Summarizing Numerical Data

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Table of contents

We will use the `births` data set to summarize and visualize numerical variables using the *base R* approach

Numerical data refers to data that can be measured and expressed as a number, such as age, height, weight, and temperature. Numerical data can be *discrete* or *continuous*

Single numerical variable

One way to extract all the numerical columns is using both `Filter` and `is.numeric` functions. Below are the first five rows of all the numerical columns in `birth_dat`

```
Filter(is.numeric,birth_dat)
```

```
  X weight Apgar1 Fage Mage Feduc Meduc TotPreg Visits Gained
1 1    116      9   28   34     6     3       2     10     30
2 2    126      8   30   18    12    12       1     14     50
3 3    161      8   28   29    12    12       3     14     65
4 4    133      9   26   23     8     9       3     10      8
5 5    119      8   30   19    12    12       2     12     20
```

The names of the numerical columns can be obtained using `colnames()` function in combination with the above statement

```
colnames(Filter(is.numeric,birth_dat) )
```

```
 [1] "X"       "weight"  "Apgar1"  "Fage"    "Mage"    "Feduc"   "Meduc"  
 [8] "TotPreg" "Visits"  "Gained" 
```

We will only consider the `weight` variable from our dataset to demonstrate methods to summarize and visualize a numerical variable.

Functions for numerical summaries include, but not limited to,

Function	Description
`mean()`	mean
`median()`	median
`mode()`	mode
`sd()`	standard deviation
`var()`	variance
`min()`	minimum
`max()`	maximum
`summary()`	Computes the following: *Minimum ,1st Quartile, Median,Mean ,3rd Quartile,Maximum*

Next, we'll save the values from `weight` column into a separate variable and compute several numerical summaries listed above

```
birth_weight <- birth_dat$weight
```

```
mean(birth_weight)
```

```
[1] 116.0536
```

```
median(birth_weight)
```

```
[1] 117
```

```
min(birth_weight)
```

```
[1] 14
```

```
max(birth_weight)
```

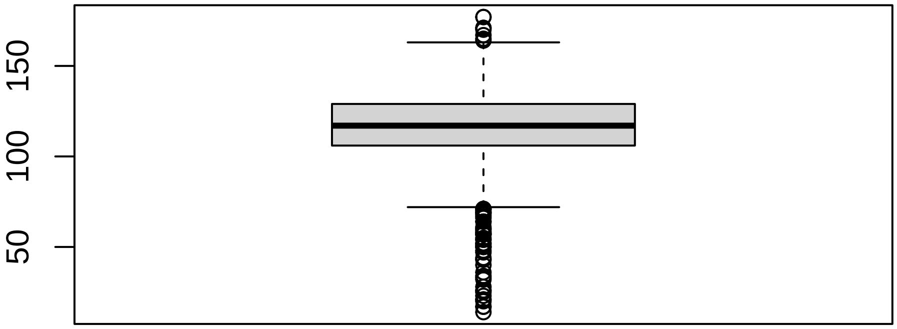
```
[1] 177
```

```
summary(birth_weight)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
   14.0   106.0   117.0   116.1   129.0   177.0 
```

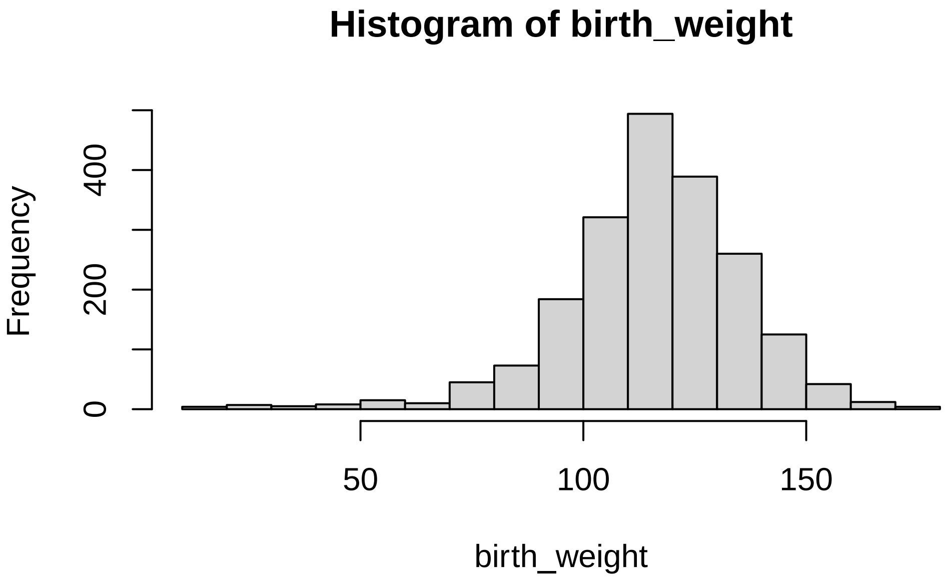
While `summary()` give us a quick numerical summary of our distribution, it is important to also visualize the overall distribution using a plot such as a boxplot

```
boxplot(birth_weight)
```



or a histogram

```
hist(birth_weight)
```

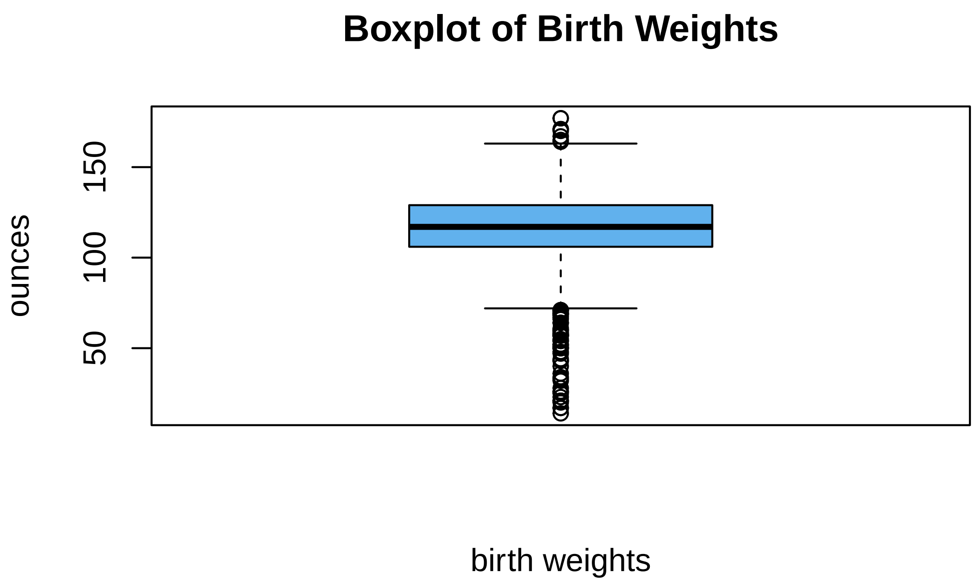


From the histogram above, while the overall distribution of the birth weights is symmetrical there are outliers causing the distribution to be skewed to the left.

For `boxplot()` and `hist()` we used the default settings, while they are informative we can alter their appearance to be more professional.

For example, we changed the x-axis label and y-axis label using `xlab`,`ylab` arguments,respectively. We changed the title with `main` and the color of the boxplot with `col`. The `col` argument can take values such as `red`,`blue` or any HEX code, see `?boxplot` for further customization.

```
boxplot(birth_weight,
        main='Boxplot of Birth Weights',
        xlab ='birth weights', ylab='ounces',
        col='#61b1ed')
```

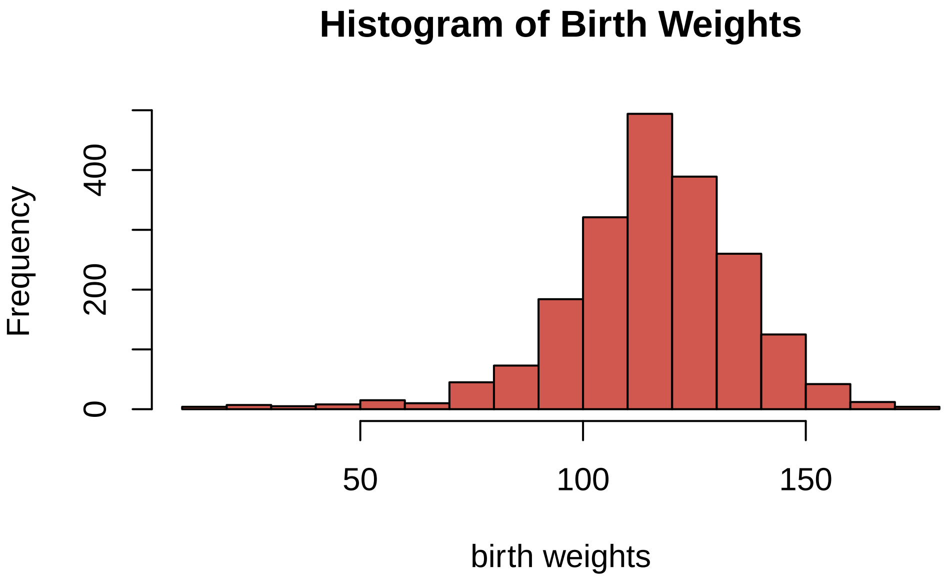


Tip

Search ‘color picker’ in Google and copy/paste the generated hex code

We can apply similar customization to our histogram

```r
hist(birth_weight,
     main='Histogram of Birth Weights',
     xlab ='birth weights',
     col='#d1584f',
     breaks=20)
```



The `hist` function uses the Sturges method by default to determine the number of `breaks` on the histogram. We can manually change the number of breaks, but we should be careful not to specify a low or high number of breaks. Usually the default setting is appropriate for most scenarios.

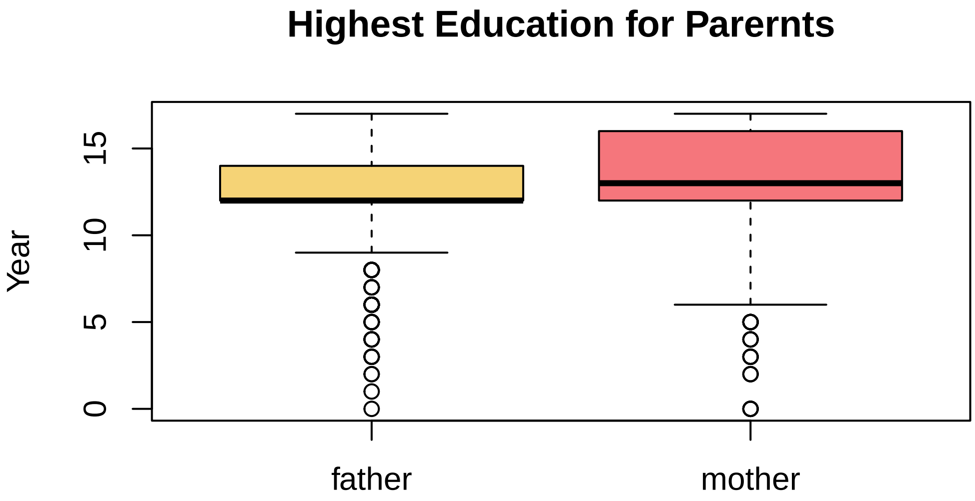
Two numerical variables

We consider the following two numerical variables: `Feduc` and `Meduc`, which is the highest education for fathers and mothers in this dataset, respectively.

```
father_eduction <- birth_dat$Feduc
mother_education <- birth_dat$Meduc
```

We can compare their distributions in a single plot as we did in *Section 2* with boxplots

```
boxplot(father_eduction,mother_education,
        names = c('father','mother'),
        col=c('#f5d376','#f5767c'),
        main = 'Highest Education for Parernts',
        ylab = 'Year')
```



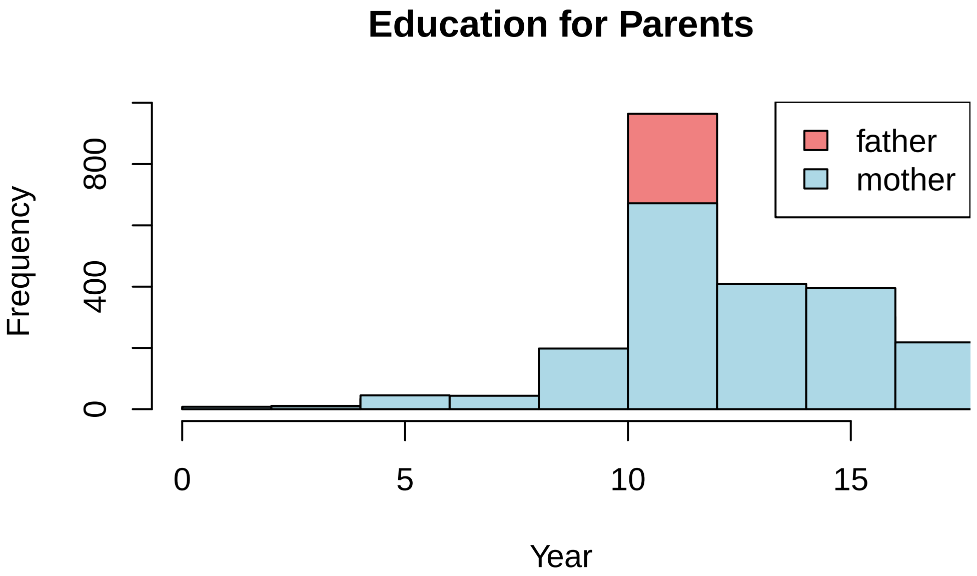
For boxplots its pretty straight forward to compare two numerical distributions using the syntax `boxplot(v1,v2,...)`. For histograms it requires a bit more work.

We start by creating a histogram for the first variable, then creating another histogram for the second variable but using the argument `add=TRUE`. We must specify a unique color for each histogram representing the variables. In order for both of the histograms to fit properly on the same plot we must take into account the lowest and highest values among the multiple numerical variables.

```
low_x <- min(father_eduction,mother_education)
high_x <- max(father_eduction,mother_education)
```

Lastly, we must specify a legend to appropriately distinguish the multiple histograms using the function `legend()`.

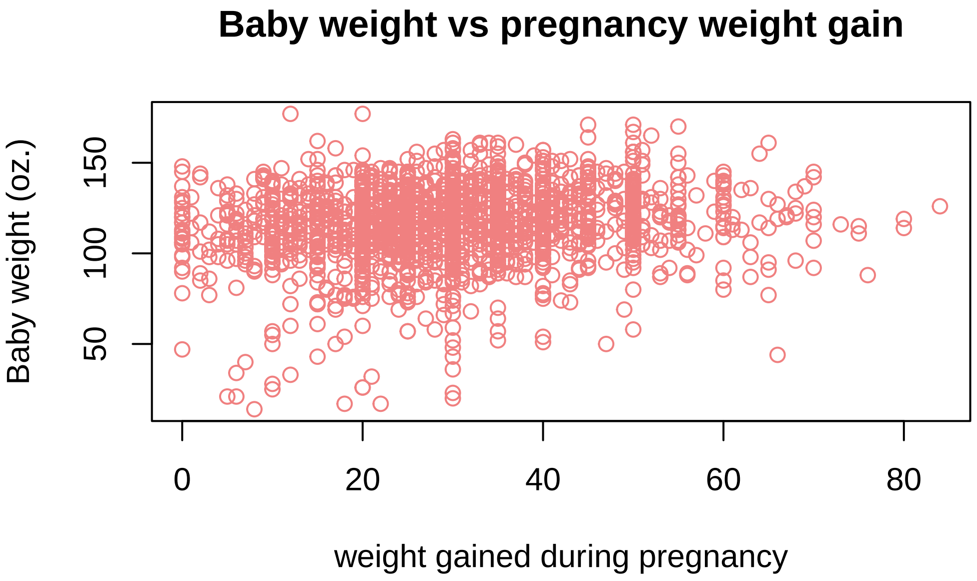
```
hist(father_eduction, col='lightcoral',
     xlim=c(low_x,high_x),
     main='Education for Parents', xlab='Year')
hist(mother_education, col='lightblue', add=TRUE)
legend('topright', legend = c('father', 'mother'),
       fill=c('lightcoral', 'lightblue'))
```



> ⚠ Warning
>
> When using `legend()` it is important that you specify the correct ordering of colors for each group, otherwise the legend would be incorrect. For example, in our first histogram we chose “lightcoral” to represent “father” and “lightblue” to represent “mother” distributions. Which is why we used the arguments: `legend=c('father','mother'), fill = c('lightcoral','lightblue')` in that order

We can also consider a *scatter plot* to visualize the relationship between two numerical variables. We consider the two numerical variables `Gained` and `weight`. `Gained` describes the weight gained during the pregnancy term and `weight` describe the weight of the baby at birth.

```r
plot(x = birth_dat$Gained,y = birth_dat$weight,
     main = 'Baby weight vs pregnancy weight gain',
     xlab = 'weight gained during pregnancy',
     ylab = 'Baby weight (oz.)',
     col='lightcoral')
```


Baby weight vs pregnancy weight gain
Baby weight (oz.)
50
100
150
0
20
40
60
80
weight gained during pregnancy