Bar Charts in ggplot2

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2022-03-31

Contents

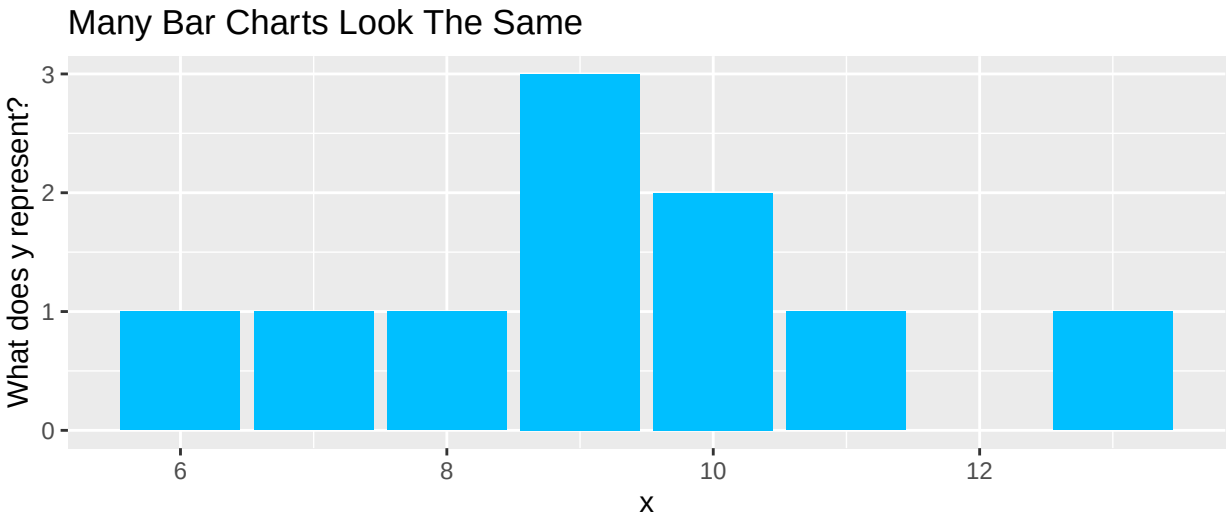
1 Background

While `ggplot2`, and the ideas of an underlying *"grammar of graphics"*, make some kinds of graphing easier, `ggplot2` can make other types of graphing more difficult.

One often tricky type of graph is the bar chart. I have come to think that part of the difficulty with thinking about bar charts in `ggplot2` is that sometimes **three very different types of bar charts look similar**.

2 Introduction

Many bar charts look **something like** the bar chart below.



Similar looking bar charts can represent different underlying 'data stories'.

However, there are actually three slightly separate underlying *"grammars of graphics"* that might underlie a bar chart:

1. Bar charts where the height of the bars is the **number of observations** in each category.
2. Bar charts where the height of the bars is the **average value of the y variable** for that category.

3. Bar charts where the height of the bars is the **actual value of the y variable** for that **individual observation**.

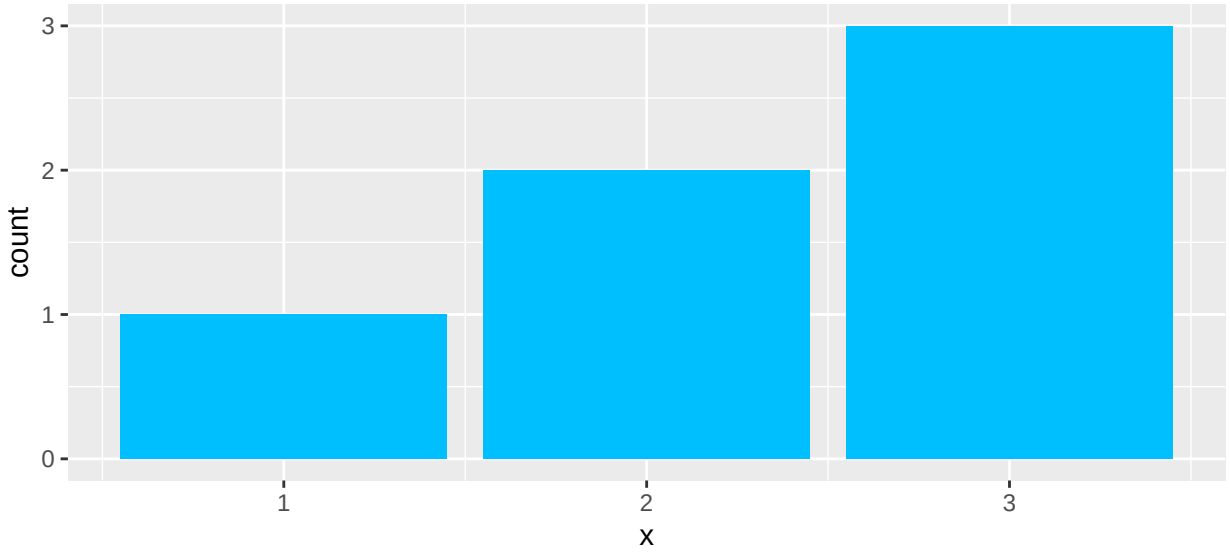
Let's look at each situation in turn, since each situation demands a slightly different syntax.

3 Our Data

x	y
1	10
2	5
2	9
3	8
3	9
3	10

4 Bar charts where the height of the bars is the number of observations in each category.

```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x)) + # 'aesthetic' only includes x
  geom_bar(fill = "deepskyblue") # using bars to graph
```

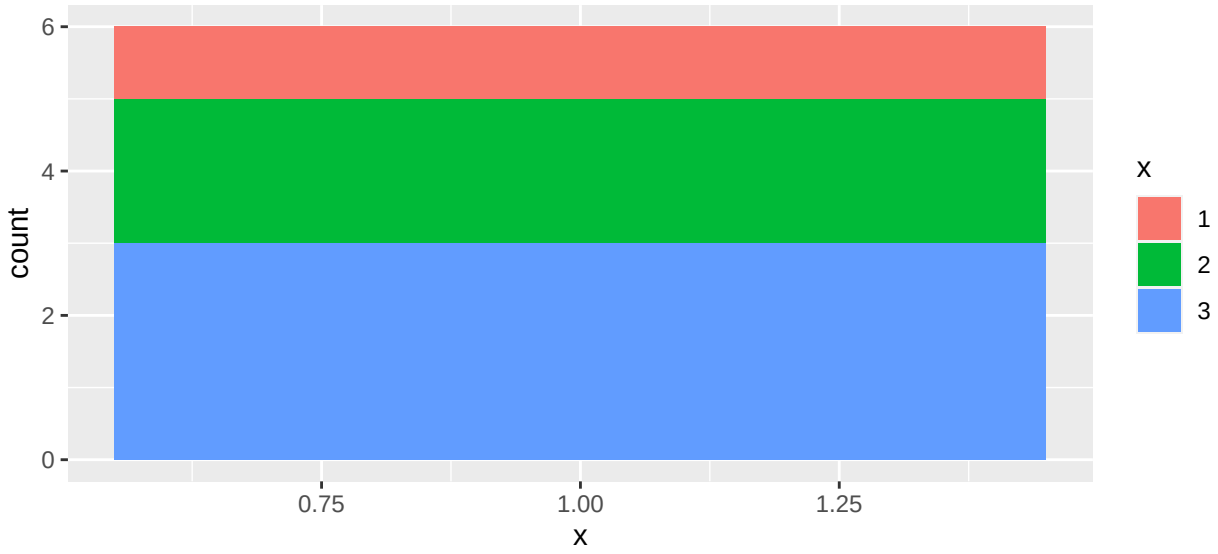


4.1 Stacked Bar Chart

A simple change to the above aesthetic yields a stacked bar chart.

Note that *fill* now becomes part of the *aesthetic* so that color fill differentiates the parts of the bar.

```
ggplot(mydata, # the data that I am using
       aes(x = 1, # x is 1
           fill = factor(x))) + # fill is x as a factor
  geom_bar() + # using bars to graph
  scale_fill_discrete(name = "x") # modify name of legend
```



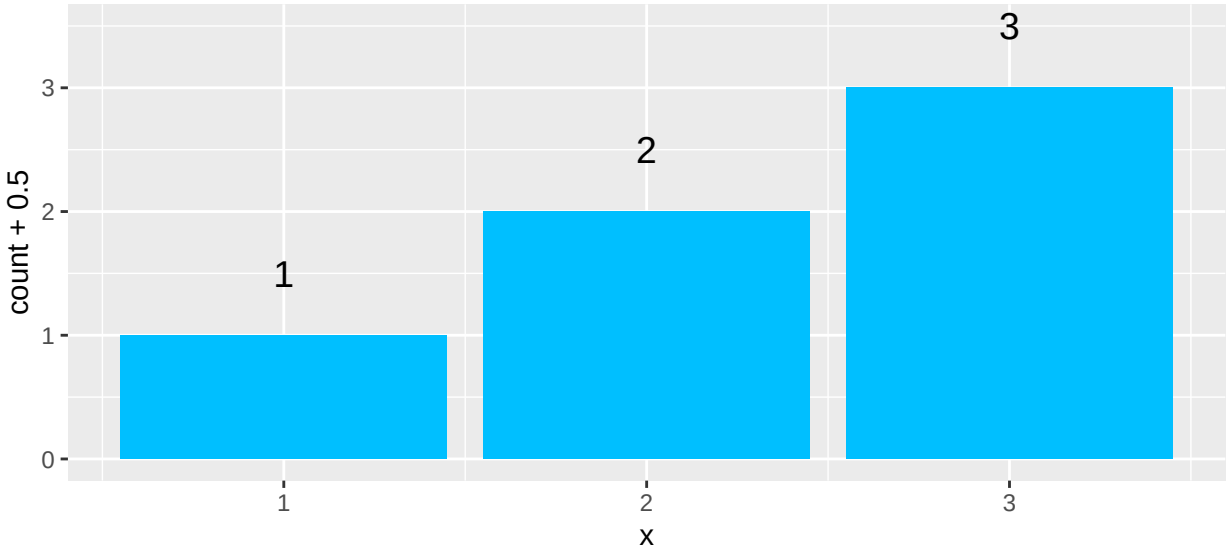
We then return to an unstacked bar chart to consider the syntax for adding labels.

4.2 Add Labels

Adding labels requires adding an extra geom, `geom_text`. We have to add a new, non-intuitive aesthetic to `geom_text` to tell it where the labels are located, and that they represent the count of observations in each category. This aesthetic uses the special variable `..count..` to tell us how many observations are in each category.

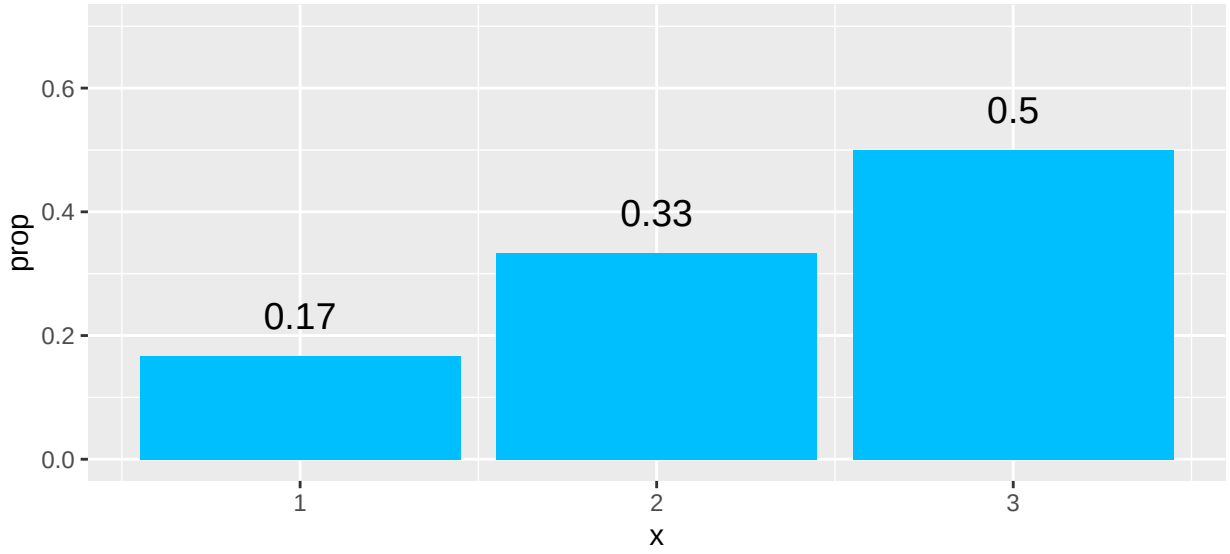
```
ggplot(mydata, # the data that I am using
       aes(x = x)) + # 'aesthetic' only includes x
  geom_bar(fill = "deepskyblue") + # using bars to graph
  geom_text(stat = "count",
```

```
        aes(label = ..count.., # text of the label
            y = ..count.. + .5), # location of the label
        size = 5) # size of the label
```



Alternatively, we could use `..prop..` to calculate and display proportions.

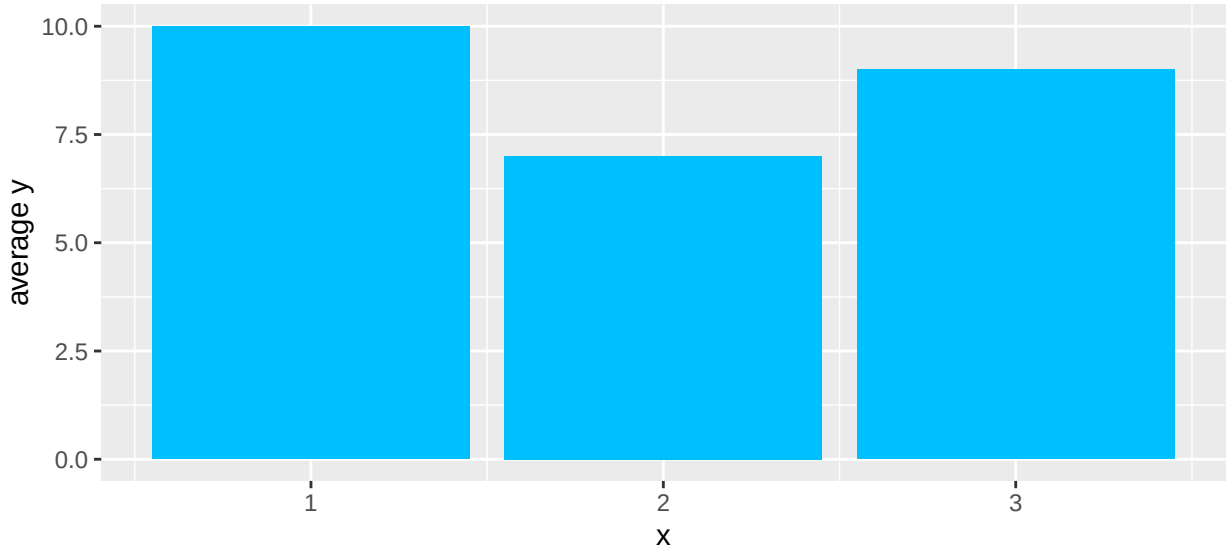
```
ggplot(mydata, # the data that I am using
       aes(x = x)) +
  geom_bar(aes(y = ..prop..), # using bars to graph
           stat = "count",
           fill = "deepskyblue") +
  geom_text(aes(label = round(..prop.., digits = 2), # text of the label
                y = ..prop.. ), # location of the label
            stat = "count",
            size = 5, # size of the label
            vjust = -1) + # vertical justification
  ylim(0, .7)
```



5 Bar charts where the height of the bars is the average value of the y variable for that category.

For this kind of bar chart, we need ask R to summarize the value of `y` for different categories of `x`. The syntax is–shall we say–not very intuitive, but does make sense.

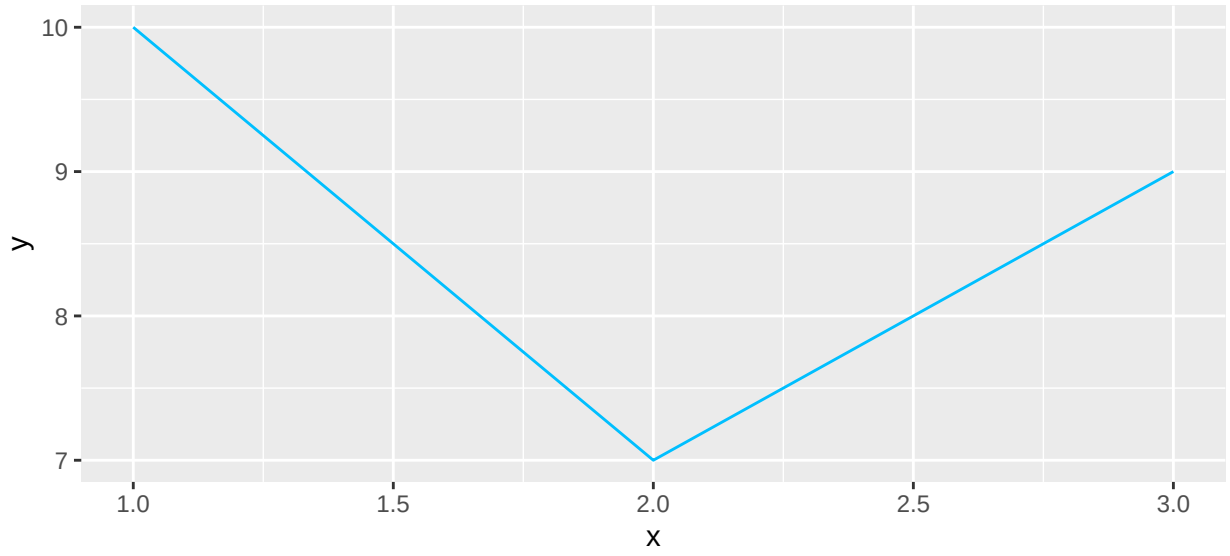
```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x, # 'aesthetic' includes x
           y = y)) + # and y
  stat_summary(fun = mean, # summarizing y
               geom = "bar", # with bars
               fill = "deepskyblue") +
  labs(y = "average y")
```



5.1 What About a Line Chart?

A line chart requires the addition of `group` to the aesthetic, and the use of a different geometry.

```
ggplot(mydata, # the data that I am using
       aes(x = x,
           y = y,
           group = 1)) + # add 'group'
   stat_summary(geom = "line", # with line
                fun = mean,
                color = "deepskyblue")
```



6 Bar charts where the height of the bars is the actual value of the y variable for that category.

Here is where things get complicated. We try something we've tried before, but now adding y to the aesthetic.

```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x, # 'aesthetic' includes x
           y = y)) + # and y
  geom_bar()
```

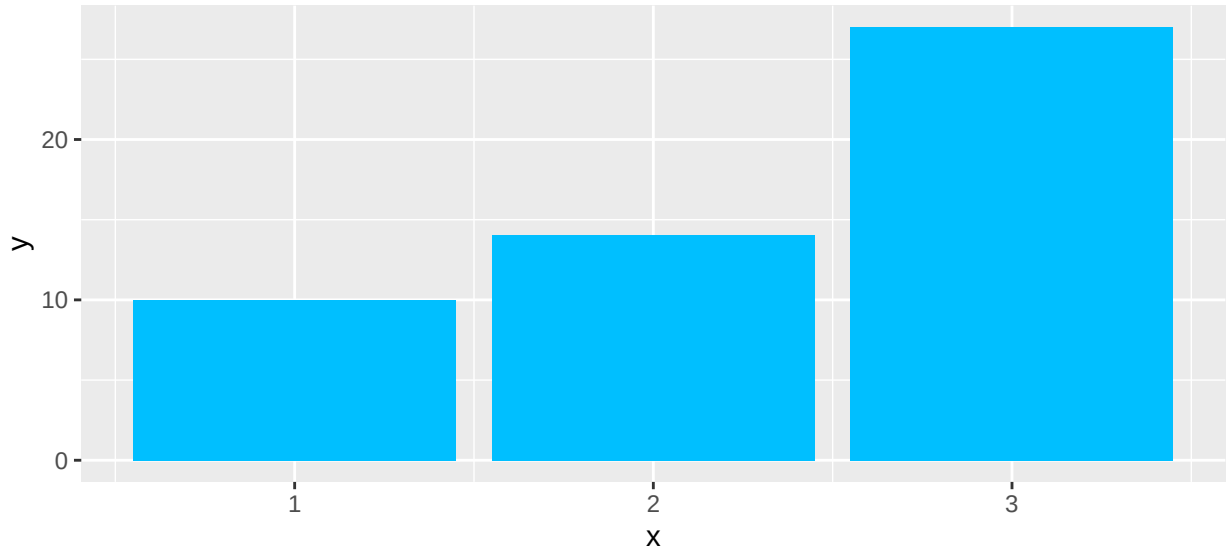
This generates the following error message:

```
Error: stat_count() must not be used with a y aesthetic.
```

The reason that we are getting this error is that, by default, `geom_bar()` is trying to **count up** the number of x values, and in **counting up** the number of x values, `geom_bar()` does not know what to do with the y value.

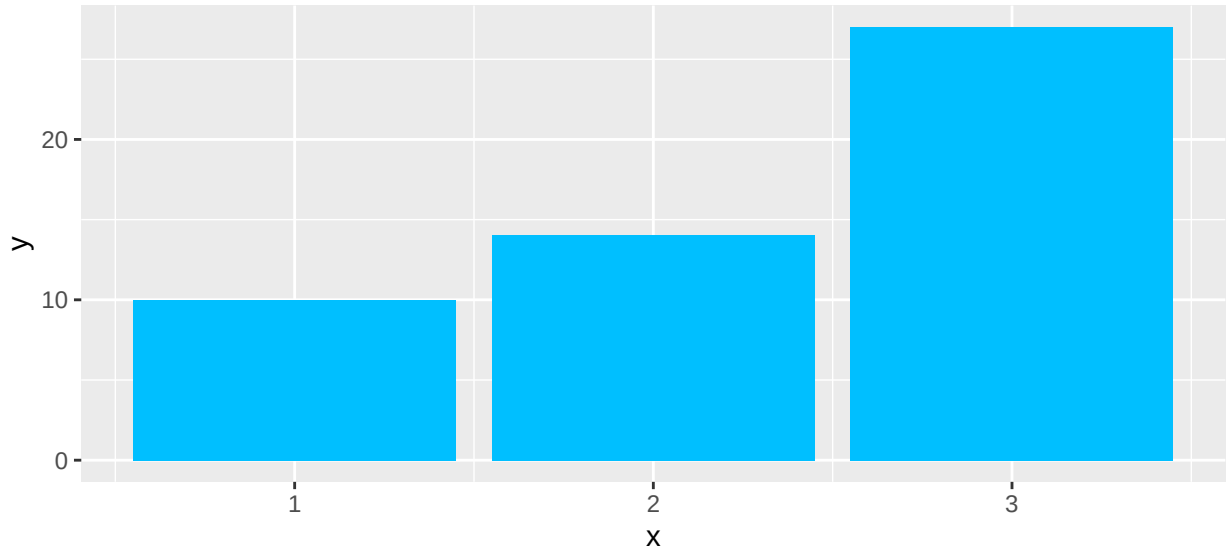
So we change this using a different *geometry*, `geom_col()`, whose default behavior is defined to fit this situation: y = height of bars.

```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x, # 'aesthetic' includes x
           y = y)) + # and y
  geom_col(fill = "deepskyblue") # use ACTUAL y for bar height
```



Alternatively, we could also use `stat = "identity"` within `geom_bar()` to indicate that y represents the *actual* height of the bars …

```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x, # 'aesthetic' includes x
           y = y)) + # and y
  geom_bar(stat = "identity",  # use ACTUAL y for bar height
           fill = "deepskyblue")
```



7 A Potential Problem

If we go back and look at our data, we remember that we have some duplicate x's,

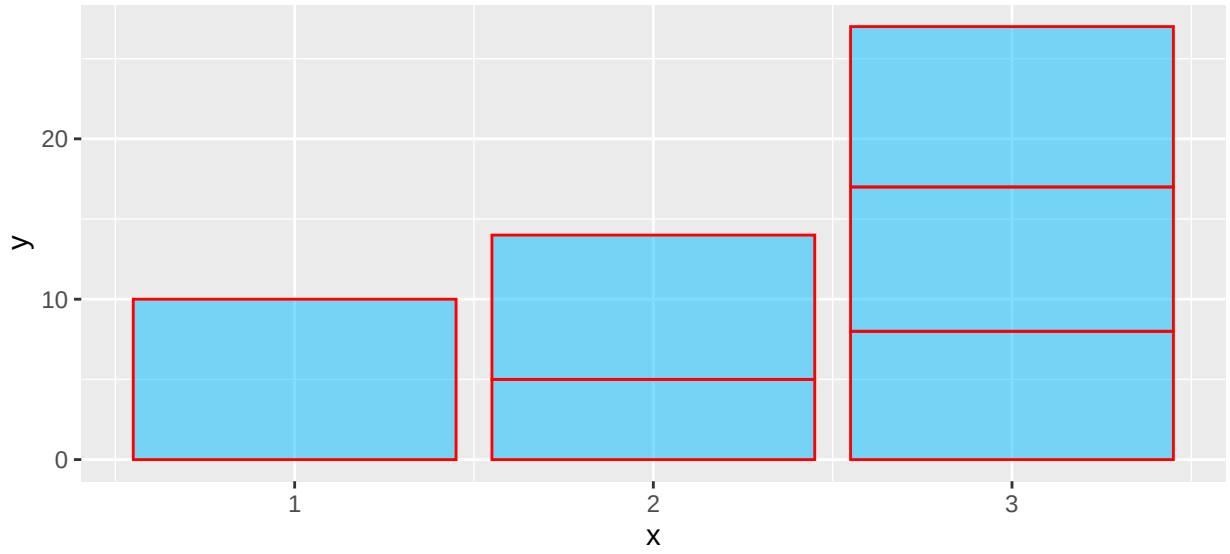
1, *2*, *2*, *3*, *3* and *3*

so some of the bars are actually **over-printing**.

We can see this if we make the bars semi-transparent, and outline the bars with a different color.

```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = x,
           y = y)) + # 'aesthetic' only includes x
  geom_bar(stat="identity", # use ACTUAL y for bar height
```

```
fill = "deepskyblue", # fill
color = "red", # outline
alpha = .5) # transparency
```



8 Thinking Through The Issue

What is the solution? We may want to go back and look at our data to ensure that if we are using the actual y value for the height of the bars that we do **not** have duplicate values of x in our data.

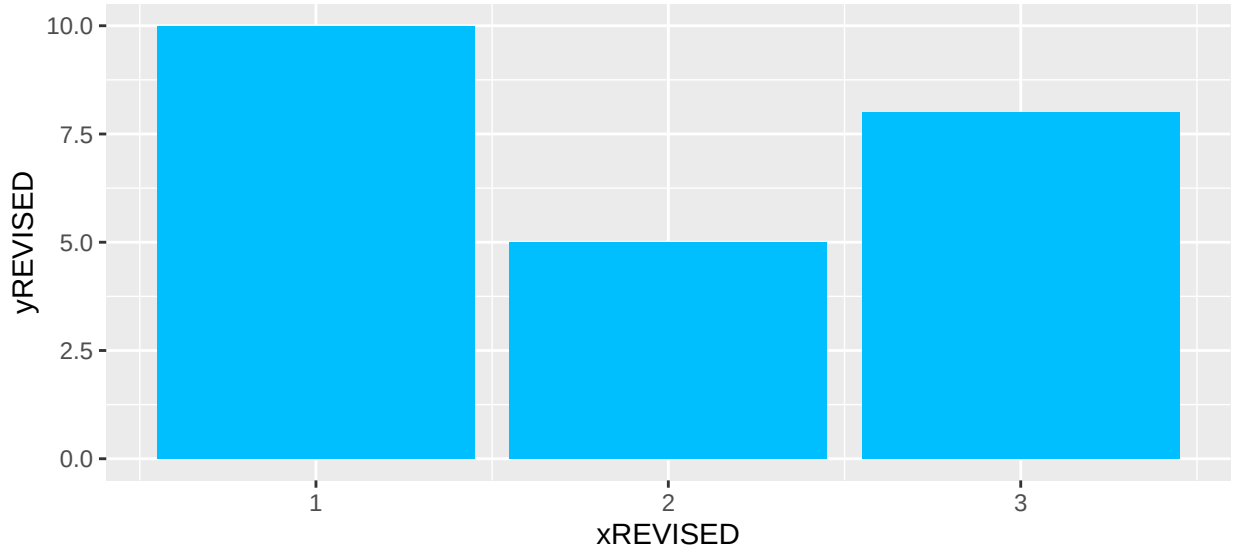
Or, we may want to have the bars represent the **average value of y** rather than the **actual values of y**, as we did in one of the examples above.

9 Of Course The Problem Wouldn't Come Up If We Had Different Data, Without Those Duplicate x Observations

xREVISED	yREVISED
1	10
2	5
3	8

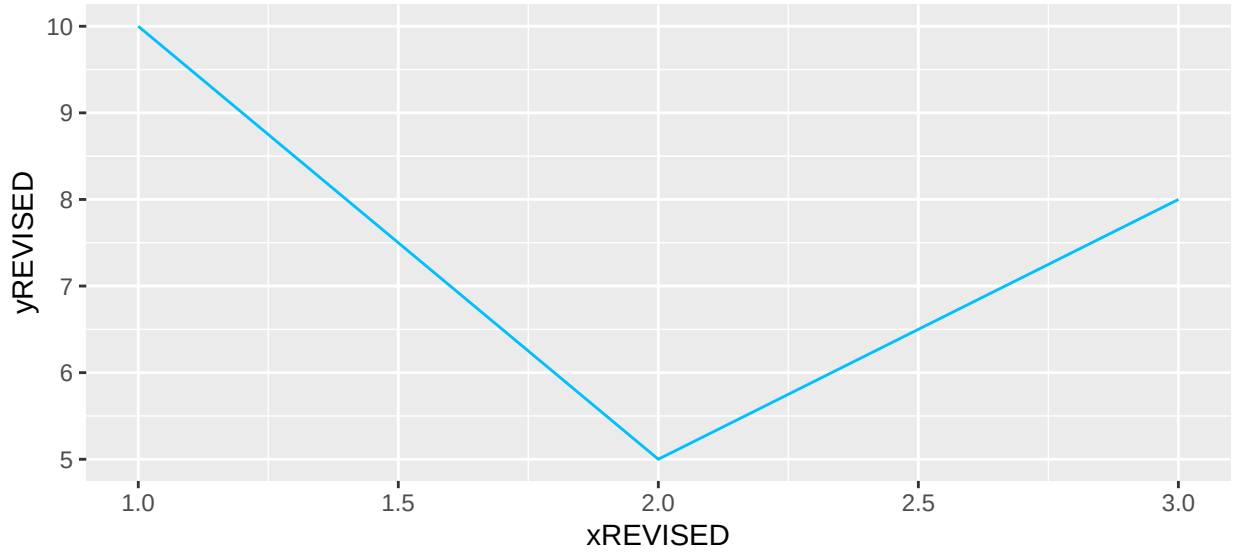
9.1 And Then A Bar Chart Is Easy

```
library(ggplot2)

ggplot(mydataREVISED, # the data that I am using
       aes(x = xREVISED, # 'aesthetic' includes x
           y = yREVISED)) + # and y
  geom_bar(stat = "identity", # use ACTUAL y for bar height
           fill = "deepskyblue")
```



9.2 A Line Chart Is Easy Too

```
library(ggplot2)

ggplot(mydataREVISED, # the data that I am using
       aes(x = xREVISED, # 'aesthetic' includes x
           y = yREVISED)) + # and y
  geom_line(stat = "identity", # use ACTUAL y for bar height
           color = "deepskyblue")
```



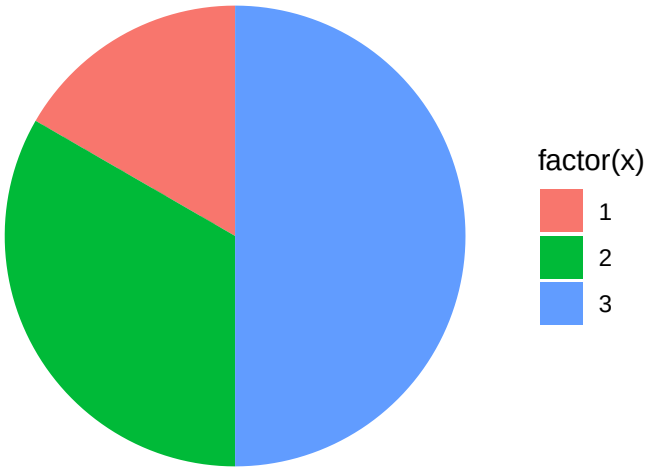
10 And Then There Are Pie Charts

In some ways it is confusing, and in some ways it is helpful, that according to the underlying *grammar of graphics* in `ggplot2`, pie charts can be seen as **bar charts that use polar coordinates**. With that in mind, we take some of our earlier code, and add `coord_polar()`.

In the code below, I need to ensure that `ggplot2` sees x as a **factor**, and to use x as a **fill**. **Fill** is a *crucial* piece of information in a pie chart.

I also need to change `x=` in the `aes`thetic to `1` so that ggplot locates all the slices at the same place in terms of *polar coordinates*.

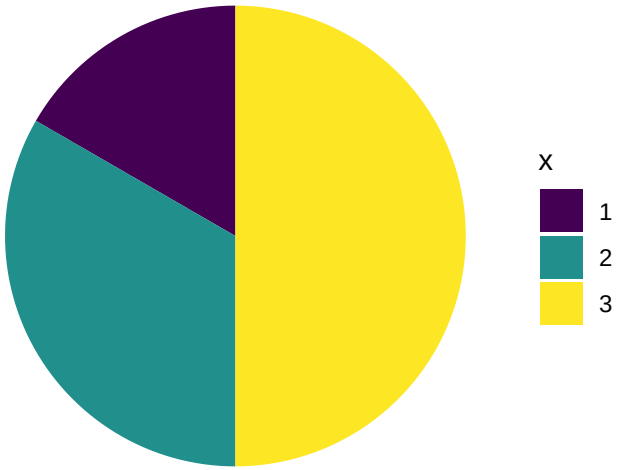
```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = 1, # all the slices have the same x
           fill = factor(x))) + # x is now the fill
  geom_bar() + # using bars to graph
  coord_polar(theta = "y") + # polar coordinates
  theme_void() # get rid of distracting numbers
```



Unfortunately, pie charts are deprecated in some circles, so support for pie charts is not very strong in `ggplot`. It is certainly possible to create a pie chart in `ggplot`, but adding labels to a pie chart ends up being very very difficult.

10.1 Pie Chart With Better Colors

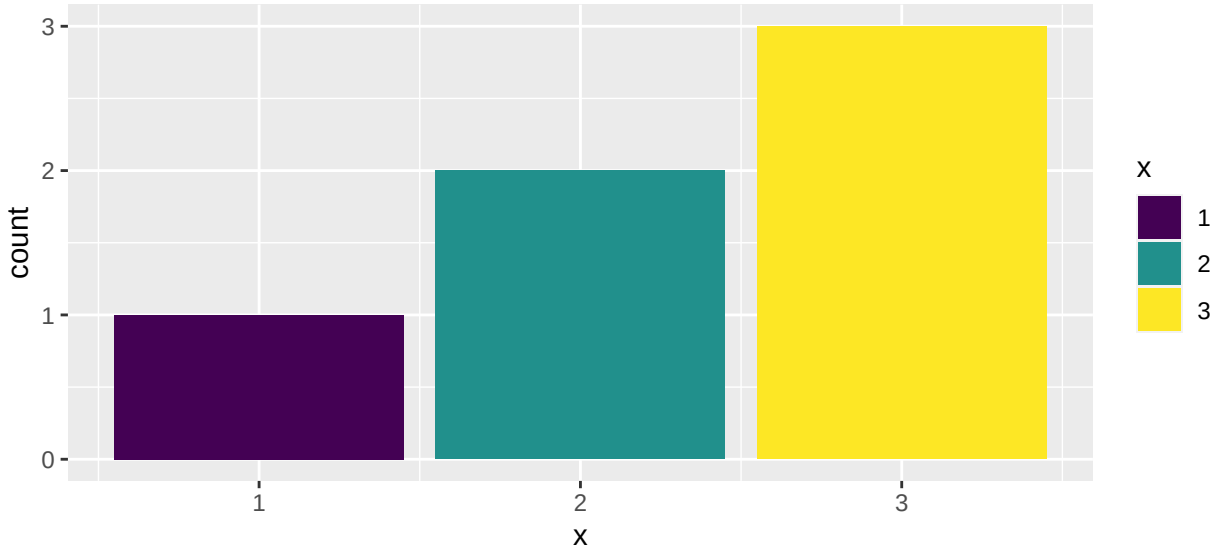
```
library(ggplot2)

ggplot(mydata, # the data that I am using
       aes(x = 1,
           fill = factor(x))) +
  geom_bar() + # using bars to graph
  coord_polar(theta = "y") + # polar coordinates
  scale_fill_viridis_d(name = "x") + # beautiful colors; named legend
  theme_void() # get rid of distracting numbers
```



11 Bar Chart With Better Colors

Up until now, we have had a *minimalist* vision of bar charts, where every bar is the same color, because color would not add **additional information**, over and above the information contained in the position on the x axis. However, for the sake of design, we may also choose to add some color to our bar charts. `ggthemes`, `ggthemr` and `viridis` are all ways of adding color to `ggplot` graphs.

```
library(ggplot2)

library(viridis) # wonderful colors

ggplot(mydata, # the data that I am using
       aes(x = x, # x is on the x axis
           fill = factor(x))) + # x is also a factor for fill
  geom_bar() + # using bars to graph
  scale_fill_viridis_d(name = "x") # colors; named legend
```



12 More Examples

More examples can be found here