Proposed Content

Title: Effective Data Visualization for Actuaries

Session Description:

As actuaries, we are expected to understand the structure and rationale behind complex statistical models. Beyond that, we need to evaluate. whether one model is preferred over another in a well-defined business context. Finally, these conclusions must be shared with stakeholders who are then expected to digest and support the actuary's conclusions. Although data visualization is often touted as having maximal benefit for the last step of the process, we contend that it provides value throughout

In this session, Brian Fannin and Jordan Bonner will highlight key actuarial concepts and exhibits that can be better understood through data visualization. R's `ggplot2` package will be used to create exhibits that allow for a deeper level of understanding and intuition. By growing comfortable with the value and mechanics of visualization at all stages of the analytics cycle, actuaries will become more facile in communicating with any stakeholder at any stage.

Learning Objectives:

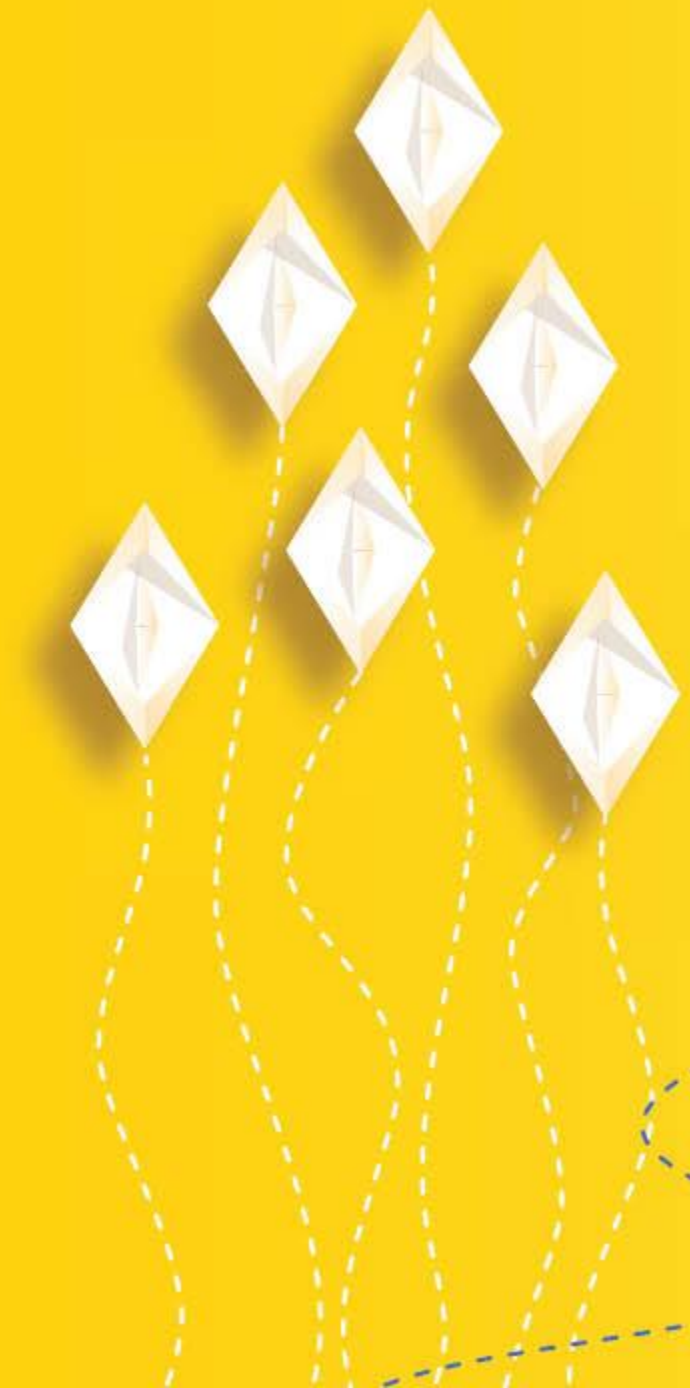
1. Unlock a deeper understanding of complicated concepts through data visualization
2. Leverage R's `ggplot2` package to create compelling actuarial exhibits
3. Restructure data visualizations to tell the right story for your audience

To Be Removed. For Reference Only.

Ideas for Interactivity

- **Familiarity with R**
- **“Which chart is easier to interpret”**
- **Test Bar/Line bias (**https://bit.ly/3ymQ1eE**)**

NAVIGATE.
PREDICT. LEAD.



SPRING MEETING

May 7–10, 2023
The Westin Boston Seaport District
Boston, MA

Effective Data Visualization for Actuaries

Jordan Bonner

Brian Fannin

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Agenda

- Seeing is Believing
- Decoding Complexity
- The Power of Persuasion

Seeing is Believing

Seeing is Believing

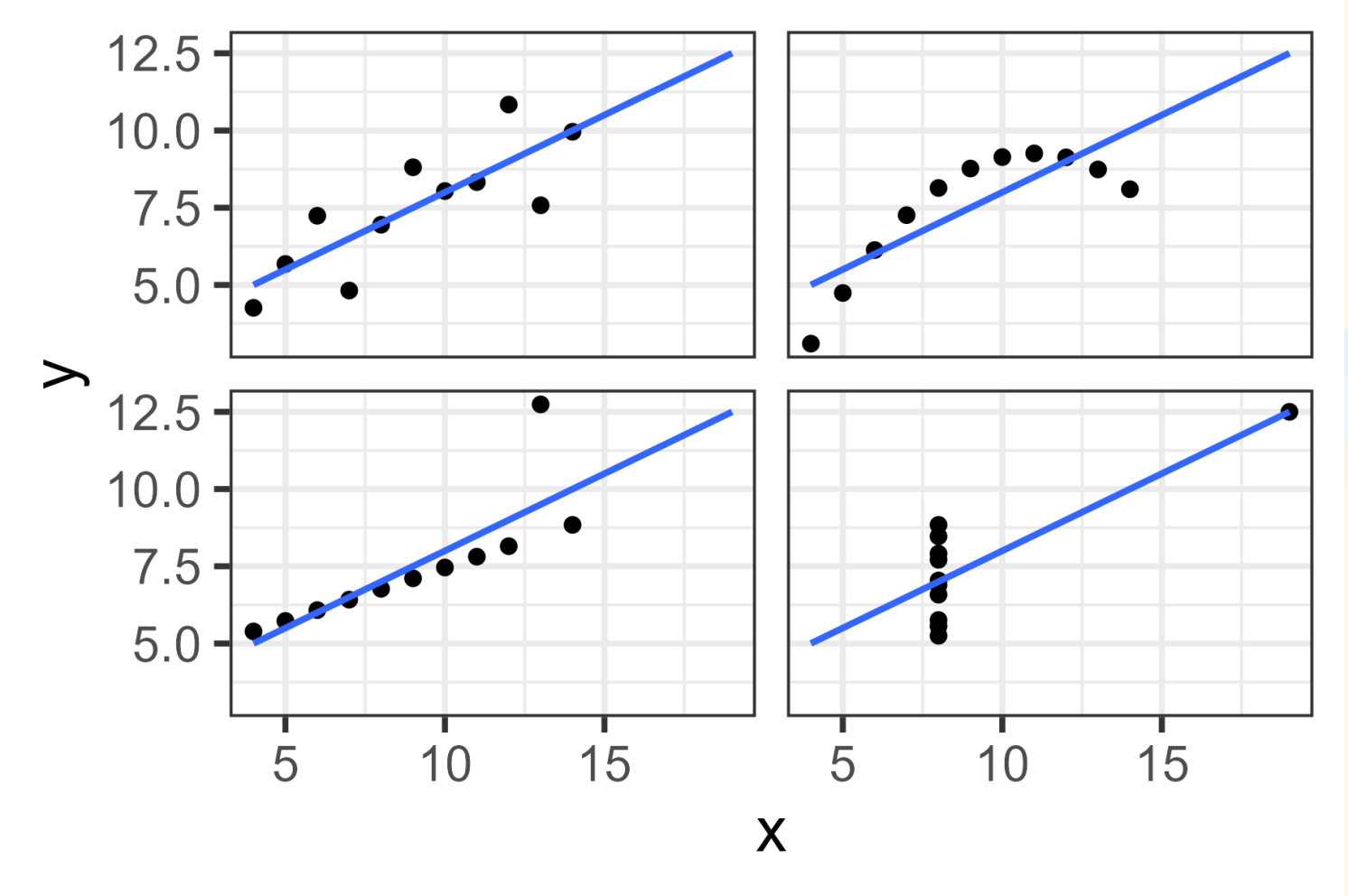
Imagine you have two datasets with two variables each (x, y).

Suppose the datasets have the same:

- means $(\bar{x}, \bar{y})$
- sample variances (s_x^2, s_y^2)
- correlation (ρ_{xy}),
- coefficient of determination (R^2)
- fitted regression line

How similar might these datasets be?

Anscombe's Quartet



Descriptive Statistics Shared:

$\bar{x}, \bar{y}$

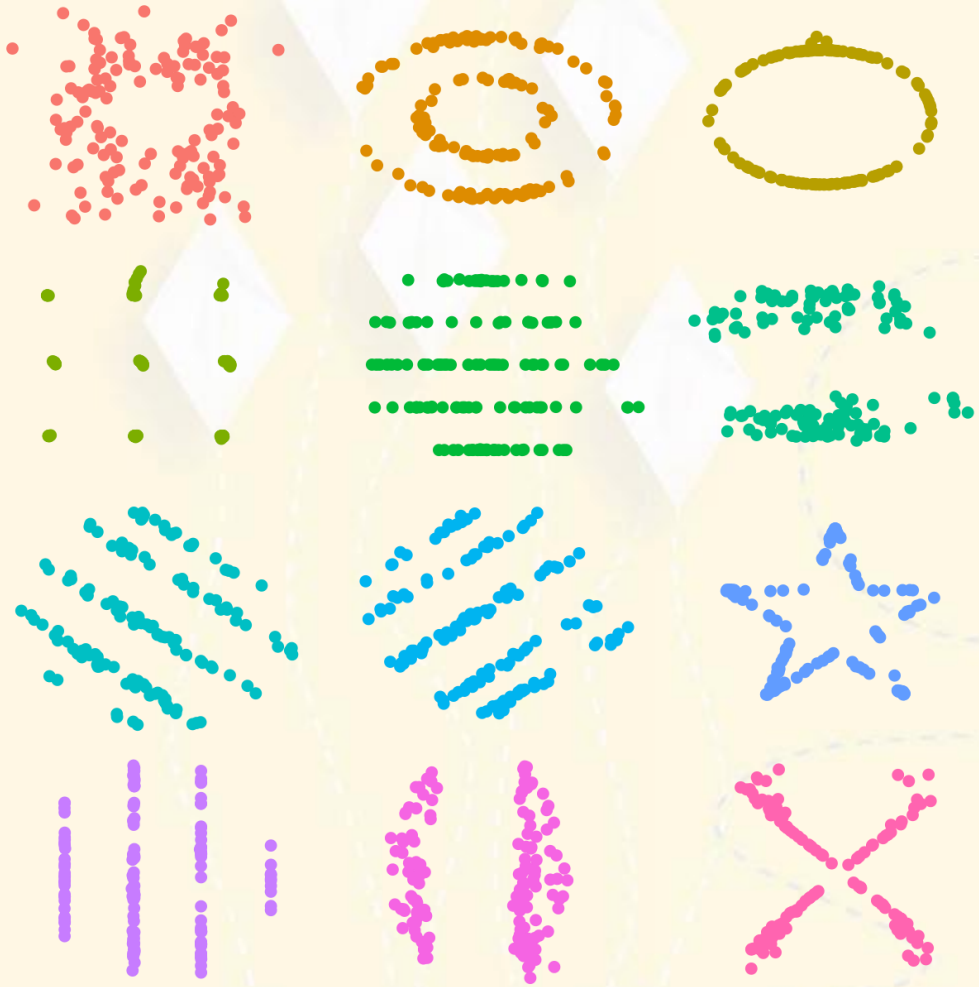
s_x^2, s_y^2

ρ_{xy}

R^2

$\hat{\beta}_0$ and $\hat{\beta}_1$

The Datasaurus Dozen



Descriptive Statistics Shared:

$\bar{x}, \bar{y}$

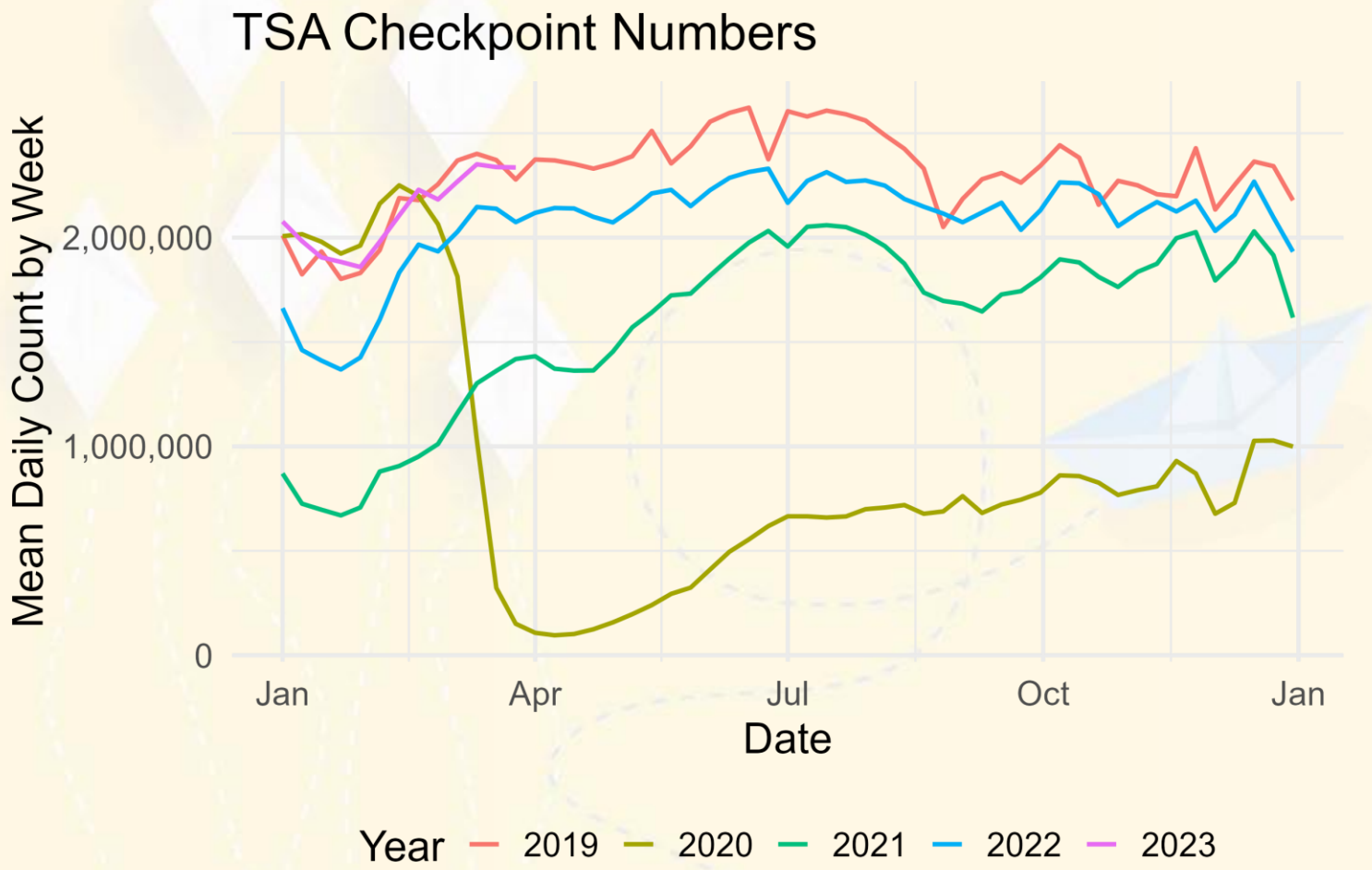
s_x^2, s_y^2

ρ_{xy}

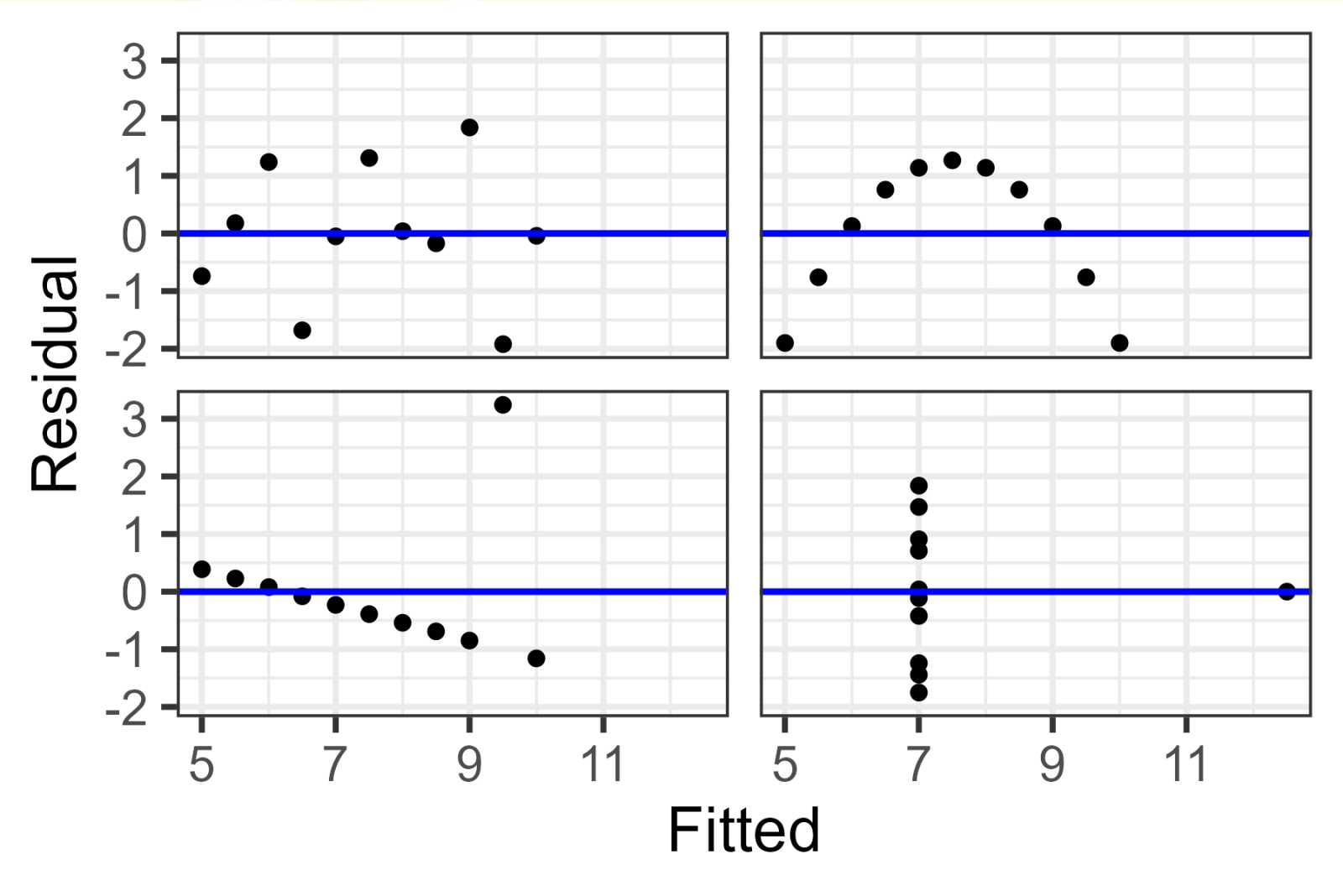
Why Seeing is Believing

- Better Pattern Identification
- Identifying Outliers
- Spotting the “Big Picture”
- Memory Retention

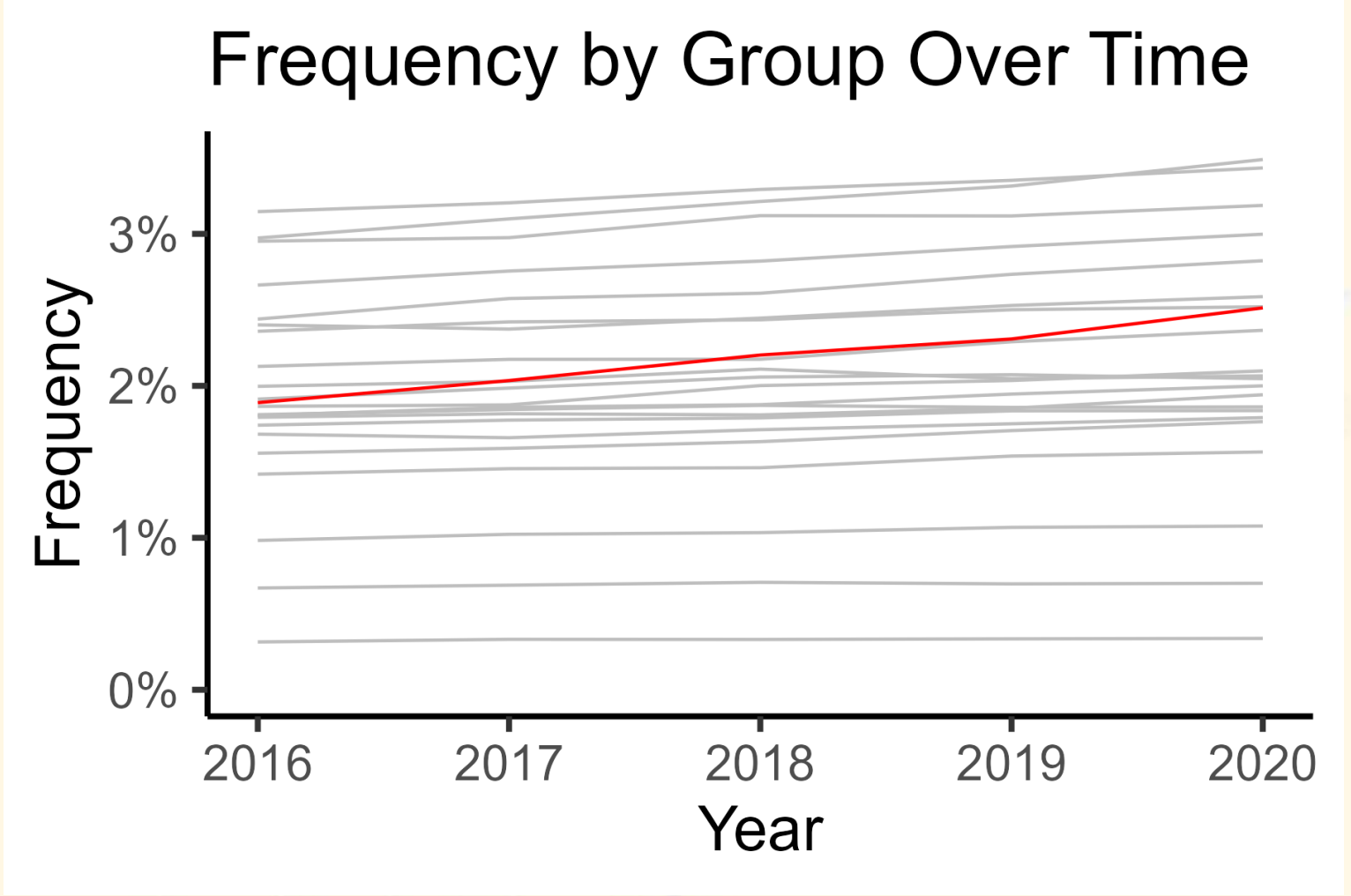
Better Pattern Identification - **Seasonality**



Identifying Outliers – **Residual Plots**

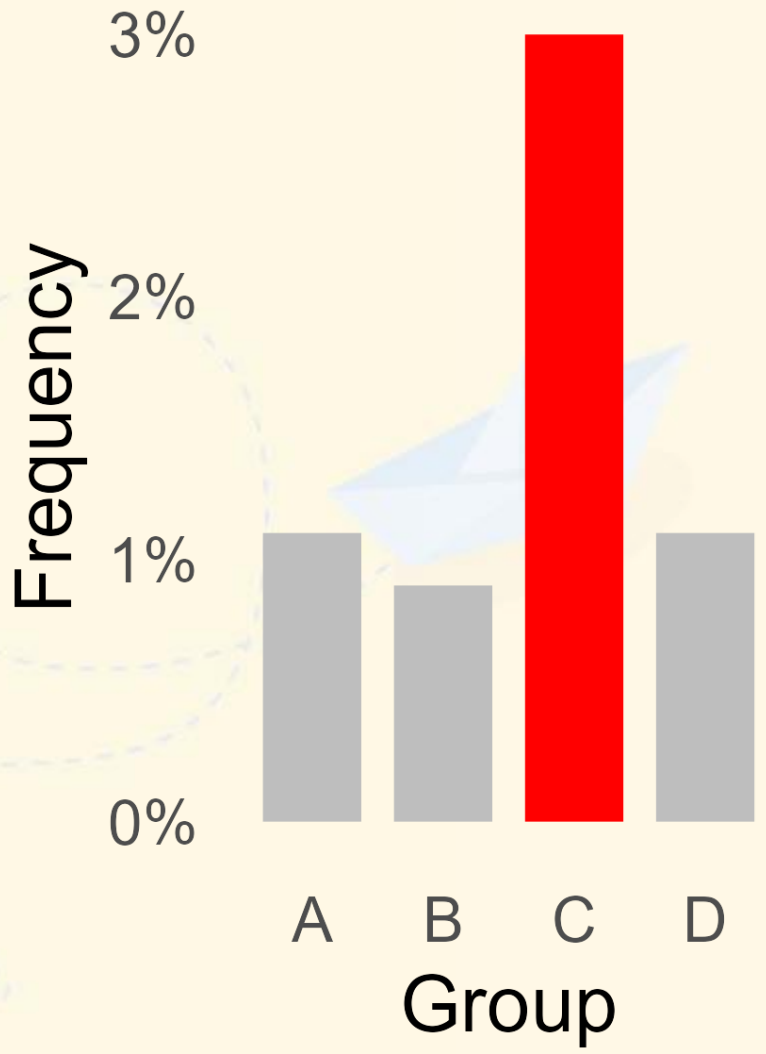


Spotting the “Big Picture”



Memory Retention

Group C Risks are 70% more likely to file a claim.



Decoding Complexity

Decoding Complexity

- Univariate Linear Regression
- Principal Components Analysis
- Decision Trees
- Correlation & Tail Correlation

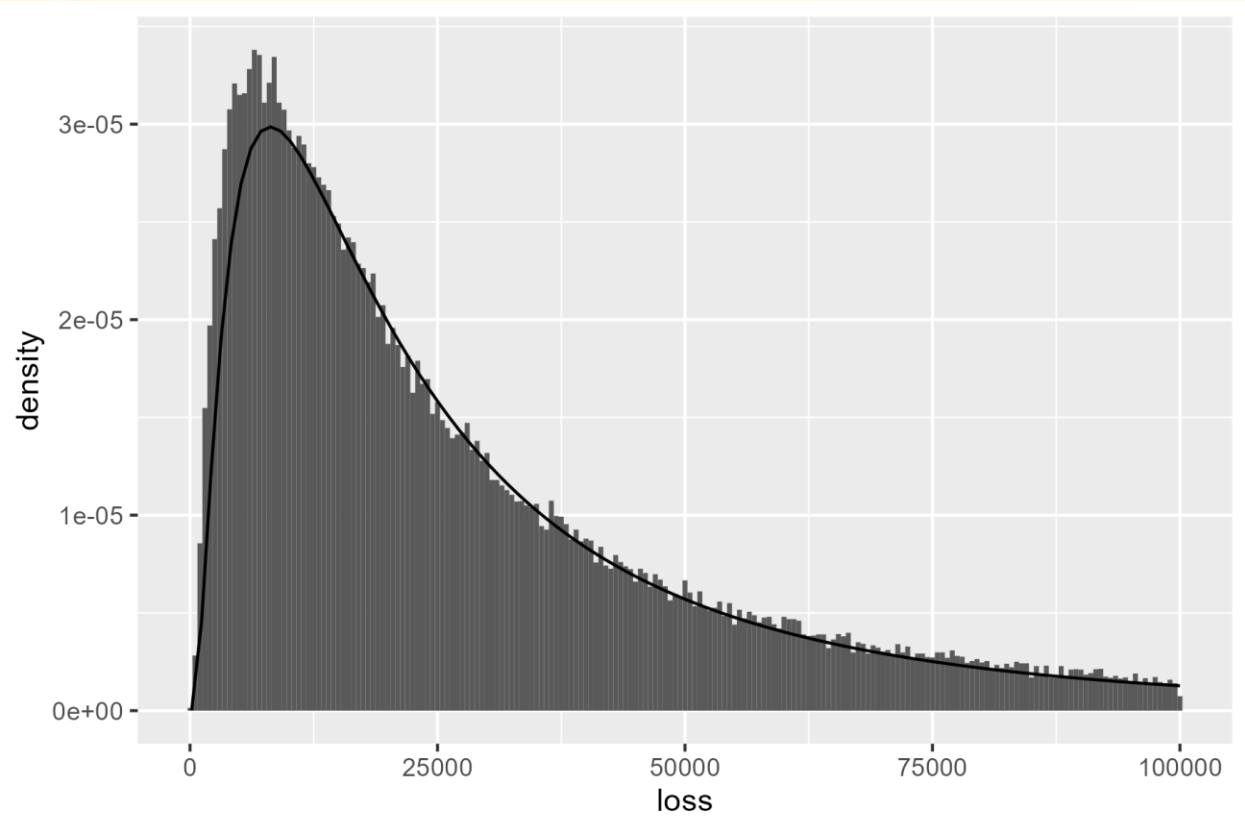
The Power of Persuasion

The Power of Persuasion

- Highlighting Key Insights
- Telling a Story
- Providing Context
- Show Comparisons

Initial Example: Fitted Severity

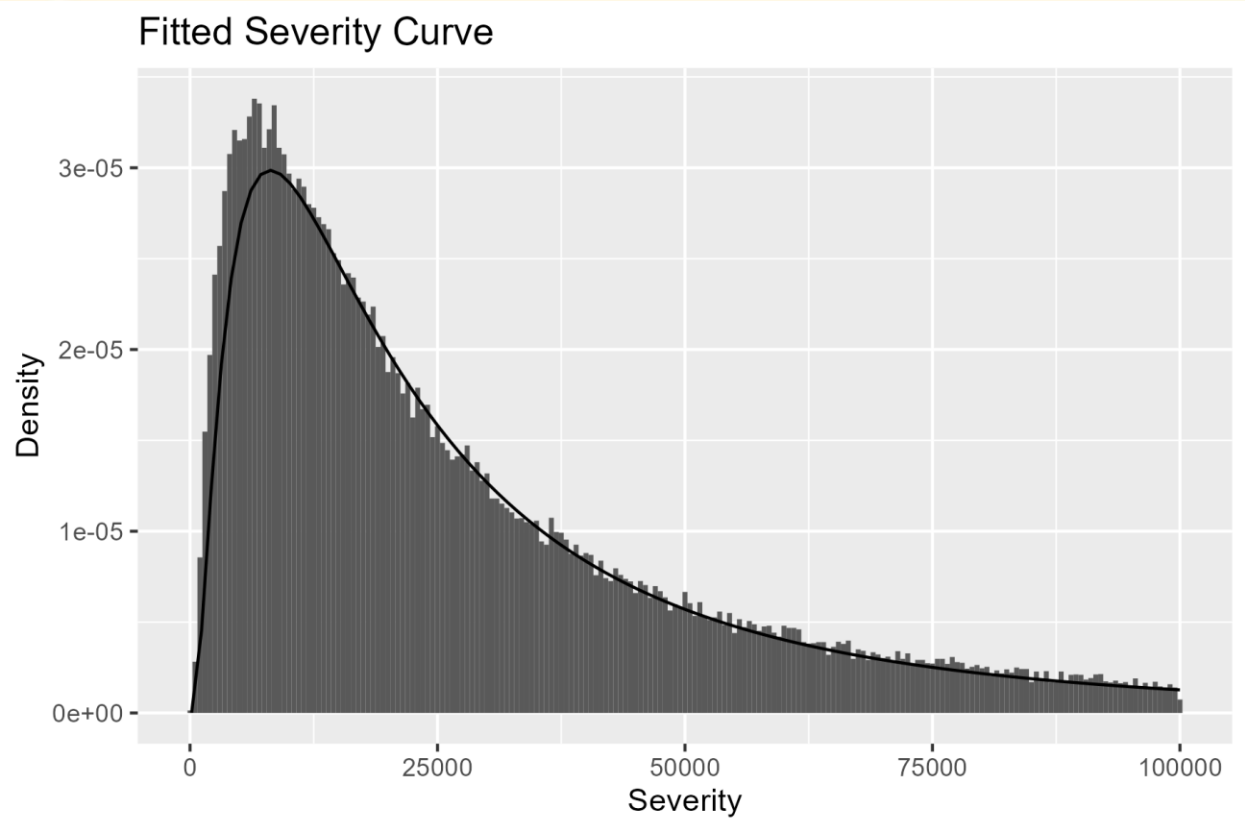
How can we improve upon this chart?




```
p <- data |>
  geom_histogram(aes(x = loss, after_stat(density)) +
  stat_function(fun = dlnorm,
                args = list(meanlog = 10, sdlog = 1.0))
```

Titles & Renaming Variables

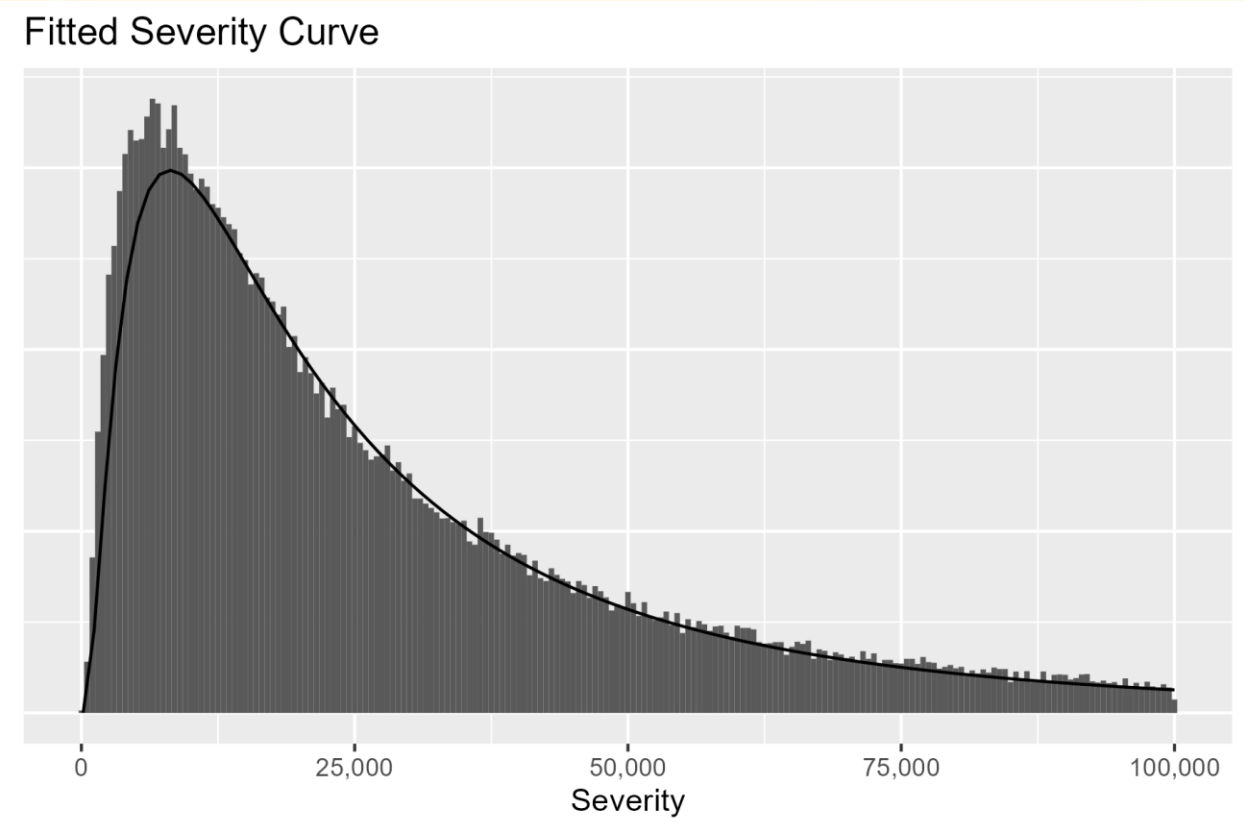
Adding a title and variable names goes a long way.




```
p <- p +
 labs(
    x = "Severity",
    y = "Density",
    title = "Fitted Severity Curve"
  )
```

Cleaning Axes

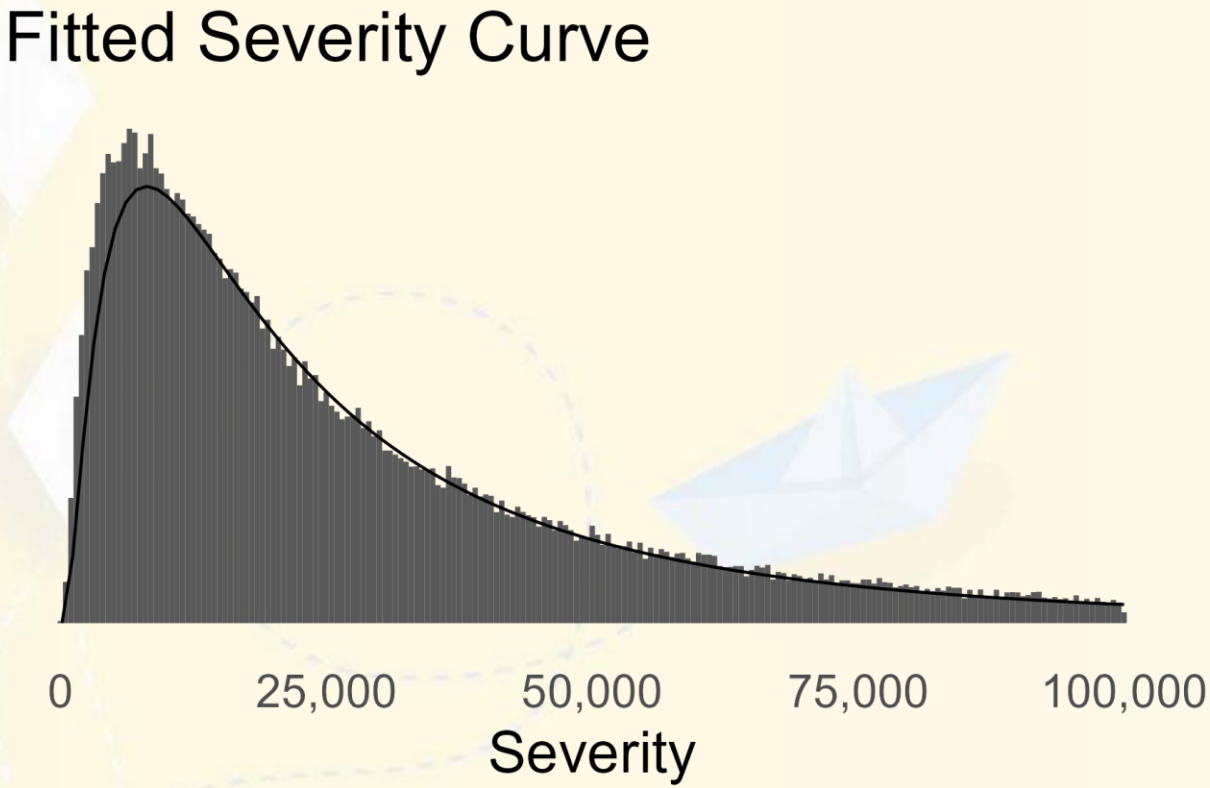
We can change the x-axis labels and remove the y-axis.




```
p <- p +
  scale_x_continuous(labels = scales::comma) +
  theme(axis.text.y = element_blank(),
        axis.ticks.y = element_blank(),
        axis.title.y = element_blank())
```

Text Size & Theme

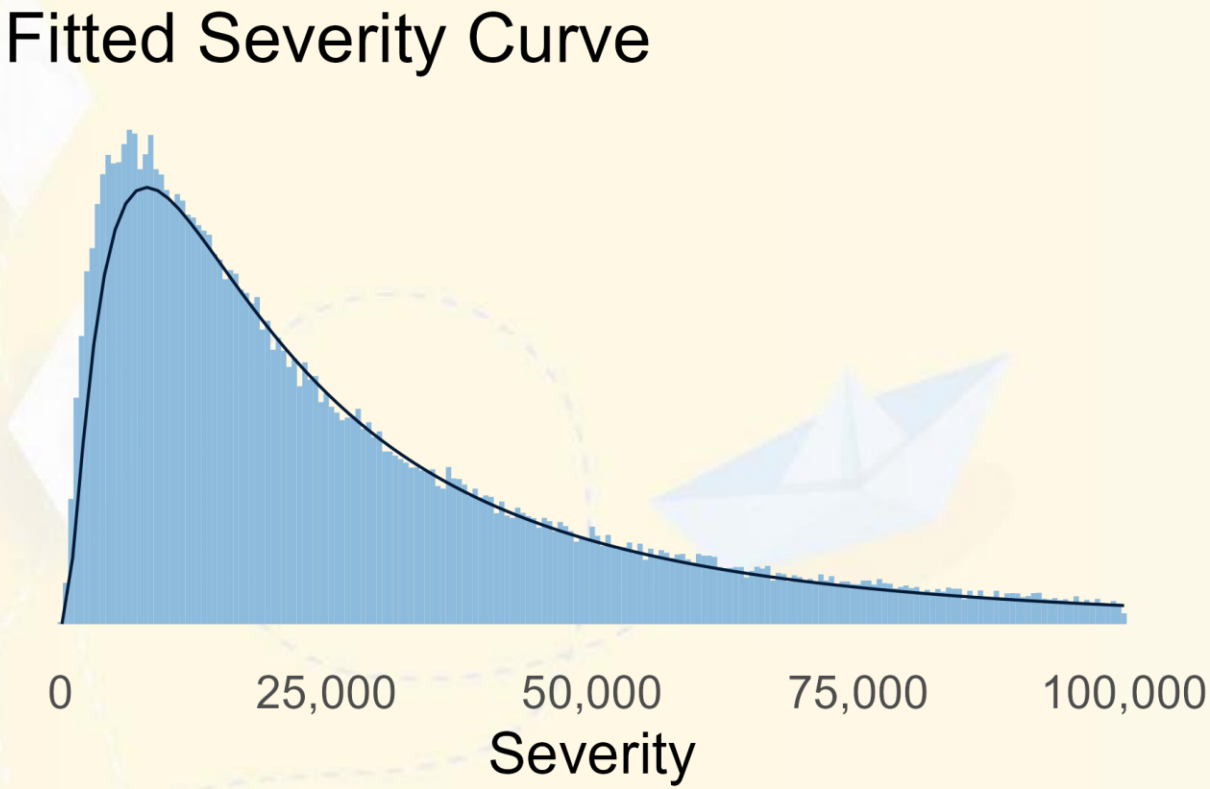
We can increase text size and select a simpler theme.




```
p <- p +
  theme_minimal(base_size = 20) +
  theme(panel.grid.major = element_blank(),
        panel.grid.minor = element_blank()) +
  scale_x_continuous(labels = scales::comma) +
  theme(axis.text.y = element_blank(),
        axis.ticks.y = element_blank(),
        axis.title.y = element_blank())
```

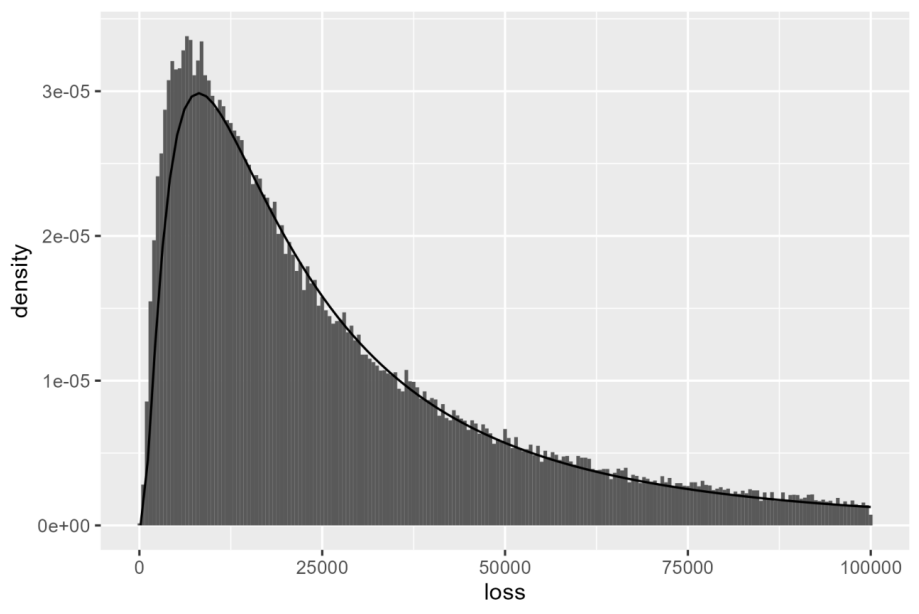
Color

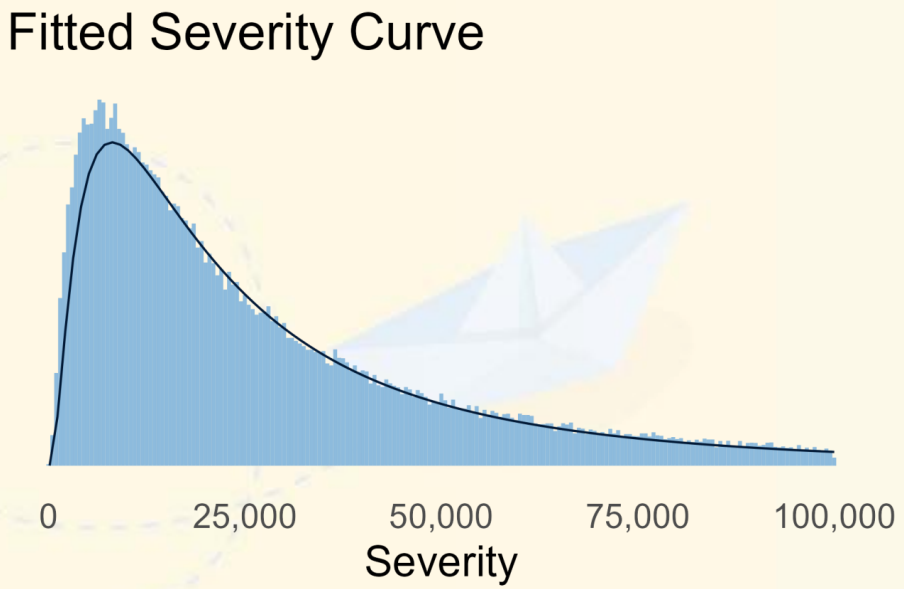
We can also update the color, if desired.



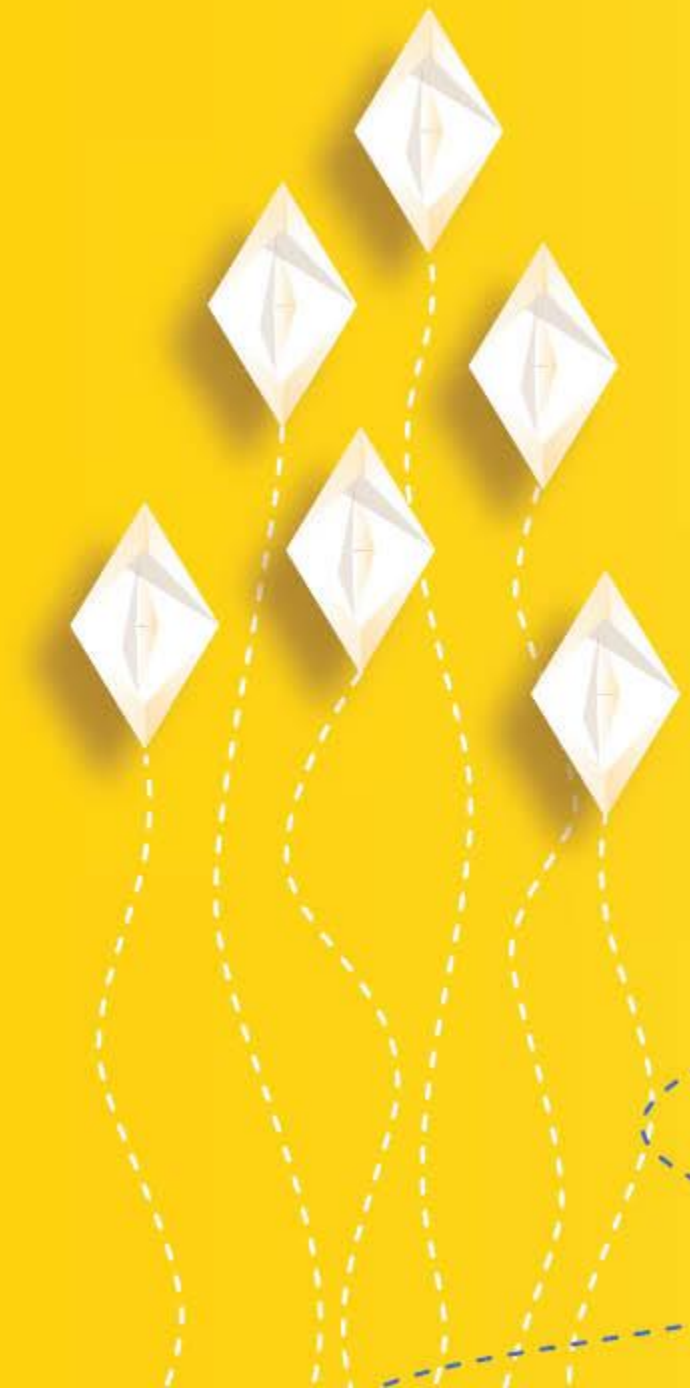

```
...
  geom_histogram(aes(x = loss, after_stat(density)),
                 fill = pal_CAS["light_blue"]) +
  stat_function(fun = dlnorm,
                args = list(meanlog = 10, sdlog = 1.0),
                color = pal_CAS["dark_blue"]) +
...
```

Comparison


3e-05
2e-05
1e-05
0e+00
density
0
25000
50000
75000
100000
loss


Fitted Severity Curve
0
25,000
50,000
75,000
100,000
Severity

NAVIGATE.
PREDICT. LEAD.



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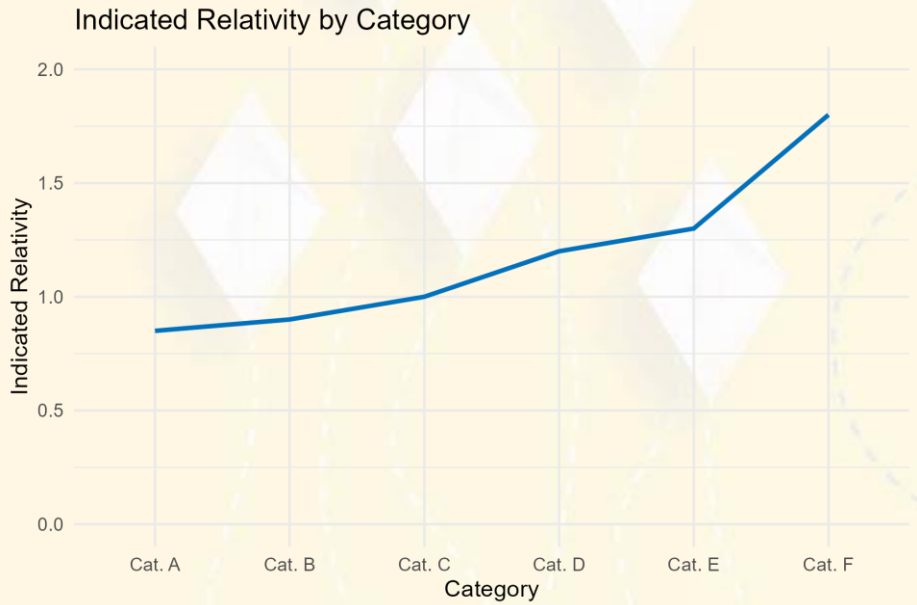
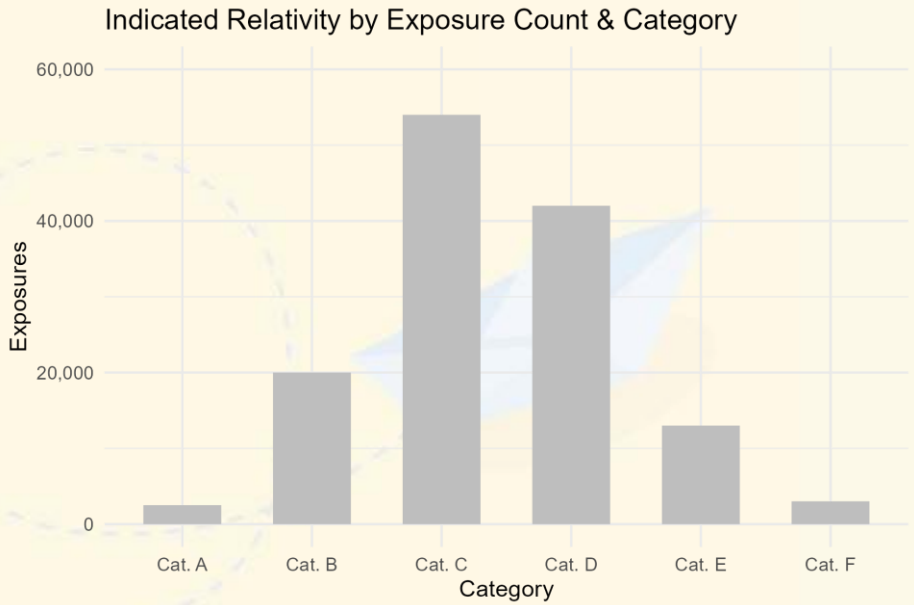
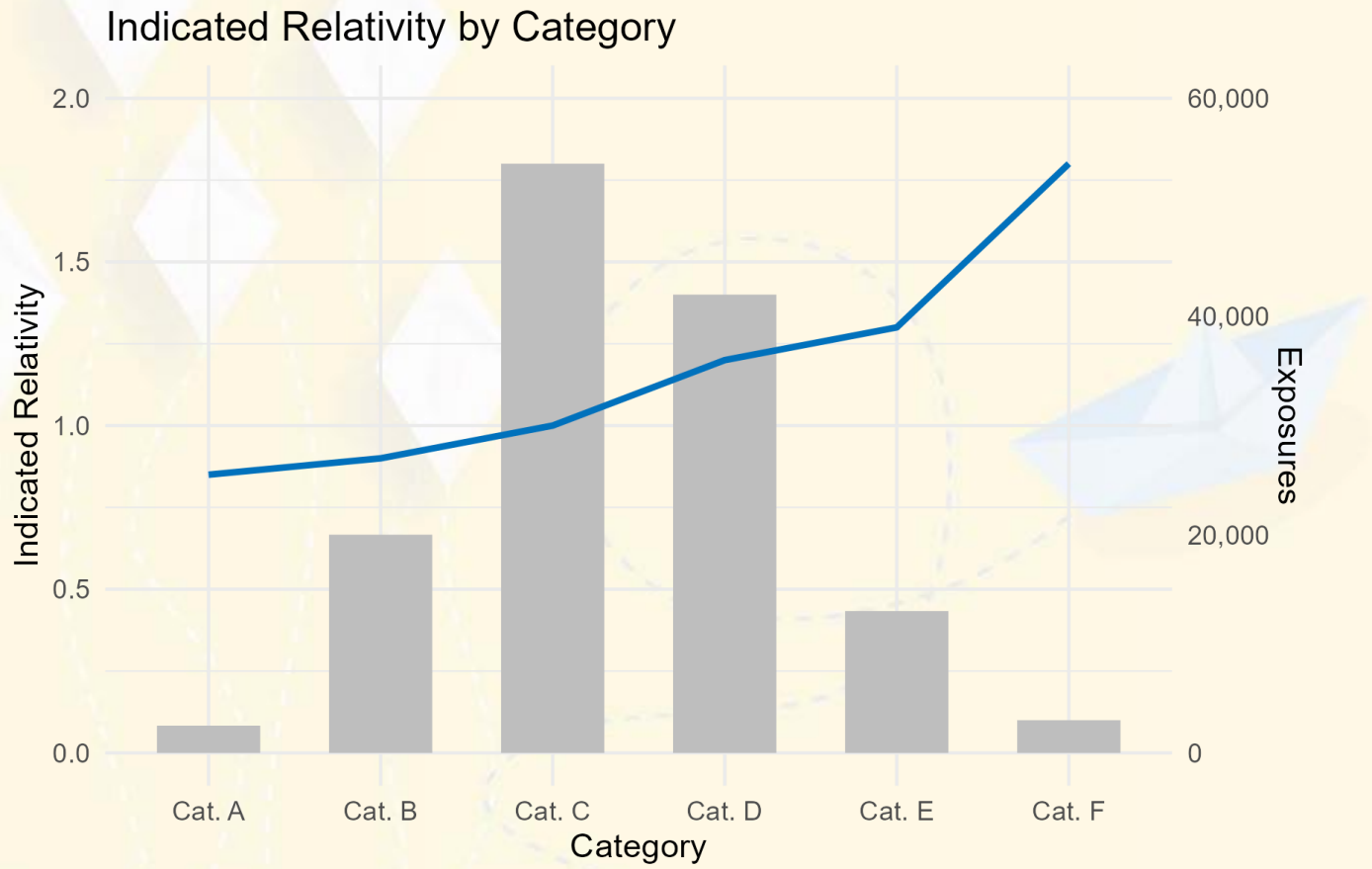
Appendix

Two Axes vs Two Charts

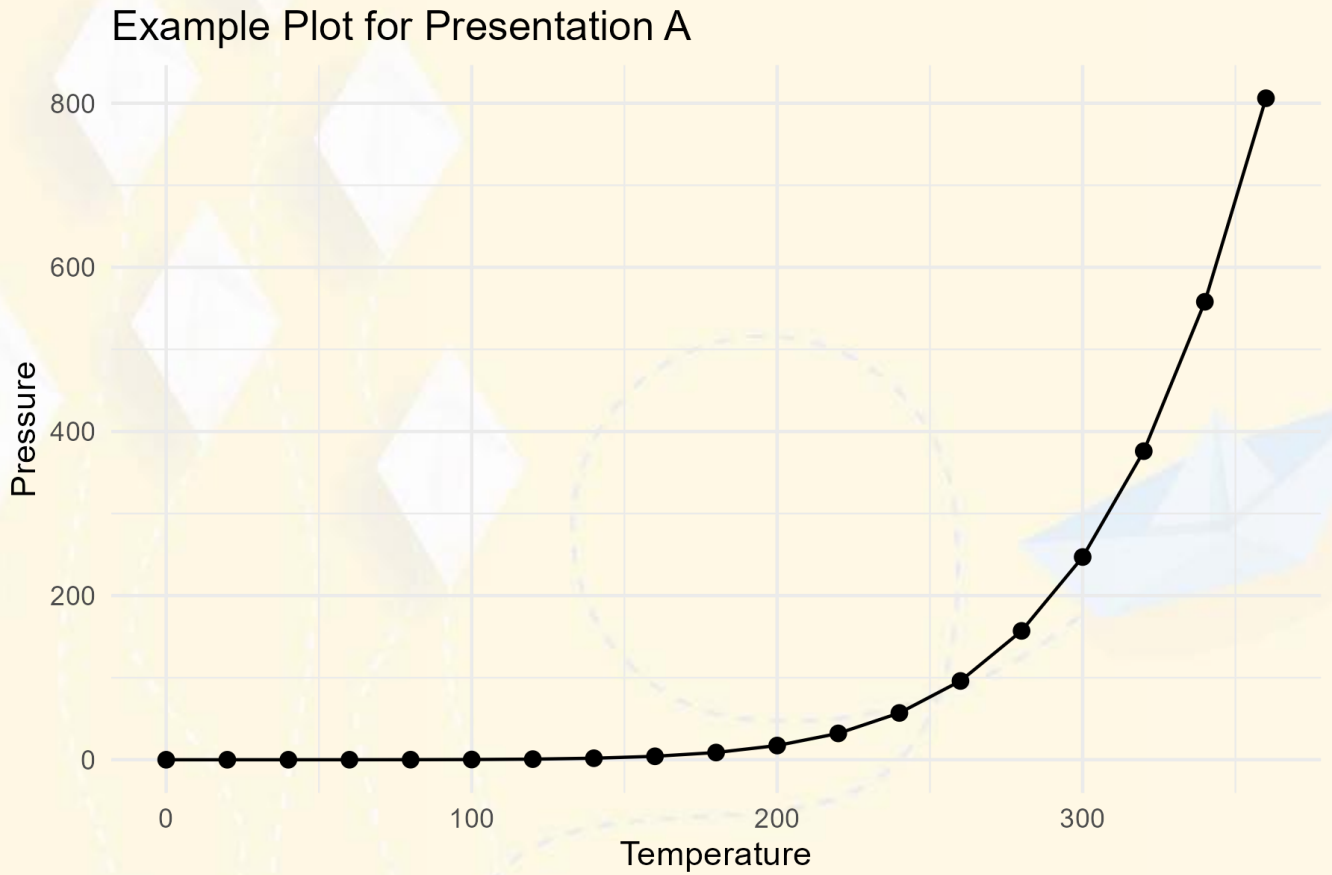




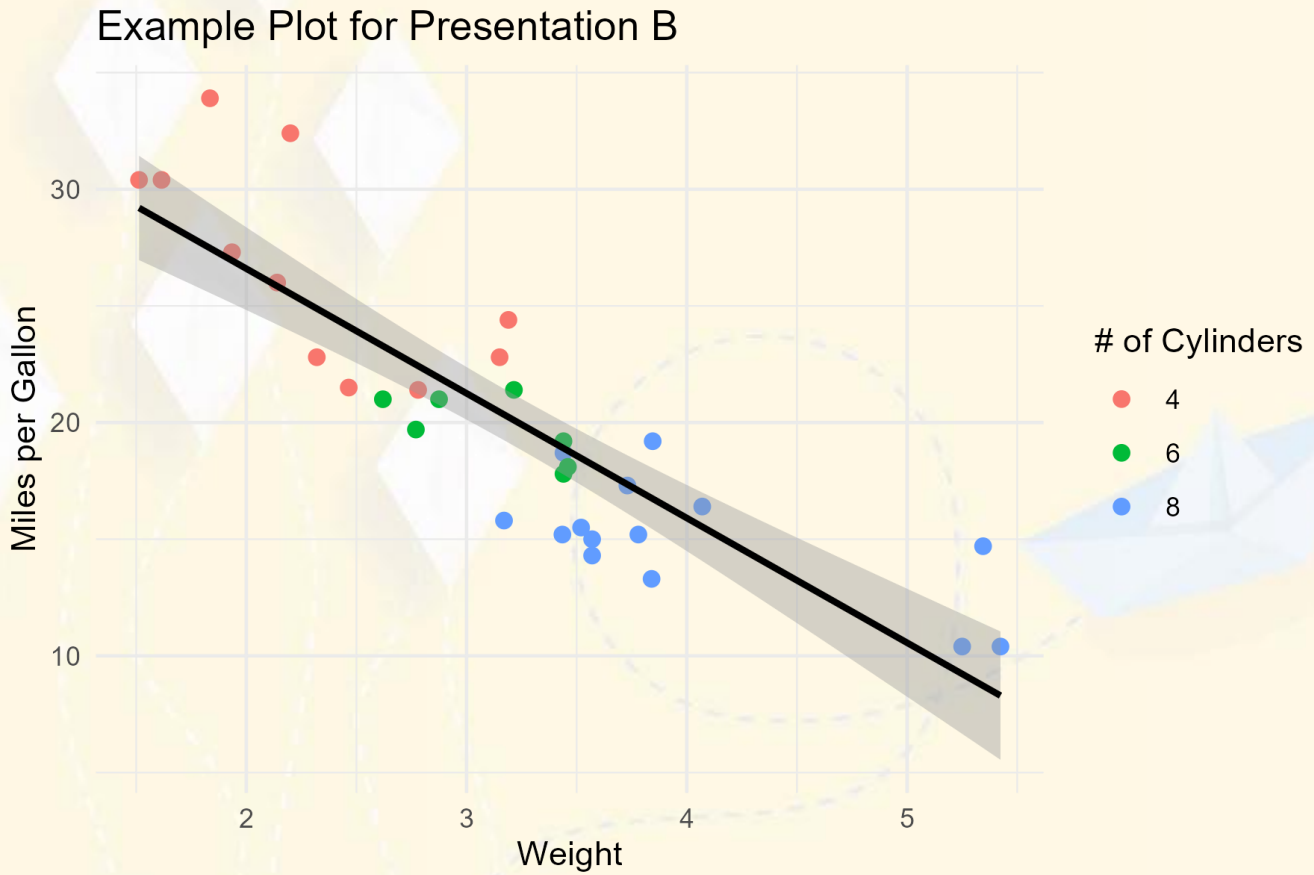
Two Axes vs Two Charts



Example Plot A



Example Plot B



Example Plot C