SYNTHETIC FINANCIAL DATA:
AN APPLICATION TO REGULATORY COMPLIANCE FOR BROKER-DEALERS

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Part 1: Big Data

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This comes with two major problems.

- Historical data from an earlier time may tell us little or nothing about future prices and returns.

- Inferences about the profitability of investment strategies may be sensitive to a handful of outliers.

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In a pathbreaking work:

- Bessembinder (2018) finds that the majority of U.S. listed common stocks have returned (inclusive of dividends) less than the risk-free rate (that is, the one-month Treasury bill) over their lives as listed companies.

- Just 4% of listed U.S. companies account for all of the gains of the U.S. stock market from 1926 to 2016.

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Financial markets present a far different problem.

- We know very little about the mechanisms that generate prices.

- Financial-market data is likely to be generated by mechanisms (interactions of traders using information) that are not stable through time.

- Even if a researcher finds a good model of price behavior in a particular period of time, there is little reason to believe that prices will behave today as they did 10 or 20, or even 5 years, ago.

Part 2: Financial Regulation

The New Compliance Risk

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- In June 2019, the U.S. Securities and Exchange Commission (SEC) adopted Regulation Best Interest (RBI). The regulation requires broker-dealers to exercise reasonable diligence, care, and skill in making a recommendation to a retail customer. This is known as the “Care Obligation.”

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The SEC's Final Rule states:

- "Whether a broker-dealer's recommendation satisfies the Care Obligation will be an objective evaluation turning on the facts and circumstances of the particular recommendation and the particular retail customer."

- The care obligation requires that a broker-dealer understands "potential risks, rewards, and costs associated with the recommendation."

- "[Bad intent] will not be required to establish a violation of Regulation Best Interest."

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- Given the known limitations of historical data, how can a broker or fiduciary gain confidence that an investment strategy **will not result in future regulatory action or litigation?**

- **What work would a broker-dealer or fiduciary want to show was done** to support its recommendations and actions if accused of basing advice on bad inferences from historical data?

Part 3: Possible Solutions

A Synthetic Data Approach

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- We use a **fraud-detection approach to identify high-dimensional outliers** in the historical dataset.

- We replace the outliers with a larger alternative dataset that reflects the different ways in which the joint prices might alternatively have been realized in the past.

- The resulting synthetic datasets have **little to no dependence on historical outliers** while maintaining all other characteristics with a high degree of accuracy.

Example:

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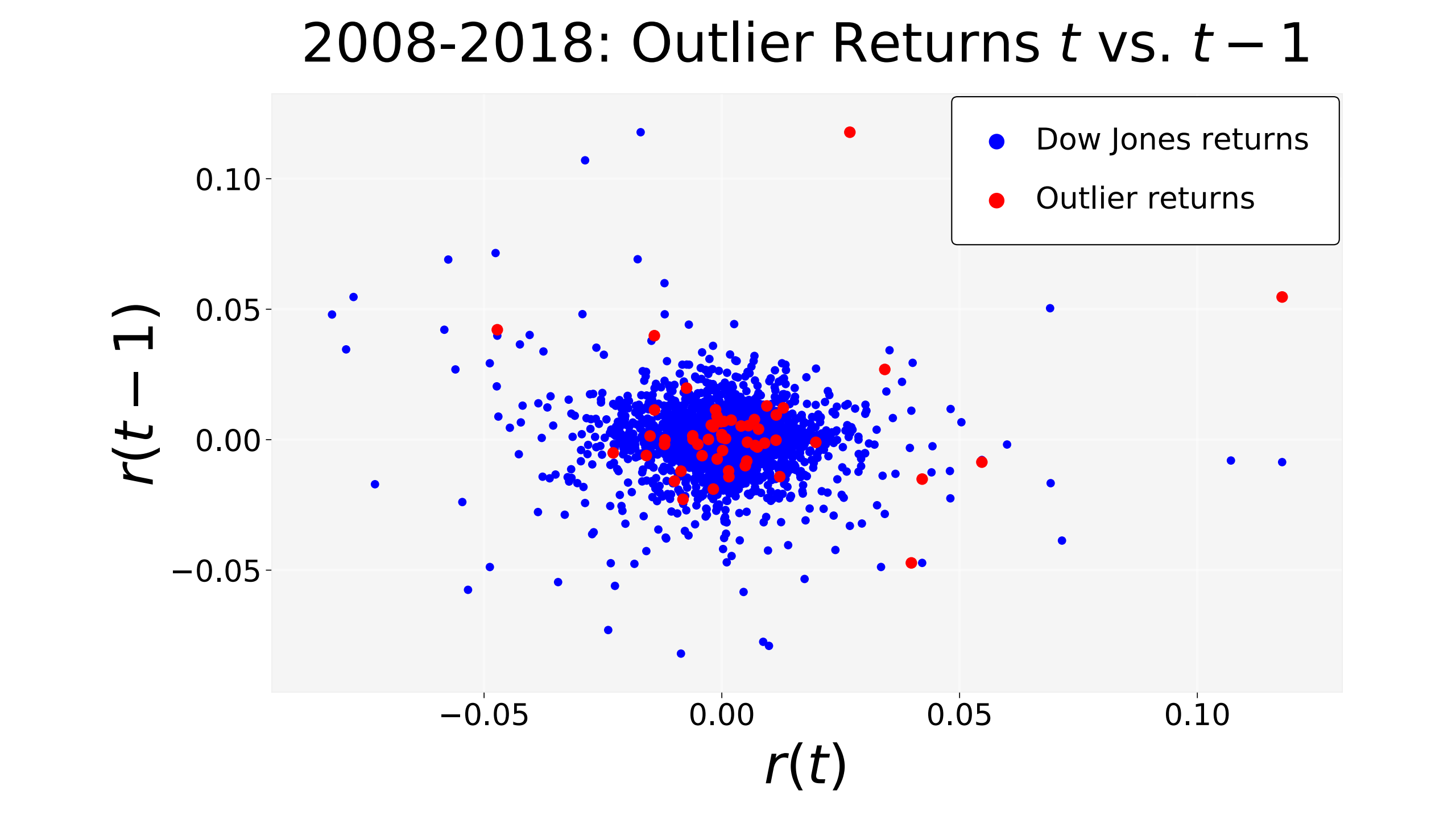
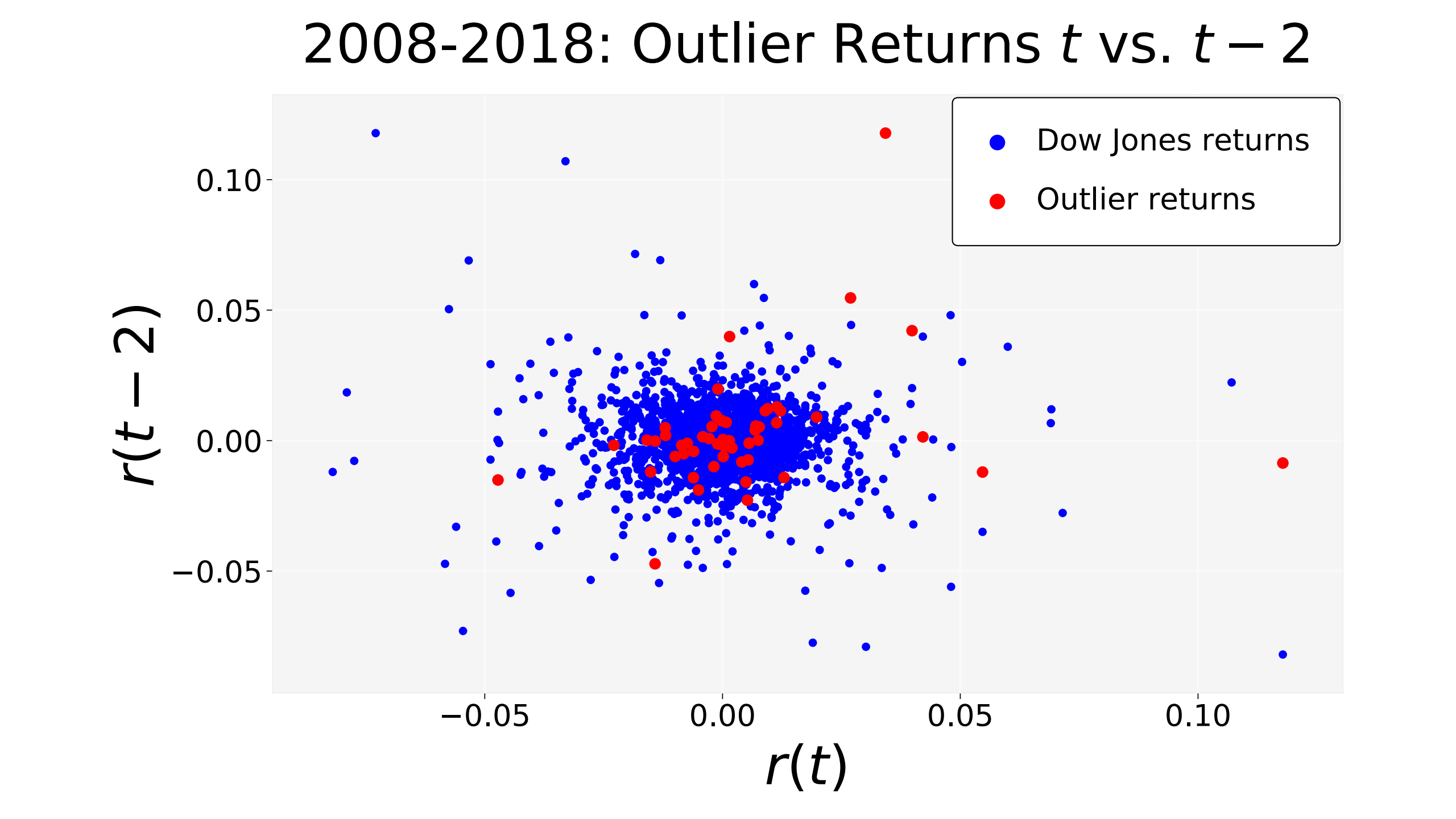
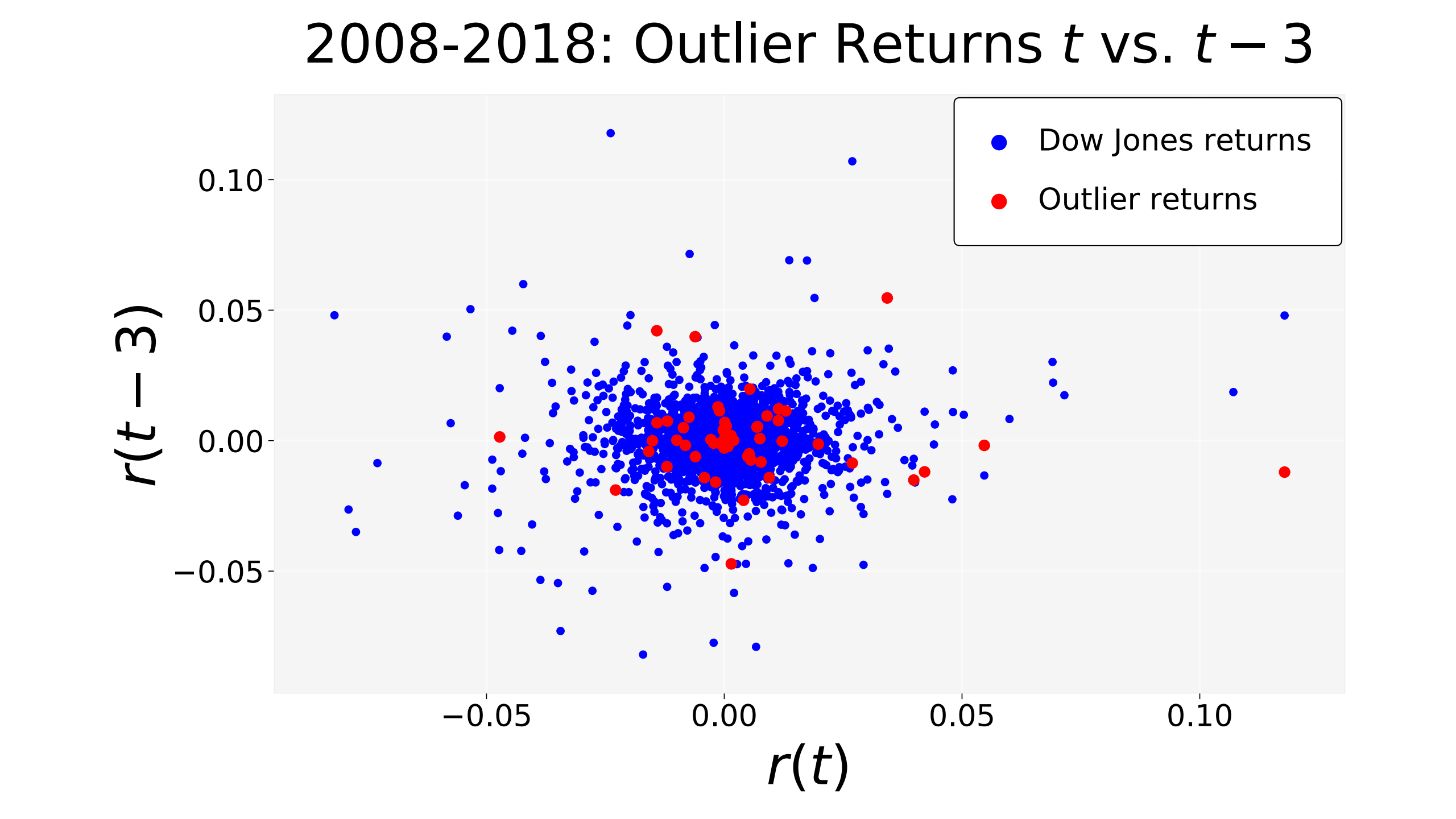
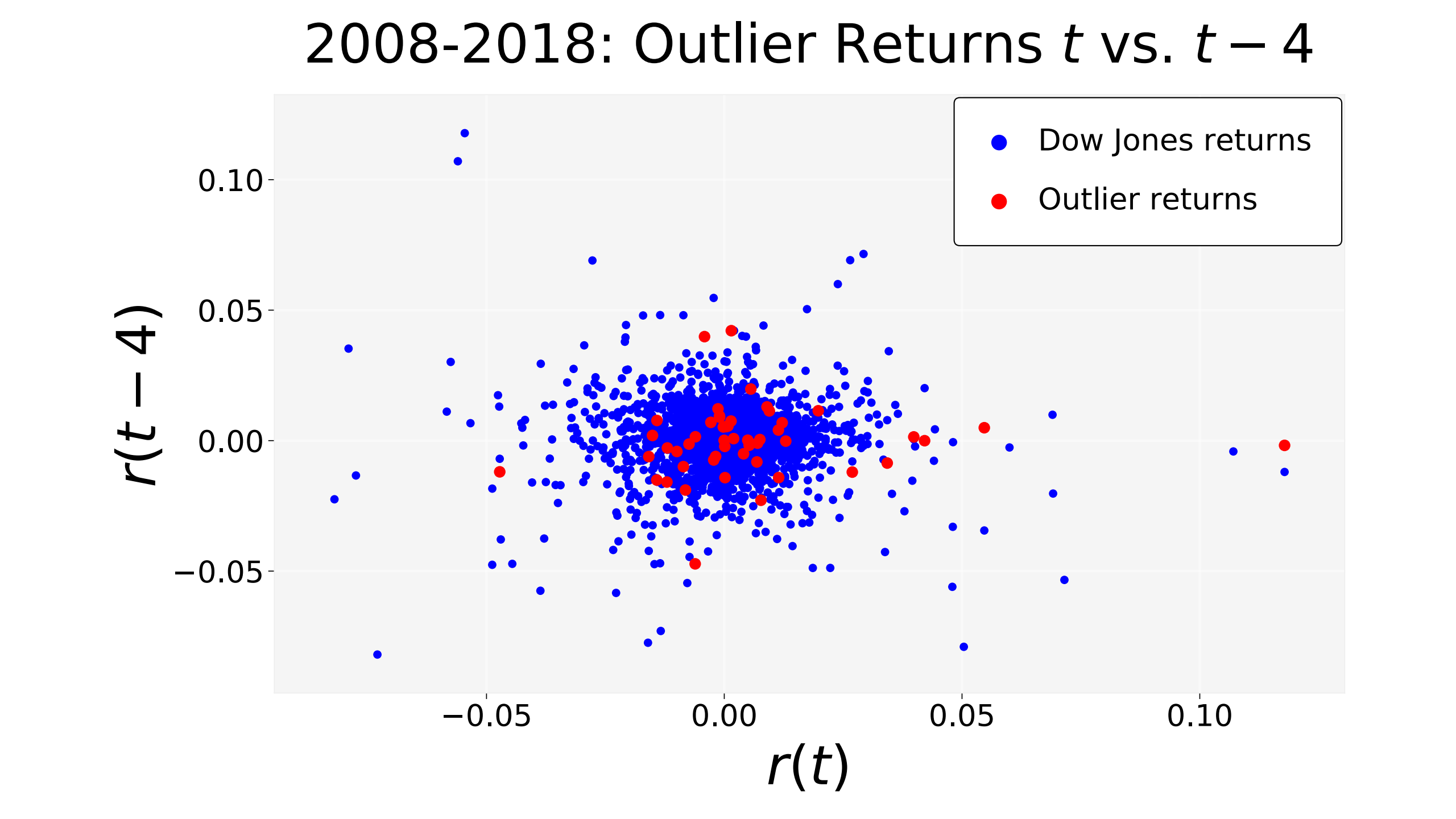
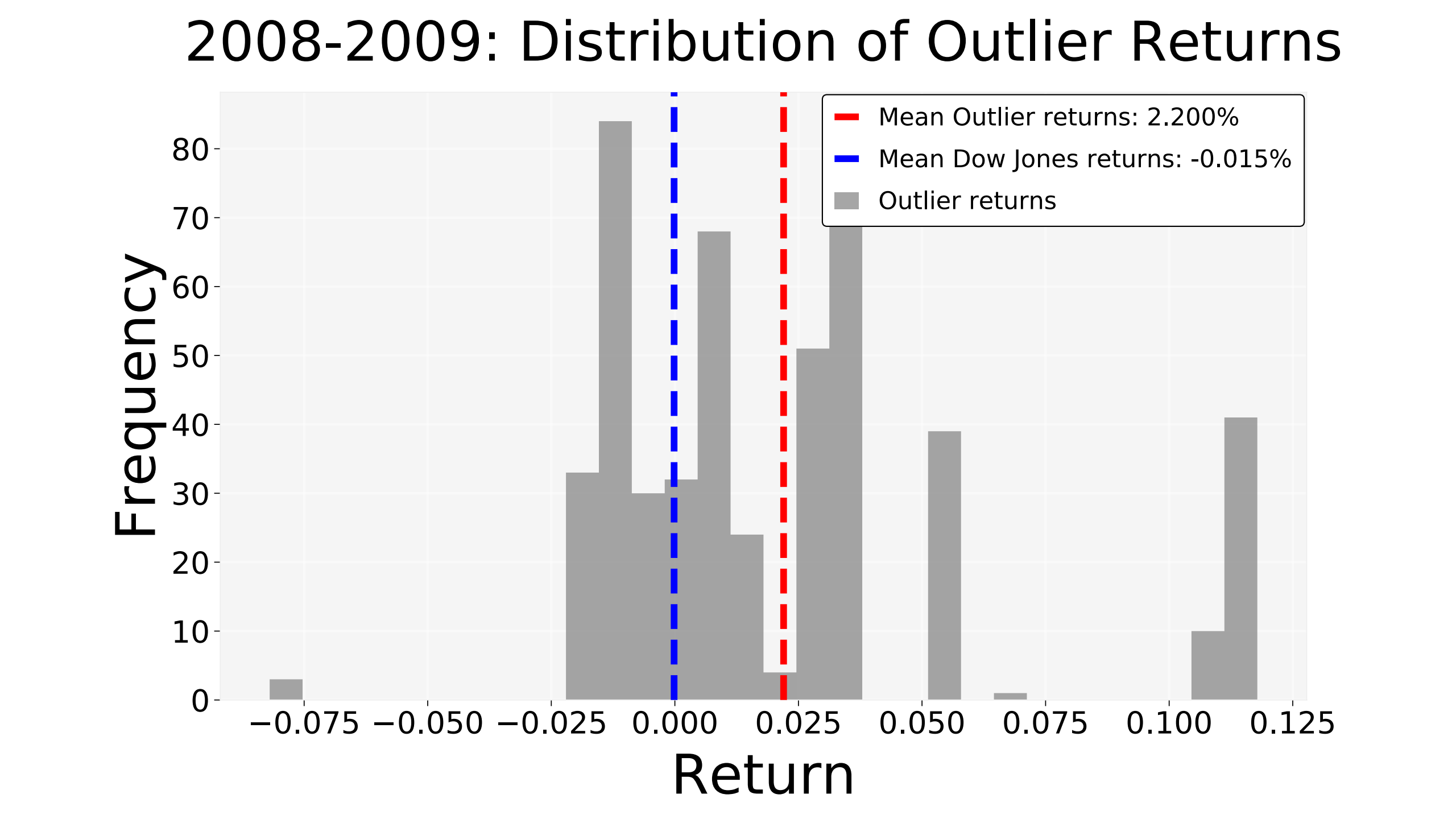
- Consider daily closing prices for Dow Jones Industrial Average (DJIA) from 2 January 2008 to 22 May 2019.


2008-2018: Outlier Returns t vs. $t-1$
Dow Jones returns
Outlier returns
0.10
0.05
0.00
−0.05
$r(t-1)$
−0.05
0.00
0.05
0.10
$r(t)$

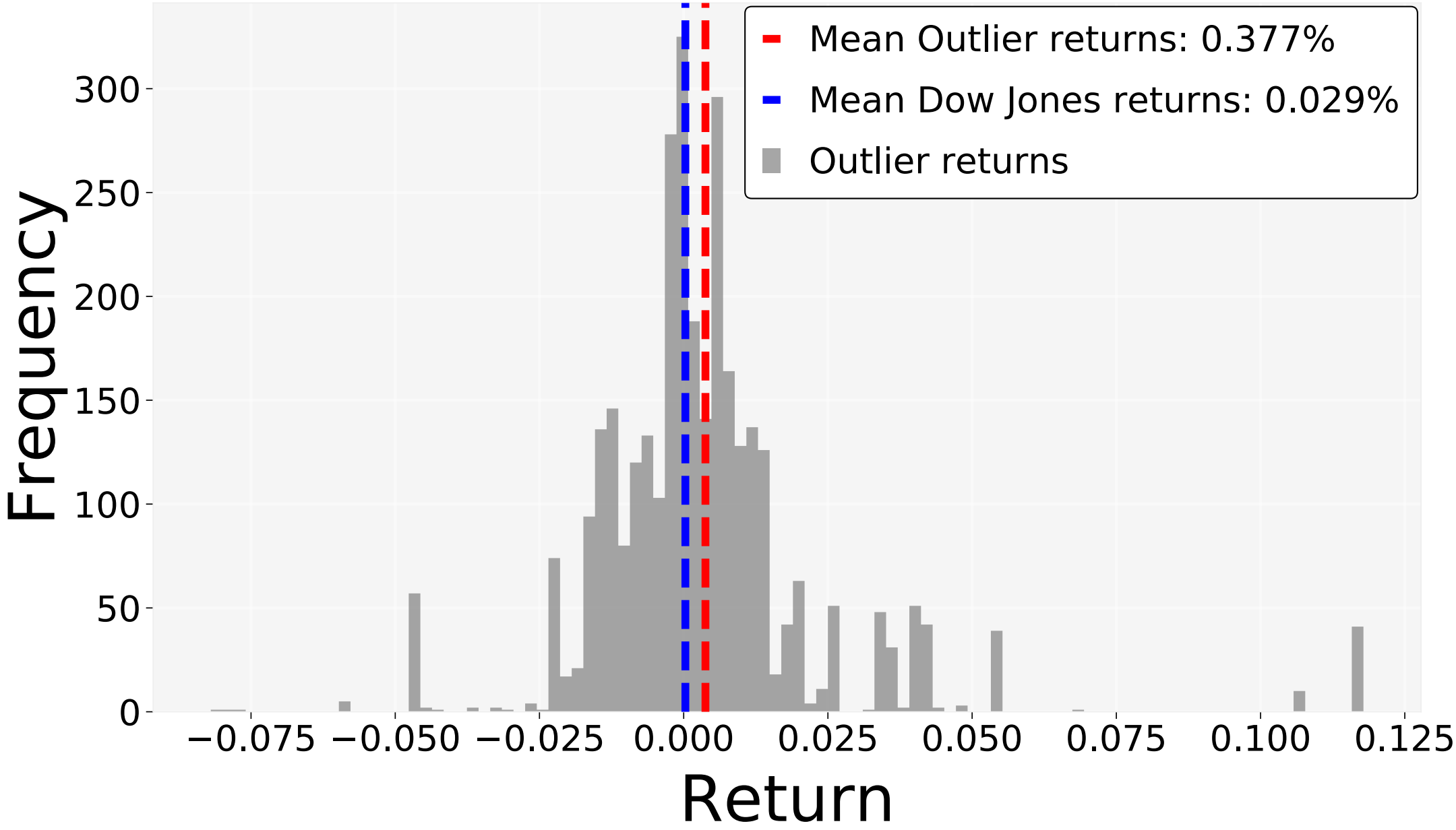

2008-2018: Outlier Returns t vs. $t-2$
Dow Jones returns
Outlier returns
0.10
0.05
0.00
−0.05
$r(t-2)$
−0.05
0.00
0.05
0.10
$r(t)$

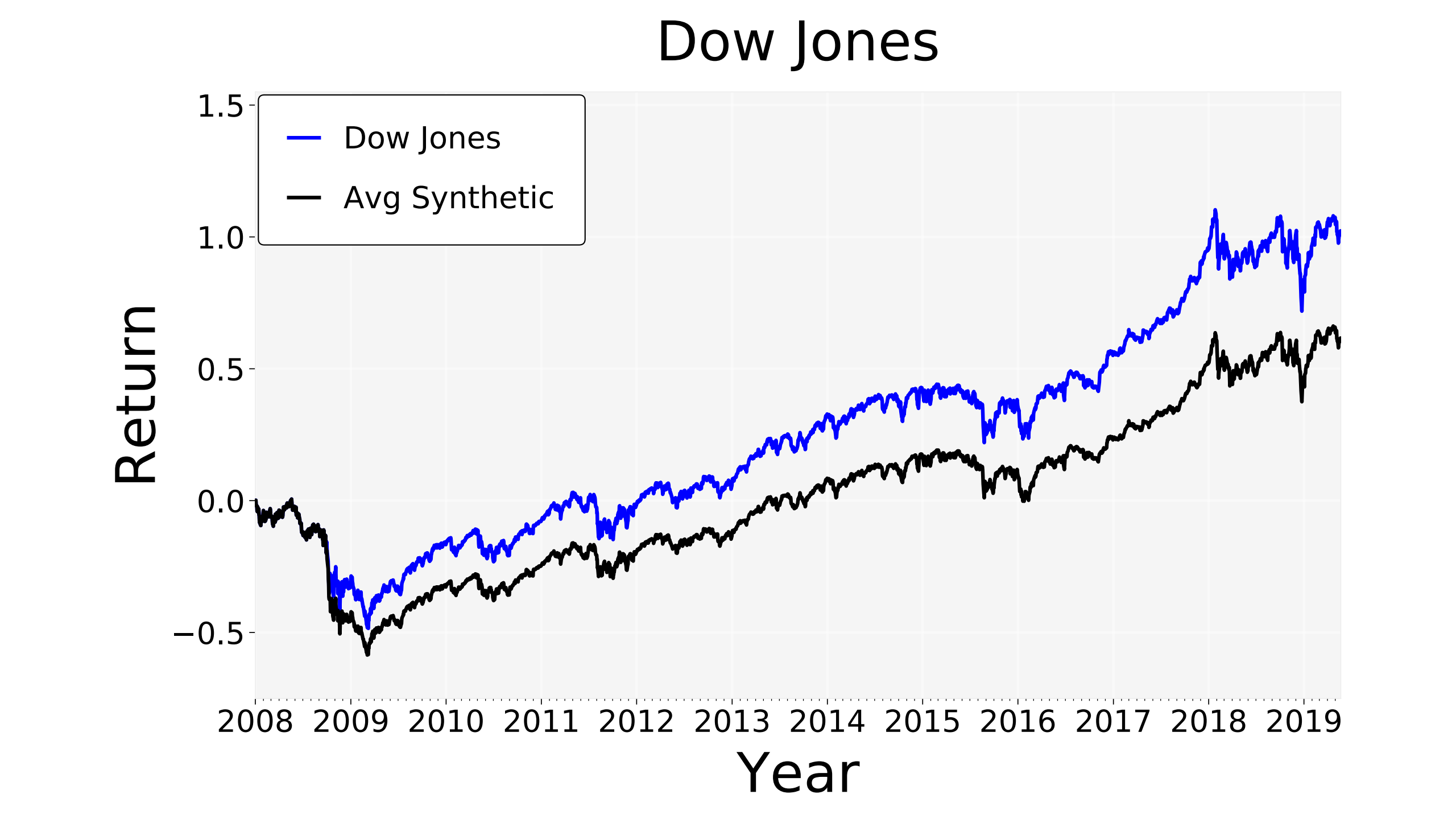

2008-2018: Outlier Returns t vs. $t-3$
Dow Jones returns
Outlier returns
0.10
0.05
0.00
−0.05
$r(t-3)$
−0.05
0.00
0.05
0.10
$r(t)$

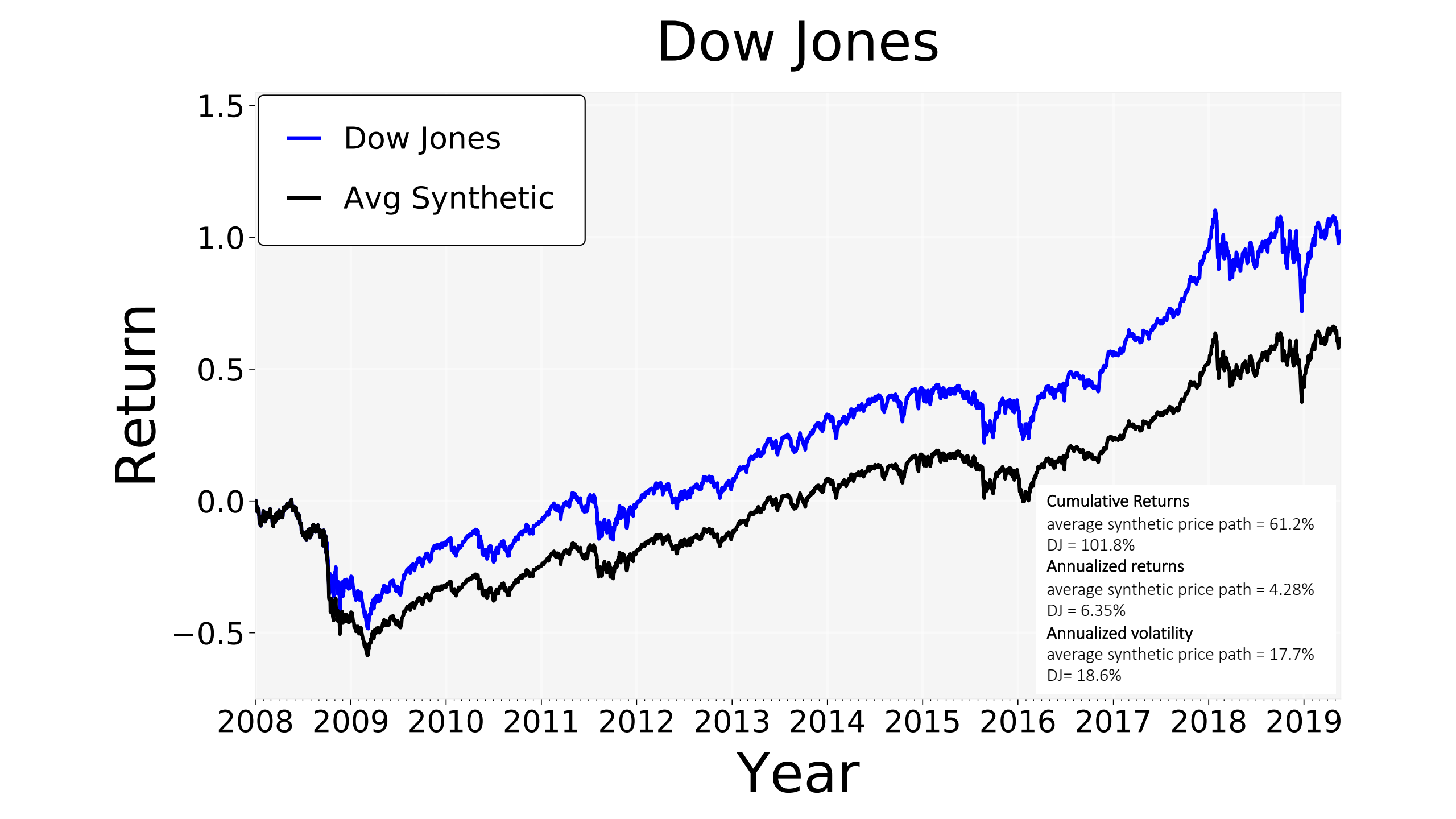

2008-2018: Outlier Returns t vs. $t-4$
Dow Jones returns
Outlier returns
0.10
0.05
0.00
−0.05
$r(t-4)$
−0.05
0.00
0.05
0.10
$r(t)$


2008-2009: Distribution of Outlier Returns
Mean Outlier returns: 2.200%
Mean Dow Jones returns: -0.015%
Outlier returns
Frequency
0
10
20
30
40
50
60
70
80
−0.075
−0.050
−0.025
0.000
0.025
0.050
0.075
0.100
0.125
Return

2008-2018: Distribution of Outlier Returns




Dow Jones
Dow Jones
Avg Synthetic
1.5
1.0
0.5
0.0
−0.5
Return
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year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Avg Synthetic
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1.0
0.5
0.0
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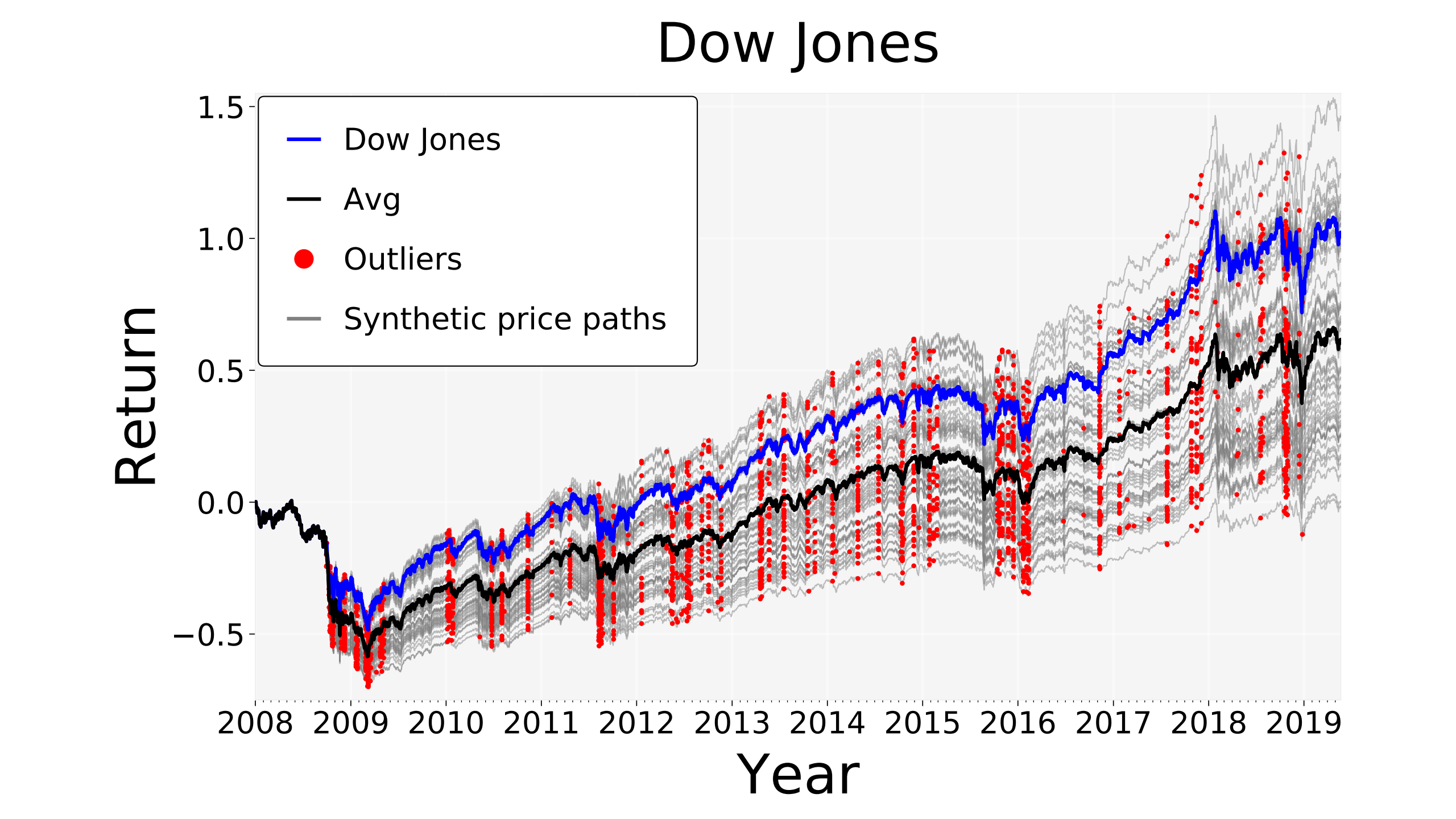
Return
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year
Cumulative Returns
average synthetic price path = 61.2%
DJ = 101.8%
Annualized returns
average synthetic price path = 4.28%
DJ = 6.35%
Annualized volatility
average synthetic price path = 17.7%
DJ= 18.6%


Dow Jones
Dow Jones
Avg
Outliers
Synthetic price paths
Return
1.5
1.0
0.5
0.0
−0.5
2008
2009
2010
2011
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2016
2017
2018
2019
Year

Part 4: Summary

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- Regulation Best Interest means broker-dealers have a Care Obligation. Bad intent is not required for regulatory violation.
- Working with historical data is misleading.
- Synthetic data is one way of meeting the Care Obligation.