Analysis of Weather with Kolmogorov's Complexity

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Let's Explore!

Introduction

Window Size analysis for Time Series Data Compression

Seasonal Changes in Complexity

Effect of severe weather conditions (Hurricanes)

Introduction

High complexity low compressibility
A completely random string
incompressible
no pattern 🥲

Low complexity high compressibility
A regular string (such as "1111111111")
easy to compress

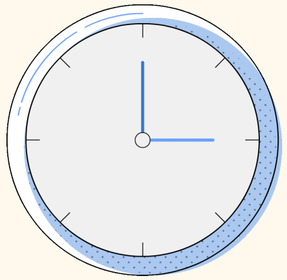
Introduction

Weather: Time series Data

Want to know: Weather patterns !
Severe weather conditions

& complexity

Compression



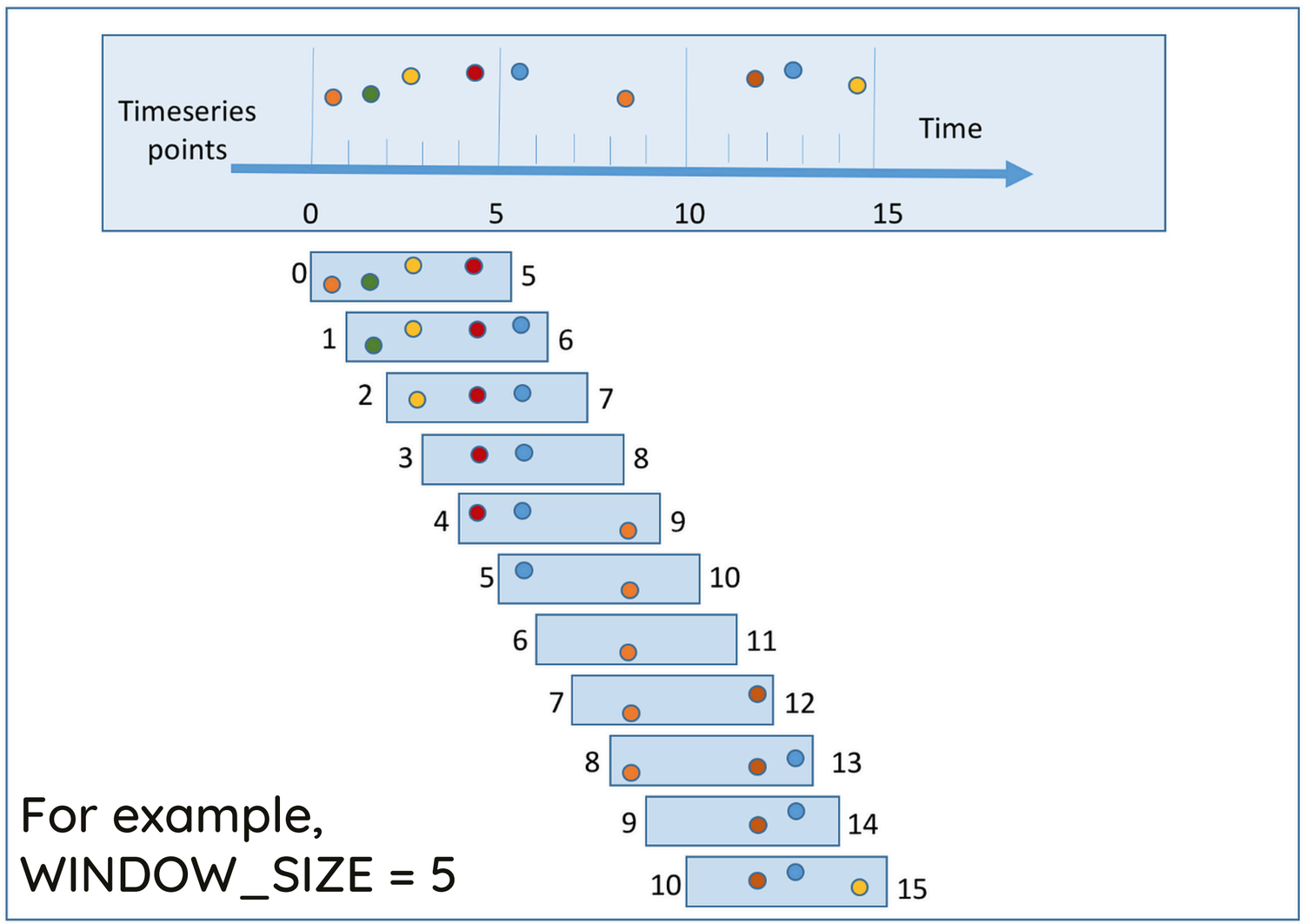
Weather Time Series:

- highly correlated
- often contains some regularity or redundant information

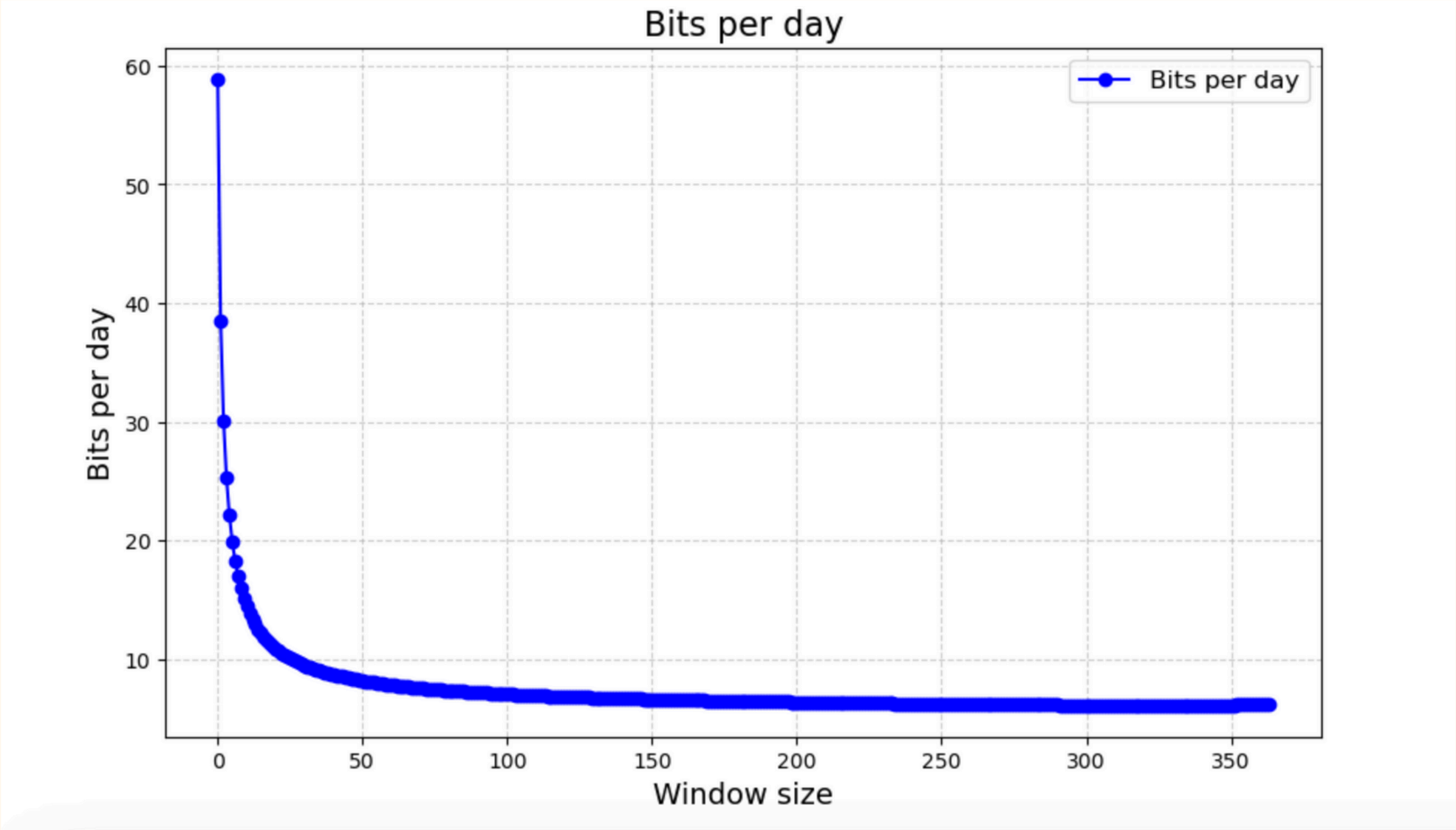
Gzip:

compresses by exploiting repeated patterns

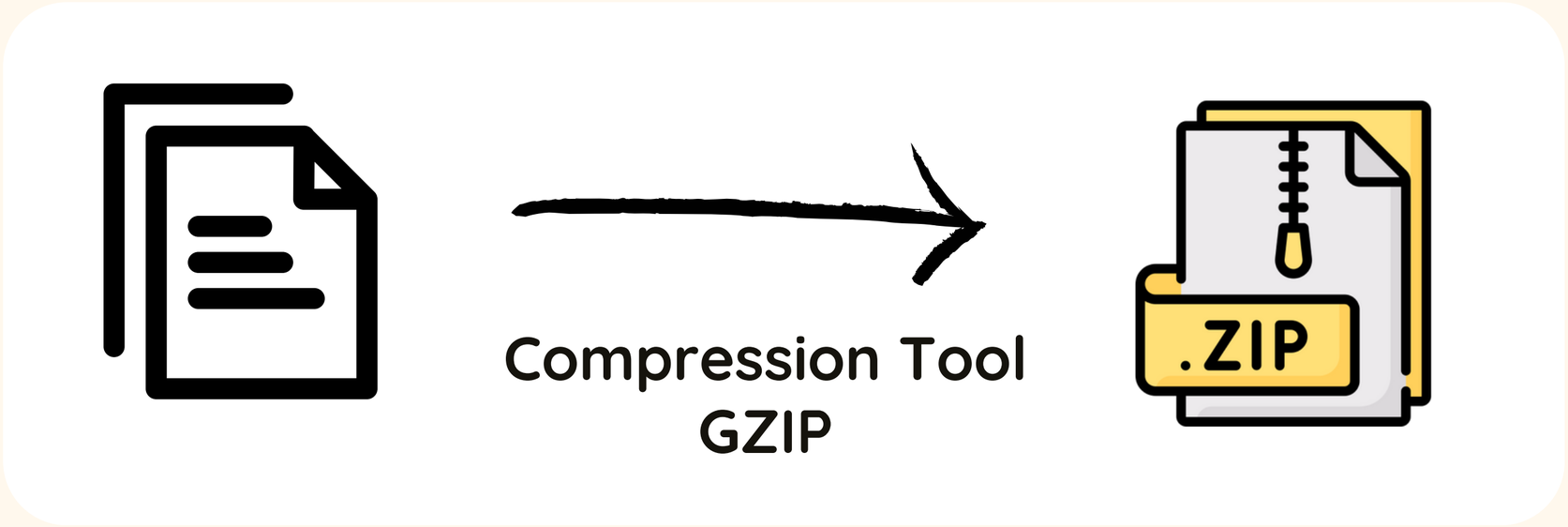
Use of window & effect of window size



Effect of window size



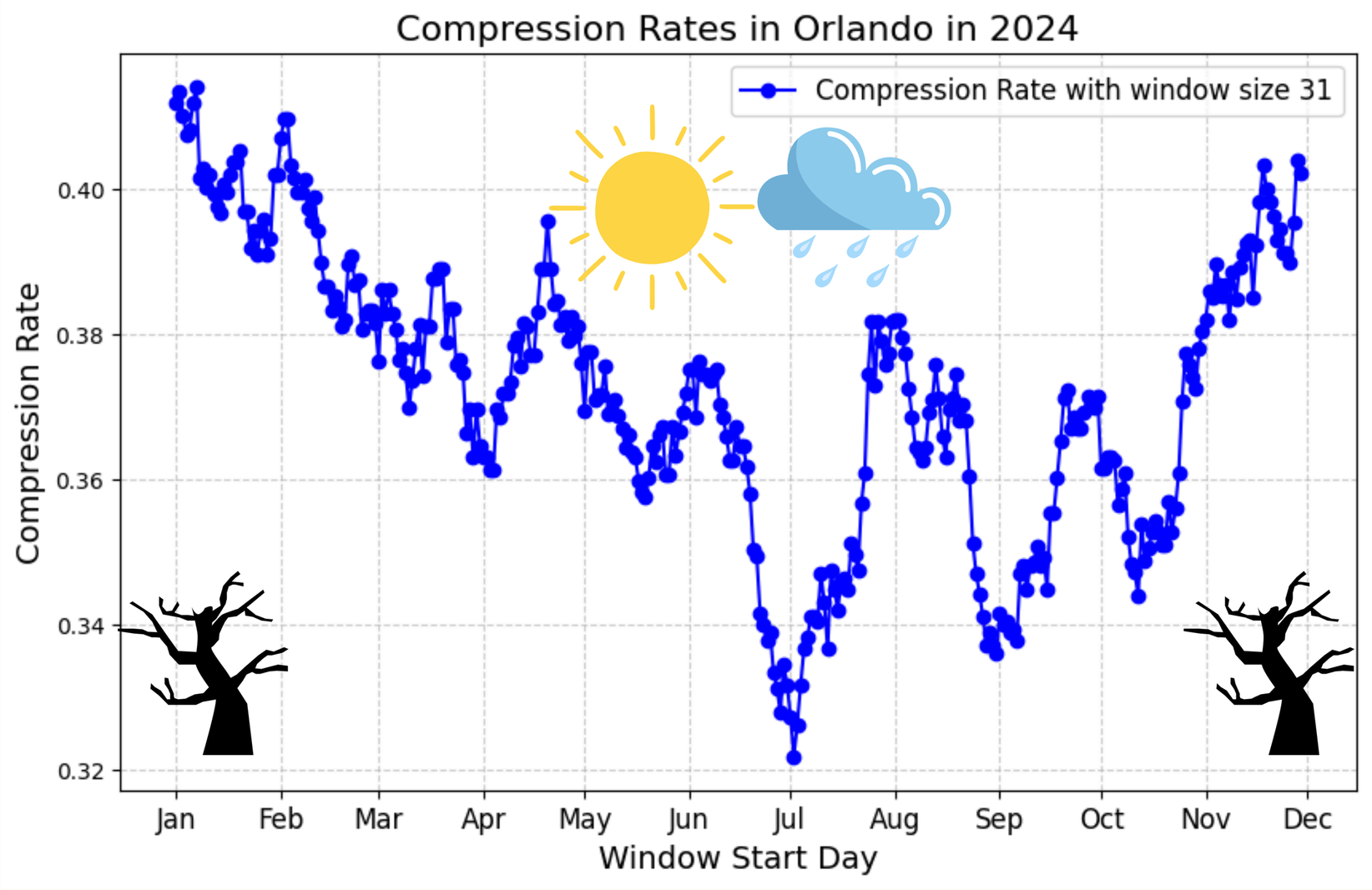
Approximating Kolmogorov's Complexity



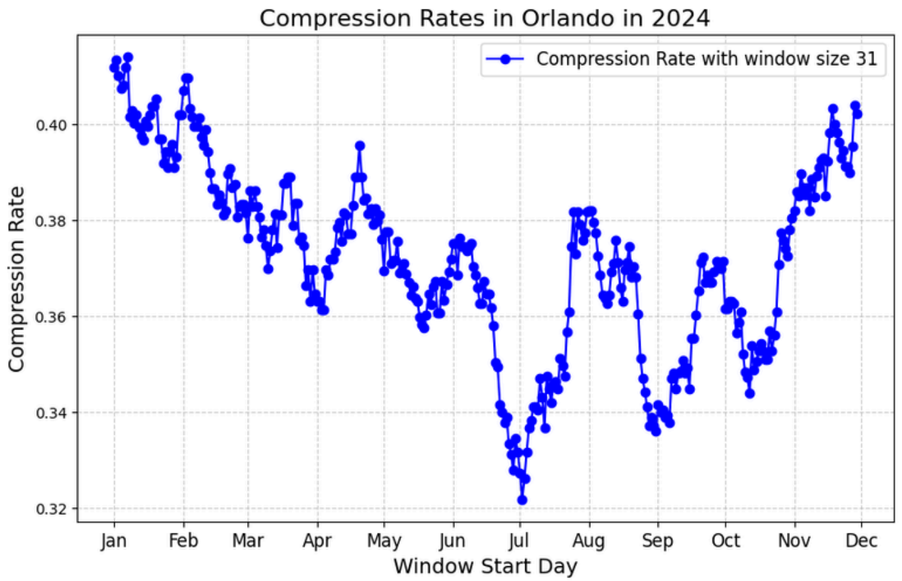
Compression Rate
= compressed_size / uncompressed_size

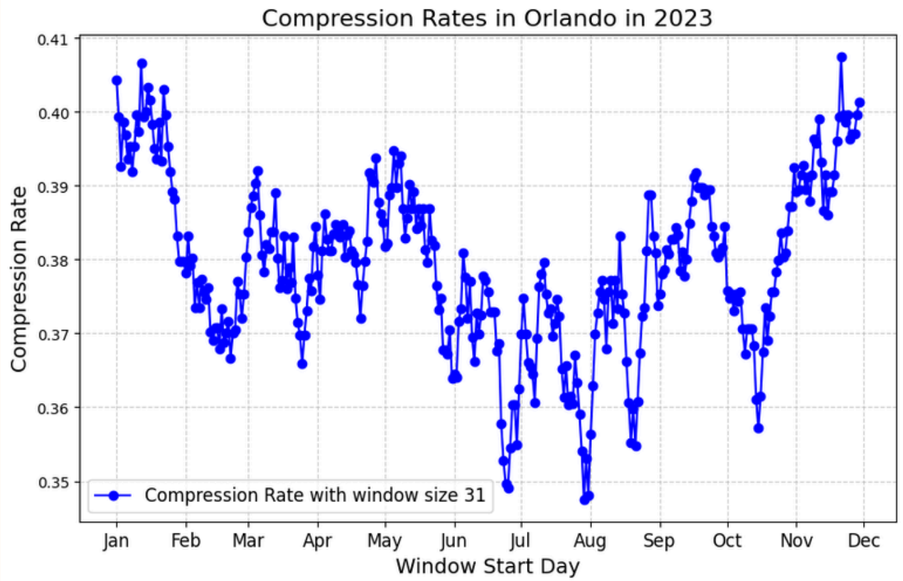
Higher compression rate
=> Lower Compressibility => Higher complexity

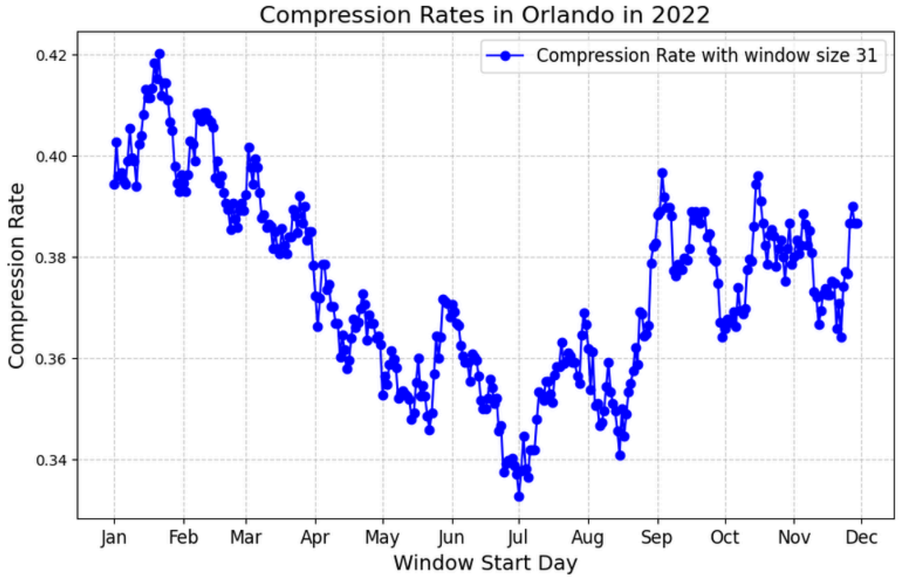
Seasonal Changes in Complexity

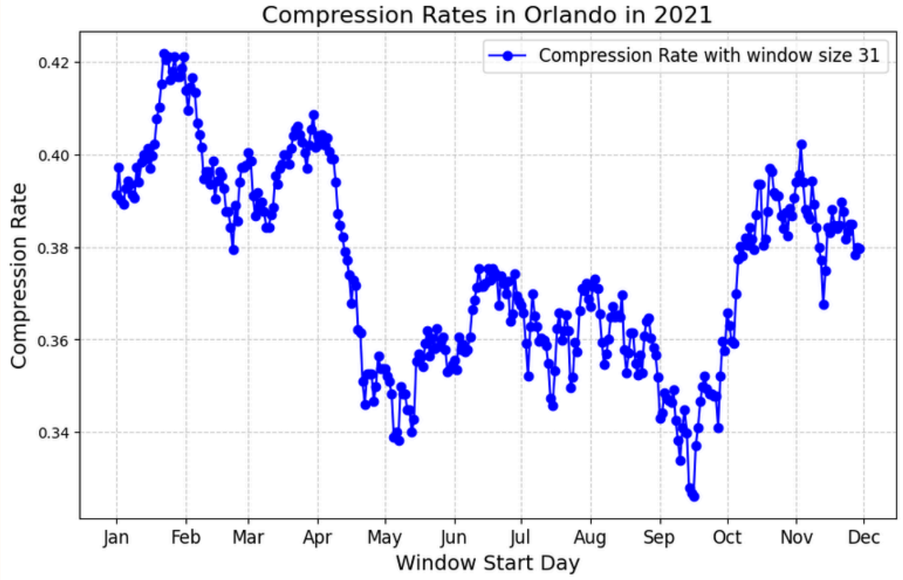


Seasonal Changes in Complexity

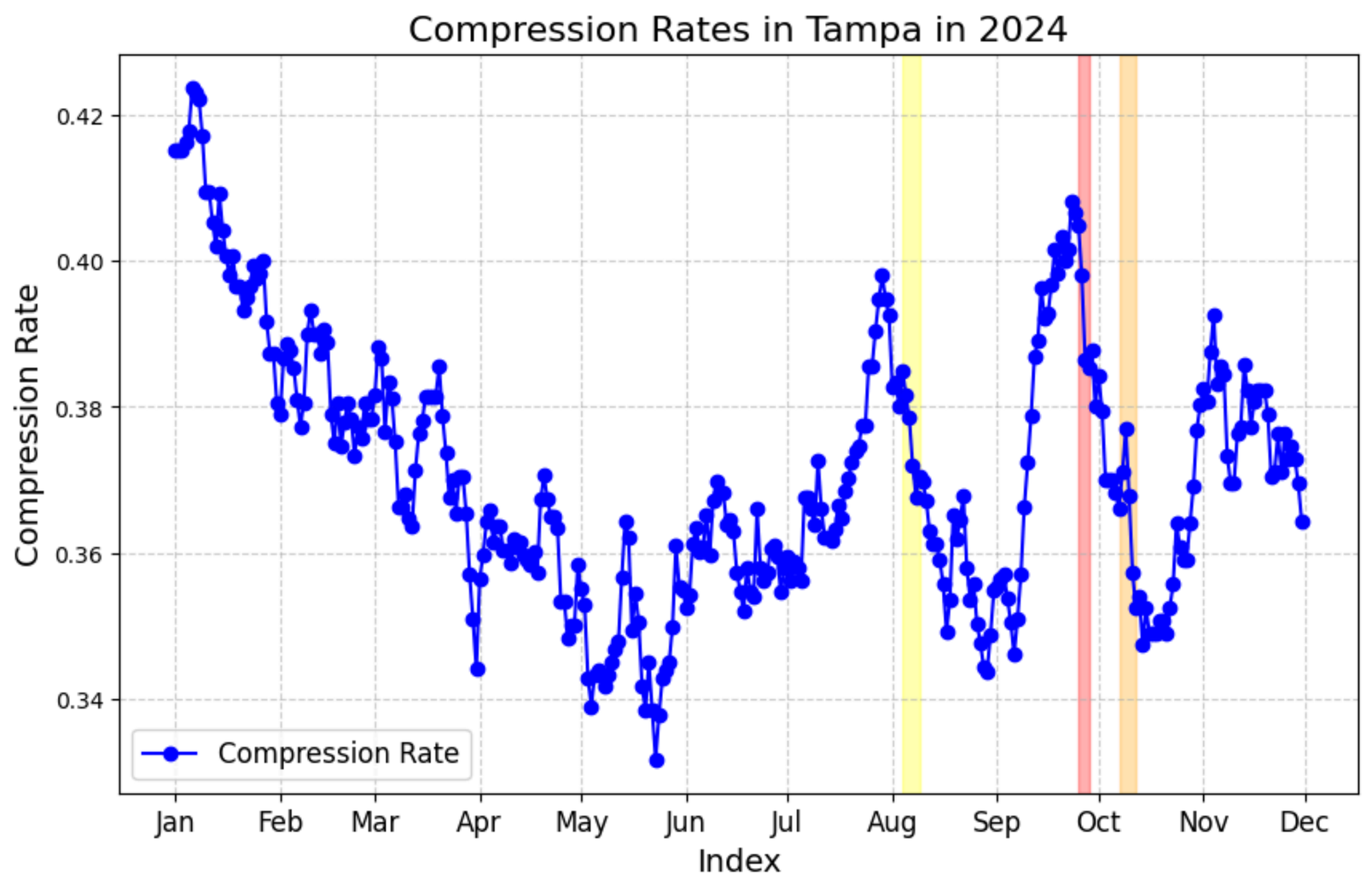








Effect of Hurricanes



Hurricane Debby

Cat 1 Hurricane

Hurricane Helene

Cat 4 Hurricane

Hurricane Milton

Forecasted as Cat 5 but veered South of Tampa in reality

“Comprehension is Compression”

SOURCES

Florida Weather Data:
https://climatecenter.fsu.edu/climate-data-access-tools/downloadable-data

Kolmogorov’s Complexity in Financial Time series:
https://www.researchgate.net/publication/275054667_Estimating_the_Algorithmic_Complexity_of_Stock_Markets