Analysis of tree frog limb measurements

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My GitHub repository is accessible here (https://github.com/SaraGama4/BIOL432_Assignment1_SG (https://github.com/SaraGama4/BIOL432_Assignment1_SG)).

1: Loading files

Load required libraries

```
library(dplyr)
```

```
##
## 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
```

```
library(ggplot2)
library(tidyr)
```

I loaded the revised ‘measurements.csv’ file which now includes the ‘Volume’ column. I also loaded in my generated data and estimated volume scripts.

In the generated data script I chose five Canadian tree frog species and put them in a vector which I then randomly sampled from for a total of n= 100. I did the same process for generating three recorded names from observations. As for generating hypothetical values for limb width and lengths, I set plausible parameters for the normal distribution including a mean and standard deviation for both variables. This was followed by generating 100 random values from said normal distribution. Finally I combined all of the vectors to be separate columns in a csv file!

In the estimated volume script I read the csv file into a data frame and estimated limb volume using the formula for the volume of a cylinder (for biological relevance). I then mutated the values for each calculation into rows of a new column labelled “volume”.

```
source("C:/Users/sgama/Downloads/432/BIOL432_Assignment1_SG/dataGenerato.R")
```

```
##   [1] "Hyla versicolor"     "Pseudacris regilla"  "Hyla chrysoscelis"
##   [4] "Hyla chrysoscelis"   "Hyla versicolor"     "Pseudacris regilla"
##   [7] "Pseudacris maculata" "Hyla versicolor"     "Acris crepitans"
##  [10] "Hyla versicolor"     "Acris crepitans"     "Pseudacris maculata"
##  [13] "Pseudacris maculata" "Hyla versicolor"     "Pseudacris maculata"
##  [16] "Hyla versicolor"     "Pseudacris regilla"  "Hyla chrysoscelis"
##  [19] "Acris crepitans"     "Acris crepitans"     "Pseudacris regilla"
##  [22] "Hyla versicolor"     "Acris crepitans"     "Pseudacris regilla"
##  [25] "Pseudacris maculata" "Hyla versicolor"     "Pseudacris maculata"
##  [28] "Pseudacris regilla"  "Acris crepitans"     "Hyla chrysoscelis"
##  [31] "Hyla versicolor"     "Hyla versicolor"     "Hyla versicolor"
##  [34] "Pseudacris regilla"  "Pseudacris maculata" "Pseudacris maculata"
##  [37] "Hyla versicolor"     "Pseudacris regilla"  "Pseudacris maculata"
##  [40] "Pseudacris regilla"  "Hyla versicolor"     "Hyla chrysoscelis"
##  [43] "Hyla versicolor"     "Hyla chrysoscelis"   "Pseudacris maculata"
##  [46] "Pseudacris regilla"  "Hyla chrysoscelis"   "Pseudacris maculata"
##  [49] "Acris crepitans"     "Hyla versicolor"     "Hyla chrysoscelis"
##  [52] "Pseudacris maculata" "Acris crepitans"     "Hyla versicolor"
##  [55] "Pseudacris maculata" "Pseudacris regilla"  "Hyla versicolor"
##  [58] "Pseudacris maculata" "Pseudacris regilla"  "Hyla versicolor"
##  [61] "Pseudacris regilla"  "Hyla chrysoscelis"   "Hyla chrysoscelis"
##  [64] "Pseudacris maculata" "Acris crepitans"     "Hyla chrysoscelis"
##  [67] "Hyla versicolor"     "Pseudacris maculata" "Pseudacris maculata"
##  [70] "Pseudacris maculata" "Hyla versicolor"     "Acris crepitans"
##  [73] "Pseudacris maculata" "Hyla versicolor"     "Acris crepitans"
##  [76] "Pseudacris maculata" "Pseudacris maculata" "Hyla versicolor"
##  [79] "Acris crepitans"     "Hyla chrysoscelis"   "Acris crepitans"
##  [82] "Hyla chrysoscelis"   "Pseudacris maculata" "Hyla versicolor"
##  [85] "Hyla chrysoscelis"   "Hyla chrysoscelis"   "Pseudacris regilla"
##  [88] "Acris crepitans"     "Pseudacris maculata" "Pseudacris maculata"
##  [91] "Hyla chrysoscelis"   "Hyla versicolor"     "Pseudacris regilla"
##  [94] "Pseudacris maculata" "Hyla chrysoscelis"   "Pseudacris regilla"
##  [97] "Hyla chrysoscelis"   "Acris crepitans"     "Pseudacris maculata"
## [100] "Hyla versicolor"
##   [1] 2.504421825 0.417774204 0.619476729 2.736367925 1.233766724 0.962226637
##   [7] 3.560311059 0.009119462 0.065228030 0.779443565 1.988409507 1.071937138
##  [13] 1.989366902 2.387739233 0.073337778 2.789104496 1.359161722 0.704056385
##  [19] 1.145601390 2.252496496 2.980207276 0.417954937 0.760310325 1.357397398
##  [25] 1.893353644 2.702068030 1.296676357 3.699392095 3.130260946 1.925153842
##  [31] 0.596687900 2.689413310 0.533018343 0.040795633 0.967712116 1.379110758
##  [37] 0.973534328 0.459485457 1.439203906 0.597763665 0.722066256 1.239485769
##  [43] 2.449940786 1.375659152 0.542469489 1.643013159 2.546295562 3.035561386
##  [49] 1.274105266 2.907267923 1.455235851 0.863070607 0.452419753 2.208089387
##  [55] 0.112733482 3.054298279 2.415826622 2.142040958 0.851011993 1.365530627
##  [61] 2.159804951 1.587145568 1.530688851 0.423280143 0.500820049 1.052094763
##  [67] 1.907405502 0.212369574 1.155948638 0.842159910 1.207683240 2.402656824
##  [73] 1.963820894 1.711529428 2.419793581 1.399046163 2.708569065 2.172813366
##  [79] 3.790169475 1.174123571 0.433581939 2.662420350 0.035691186 1.423056232
##  [85] 3.090278153 1.929999116 2.548399082 0.056513380 0.368926421 0.155903300
##  [91] 0.824291034 0.063385470 1.332217643 1.239588534 0.571085297 0.985756967
##  [97] 2.676897658 2.282263772 1.934255544 0.124540115
##   [1] 6.243680 6.610564 5.659189 6.297962 4.680477 3.907899 5.245519 5.842457
```

```
##   [9] 5.652824 5.257728 5.373790 5.465353 6.657432 5.479266 7.580857 4.973008
##  [17] 5.823735 5.733285 6.819742 5.487488 6.068129 5.691221 6.128030 6.472252
##  [25] 6.428009 3.748006 5.813740 7.096987 3.749508 5.761547 5.071129 5.589225
##  [33] 6.206504 6.708546 6.504964 7.032635 7.582748 6.212151 6.028172 5.267428
##  [41] 7.112701 4.794642 6.692592 5.408878 6.063432 6.372195 8.392913 5.080058
##  [49] 5.664785 7.264838 4.717698 5.980703 6.098206 4.601221 5.695973 7.963931
##  [57] 7.717893 4.828827 6.992922 5.767037 6.770376 5.475432 6.626789 6.829141
##  [65] 6.103513 6.507283 5.652777 5.204566 4.886884 4.470582 5.870602 6.565744
##  [73] 5.857908 6.928920 6.361472 5.014382 6.505332 6.460826 6.275238 5.867624
##  [81] 8.596679 5.308549 6.149865 6.548204 6.076466 5.004060 6.752710 5.684499
##  [89] 5.576274 4.889643 6.142013 6.626337 7.062955 4.580210 6.486641 5.102394
##  [97] 7.479512 5.076272 5.645986 5.117565
##          random_species  limb_width limb_length random_observer
## 1       Hyla versicolor 2.504421825    6.243680       Modernism
## 2    Pseudacris regilla 0.417774204    6.610564       Modernism
## 3     Hyla chrysoscelis 0.619476729    5.659189      Minimalism
## 4     Hyla chrysoscelis 2.736367925    6.297962       Modernism
## 5       Hyla versicolor 1.233766724    4.680477        Futurism
## 6    Pseudacris regilla 0.962226637    3.907899      Minimalism
## 7   Pseudacris maculata 3.560311059    5.245519      Minimalism
## 8       Hyla versicolor 0.009119462    5.842457      Minimalism
## 9       Acris crepitans 0.065228030    5.652824        Futurism
## 10      Hyla versicolor 0.779443565    5.257728       Modernism
## 11      Acris crepitans 1.988409507    5.373790       Modernism
## 12  Pseudacris maculata 1.071937138    5.465353        Futurism
## 13  Pseudacris maculata 1.989366902    6.657432        Futurism
## 14      Hyla versicolor 2.387739233    5.479266       Modernism
## 15  Pseudacris maculata 0.073337778    7.580857      Minimalism
## 16      Hyla versicolor 2.789104496    4.973008       Modernism
## 17   Pseudacris regilla 1.359161722    5.823735       Modernism
## 18    Hyla chrysoscelis 0.704056385    5.733285        Futurism
## 19      Acris crepitans 1.145601390    6.819742      Minimalism
## 20      Acris crepitans 2.252496496    5.487488        Futurism
## 21   Pseudacris regilla 2.980207276    6.068129       Modernism
## 22      Hyla versicolor 0.417954937    5.691221        Futurism
## 23      Acris crepitans 0.760310325    6.128030        Futurism
## 24   Pseudacris regilla 1.357397398    6.472252       Modernism
## 25  Pseudacris maculata 1.893353644    6.428009       Modernism
## 26      Hyla versicolor 2.702068030    3.748006       Modernism
## 27  Pseudacris maculata 1.296676357    5.813740       Modernism
## 28   Pseudacris regilla 3.699392095    7.096987      Minimalism
## 29      Acris crepitans 3.130260946    3.749508      Minimalism
## 30    Hyla chrysoscelis 1.925153842    5.761547       Modernism
## 31      Hyla versicolor 0.596687900    5.071129       Modernism
## 32      Hyla versicolor 2.689413310    5.589225       Modernism
## 33      Hyla versicolor 0.533018343    6.206504      Minimalism
## 34   Pseudacris regilla 0.040795633    6.708546      Minimalism
## 35  Pseudacris maculata 0.967712116    6.504964       Modernism
## 36  Pseudacris maculata 1.379110758    7.032635        Futurism
## 37      Hyla versicolor 0.973534328    7.582748       Modernism
## 38   Pseudacris regilla 0.459485457    6.212151       Modernism
## 39  Pseudacris maculata 1.439203906    6.028172      Minimalism
```

```
## 40   Pseudacris regilla 0.597763665    5.267428       Modernism
## 41      Hyla versicolor 0.722066256    7.112701      Minimalism
## 42    Hyla chrysoscelis 1.239485769    4.794642      Minimalism
## 43      Hyla versicolor 2.449940786    6.692592        Futurism
## 44    Hyla chrysoscelis 1.375659152    5.408878      Minimalism
## 45  Pseudacris maculata 0.542469489    6.063432      Minimalism
## 46   Pseudacris regilla 1.643013159    6.372195        Futurism
## 47    Hyla chrysoscelis 2.546295562    8.392913       Modernism
## 48  Pseudacris maculata 3.035561386    5.080058       Modernism
## 49      Acris crepitans 1.274105266    5.664785      Minimalism
## 50      Hyla versicolor 2.907267923    7.264838        Futurism
## 51    Hyla chrysoscelis 1.455235851    4.717698      Minimalism
## 52  Pseudacris maculata 0.863070607    5.980703       Modernism
## 53      Acris crepitans 0.452419753    6.098206       Modernism
## 54      Hyla versicolor 2.208089387    4.601221        Futurism
## 55  Pseudacris maculata 0.112733482    5.695973        Futurism
## 56   Pseudacris regilla 3.054298279    7.963931      Minimalism
## 57      Hyla versicolor 2.415826622    7.717893        Futurism
## 58  Pseudacris maculata 2.142040958    4.828827        Futurism
## 59   Pseudacris regilla 0.851011993    6.992922      Minimalism
## 60      Hyla versicolor 1.365530627    5.767037       Modernism
## 61   Pseudacris regilla 2.159804951    6.770376        Futurism
## 62    Hyla chrysoscelis 1.587145568    5.475432      Minimalism
## 63    Hyla chrysoscelis 1.530688851    6.626789        Futurism
## 64  Pseudacris maculata 0.423280143    6.829141       Modernism
## 65      Acris crepitans 0.500820049    6.103513      Minimalism
## 66    Hyla chrysoscelis 1.052094763    6.507283      Minimalism
## 67      Hyla versicolor 1.907405502    5.652777      Minimalism
## 68  Pseudacris maculata 0.212369574    5.204566        Futurism
## 69  Pseudacris maculata 1.155948638    4.886884        Futurism
## 70  Pseudacris maculata 0.842159910    4.470582       Modernism
## 71      Hyla versicolor 1.207683240    5.870602       Modernism
## 72      Acris crepitans 2.402656824    6.565744       Modernism
## 73  Pseudacris maculata 1.963820894    5.857908      Minimalism
## 74      Hyla versicolor 1.711529428    6.928920        Futurism
## 75      Acris crepitans 2.419793581    6.361472      Minimalism
## 76  Pseudacris maculata 1.399046163    5.014382        Futurism
## 77  Pseudacris maculata 2.708569065    6.505332      Minimalism
## 78      Hyla versicolor 2.172813366    6.460826        Futurism
## 79      Acris crepitans 3.790169475    6.275238      Minimalism
## 80    Hyla chrysoscelis 1.174123571    5.867624        Futurism
## 81      Acris crepitans 0.433581939    8.596679       Modernism
## 82    Hyla chrysoscelis 2.662420350    5.308549        Futurism
## 83  Pseudacris maculata 0.035691186    6.149865       Modernism
## 84      Hyla versicolor 1.423056232    6.548204       Modernism
## 85    Hyla chrysoscelis 3.090278153    6.076466      Minimalism
## 86    Hyla chrysoscelis 1.929999116    5.004060      Minimalism
## 87   Pseudacris regilla 2.548399082    6.752710        Futurism
## 88      Acris crepitans 0.056513380    5.684499       Modernism
## 89  Pseudacris maculata 0.368926421    5.576274        Futurism
## 90  Pseudacris maculata 0.155903300    4.889643        Futurism
## 91    Hyla chrysoscelis 0.824291034    6.142013        Futurism
```

```
## 92      Hyla versicolor 0.063385470    6.626337       Modernism
## 93   Pseudacris regilla 1.332217643    7.062955       Modernism
## 94  Pseudacris maculata 1.239588534    4.580210      Minimalism
## 95    Hyla chrysoscelis 0.571085297    6.486641        Futurism
## 96   Pseudacris regilla 0.985756967    5.102394        Futurism
## 97    Hyla chrysoscelis 2.676897658    7.479512        Futurism
## 98      Acris crepitans 2.282263772    5.076272        Futurism
## 99  Pseudacris maculata 1.934255544    5.645986        Futurism
## 100     Hyla versicolor 0.124540115    5.117565        Futurism
```

```
source("C:/Users/sgama/Downloads/432/BIOL432_Assignment1_SG/volumeEstimato.R")
```

```
##          random_species  limb_width limb_length random_observer       Volume
## 1       Hyla versicolor 2.504421825    6.243680       Modernism 3.075711e+01
## 2    Pseudacris regilla 0.417774204    6.610564       Modernism 9.061741e-01
## 3     Hyla chrysoscelis 0.619476729    5.659189      Minimalism 1.705666e+00
## 4     Hyla chrysoscelis 2.736367925    6.297962       Modernism 3.703726e+01
## 5       Hyla versicolor 1.233766724    4.680477        Futurism 5.595593e+00
## 6    Pseudacris regilla 0.962226637    3.907899      Minimalism 2.841764e+00
## 7   Pseudacris maculata 3.560311059    5.245519      Minimalism 5.222209e+01
## 8       Hyla versicolor 0.009119462    5.842457      Minimalism 3.816136e-04
## 9       Acris crepitans 0.065228030    5.652824        Futurism 1.888965e-02
## 10      Hyla versicolor 0.779443565    5.257728       Modernism 2.508750e+00
## 11      Acris crepitans 1.988409507    5.373790       Modernism 1.668715e+01
## 12  Pseudacris maculata 1.071937138    5.465353        Futurism 4.932269e+00
## 13  Pseudacris maculata 1.989366902    6.657432        Futurism 2.069314e+01
## 14      Hyla versicolor 2.387739233    5.479266       Modernism 2.453500e+01
## 15  Pseudacris maculata 0.073337778    7.580857      Minimalism 3.202312e-02
## 16      Hyla versicolor 2.789104496    4.973008       Modernism 3.038356e+01
## 17   Pseudacris regilla 1.359161722    5.823735       Modernism 8.449554e+00
## 18    Hyla chrysoscelis 0.704056385    5.733285        Futurism 2.232072e+00
## 19      Acris crepitans 1.145601390    6.819742      Minimalism 7.029507e+00
## 20      Acris crepitans 2.252496496    5.487488        Futurism 2.186713e+01
## 21   Pseudacris regilla 2.980207276    6.068129       Modernism 4.232896e+01
## 22      Hyla versicolor 0.417954937    5.691221        Futurism 7.808259e-01
## 23      Acris crepitans 0.760310325    6.128030        Futurism 2.782227e+00
## 24   Pseudacris regilla 1.357397398    6.472252       Modernism 9.366112e+00
## 25  Pseudacris maculata 1.893353644    6.428009       Modernism 1.809797e+01
## 26      Hyla versicolor 2.702068030    3.748006       Modernism 2.149229e+01
## 27  Pseudacris maculata 1.296676357    5.813740       Modernism 7.677302e+00
## 28   Pseudacris regilla 3.699392095    7.096987      Minimalism 7.628244e+01
## 29      Acris crepitans 3.130260946    3.749508      Minimalism 2.885528e+01
## 30    Hyla chrysoscelis 1.925153842    5.761547       Modernism 1.677104e+01
## 31      Hyla versicolor 0.596687900    5.071129       Modernism 1.418042e+00
## 32      Hyla versicolor 2.689413310    5.589225       Modernism 3.175094e+01
## 33      Hyla versicolor 0.533018343    6.206504      Minimalism 1.384909e+00
## 34   Pseudacris regilla 0.040795633    6.708546      Minimalism 8.768911e-03
## 35  Pseudacris maculata 0.967712116    6.504964       Modernism 4.784396e+00
## 36  Pseudacris maculata 1.379110758    7.032635        Futurism 1.050525e+01
## 37      Hyla versicolor 0.973534328    7.582748       Modernism 5.644416e+00
## 38   Pseudacris regilla 0.459485457    6.212151       Modernism 1.030091e+00
## 39  Pseudacris maculata 1.439203906    6.028172      Minimalism 9.806638e+00
## 40   Pseudacris regilla 0.597763665    5.267428       Modernism 1.478249e+00
## 41      Hyla versicolor 0.722066256    7.112701      Minimalism 2.912585e+00
## 42    Hyla chrysoscelis 1.239485769    4.794642      Minimalism 5.785343e+00
## 43      Hyla versicolor 2.449940786    6.692592        Futurism 3.154971e+01
## 44    Hyla chrysoscelis 1.375659152    5.408878      Minimalism 8.039309e+00
## 45  Pseudacris maculata 0.542469489    6.063432      Minimalism 1.401390e+00
## 46   Pseudacris regilla 1.643013159    6.372195        Futurism 1.351018e+01
## 47    Hyla chrysoscelis 2.546295562    8.392913       Modernism 4.273859e+01
## 48  Pseudacris maculata 3.035561386    5.080058       Modernism 3.676517e+01
## 49      Acris crepitans 1.274105266    5.664785      Minimalism 7.222440e+00
## 50      Hyla versicolor 2.907267923    7.264838        Futurism 4.822652e+01
## 51    Hyla chrysoscelis 1.455235851    4.717698      Minimalism 7.846695e+00
```

```
## 52  Pseudacris maculata 0.863070607    5.980703       Modernism 3.498926e+00
## 53      Acris crepitans 0.452419753    6.098206       Modernism 9.803362e-01
## 54      Hyla versicolor 2.208089387    4.601221        Futurism 1.761961e+01
## 55  Pseudacris maculata 0.112733482    5.695973        Futurism 5.685434e-02
## 56   Pseudacris regilla 3.054298279    7.963931      Minimalism 5.834992e+01
## 57      Hyla versicolor 2.415826622    7.717893        Futurism 3.537693e+01
## 58  Pseudacris maculata 2.142040958    4.828827        Futurism 1.740152e+01
## 59   Pseudacris regilla 0.851011993    6.992922      Minimalism 3.977589e+00
## 60      Hyla versicolor 1.365530627    5.767037       Modernism 8.445891e+00
## 61   Pseudacris regilla 2.159804951    6.770376        Futurism 2.480457e+01
## 62    Hyla chrysoscelis 1.587145568    5.475432      Minimalism 1.083283e+01
## 63    Hyla chrysoscelis 1.530688851    6.626789        Futurism 1.219458e+01
## 64  Pseudacris maculata 0.423280143    6.829141       Modernism 9.609743e-01
## 65      Acris crepitans 0.500820049    6.103513      Minimalism 1.202356e+00
## 66    Hyla chrysoscelis 1.052094763    6.507283      Minimalism 5.657171e+00
## 67      Hyla versicolor 1.907405502    5.652777      Minimalism 1.615243e+01
## 68  Pseudacris maculata 0.212369574    5.204566        Futurism 1.843567e-01
## 69  Pseudacris maculata 1.155948638    4.886884        Futurism 5.128602e+00
## 70  Pseudacris maculata 0.842159910    4.470582       Modernism 2.490251e+00
## 71      Hyla versicolor 1.207683240    5.870602       Modernism 6.724788e+00
## 72      Acris crepitans 2.402656824    6.565744       Modernism 2.976852e+01
## 73  Pseudacris maculata 1.963820894    5.857908      Minimalism 1.774337e+01
## 74      Hyla versicolor 1.711529428    6.928920        Futurism 1.594132e+01
## 75      Acris crepitans 2.419793581    6.361472      Minimalism 2.925527e+01
## 76  Pseudacris maculata 1.399046163    5.014382        Futurism 7.708527e+00
## 77  Pseudacris maculata 2.708569065    6.505332      Minimalism 3.748342e+01
## 78      Hyla versicolor 2.172813366    6.460826        Futurism 2.395647e+01
## 79      Acris crepitans 3.790169475    6.275238      Minimalism 7.080066e+01
## 80    Hyla chrysoscelis 1.174123571    5.867624        Futurism 6.353014e+00
## 81      Acris crepitans 0.433581939    8.596679       Modernism 1.269296e+00
## 82    Hyla chrysoscelis 2.662420350    5.308549        Futurism 2.955419e+01
## 83  Pseudacris maculata 0.035691186    6.149865       Modernism 6.152865e-03
## 84      Hyla versicolor 1.423056232    6.548204       Modernism 1.041493e+01
## 85    Hyla chrysoscelis 3.090278153    6.076466      Minimalism 4.557599e+01
## 86    Hyla chrysoscelis 1.929999116    5.004060      Minimalism 1.463951e+01
## 87   Pseudacris regilla 2.548399082    6.752710        Futurism 3.444315e+01
## 88      Acris crepitans 0.056513380    5.684499       Modernism 1.425885e-02
## 89  Pseudacris maculata 0.368926421    5.576274        Futurism 5.960923e-01
## 90  Pseudacris maculata 0.155903300    4.889643        Futurism 9.334212e-02
## 91    Hyla chrysoscelis 0.824291034    6.142013        Futurism 3.277644e+00
## 92      Hyla versicolor 0.063385470    6.626337       Modernism 2.090946e-02
## 93   Pseudacris regilla 1.332217643    7.062955       Modernism 9.845248e+00
## 94  Pseudacris maculata 1.239588534    4.580210      Minimalism 5.527520e+00
## 95    Hyla chrysoscelis 0.571085297    6.486641        Futurism 1.661543e+00
## 96   Pseudacris regilla 0.985756967    5.102394        Futurism 3.894068e+00
## 97    Hyla chrysoscelis 2.676897658    7.479512        Futurism 4.209463e+01
## 98      Acris crepitans 2.282263772    5.076272        Futurism 2.076665e+01
## 99  Pseudacris maculata 1.934255544    5.645986        Futurism 1.659042e+01
## 100     Hyla versicolor 0.124540115    5.117565        Futurism 6.234071e-02
```

```
read.csv("C:/Users/sgama/Downloads/432/BIOL432_Assignment1_SG/measurements.csv")
```

```
##          random_species  limb_width limb_length random_observer       Volume
## 1       Hyla versicolor 2.504421825    6.243680       Modernism 3.075711e+01
## 2    Pseudacris regilla 0.417774204    6.610564       Modernism 9.061741e-01
## 3     Hyla chrysoscelis 0.619476729    5.659189      Minimalism 1.705666e+00
## 4     Hyla chrysoscelis 2.736367925    6.297962       Modernism 3.703726e+01
## 5       Hyla versicolor 1.233766724    4.680477        Futurism 5.595593e+00
## 6    Pseudacris regilla 0.962226637    3.907899      Minimalism 2.841764e+00
## 7   Pseudacris maculata 3.560311059    5.245519      Minimalism 5.222209e+01
## 8       Hyla versicolor 0.009119462    5.842457      Minimalism 3.816136e-04
## 9       Acris crepitans 0.065228030    5.652824        Futurism 1.888965e-02
## 10      Hyla versicolor 0.779443565    5.257728       Modernism 2.508750e+00
## 11      Acris crepitans 1.988409507    5.373790       Modernism 1.668715e+01
## 12  Pseudacris maculata 1.071937138    5.465353        Futurism 4.932269e+00
## 13  Pseudacris maculata 1.989366902    6.657432        Futurism 2.069314e+01
## 14      Hyla versicolor 2.387739233    5.479266       Modernism 2.453500e+01
## 15  Pseudacris maculata 0.073337778    7.580857      Minimalism 3.202312e-02
## 16      Hyla versicolor 2.789104496    4.973008       Modernism 3.038356e+01
## 17   Pseudacris regilla 1.359161722    5.823735       Modernism 8.449554e+00
## 18    Hyla chrysoscelis 0.704056385    5.733285        Futurism 2.232072e+00
## 19      Acris crepitans 1.145601390    6.819742      Minimalism 7.029507e+00
## 20      Acris crepitans 2.252496496    5.487488        Futurism 2.186713e+01
## 21   Pseudacris regilla 2.980207276    6.068129       Modernism 4.232896e+01
## 22      Hyla versicolor 0.417954937    5.691221        Futurism 7.808259e-01
## 23      Acris crepitans 0.760310325    6.128030        Futurism 2.782227e+00
## 24   Pseudacris regilla 1.357397398    6.472252       Modernism 9.366112e+00
## 25  Pseudacris maculata 1.893353644    6.428009       Modernism 1.809797e+01
## 26      Hyla versicolor 2.702068030    3.748006       Modernism 2.149229e+01
## 27  Pseudacris maculata 1.296676357    5.813740       Modernism 7.677302e+00
## 28   Pseudacris regilla 3.699392095    7.096987      Minimalism 7.628244e+01
## 29      Acris crepitans 3.130260946    3.749508      Minimalism 2.885528e+01
## 30    Hyla chrysoscelis 1.925153842    5.761547       Modernism 1.677104e+01
## 31      Hyla versicolor 0.596687900    5.071129       Modernism 1.418042e+00
## 32      Hyla versicolor 2.689413310    5.589225       Modernism 3.175094e+01
## 33      Hyla versicolor 0.533018343    6.206504      Minimalism 1.384909e+00
## 34   Pseudacris regilla 0.040795633    6.708546      Minimalism 8.768911e-03
## 35  Pseudacris maculata 0.967712116    6.504964       Modernism 4.784396e+00
## 36  Pseudacris maculata 1.379110758    7.032635        Futurism 1.050525e+01
## 37      Hyla versicolor 0.973534328    7.582748       Modernism 5.644416e+00
## 38   Pseudacris regilla 0.459485457    6.212151       Modernism 1.030091e+00
## 39  Pseudacris maculata 1.439203906    6.028172      Minimalism 9.806638e+00
## 40   Pseudacris regilla 0.597763665    5.267428       Modernism 1.478249e+00
## 41      Hyla versicolor 0.722066256    7.112701      Minimalism 2.912585e+00
## 42    Hyla chrysoscelis 1.239485769    4.794642      Minimalism 5.785343e+00
## 43      Hyla versicolor 2.449940786    6.692592        Futurism 3.154971e+01
## 44    Hyla chrysoscelis 1.375659152    5.408878      Minimalism 8.039309e+00
## 45  Pseudacris maculata 0.542469489    6.063432      Minimalism 1.401390e+00
## 46   Pseudacris regilla 1.643013159    6.372195        Futurism 1.351018e+01
## 47    Hyla chrysoscelis 2.546295562    8.392913       Modernism 4.273859e+01
## 48  Pseudacris maculata 3.035561386    5.080058       Modernism 3.676517e+01
## 49      Acris crepitans 1.274105266    5.664785      Minimalism 7.222440e+00
## 50      Hyla versicolor 2.907267923    7.264838        Futurism 4.822652e+01
## 51    Hyla chrysoscelis 1.455235851    4.717698      Minimalism 7.846695e+00
```

```
## 52  Pseudacris maculata 0.863070607    5.980703       Modernism 3.498926e+00
## 53      Acris crepitans 0.452419753    6.098206       Modernism 9.803362e-01
## 54      Hyla versicolor 2.208089387    4.601221        Futurism 1.761961e+01
## 55  Pseudacris maculata 0.112733482    5.695973        Futurism 5.685434e-02
## 56   Pseudacris regilla 3.054298279    7.963931      Minimalism 5.834992e+01
## 57      Hyla versicolor 2.415826622    7.717893        Futurism 3.537693e+01
## 58  Pseudacris maculata 2.142040958    4.828827        Futurism 1.740152e+01
## 59   Pseudacris regilla 0.851011993    6.992922      Minimalism 3.977589e+00
## 60      Hyla versicolor 1.365530627    5.767037       Modernism 8.445891e+00
## 61   Pseudacris regilla 2.159804951    6.770376        Futurism 2.480457e+01
## 62    Hyla chrysoscelis 1.587145568    5.475432      Minimalism 1.083283e+01
## 63    Hyla chrysoscelis 1.530688851    6.626789        Futurism 1.219458e+01
## 64  Pseudacris maculata 0.423280143    6.829141       Modernism 9.609743e-01
## 65      Acris crepitans 0.500820049    6.103513      Minimalism 1.202356e+00
## 66    Hyla chrysoscelis 1.052094763    6.507283      Minimalism 5.657171e+00
## 67      Hyla versicolor 1.907405502    5.652777      Minimalism 1.615243e+01
## 68  Pseudacris maculata 0.212369574    5.204566        Futurism 1.843567e-01
## 69  Pseudacris maculata 1.155948638    4.886884        Futurism 5.128602e+00
## 70  Pseudacris maculata 0.842159910    4.470582       Modernism 2.490251e+00
## 71      Hyla versicolor 1.207683240    5.870602       Modernism 6.724788e+00
## 72      Acris crepitans 2.402656824    6.565744       Modernism 2.976852e+01
## 73  Pseudacris maculata 1.963820894    5.857908      Minimalism 1.774337e+01
## 74      Hyla versicolor 1.711529428    6.928920        Futurism 1.594132e+01
## 75      Acris crepitans 2.419793581    6.361472      Minimalism 2.925527e+01
## 76  Pseudacris maculata 1.399046163    5.014382        Futurism 7.708527e+00
## 77  Pseudacris maculata 2.708569065    6.505332      Minimalism 3.748342e+01
## 78      Hyla versicolor 2.172813366    6.460826        Futurism 2.395647e+01
## 79      Acris crepitans 3.790169475    6.275238      Minimalism 7.080066e+01
## 80    Hyla chrysoscelis 1.174123571    5.867624        Futurism 6.353014e+00
## 81      Acris crepitans 0.433581939    8.596679       Modernism 1.269296e+00
## 82    Hyla chrysoscelis 2.662420350    5.308549        Futurism 2.955419e+01
## 83  Pseudacris maculata 0.035691186    6.149865       Modernism 6.152865e-03
## 84      Hyla versicolor 1.423056232    6.548204       Modernism 1.041493e+01
## 85    Hyla chrysoscelis 3.090278153    6.076466      Minimalism 4.557599e+01
## 86    Hyla chrysoscelis 1.929999116    5.004060      Minimalism 1.463951e+01
## 87   Pseudacris regilla 2.548399082    6.752710        Futurism 3.444315e+01
## 88      Acris crepitans 0.056513380    5.684499       Modernism 1.425885e-02
## 89  Pseudacris maculata 0.368926421    5.576274        Futurism 5.960923e-01
## 90  Pseudacris maculata 0.155903300    4.889643        Futurism 9.334212e-02
## 91    Hyla chrysoscelis 0.824291034    6.142013        Futurism 3.277644e+00
## 92      Hyla versicolor 0.063385470    6.626337       Modernism 2.090946e-02
## 93   Pseudacris regilla 1.332217643    7.062955       Modernism 9.845248e+00
## 94  Pseudacris maculata 1.239588534    4.580210      Minimalism 5.527520e+00
## 95    Hyla chrysoscelis 0.571085297    6.486641        Futurism 1.661543e+00
## 96   Pseudacris regilla 0.985756967    5.102394        Futurism 3.894068e+00
## 97    Hyla chrysoscelis 2.676897658    7.479512        Futurism 4.209463e+01
## 98      Acris crepitans 2.282263772    5.076272        Futurism 2.076665e+01
## 99  Pseudacris maculata 1.934255544    5.645986        Futurism 1.659042e+01
## 100     Hyla versicolor 0.124540115    5.117565        Futurism 6.234071e-02
```

2: Sorting the data

I sorted the data first by species, then by observer, and by the limb volume using the arrange function

```
sorted_df <- measurements_df %>%
  arrange(random_species, random_observer, Volume)

head(sorted_df)
```

```
##    random_species limb_width limb_length random_observer      Volume
## 1 Acris crepitans 0.06522803    5.652824        Futurism  0.01888965
## 2 Acris crepitans 0.76031033    6.128030        Futurism  2.78222690
## 3 Acris crepitans 2.28226377    5.076272        Futurism 20.76665017
## 4 Acris crepitans 2.25249650    5.487488        Futurism 21.86712559
## 5 Acris crepitans 0.50082005    6.103513      Minimalism  1.20235628
## 6 Acris crepitans 1.14560139    6.819742      Minimalism  7.02950724
```

3: Calculating averages for a variable of interest

I calculated the average limb volume for each species in a table

```
avg_vol_species <- measurements_df %>%
  group_by(random_species) %>%
  summarize(avg_vol = mean(Volume, na.rm = TRUE))

avg_vol_species
```

```
## # A tibble: 5 × 2
##   random_species      avg_vol
##   <chr>                 <dbl>
## 1 Acris crepitans        15.9
## 2 Hyla chrysoscelis      16.3
## 3 Hyla versicolor        14.9
## 4 Pseudacris maculata    10.9
## 5 Pseudacris regilla     18.2
```

4: Counting the number of observations occurring in two variables

I made a table for the number of observations (rows) for each combination of species and observer.

```
obs_species_observer <- measurements_df %>%
  group_by(random_species, random_observer) %>%
  summarise(num_obs = n())
```

```
## `summarise()` has grouped output by 'random_species'. You can override using
## the `.groups` argument.
```

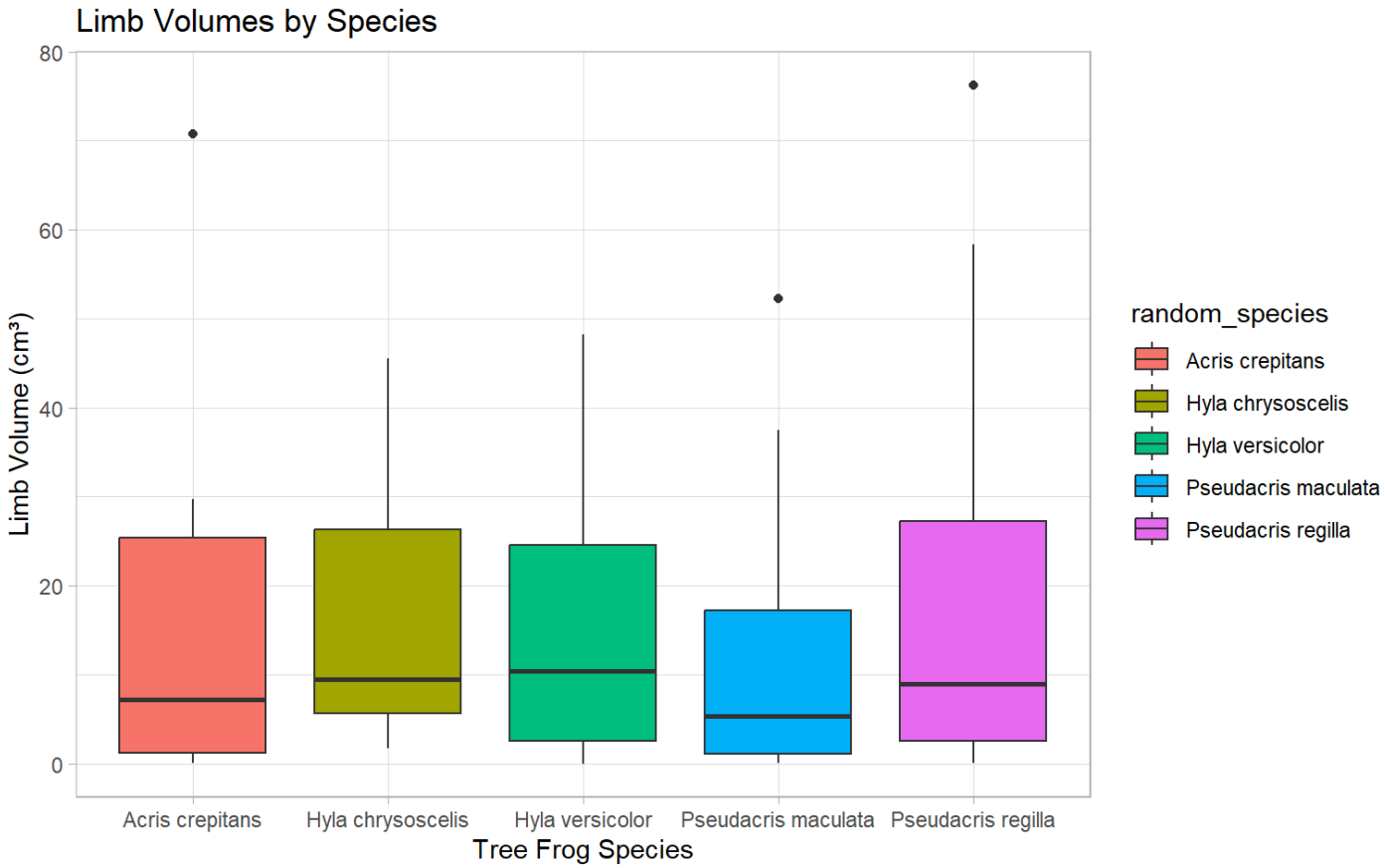
```
obs_species_observer
```

```
## # A tibble: 15 × 3
## # Groups:   random_species [5]
##    random_species      random_observer num_obs
##    <chr>               <chr>             <int>
##  1 Acris crepitans     Futurism              4
##  2 Acris crepitans     Minimalism            6
##  3 Acris crepitans     Modernism             5
##  4 Hyla chrysoscelis   Futurism              7
##  5 Hyla chrysoscelis   Minimalism            8
##  6 Hyla chrysoscelis   Modernism             3
##  7 Hyla versicolor     Futurism              9
##  8 Hyla versicolor     Minimalism            4
##  9 Hyla versicolor     Modernism            12
## 10 Pseudacris maculata Futurism             11
## 11 Pseudacris maculata Minimalism            7
## 12 Pseudacris maculata Modernism             8
## 13 Pseudacris regilla  Futurism              4
## 14 Pseudacris regilla  Minimalism            5
## 15 Pseudacris regilla  Modernism             7
```

5: Visualizing tree frog limb volume distributions

I created a box plot comparing limb volumes for each species

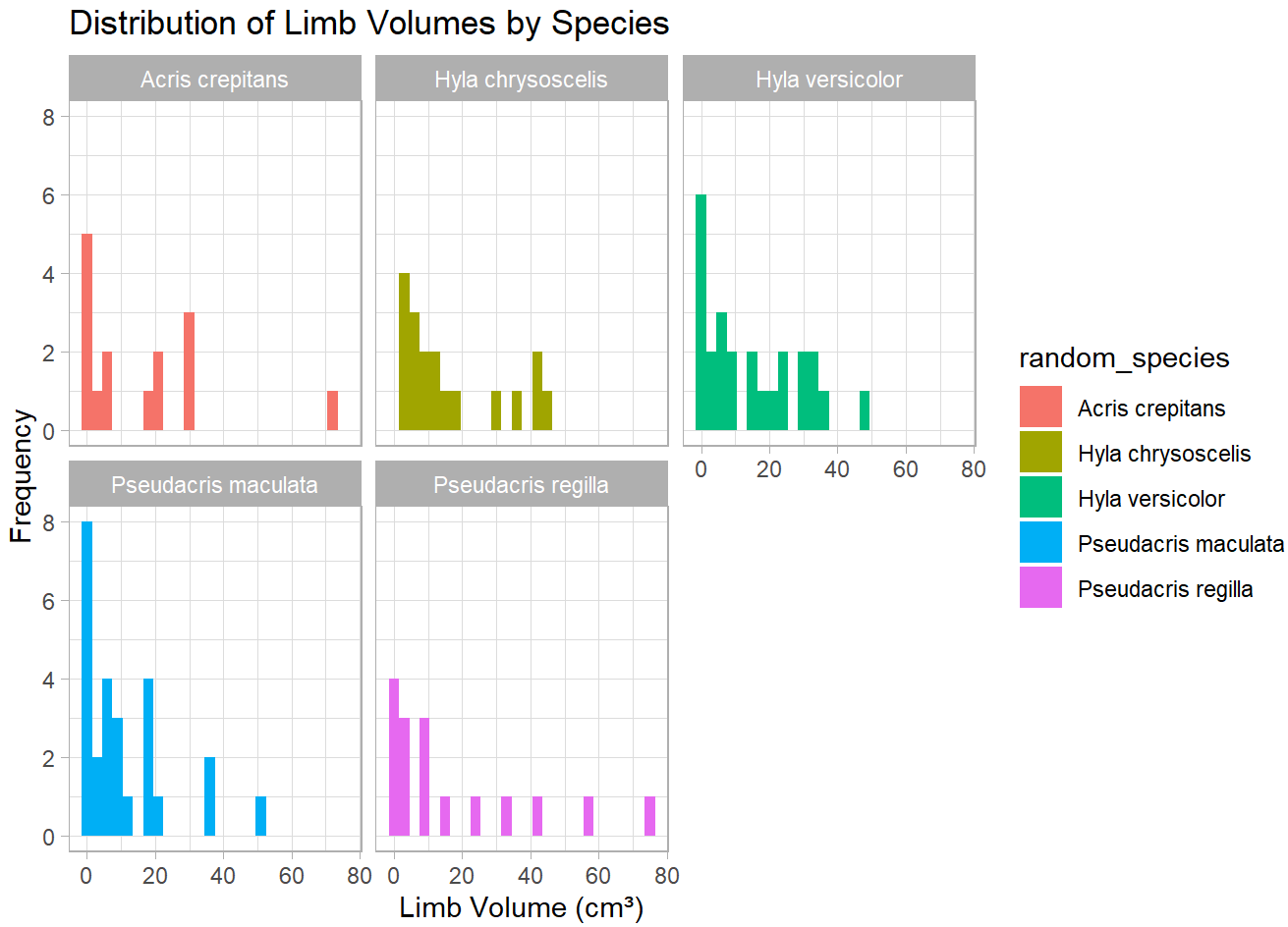
```
ggplot(measurements_df, aes(x = random_species, y = Volume)) +
  geom_boxplot(aes(fill = random_species)) +
  labs(title = "Limb Volumes by Species",
       x = "Tree Frog Species",
       y = "Limb Volume (cm³)") +
  theme_light()
```



6: Visualizing distributions of limb volumes in a histogram

I created a multi-panel plot of frequency histograms by species

```
ggplot(measurements_df, aes(x = Volume)) +
  geom_histogram(aes(fill = random_species),binwidth = 3) +
  facet_wrap(~random_species) +
  labs(title = "Distribution of Limb Volumes by Species",
       x = "Limb Volume (cm³)",
       y = "Frequency") +
  theme_light()
```


Distribution of Limb Volumes by Species
Acris crepitans
Hyla chrysoscelis
Hyla versicolor
Pseudacris maculata
Pseudacris regilla
Frequency
Limb Volume (cm³)
random_species
Acris crepitans
Hyla chrysoscelis
Hyla versicolor
Pseudacris maculata
Pseudacris regilla