Correlating forest fires with bird diversity

16 december 2024

Studenten:
Ceylan Siegertsz
14748215

Jort Bakker
14606712

Groep:
15

Docent:
Rick Quax

Universiteit van Amsterdam
Informatica

Table of contents

1. Idea
2. Research questions & hypothesis
3. Data
4. Method
5. Results
6. Conclusion

Idea

Find enough data

Ecological interest

Correlating two parts

Research questions and hypothesis

R1: Is there a correlation between intensity/frequency of forest fires and the diversity of bird species?

R2: Is there a correlation between intensity/frequency of forest fires and the size of bird populations?

H0: Forest fires have no standard effect on bird diversity or populations
H1: Forest fires have a standard effect on bird diversity or populations

Data

- Wildfire dataset 1.88 million wildfires - US 1992-2015
  - recorded wildfires, regardless of size
- EBird, 100GB+ bird data - 2006 onwards
  - bird monitoring app

Wildfire dataset

- Expansive
- Location (coordinates & state, county etc)
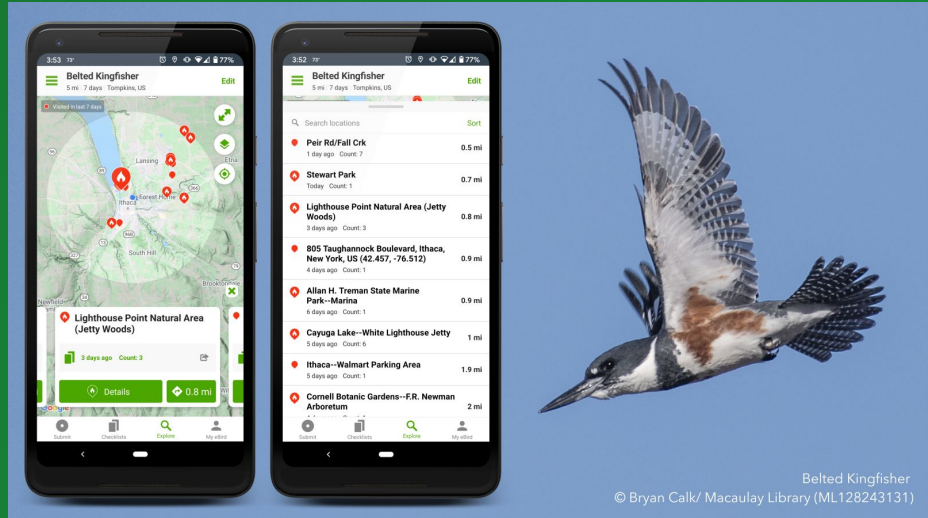- Discovery date
- Acres burnt
- Duration

EBird

Cornell Lab

Hobbyist and professional spotters

Requested Access to database

Belted Kingfisher
© Bryan Calk/ Macaulay Library (ML128243131)

Ebird dataset

- Very detailed
- Location, Species, Discovery date, etc
- Dependent on users
- Observer bias
- Observer effort
- Userbase size

EBird citation

eBird. 2024. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org. (Accessed: Date December 2, 2024).
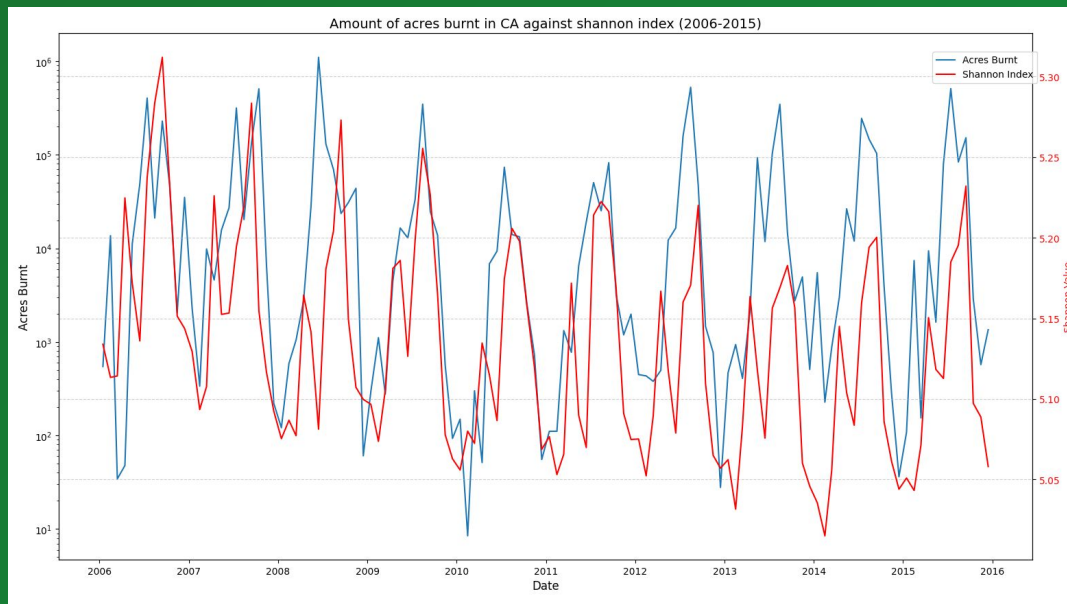
Method

1. Zooming in on California
2. Shannon index
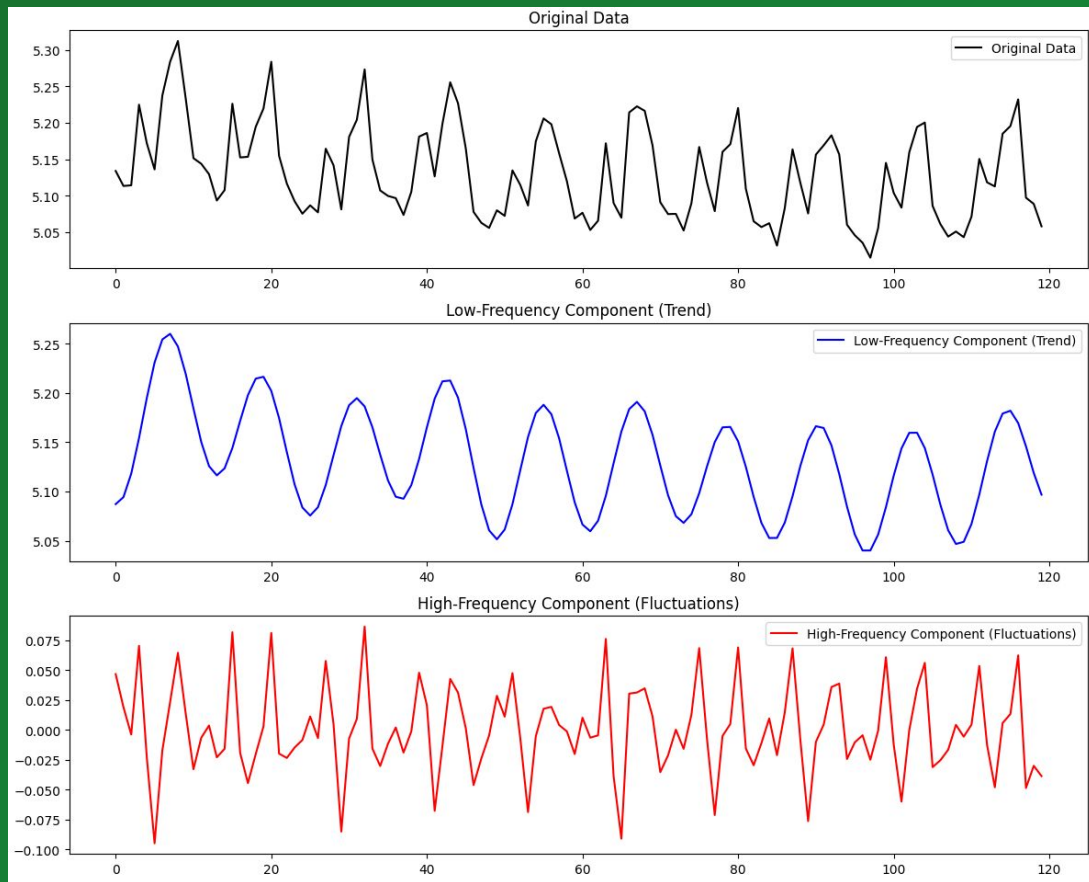3. Fourier transform
4. Linear regression

Shannon index

- species diversity
- accounts for species richness and species evenness

- $-\sum_{i=1}^{S} p_i \ln(p_i)$

Amount of acres burnt in CA against shannon index (2006-2015)
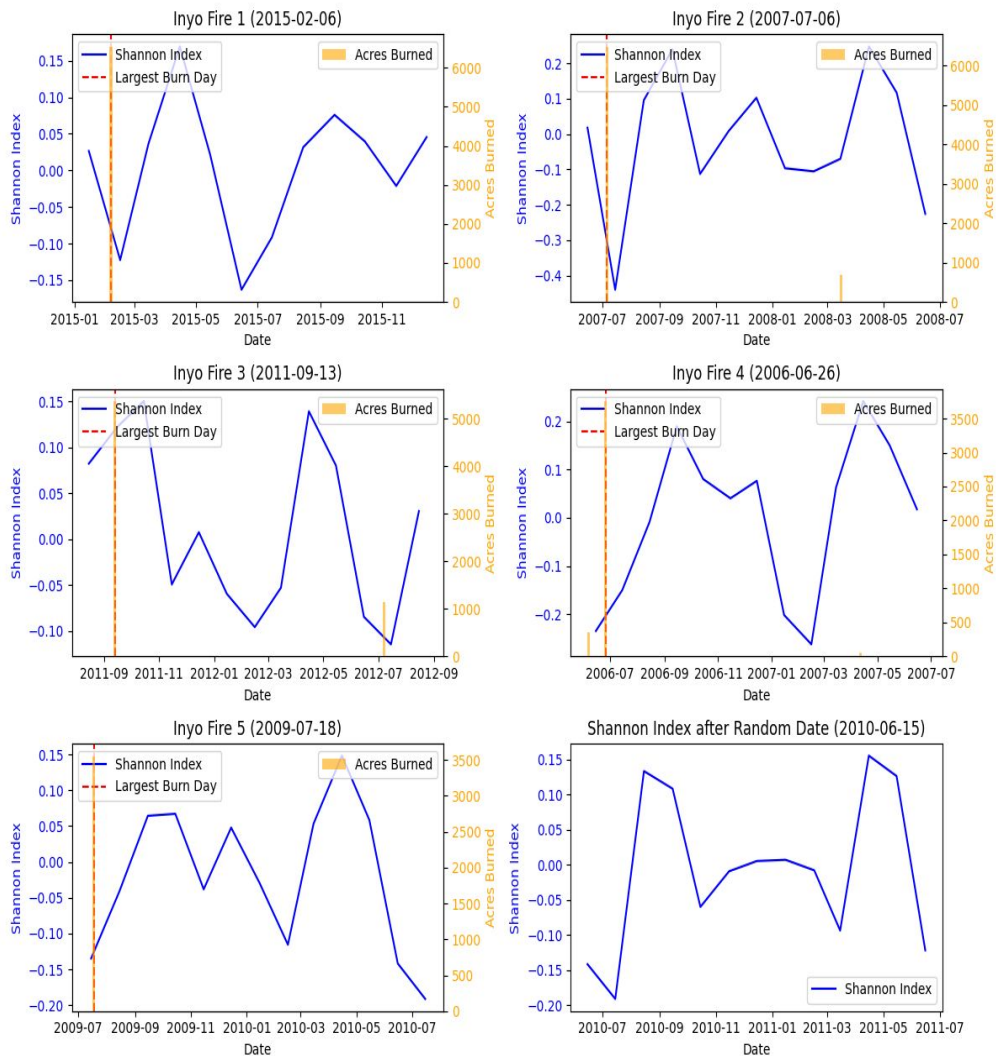
Fourier transform

- Clear periodic components
- Preserves high frequency components
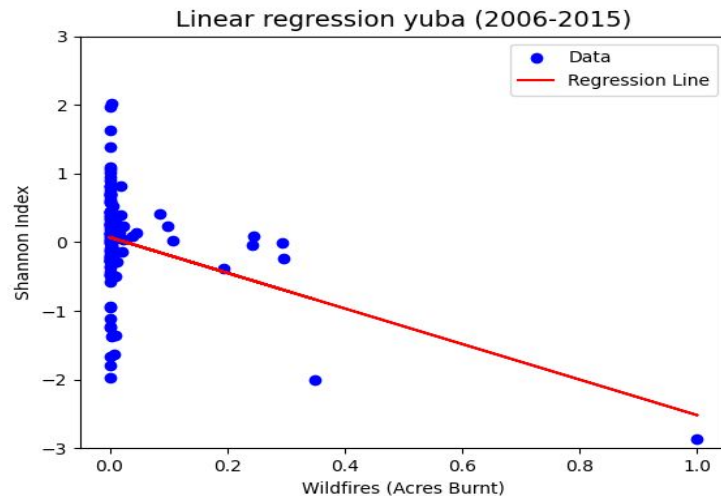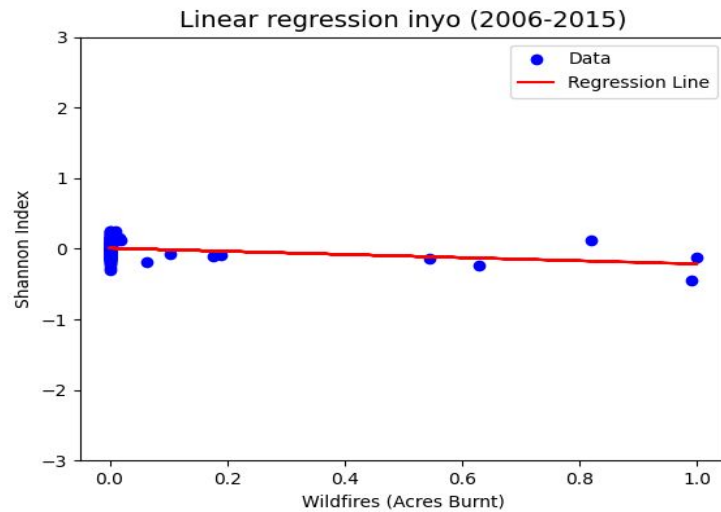
5 fire test

Compare plots of largest fires in

county and shannon values following fire

Linear regression

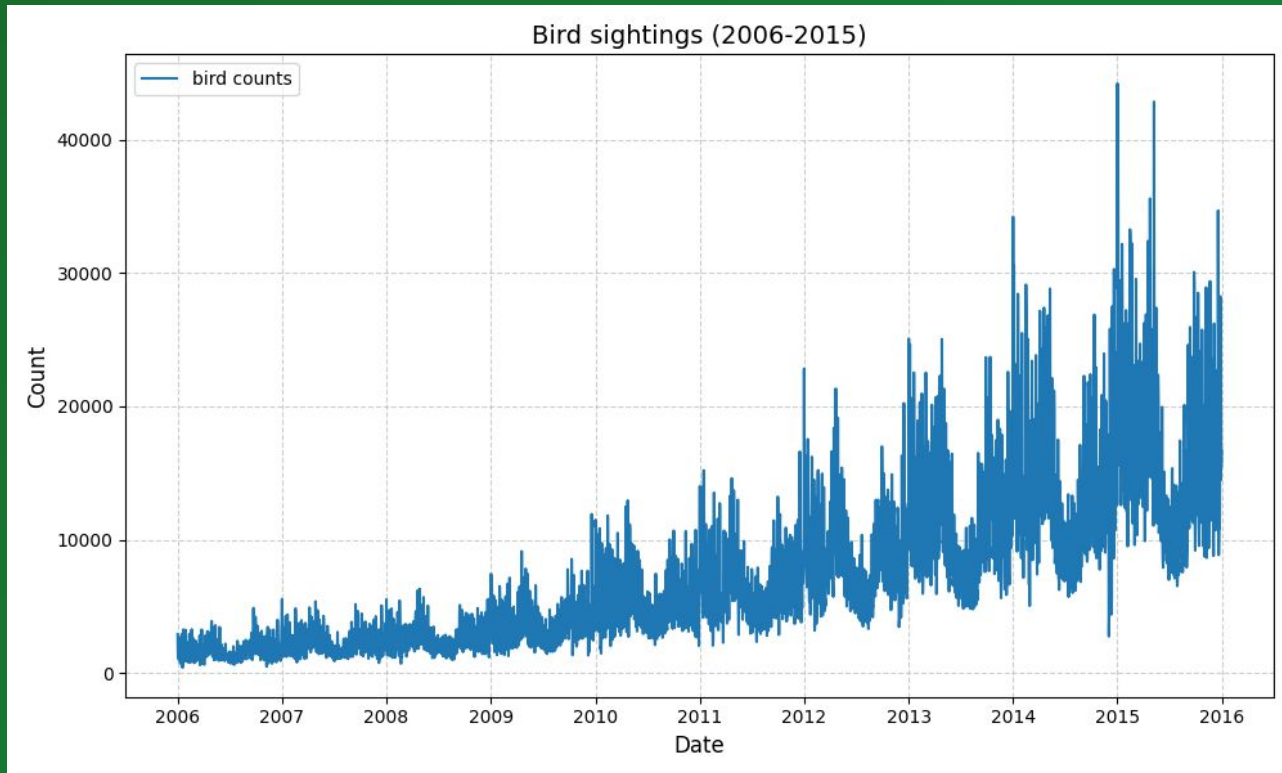- On county level
- OLS (ordinary least squares)
- Simple

County	slope	p-value	R²
Yuba	-2.590	0.0001	0.118
Inyo	-0.223	0.0008	0.089
Alameda	-0.043	0.403	0.005
San Mateo	-0.041	0.538	0.003
Plumas	0.071	0.868	0.0002

Linear regression inyo (2006-2015)

Linear regression yuba (2006-2015)

Population numbers

- Alternative to shannon index
- More dependent on amount of observations
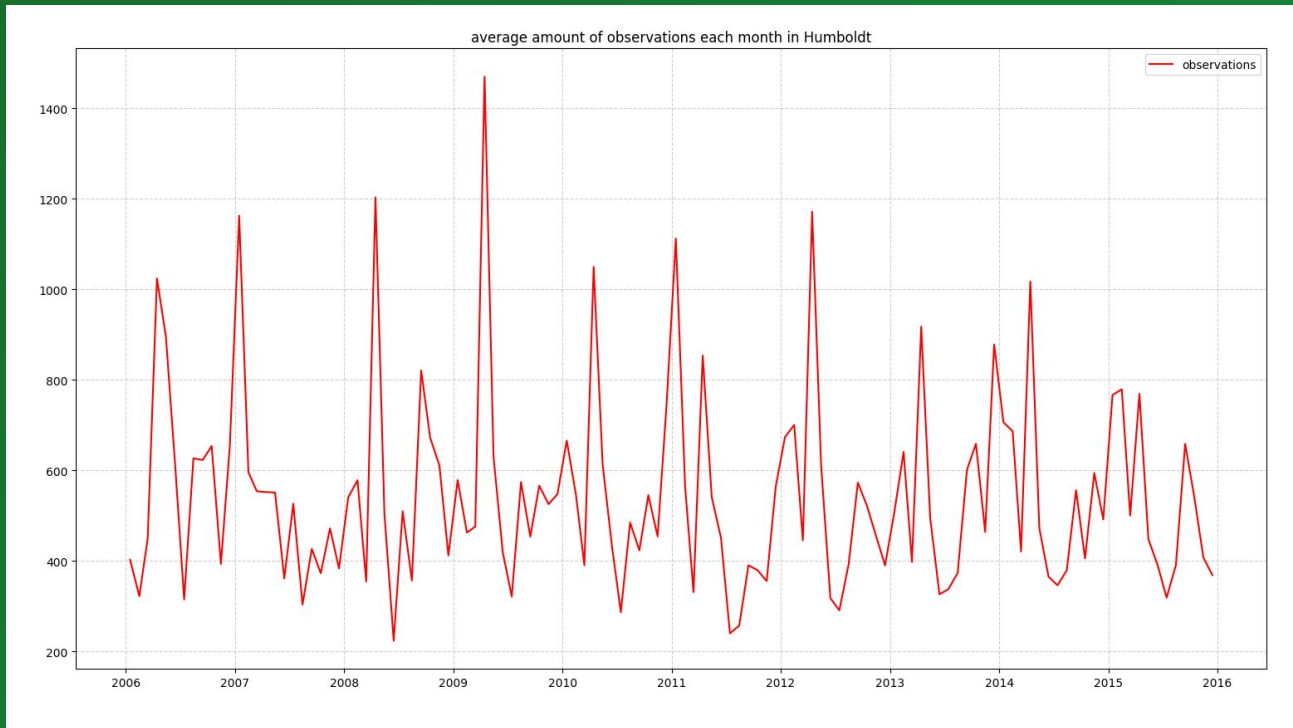- But might be easier to find a correlation
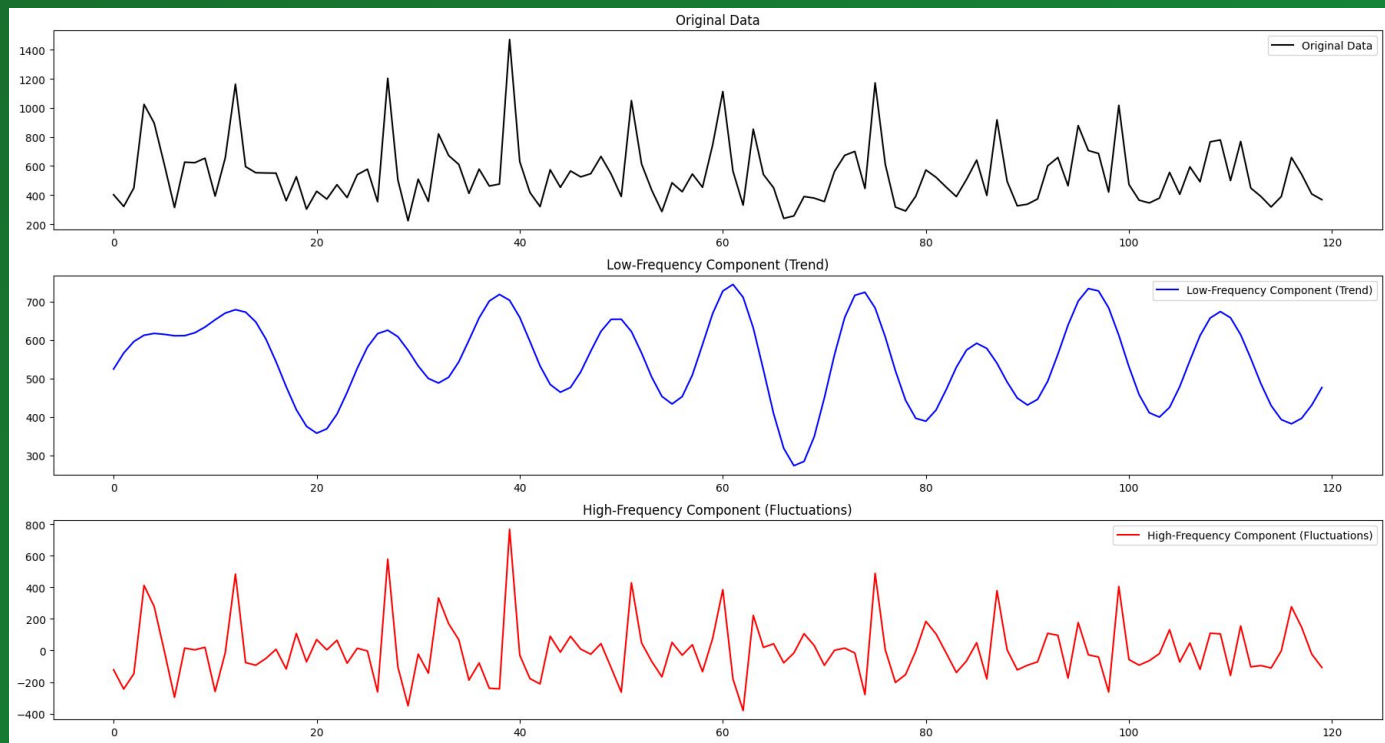
State level

Bird sightings (2006-2015)

County level

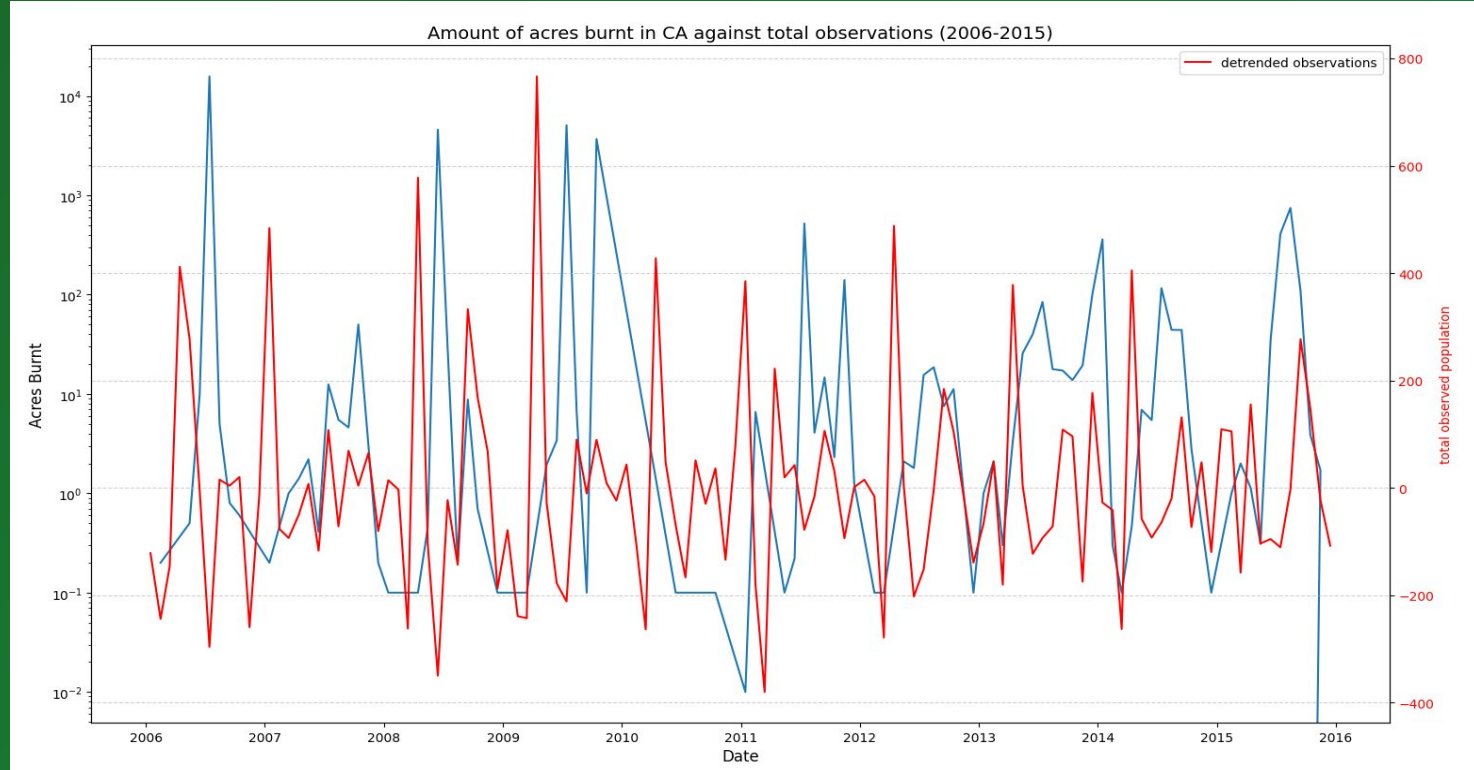- Weighting based on effort
- effort = unique sampling event

Decomposition

- Fourier

Detrended observations vs Wildfires

Linear regression (OLS)

- 5 random counties
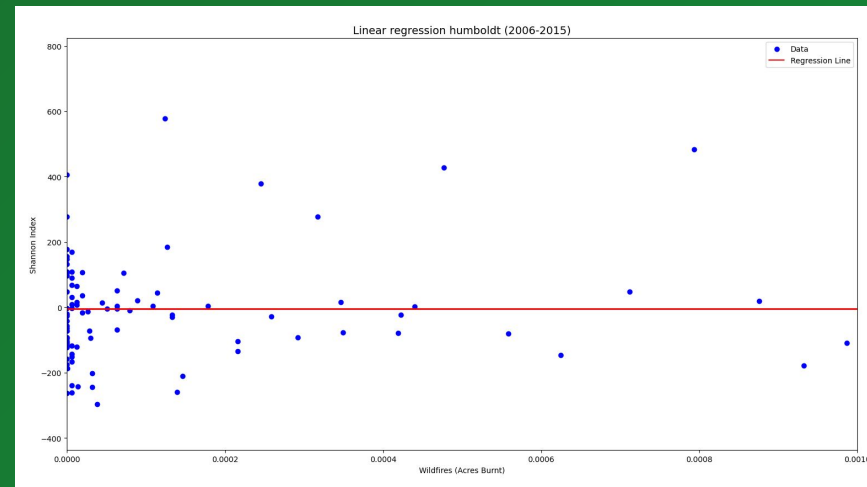
County	Slope	p-value Slope	R²
Humboldt	347.588	0.043	0.033
Orange	-134.487	0.210	0.013
Mendocino	-106.894	0.128	0.019
San Diego	216.717	0.359	0.007
San Bernardino	-23.331	0.838	0.0003

Lag

- correlation might have a lag
- short term
- long term

Cross-Correlation Between Acres Burnt and Shannon Index
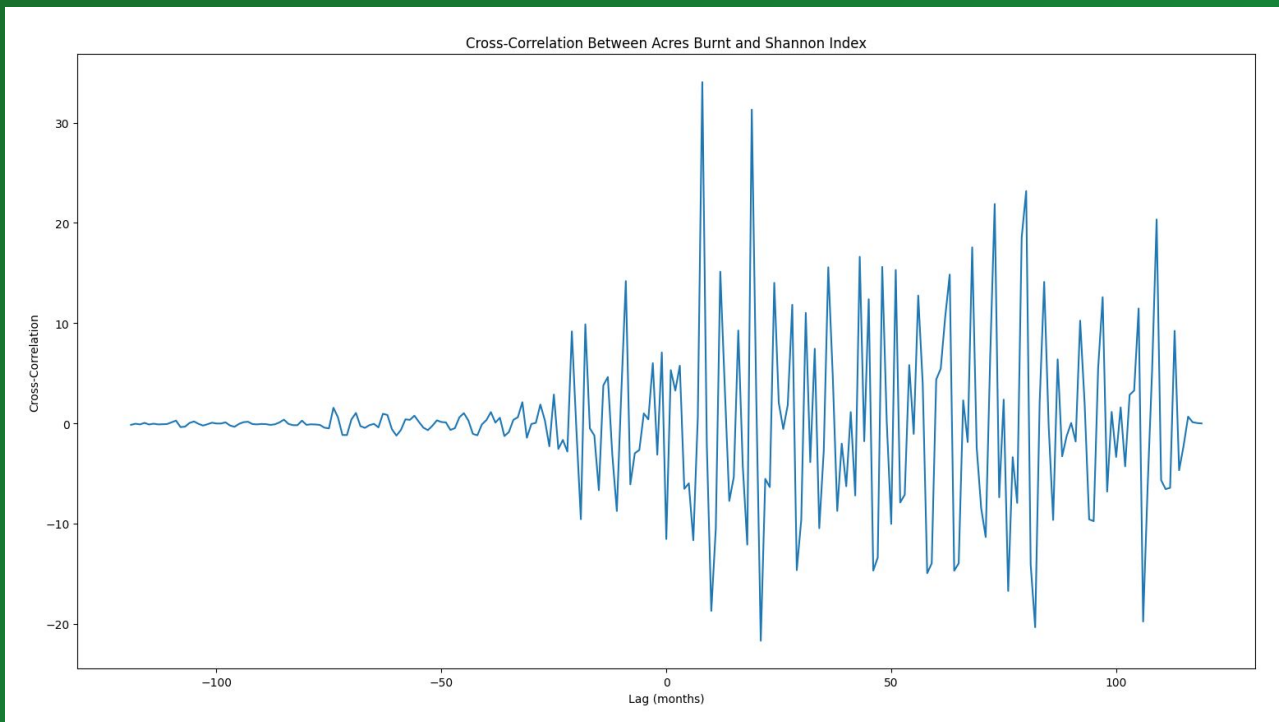
Results

P-value

Somewhat consistent fluctuations

Shannon index acts seasonal

Lot of noise

Conclusion

- R1: Is there a correlation between intensity/frequency of forest fires and the diversity of bird species?
- H0: Forest fires have no standard effect on bird diversity and populations
  - Fail to reject H0
  - Not enough evidence
  - Complex
  - State-dependent

Conclusion

- R2: Is there a correlation between intensity/frequency of forest fires and the size of bird populations?
- H0: Forest fires have no standard effect on bird diversity and populations
 - Fail to reject H0
 - Not enough evidence
 - Complex
 - State-dependent

Further research

- Other locations
- Natural cycle
- Isolate other factors
- More complex linear regression models
- Detailed lag analysis

`