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Learn R: Fundamentals of Data Visualization with ggplot2

Grammar of Graphics with ggplot2

ggplot2 uses the basic units of the "grammar of graphics" to construct data visualizations in a layered approach. The basic units in the "grammar of graphics" consist of:

- The *data* or the actual information that is to be visualized.
- The *geometries*, shortened to "geoms", which describe the shapes that represent the data. These shapes can be dots on a scatter plot, bar charts on the graph, or a line to plot the data. Data are mapped to geoms.
- The *aesthetics*, or the visual attributes of the plot, including the scales on the axes, the color, the fill, and other attributes concerning appearance.

Visualizations in ggplot2 begin with a blank canvas, which is just an empty plot with data associated to it. Geoms are "added" as *layers* to the original canvas, adding representations of the data to the visualization.

In the visual above:

- The first line declares the *data* that will be used in the plot (`mtcars`) and creates the *aesthetic* mapping of `wt` to `mpg` .
- The second line creates the data point *geom* layer.
- The third line creates the smoothed *geom* layer.

The key is that the `aes()` (*aesthetic* function) on line one maps the data onto each of the two geom layers

Geom Aesthetics

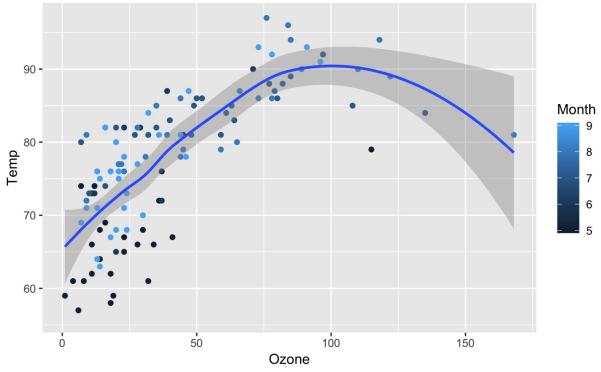
In ggplot2 geom aesthetics are data-driven instructions that determine the visual properties of an individual geom.

Geom aesthetics allow individual layers of a visualization to have their own aesthetic mappings. These aesthetic mappings can vary depending on the geom.

For example, the `geom_point()` geom can color-code the data points on a scatterplot based on a property with the following code:

```
viz <- ggplot(data=airquality, aes
       geom_point(aes(color=Month))
       geom_smooth()
```

The code above would *only* change the color of the point layer, it would not affect the color of the smooth layer since the `aes()` aesthetic mapping is passed at the point layer.



ggplot2 Aesthetics

In ggplot2 aesthetics are the instructions that determine the visual properties of a plot and its geometries. Examples of ggplot2 aesthetics include:

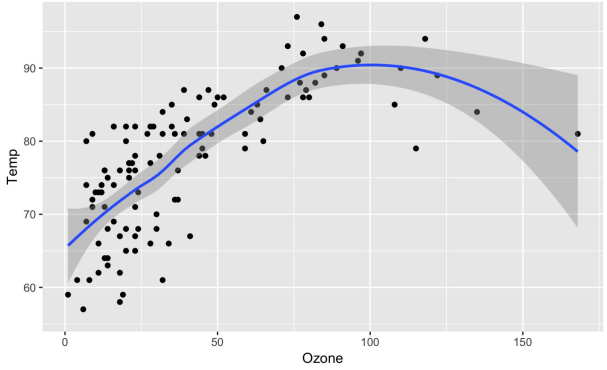
- scales for the x and y axes
- color of the data points on the plot based on a property or on a color preference
- the size or shape of different geometries

Aesthetics are set either manually or by *aesthetic mappings*. Aesthetic mappings "map" variables from the bound data frame to visual properties in the plot. These mappings are provided in two ways using the `aes()` mapping function:

1. At the canvas level: All subsequent layers on the canvas will inherit the aesthetic mappings defined when the ggplot object was created with `ggplot()`.
2. At the geom level: Only that layer will use the aesthetic mappings provided.

For example, the following code assigns `aes()` mappings for the `x` and `y` scales at the canvas level:

```
viz <- ggplot(data=airquality, aes
       geom_point() +
       geom_smooth()
```



In the example above:

- The aesthetic mapping is wrapped in the `aes()` aesthetic mapping function as an additional argument to `ggplot()`.
- Both of the subsequent geom layers, `geom_point()` and `geom_smooth()` use the scales defined inside the aesthetic mapping assigned at the canvas level.

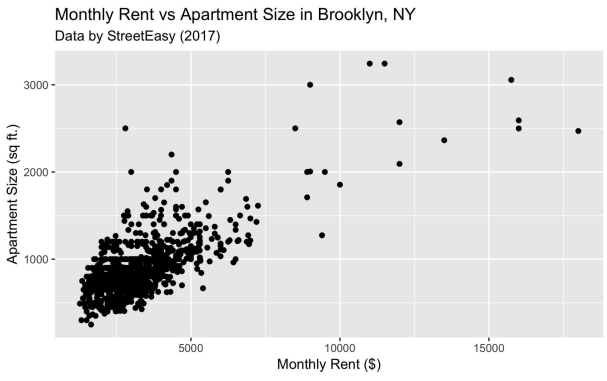
You could create the same plot by setting the aesthetics at the geom level, as follows:

```
viz <- ggplot(data=airquality) +
  geom_point(aes(x=Ozone, y=Temp))
  geom_smooth(aes(x=Ozone, y=Temp)
```

ggplot2 Labels

In ggplot2, *labels* add meaning and clarity to a data visualization.
ggplot2 automatically assigns the name of the variable corresponding to components, like axes labels. Because data frame variable names are not always legible to outside readers, the `labs()` function allows you to manually set labels.
To customize a plot's labels, add a `labs()` function call to the ggplot object. Inside the function call to `labs()`, you can provide labels for the `x` and `y` axes as well as a `title`, `subtitle`, or `caption`. The list of available label arguments can be found in the `labs()` documentation.
The following `labs()` function call and these specified arguments would render the following plot:

```
viz <- ggplot(df, aes(x=rent, y=si
       geom_point() +
       labs(title="Monthly Rent vs
viz
```



ggplot() Initializes a ggplot Object

Invoking the `ggplot()` function returns an object that serves as the base of a ggplot2 visualization.

```
viz <- ggplot()
viz # renders blank plot
```

Data is bound to a ggplot2 visualization by passing a data frame as the first argument in the `ggplot()` function call. Layers can be added to the plot object by adding function calls after `ggplot()` with a `+` plus sign. These functions have access to the data frame and can use the column names as variables.
For example, consider a data frame `sales` with the columns `cost` and `profit`. To assign the data frame `sales` to the `ggplot()` object that is initialized:

```
viz <- ggplot(data=sales) +
       geom_point(aes(x=cost, y=pr
viz # renders plot
```

In the example above:

- The ggplot object or canvas was initialized with the data frame `sales` assigned to it
- The subsequent `geom_point` layer used the `cost` and `profit` columns to define the scales of the axes for that particular geom. Notice that it referred to those columns with their column names.
- The variable name of the ggplot object is stated so the plot is viewable.

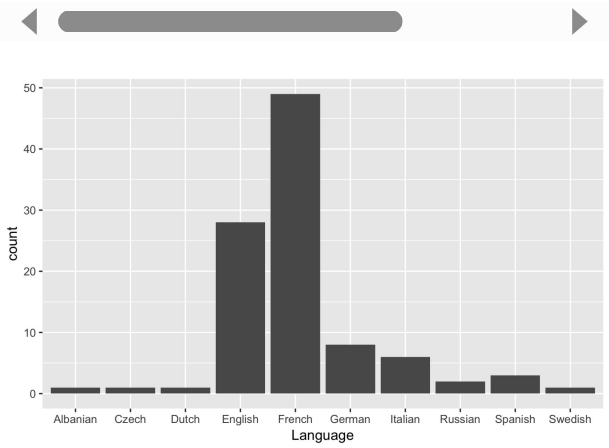
ggplot2 Bar Chart

The `geom_bar()` layer adds a bar chart to a ggplot2 canvas.

Typically when creating a bar chart, an `aes()` aesthetic mapping with a single categorical value on the `x` axes and the `aes()` function will compute the count for each category and display the count values on the `y` axis.

To create a bar chart displaying the number of books in each `Language` from a `books` data frame :

```
bar <- ggplot(books, aes(x=Languag
bar
```



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