Midterm 1 W26

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Instructions

Answer the following questions and complete the exercises in RMarkdown. Please embed all of your code and push your final work to your repository. Your code must be organized, clean, and run free from errors. Remember, you must remove the `#` for any included code chunks to run. Be sure to add your name to the author header above.

Your code must knit in order to be considered. If you are stuck and cannot answer a question, then comment out your code and knit the document. You may use your notes, labs, and homework to help you complete this exam. Do not use any other resources- including AI assistance or other students' work.

Don't forget to answer any questions that are asked in the prompt! Each question must be coded; it cannot be answered by a sort in a spreadsheet or a written response only.

For all plots you create, a title and clearly labeled axes must be provided. We also expect pipes `%>%` to be used wherever possible.

Be sure to push your completed midterm to your repository and upload the document to Gradescope. This exam is worth 50 points.

Please load the following libraries.

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

Part 1: Repository

Question 1. (3 points) Before you start analyzing data, please put a link to your GitHub repository below. Your repository should have a clear README and be well-organized. Add `jmledford3115` and `bryshalm` as collaborators to your repository if you haven't already done so.

Link to repository: https://github.com/wanghouyushenglhj-web/Bis-015L.git (https://github.com/wanghouyushenglhj-web/Bis-015L.git)

Part 2: Data and Analysis

In the midterm 1 folder there is a second folder called `data`. Inside the `data` folder, there is a .csv file called `anolis_dat.csv`. These data came from D. Luke Mahler, Liam J. Revell, Richard E. Glor, Jonathan B. Losos, ECOLOGICAL OPPORTUNITY AND THE RATE OF MORPHOLOGICAL EVOLUTION IN THE DIVERSIFICATION OF

GREATER ANTILLEAN ANOLES, Evolution, Volume 64, Issue 9, 1 September 2010, Pages 2731–2745 (https://academic.oup.com/evolut/article/64/9/2731/6854302?login=true). The original research article is included in the data folder.

Anolis is a genus of lizards commonly known as anoles. Anoles are found throughout the Americas, but are especially diverse in the Caribbean. The data include morphological measurements for *Anolis* lizards from the islands of the Greater Antilles. These data can be used to study patterns of morphological evolution and adaptation in *Anolis* lizards.

The variables include:
- `species` : Species name of the anole lizard.
- `habitat` : Habitat type where the lizard was found.
- `hindlimb_length_mm` : Length of the lizard's hindlimbs (in millimeters).
- `tail_length_mm` : Length of the lizard's tail (in millimeters).
- `body_length_mm` : Length of the lizard's body (in millimeters).
- `toepad_lamellae_count` : Count of lamellae on the lizard's toepads.
- `island` : Island where the lizard was found.

Question 2. (2 points) Load the data and store it as an object called `anolis` .

```
anolis <- read.csv("data/anolis_dat.csv")
```

```
names(anolis)
```

```
## [1] "Species"                 "Habitat"
## [3] "Hindlimb.length..mm."    "Tail.length..mm."
## [5] "Body.length..mm."        "Toepad.lamellae..count."
## [7] "Island"
```

Question 3. (2 points) Use a summary function of your choice to get an idea of the structure of the data.

```
str(anolis)
```

```
## 'data.frame':    52 obs. of  7 variables:
##  $ Species               : chr  "A. ahli" "A. alayoni" "A. alfaroi" "A. aliniger"
...
##  $ Habitat               : chr  "Trunk-ground" "Twig" "Grass-bush" "Trunk-crown" ...
##  $ Hindlimb.length..mm.  : num  50.5 25.5 26.2 36.8 50.4 ...
##  $ Tail.length..mm.      : num  82 54.8 79 84.9 154.4 ...
##  $ Body.length..mm.      : num  51.7 41.3 30.9 51.5 72.3 ...
##  $ Toepad.lamellae..count.: int  27 31 24 36 41 28 29 28 28 31 ...
##  $ Island                : chr  "Cuba" "Cuba" "Cuba" "Hispaniola" ...
```

```
glimpse(anolis)
```

```
## Rows: 52
## Columns: 7
## $ Species                <chr> "A. ahli", "A. alayoni", "A. alfaroi", "A. ali…
## $ Habitat                <chr> "Trunk-ground", "Twig", "Grass-bush", "Trunk-c…
## $ Hindlimb.length..mm.   <dbl> 50.46, 25.50, 26.17, 36.80, 50.39, 49.37, 29.9…
## $ Tail.length..mm.       <dbl> 81.99, 54.75, 79.00, 84.88, 154.45, 91.01, 106…
## $ Body.length..mm.       <dbl> 51.67, 41.32, 30.95, 51.53, 72.32, 51.72, 32.9…
## $ Toepad.lamellae..count. <int> 27, 31, 24, 36, 41, 28, 29, 28, 28, 31, 32, 32…
## $ Island                 <chr> "Cuba", "Cuba", "Cuba", "Hispaniola", "Cuba", …
```

```
summary(anolis)
```

```
##    Species            Habitat          Hindlimb.length..mm. Tail.length..mm.
##  Length:52          Length:52          Min.   :20.00        Min.   : 39.79
##  Class :character   Class :character   1st Qu.:31.70        1st Qu.: 82.19
##  Mode  :character   Mode  :character   Median :40.01        Median :101.86
##                                        Mean   :40.51        Mean   :102.81
##                                        3rd Qu.:49.27        3rd Qu.:121.92
##                                        Max.   :65.48        Max.   :154.45
##  Body.length..mm. Toepad.lamellae..count.    Island
##  Min.   :29.01    Min.   :23.00           Length:52
##  1st Qu.:40.07    1st Qu.:28.00           Class :character
##  Median :47.05    Median :29.00           Mode  :character
##  Mean   :47.65    Mean   :30.54
##  3rd Qu.:54.53    3rd Qu.:33.00
##  Max.   :72.32    Max.   :44.00
```

Question 4. (2 points) Clean the variable names so they are all lowercase and without special characters or spaces. Be sure to use the cleaned data for all subsequent analyses.

```
anolis <- anolis%>%
  clean_names() %>%
  mutate(across(where(is.character),tolower))
```

```
anolis
```

```
##               species      habitat hindlimb_length_mm tail_length_mm
## 1             a. ahli trunk-ground              50.46          81.99
## 2          a. alayoni         twig              25.50          54.75
## 3          a. alfaroi   grass-bush              26.17          79.00
## 4         a. aliniger  trunk-crown              36.80          84.88
## 5         a. allisoni  trunk-crown              50.39         154.45
## 6          a. allogus trunk-ground              49.37          91.01
## 7          a. alumina   grass-bush              29.97         106.40
## 8        a. alutaceus   grass-bush              27.39          94.62
## 9      a. angusticeps         twig              24.37          65.10
## 10         a. armouri trunk-ground              51.81         101.37
## 11   a. bahorucoensis   grass-bush              38.71         115.82
## 12         a. bremeri trunk-ground              47.44         114.01
## 13        a. breslini trunk-ground              49.84         122.85
## 14    a. chlorocyanus  trunk-crown              48.55         142.12
## 15       a. clivicola   grass-bush              34.79          98.75
## 16        a. confusus trunk-ground              41.63          78.31
## 17           a. cooki trunk-ground              48.50         134.57
## 18    a. cupeyalensis   grass-bush              22.88          93.90
## 19    a. cyanopleurus   grass-bush              31.38         111.68
## 20 a. dolichocephalus   grass-bush              39.49         131.27
## 21         a. grahami  trunk-crown              48.71         119.78
## 22           a. guafe trunk-ground              39.09          69.45
## 23         a. guazuma         twig              20.46          39.79
## 24       a. gundlachi trunk-ground              58.32         136.13
## 25       a. haetianus trunk-ground              65.48         154.41
## 26      a. hendersoni   grass-bush              38.53         128.81
## 27      a. homolechis trunk-ground              44.97          90.92
## 28           a. imias trunk-ground              51.67         104.67
## 29    a. inexpectatus   grass-bush              26.80         101.12
## 30       a. insolitus         twig              26.13          50.77
## 31           a. jubar trunk-ground              41.08          82.15
## 32           a. krugi   grass-bush              40.53         130.76
## 33      a. lineatopus trunk-ground              52.71         119.97
## 34   a. longitibialis trunk-ground              61.92         140.36
## 35      a. macilentus   grass-bush              31.80          97.35
## 36        a. marcanoi trunk-ground              49.24         123.95
## 37         a. mestrei trunk-ground              44.93          92.11
## 38        a. opalinus  trunk-crown              35.67          82.15
## 39      a. ophiolepis   grass-bush              26.88          81.13
## 40        a. placidus         twig              20.00          47.96
## 41       a. poncensis   grass-bush              33.39         118.20
## 42        a. porcatus  trunk-crown              44.58         140.26
## 43 a. quadriocellifer trunk-ground              39.05          82.20
## 44     a. rubribarbus trunk-ground              50.43          93.94
## 45          a. sagrei trunk-ground              45.47         111.90
## 46    a. semilineatus   grass-bush              33.99         121.61
## 47         a. shrevei trunk-ground              43.61         102.53
## 48      a. singularis  trunk-crown              38.42         102.34
## 49         a. strahmi trunk-ground              65.24         138.87
## 50       a. stratulus  trunk-crown              34.38          77.93
## 51       a. vanidicus   grass-bush              26.45          90.60
```

```
## 52       a. whitemani trunk-ground             51.06         115.26
##    body_length_mm toepad_lamellae_count      island
## 1           51.67                    27        cuba
## 2           41.32                    31        cuba
## 3           30.95                    24        cuba
## 4           51.53                    36  hispaniola
## 5           72.32                    41        cuba
## 6           51.72                    28        cuba
## 7           32.94                    29  hispaniola
## 8           31.84                    28        cuba
## 9           40.22                    28        cuba
## 10          56.11                    31  hispaniola
## 11          41.81                    32  hispaniola
## 12          55.65                    32        cuba
## 13          52.29                    29  hispaniola
## 14          65.44                    42  hispaniola
## 15          39.03                    26        cuba
## 16          46.72                    32        cuba
## 17          54.45                    33 puerto rico
## 18          29.01                    24        cuba
## 19          34.32                    26        cuba
## 20          45.34                    36  hispaniola
## 21          57.97                    38     jamacia
## 22          43.95                    29        cuba
## 23          39.24                    28        cuba
## 24          59.97                    28 puerto rico
## 25          68.19                    33  hispaniola
## 26          43.19                    34  hispaniola
## 27          51.34                    32        cuba
## 28          54.89                    28        cuba
## 29          31.28                    27        cuba
## 30          40.70                    25  hispaniola
## 31          47.38                    29        cuba
## 32          44.35                    33 puerto rico
## 33          56.50                    29     jamacia
## 34          63.29                    28  hispaniola
## 35          37.39                    28        cuba
## 36          53.79                    33  hispaniola
## 37          49.05                    30        cuba
## 38          42.27                    35     jamacia
## 39          34.59                    24        cuba
## 40          39.63                    26  hispaniola
## 41          41.52                    29 puerto rico
## 42          64.37                    44        cuba
## 43          45.03                    28        cuba
## 44          53.74                    29        cuba
## 45          53.14                    33        cuba
## 46          36.68                    30  hispaniola
## 47          48.85                    28  hispaniola
## 48          52.65                    38  hispaniola
## 49          65.36                    31  hispaniola
## 50          43.62                    34 puerto rico
```

```
## 51          34.19                    23        cuba
## 52          54.77                    29  hispaniola
```

Question 5. (4 points) Convert the `habitat` and `island` variables to factors.

```
names(anolis)
```

```
## [1] "species"               "habitat"               "hindlimb_length_mm"
## [4] "tail_length_mm"        "body_length_mm"        "toepad_lamellae_count"
## [7] "island"
```

```
anolis %>%
  mutate(across(c(habitat,island),as.factor))
```

```
##               species      habitat hindlimb_length_mm tail_length_mm
## 1             a. ahli trunk-ground              50.46          81.99
## 2          a. alayoni         twig              25.50          54.75
## 3          a. alfaroi   grass-bush              26.17          79.00
## 4         a. aliniger  trunk-crown              36.80          84.88
## 5         a. allisoni  trunk-crown              50.39         154.45
## 6          a. allogus trunk-ground              49.37          91.01
## 7          a. alumina   grass-bush              29.97         106.40
## 8        a. alutaceus   grass-bush              27.39          94.62
## 9      a. angusticeps         twig              24.37          65.10
## 10         a. armouri trunk-ground              51.81         101.37
## 11   a. bahorucoensis   grass-bush              38.71         115.82
## 12         a. bremeri trunk-ground              47.44         114.01
## 13        a. breslini trunk-ground              49.84         122.85
## 14    a. chlorocyanus  trunk-crown              48.55         142.12
## 15       a. clivicola   grass-bush              34.79          98.75
## 16        a. confusus trunk-ground              41.63          78.31
## 17           a. cooki trunk-ground              48.50         134.57
## 18    a. cupeyalensis   grass-bush              22.88          93.90
## 19    a. cyanopleurus   grass-bush              31.38         111.68
## 20 a. dolichocephalus   grass-bush              39.49         131.27
## 21         a. grahami  trunk-crown              48.71         119.78
## 22           a. guafe trunk-ground              39.09          69.45
## 23         a. guazuma         twig              20.46          39.79
## 24       a. gundlachi trunk-ground              58.32         136.13
## 25       a. haetianus trunk-ground              65.48         154.41
## 26      a. hendersoni   grass-bush              38.53         128.81
## 27      a. homolechis trunk-ground              44.97          90.92
## 28           a. imias trunk-ground              51.67         104.67
## 29    a. inexpectatus   grass-bush              26.80         101.12
## 30       a. insolitus         twig              26.13          50.77
## 31           a. jubar trunk-ground              41.08          82.15
## 32           a. krugi   grass-bush              40.53         130.76
## 33      a. lineatopus trunk-ground              52.71         119.97
## 34   a. longitibialis trunk-ground              61.92         140.36
## 35      a. macilentus   grass-bush              31.80          97.35
## 36        a. marcanoi trunk-ground              49.24         123.95
## 37         a. mestrei trunk-ground              44.93          92.11
## 38        a. opalinus  trunk-crown              35.67          82.15
## 39      a. ophiolepis   grass-bush              26.88          81.13
## 40        a. placidus         twig              20.00          47.96
## 41       a. poncensis   grass-bush              33.39         118.20
## 42        a. porcatus  trunk-crown              44.58         140.26
## 43 a. quadriocellifer trunk-ground              39.05          82.20
## 44     a. rubribarbus trunk-ground              50.43          93.94
## 45          a. sagrei trunk-ground              45.47         111.90
## 46    a. semilineatus   grass-bush              33.99         121.61
## 47         a. shrevei trunk-ground              43.61         102.53
## 48      a. singularis  trunk-crown              38.42         102.34
## 49         a. strahmi trunk-ground              65.24         138.87
## 50       a. stratulus  trunk-crown              34.38          77.93
## 51       a. vanidicus   grass-bush              26.45          90.60
```

```
## 52       a. whitemani trunk-ground             51.06         115.26
##    body_length_mm toepad_lamellae_count      island
## 1           51.67                    27        cuba
## 2           41.32                    31        cuba
## 3           30.95                    24        cuba
## 4           51.53                    36  hispaniola
## 5           72.32                    41        cuba
## 6           51.72                    28        cuba
## 7           32.94                    29  hispaniola
## 8           31.84                    28        cuba
## 9           40.22                    28        cuba
## 10          56.11                    31  hispaniola
## 11          41.81                    32  hispaniola
## 12          55.65                    32        cuba
## 13          52.29                    29  hispaniola
## 14          65.44                    42  hispaniola
## 15          39.03                    26        cuba
## 16          46.72                    32        cuba
## 17          54.45                    33 puerto rico
## 18          29.01                    24        cuba
## 19          34.32                    26        cuba
## 20          45.34                    36  hispaniola
## 21          57.97                    38     jamacia
## 22          43.95                    29        cuba
## 23          39.24                    28        cuba
## 24          59.97                    28 puerto rico
## 25          68.19                    33  hispaniola
## 26          43.19                    34  hispaniola
## 27          51.34                    32        cuba
## 28          54.89                    28        cuba
## 29          31.28                    27        cuba
## 30          40.70                    25  hispaniola
## 31          47.38                    29        cuba
## 32          44.35                    33 puerto rico
## 33          56.50                    29     jamacia
## 34          63.29                    28  hispaniola
## 35          37.39                    28        cuba
## 36          53.79                    33  hispaniola
## 37          49.05                    30        cuba
## 38          42.27                    35     jamacia
## 39          34.59                    24        cuba
## 40          39.63                    26  hispaniola
## 41          41.52                    29 puerto rico
## 42          64.37                    44        cuba
## 43          45.03                    28        cuba
## 44          53.74                    29        cuba
## 45          53.14                    33        cuba
## 46          36.68                    30  hispaniola
## 47          48.85                    28  hispaniola
## 48          52.65                    38  hispaniola
## 49          65.36                    31  hispaniola
## 50          43.62                    34 puerto rico
```

```
## 51          34.19                    23        cuba
## 52          54.77                    29  hispaniola
```

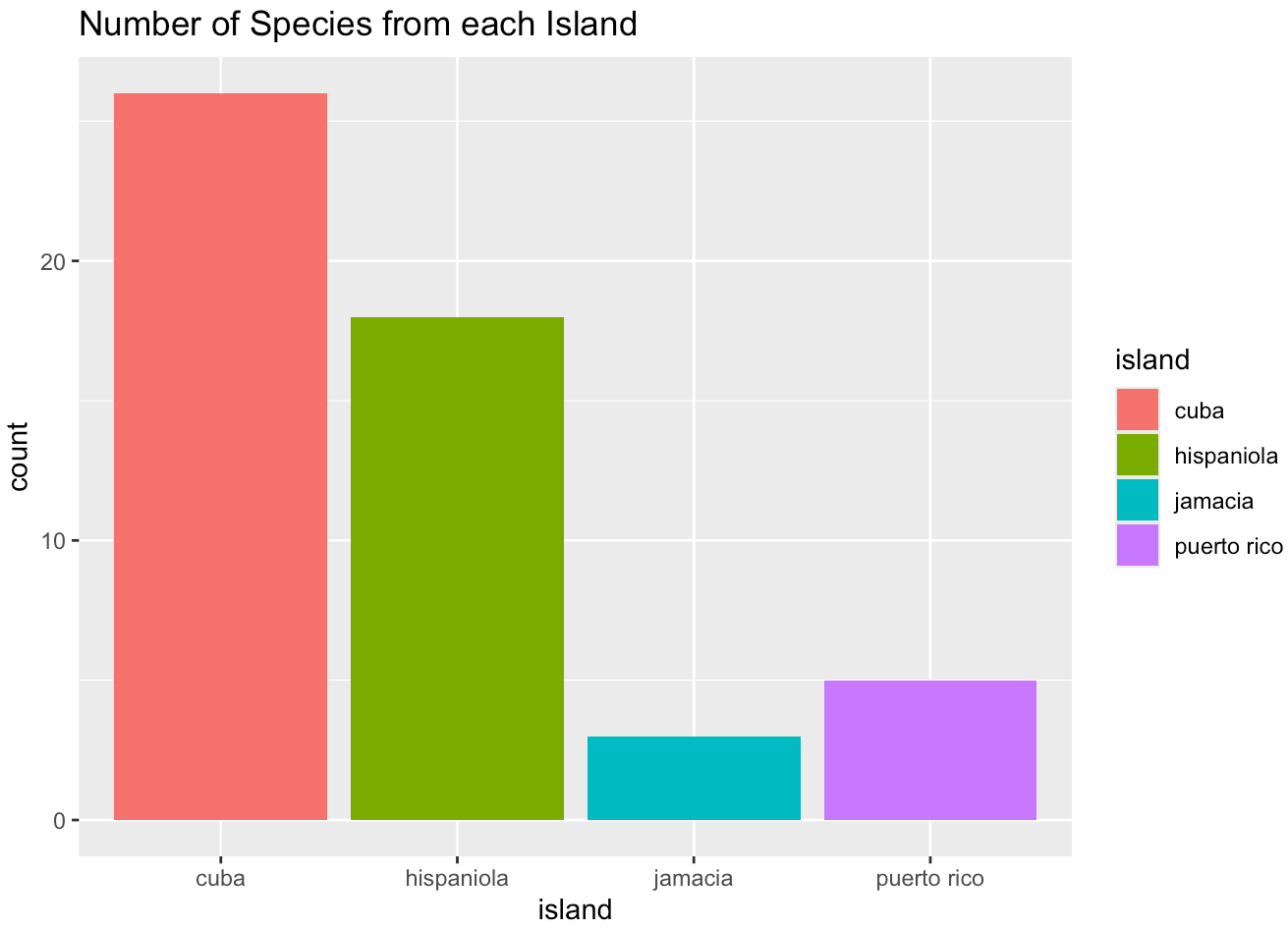
Question 6. (2 points) Anole species were sampled from multiple islands. Which islands are represented in the data? Display the island names.

```
anolis %>%
  count(island)#Cuba is represented island in the data.
```

```
##        island  n
## 1        cuba 26
## 2  hispaniola 18
## 3     jamacia  3
## 4 puerto rico  5
```

Question 7. (4 points) Is sampling equal across islands? Create a plot to visualize the number of anole species sampled from each island. Be sure to label your axes and add a title.

```
anolis %>%
  ggplot(mapping=aes(x=island))+
  geom_bar(mapping = aes(fill=island))+
  labs(title="Number of Species from each Island")
```



Question 8. (2 points) Which habitat types are represented in the data? Display the names of the habitat types.

```
anolis %>%
  count(habitat) %>%
  arrange(desc(n))#trunk_ground represented in the data for habitat.
```

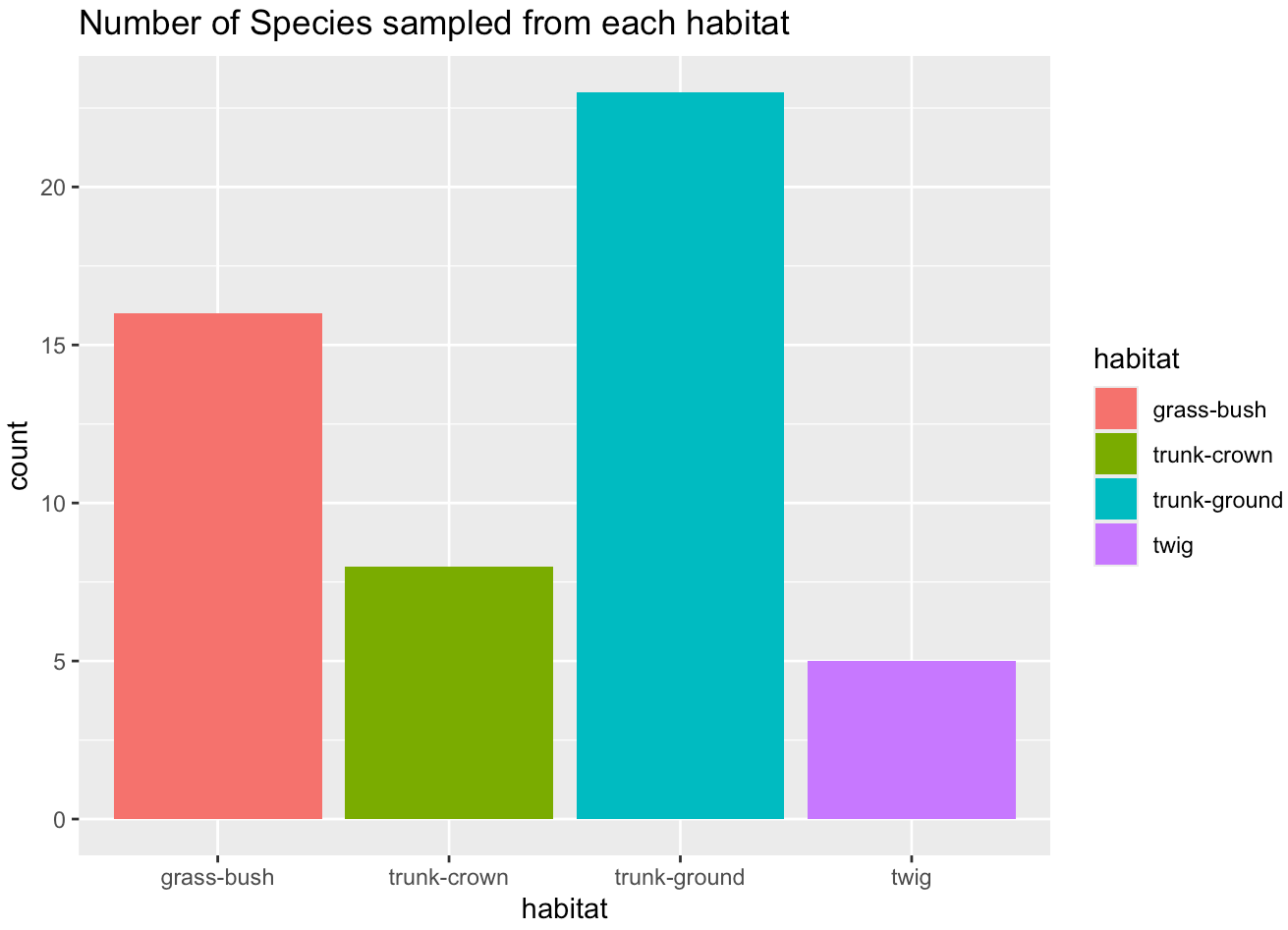
```
##        habitat  n
## 1 trunk-ground 23
## 2   grass-bush 16
## 3  trunk-crown  8
## 4         twig  5
```

Question 9. (4 points) Is sampling equal across habitat types? Create a plot to visualize the number of anole species sampled from each habitat type. Be sure to label your axes and add a title.

```
names(anolis)
```

```
## [1] "species"              "habitat"              "hindlimb_length_mm"
## [4] "tail_length_mm"       "body_length_mm"       "toepad_lamellae_count"
## [7] "island"
```

```
anolis %>%
  ggplot(mapping=aes(x=habitat))+
  geom_bar(mapping = aes(fill=habitat))+
  labs(title="Number of Species sampled from each habitat")
```

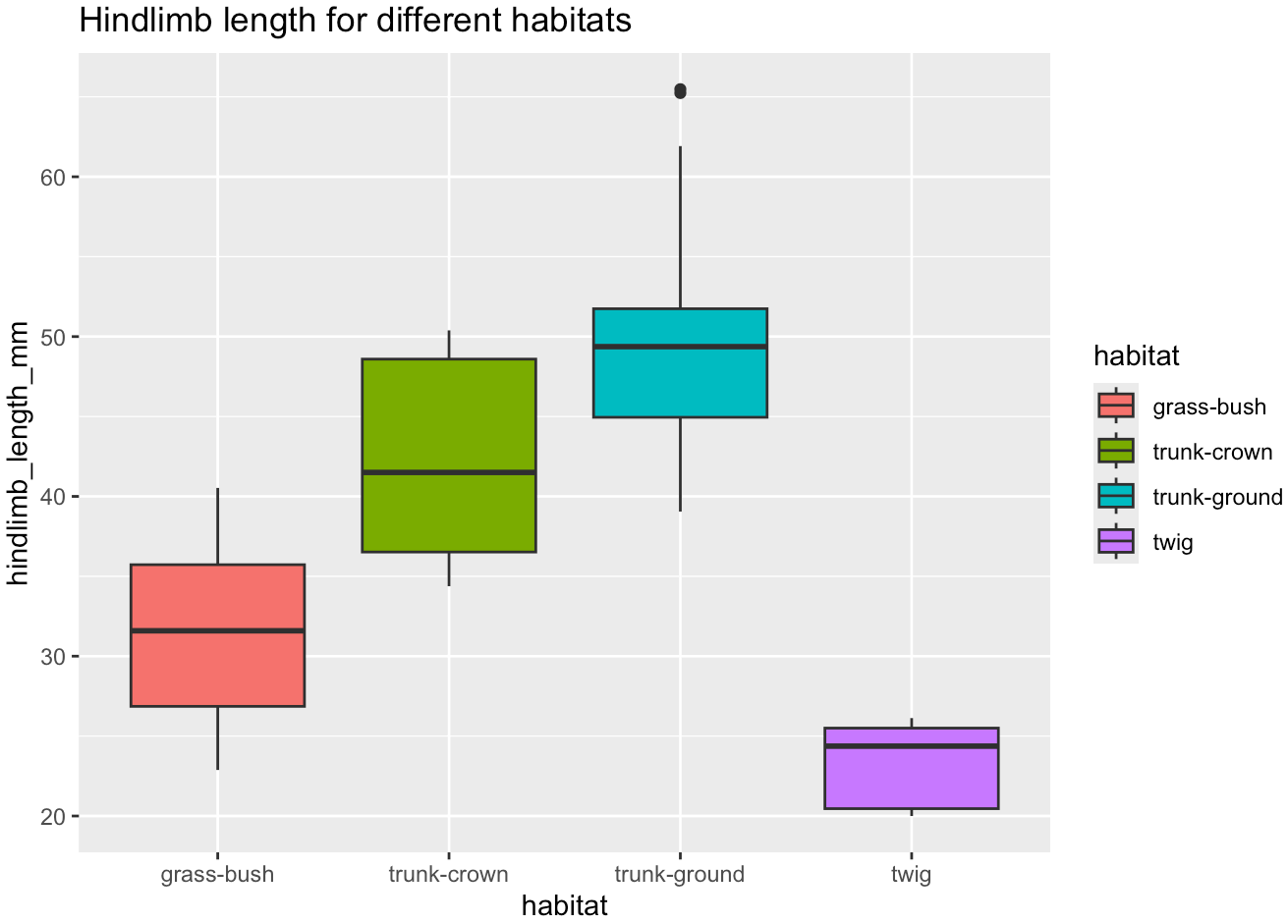


Question 10. (4 points) The morphology of anoles varies based on their habitat. How does the range of hindlimb length compare among different habitats? Create a plot to visualize the distribution of hindlimb lengths across habitat types. Be sure to label your axes and add a title.

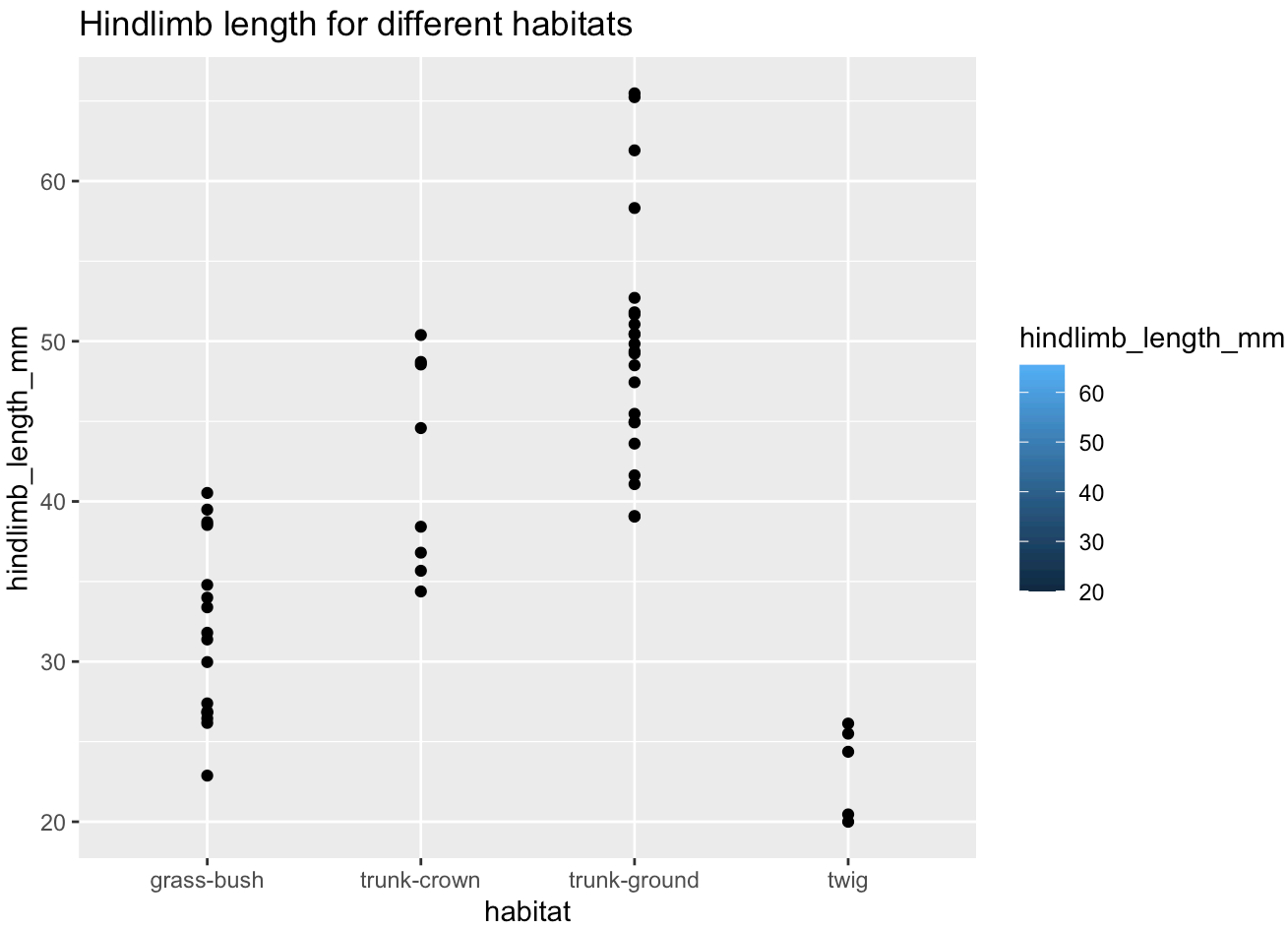
```
names(anolis)
```

```
## [1] "species"              "habitat"              "hindlimb_length_mm"
## [4] "tail_length_mm"       "body_length_mm"       "toepad_lamellae_count"
## [7] "island"
```

```
anolis %>%
  ggplot(mapping=aes(x=habitat,y=hindlimb_length_mm))+
  geom_boxplot(mapping = aes(fill=habitat))+
  labs(title="Hindlimb length for different habitats")
```




```
anolis %>%
  ggplot(mapping=aes(x=habitat,y=hindlimb_length_mm))+
  geom_point(mapping = aes(fill=hindlimb_length_mm))+
  labs(title="Hindlimb length for different habitats")
```



Question 11. (4 points) The plot above is compelling, but don't we expect larger lizards to have longer limbs? What about tail length? Shouldn't longer lizards have longer tails? To correct for this, make two new columns: 1. `ratio_of_hindlimb_to_body` , and 2. `ratio_of_tail_to_body` . Don't forget to add these columns to the anolis data frame.

```
names(anolis)
```

```
## [1] "species"              "habitat"              "hindlimb_length_mm"
## [4] "tail_length_mm"       "body_length_mm"       "toepad_lamellae_count"
## [7] "island"
```

```
anolis <- anolis %>%
  mutate(ratio_of_hindlimb_to_body=hindlimb_length_mm/body_length_mm,
         ratio_of_tail_to_body=tail_length_mm/body_length_mm)
```

```
anolis
```

```
##               species      habitat hindlimb_length_mm tail_length_mm
## 1             a. ahli trunk-ground              50.46          81.99
## 2          a. alayoni         twig              25.50          54.75
## 3          a. alfaroi   grass-bush              26.17          79.00
## 4         a. aliniger  trunk-crown              36.80          84.88
## 5         a. allisoni  trunk-crown              50.39         154.45
## 6          a. allogus trunk-ground              49.37          91.01
## 7          a. alumina   grass-bush              29.97         106.40
## 8        a. alutaceus   grass-bush              27.39          94.62
## 9      a. angusticeps         twig              24.37          65.10
## 10         a. armouri trunk-ground              51.81         101.37
## 11   a. bahorucoensis   grass-bush              38.71         115.82
## 12         a. bremeri trunk-ground              47.44         114.01
## 13        a. breslini trunk-ground              49.84         122.85
## 14    a. chlorocyanus  trunk-crown              48.55         142.12
## 15       a. clivicola   grass-bush              34.79          98.75
## 16        a. confusus trunk-ground              41.63          78.31
## 17           a. cooki trunk-ground              48.50         134.57
## 18    a. cupeyalensis   grass-bush              22.88          93.90
## 19    a. cyanopleurus   grass-bush              31.38         111.68
## 20 a. dolichocephalus   grass-bush              39.49         131.27
## 21         a. grahami  trunk-crown              48.71         119.78
## 22           a. guafe trunk-ground              39.09          69.45
## 23         a. guazuma         twig              20.46          39.79
## 24       a. gundlachi trunk-ground              58.32         136.13
## 25       a. haetianus trunk-ground              65.48         154.41
## 26      a. hendersoni   grass-bush              38.53         128.81
## 27      a. homolechis trunk-ground              44.97          90.92
## 28           a. imias trunk-ground              51.67         104.67
## 29    a. inexpectatus   grass-bush              26.80         101.12
## 30       a. insolitus         twig              26.13          50.77
## 31           a. jubar trunk-ground              41.08          82.15
## 32           a. krugi   grass-bush              40.53         130.76
## 33      a. lineatopus trunk-ground              52.71         119.97
## 34   a. longitibialis trunk-ground              61.92         140.36
## 35      a. macilentus   grass-bush              31.80          97.35
## 36        a. marcanoi trunk-ground              49.24         123.95
## 37         a. mestrei trunk-ground              44.93          92.11
## 38        a. opalinus  trunk-crown              35.67          82.15
## 39      a. ophiolepis   grass-bush              26.88          81.13
## 40        a. placidus         twig              20.00          47.96
## 41       a. poncensis   grass-bush              33.39         118.20
## 42        a. porcatus  trunk-crown              44.58         140.26
## 43 a. quadriocellifer trunk-ground              39.05          82.20
## 44     a. rubribarbus trunk-ground              50.43          93.94
## 45          a. sagrei trunk-ground              45.47         111.90
## 46    a. semilineatus   grass-bush              33.99         121.61
## 47         a. shrevei trunk-ground              43.61         102.53
## 48      a. singularis  trunk-crown              38.42         102.34
## 49         a. strahmi trunk-ground              65.24         138.87
## 50       a. stratulus  trunk-crown              34.38          77.93
## 51       a. vanidicus   grass-bush              26.45          90.60
```

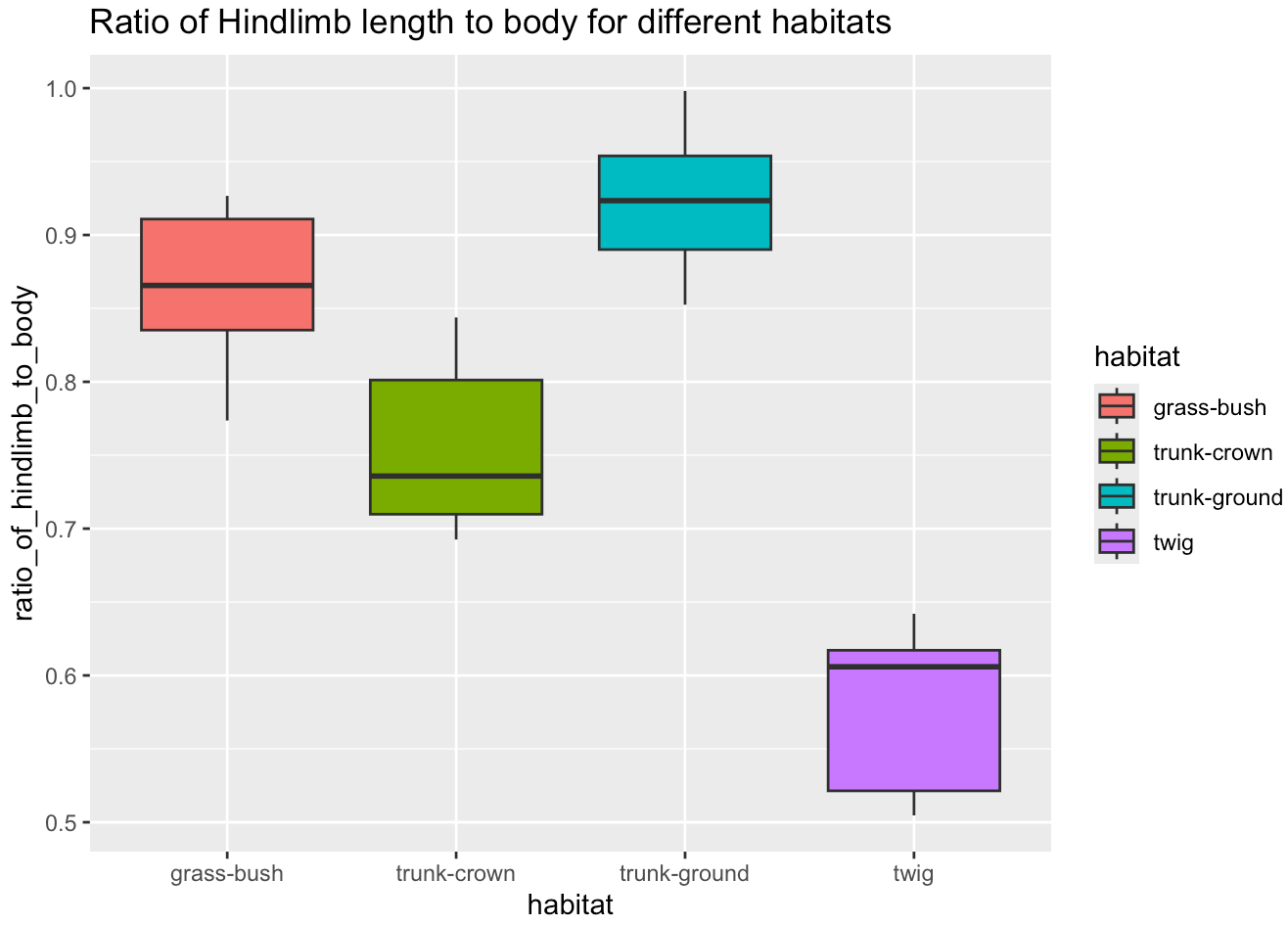
```
## 52       a. whitemani trunk-ground             51.06         115.26
##    body_length_mm toepad_lamellae_count      island ratio_of_hindlimb_to_body
## 1           51.67                    27        cuba                 0.9765822
## 2           41.32                    31        cuba                 0.6171346
## 3           30.95                    24        cuba                 0.8455574
## 4           51.53                    36  hispaniola                 0.7141471
## 5           72.32                    41        cuba                 0.6967644
## 6           51.72                    28        cuba                 0.9545630
## 7           32.94                    29  hispaniola                 0.9098361
## 8           31.84                    28        cuba                 0.8602387
## 9           40.22                    28        cuba                 0.6059175
## 10          56.11                    31  hispaniola                 0.9233648
## 11          41.81                    32  hispaniola                 0.9258551
## 12          55.65                    32        cuba                 0.8524708
## 13          52.29                    29  hispaniola                 0.9531459
## 14          65.44                    42  hispaniola                 0.7419010
## 15          39.03                    26        cuba                 0.8913656
## 16          46.72                    32        cuba                 0.8910531
## 17          54.45                    33 puerto rico                 0.8907254
## 18          29.01                    24        cuba                 0.7886936
## 19          34.32                    26        cuba                 0.9143357
## 20          45.34                    36  hispaniola                 0.8709749
## 21          57.97                    38     jamacia                 0.8402622
## 22          43.95                    29        cuba                 0.8894198
## 23          39.24                    28        cuba                 0.5214067
## 24          59.97                    28 puerto rico                 0.9724862
## 25          68.19                    33  hispaniola                 0.9602581
## 26          43.19                    34  hispaniola                 0.8921047
## 27          51.34                    32        cuba                 0.8759252
## 28          54.89                    28        cuba                 0.9413372
## 29          31.28                    27        cuba                 0.8567775
## 30          40.70                    25  hispaniola                 0.6420147
## 31          47.38                    29        cuba                 0.8670325
## 32          44.35                    33 puerto rico                 0.9138670
## 33          56.50                    29     jamacia                 0.9329204
## 34          63.29                    28  hispaniola                 0.9783536
## 35          37.39                    28        cuba                 0.8504948
## 36          53.79                    33  hispaniola                 0.9154118
## 37          49.05                    30        cuba                 0.9160041
## 38          42.27                    35     jamacia                 0.8438609
## 39          34.59                    24        cuba                 0.7771032
## 40          39.63                    26  hispaniola                 0.5046682
## 41          41.52                    29 puerto rico                 0.8041908
## 42          64.37                    44        cuba                 0.6925586
## 43          45.03                    28        cuba                 0.8671996
## 44          53.74                    29        cuba                 0.9384071
## 45          53.14                    33        cuba                 0.8556643
## 46          36.68                    30  hispaniola                 0.9266630
## 47          48.85                    28  hispaniola                 0.8927329
## 48          52.65                    38  hispaniola                 0.7297246
## 49          65.36                    31  hispaniola                 0.9981640
## 50          43.62                    34 puerto rico                 0.7881706
```

```
## 51          34.19                  23        cuba                  0.7736180
## 52          54.77                  29  hispaniola                  0.9322622
##    ratio_of_tail_to_body
## 1               1.586801
## 2               1.325024
## 3               2.552504
## 4               1.647196
## 5               2.135647
## 6               1.759667
## 7               3.230115
## 8               2.971734
## 9               1.618598
## 10              1.806630
## 11              2.770151
## 12              2.048697
## 13              2.349398
## 14              2.171760
## 15              2.530105
## 16              1.676156
## 17              2.471442
## 18              3.236815
## 19              3.254079
## 20              2.895236
## 21              2.066241
## 22              1.580205
## 23              1.014016
## 24              2.269968
## 25              2.264408
## 26              2.982403
## 27              1.770939
## 28              1.906905
## 29              3.232737
## 30              1.247420
## 31              1.733854
## 32              2.948365
## 33              2.123363
## 34              2.217728
## 35              2.603637
## 36              2.304332
## 37              1.877880
## 38              1.943459
## 39              2.345476
## 40              1.210194
## 41              2.846821
## 42              2.178965
## 43              1.825450
## 44              1.748046
## 45              2.105758
## 46              3.315431
## 47              2.098874
## 48              1.943780
## 49              2.124694
```

```
## 50              1.786566
## 51              2.649898
## 52              2.104437
```

Question 12. (4 points) Create a new plot that examines the distribution of `ratio_of_hindlimb_to_body` across habitat types. How does this plot differ from the one you made in Problem 10? Be sure to label your axes and add a title.

```
anolis %>%
  ggplot(mapping=aes(x=habitat,y=ratio_of_hindlimb_to_body))+
  geom_boxplot(mapping = aes(fill=habitat))+
  labs(title="Ratio of Hindlimb length to body for different habitats")#The trunk_ground not only have the greatest average hindlimb length but also greatest ratio of hindlimb to body length.The grass_bush doesn't have large hindlimbs but the ratio of hindlimb to body is kind higher.
```



Problem 13. (4 points) A longer tail provides better balance and agility. Create a plot that examines the relationship between body length and tail length. Color the points by habitat type and add a line of best fit. What does this plot suggest about the relationship between body length and tail length? What do you

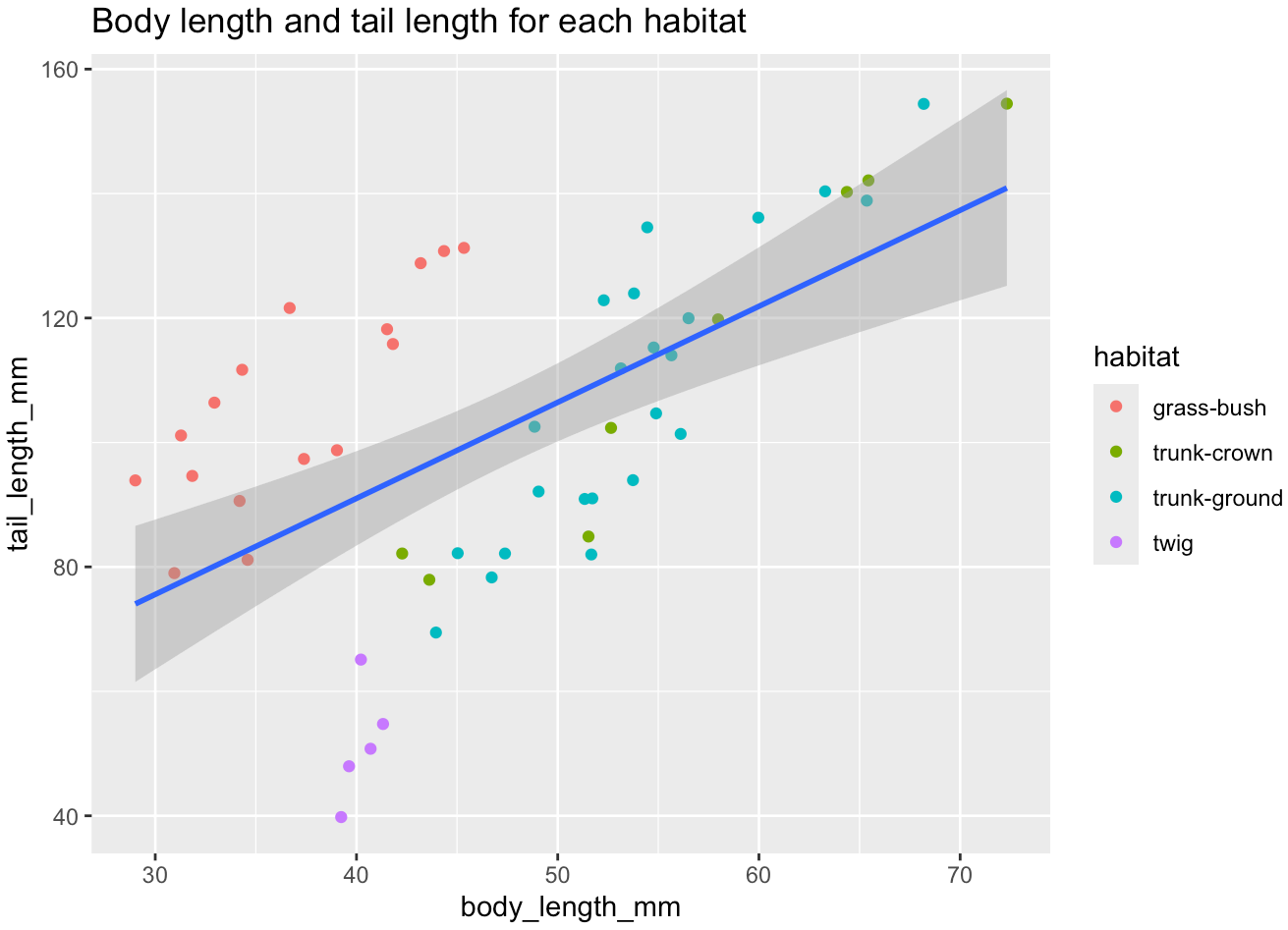
notice about lizards in the `Grass-bush` habitat? Be sure to label your axes and add a title.

```
names(anolis)
```

```
## [1] "species"                   "habitat"
## [3] "hindlimb_length_mm"        "tail_length_mm"
## [5] "body_length_mm"            "toepad_lamellae_count"
## [7] "island"                    "ratio_of_hindlimb_to_body"
## [9] "ratio_of_tail_to_body"
```

```
anolis %>%
  ggplot(mapping = aes(x=body_length_mm,y=tail_length_mm))+
  geom_point(mapping = aes(color=habitat))+
  geom_smooth(method = "lm")+
  labs(title="Body length and tail length for each habitat")#1.For most of the data it s
hows a relationship of larger body length have a longer tail length.2.But fir grass_bush
habitat with low body length there are some individuals have a long tail length.
```

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



Problem 14. (4 points) Toepad lamellae are transverse, plate-like structures found on the ventral surface of the digits. They are a key adaptation that allows anoles to cling to and move efficiently on smooth and vertical surfaces. What is the mean number of toepad lamellae for each habitat type?

```
names(anolis)
```

```
## [1] "species"                   "habitat"
## [3] "hindlimb_length_mm"        "tail_length_mm"
## [5] "body_length_mm"            "toepad_lamellae_count"
## [7] "island"                    "ratio_of_hindlimb_to_body"
## [9] "ratio_of_tail_to_body"
```

```
anolis %>%
  filter(habitat=="trunk-ground") %>%
  mutate(mean_toepad_lamellae_trunk_ground=mean(toepad_lamellae_count))#mean number of t
oepad lamellae for trunk-ground is 29.95652.
```

```
##               species      habitat hindlimb_length_mm tail_length_mm
## 1             a. ahli trunk-ground              50.46          81.99
## 2          a. allogus trunk-ground              49.37          91.01
## 3          a. armouri trunk-ground              51.81         101.37
## 4          a. bremeri trunk-ground              47.44         114.01
## 5         a. breslini trunk-ground              49.84         122.85
## 6         a. confusus trunk-ground              41.63          78.31
## 7            a. cooki trunk-ground              48.50         134.57
## 8            a. guafe trunk-ground              39.09          69.45
## 9        a. gundlachi trunk-ground              58.32         136.13
## 10       a. haetianus trunk-ground              65.48         154.41
## 11      a. homolechis trunk-ground              44.97          90.92
## 12           a. imias trunk-ground              51.67         104.67
## 13           a. jubar trunk-ground              41.08          82.15
## 14      a. lineatopus trunk-ground              52.71         119.97
## 15   a. longitibialis trunk-ground              61.92         140.36
## 16        a. marcanoi trunk-ground              49.24         123.95
## 17         a. mestrei trunk-ground              44.93          92.11
## 18 a. quadriocellifer trunk-ground              39.05          82.20
## 19     a. rubribarbus trunk-ground              50.43          93.94
## 20          a. sagrei trunk-ground              45.47         111.90
## 21         a. shrevei trunk-ground              43.61         102.53
## 22         a. strahmi trunk-ground              65.24         138.87
## 23       a. whitemani trunk-ground              51.06         115.26
##    body_length_mm toepad_lamellae_count      island ratio_of_hindlimb_to_body
## 1           51.67                    27        cuba                 0.9765822
## 2           51.72                    28        cuba                 0.9545630
## 3           56.11                    31  hispaniola                 0.9233648
## 4           55.65                    32        cuba                 0.8524708
## 5           52.29                    29  hispaniola                 0.9531459
## 6           46.72                    32        cuba                 0.8910531
## 7           54.45                    33 puerto rico                 0.8907254
## 8           43.95                    29        cuba                 0.8894198
## 9           59.97                    28 puerto rico                 0.9724862
## 10          68.19                    33  hispaniola                 0.9602581
## 11          51.34                    32        cuba                 0.8759252
## 12          54.89                    28        cuba                 0.9413372
## 13          47.38                    29        cuba                 0.8670325
## 14          56.50                    29     jamacia                 0.9329204
## 15          63.29                    28  hispaniola                 0.9783536
## 16          53.79                    33  hispaniola                 0.9154118
## 17          49.05                    30        cuba                 0.9160041
## 18          45.03                    28        cuba                 0.8671996
## 19          53.74                    29        cuba                 0.9384071
## 20          53.14                    33        cuba                 0.8556643
## 21          48.85                    28  hispaniola                 0.8927329
## 22          65.36                    31  hispaniola                 0.9981640
## 23          54.77                    29  hispaniola                 0.9322622
##    ratio_of_tail_to_body mean_toepad_lamellae_trunk_ground
## 1               1.586801                          29.95652
## 2               1.759667                          29.95652
## 3               1.806630                          29.95652
```

```
## 4               2.048697                          29.95652
## 5               2.349398                          29.95652
## 6               1.676156                          29.95652
## 7               2.471442                          29.95652
## 8               1.580205                          29.95652
## 9               2.269968                          29.95652
## 10              2.264408                          29.95652
## 11              1.770939                          29.95652
## 12              1.906905                          29.95652
## 13              1.733854                          29.95652
## 14              2.123363                          29.95652
## 15              2.217728                          29.95652
## 16              2.304332                          29.95652
## 17              1.877880                          29.95652
## 18              1.825450                          29.95652
## 19              1.748046                          29.95652
## 20              2.105758                          29.95652
## 21              2.098874                          29.95652
## 22              2.124694                          29.95652
## 23              2.104437                          29.95652
```

```
anolis %>%
  filter(habitat=="twig")%>%
  mutate(mean_toepad_lamellae_twig=mean(toepad_lamellae_count))#mean number of toepad la
mellae for twig is 27.6.
```

```
##          species habitat hindlimb_length_mm tail_length_mm body_length_mm
## 1     a. alayoni    twig              25.50          54.75          41.32
## 2 a. angusticeps    twig              24.37          65.10          40.22
## 3     a. guazuma    twig              20.46          39.79          39.24
## 4   a. insolitus    twig              26.13          50.77          40.70
## 5    a. placidus    twig              20.00          47.96          39.63
##   toepad_lamellae_count     island ratio_of_hindlimb_to_body
## 1                    31       cuba                 0.6171346
## 2                    28       cuba                 0.6059175
## 3                    28       cuba                 0.5214067
## 4                    25 hispaniola                 0.6420147
## 5                    26 hispaniola                 0.5046682
##   ratio_of_tail_to_body mean_toepad_lamellae_twig
## 1              1.325024                      27.6
## 2              1.618598                      27.6
## 3              1.014016                      27.6
## 4              1.247420                      27.6
## 5              1.210194                      27.6
```

```
anolis %>%
  filter(habitat=="grass-bush")%>%
  mutate(mean_toepad_lamellae_grass_bush=mean(toepad_lamellae_count))#mean number of toe
pad lamellae for grass_bush is 28.3125.
```

```
##               species    habitat hindlimb_length_mm tail_length_mm
## 1          a. alfaroi grass-bush              26.17          79.00
## 2          a. alumina grass-bush              29.97         106.40
## 3        a. alutaceus grass-bush              27.39          94.62
## 4    a. bahorucoensis grass-bush              38.71         115.82
## 5        a. clivicola grass-bush              34.79          98.75
## 6     a. cupeyalensis grass-bush              22.88          93.90
## 7     a. cyanopleurus grass-bush              31.38         111.68
## 8  a. dolichocephalus grass-bush              39.49         131.27
## 9       a. hendersoni grass-bush              38.53         128.81
## 10    a. inexpectatus grass-bush              26.80         101.12
## 11           a. krugi grass-bush              40.53         130.76
## 12      a. macilentus grass-bush              31.80          97.35
## 13      a. ophiolepis grass-bush              26.88          81.13
## 14       a. poncensis grass-bush              33.39         118.20
## 15    a. semilineatus grass-bush              33.99         121.61
## 16       a. vanidicus grass-bush              26.45          90.60
##    body_length_mm toepad_lamellae_count      island ratio_of_hindlimb_to_body
## 1           30.95                    24        cuba                 0.8455574
## 2           32.94                    29  hispaniola                 0.9098361
## 3           31.84                    28        cuba                 0.8602387
## 4           41.81                    32  hispaniola                 0.9258551
## 5           39.03                    26        cuba                 0.8913656
## 6           29.01                    24        cuba                 0.7886936
## 7           34.32                    26        cuba                 0.9143357
## 8           45.34                    36  hispaniola                 0.8709749
## 9           43.19                    34  hispaniola                 0.8921047
## 10          31.28                    27        cuba                 0.8567775
## 11          44.35                    33 puerto rico                 0.9138670
## 12          37.39                    28        cuba                 0.8504948
## 13          34.59                    24        cuba                 0.7771032
## 14          41.52                    29 puerto rico                 0.8041908
## 15          36.68                    30  hispaniola                 0.9266630
## 16          34.19                    23        cuba                 0.7736180
##    ratio_of_tail_to_body mean_toepad_lamellae_grass_bush
## 1               2.552504                         28.3125
## 2               3.230115                         28.3125
## 3               2.971734                         28.3125
## 4               2.770151                         28.3125
## 5               2.530105                         28.3125
## 6               3.236815                         28.3125
## 7               3.254079                         28.3125
## 8               2.895236                         28.3125
## 9               2.982403                         28.3125
## 10              3.232737                         28.3125
## 11              2.948365                         28.3125
## 12              2.603637                         28.3125
## 13              2.345476                         28.3125
## 14              2.846821                         28.3125
## 15              3.315431                         28.3125
## 16              2.649898                         28.3125
```

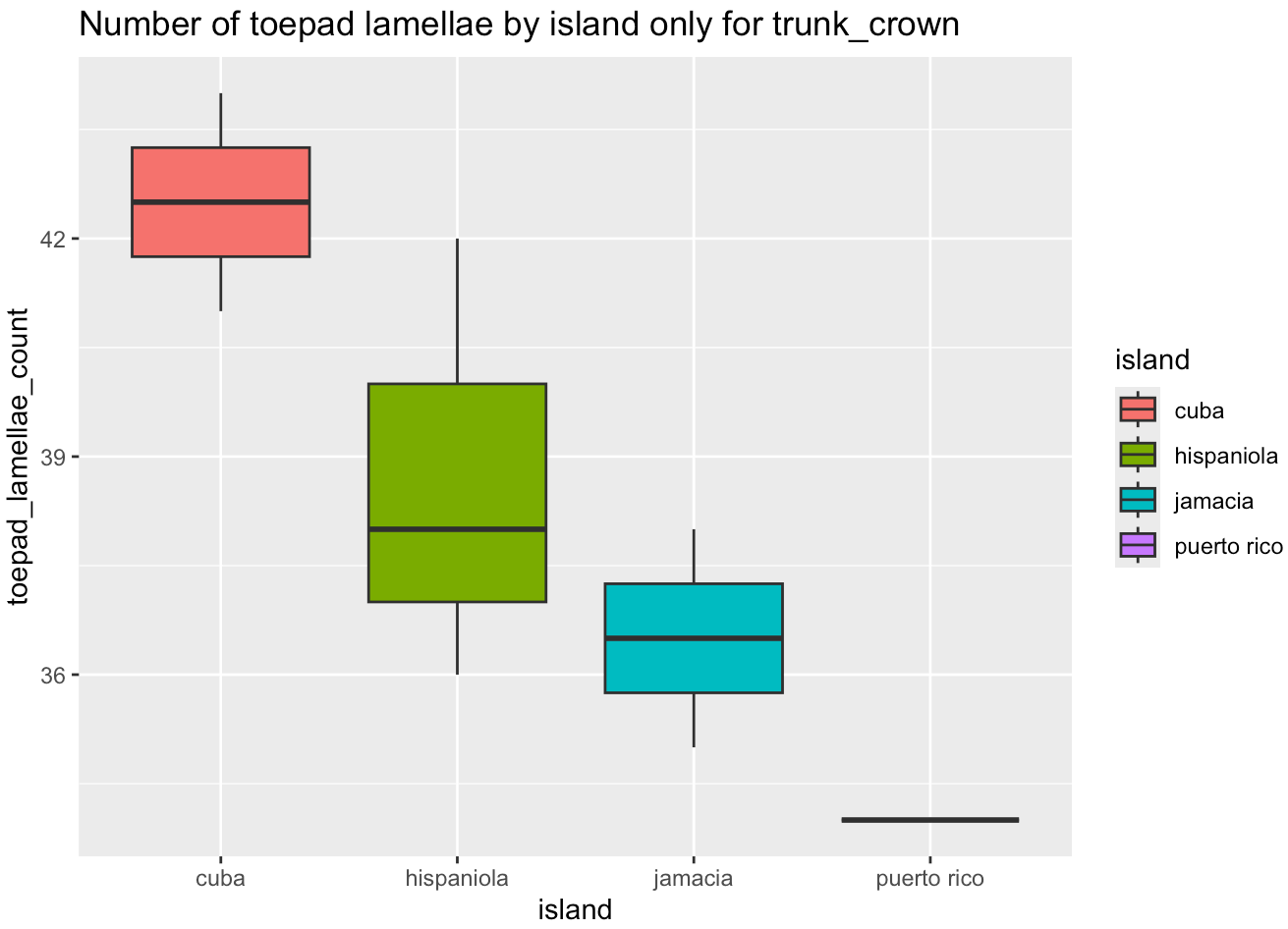
```
anolis %>%
  filter(habitat=="trunk-crown")%>%
  mutate(mean_toepad_lamellae_trunk_crown=mean(toepad_lamellae_count))#mean number of to
epad lamellae for trunk-crown is 38.5.
```

```
##           species     habitat hindlimb_length_mm tail_length_mm body_length_mm
## 1     a. aliniger trunk-crown              36.80          84.88          51.53
## 2     a. allisoni trunk-crown              50.39         154.45          72.32
## 3 a. chlorocyanus trunk-crown              48.55         142.12          65.44
## 4      a. grahami trunk-crown              48.71         119.78          57.97
## 5     a. opalinus trunk-crown              35.67          82.15          42.27
## 6     a. porcatus trunk-crown              44.58         140.26          64.37
## 7   a. singularis trunk-crown              38.42         102.34          52.65
## 8    a. stratulus trunk-crown              34.38          77.93          43.62
##   toepad_lamellae_count      island ratio_of_hindlimb_to_body
## 1                    36  hispaniola                 0.7141471
## 2                    41        cuba                 0.6967644
## 3                    42  hispaniola                 0.7419010
## 4                    38     jamacia                 0.8402622
## 5                    35     jamacia                 0.8438609
## 6                    44        cuba                 0.6925586
## 7                    38  hispaniola                 0.7297246
## 8                    34 puerto rico                 0.7881706
##   ratio_of_tail_to_body mean_toepad_lamellae_trunk_crown
## 1              1.647196                              38.5
## 2              2.135647                              38.5
## 3              2.171760                              38.5
## 4              2.066241                              38.5
## 5              1.943459                              38.5
## 6              2.178965                              38.5
## 7              1.943780                              38.5
## 8              1.786566                              38.5
```

#The mean number of toepad lamellae of trunk_ground is:29.95652 #The mean number of toepad lamellae of trunk-crown is:38.5 #The mean number of toepad lamellae of grass_bush is:28.3125 #The mean number of toepad lamellae of twig is:27.6

Problem 15. (5 points) The number of toepad lamellae is significantly different for trunk-crown species. But, is this consistent across all islands? Make a plot that shows the range in number of toepad lamellae by island for trunk-crown species only. Be sure to label your axes and add a title.

```
anolis %>%
  filter(habitat=="trunk-crown") %>%
  ggplot(mapping = aes(x=island,y=toepad_lamellae_count))+
  geom_boxplot(mapping = aes(fill=island))+
  labs(title="Number of toepad lamellae by island only for trunk_crown")
```



Submit the Midterm

1. Save your work and knit the .rmd file.
2. Open the .html file and “print” it to a .pdf file in Google Chrome (not Safari).
3. Go to the class Canvas page and open Gradescope.
4. Submit your .pdf file to the midterm assignment- be sure to assign the pages to the correct questions.
5. Commit and push your work to your repository.