



Utilizing Two Smoothing Techniques to Understand The Seasonality and Long-Term Trend of Area Burned by Wildfire in Alberta

WILDLAND FIRE SCIENCE LABORATORY

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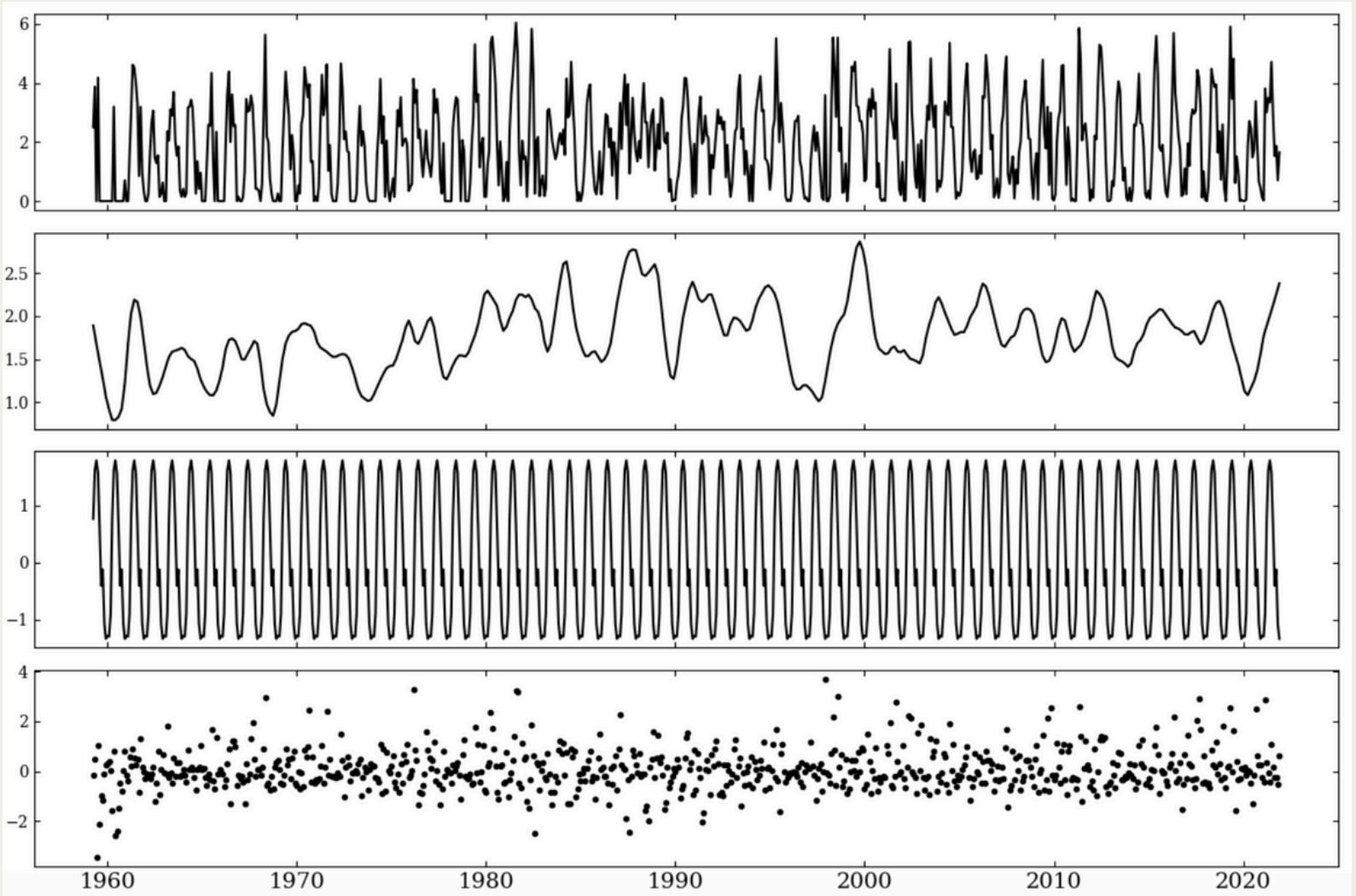
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Course: SS4999Z

Date: April 25, 2024

OUTLINE

- Research Objectives
- Introduction
- Data
- Methods
- Results
- Discussion
- Conclusion
- Future Work



RESEARCH OBJECTIVES



Objective 1: To understand the seasonality and long-term trend of area burned by wildfire in Alberta.

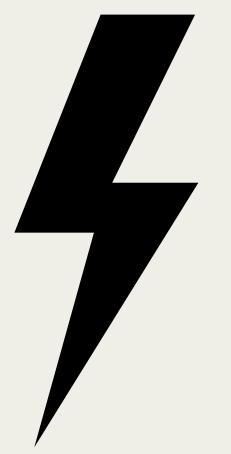
Objective 2: To learn two different smoothing methods (STL and GAMs) that can be used to decompose a time series.

Objective 3: To determine the advantages and disadvantages of using the two smoothing methods to decompose an area burned time series.

INTRODUCTION



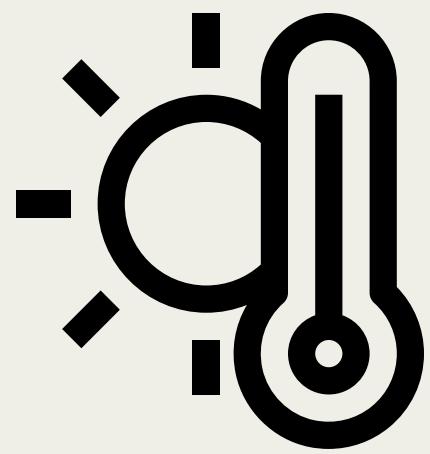
Frequency



Causes



Effects



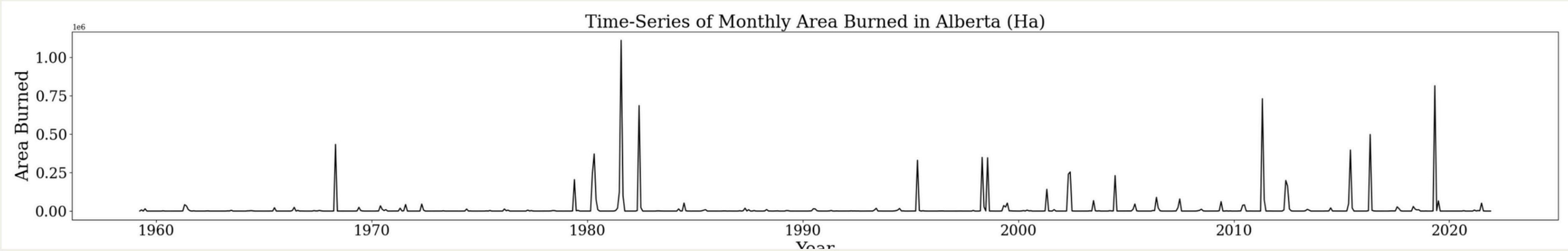
Future



Why
Understand?

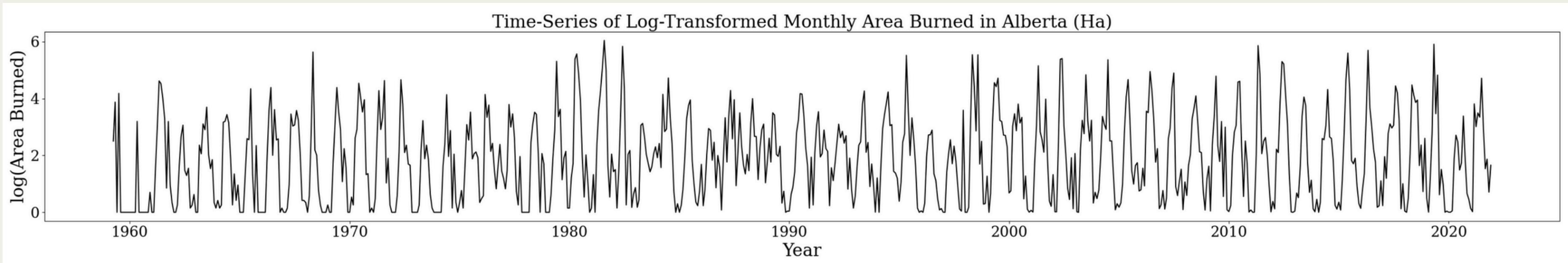


DATA

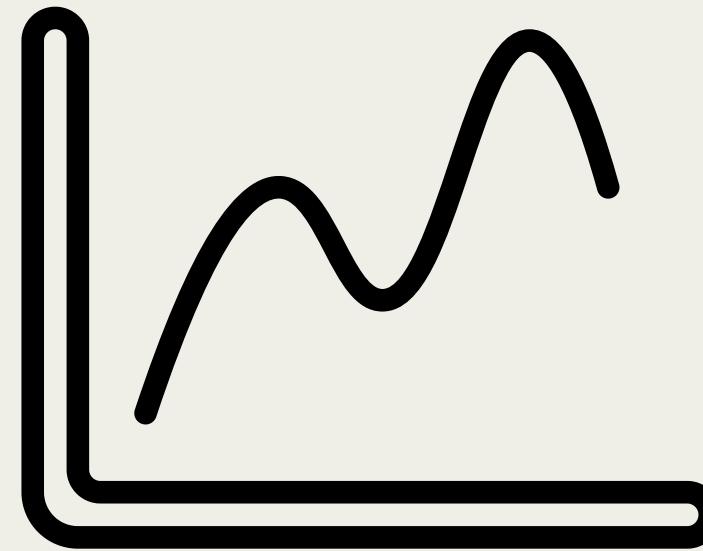




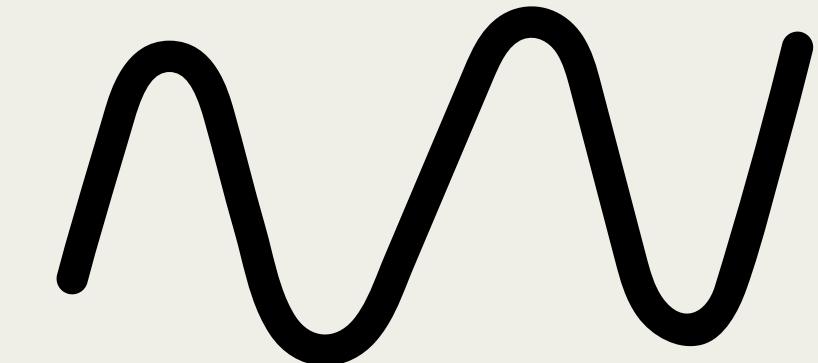
DATA



METHODOLOGY - INTRODUCTION

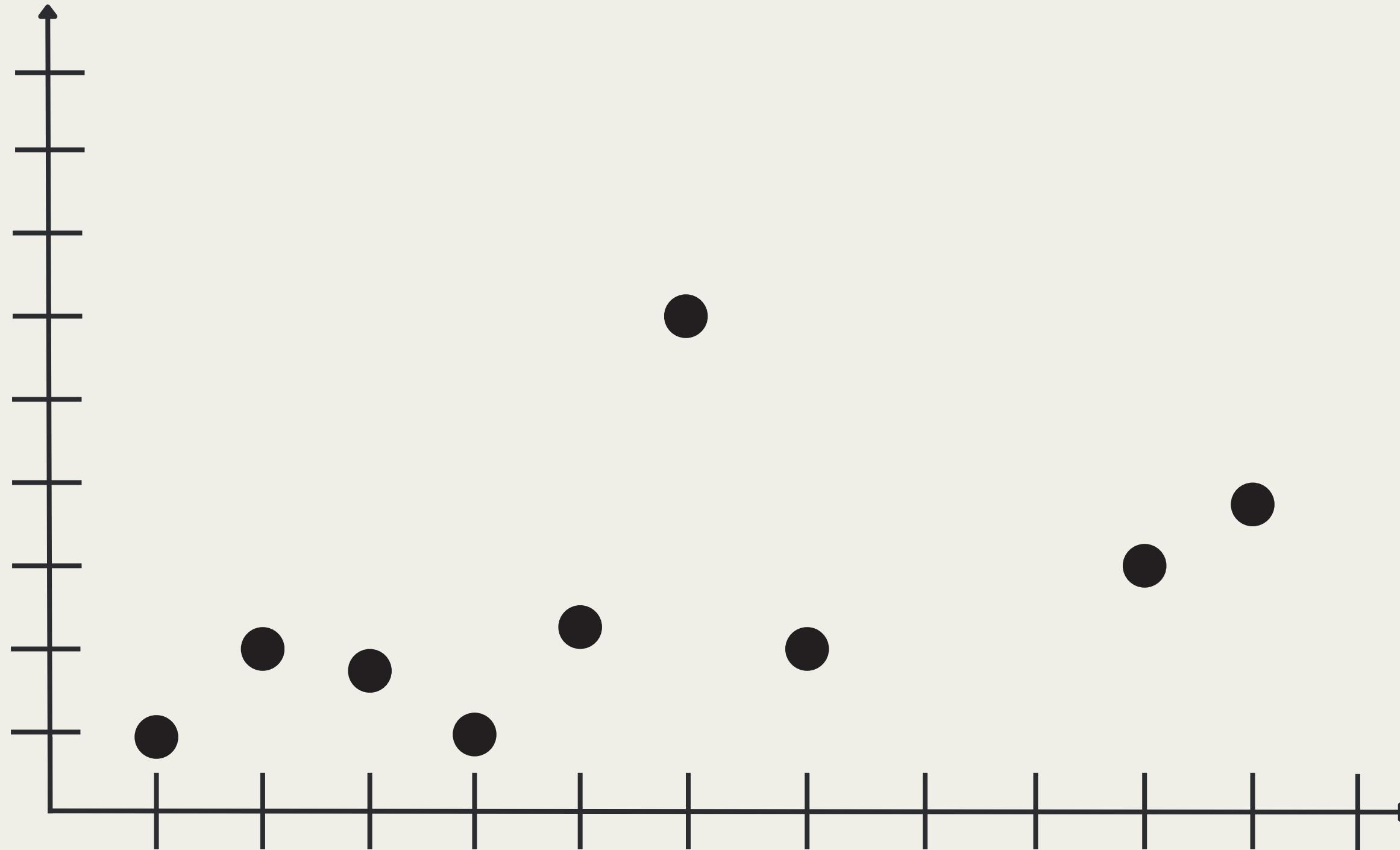


**Seasonal trend
decomposition using
Loess (STL)**

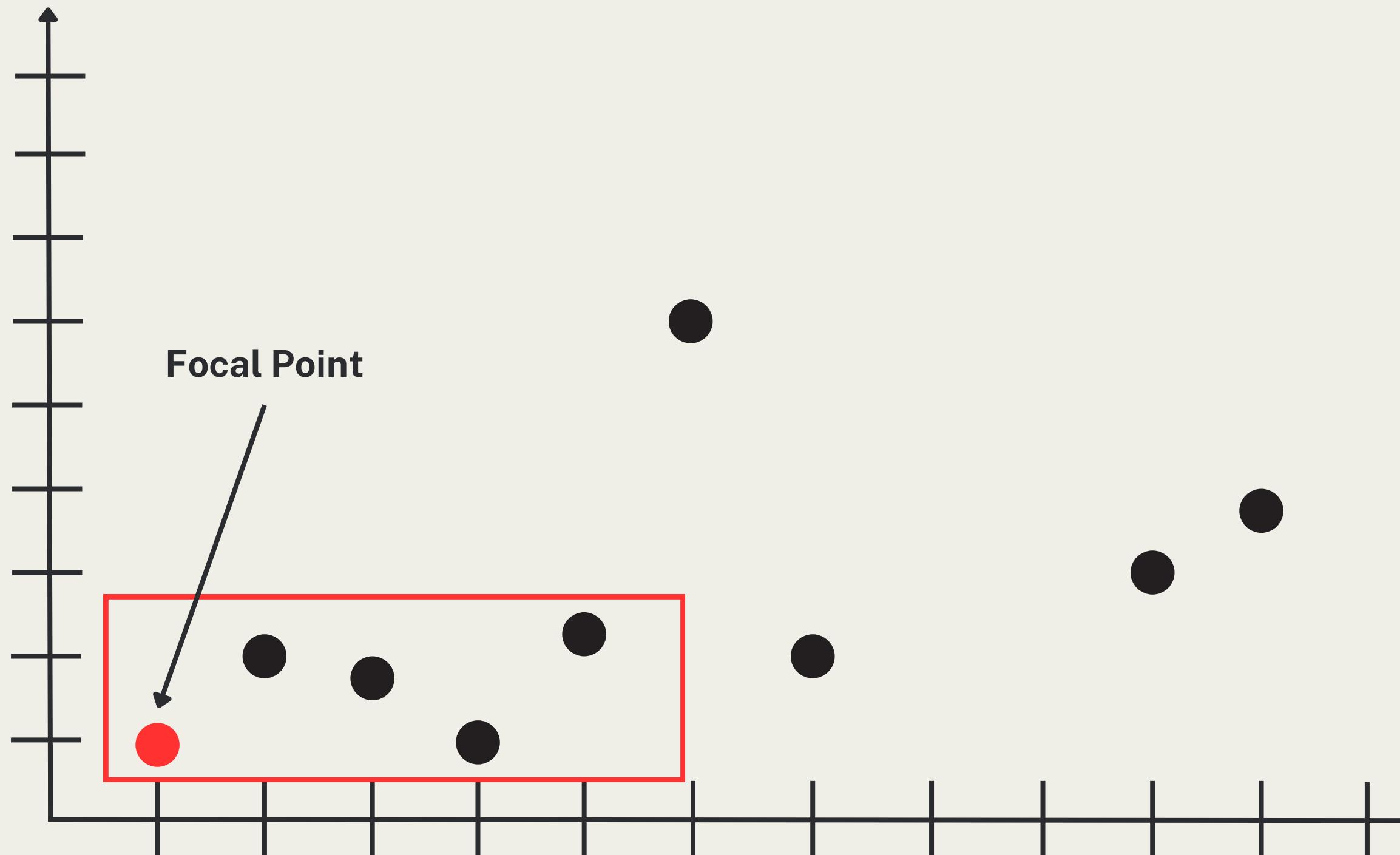


**Generalized
Additive
Models (GAMs)**

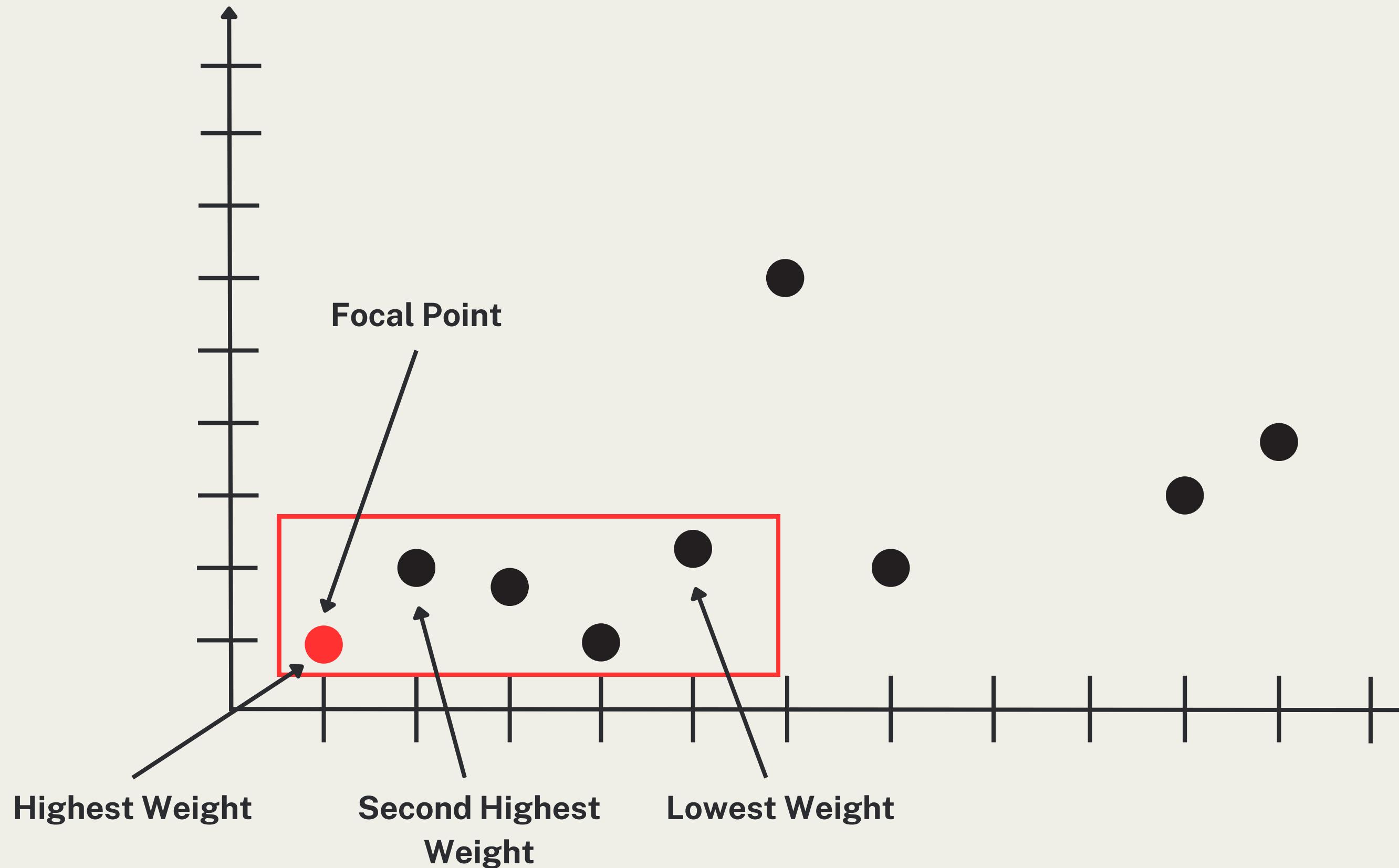
METHODOLOGY - LOESS



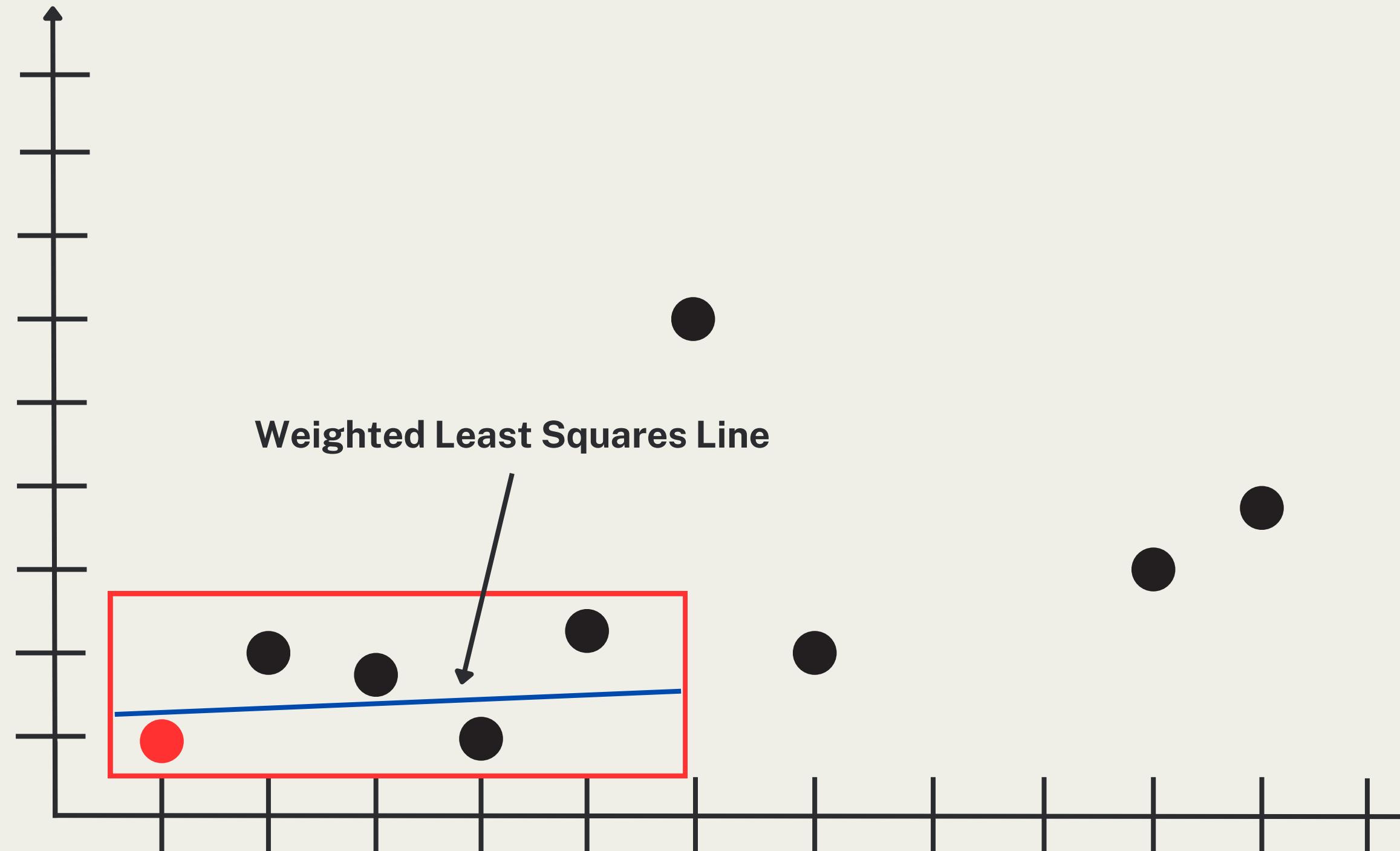
METHODOLOGY - LOESS



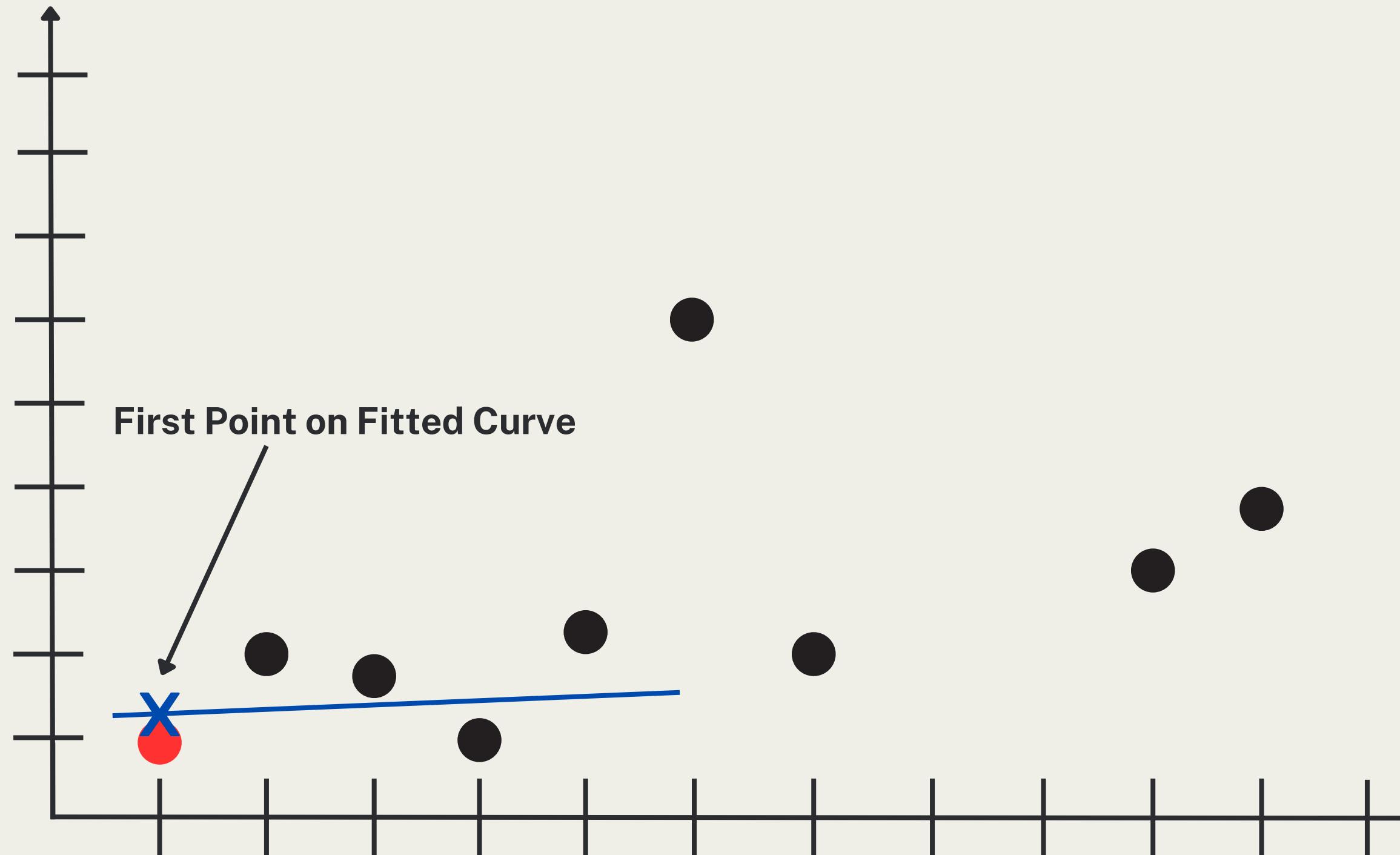
METHODOLOGY - LOESS



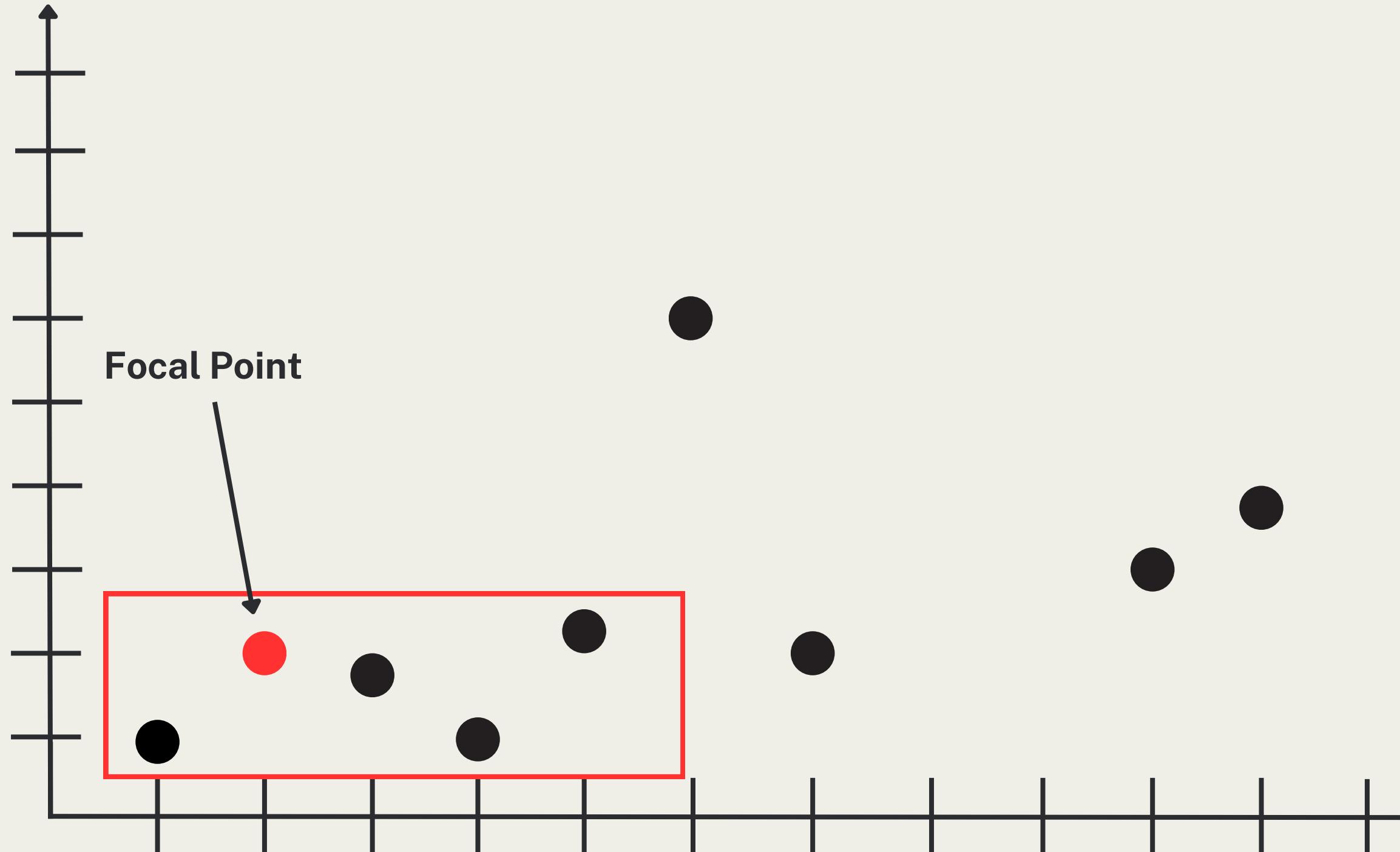
METHODOLOGY - LOESS



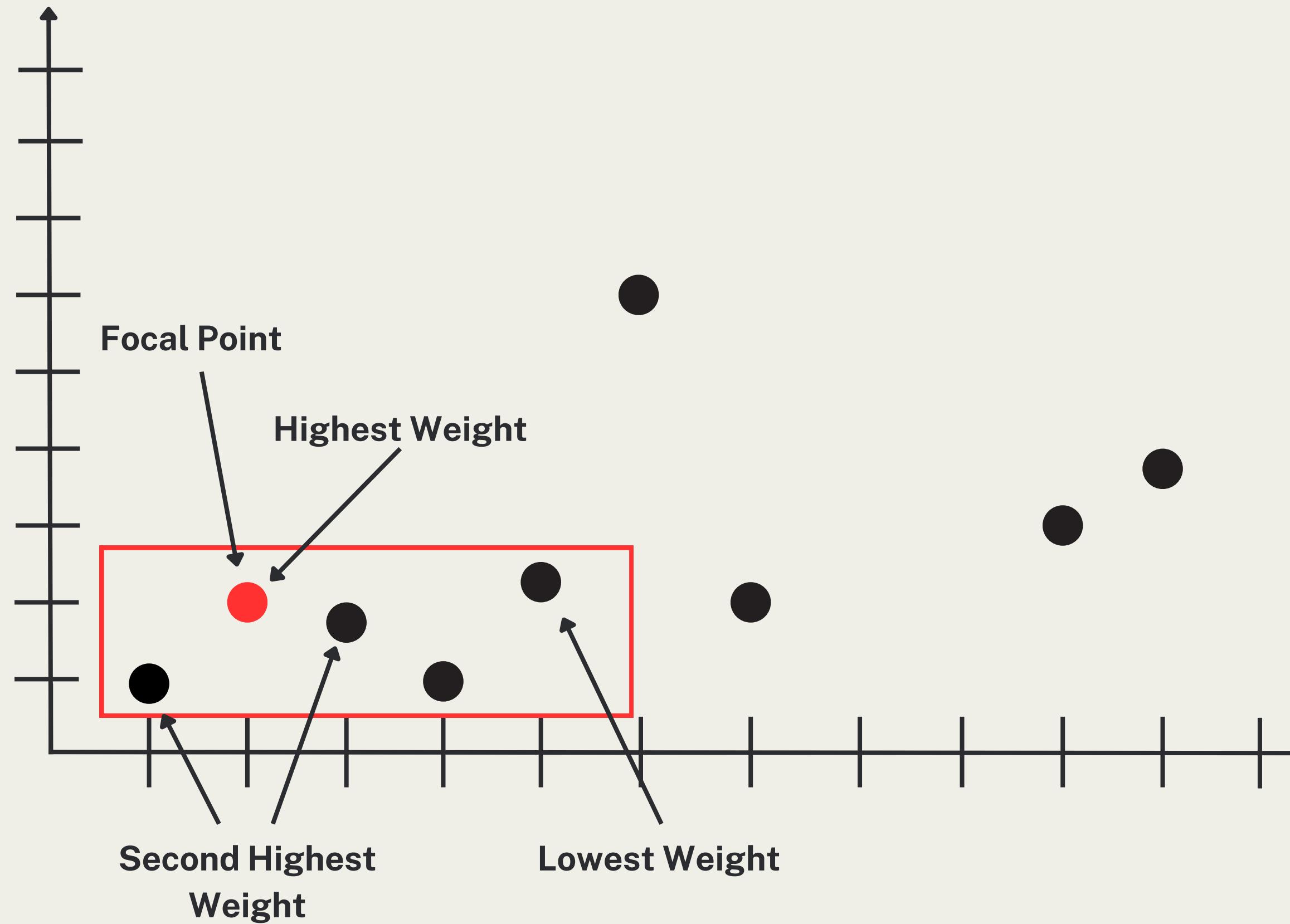
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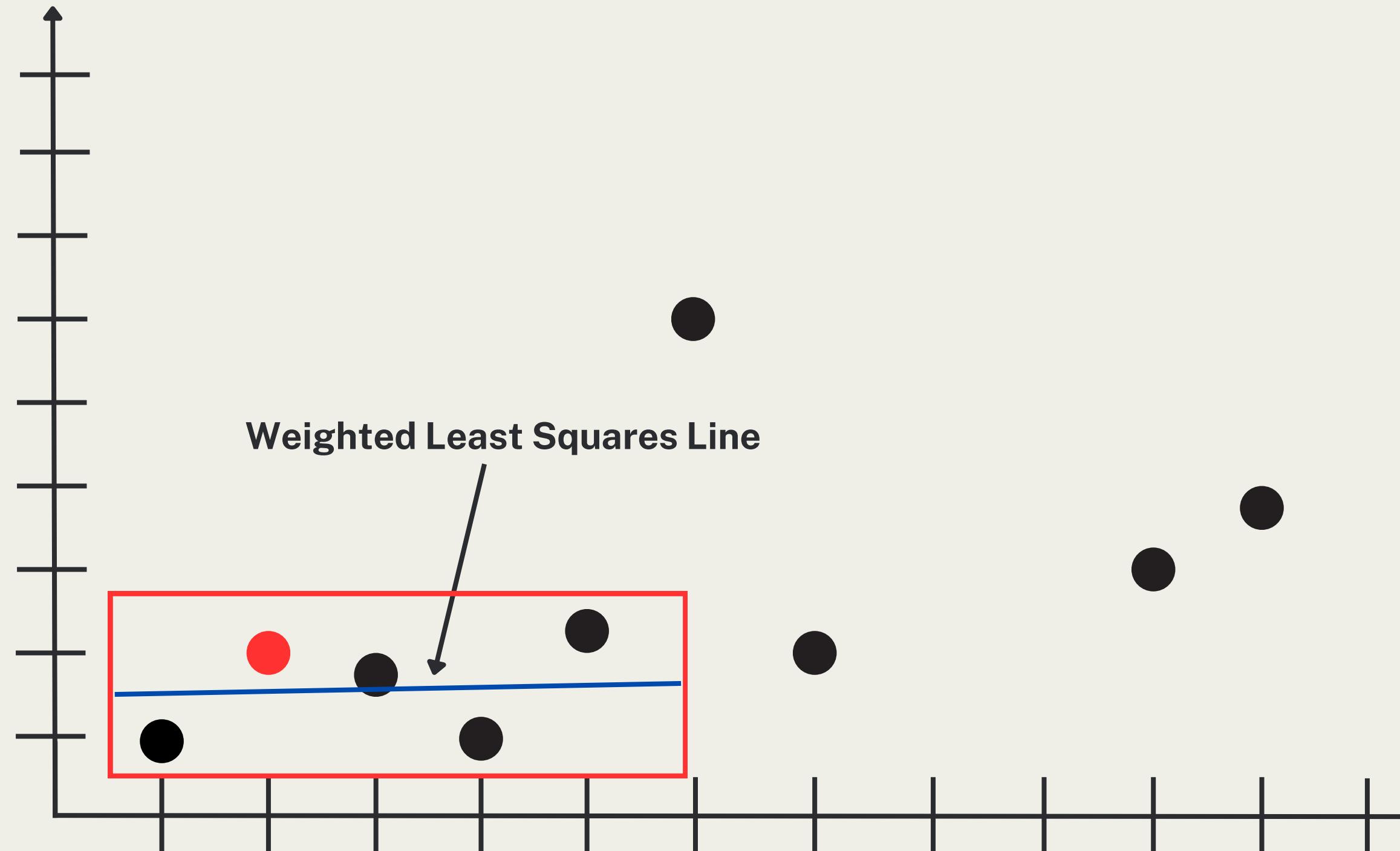
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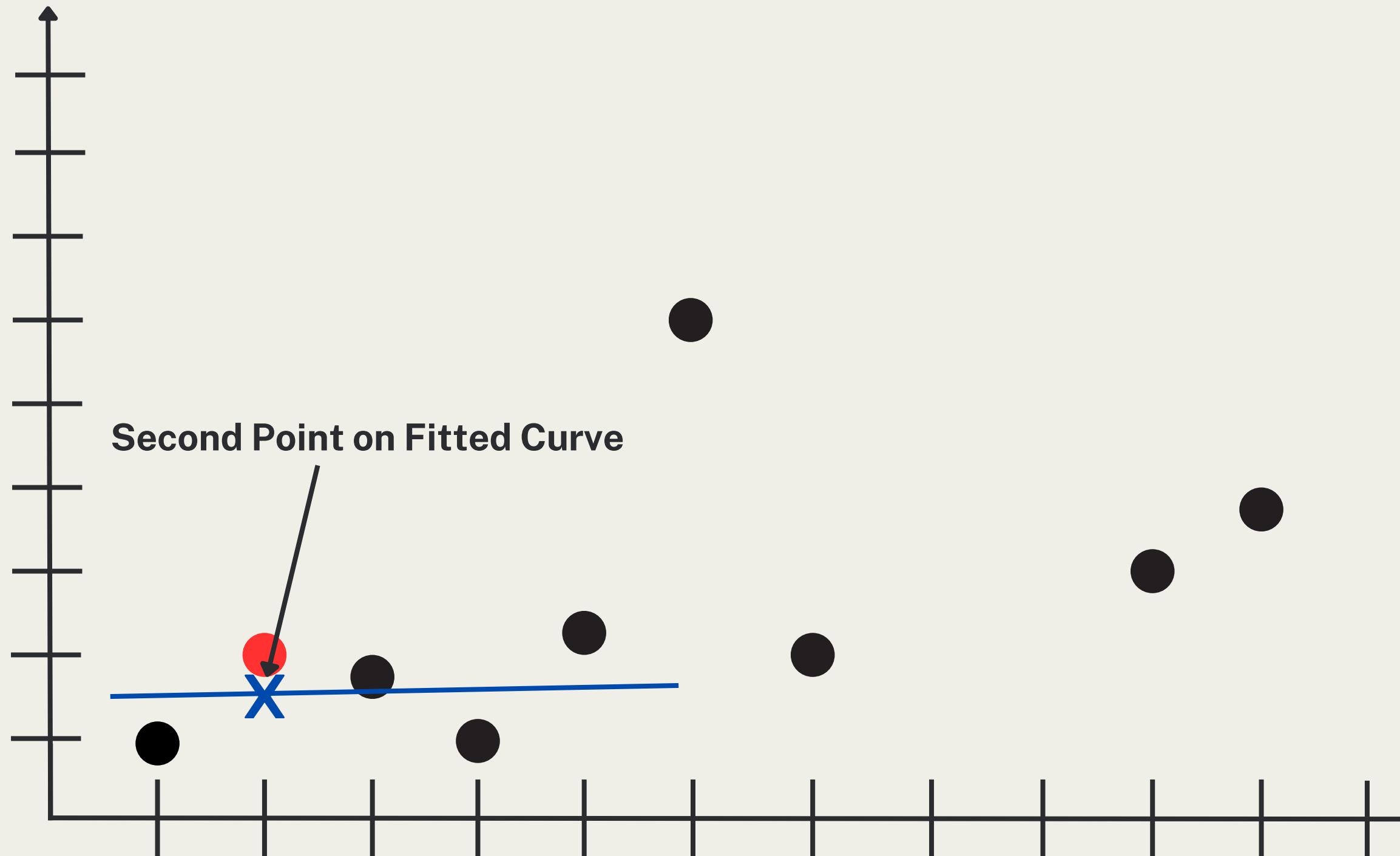
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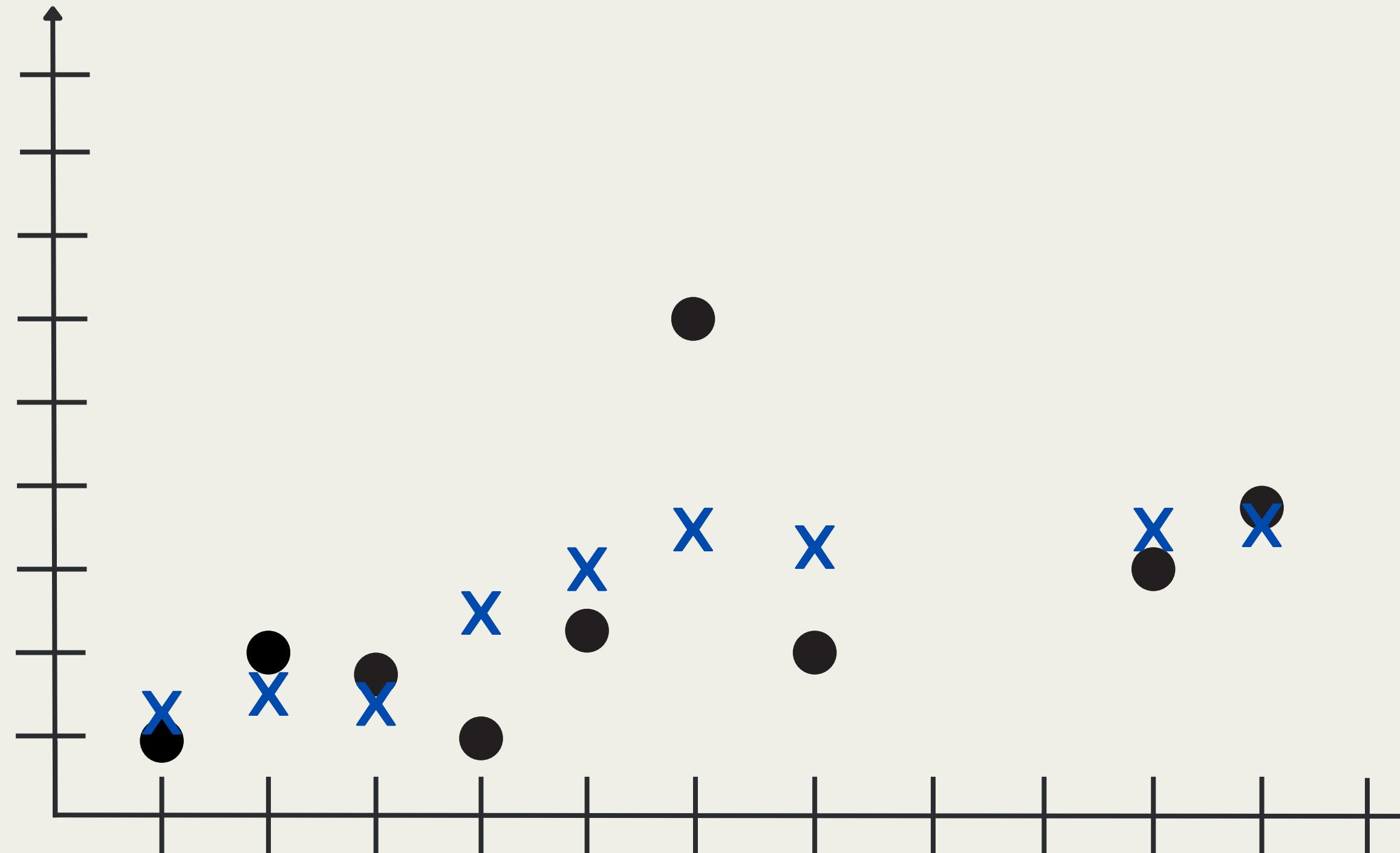
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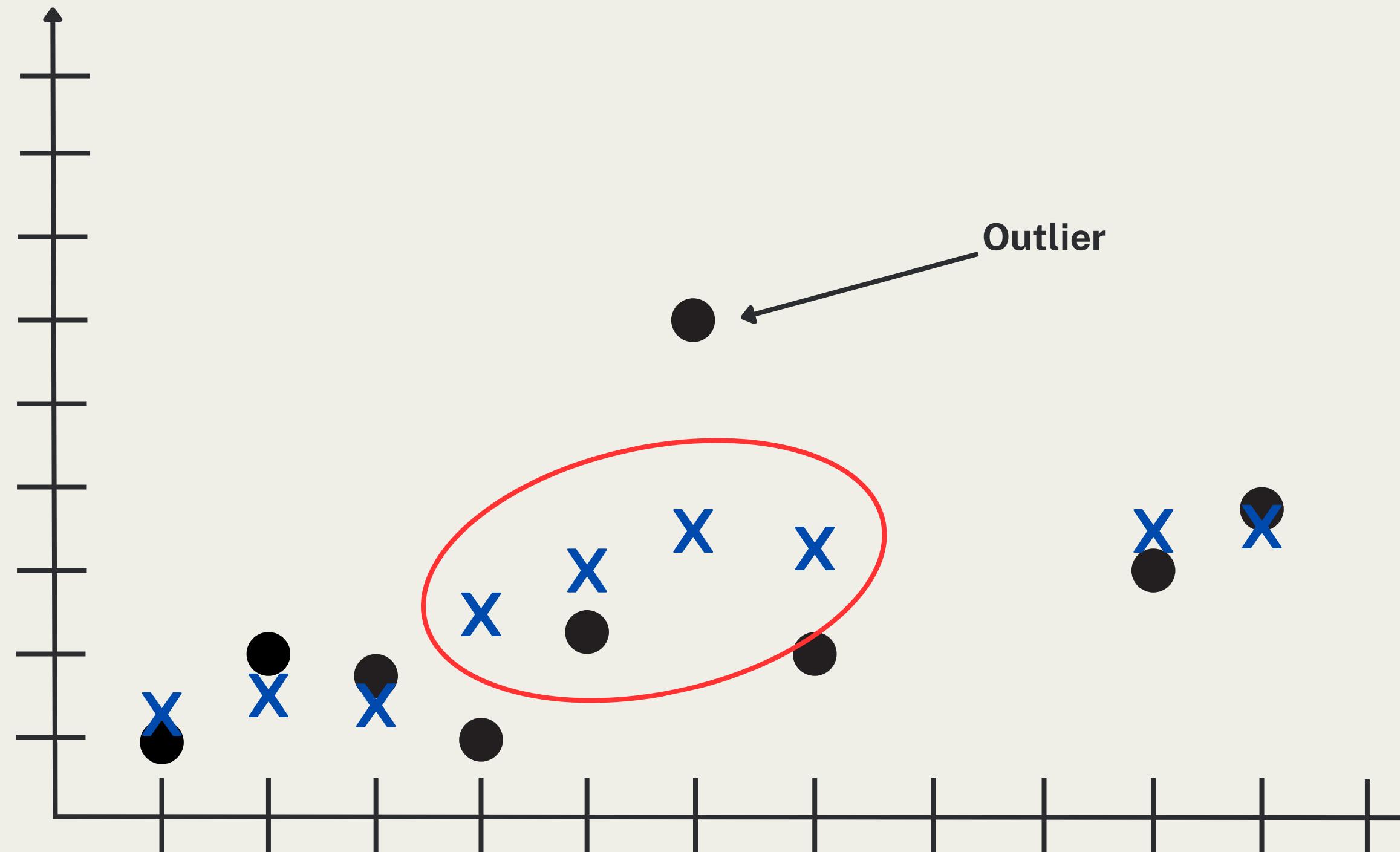
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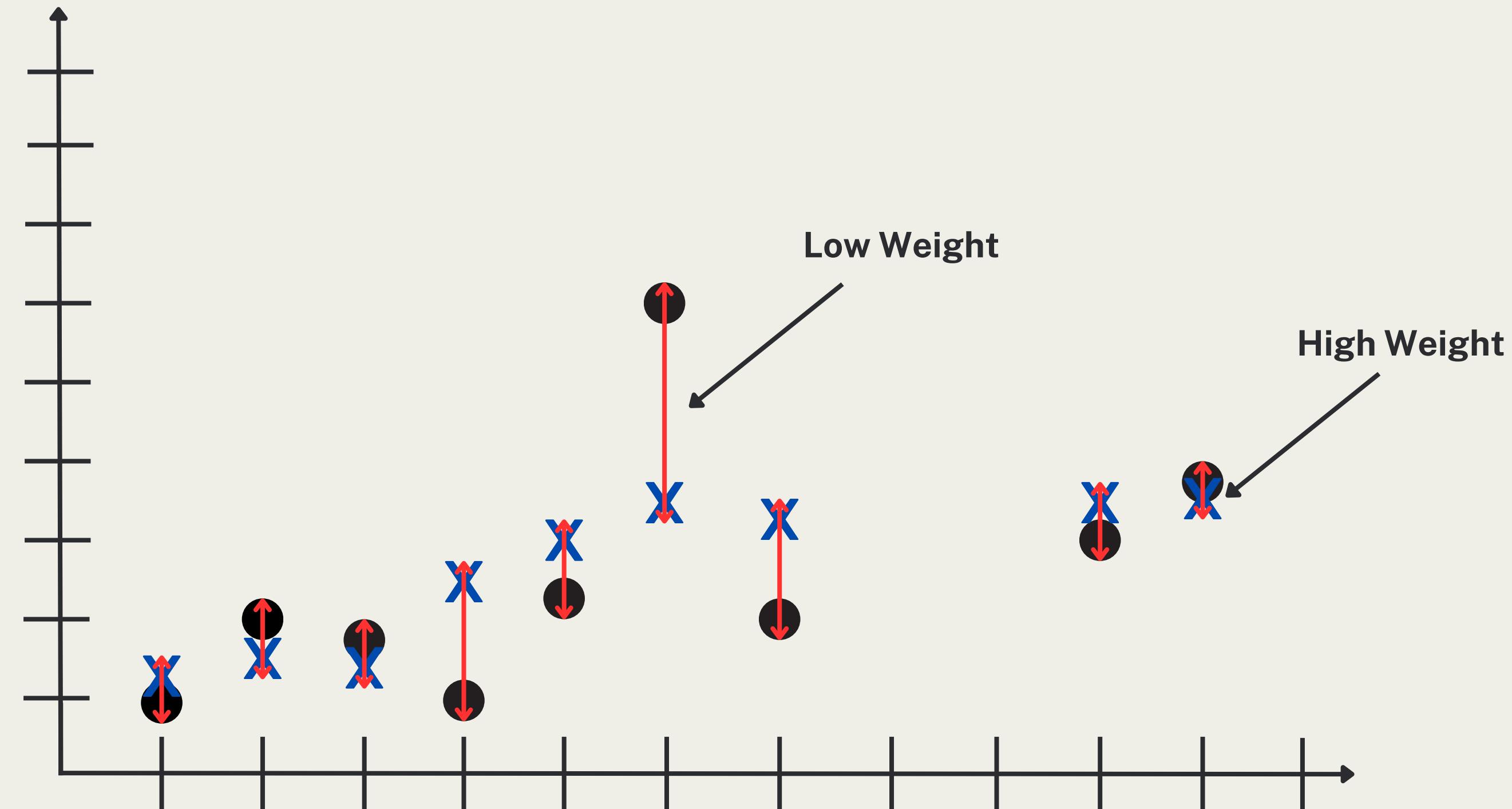
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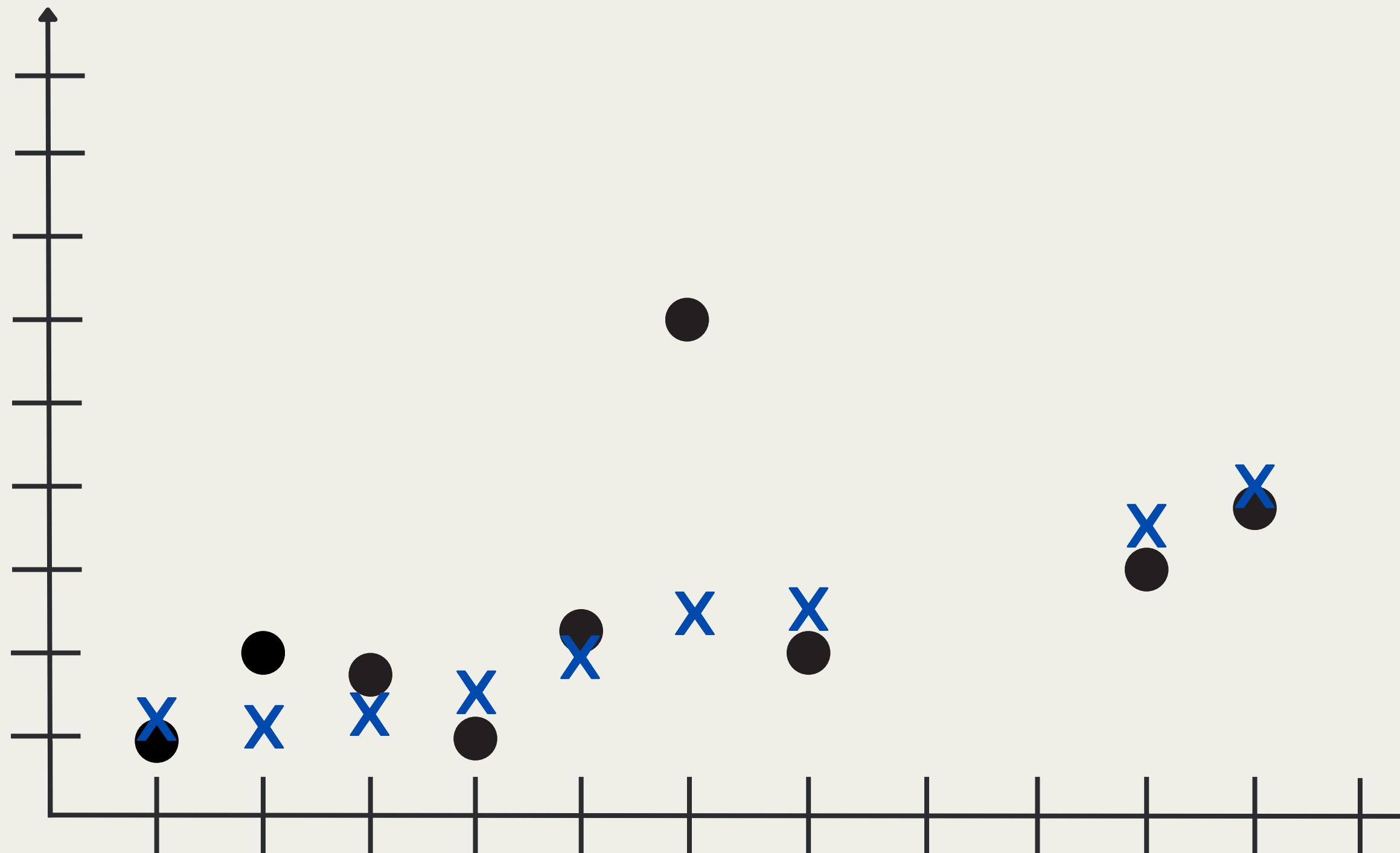
METHODOLOGY - LOESS



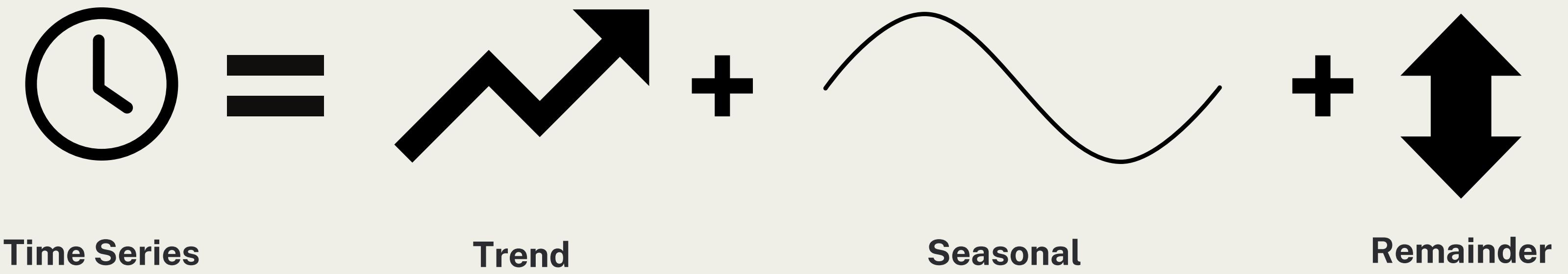
METHODOLOGY - LOESS



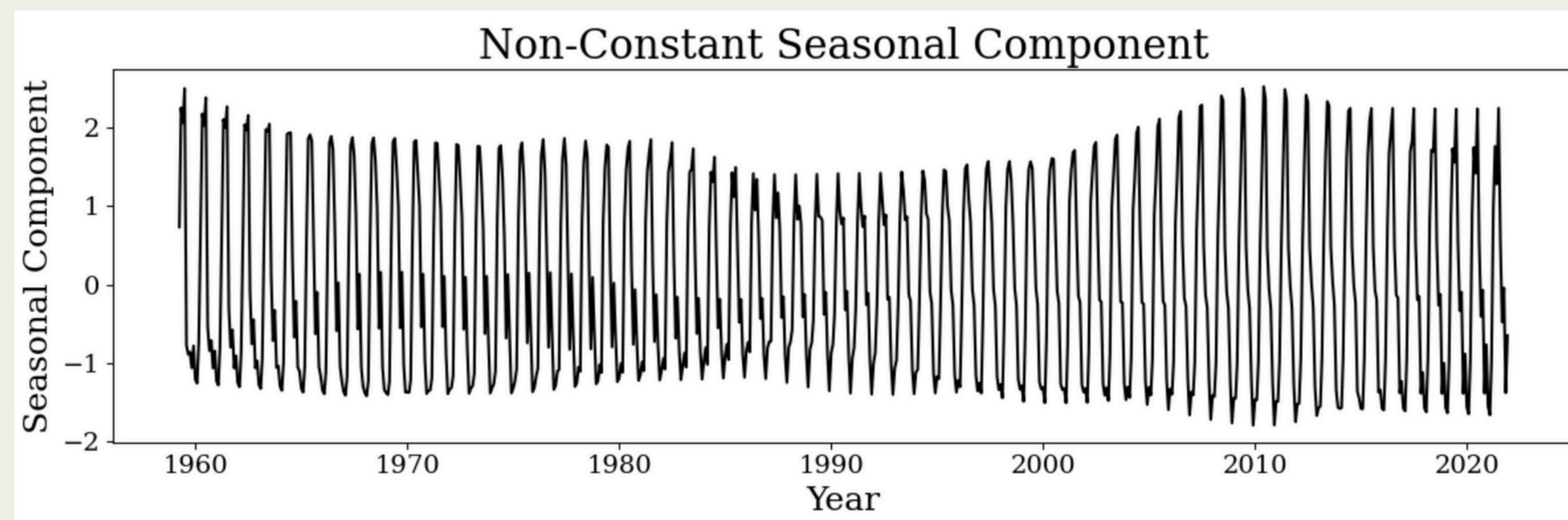
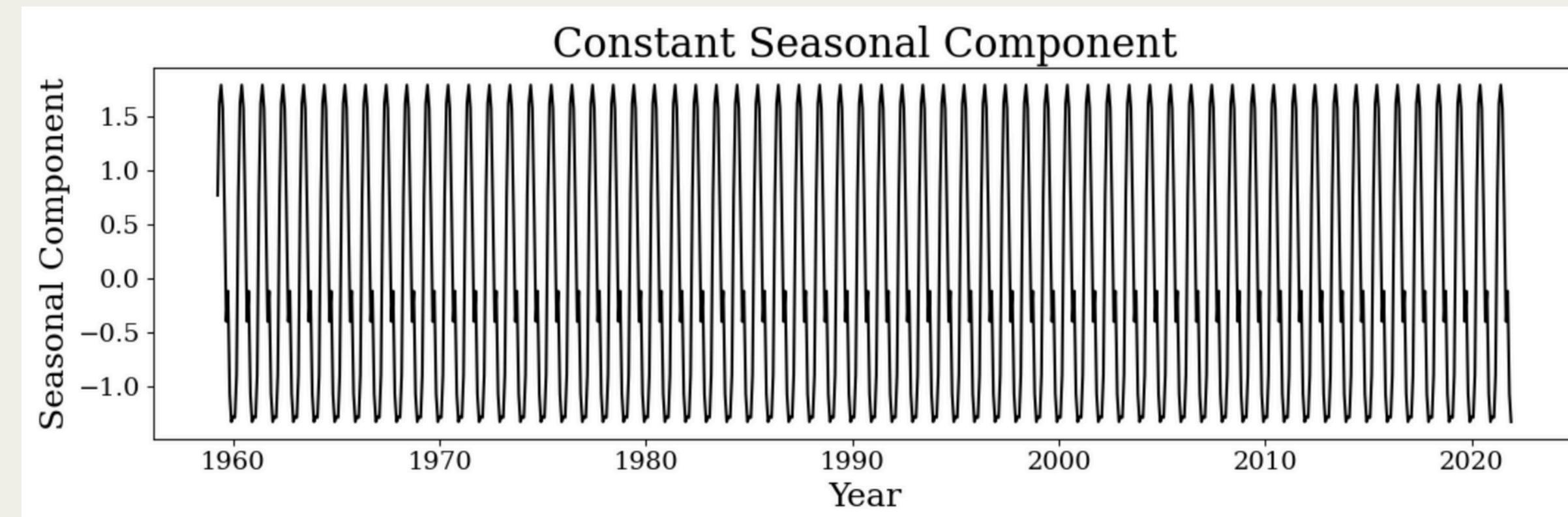
METHODOLOGY - LOESS



METHODOLOGY - STL

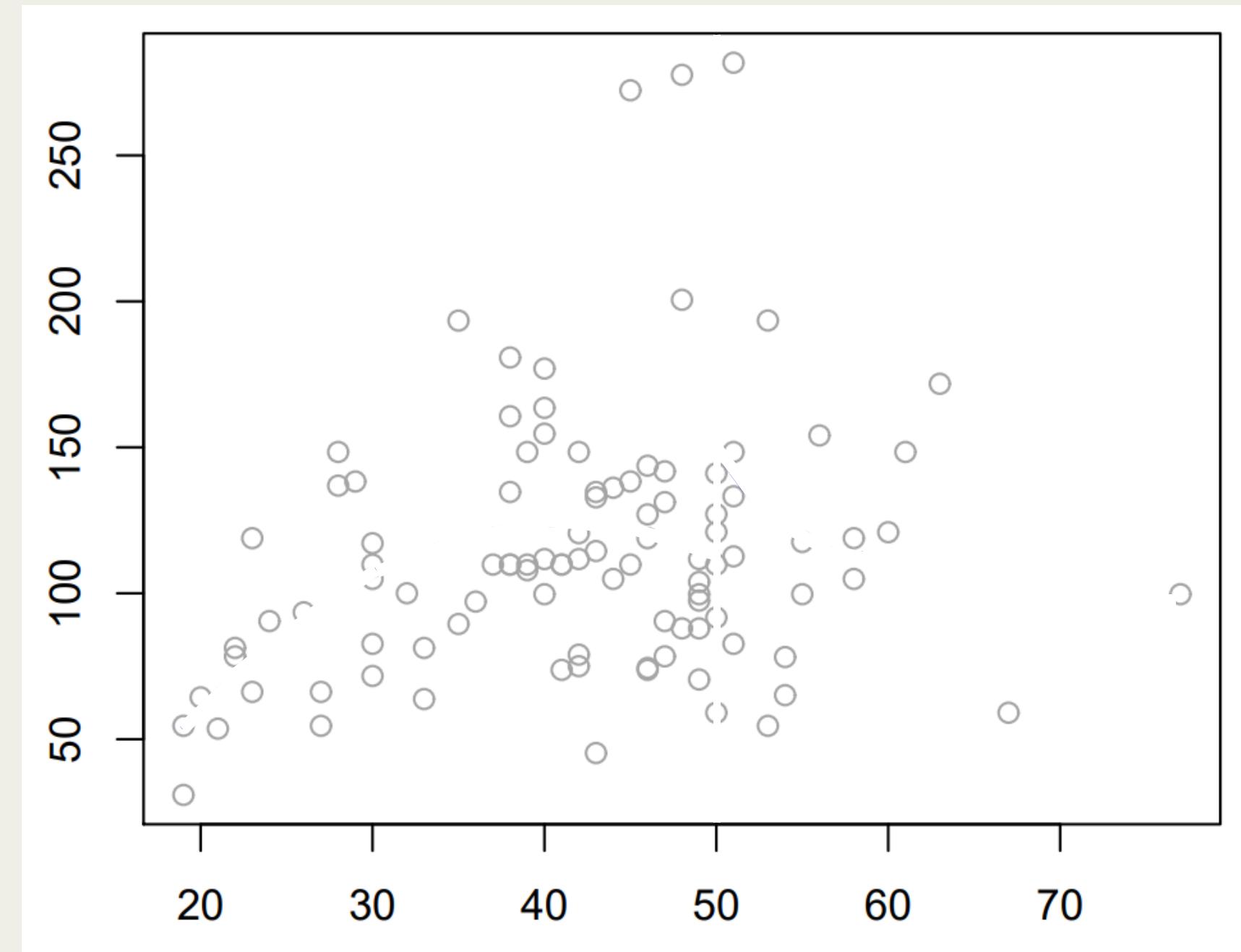


METHODOLOGY - CONSTANT VS NON-CONSTANT SEASONALITY

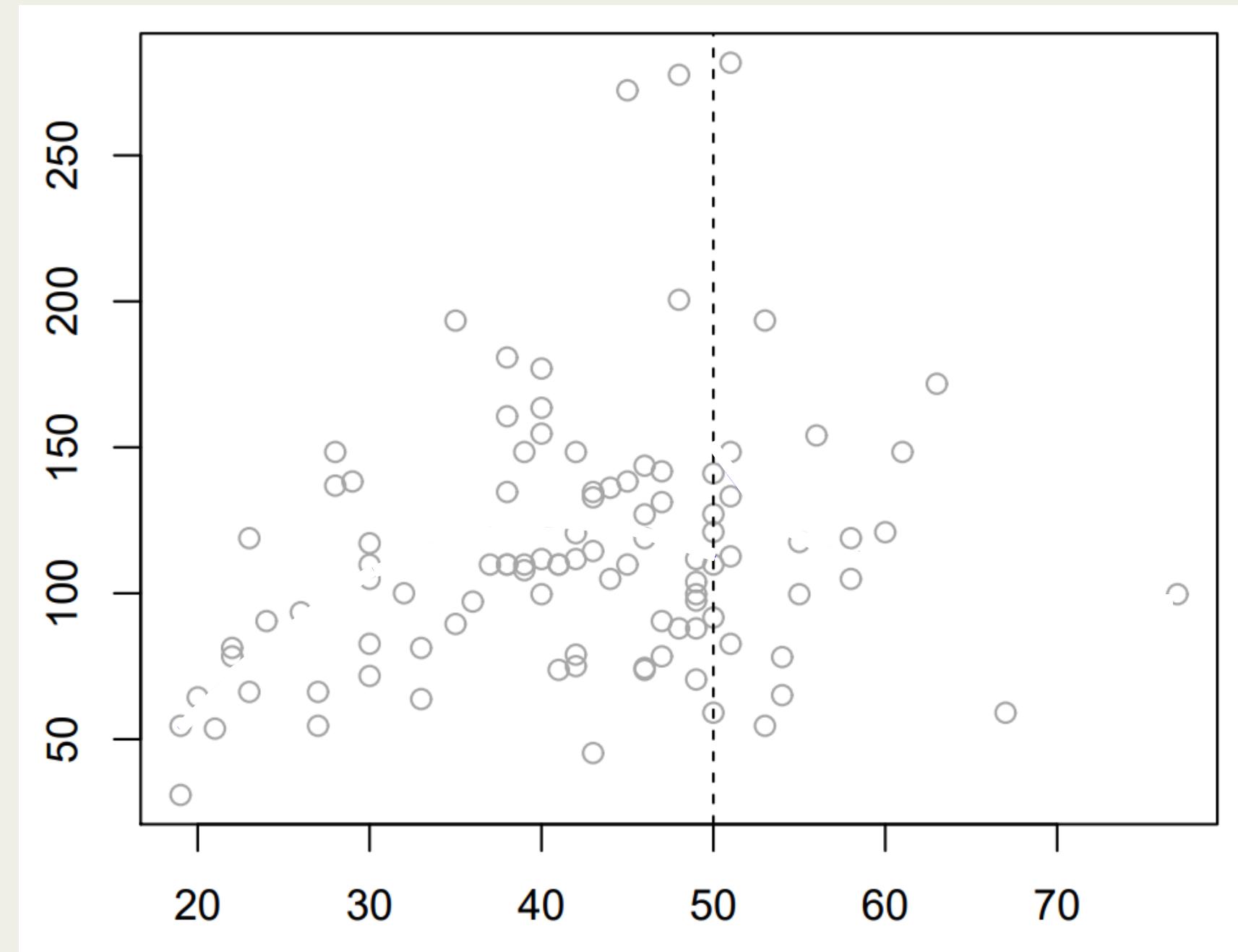




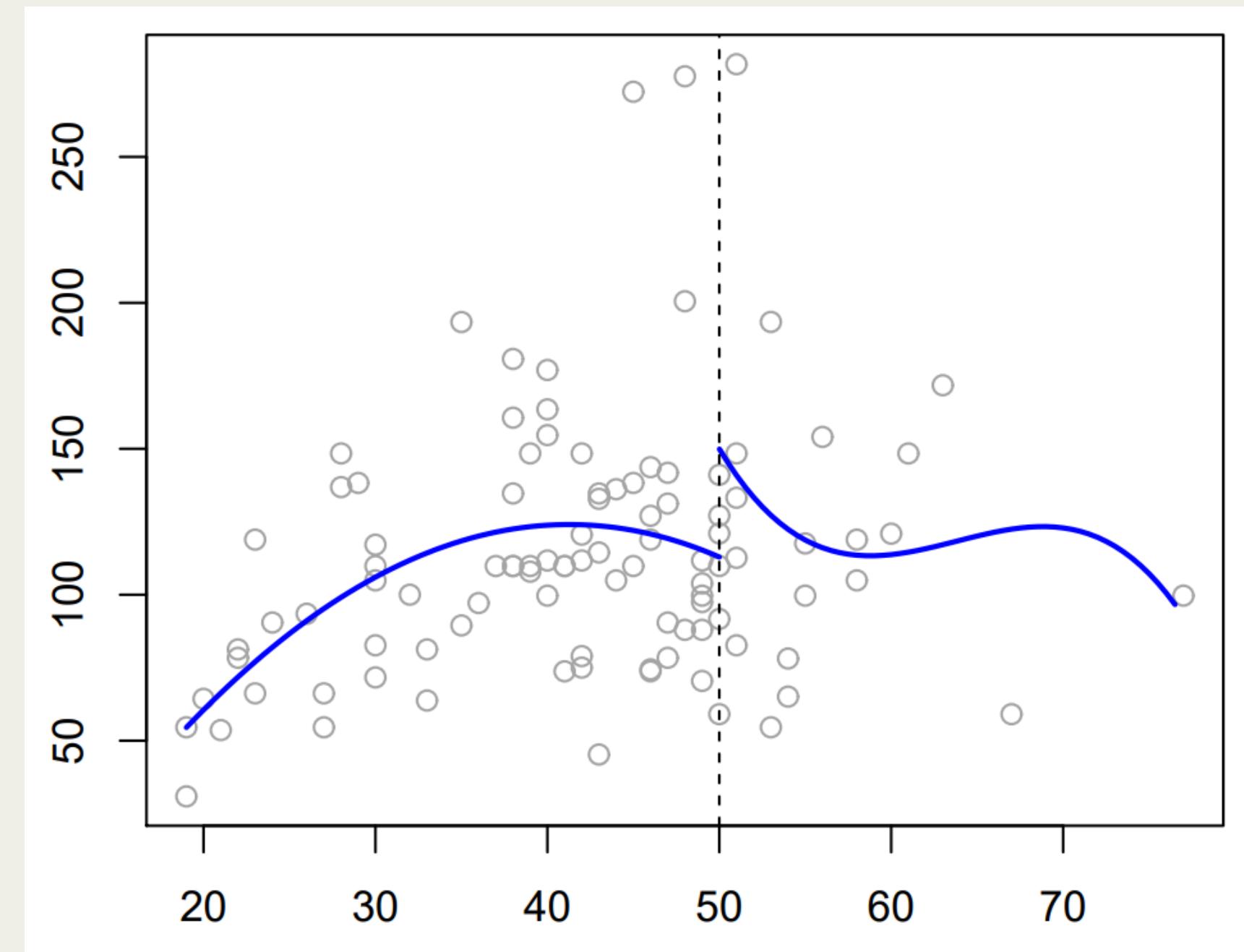
METHODOLOGY - REGRESSION SPLINES



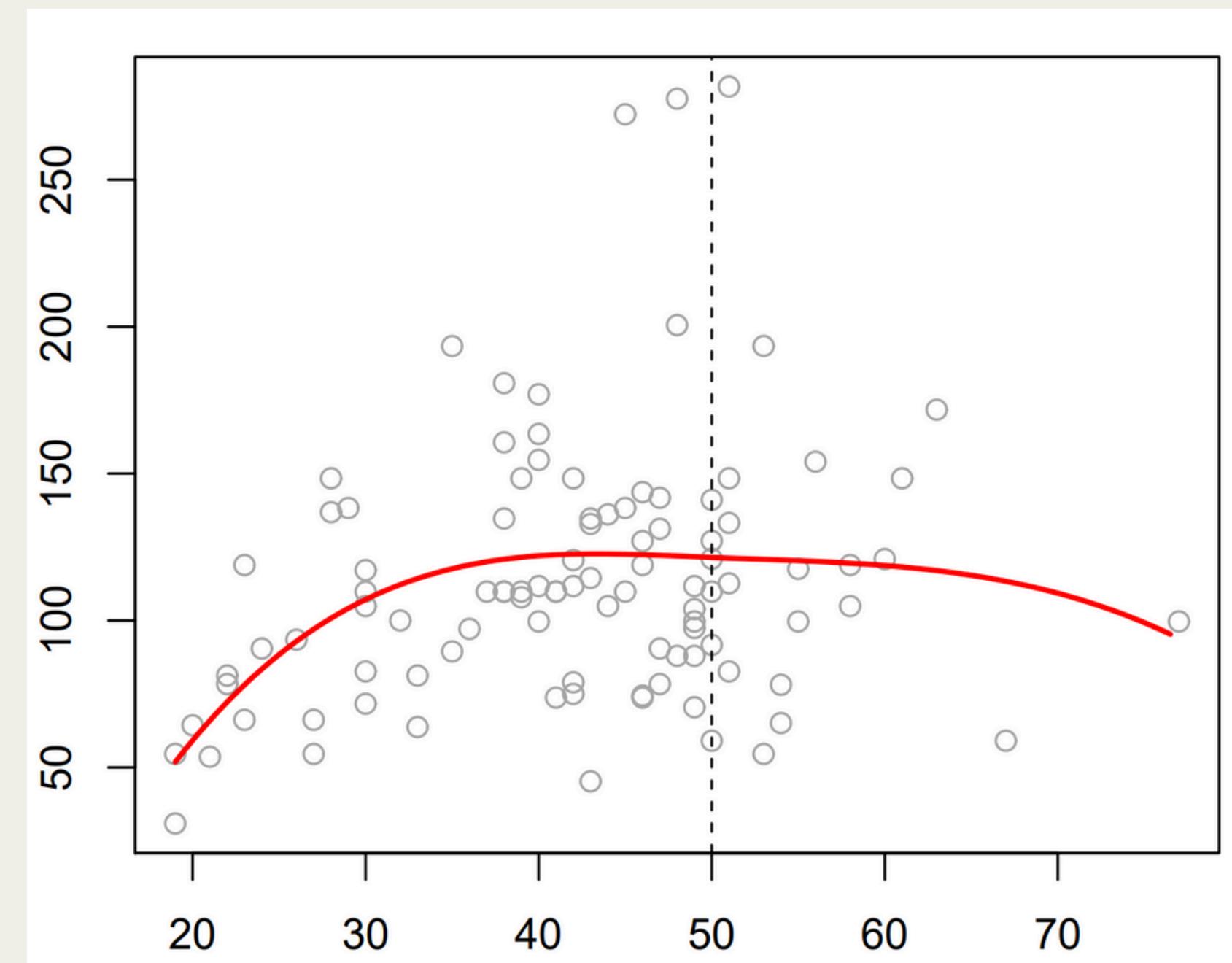
METHODOLOGY - REGRESSION SPLINES



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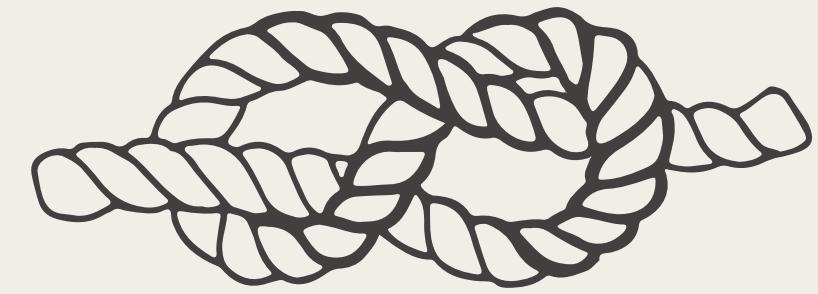


METHODOLOGY - CUBIC SPLINES

$$g(x) = \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3 + \sum_{j=1}^K \beta_{(3+j)} (x - \tau)_+^3 \quad (1)$$

$$RSS = \sum_{i=1}^n (y - g(x))^2 \quad (2)$$

METHODOLOGY - PENALIZED REGRESSION SPLINES



Issue: Knot Location
Selection



Fix: Many Knots and
Penalty Term



METHODOLOGY - GAMS

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{i2} + \dots + \beta_p x_{ip}$$



METHODOLOGY - GAMS

$$y_i = \beta_0 + f(x_{1i}) + f(x_{i2}) + \dots + f(x_{ip})$$



METHODOLOGY - GAM CONSTANT SEASONALITY

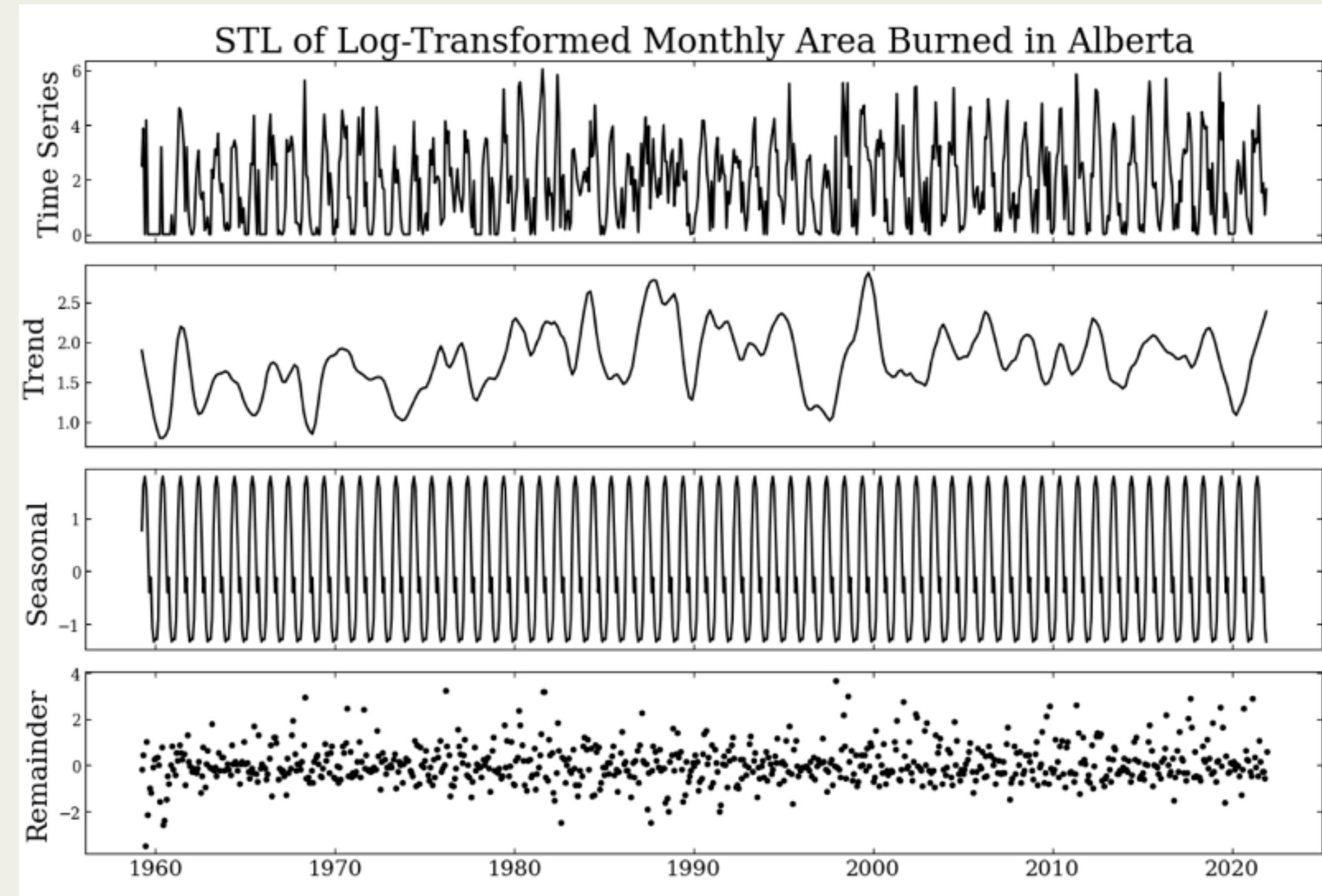
$$\log(\text{Area Burned}) = \beta_0 + f(\text{Month}) + f(\text{Year})$$

METHODOLOGY - GAM SURFACE

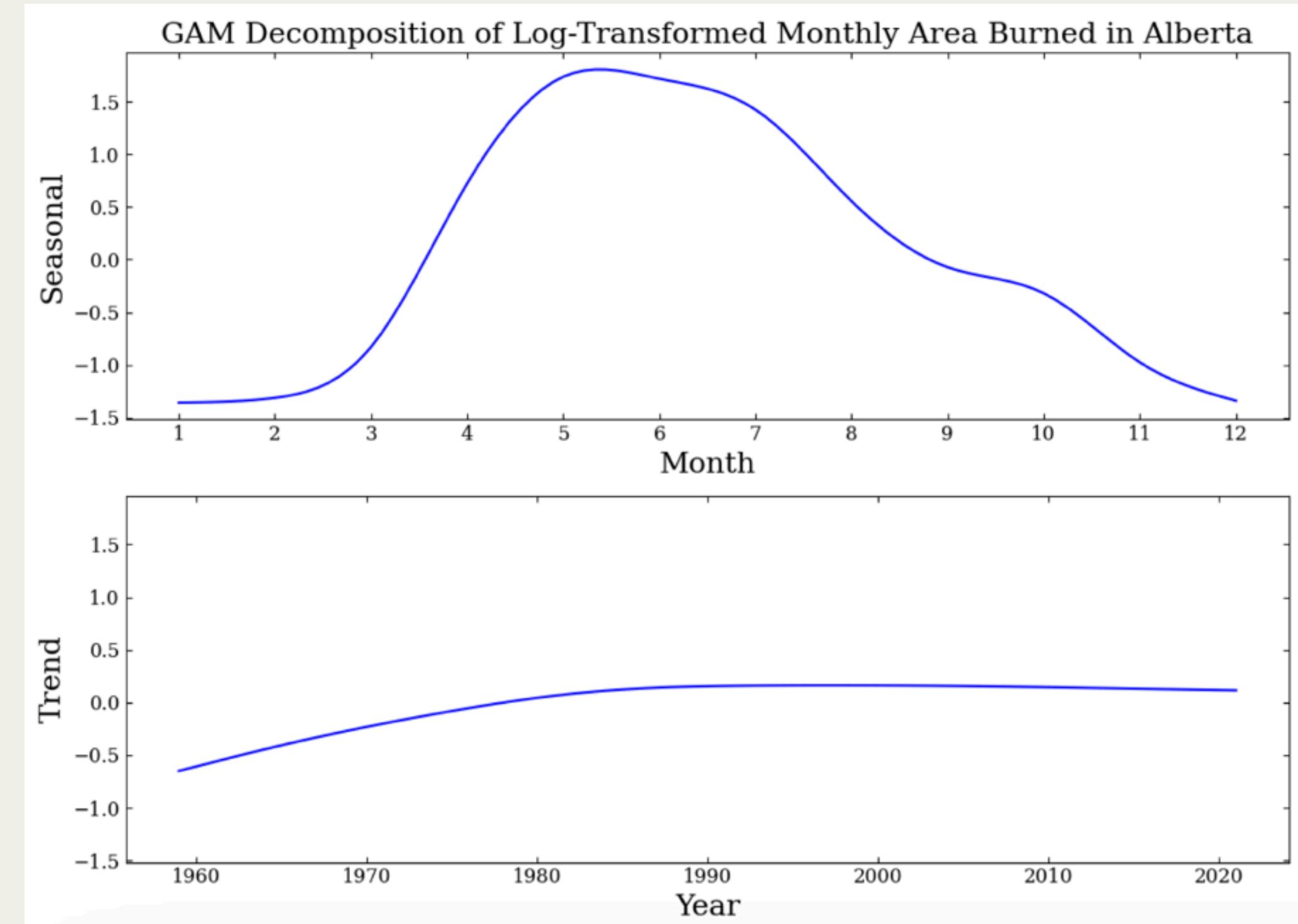


$$\log(\text{Area Burned}) = \beta_0 + f(\text{Month}, \text{Year})$$

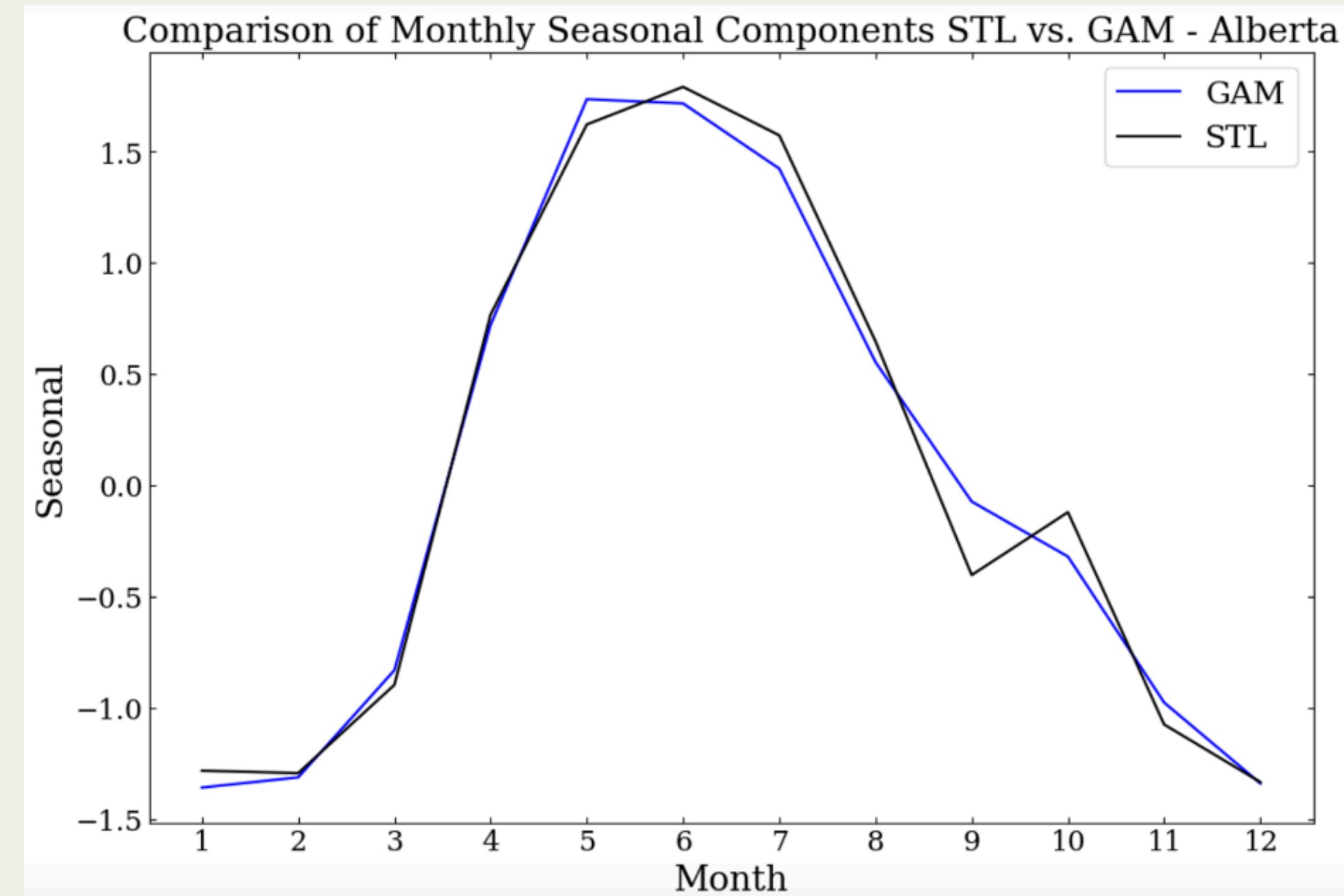
RESULTS - STL DECOMPOSITION



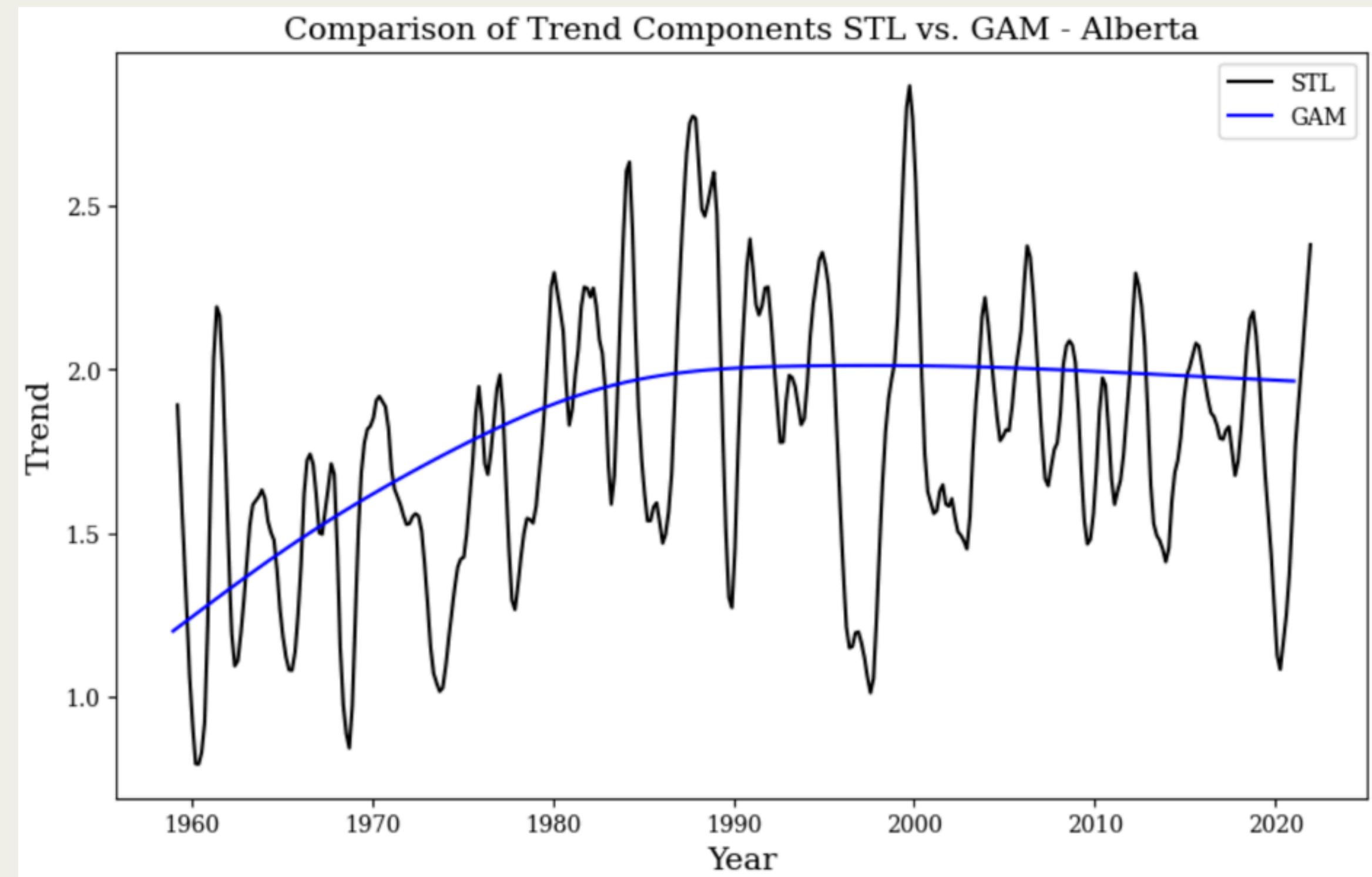
RESULTS - GAM DECOMPOSITION



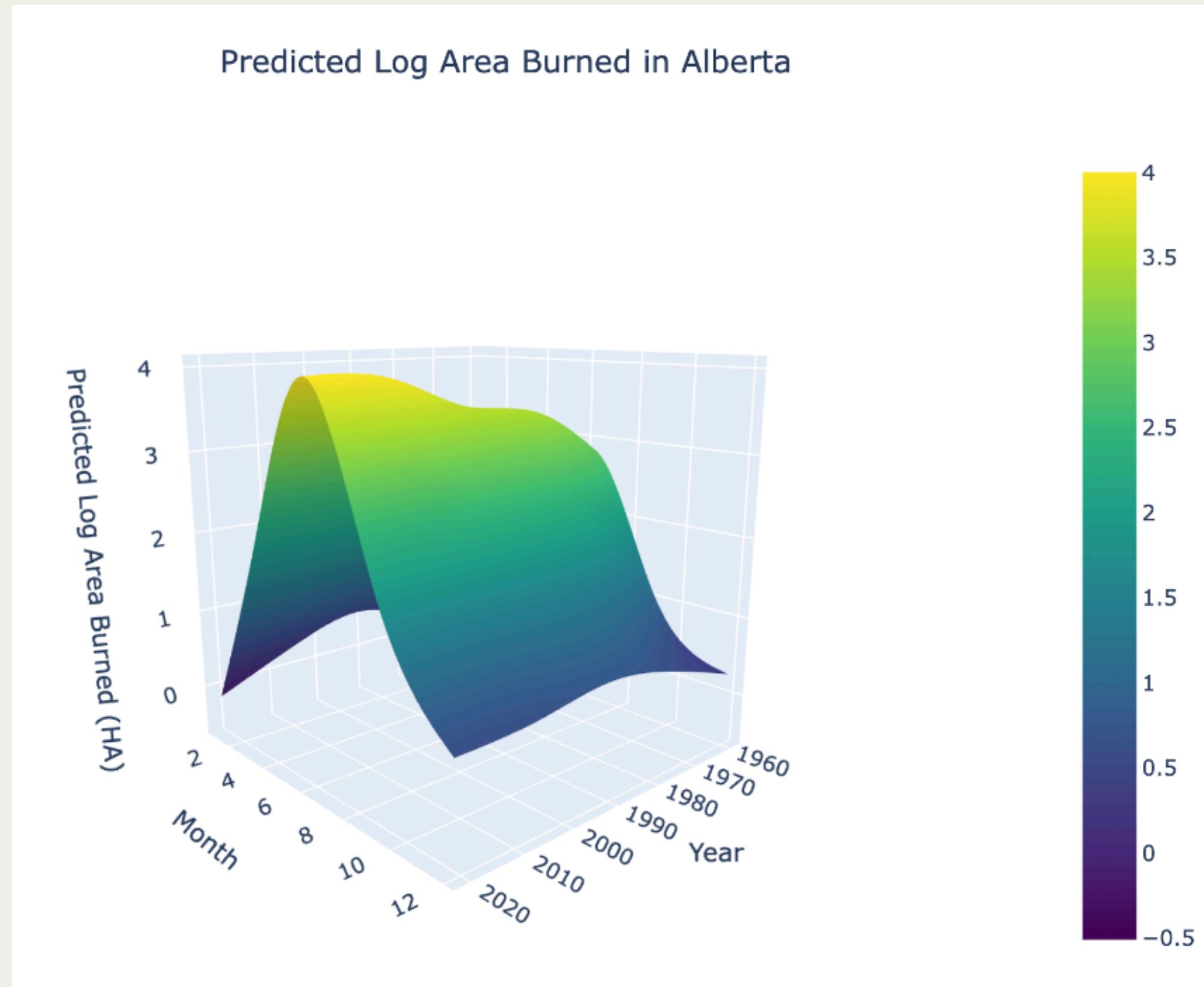
RESULTS - SEASONAL COMPARISON



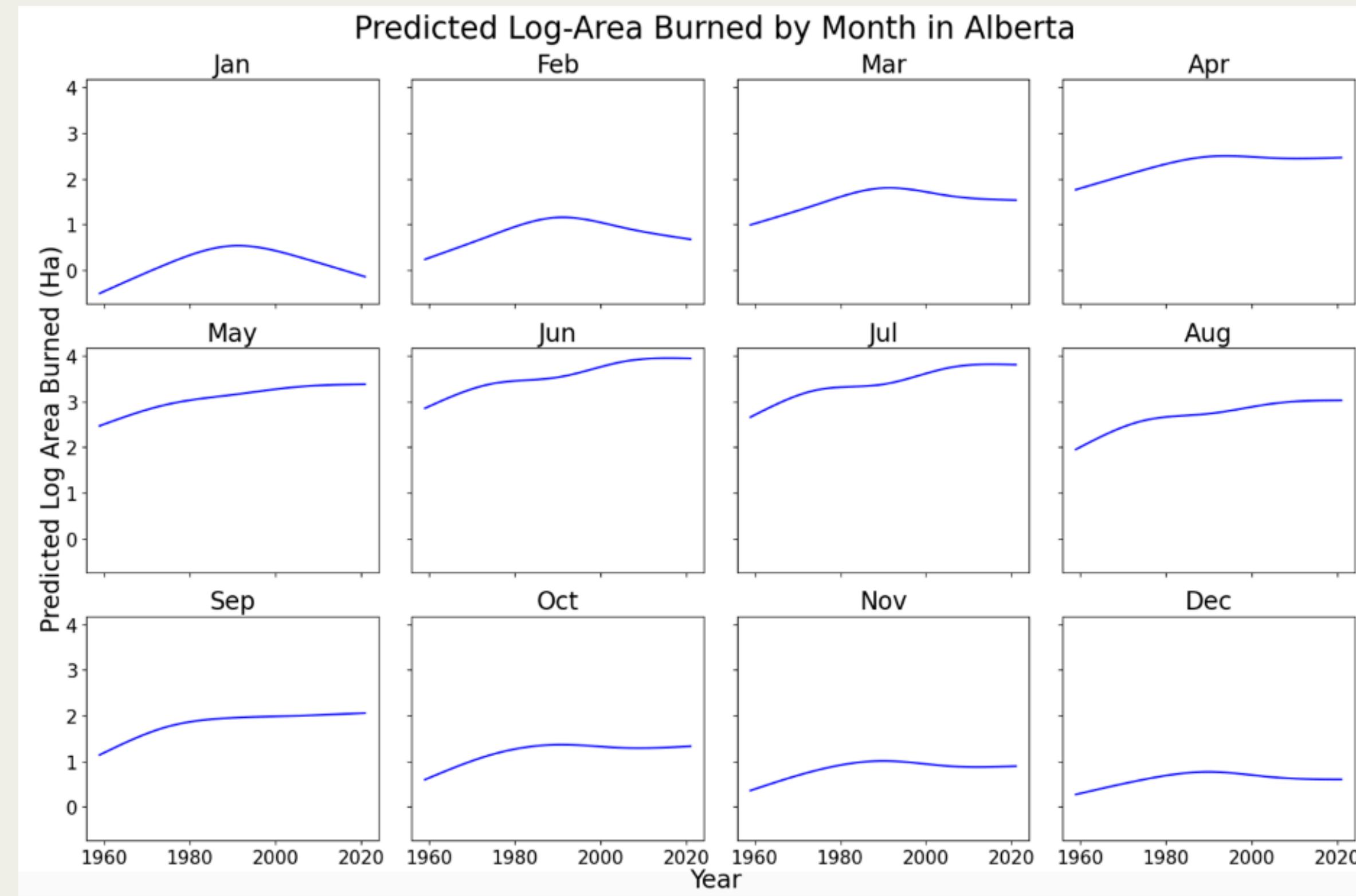
RESULTS - TREND COMPARISON



RESULTS - GAM SURFACE



RESULTS - GAM SURFACE





DISCUSSION - STL ADVANTAGES

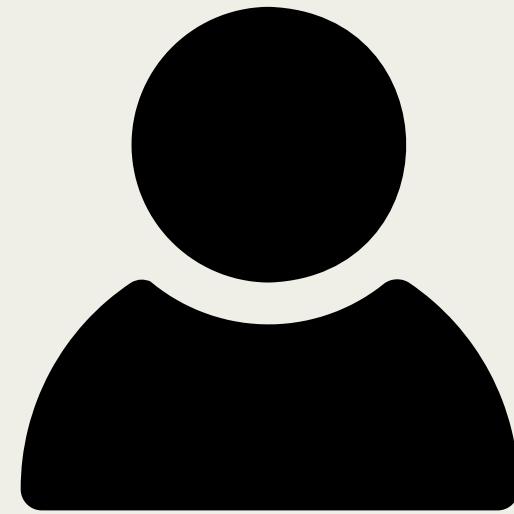


**Captures Short-Term
fluctuations in Trend**

DISCUSSION - GAM ADVANTAGES



**Captures Smooth
Long-Term Trend**



**User
Friendly**



DISCUSSION - STL DISADVANTAGES

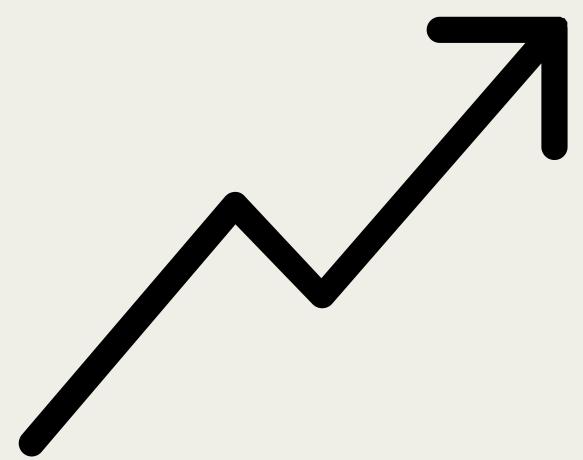


**Not User
Friendly**

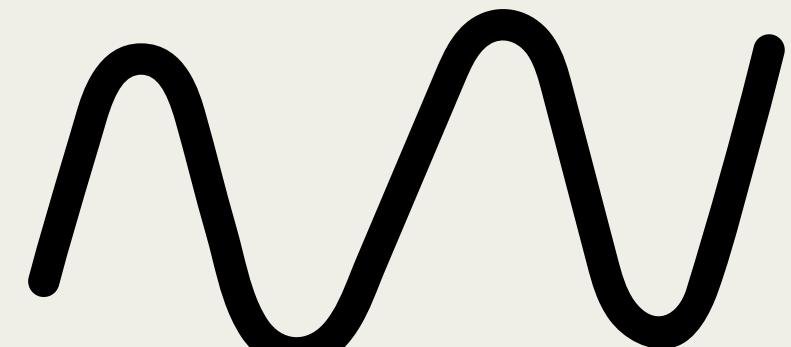
CONCLUSION



**Area Burned Peaks in
May/June**

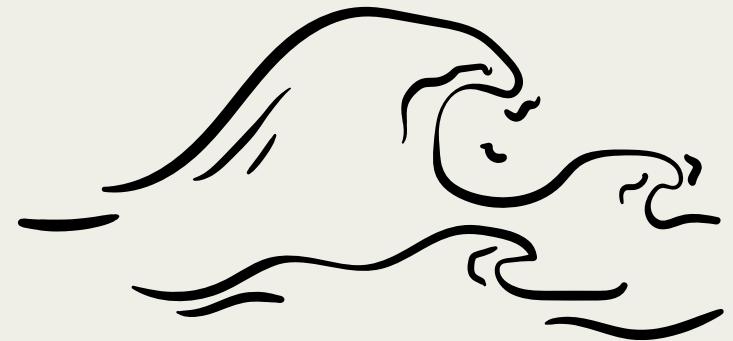


**Area Burned Has
Increased in Months
April-Spetember**



GAM vs. STL

FUTURE WORK



**Determine Cause of
Increasing Trends**



**Examine Other
Provinces**



**Consider Weekly Area
Burned**