Data and Visualization Types

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Visualization types

- What visualization type should I choose?
  - It all depends on the data you have!
- There are two main types of data:
  - Categorical
  - Numeric

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Visualization types

- Many others to choose from, and an infinite number of combinations!

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Categorical Variables

- A categorical variable (also called qualitative variable) refers to a characteristic that can't be quantifiable.
- Categorical variables can be either:
  - Nominal, one that describes a name, label, or category without a natural order
  - Ordinal, its values are defined by an order relation between different categories

What's the difference?

- You **can't** compare and order nominal variables
- You **can** compare and order ordinal variables

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Nominal Variables

- A nominal variable is one that describes a name, label, or category without a natural order.
- Examples of nominal variables include:
  - Gender
  - Type of dwelling

What cookie do you like the most?

Cookies	Cookie.Lovers
Oreo	1000
Chocolate Cookie	1234
Oatmeal Cookie	2713

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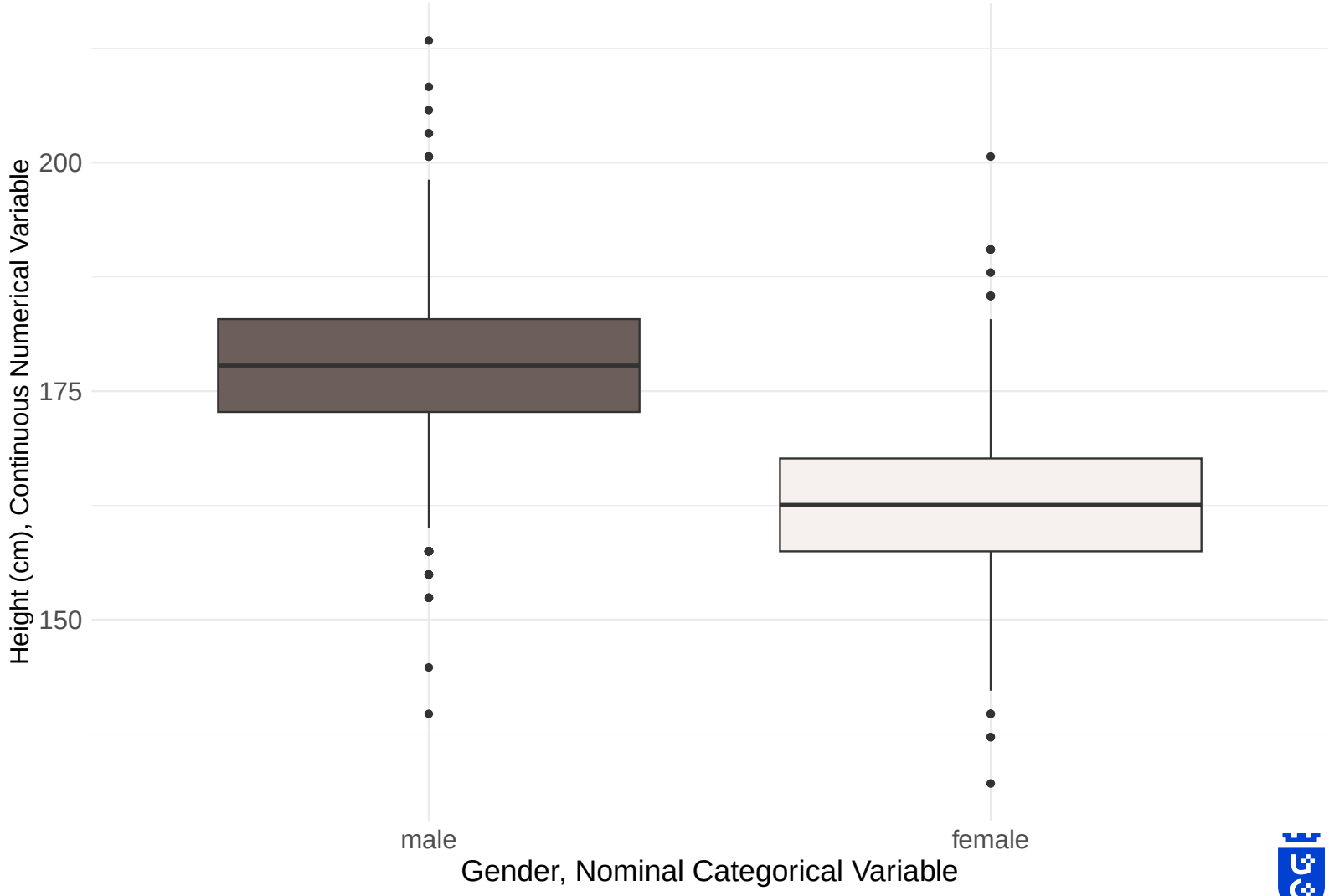
Distribution of Heights by Gender



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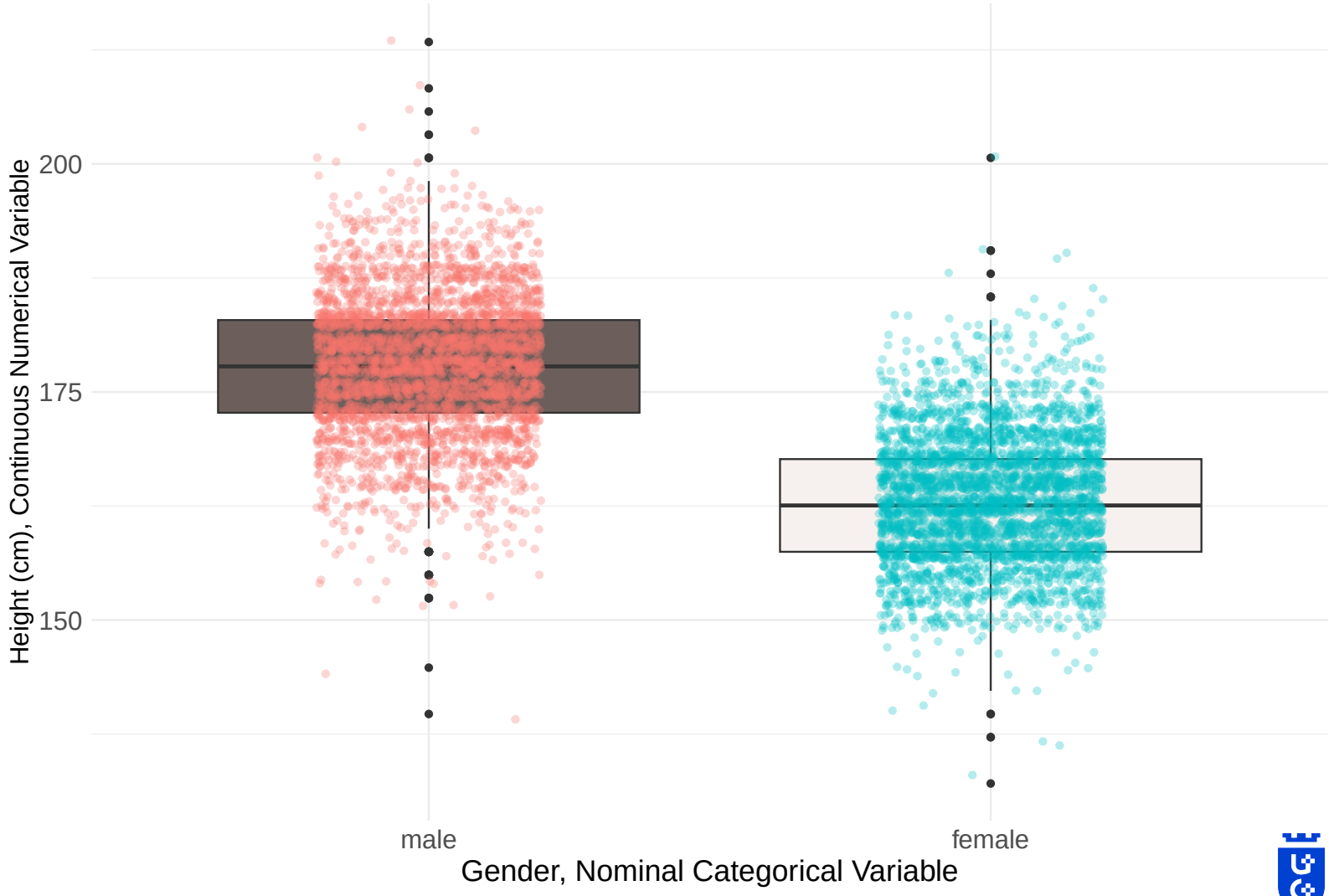
Distribution of Heights by Gender with Jitter



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Code for the visualization above

```r
# packages and heights dataset is already loaded
heightsMODED <- heights
heightsMODED$height_cm <- heightsMODED$height * 2.54

custom_colors = c('#6C5F5B', '#F6F1EE') # hex colors (google for reference)

ggplot(heightsMODED, aes(x = sex, y = height_cm, fill = sex)) +
  geom_boxplot(custom_colors) +
  geom_jitter( # added on jitter plot
    aes(color = sex), width = 0.2, alpha = 0.3
    ) +
  labs(
    title = "",
    x = "Gender, Nominal Categorical Variable",
    y = "Height (cm), Continuous Numerical Variable"
  ) +
  theme_minimal()+
    theme(legend.position = "none",  # remove legend
        axis.text.x = element_text(size = 14), # change size of x axis text
        axis.text.y = element_text(size = 14),
        axis.title.x = element_text(size = 16), # change size of x axis title
        axis.title.y = element_text(size = 14)
        )
```

Ordinal Variables

- There is some natural ordering, but the exact magnitude of the differences is (usually) not known.
- Examples of ordinal variables include:
  - Education level
  - Income level

Exam Results:

Category	Number.of.students
Excellent	5
Very good	12
Good	10
Bad	2

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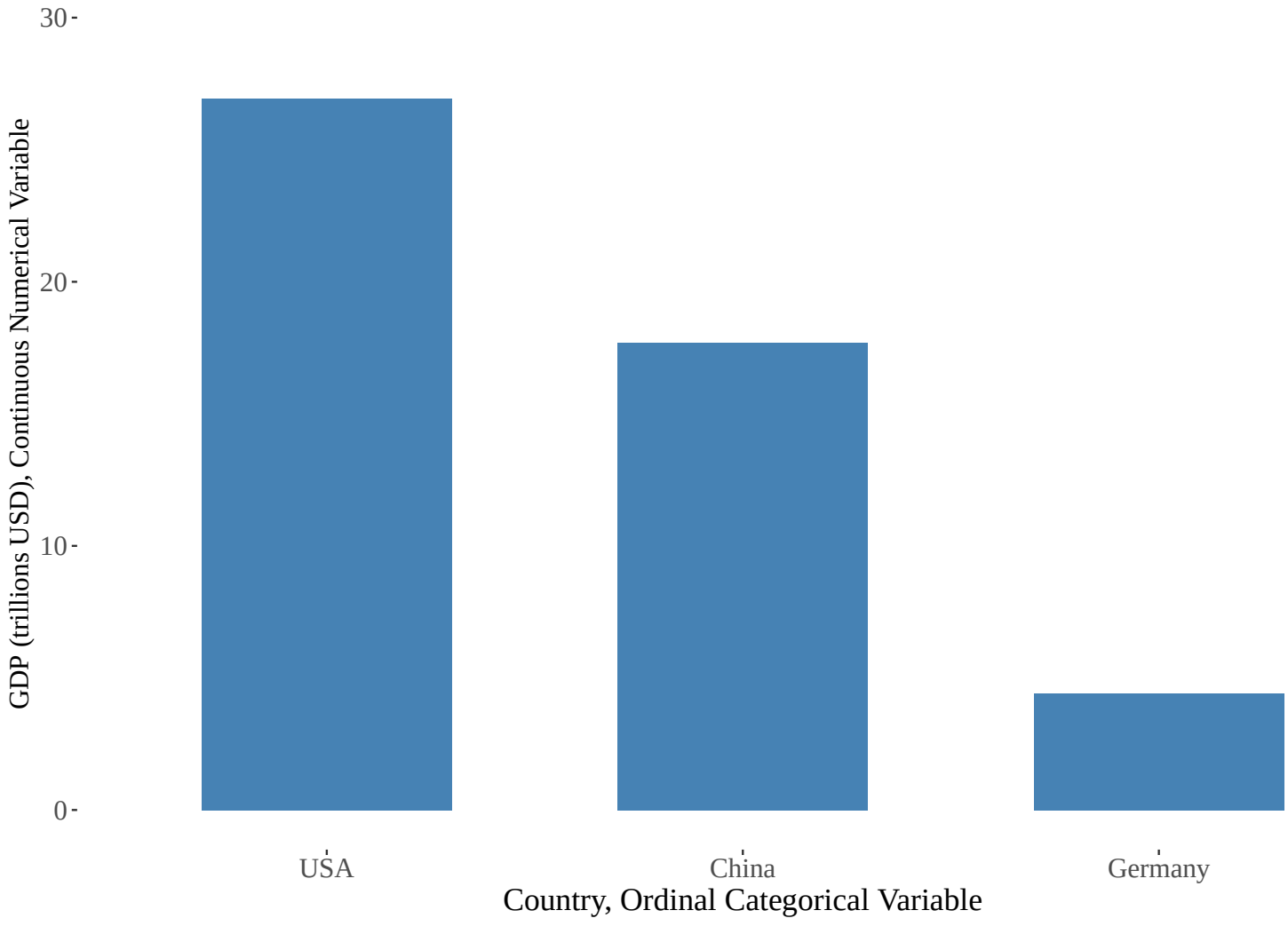
GDP Estimation, 2023



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Code for the visualization above

```r
data <- data.frame(
  Country = c("USA", "China", "Germany"),
  GDP_2023 = c(26.94, 17.70, 4.42)
)

ggplot(data, aes(x = reorder(Country, -GDP_2023), y = GDP_2023)) +
  geom_bar(stat = "identity", fill = "steelblue", width= 0.6) +
  labs(
    title = "",
    x = "Country, Ordinal Categorical Variable",
    y = "GDP (trilions USD), Continuous Numerical Variable"
  ) +
  theme_tufte() +
  scale_y_continuous(limits= c(0, 30)) + # redefining y axis
  theme(axis.text.x = element_text(size = 14),
        axis.text.y = element_text(size = 14),
        axis.title.x = element_text(size = 16),
        axis.title.y = element_text(size = 14)
        )
```

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Numeric Variables

- A numeric variable (also called quantitative variable) is a quantifiable characteristic whose values are numbers.
- Numeric variables may be either continuous or discrete.
- A category might be represented by a single number or by a distribution of numbers.

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Continuous Variables

- A variable is said to be continuous if it can assume an infinite number of real values within a given interval.
- Examples of continuous variables include:
  - Height
  - Temperature

Example Table:

Time.hours	Temperature
0	23.3
1	25.7
2	27.1

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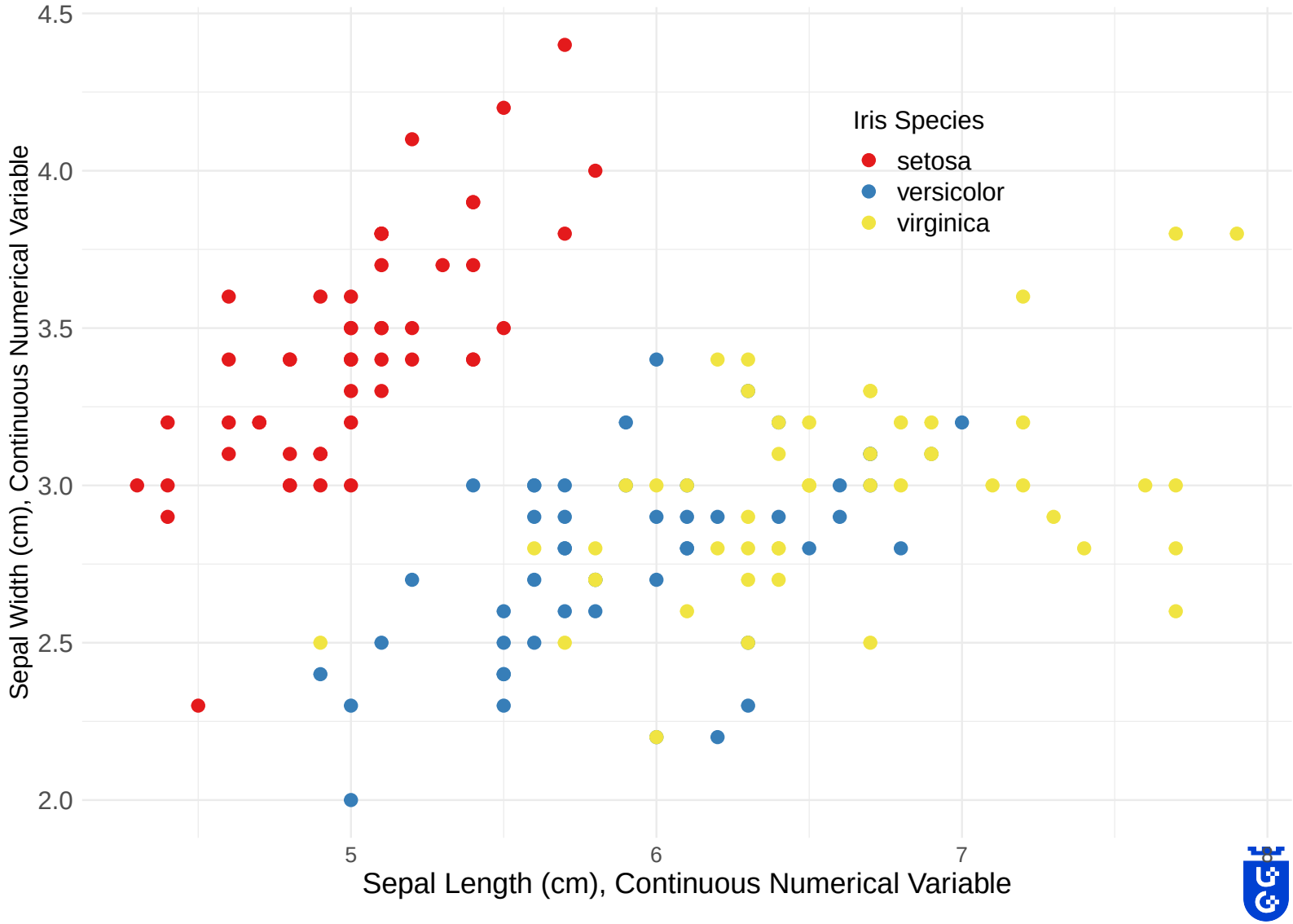
Iris Sepal Length vs. Sepal Width



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Iris sepal

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Code for the visualization above

```r
custom_colors <- c("#E41A1C", "#377EB8", "#f0e442")

ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, color = Species)) +
  geom_point(size = 3) +
  labs(
    x = "Sepal Length (cm), Continuous Numerical Variable",
    y = "Sepal Width (cm), Continuous Numerical Variable",
    color = 'Iris Species'  # Custom legend title
  ) +
  theme_minimal() +
   scale_color_manual(values = custom_colors) +
  theme(
    legend.position = c(0.7, 0.8),  # Custom legend position
    axis.text.x = element_text(size = 12),
    axis.text.y = element_text(size = 14),
    axis.title.x = element_text(size = 16),
    axis.title.y = element_text(size = 14),
    legend.text = element_text(size = 14),
    legend.title = element_text(size = 14)
  )
```

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Discrete Variables

- A discrete variable can assume only a finite number of real values within a given interval.
- Examples of discrete variables include:
  - Number of customers
  - Number of products sold

Example Table:

Items	Sells
Bananas	10
Apples	15
Oranges	20

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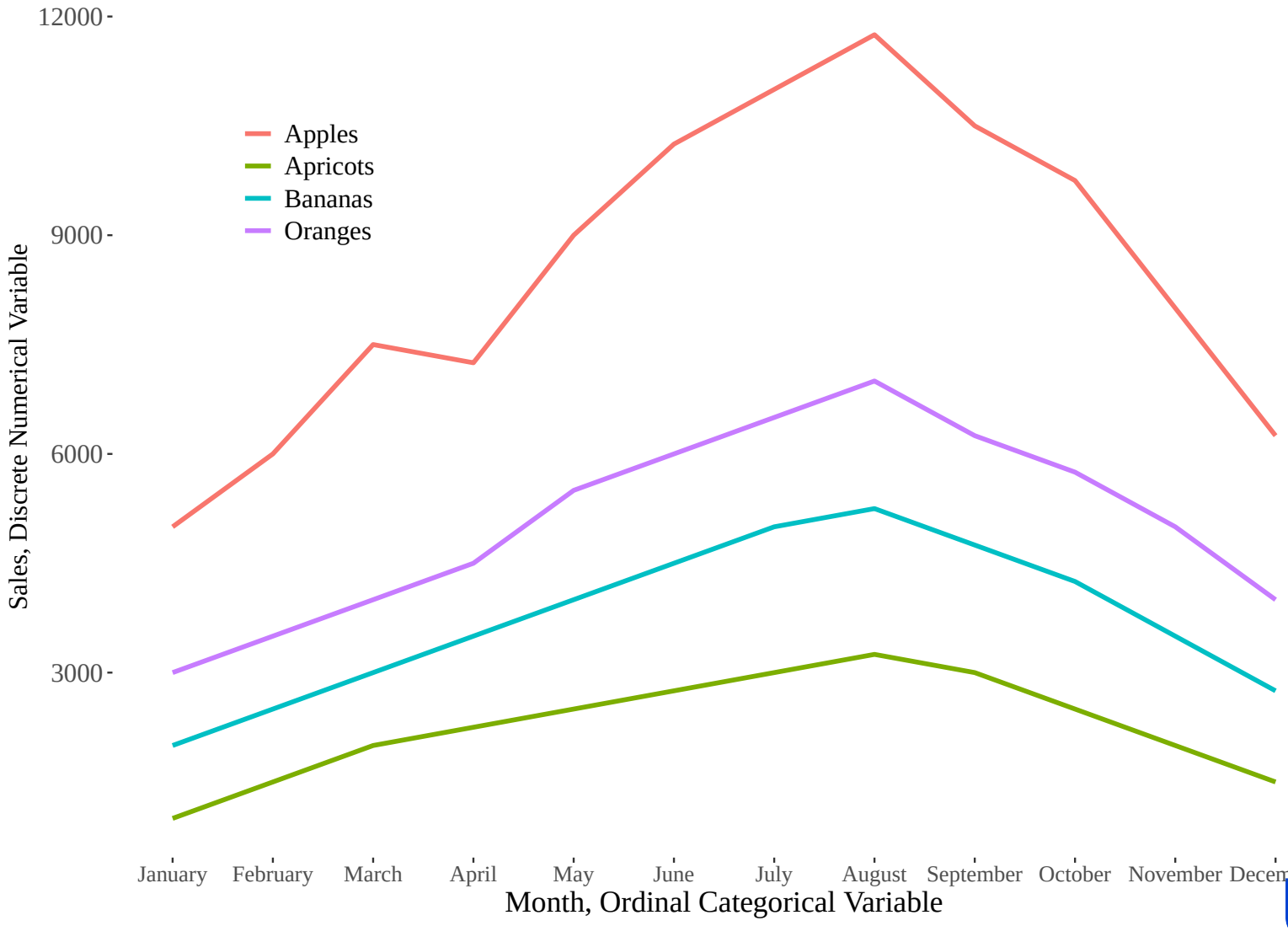
Monthly Sales of Fruits, 2022



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Code for the visualization above

```r
sales_data <- data.frame(
    Month = c("January", "February", "March", "April", "May", "June",
     "July", "August", "September", "October", "November", "December"),
    Apples = c(5000, 6000, 7500, 7250, 9000, 10250, 11000, 11750, 10500, 9750, 8000, 6250),
    Oranges = c(3000, 3500, 4000, 4500, 5500, 6000, 6500, 7000, 6250, 5750, 5000, 4000),
    Bananas = c(2000, 2500, 3000, 3500, 4000, 4500, 5000, 5250, 4750, 4250, 3500, 2750),
    Apricots = c(1000, 1500, 2000, 2250, 2500, 2750, 3000, 3250, 3000, 2500, 2000, 1500))

melted_data <- sales_data %>%
  gather(Fruits, Sales, -Month) # gather to convert to long format

melted_data$Month <- factor(melted_data$Month, levels = c("January", "February", "March",
 "April", "May", "June", "July", "August", "September", "October", "November", "December"))
melted_data$Fruits <- as.factor(melted_data$Fruits) # converting strings to factors


ggplot(melted_data, aes(x = Month, y = Sales, color = Fruits)) +
  geom_line(aes(group = Fruits), linewidth= 1.2) +  # group to specify the variable to group by
  labs(x = "Month, Ordinal Categorical Variable",
       y = "Sales, Discrete Numerical Variable",
       color = "")+ # remove legend title
    theme_tufte() +
    theme(legend.position = c(0.16, 0.8), # custom legend position
        axis.text.x = element_text(size = 12),
        axis.text.y = element_text(size = 14),
        axis.title.x = element_text(size = 16),
        axis.title.y = element_text(size = 14),
        legend.text = element_text(size = 14)
        )
```

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Additional Resources

Cool youtube videos to checkout:

- Science of Data Visualization | Bar, scatter plot, line...
- How To Choose The Right Graph

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