Investigating the Impact of Noise Infusion on Seasonal Adjustment in the Quarterly Financial Report

(a work in progress)

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United States® Census Bureau

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The Quarterly Financial Report (QFR)

An official website of the United States government

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Quarterly Financial Report

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Release Schedule

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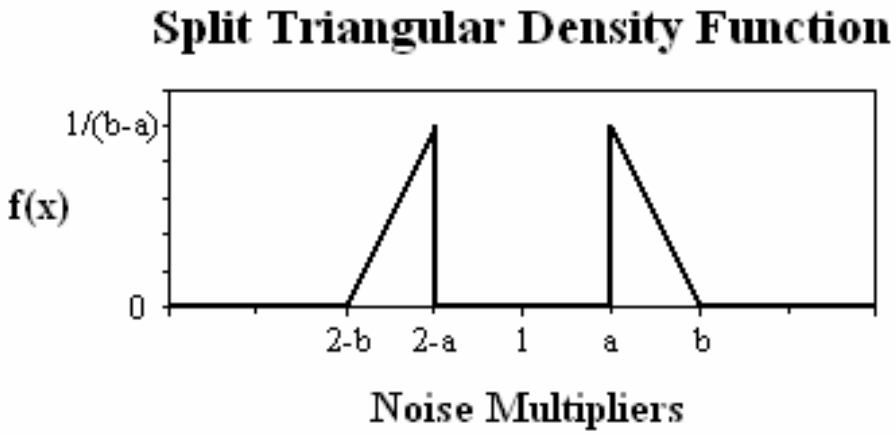
https://www.census.gov/econ/qfr/index.html

EZS Noise Infusion

- Randomly assign noise factor using a split symmetric distribution



For example, let a = 1.10 and b = 1.15

- Apply noise factor at the microdata level for each reported data value
- Sum up all the perturbed values over a specified domain

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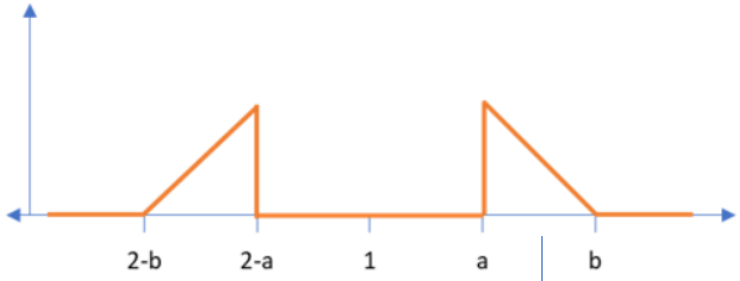
EZA Noise Example

	Reported Data Value
company A	114372
company B	126691
company C	43468
company D	482825
company E	977120
company F	457678
company G	837884
company H	522126
company I	808820
…	…

Fabricated Data



δ_j

For example, suppose a = 1.10 and b = 1.15

X_{djt}

Noise Factor
1.1005
1.1163
1.1342
1.107
1.1115
1.1051
1.1002
1.1383
1.1169
…

Fabricated Data

$X^*_{djt} = \delta_j X_{djt}$

Perturbed Data Value
125866
141425
49301
534488
1086068
505780
921840
594336
903371
…

$\sum$

Final Published Estimate
185446045

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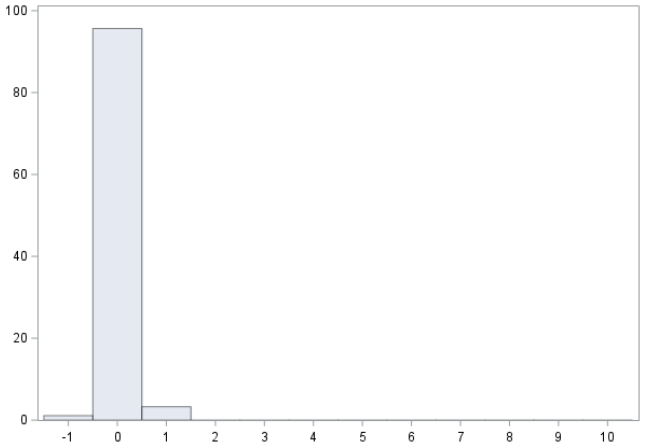
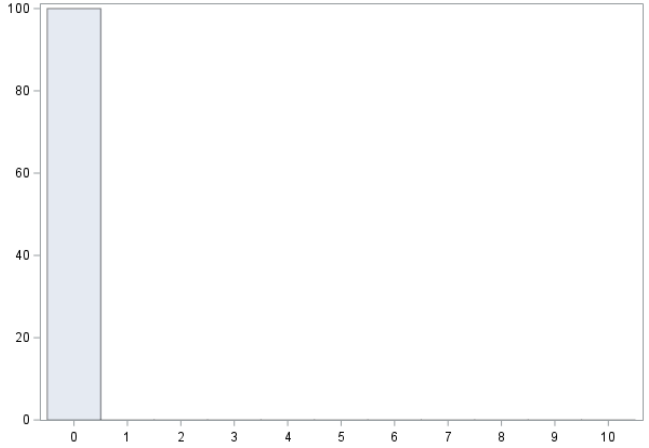
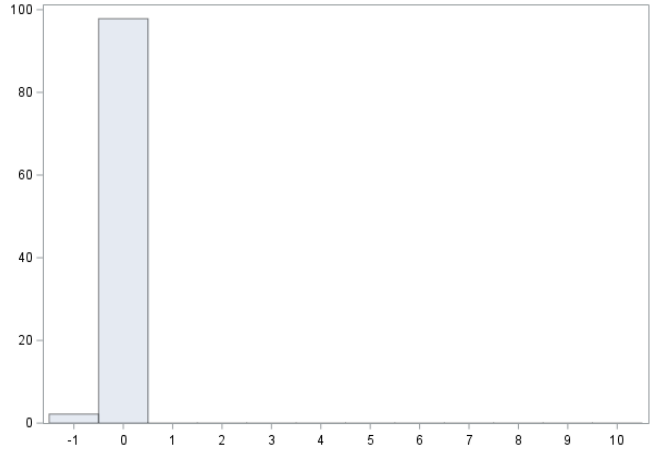
Time Series Comparison



Percent Change between non-noise-infused and noise-infused MFG Nondurable NIAT 2023Q4 Quarterly Financial Report, U.S. Census Bureau



Percent Change between non-noise-infused and noise-infused MFG Nondurable Sales 2023Q4 Quarterly Financial Report, U.S. Census Bureau



Percent Change between non-noise-infused and noise-infused RET C&GM Sales 2023Q4 Quarterly Financial Report, U.S. Census Bureau

- Our findings indicate that the relative differences between the noise-infused and non-noise-infused series are typically within a 1% threshold

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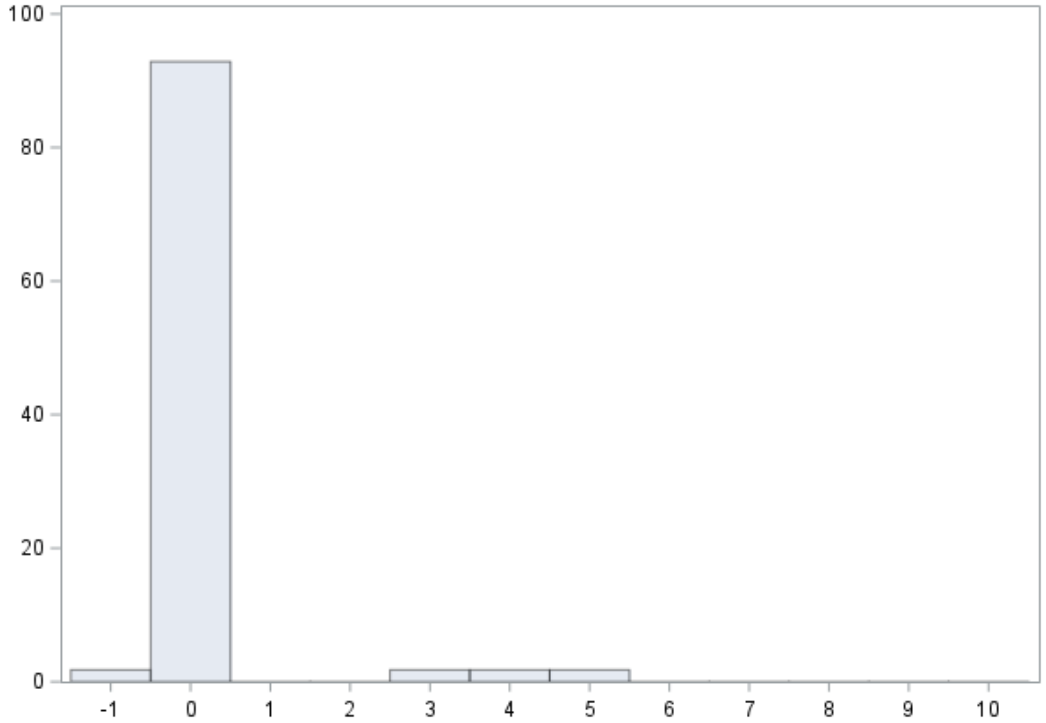
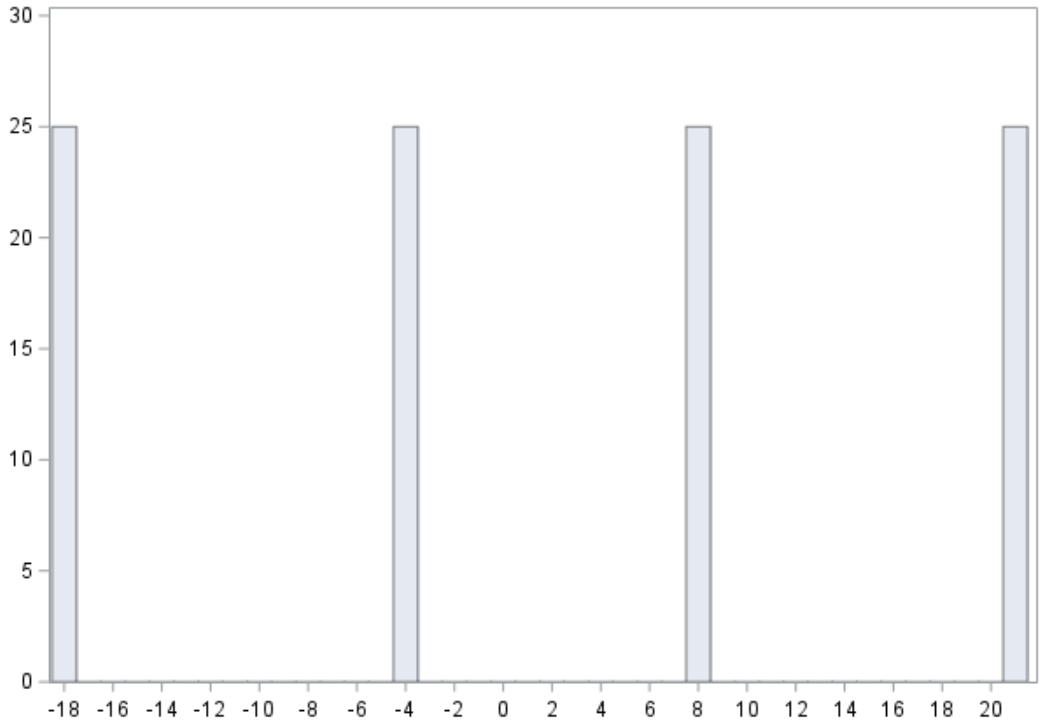
Time Series Comparison

Unadjusted Series



Adjusted Series



Percent Change between non-noise-infused and noise-infused PTS NIAT
2023Q4 Quarterly Financial Report, U.S. Census Bureau

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Time Series Comparison

STATP	UnAdj_n	UnAdj_no_n	UnAdj %Δ	SA_Adj_n	SA_Adj_no_n	SA_Adj %Δ	UnAdj_n & SA_Adj_n %Δ	UnAdj_no_n & SA_Adj_no_n %Δ
2022Q3	-13,923	-13,923	0.00	-13,591	-13,591	0.00	2.45	2.45
2022Q4	-24,649	-26,763	8.58	-26,414	-28,516	7.96	6.68	6.15
2023Q1	-10,845	-11,022	1.63	-8,943	-9,084	1.59	21.27	21.33
2023Q2	-16,136	-16,725	3.65	-16,556	-17,159	3.64	2.54	2.53
2023Q3	-5,281	-5,261	0.38	-4,986	-5,002	0.33	5.92	5.17
2023Q4	-2,552	unpublished	unpublished	-4,404	unpublished	unpublished	72.56	65.51

Percent Change between non-noise-infused and noise-infused PTS NIAT 2023Q4 Quarterly Financial Report, U.S. Census Bureau

- Conclusion: the ARIMA model built on non-noisy data was no longer a good candidate for the noisy data.
- Solution: build the ARIMA model on the mixed data and monitor the series over time.

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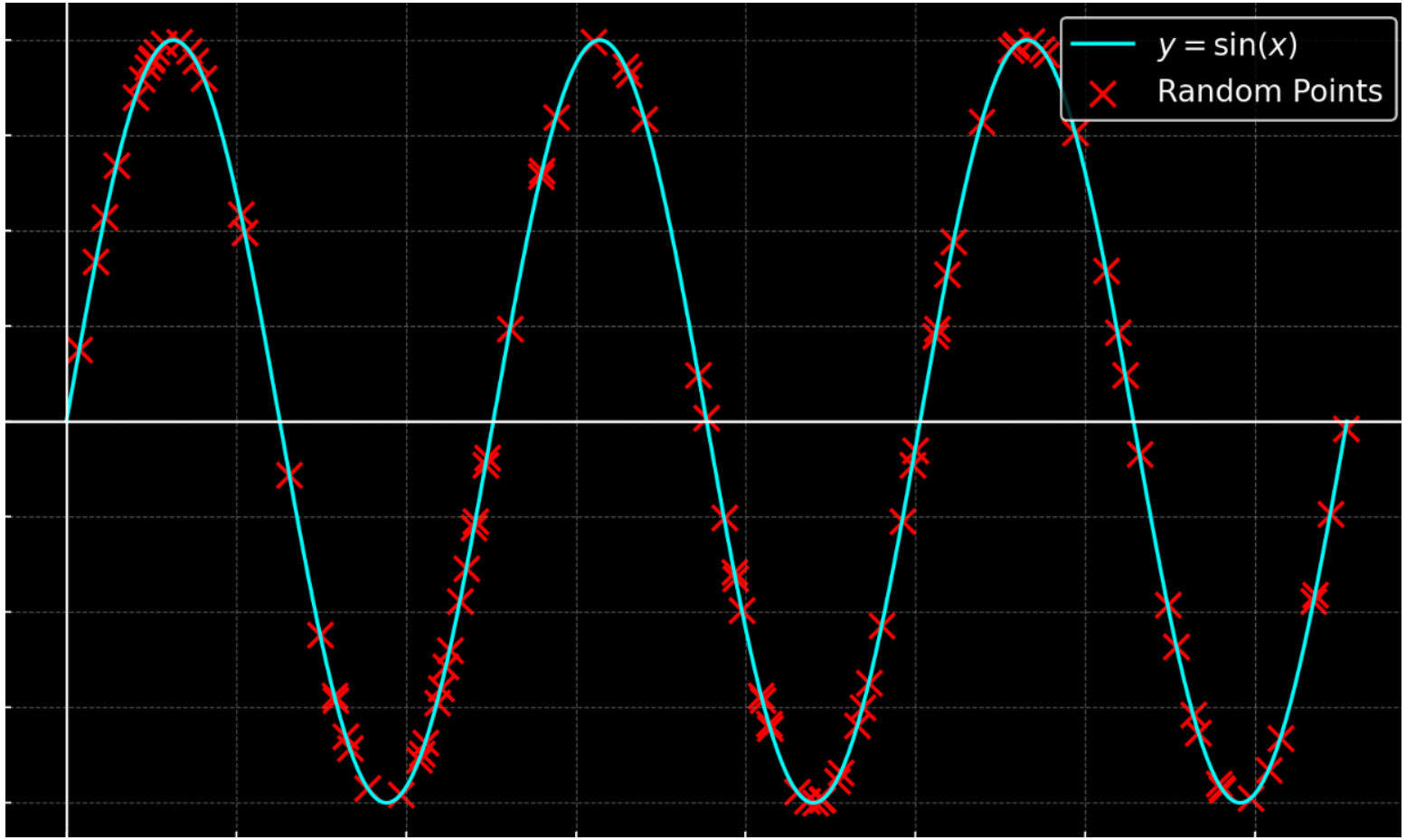
Future Work

- One possibility is exploring the use of simulated data to derive a more generalized methodology.



- For example, we could take points from a know function
- Build an ARIMA model on non-noisy data
- Apply EZS noise infusion
- Build the ARIMA model on mixed or noisy data
- Analysis of comparison

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Conclusion & Acknowledgements

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  - Tony Caruso

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