

# ISA 401: Business Intelligence & Data Visualization

## 19: Charts Used for Time-Series Data

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 Automated Scheduler for Office Hours

Fall 2025

10:00

# Non-graded: COVID19 Data Viz

Over the next 10 minutes, use Tableau to answer the following questions based on the [`covid\_cases\_county.csv`](#) (which can be downloaded from Canvas):

- **What are the total number of cases per county?** Use a suitable map to answer this question.
- **What are the total number of deaths per state?** You can show that using either a table or a map. In case of a map, please show the numbers for each state on the map as well.

# Learning Objectives for Today's Class

- Understand main goals behind visualizing time-series data
- Explain the different types of charts for univariate and multivariate time-series

# Types of Data Over Time

# Cross Sectional Data

**Cross Sectional Data:** Measurements on multiple units, recorded in a single time period.

**Example 1:** H1B 2020-2025 Data for Senior Data Scientists at Netflix

	START DATE	JOB TITLE	BASE SALARY	LOCATION
1	2021-08-11	SENIOR DATA SCIENTIST	118,955	LOS GATOS, CA
2	2021-06-14	SENIOR DATA SCIENTIST	143,291	LOS GATOS, CA
3	2021-06-14	SENIOR DATA SCIENTIST	143,291	LOS GATOS, CA
4	2021-06-14	SENIOR DATA SCIENTIST	143,291	LOS GATOS, CA
5	2021-09-09	SENIOR DATA SCIENTIST	143,291	LOS GATOS, CA

Showing 1 to 5 of 24 entries

Previous

1

2

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5

Next

# Cross Sectional Data

**Cross Sectional Data:** Measurements on multiple units, recorded in a single time period.

**Example 2:** NBA 2025-2026 Leaders - Top Players in PTS/Game

Player	Pos	Age	G	FG	FG%	eFG%	PTS
1 Luka Dončić	PG	26	2	15.5	0.62	0.69	46
2 Tyrese Maxey	PG	25	3	11.7	0.461	0.559	37
3 Giannis Antetokounmpo	PF	31	3	13.7	0.683	0.717	36
4 Shai Gilgeous-Alexander	PG	27	4	12.3	0.51	0.542	35.8
5 Austin Reaves	SG	27	4	10.8	0.573	0.653	35.8

Showing 1 to 5 of 415 entries

Previous

1

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...

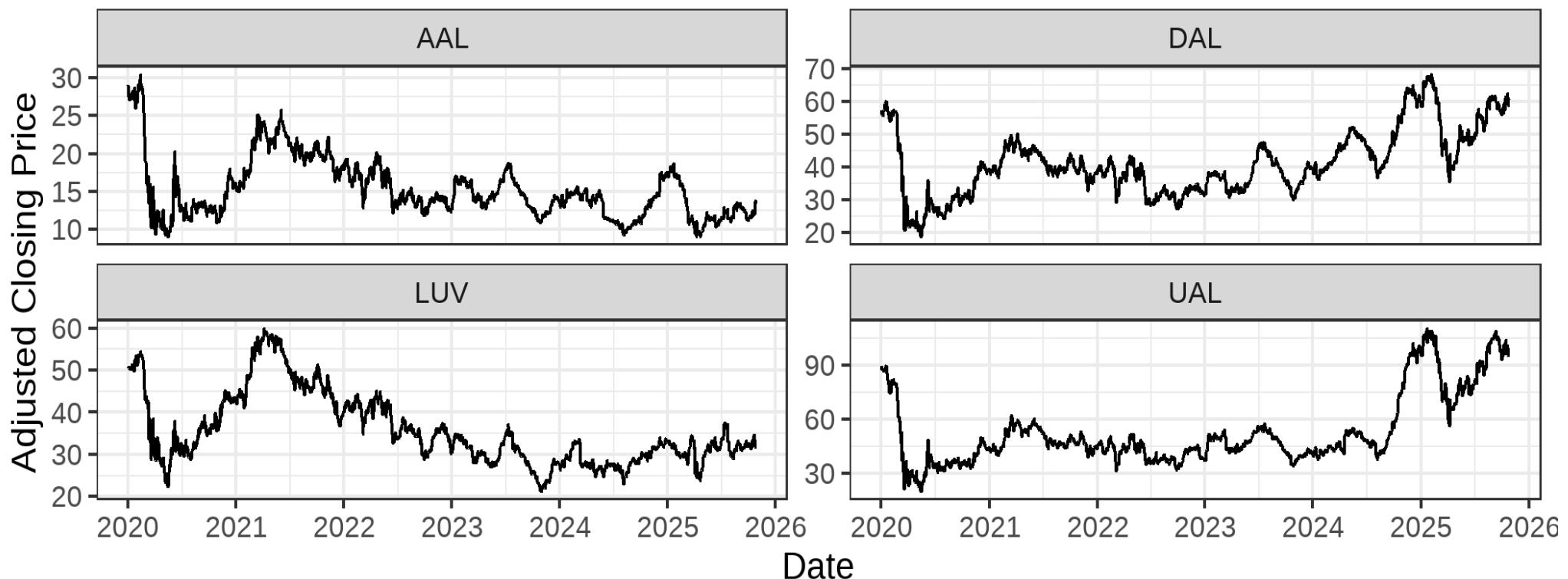
83

Next

# Time Series Data

**Time Series Data:** Comparable measurements recorded on a single (or a few) variables over time (usually a long period of time).

**Example 2:** Stock prices of U.S. Airlines



# Panel Data

**Panel Data:** Cross sectional measurements (usually many variables) repeated over time (usually over a few time periods).

**Example:** World Bank's Data

	iso3c◆	date◆	NY.GDP.MKTP.KD.ZG◆	SH.DYN.NMRT◆	SH.HIV.INCD.ZS◆	SH.MED.BED◆
1	CHN	2022	3.1	3		
2	CHN	2023	5.4	2.8		
3	CHN	2024	5	2.8		
4	EGY	2022	6.6	9.6	0.1	
5	EGY	2023	3.8	9.3	0.1	

Showing 1 to 5 of 9 entries

Previous

1

2

Next

**Source:** Data queried from the [World Bank Data](#) using the `wbstats`  in R. The printed results show a snapshot of 7 variables (out of a much larger panel dataset). You can think of panel data as a cross-sectional dataset with a longitudinal/time component.

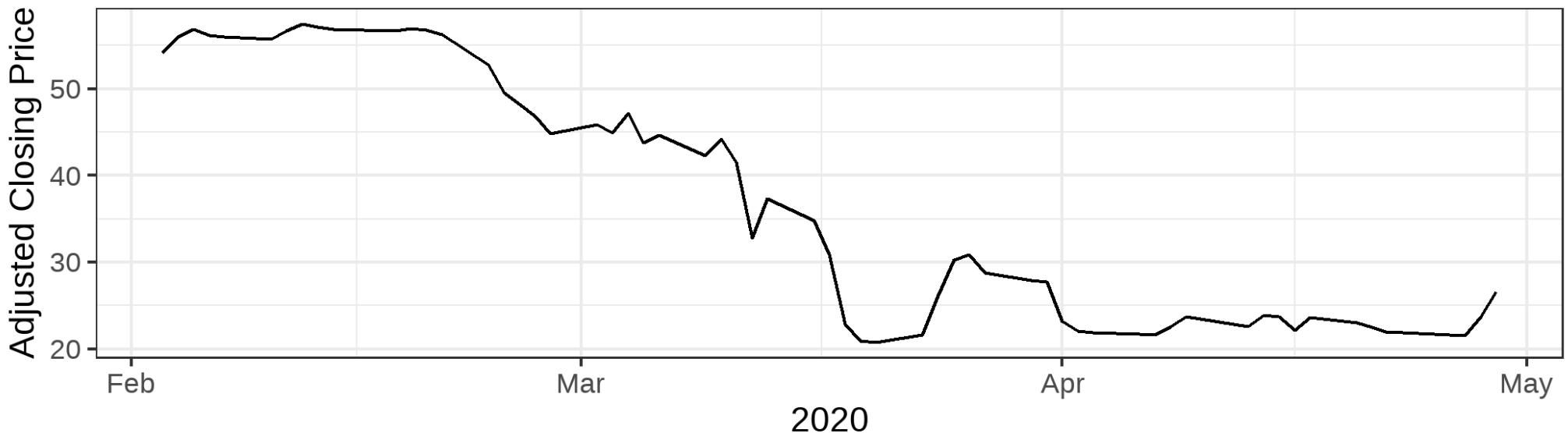
# Components of a Time Series

# Trend

A **trend** is an increasing or decreasing pattern over time.

## Decreasing Trend

The decline in \$DAL from 2020-02-03 to 2020-04-30



# Seasonality

**Seasonality** refers to the property of a time series that displays REGULAR patterns that repeat at a constant frequency ( $m$ ).

## Seasonality with a Multiplicative Trend

Non-linear trend & seasonal component grows over time

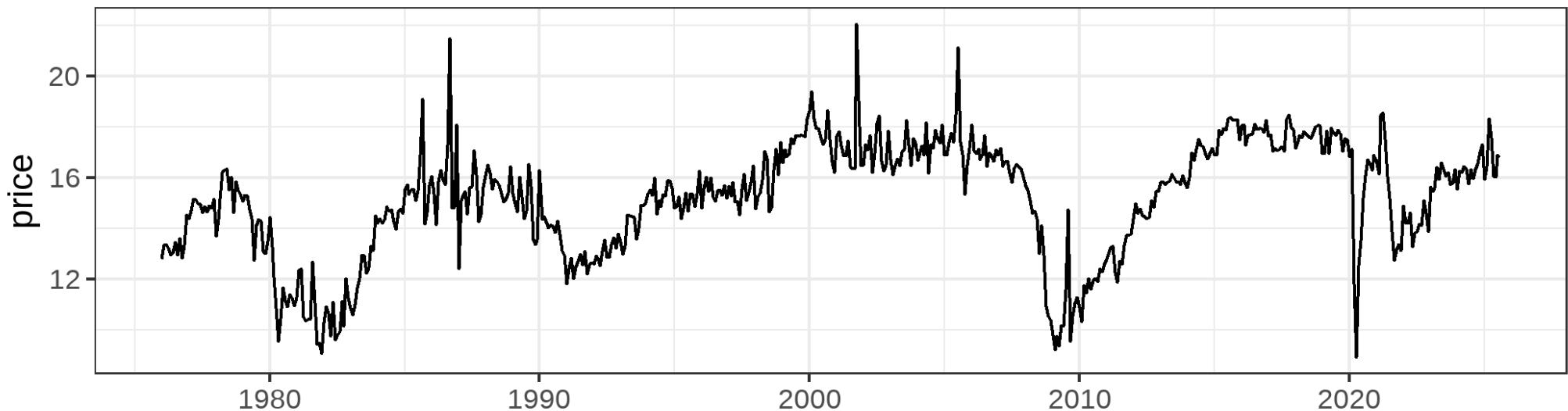


AirPassengers R Dataset -- Source: Box, G. E. P., Jenkins, G. M. and  
Reinsel, G. C. (1976) Time Series Analysis, Forecasting and Control.

# Cycle

**Cyclical fluctuations** are somewhat irregular (unknown duration).

The cyclical nature of auto sales



U.S. Bureau of Economic Analysis, Total Vehicle Sales [TOTALSA], retrieved from FRED, Federal Reserve Bank of St. Louis  
<https://fred.stlouisfed.org/series/TOTALSA>, on October 28, 2025

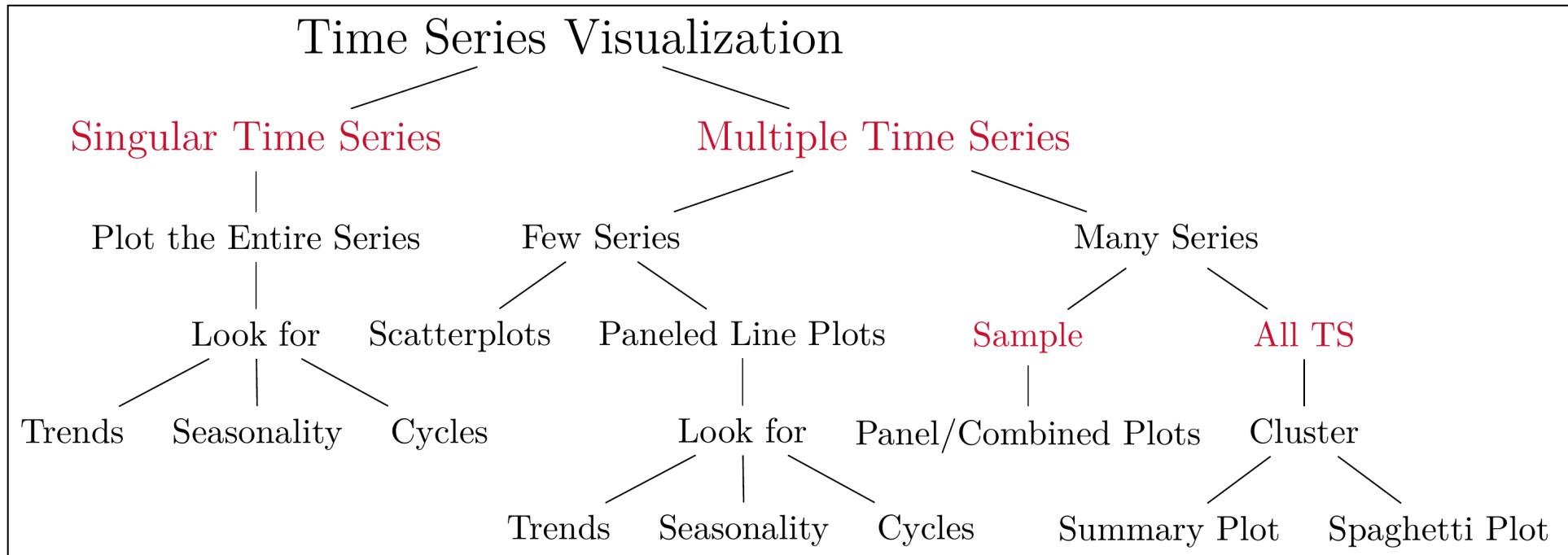
# The Goals Behind Visualizing (Time Series) Data

# Exploratory vs Confirmatory Viz Goals

*Visualizations can be used to explore data, to confirm a hypothesis, or to manipulate a viewer. . . In exploratory visualization the user does not necessarily know what he is looking for. This creates a dynamic scenario in which interaction is critical. . . In a confirmatory visualization, the user has a hypothesis that needs to be tested. This scenario is more stable and predictable. System parameters are often predetermined.*

-- (Grinstein and Ward 2001, 22)

# A Structured Approach for Time Series Viz

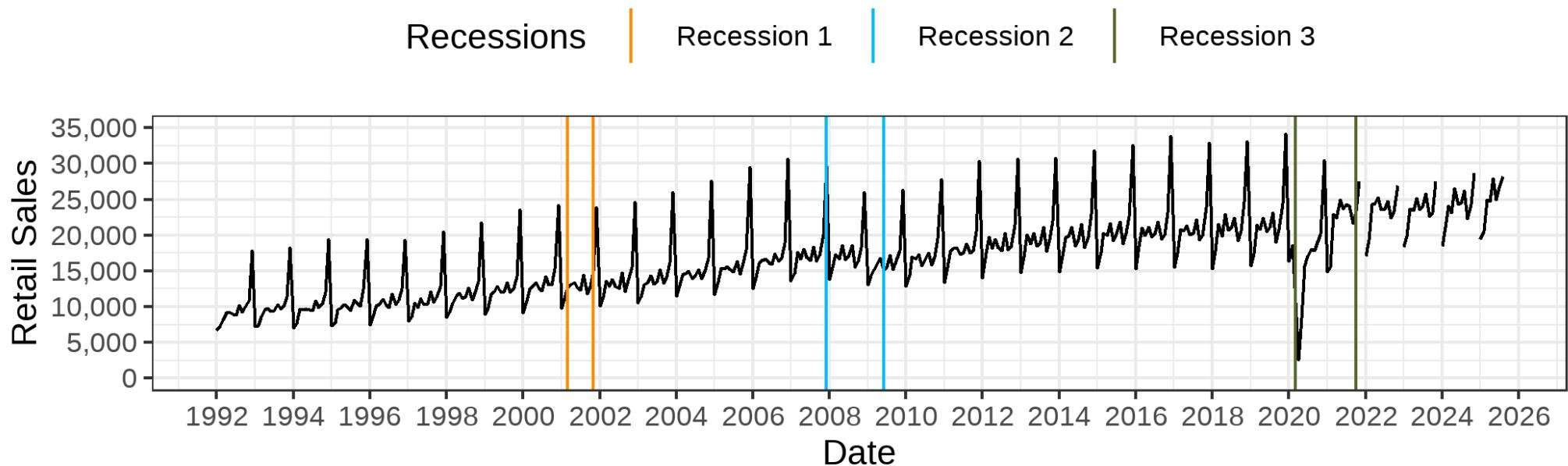


A Potential Framework for Time Series Visualization

This is my best attempt to improve on the general advice provided in the previous slide. Many of the suggestions, presented in this flow chart, stem from my past and current research/consulting collaborations. They are by no means a comprehensive list of everything that you can do.

# Singular TS

Monthly Retail Sales (RSCCASN) in the U.S.

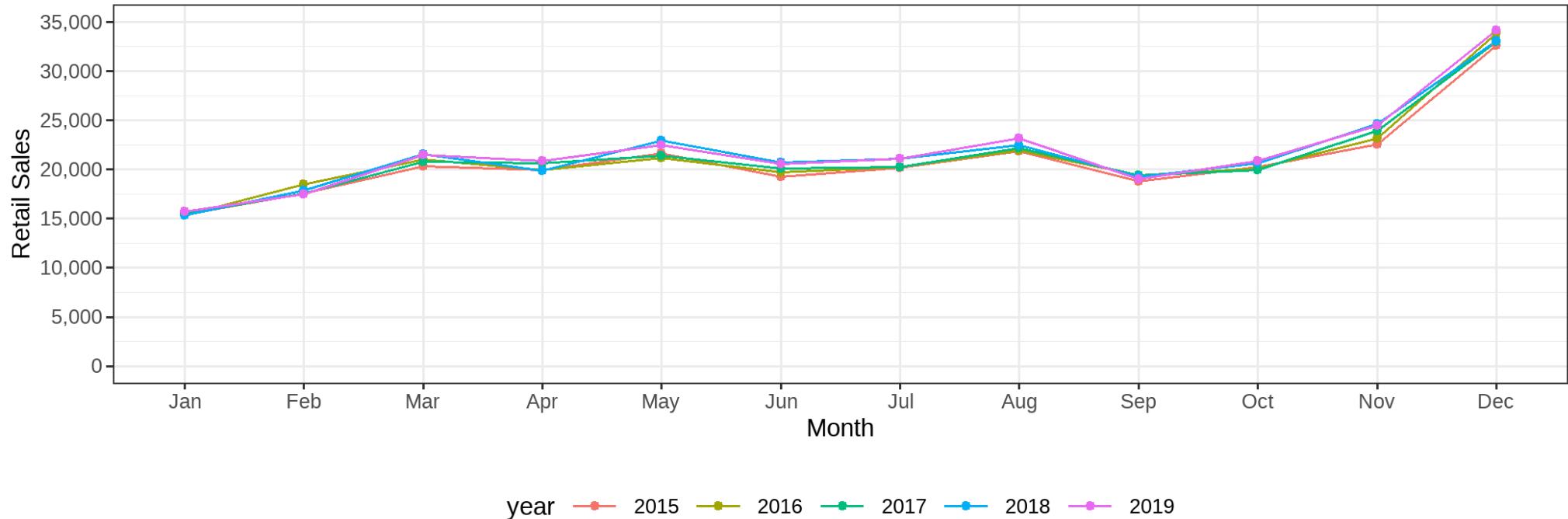


# Looking for Trends

Monthly Retail Sales (RSCCASN) in the U.S.

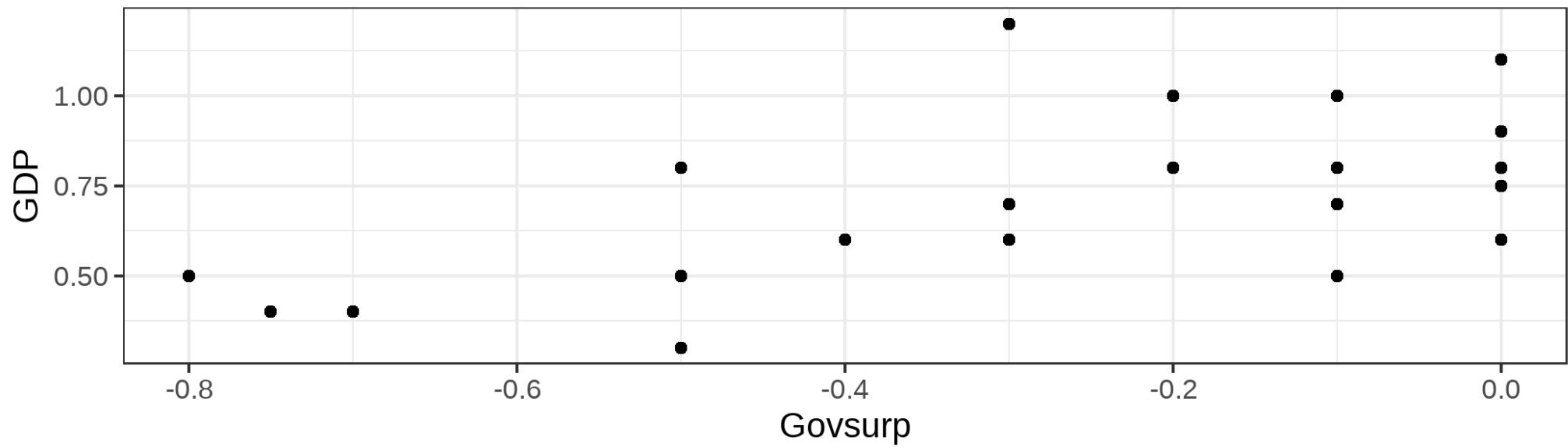


# Looking for Seasonality



# Multiple TS: Scatterplots

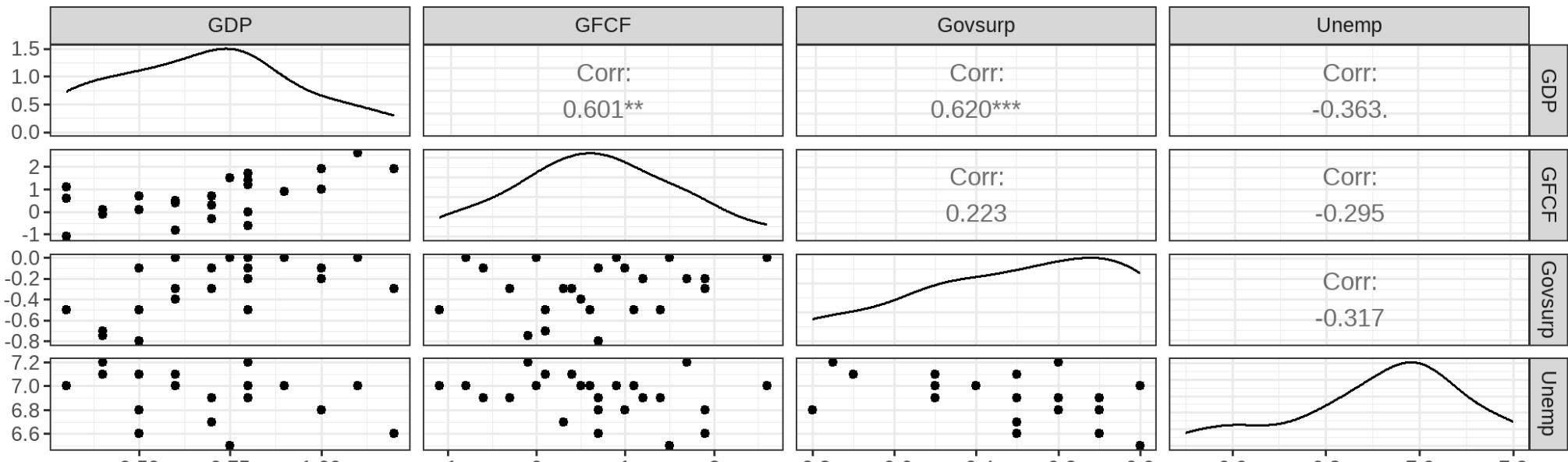
Scatterplot of GDP vs. Government Spending



Data from Muller-Droge et al. (2016)

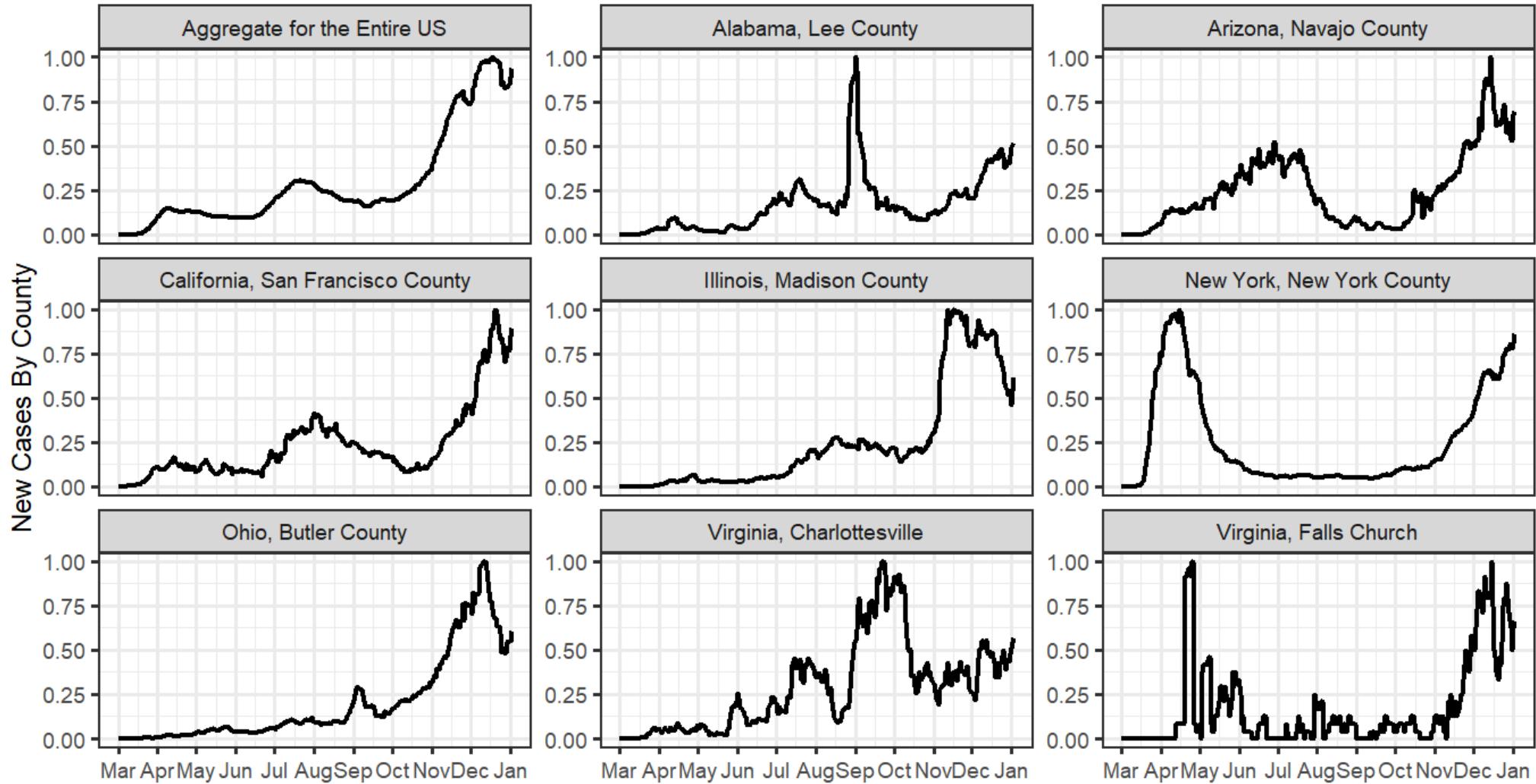
# Multiple TS: Scatterplot Matrix

Matrix Plot of GDP, GFDCF, Govsurp & Unemp

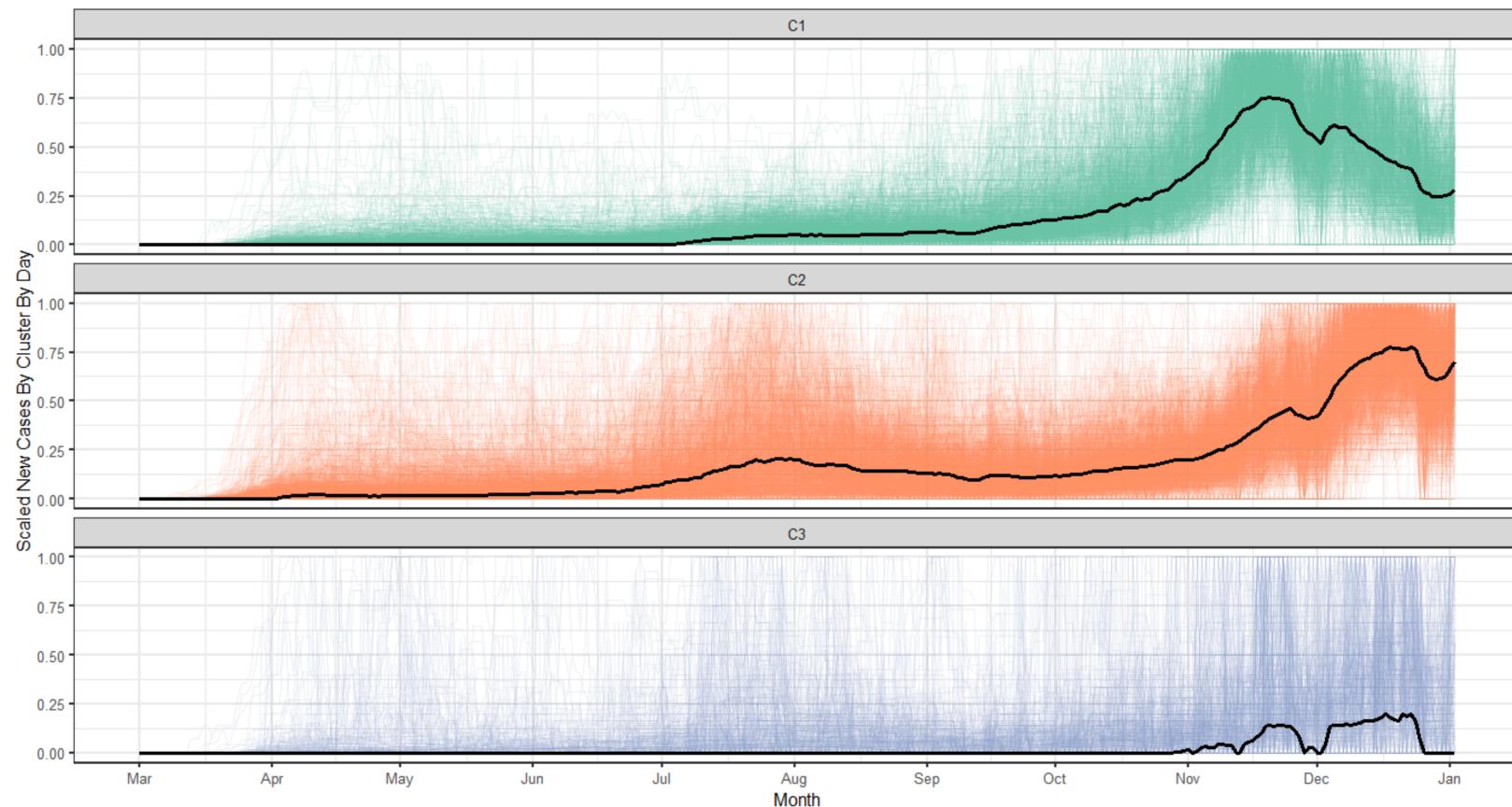


Data from Muller-Droge et al. (2016)

# Multiple TS: Panel Plots

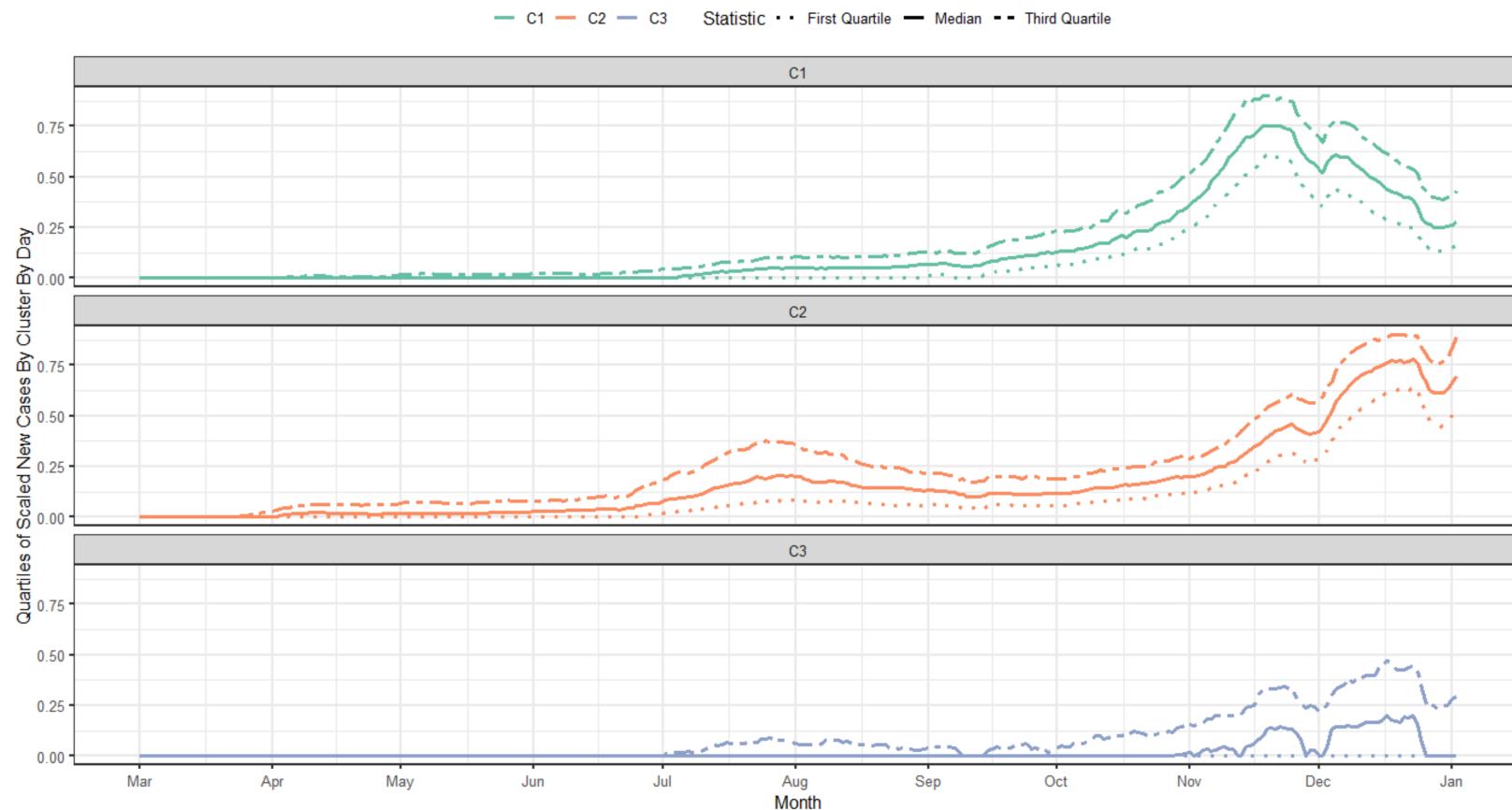


# Spaghetti Plots (Often w/ Clustering)



Solid black line represents the median for each cluster.  
Based on Data from March 01, 2020 - Jan 02, 2021

# Summary Plots (Often w/ Clustering)



# Recap

# Summary of Main Points

- Understand main goals behind visualizing time-series data
- Explain the different types of charts for univariate and multivariate time-series