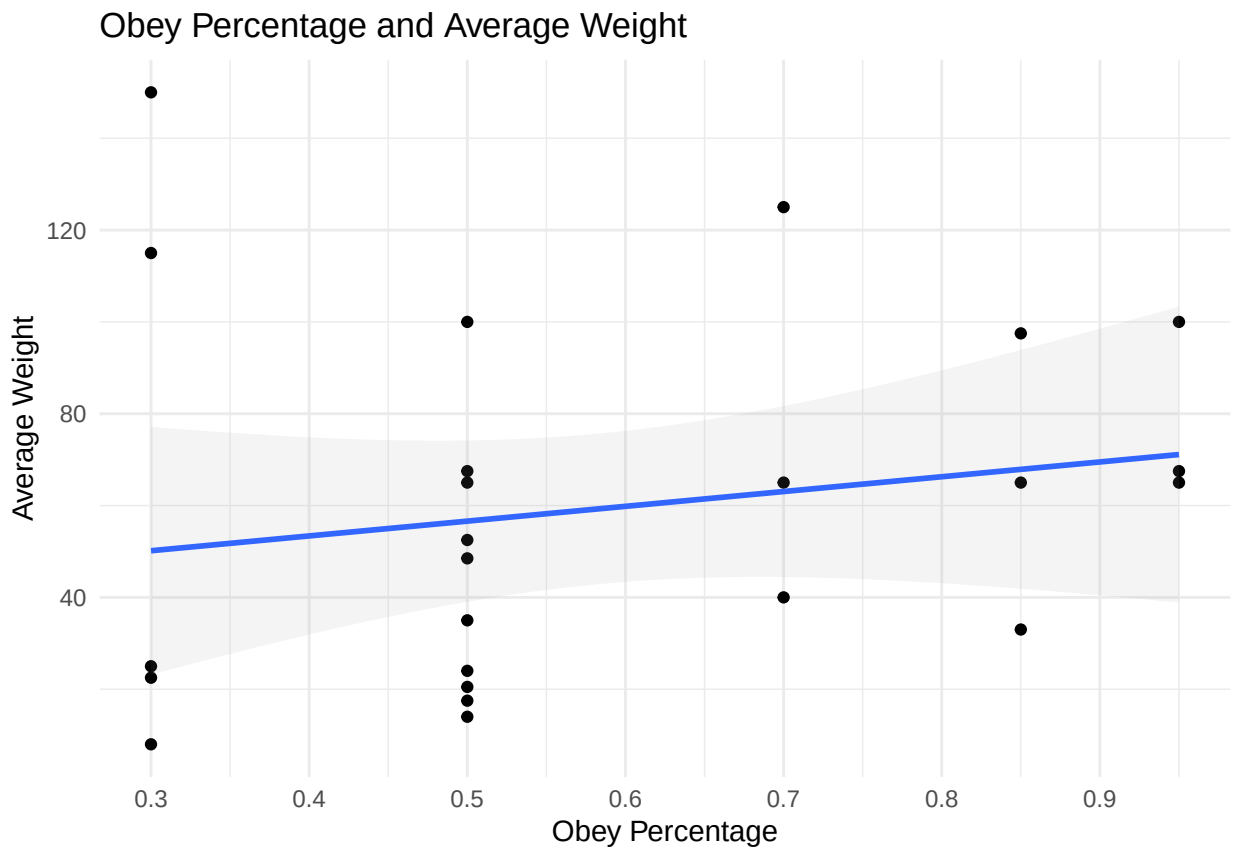

```
ggplot(combined_complete, aes(Heterozygosity_x10_4)) +
    labs(title = "Histogram Heterozygosity_x10_4",
        x = "Heterozygosity_x10_4", y = "Frequency") +
    geom_histogram(bins = 10, aes(y = ..density..), color = "black", fill = "black") +
    stat_function(fun = dnorm,
                  args = list(mean = mean(combined_complete$Heterozygosity_x10_4, na.rm = TRUE),
                              sd = sd(combined_complete$Heterozygosity_x10_4, na.rm = TRUE)),
                              color = 'red', size = 1)
```



- **Scatter Plot of obey and avg.weight**

```
scatter <- ggplot(combined_complete, aes(obey, avg.weight))
scatter + geom_point() +
    scale_x_continuous(n.breaks = 10) +
    geom_smooth(method = 'lm', alpha = 0.1) +
                    labs(x = "Obey Percentage", y = "Average Weight") +
    ggtitle('Obey Percentage and Average Weight')
```

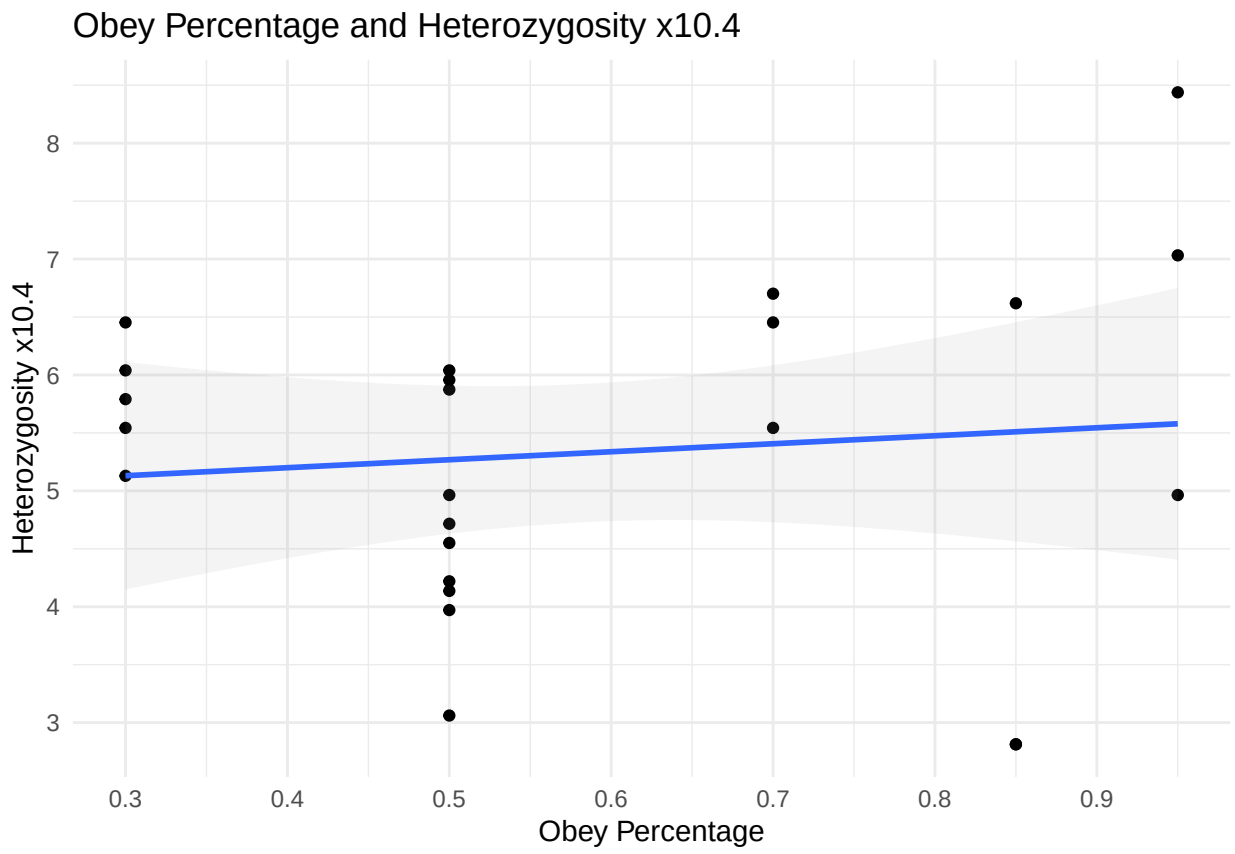
```
## `geom_smooth()` using formula 'y ~ x'
```



- **Scatter Plot of obey and Heterozygosity_x10_4**

```
scatter <- ggplot(combined_complete, aes(obey, Heterozygosity_x10_4))
scatter + geom_point() +
    scale_x_continuous(n.breaks = 10) +
    geom_smooth(method = 'lm', alpha = 0.1) +
                    labs(x = "Obey Percentage", y = "Heterozygosity x10.4") +
    ggtitle('Obey Percentage and Heterozygosity x10.4')
```

```
## `geom_smooth()` using formula 'y ~ x'
```



- **Correlation between obey percentage and avg.weight**

```
cor.test(combined_df$obey, combined_df$avg.weight, use = "complete.obs")
```

```
##
##  Pearson's product-moment correlation
##
## data:  combined_df$obey and combined_df$avg.weight
## t = 0.88343, df = 22, p-value = 0.3866
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.2359190  0.5476023
## sample estimates:
##       cor
## 0.1850928
```

Since the correlation is 0.19 and the p-value is 0.39 we can say that the correlation between the two variables is not significant. Also, the intervals cross 0 so as one goes up the other goes up but then it is reversed.

- **Correlation between obey percentage and Heterozygosity_x10_4**

```
cor.test(combined_df$obey, combined_df$Heterozygosity_x10_4, use = "complete.obs")
```

```
##
##  Pearson's product-moment correlation
##
## data:  combined_df$obey and combined_df$Heterozygosity_x10_4
## t = 0.43369, df = 23, p-value = 0.6686
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.3163255  0.4685203
## sample estimates:
##       cor
## 0.09006233
```

Since the correlation is 0.09 and the p-value is 0.66 we can say that the correlation between the two variables is not significant. Also, the intervals cross 0 so as one goes up the other goes up but then it is reversed.

- **Correlation between avg.weight and Heterozygosity_x10_4**

```
cor.test(combined_df$avg.weight, combined_df$Heterozygosity_x10_4, use = "complete.obs")
```

```
##
##  Pearson's product-moment correlation
##
## data:  combined_df$avg.weight and combined_df$Heterozygosity_x10_4
## t = -0.16629, df = 26, p-value = 0.8692
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.4007977  0.3446736
## sample estimates:
##        cor
## -0.03259464
```

Do you plan on incorporating any machine learning techniques to answer your research questions? Explain.

```
combined_model <- lm(obey ~ avg.weight + avg.height + Heterozygosity_x10_4, data = combined_df)

summary(combined_model)
```

```
##
## Call:
## lm(formula = obey ~ avg.weight + avg.height + Heterozygosity_x10_4,
##     data = combined_df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.31265 -0.16426 -0.00432  0.14696  0.34899
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)           0.2566674  0.2573047   0.998    0.330
```

```
## avg.weight           -0.0008206  0.0020733  -0.396    0.696
## avg.height            0.0142519  0.0129588   1.100    0.284
## Heterozygosity_x10_4  0.0155575  0.0340134   0.457    0.652
##
## Residual standard error: 0.2256 on 20 degrees of freedom
##   (5 observations deleted due to missingness)
## Multiple R-squared:  0.09806,    Adjusted R-squared:  -0.03723
## F-statistic: 0.7248 on 3 and 20 DF,  p-value: 0.549
```

Looking at the Adjusted R-squared of -0.37 and all p-values for the variables are not significant it does not look like any other the variables help with the percentage a dog can obey.

Questions for future steps.

More research would need to be done to find out if any other data can be linked to a dog's intelligence.