AFFECTS OF INTEREST RATES

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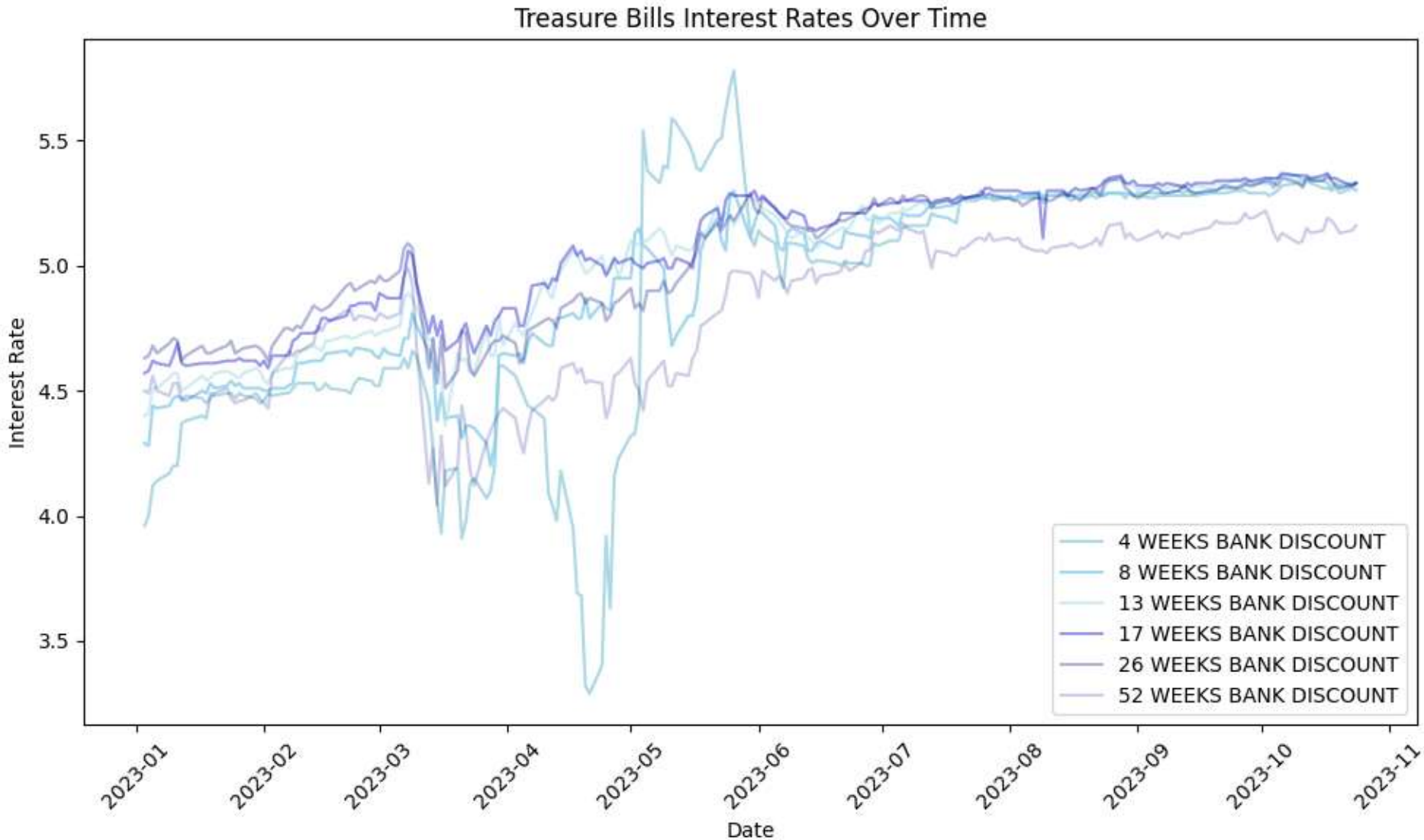
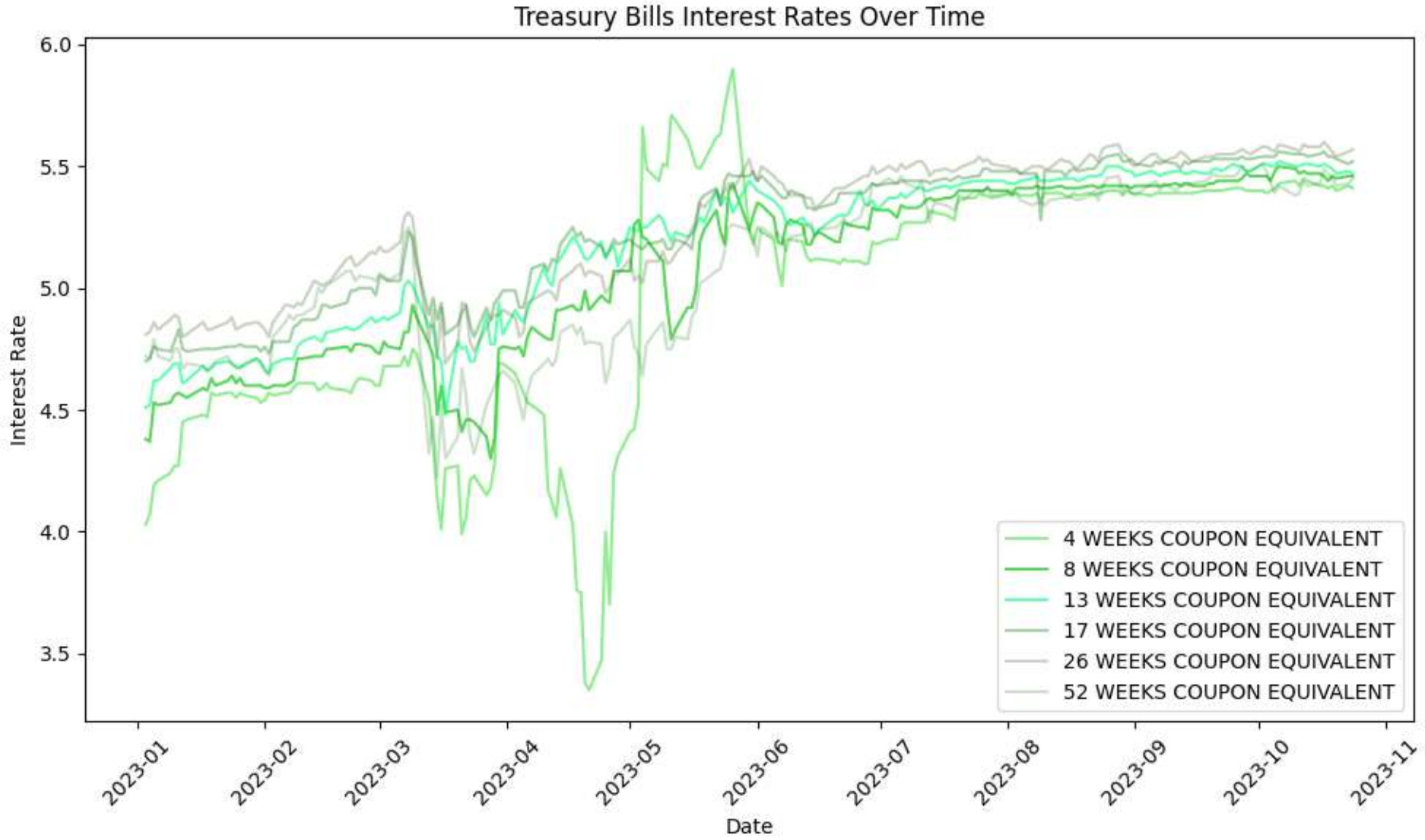
INTRODUCTION

Question 1: Is there a liner relationship between short-term interest rates and long-term interest rates?

Question 2: Is there a liner relationship between short-term interest rates and change in S&P500?

Question 3: Is there a liner relationship between sunspot activity and short-term interest rates?


Treasure Bills Interest Rates Over Time
Interest Rate
5.5
5.0
4.5
4.0
3.5
2023-01
2023-02
2023-03
2023-04
2023-05
2023-06
2023-07
2023-08
2023-09
2023-10
2023-11
Date
4 WEEKS BANK DISCOUNT
8 WEEKS BANK DISCOUNT
13 WEEKS BANK DISCOUNT
17 WEEKS BANK DISCOUNT
26 WEEKS BANK DISCOUNT
52 WEEKS BANK DISCOUNT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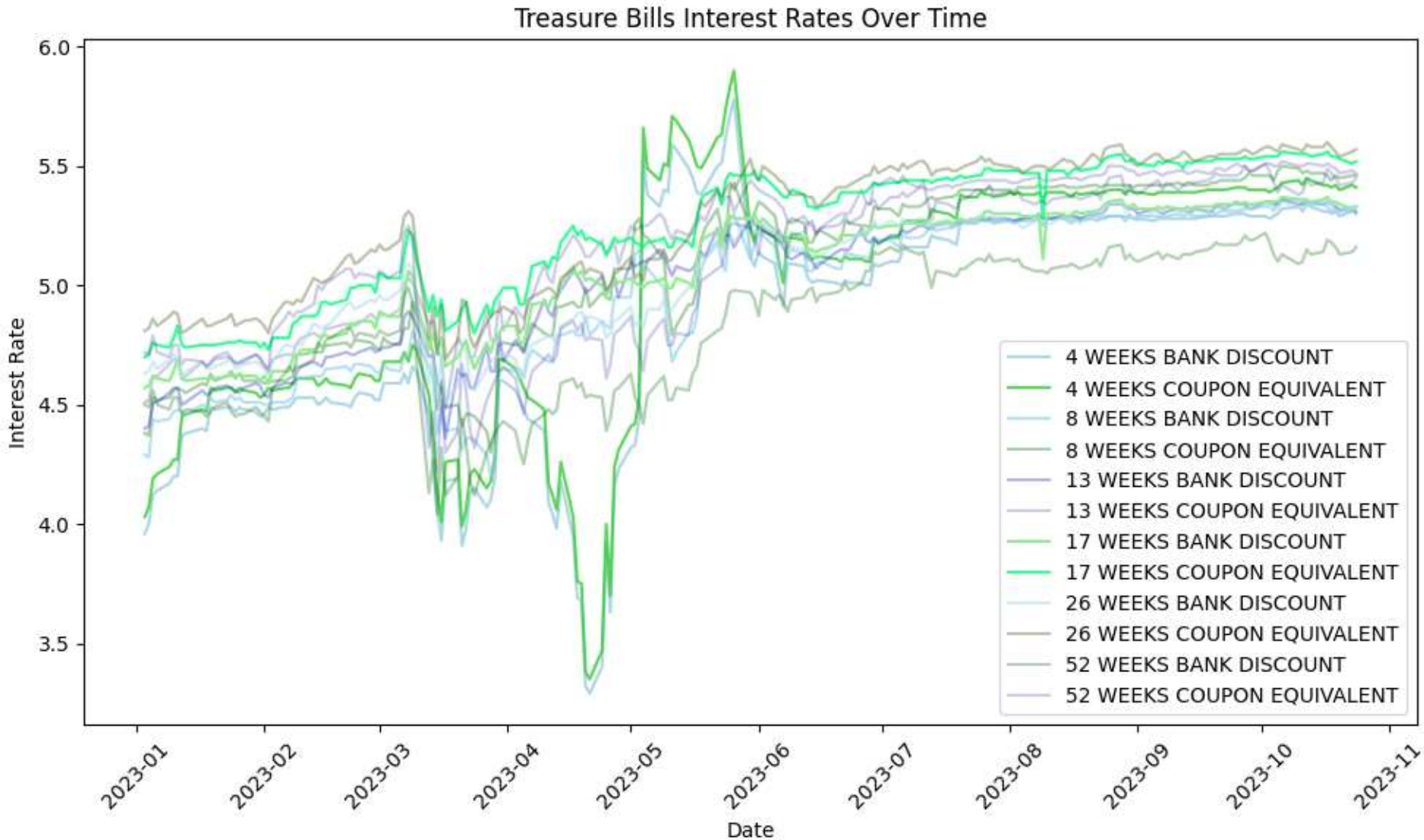
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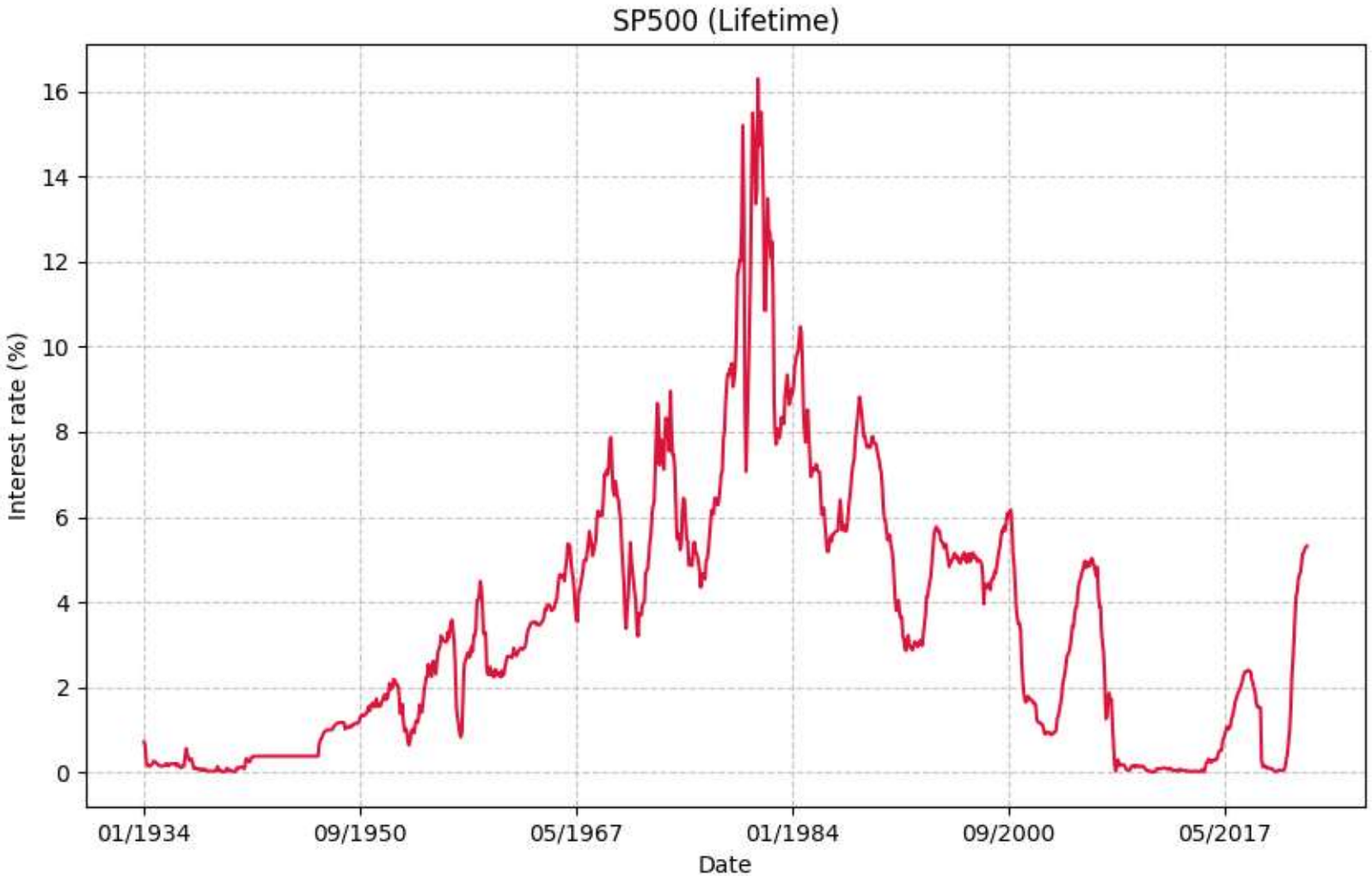
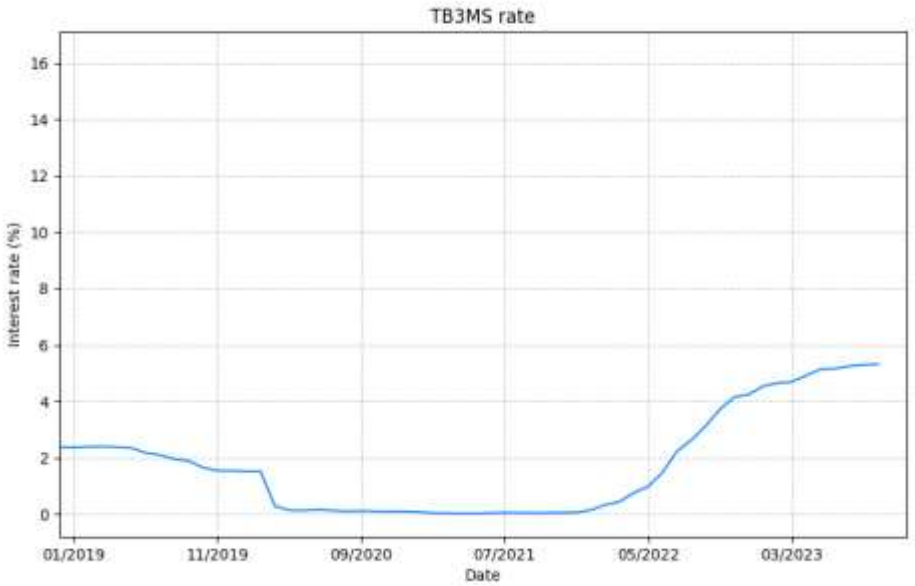
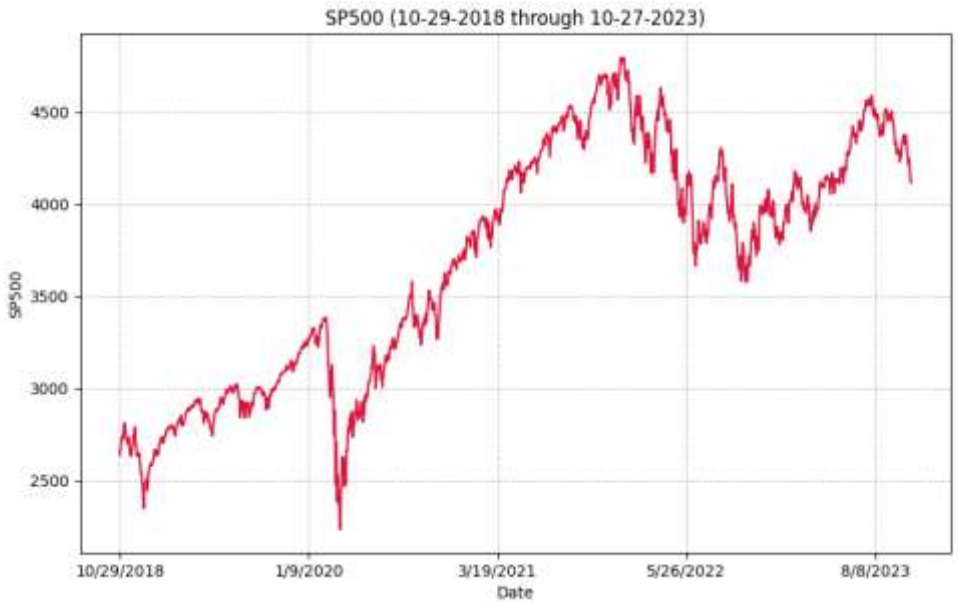
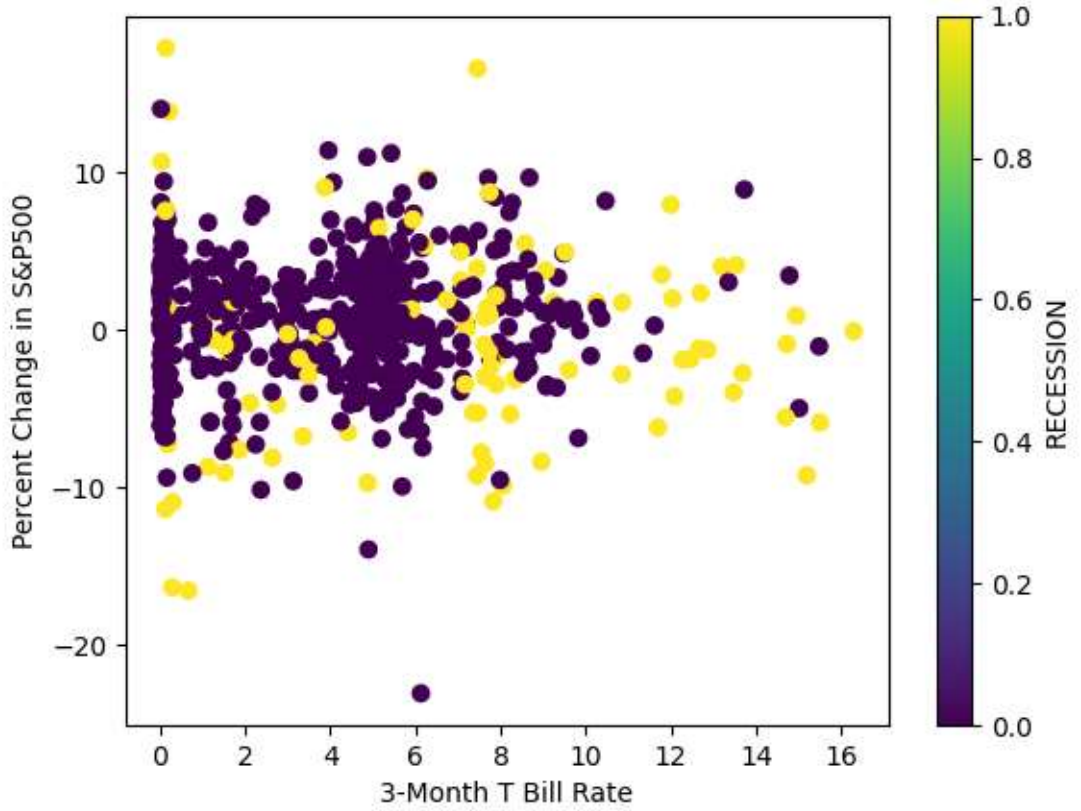

SP500 (Lifetime)
Interest rate (%)
16
14
12
10
8
6
4
2
0
01/1934
09/1950
05/1967
01/1984
09/2000
05/2017
Date

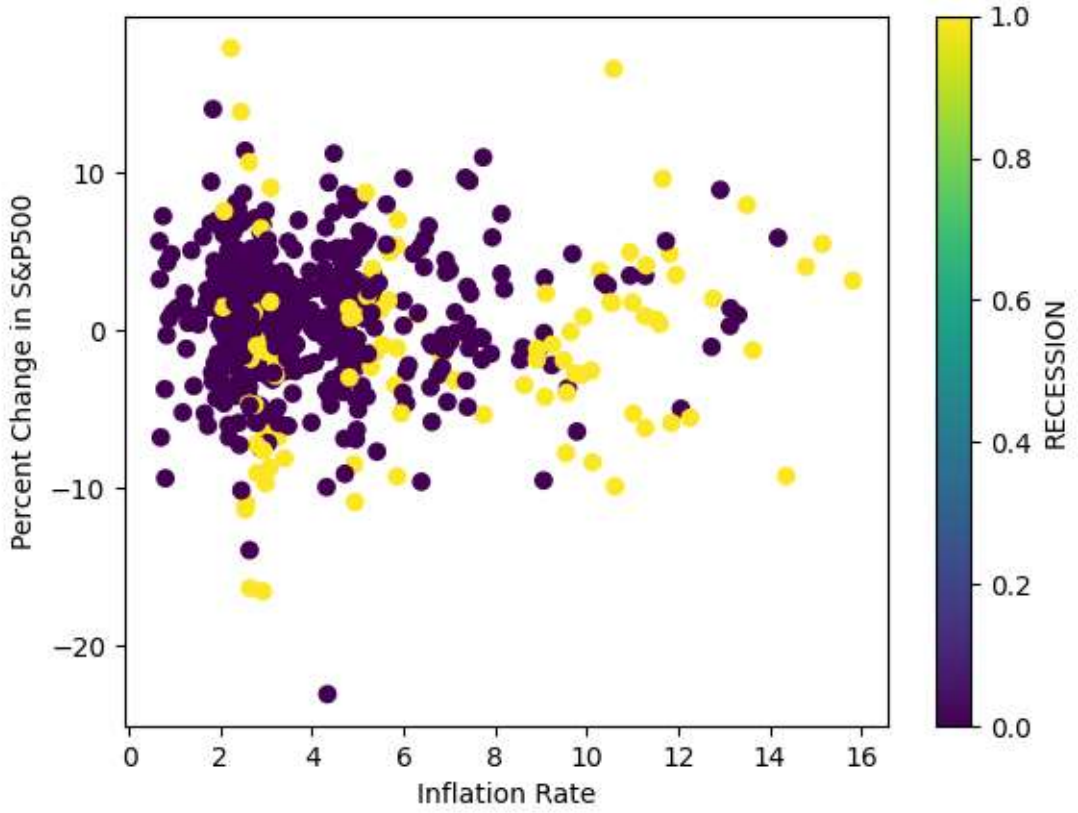

TB3MS rate
Interest rate (%)
16
14
12
10
8
6
4
2
0
01/2019
11/2019
09/2020
07/2021
05/2022
03/2023
Date


SP500 (10-29-2018 through 10-27-2023)
SP500
4500
4000
3500
3000
2500
10/29/2018
1/9/2020
3/19/2021
5/26/2022
8/8/2023
Date

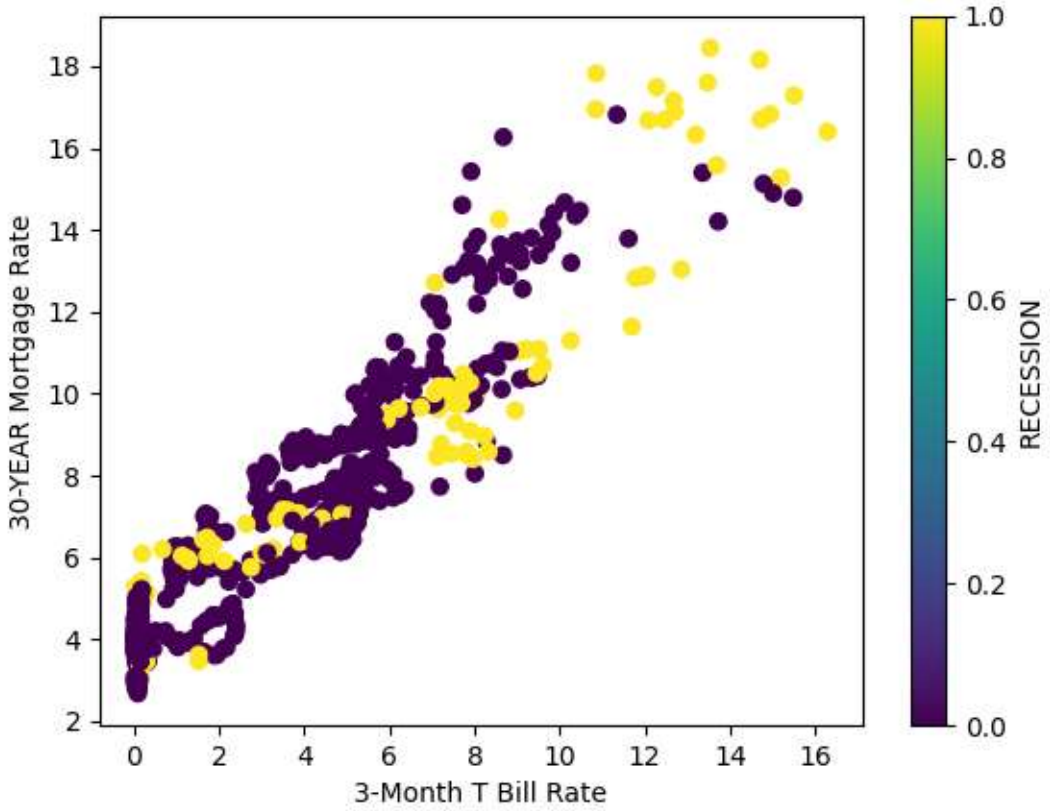
Short term interest VS. SP500



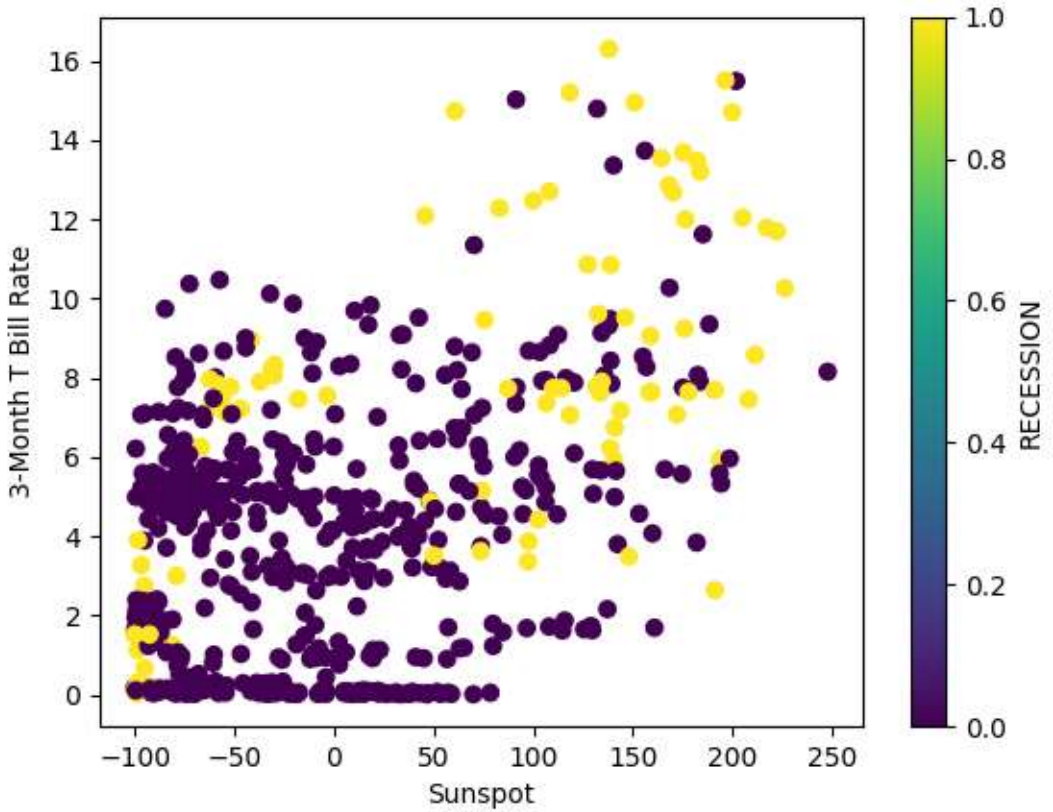
Inflation vs. SP500



Short term interest VS. long term interest



Sunspot vs. short term interest rate



CONCLUSION TO QUESTION 1

Question 1: Is there a liner relationship between short-term interest rates and long-term interest rates?

Random Variable X = TB3MS = 3-month treasury bill interest rate
Random Variable Y = 30YEAR = home mortgage interest rates on a 30-year fixed mortgage
ASSUME: There is no linear relationship between random variables X and Y

- Null Hypothesis, H_0 : ρ = 0
- Alternate Hypothesis, H_1 : ρ ≠ 0

Correlation Coefficient (X , Y) = ρ = 0.929872
T-test statistic = ρ [(n-2)/(1 – ρ ^ 2)] ^ ½ = 0.93 [628 / (1 – 0.93 ^2)] ^ ½ = 23.3
2-tail test with α = 0.05 ; n = 630 ; 2 degrees freedom → critical value t-dist = 1.964

Conclusion:

- Conclusion: We reject null hypothesis.
- Data is consistent with linear relation between long term and short-term interest rates.
- This is exactly what we would expect because interest rates tend to move together.

CONCLUSION TO QUESTION 2

Question 2: Is there a liner relationship between short-term interest rates and change in S&P500?

Random Variable X = TB3MS = 3-month treasury bill interest rate
Random Variable Y = SP500 = Percent change in SP Index over the month
ASSUME: There is no linear relationship between random variables X and Y

- Null Hypothesis, H_0 : ρ = 0
- Alternate Hypothesis, H_1 : ρ ≠ 0

Correlation Coefficient (X , Y) = ρ = -0.02
T-test statistic = ρ [(n-2)/(1 – ρ ^ 2)] ^ ½ = -0.02 [628 / (1 – (-0.02 ^2))] ^ ½ = -0.52
2-tail test with α = 0.05 ; n = 630 ; 2 degrees freedom → critical value t-dist = 1.964
[T-test statistic = | -0.52|] < [Critical value = 1.964] → WE ACCEPT NULL HYPOTHESIS

Conclusion

- Conclusion: We can not reject null hypothesis.
- Data is consistent with NO linear relation btwn short-term interest rates and ∆ SP500.
- This was kind of surprising because people say interest rates strongly impact stock market.
- Dig deeper and it's CHANGE in EXPECTIONS for future interest rates that drive stock market
- Presumably we'd have strong linear relationship with expected future change in interest rates.

CONCLUSION TO QUESTION 3

Question 3: Is there a liner relationship between sunspot activity and short-term interest rates?

Random Variable X = SUNSPOTS = Percent change in sunspots compared to historical average
Random Variable Y = TB3MS = 3-month treasury bill interest rate
ASSUME: There is no linear relationship between random variables X and Y

- Null Hypothesis, $H_0 : \rho = 0$
- Alternate Hypothesis, $H_1 : \rho \neq 0$

Correlation Coefficient (X , Y) = ρ = 0.44
T-test statistic = ρ [(n-2)/(1 – ρ ^ 2)] ^ ½ = -0.02 [628 / (1 – 0.44 ^2)] ^ ½ = 12.4
2-tail test with α = 0.05 ; n = 630 ; 2 degrees freedom → critical value t-dist = 1.964
[T-test statistic = 12.4] > [Critical value = 1.964] → WE REJECT NULL HYPOTHESIS

Conclusion

- Conclusion: We reject null hypothesis.
- SUNSPOTS CORRELATE To INTEREST RATES !!!
- Awesome example of limitations of looking to correlation matrix for significance.

THANK YOU