Class Activity 5

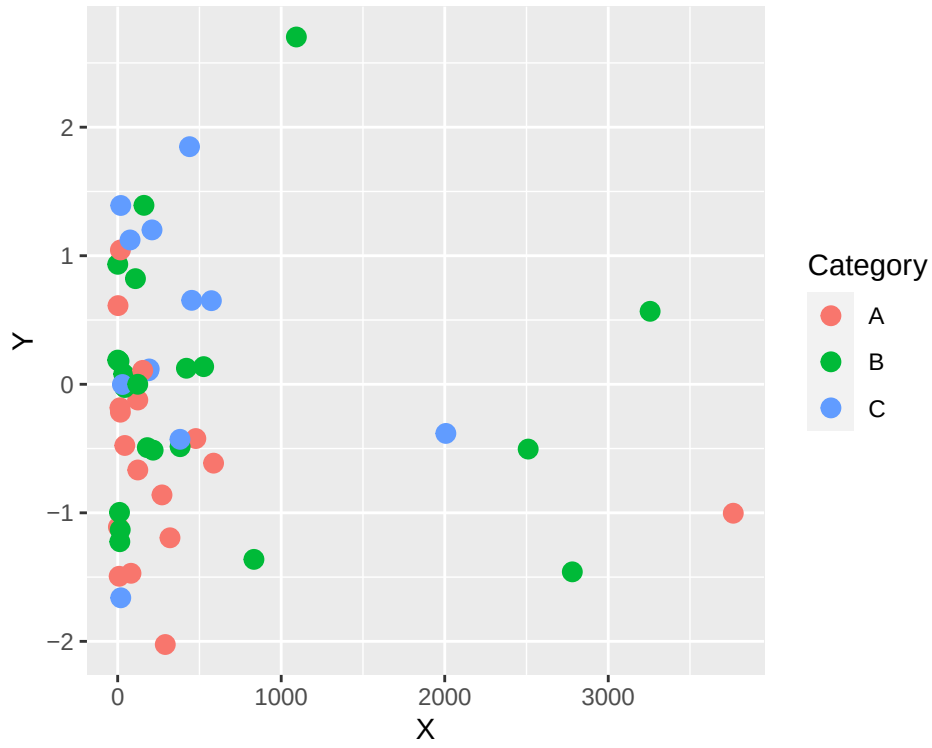
Your name here

2024-04-02

Problem 1: Changing color and scales

In this problem, you will learn about the effects of changing colors, scales, and shapes in `ggplot2` for both gradient and discrete color choices. You will be given a series of questions and examples to enhance your understanding. Consider the following scatter plot

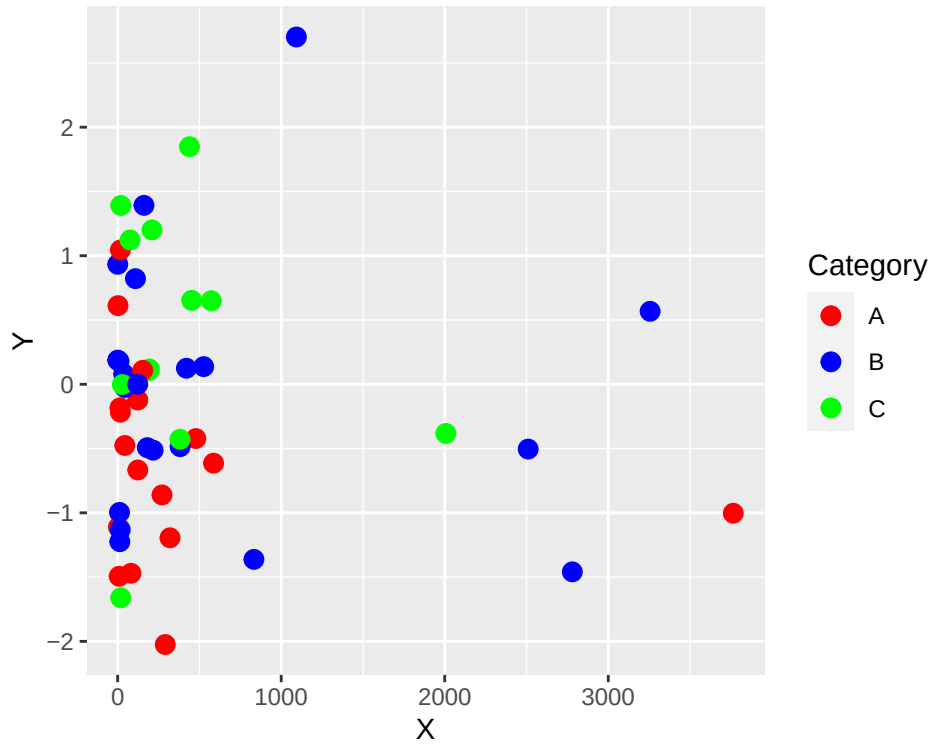
```
# Generate sample data
set.seed(42)
data <- data.frame(
  Category = factor(sample(1:3, 50, replace = TRUE), labels = c("A", "B", "C")),
  X = 10 ^ rnorm(50, mean = 2, sd = 1),
  Y = rnorm(50, mean = 0, sd = 1)
)

p <- ggplot(data, aes(x = X, y = Y, color = Category)) +
  geom_point(size = 3)

p
```



a. Modify the scatter plot to use custom colors for each category using `scale_color_manual()`. What is the effect of changing the colors on the plot's readability?

Answer: Changing colors using `scale_color_manual()` allows for better distinction between categories and enhances the plot's readability.

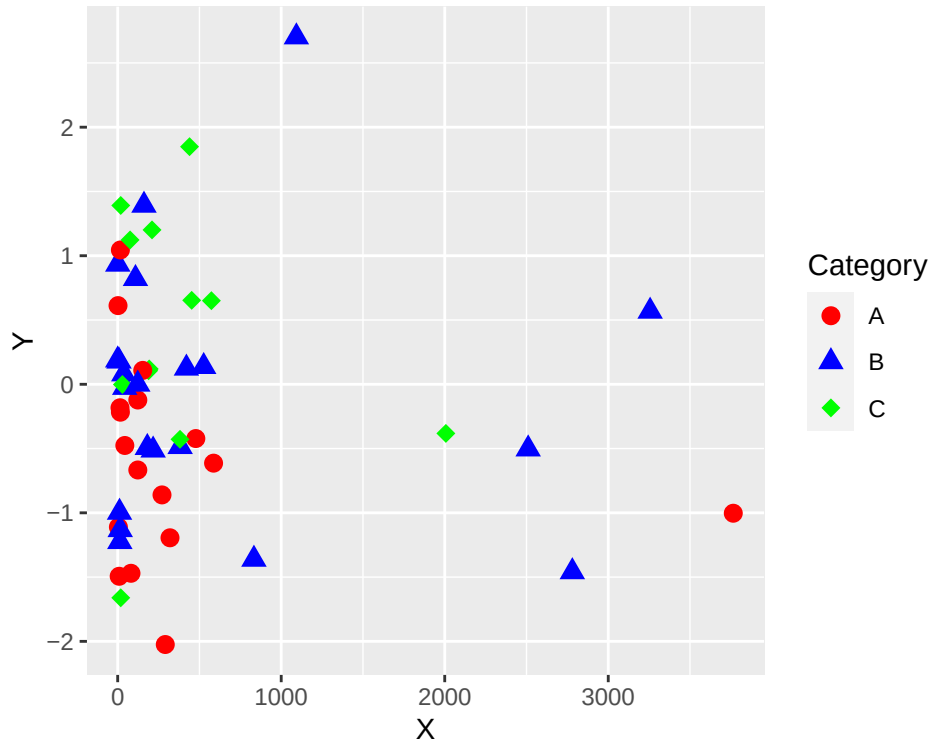
```
p <- ggplot(data, aes(x = X, y = Y, color = Category)) +
  geom_point(size = 3) +
  scale_color_manual(values = c("red", "blue", "green"))
p
```



b. Modify the scatter plot to use custom shapes for each category using `scale_shape_manual()`. What is the effect of changing the shapes on the plot's readability?

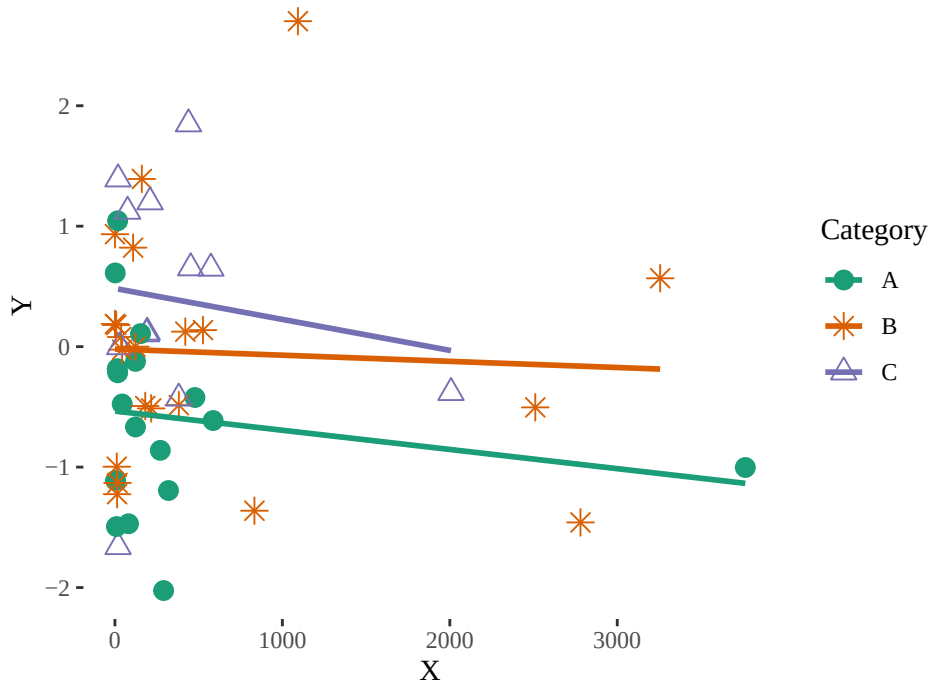
Answer: Changing the shapes using scale_shape_manual() helps to distinguish between categories and improves the plot's readability

```
p <- ggplot(data, aes(x = X, y = Y, shape = Category,  color = Category)) +
  geom_point(size = 3) +
  scale_shape_manual(values = c("A" = 16, "B" = 17, "C" = 18)) +
  scale_color_manual(values = c("A" = "red", "B" = "blue", "C" = "green"))

p
```



c. Try modifying the plot by combining color, shape, and theme customization. Additionally, try using `geom_smooth()` to add trend lines for each category. Pay attention to how each element affects the overall readability and interpretability of the plot.

```
p <- ggplot(data, aes(x = X, y = Y)) +
  geom_point(aes(color = Category, shape = Category), size = 3) +
  geom_smooth(aes(group = Category, color = Category), method = "lm", se = FALSE) +
  scale_shape_manual(values = c("A" = 19, "B" = 8, "C" = 24)) +
  scale_color_brewer(palette = "Dark2") +
  ggthemes::theme_tufte() +
  labs(title = "Separate Trend Lines for Each Category")

p
```



Problem 2: Chloropeth map

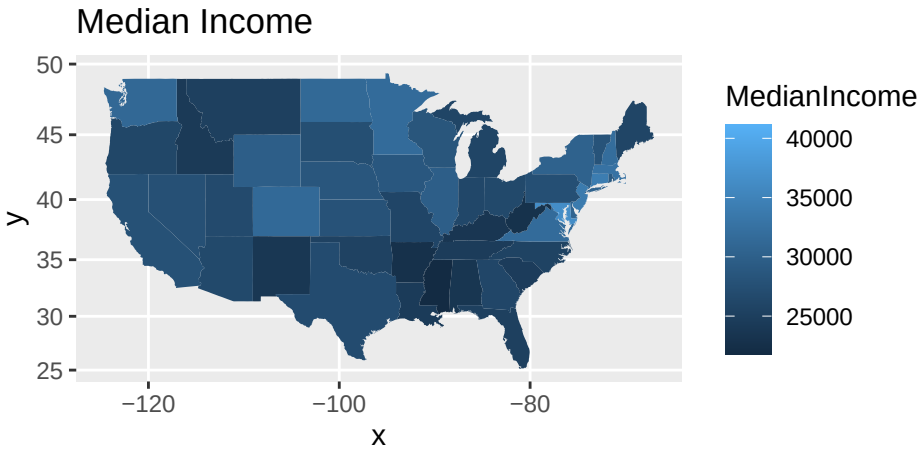
In today's class we created `cloropleth` maps of states in the US based on ACS data.

```
states <- map_data("state")
ACS <- read.csv("https://raw.githubusercontent.com/deepbas/statdatasets/main/ACS.csv")
ACS <- dplyr::filter(ACS, !(region  %in% c("Alaska", "Hawaii"))) # only 48+D.C.
ACS$region <- tolower(ACS$region)  # lower case (match states regions)
```

(a) Mapping median income

Create a `cloropleth` plot that uses color to create a `MedianIncome` map of the US.

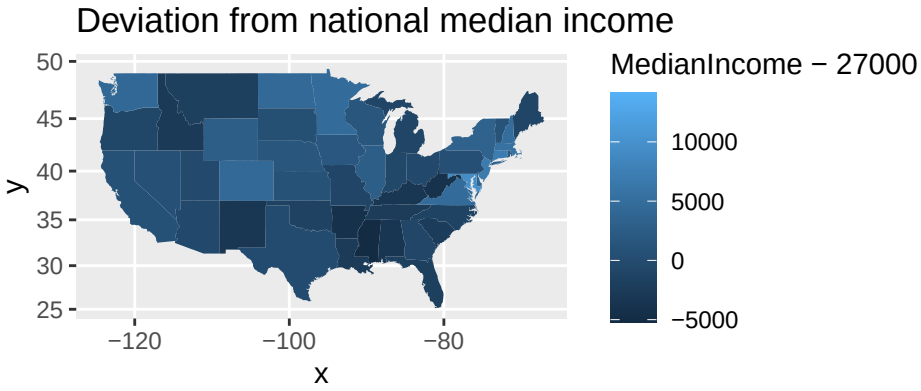
```
# map median income
ggplot(data=ACS) + coord_map() +
  geom_map(aes(map_id = region, fill = MedianIncome), map = states) +
  expand_limits(x=states$long, y=states$lat) + ggtitle("Median Income")
```



(b) Mapping deviations from national median income

The median income in the US in 2016 was estimated to be $27,000. Redraw your map in (a) to visualize each state's deviation from national median income.

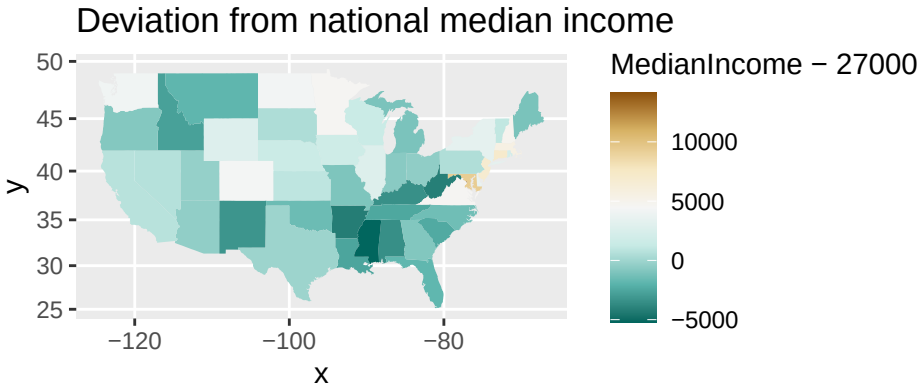
```
# compare state income to national income
ggplot(data=ACS) + coord_map() +
  geom_map(aes(map_id = region, fill = MedianIncome - 27000), map = states) +
  expand_limits(x=states$long, y=states$lat) + ggtitle("Deviation from national median income
```



(c) Changing numerically scaled color

You should use a *diverging* color for (b) to highlight larger deviations from the national median. Add `scale_fill_distiller` to the map from (b) and select a diverging palette.

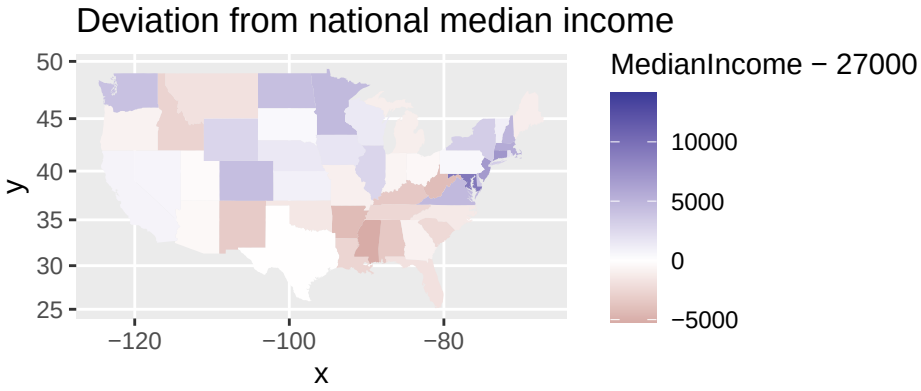
```
# change to a diverging color
ggplot(data=ACS) + coord_map() +
  geom_map(aes(map_id = region, fill = MedianIncome - 27000), map = states) +
  expand_limits(x=states$long, y=states$lat) + ggtitle("Deviation from national median income
  scale_fill_distiller(type = "div")
```



(d) Fixing a midpoint on a diverging scale

Use `scale_fill_gradient2` to fix a midpoint scale value at a white color, with diverging colors for larger positive and negative values. Apply this color to your map in (b) and fix the `midpoint` at an appropriate value.

```
# change to a gradient fill color
ggplot(data=ACS) + coord_map() +
  geom_map(aes(map_id = region, fill = MedianIncome - 27000), map = states) +
  expand_limits(x=states$long, y=states$lat) + ggtitle("Deviation from national median income
  scale_fill_gradient2(midpoint = 0)
```



Next, we will use this merged data to create a polygon map that focuses on the boundaries and shapes of each state, colored by median income.

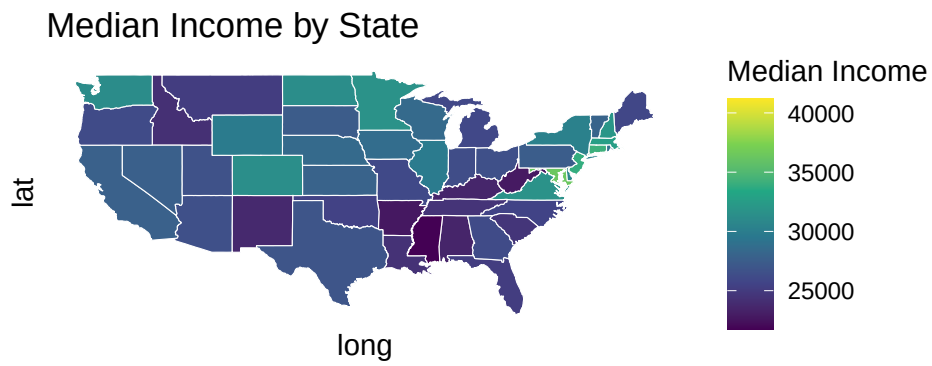
(e) Polygon map

```
# Merge income data with geographic information
income_data <- left_join(states, ACS, by = c("region" = "region"))
```

For this task, you will create a polygon map to visualize the `MedianIncome` across different states using the. Pay attention to the shapes and sizes of states as depicted on the map.

```
library(sf)

ggplot(data = income_data) +
  geom_polygon(aes(x = long, y = lat, group = group, fill = MedianIncome),
               color = "white", size = 0.2) +
  coord_sf(datum = NA) +
  labs(fill = "Median Income", title = "Median Income by State") +
```

```
  theme_minimal() +
  scale_fill_viridis_c()
```



(f) Visualizing Relative Income Deviation

```
# Calculate income deviation as a percentage
national_median <- 27000

# Merge the updated income data with geographic information
ACS$IncomeDeviationPercent <- ((ACS$MedianIncome - national_median) / national_median) * 100
income_data <- left_join(states, ACS, by = c("region" = "region"))

# Plot the income deviation using Robinson projection with geom_polygon
ggplot(data = income_data) +
  geom_polygon(aes(x = long, y = lat, group = group, fill = IncomeDeviationPercent),
               color = "white", size = 0.2) +
  coord_map(projection = "lagrange") +
  labs(fill = "Income Deviation (%)", title = "Income Deviation from National Median by State
```

```
  theme_minimal() +
  scale_fill_distiller(palette = "Spectral", name = "Deviation (%)")
```