Monitoring Temporal Crime Trends

05-24

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My Background

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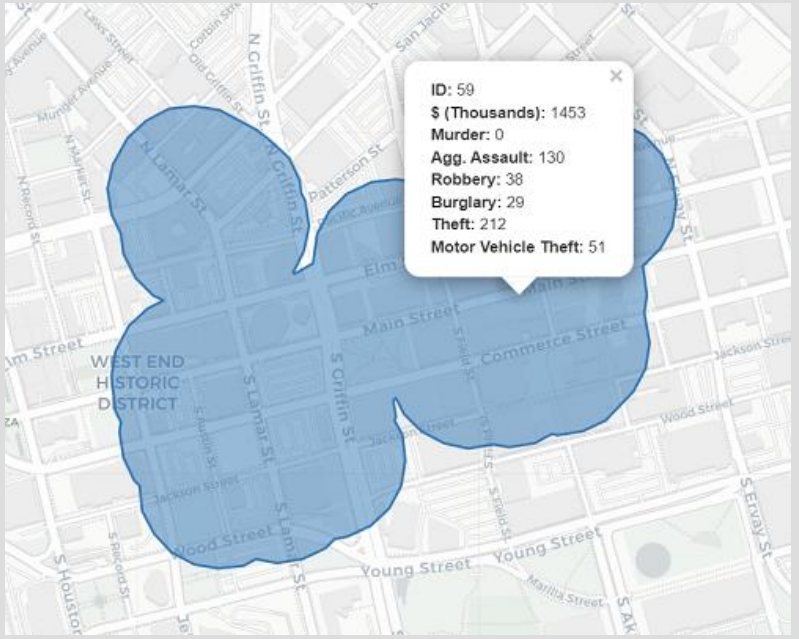
PhD Criminal Justice

- Statistical Analysis
- Operations Research
- Predictive Modelling
- Policy Analysis



Examples of Prior Work

- Optimal patrol beats with workload equality (Wheeler, 2019)
- Cost of crime hotspots (Wheeler & Reuter, 2021)
- Network algorithm to prioritize gang members (Wheeler et al., 2019)

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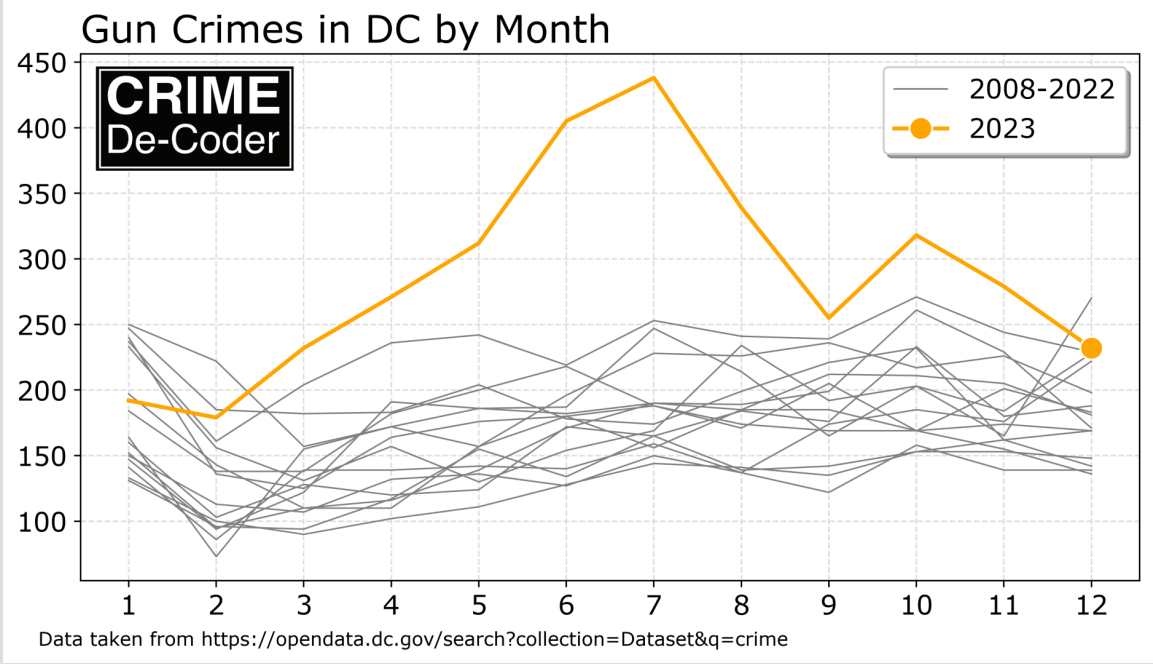
Motivation & Outline

Motivation

- Outliers due to sprees
- Don't be fooled by randomness
- *Not* for forecasting



Outline

- Simple rules for rare events
- CompStat pre/post
- Weekly chart with upticks/trends
- Seasonal chart
- Q/A

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Simple Rules for Rare Events

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If you on average had 0.8 robberies in a month, would it be weird to have a month with 3?

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Simple Rules for Rare Events

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If you on average had 0.8 robberies in month, would it be weird to have a month with 3?

- 3 events will happen 4% of the time
- Would expect that to happen almost every other year
- I would alarm at 4+ or 5+ events per month

Number in Period	% Expected	% Cumulative Expected
0	44.9%	44.9%
1	35.9%	80.9%
2	13.4%	95.3%
3	3.8%	99.1%
4	0.8%	99.9%
5	0.1%	100.0%
6	0.0%	100.0%

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Simple Rules for Rare Events

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If you had 16 events this month, and 9 last month, is that a large increase?

It is a 78% increase!

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CompStat Example

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- **Percent Change is a horrible metric**
- **I have made a new metric, the *Poisson Z-score***
  - $Z = 2 \cdot (\sqrt{\text{Current}} - \sqrt{\text{Past}})$
  - **Example: 16 current, 9 past**
  - **Z = 2*(sqrt(16) – sqrt(9)) = 2*(4 – 3) = 2**
  - **Going from 9 to 16 is typical**
- **If Z is 3+ or more, increasing**
- **If Z is -3 or less, decreasing**

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CompStat Example

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Dallas PD Year-to-Date (5/6/2024)

Address	2023	2024	Difference	Poisson-Z
MOTOR VEHICLE THEFT	9,963	10,996	1,033	10.1
DRUG/ NARCOTIC VIOLATIONS	2,306	2,762	456	9.1
TRESPASS OF REAL PROPERTY	276	425	149	8.0
FAMILY OFFENSES, NONVIOLENT	132	201	69	5.4
ROBBERY	726	803	77	2.8
FRAUD OFFENSES	598	664	66	2.6
LARCENY/ THEFT OFFENSES	9,968	10,152	184	1.8
BURGLARY/ BREAKING & ENTERING	2,012	2,093	81	1.8
STOLEN PROPERTY OFFENSES	132	150	18	1.5
ASSAULT OFFENSES	2,534	2,534	0	0.0
DESTRUCTION/ DAMAGE/ VANDALISM	3,157	3,080	-77	-1.4
WEAPON LAW VIOLATIONS	502	460	-42	-1.9
COUNTERFEITING / FORGERY	92	69	-23	-2.6
DRIVING UNDER THE INFLUENCE	483	361	-122	-6.0
TRAFFIC VIOLATION - HAZARDOUS	1,234	1,022	-212	-6.3

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Weekly chart with upticks/trends

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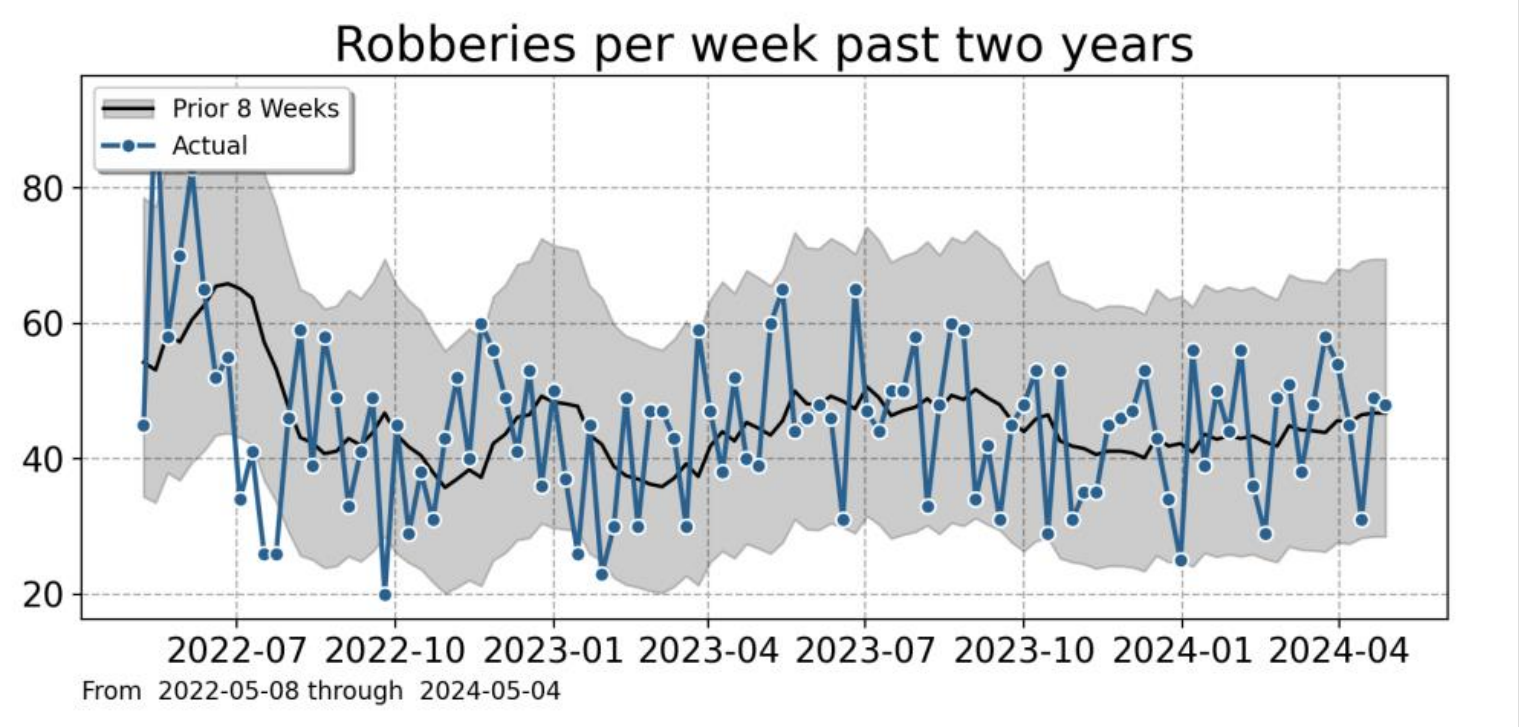
- **Prior = average over prior 8 periods**
- **Black line = prior**
- **Error bands based on same Poisson Z-score**



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Weekly chart with upticks/trends

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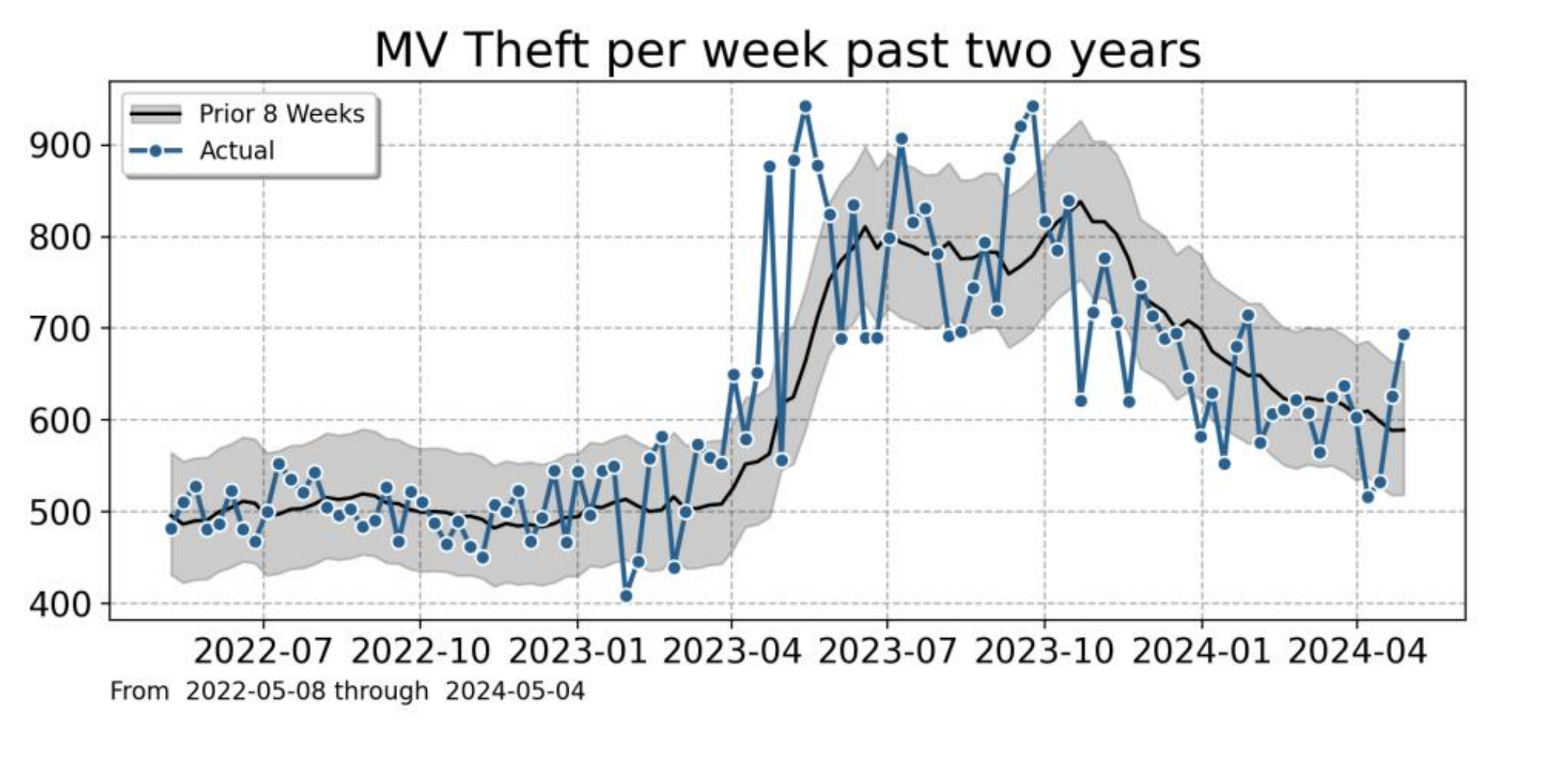

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Seasonal Chart

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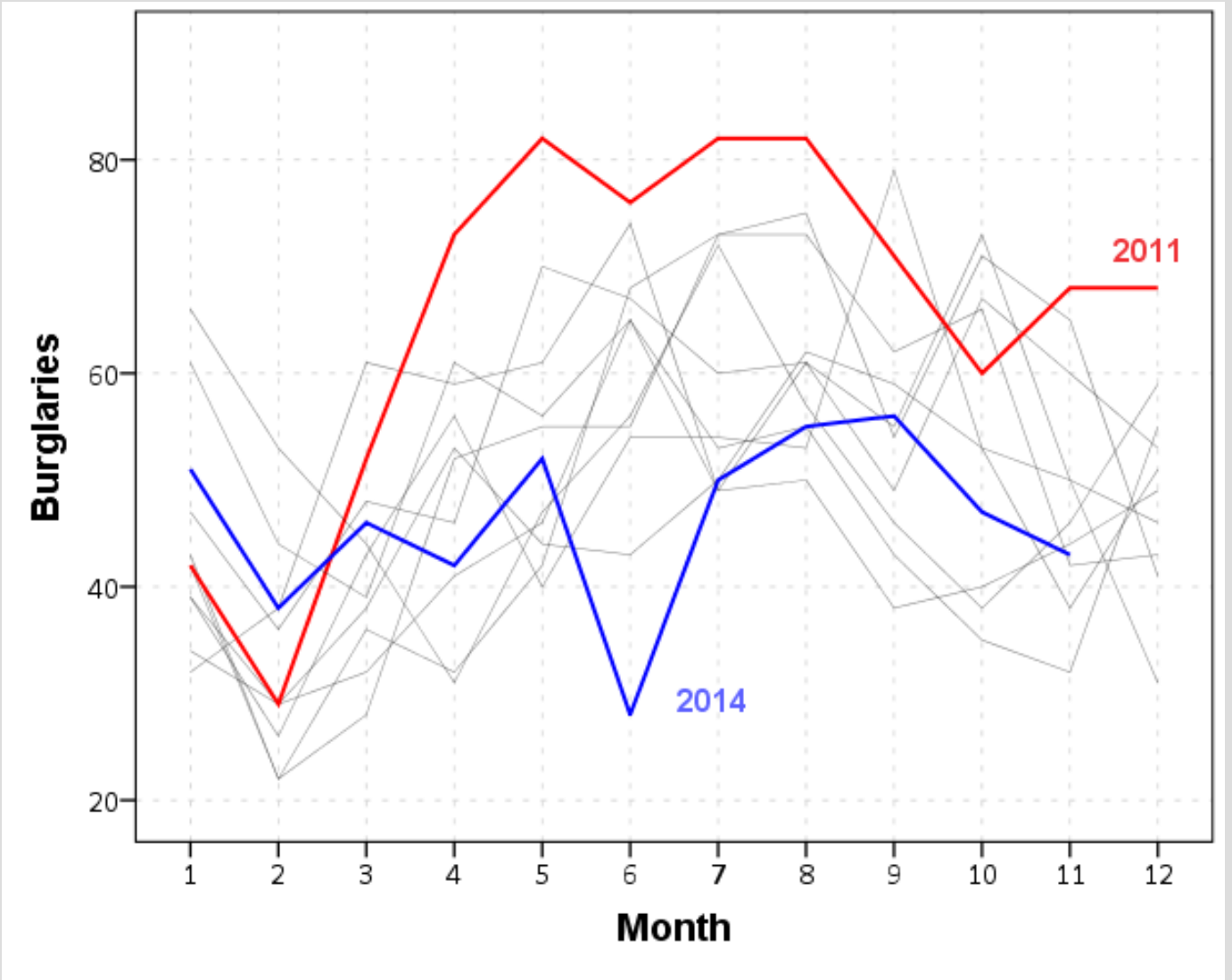
- Count per month (make sure to include 0s!)
- Older years light grey, highlight current year
- If partial reporting, can normalize to per day



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Seasonal Chart

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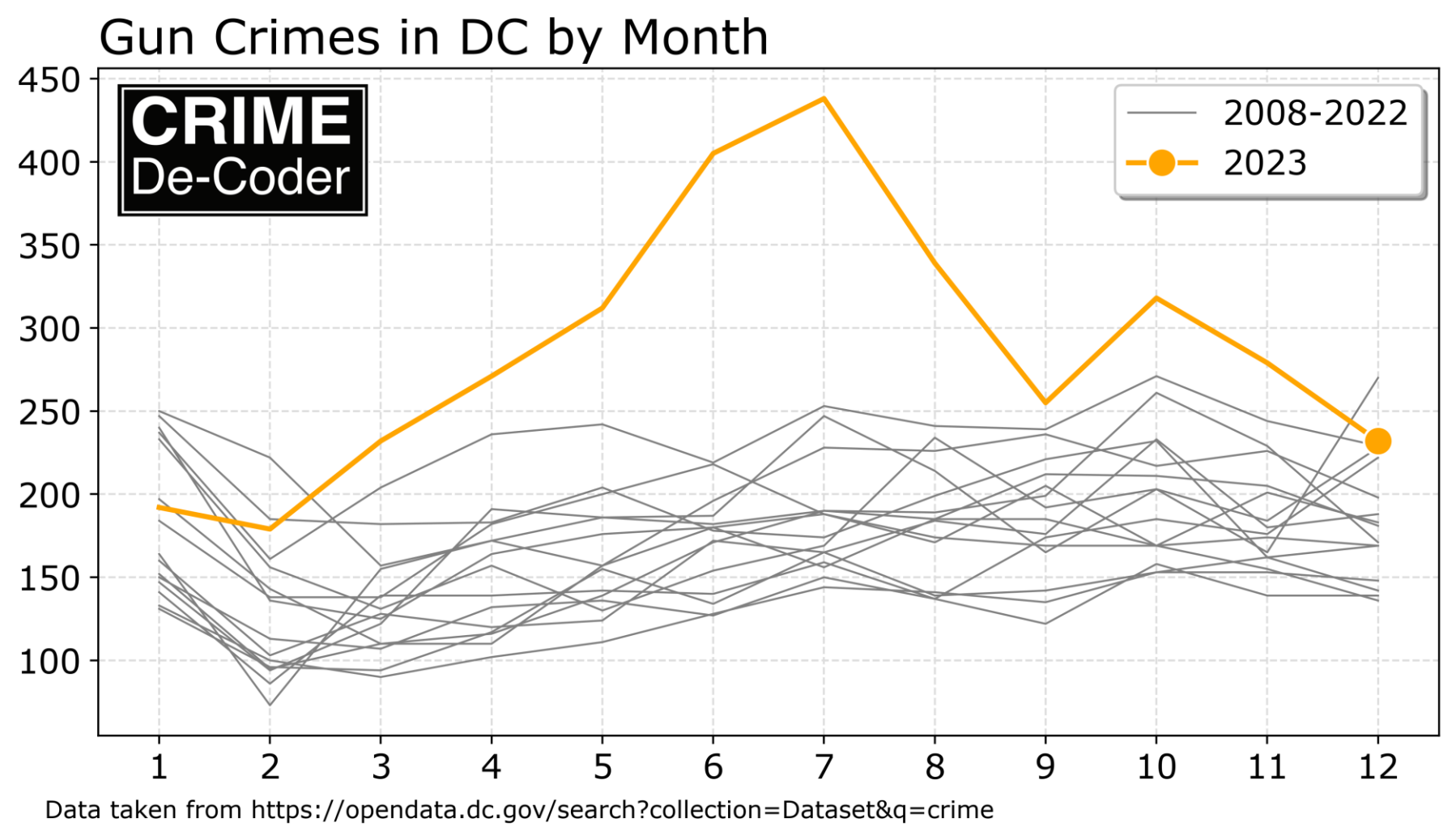

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Other Resources

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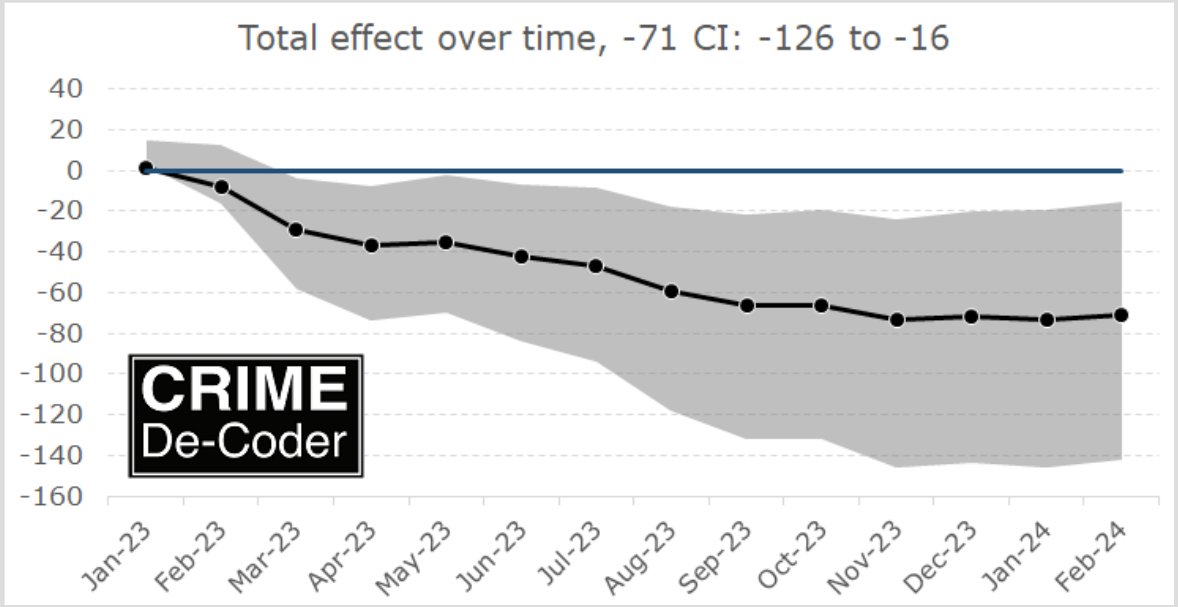
Resources

- Course Materials to replicate these charts in Excel and Tableau
- Using Poisson to identify outliers blog post
- Evaluating if crime went down post intervention (with Excel examples)
- Weighted Displacement Difference online tool



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