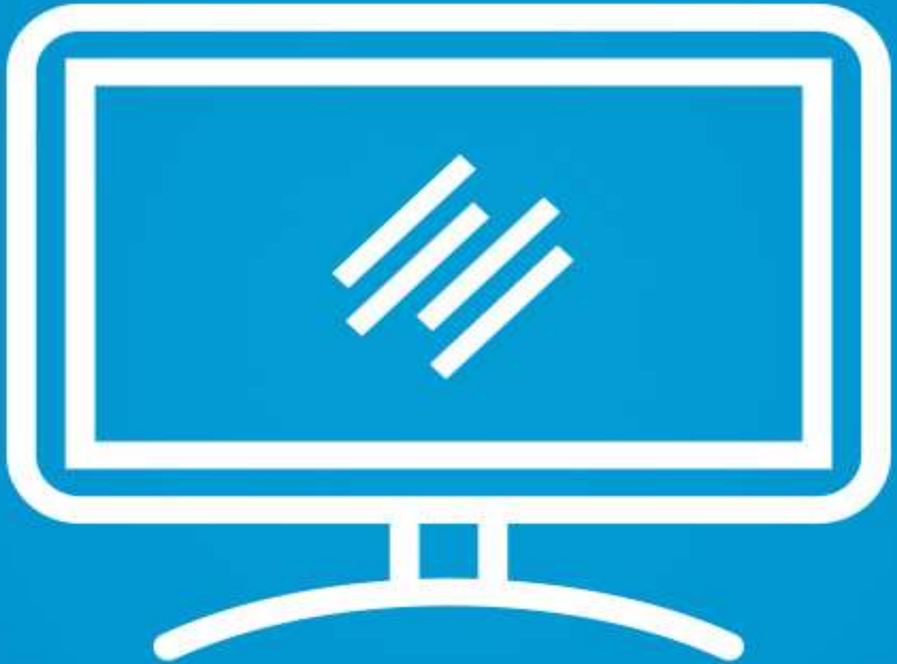
“Knowledge not shared is wasted” – Clan Jacobs



R Programming

March 04, 2017

1. Simple Plotting

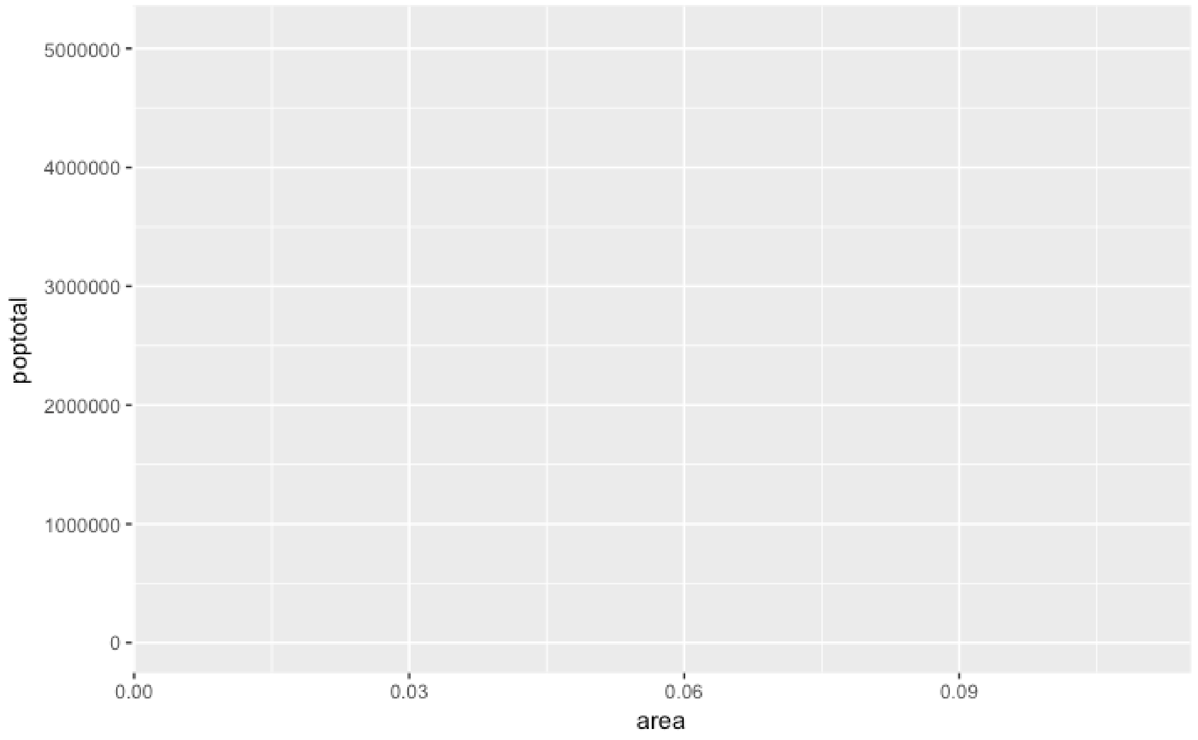
3. GGPLOT2

, unlike base graphics, ggplot works with dataframes and not individual vectors. All the data needed to make the plot is typically be contained within the dataframe supplied to the ggplot() itself or can be supplied to respective geoms

```
# Setup
options(scipen=999)  # turn off scientific notation like 1e+06
library(ggplot2)
data("midwest", package = "ggplot2")  # load the data

# Init Ggplot
ggplot(midwest, aes(x=area, y=poptotal))  # area and poptotal are columns in 'midwest'
```

Download MidWest dataset

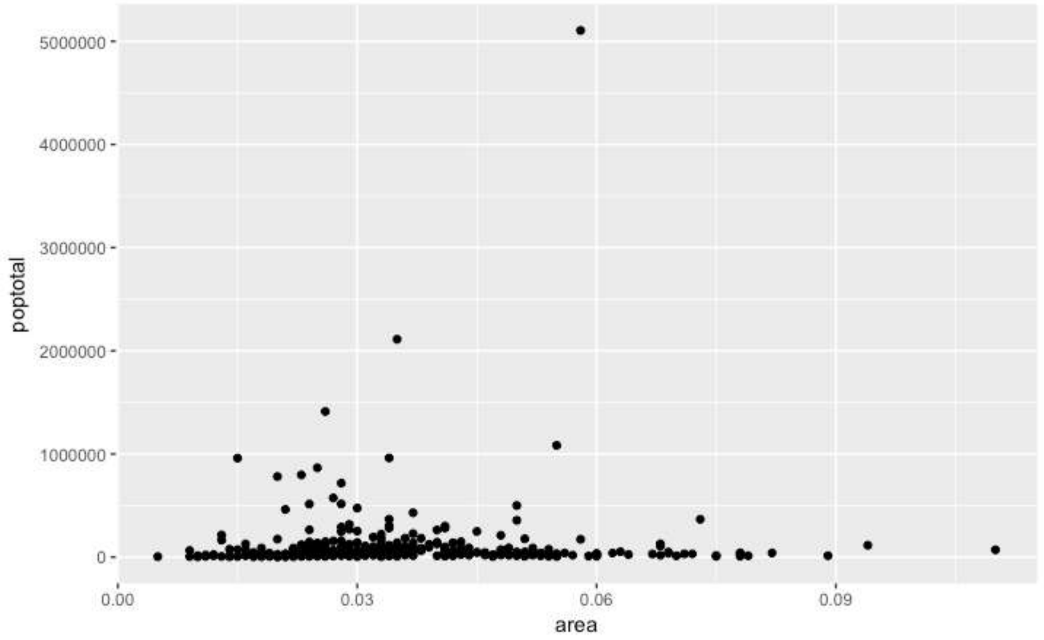


- A blank ggplot is drawn. Even though the x and y are specified, there are no points or lines in it. This is because, ggplot doesn't assume that you meant a scatterplot or a line chart to be drawn. I have only told ggplot what dataset to use and what columns should be used for X and Y axis. I haven't explicitly asked it to draw any points.
- Also note that aes() function is used to specify the X and Y axes. That's because, any information that is part of the source dataframe has to be specified inside the aes() function.

2. How to Make a Simple Scatterplot

Let’s make a scatterplot on top of the blank ggplot by adding points using a geom layer called `geom_point`.

```
library(ggplot2)
ggplot(midwest, aes(x=area, y=poptotal)) + geom_point()
```



We got a basic scatterplot, where each point represents a county. However, it lacks some basic components such as the plot title, meaningful axis labels etc. Moreover most of the points are concentrated on the bottom portion of the plot, which is not so nice. You will see how to rectify these.

Like `geom_point()`, there are many such geom layers which we will see. For now, let’s just add a smoothing layer using `geom_smooth(method='lm')`. Since the `method` is set as `lm` (short for *linear model*), it draws the line of best fit.

```
library(ggplot2)
g <- ggplot(midwest, aes(x=area, y=poptotal)) + geom_point() + geom_smooth(method="lm")  # set se=FALSE to turnoff confidence bands
plot(g)
```

2. How to Make a Simple Scatterplot

```
library(ggplot2)
g <- ggplot(midwest, aes(x=area, y=poptotal)) + geom_point() + geom_smooth(method="lm")  # set se=FALSE to turnoff confidence bands
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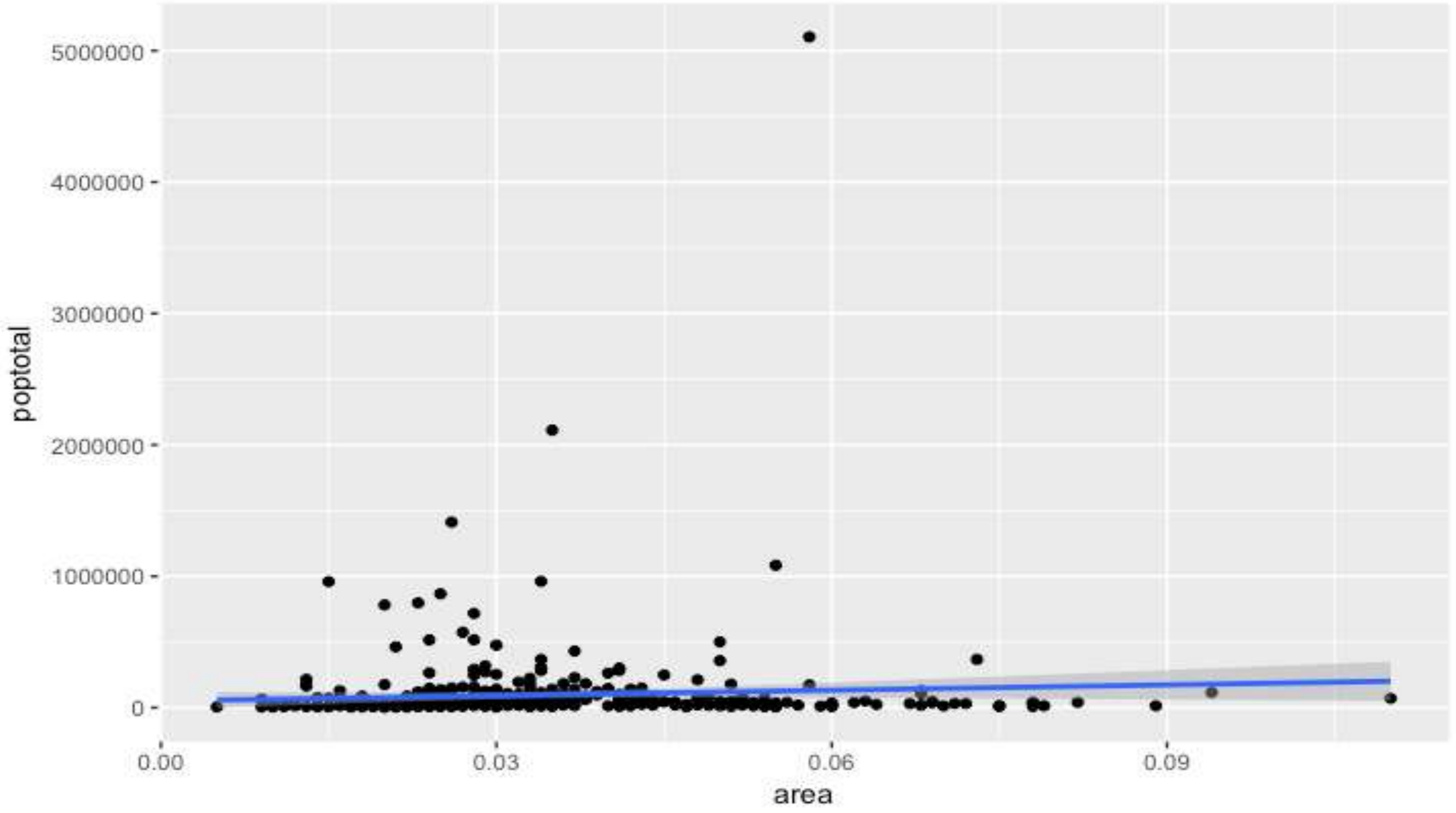


3. Adjusting the X and Y axis limits

Method 1: By deleting the points outside the range

This will change the lines of best fit or smoothing lines as compared to the original data.

This can be done by xlim() and ylim(). You can pass a numeric vector of length 2 (with max and min values) or just the max and min values itself.

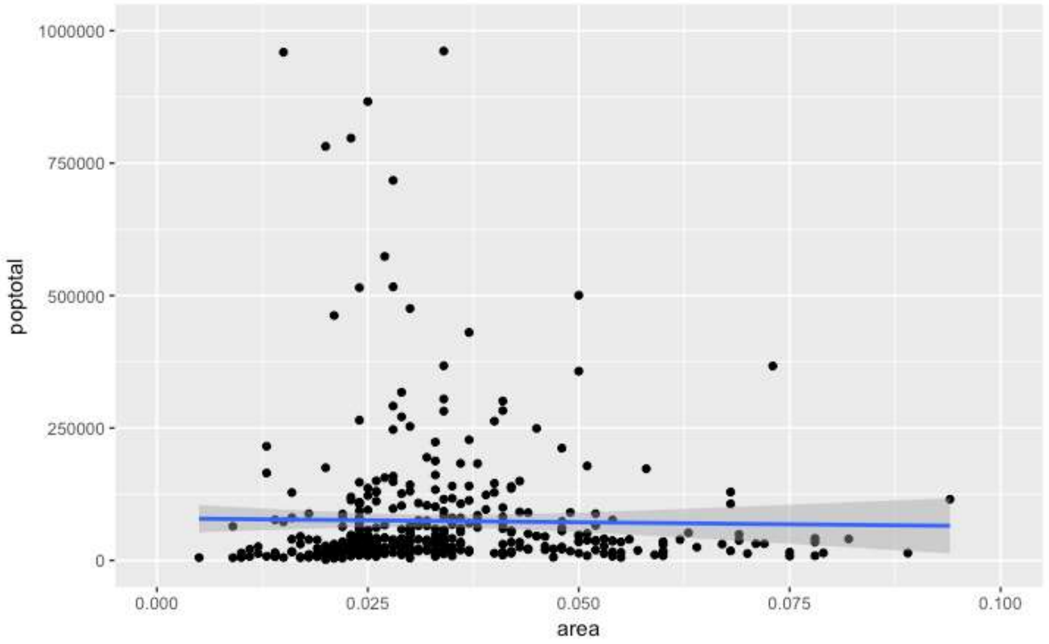
```
library(ggplot2)

g <- ggplot(midwest, aes(x=area, y=poptotal)) + geom_point() + geo
m_smooth(method="lm")

# Delete the points outside the limits

g + xlim(c(0, 0.1)) + ylim(c(0, 1000000))   # deletes points

# g + xlim(0, 0.1) + ylim(0, 1000000)   # deletes points
```



In this case, the chart was not built from scratch but rather was built on top of g.

a ggplot object, which when called will reproduce the original plot. Using ggplot, you can add more layers, themes and other settings on top of this plot.

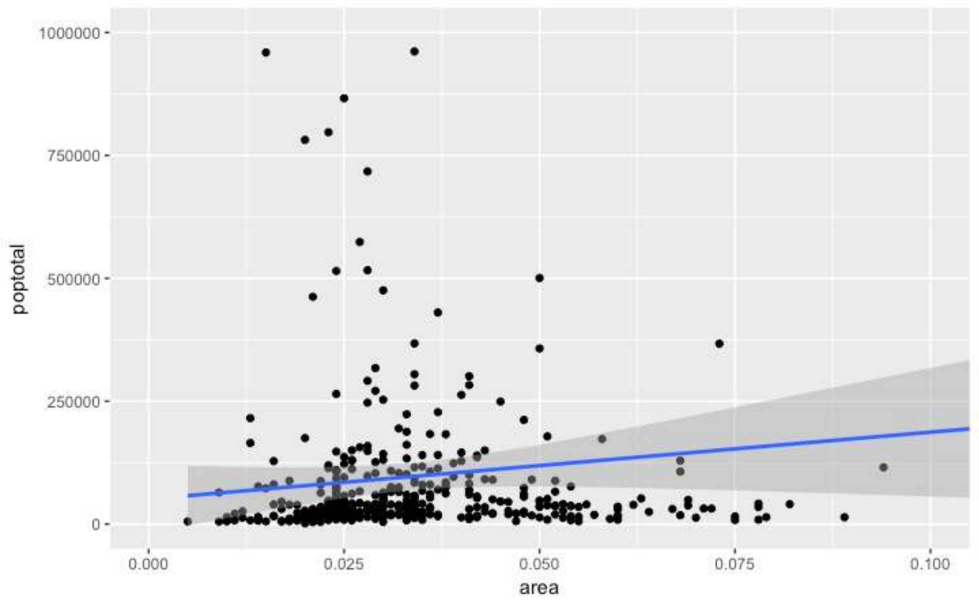
The line of best fit became more horizontal compared to the original plot because, when using xlim() and ylim(), the points outside the specified range are deleted and will not be considered while drawing the line of best fit (using geom_smooth(method='lm')). This feature might come in handy when you wish to know how the line of best fit would change when some extreme values (or outliers) are removed.

Method 2: Zooming In

The other method is to change the X and Y axis limits by zooming in to the region of interest *without* deleting the points. This is done using coord_cartesian(). Let's store this plot as g1.

```
library(ggplot2)
g <- ggplot(midwest, aes(x=area, y=poptotal)) + geom_point() + geom_smooth(method="lm")


# Zoom in without deleting the points outside the limits.
# As a result, the line of best fit is the same as the original plot.
g1 <- g + coord_cartesian(xlim=c(0,0.1), ylim=c(0, 1000000))  # zooms in
plot(g1)
```



Since all points were considered, the line of best fit did not change.

4. How to Change the Title and Axis Labels

Let’s add the plot title and labels for X and Y axis. This can be done in one go using the labs() function with title, x and y arguments. Another option is to use the ggtitle(), xlab()and ylab().

```
library(ggplot2)

g <- ggplot(midwest, aes(x=area, y=poptotal)) + geom_point() + geom_smooth(method="lm")  # set se=FALSE to turnoff confidence bands

g1 <- g + coord_cartesian(xlim=c(0,0.1), ylim=c(0, 1000000))  # zooms in

# Add Title and Labels

g1 + labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")

# or

g1 + ggtitle("Area Vs Population", subtitle="From midwest dataset") + xlab("Area") + ylab("Population")
```

```
# Full Plot call

library(ggplot2)

ggplot(midwest, aes(x=area, y=poptotal)) +

  geom_point() +

  geom_smooth(method="lm") +

  coord_cartesian(xlim=c(0,0.1), ylim=c(0, 1000000)) +

  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")
```

5. How to Change the Color and Size of Points

How to Change the Color and Size To Static? We can change the aesthetics of a geom layer by modifying the respective geoms. Let's change the color of the points and the line to a static value.

```
library(ggplot2)

ggplot(midwest, aes(x=area, y=poptotal)) +

  geom_point(col="steelblue", size=3) +   # Set static color and size for points

  geom_smooth(method="lm", col="firebrick") +  # change the color of line

  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +

  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")
```

How to Change the Color To Reflect Categories in Another Column? Suppose if we want the color to change based on another column in the source dataset (midwest), it must be specified inside the aes() function.

```
library(ggplot2)

gg <- ggplot(midwest, aes(x=area, y=poptotal)) +

  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.

  geom_smooth(method="lm", col="firebrick", size=2) +

  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +

  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")

plot(gg)
```

Now each point is colored based on the `state` it belongs because of `aes(col=state)`. Not just color, but `size`, `shape`, `stroke` (thickness of boundary) and `fill` (fill color) can be used to discriminate groupings.

As an added benefit, the legend is added automatically. If needed, it can be removed by setting the legend.position to None from within a theme() function.

```
gg + theme(legend.position="None")  # remove legend
```

Also, You can change the color palette entirely.

```
gg + scale_colour_brewer(palette = "Set1")  # change color palette
```

More of such palettes can be found in the RColorBrewer package

```
library(RColorBrewer)

head(brewer.pal.info, 10)  # show 10 palettes
```

6. How to Change the X Axis Texts and Ticks Location

Now let’s see how to change the X and Y axis text and its location. This involves two aspects: breaks and labels.

1. **Step 1: Set the breaks**
   The breaks should be of the same scale as the X axis variable. Note that I am using scale_x_continuous because, the X axis variable is a continuous variable. Had it been a date variable, scale_x_date could be used.
   Like scale_x_continuous() an equivalent scale_y_continuous() is available for Y axis.

```r
library(ggplot2)
# Base plot
gg <- ggplot(midwest, aes(x=area, y=poptotal)) +
  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.
  geom_smooth(method="lm", col="firebrick", size=2) +
  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +
  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")
# Change breaks
gg + scale_x_continuous(breaks=seq(0, 0.1, 0.01))
```

2. **Step 2: Change the labels** You can optionally change the labels at the axis ticks. labels take a vector of the same length as breaks.

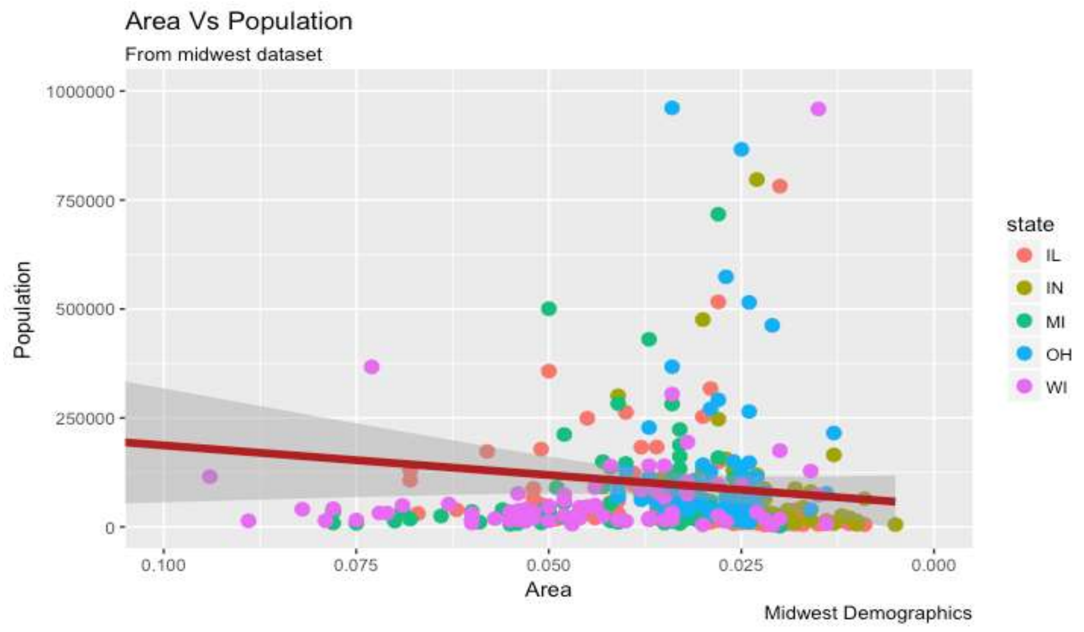
Let me demonstrate by setting the labels to alphabets from a to k (though there is no meaning to it in this context).

```
library(ggplots)
# Base Plot
gg <- ggplot(midwest, aes(x=area, y=poptotal)) +
  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.
  geom_smooth(method="lm", col="firebrick", size=2) +
  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +
  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")
# Change breaks + label
gg + scale_x_continuous(breaks=seq(0, 0.1, 0.01), labels = letters[1:11])
```

If you need to reverse the scale, use scale_x_reverse().

```
library(ggplot2)
gg <- ggplot(midwest, aes(x=area, y=poptotal)) +
  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.
  geom_smooth(method="lm", col="firebrick", size=2) +
  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +
  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")


# Reverse X Axis Scale
gg + scale_x_reverse()
```



How to Write Customized Texts for Axis Labels, by Formatting the Original Values?

Let’s set the `breaks` for Y axis text as well and format the X and Y axis labels. I have used 2 methods for formatting labels: * **Method 1**: Using `sprintf()`. (Have formatted it as % in below example) * **Method 2**: Using a custom user defined function. (Formatted 1000’s to 1K scale)

Use whichever method feels convenient.

```
library(ggplot2)


# Base Plot

gg <- ggplot(midwest, aes(x=area, y=poptotal)) +

  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.

  geom_smooth(method="lm", col="firebrick", size=2) +

  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +

  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")


# Change Axis Texts

gg + scale_x_continuous(breaks=seq(0, 0.1, 0.01), labels = sprintf("%1.2f%%", seq(0, 0.1, 0.01))) +

  scale_y_continuous(breaks=seq(0, 1000000, 200000), labels = function(x){paste0(x/1000, 'K')})
```

How to Customize the Entire Theme in One Shot using Pre-Built Themes?

This again is commonly done in couple of ways. * Use the theme_set() to set the theme before drawing the ggplot. Note that this setting will affect all future plots. * Draw the ggplot and then add the overall theme setting (eg. theme_bw())

```
library(ggplot2)
 # Base plot
gg <- ggplot(midwest, aes(x=area, y=poptotal)) +
  geom_point(aes(col=state), size=3) +  # Set color to vary based on state categories.
  geom_smooth(method="lm", col="firebrick", size=2) +
  coord_cartesian(xlim=c(0, 0.1), ylim=c(0, 1000000)) +
  labs(title="Area Vs Population", subtitle="From midwest dataset", y="Population", x="Area", caption="Midwest Demographics")
 gg <- gg + scale_x_continuous(breaks=seq(0, 0.1, 0.01))
 # method 1: Using theme_set()
theme_set(theme_classic())  # not run
gg
# method 2: Adding theme Layer itself.
gg + theme_bw() + labs(subtitle="BW Theme")
gg + theme_classic() + labs(subtitle="Classic Theme")
```

3. Advanced GGPLOT2

Refer pdf

Thank You