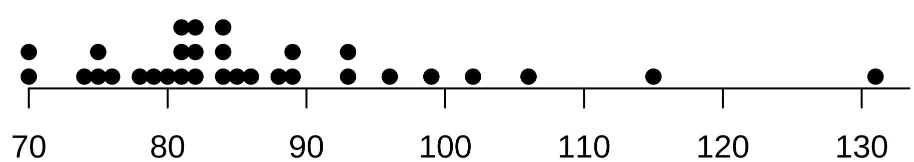
This document describes how to use a number of R commands for plotting one variable and for calculating one variable summary statistics. Specifically, it describes how to use R to create *dotplots*, *histograms*, *stemplots*, and *boxplots*, and to compute the *mean*, *median*, *five-number summary*, *standard deviation*, and *variance* of a variable.

Let's begin with the same `glucose` data set from last time.

```
> glucose = c(81, 85, 93, 93, 99, 76, 75, 84, 78, 84, 81, 82, 89,
+     81, 96, 82, 74, 70, 84, 86, 80, 70, 131, 75, 88, 102, 115,
+     89, 82, 79, 106)
```

Dotplots. R does not have a built-in dotplot function. I have written a function in R code that works. The code is on the R Help Web page. Save this file to your computer and put it in your working directory. You can source this code using the `File` menu, selecting `Source R code...`, and following the directions. Alternatively, *if the file dotplot.R is in your working directory* this command will source the code and then create the dotplot.

```
> source("dotplot.R")
> dotplot(glucose)
```

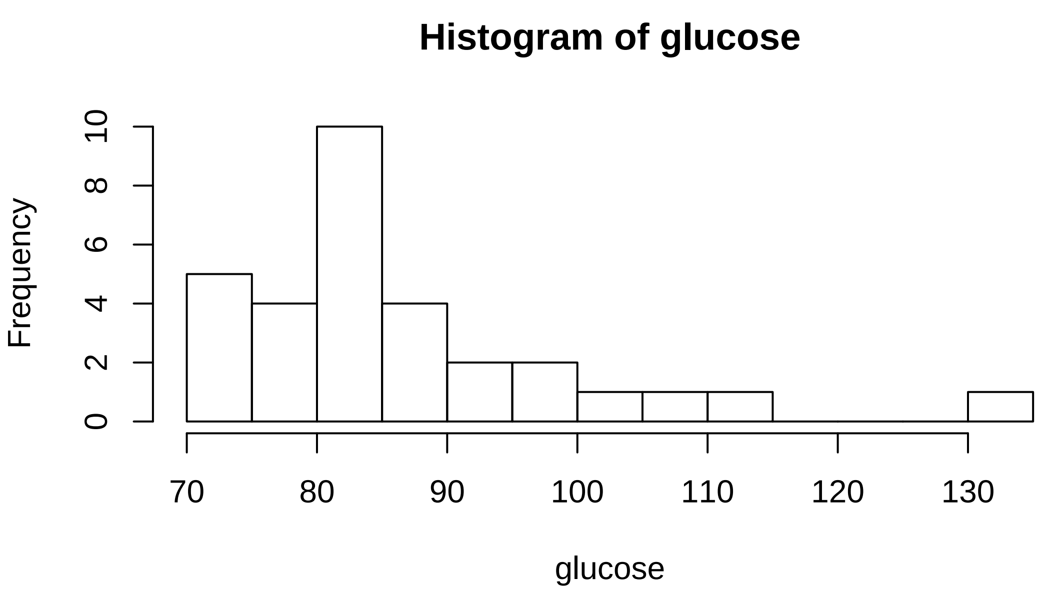


Histograms. The `hist` function produces histograms.

```
> hist(glucose)
```

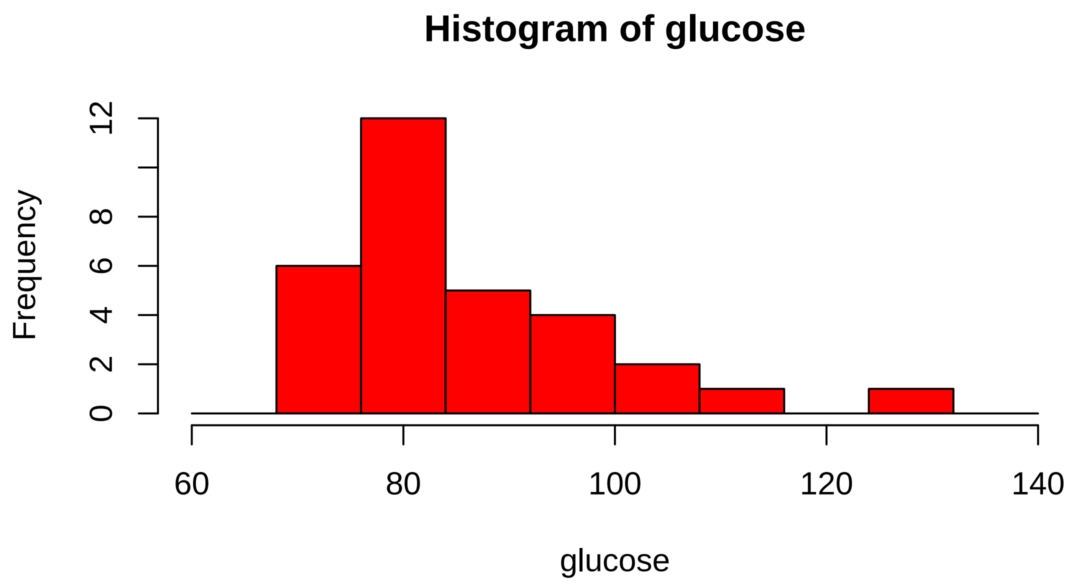
By default, there were seven classes, each of width ten, ranging from 70 to 140. If we wanted to specify a different number of classes, say 14, we could have typed this.

```
> hist(glucose, breaks = 14)
```



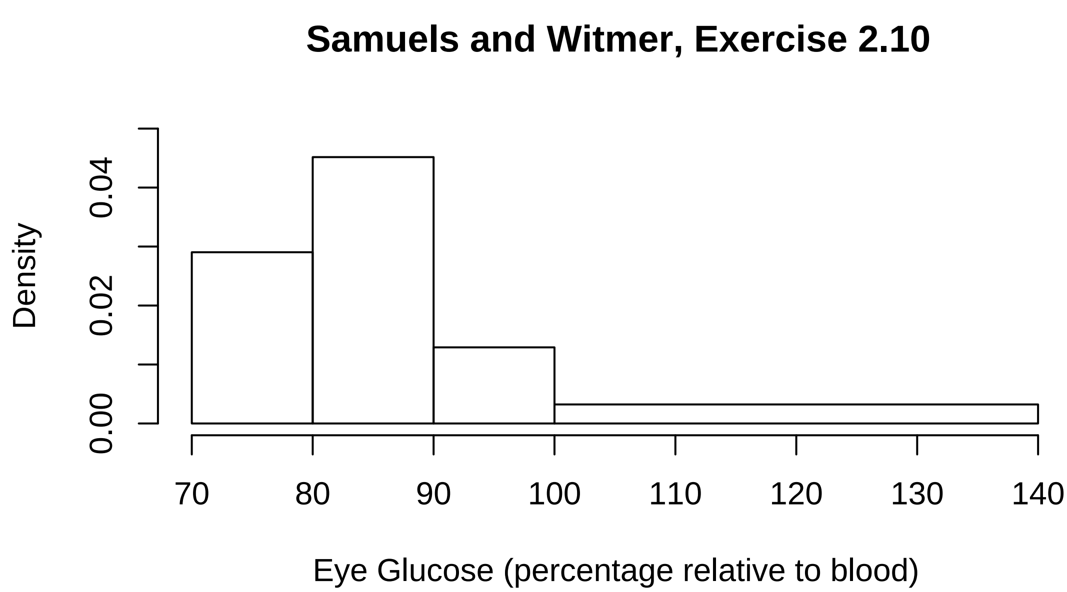
If we wished to manually set breaks to begin at 60, end at 140, and have widths of 8, while shading in the bars red (color 2), we could have done this.

```
> hist(glucose, breaks = seq(60, 140, by = 8), col = 2)
```



The values of `main`, `xlab`, and `ylab` may be set to change the main title or the labels on the x and y axes. You may also set unequal class widths. R will correctly scale the heights so the areas are proportional and relative frequencies are equal to density times class width. You may set the range of the axes with `xlim` and `ylim`.

```
> hist(glucose, breaks = c(70, 80, 90, 100, 140), xlab = "Eye Glucose (percentage relative t
+     main = "Samuels and Witmer, Exercise 2.10", ylim = c(0, 0.05))
```



Typing `?hist` opens up a help window with more options to modify histograms. The command `?par` will show you how to modify general plotting parameters (Warning: — changing graphing parameters is an advanced topic.)

Stem-and-Leaf Diagrams. The function `stem` produces *stem-and-leaf diagrams*, or *stemlots*. By default, the function may not round or split stems as you might like. In fact, sometimes the default behavior is to combine two stems to one and to place the leaves of both stems on the same row. Consider this example, the total amount of time each of twenty fruit flies spent preening (in seconds) during a six-minute of observation period.

```
> preen = c(34, 24, 10, 16, 52, 76, 33, 31, 46, 24, 18, 26, 57,
+     32, 25, 48, 22, 48, 29, 19)
> stem(preen)

  The decimal point is 1 digit(s) to the right of the |

  0 | 0689
  2 | 2445691234
  4 | 68827
  6 | 6
```

The stem-and-leaf diagram is misleading. The middle two stems are clear enough; for example, values range from 22 to 29 and then 31 to 34 in the '2' stem. However, it appears that the maximum value is 66, when, in fact, it is 76. Similarly, it is unclear as to whether the 0 stem shows values in the single digits, teens, or both. We can get around this behavior by using the `scale` parameter. Setting `scale=2` should double the number of stems.

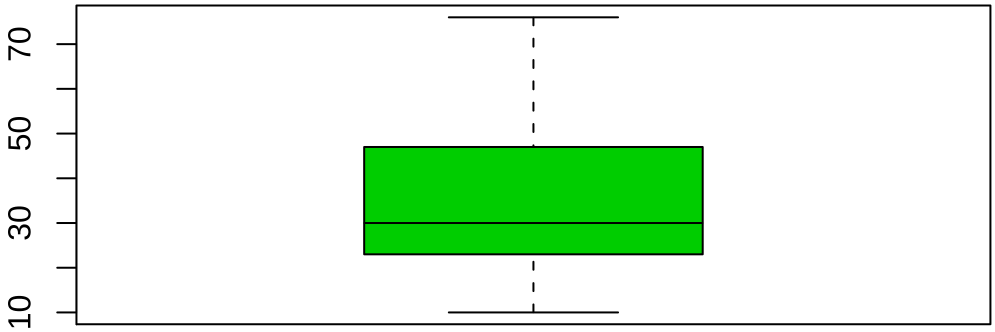
```
> stem(preen, scale = 2)

  The decimal point is 1 digit(s) to the right of the |

  1 | 0689
  2 | 244569
  3 | 1234
  4 | 688
  5 | 27
  6 |
  7 | 6
```

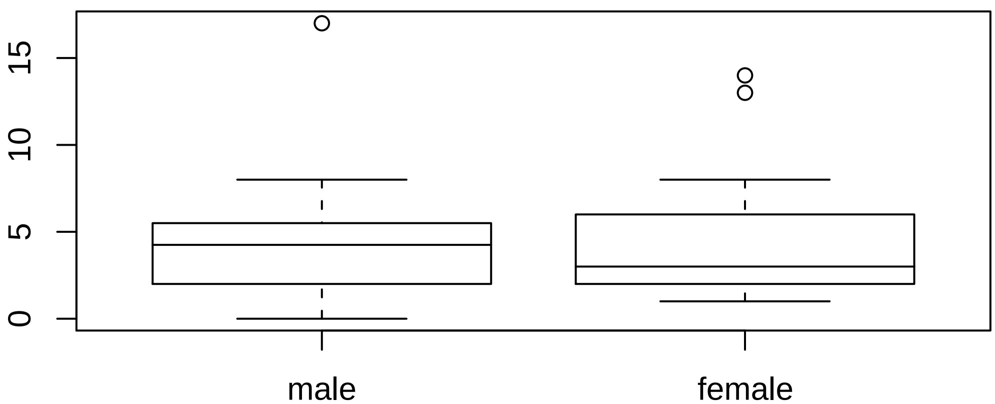
Boxplots. Boxplots are constructed using the `boxplot` function. If the argument is one vector, a single boxplot will be drawn. Parallel boxplots may be drawn by providing a list of variables, either directly using the `list` function or as the output of the `split` function which partitions one variable according to the categories of a second (categorical) variable. Here is a boxplot of the preening times from the previous example with the box shaded green.

```
> boxplot(preen, col = 3)
```



Samuels and Witmer Exercise 2.33 presents self-reported numbers of hours of exercise per week given by 25 college students, 12 men and 13 women. Here is one way to read in the data and make parallel boxplots.

```
> male = c(6, 0, 2, 1, 2, 4.5, 8, 3, 17, 4.5, 4, 5)
> female = c(5, 13, 3, 2, 6, 14, 3, 1, 1.5, 1.5, 3, 8, 4)
> boxplot(list(male = male, female = female))
```



Boxplots show less information than histograms. Their true utility is for making comparisons between different distributions. Here is an example from Samuels and Witmer, third edition, page 20, data on radish growth.

```
> growthDark = c(15, 20, 11, 30, 33, 22, 37, 20, 29, 35, 8, 10,
+     15, 25)
> growthLight = c(10, 15, 22, 25, 9, 15, 4, 11, 20, 21, 27, 20,
+     10, 20)
> boxplot(list(dark = growthDark, light = growthLight))
```

The functions `read.table` and `split` are useful to create parallel boxplots when the data were read in from a file. The function `data.frame` could also be used to create a *data frame* of the two variables.

For example, you could create a text file `ex2-26.txt` with the values of the two variables like this.

```
hours sex
6     male
0     male
2     male

.
.
.

5     male
5     female
13    female
3     female

.
.
.

4     female
```

Here is how to read it and create a data frame x.

```
> x = read.table("ex2-33.txt", header = TRUE)
> str(x)
```

```
‘data.frame’:        25 obs. of  2 variables:
 $ hours: num  6 0 2 1 2 4.5 8 3 17 4.5 ...
 $ sex  : Factor w/ 2 levels "female","male": 2 2 2 2 2 2 2 2 2 2 ...
```

```
> attach(x)
```

Alternatively, you could create the data frame using the variables entered before. The function `rep` repeats a value a specified number of times.

```
> hours = c(male, female)
> sex = c(rep("male", 12), rep("female", 13))
> x = data.frame(hours = hours, sex = sex)
```

Finally, make the parallel boxplots.

```
> boxplot(split(hours, sex))
```

Quantitative summaries. R is also useful for numerical summaries of variables. The functions `mean` and `median` compute the mean and median, respectively. The function `fivenum` may be used to find the five-number summary, the minimum, first quartile, median, third quartile, and maximum. The standard deviation may be computed with `sd`. Here are examples of their use with the preening time data.

```
> mean(preen)

[1] 33.5

> sd(preen)

[1] 16.31435

> var(preen)

[1] 266.1579

> median(preen)

[1] 30

> max(preen)

[1] 76

> min(preen)

[1] 10

> fivenum(preen)

[1] 10 23 30 47 76

> IQR(preen)

[1] 23
```

Here is a sample calculation to find the fences for a modified boxplot.

```
> fnum = fivenum(preen)
> iqr = IQR(preen)
> fnum[2] - 1.5 * iqr

[1] -11.5

> fnum[4] + 1.5 * iqr

[1] 81.5
```

Counting observations close to the mean. This code counts the number of observations within one, two, and three standard deviations of the mean for the preening-time data and then reports these as percentages. The function `abs` finds the absolute value.

A statement with '<' returns true or false for each position of an array. A sum of a vector of 'T' and 'F' counts the number that are true.

```
> m = mean(preen)
> s = sd(preen)
> n = length(preen)
> sum(abs(preen - m) < s)

[1] 15

> round(sum(abs(preen - m) < s)/n * 100)

[1] 75

> sum(abs(preen - m) < 2 * s)

[1] 19

> round(sum(abs(preen - m) < 2 * s)/n * 100)

[1] 95

> sum(abs(preen - m) < 3 * s)

[1] 20

> round(sum(abs(preen - m) < 3 * s)/n * 100)

[1] 100
```