

A Naive t Value Inflates with the Number of Observations per Day [F014]

The same signal run on five-minute bars gives 227.9935 observations a day against 19.0390 on hourly bars, and the standard error differs by a median factor of 2.5265 — and on a synthetic series known to carry no directional information, the naive t exceeds 2 in absolute value in 0.5437 of the five-minute cells

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Abstract

This paper asks what makes the t value attached to a method inflate — the answer is the number of observations per day. It claims neither a new mathematical theorem nor a new law.

First, with the same signal and the same 24-hour horizon, changing only the bar size gives median observations per day of **227.9935** (five-minute), **76.0392** (fifteen-minute) and **19.0390** (hourly), a factor of **11.9751** (Section 3).

Second, the median within-day correlation is **0.1430**, ranging from **+0.0010** to **+0.6348**. **It is not zero**. The more observations fall inside a day, the more the daily standard error exceeds the naive one: the median ratio is **2.5265**, ranging from **1.1070** to **6.1256** (Section 4).

Third, ⚠ that this ratio equals the square root of $1 + (m - 1)$ times the correlation is **an identity**, because the correlation is solved from that very relation. **What this paper measured is not the correctness of the formula but the actual values of the correlation and of m** (Section 4).

Fourth, with the same data and the same signals, changing only the denominator, **the naive t exceeds 2 in absolute value in 19 of 48 cells, while the daily-clustered t does so in 6 of 48**. The medians are **1.8046** and **0.7218** (Section 5).

Fifth, and this is the core of the paper, **on a synthetic series known by construction to carry zero directional information, the median absolute naive t on five-minute bars is 2.0893, and the share exceeding 2 is 0.5437.** On hourly bars they are **1.6494** and **0.4500** (Section 6).

Sixth, **⚠ daily clustering is not enough either.** On the same synthetic series, the median absolute daily t on hourly bars is **1.3530.** **With a 24-hour horizon, the overlap across days remains** (Section 6).

Scope of this paper (scope note): No new mathematical theorem and no new law is claimed — intraclass correlation, cluster-robust standard errors, and the fact that overlapping observations inflate t are all known. **No particular product or proponent is discussed** — no real course, author, or vendor is the subject here, and none is named. What is treated is the public way of reporting itself. **Trading is not discussed** — what is measured is how a t value is built, not trading performance including commissions, fills and money management. **The scope is intraday and a small number of instruments** — four series, three years, three bar sizes. Monthly time-series momentum (dozens of markets, holding one to twelve months) is documented in the literature, and this paper does not contradict it. **The formula is not tested** — that the ratio of standard errors equals the square root of $1 + (m - 1)$ times the correlation is an identity following from how the correlation is defined. **⚠ This paper does not write that it "confirmed" it** (Section 4). **Four signal families are fixed** — other families give other figures (Section 7). **The overlap is not removed** — the horizon is 24 hours, so observations overlap, and daily clustering leaves the part that crosses days (Sections 6 and 7). **No forecast is claimed.** **Relation to earlier papers:** this series always reports, alongside a t, what it would be by chance. F010 showed that removing the overlap drops the daily t and F013 showed that nesting makes smoothness — this paper shows that the denominator alone changes significance threefold. What is added here is **moving the observations per day by changing the bar size, measuring the within-day correlation itself, and producing the distribution of the naive t on a series known to carry no edge.**

1. Notation and the question

A method's results often come with a t value, and most of them use the standard deviation divided by the square root of the count as the denominator.

Name	How the denominator is built	What it assumes
Naive t	standard deviation ÷ square root of the count	the observations are independent
Daily-clustered t	standard deviation of the daily means ÷ square root of the number of days	independence across days
What this paper asks	how much the former inflates	

Observation 1.1: ⚠ **observations inside one day are not independent.** They count the same movement of the same market several times.

Observation 1.2: with m observations a day and a within-day correlation, the variance of a daily mean is the per-observation variance times $1 + (m - 1)$ times the correlation, divided by m . From there **the ratio of standard errors is the square root of $1 + (m - 1)$ times the correlation.** A correlation of zero means no inflation; a correlation of one means a factor of the square root of m .

Observation 1.3: ⚠ ★ **but this paper solves the correlation from that very relation.** So the ratio of standard errors and that formula are an identity, not a test. What can be measured are **the actual values of the correlation and of m .** An identity must not be written up as "confirmed".

Observation 1.4: **so the question is settled another way.** First, change the bar size to move m and see how much the inflation changes. Second, count how often the naive t actually exceeds 2 on **a synthetic series known to carry zero directional information.**

Question: what makes the t value attached to a method inflate?

2. Writing the quantity and the design in advance

Design (declared before running and unchanged at run time)

Item	Decision
Bar sizes	five-minute, fifteen-minute, hourly (mid price, completed bars only)
Horizon	24 hours for all three (288, 96 and 24 bars). ★ The same span of time is looked at
Signal 1	the sign of the last bar's move (with the trend)
Signal 2	a moving-average cross (short 5, long 20)
Signal 3	RSI(14) above or below 50
Signal 4	outside a Bollinger band(20, 2.0), against the move
Naive t	$\text{mean} \div (\text{standard deviation} \div \text{square root of the count})$
Daily t	$\text{mean of the daily means} \div (\text{their standard deviation} \div \text{square root of the number of days})$
Within-day correlation	solved from the variance of the daily means
Baseline	synthetic series random down to the movement inside each bar (10 realisations)
Instruments	USDJPY, EURUSD, GBPUSD, XAUUSD
Period	2019–2024. Evaluation 2022–2024

Observation 2.1: ⚠ the horizon is held at 24 hours across bar sizes. Without that, "did t change because of the count or because of the span looked at" cannot be separated.

Observation 2.2: ⚠️ **all four signals carry a sign.** A quantity that is only a size (volatility, say) has zero directional information by construction and is no ground on which to discuss t.

Observation 2.3: ⚠️ **the synthetic series has zero directional information by construction.** That is what makes "does t exceed 2 anyway" answerable.

The horizons in bars are **288, 96** and **24**.

3. Changing the bar size moves the observations per day by a factor of 12

Calculation 3.1 Same signal, same 24 hours, only the bar size changed (USDJPY, evaluation period)

Signal	Bar size	Count	Days	Per day	Naive t	Daily t
Last bar's sign	5m	211,932	935	226.6652	1.8711	0.9910
Last bar's sign	15m	71,021	935	75.9583	1.5341	1.3190
Last bar's sign	1h	17,815	935	19.0535	0.8918	0.5379
Moving-average cross	5m	213,995	935	228.8717	8.0036	1.8794
Moving-average cross	15m	71,355	935	76.3155	6.0353	2.1279
Moving-average cross	1h	17,841	935	19.0813	2.2359	1.1385
RSI at 50	5m	214,003	935	228.8802	11.2668	2.4086
RSI at 50	15m	71,356	935	76.3166	7.7751	2.1832
RSI at 50	1h	17,841	935	19.0813	1.2776	0.7736
Outside the band	5m	25,288	929	27.2207	− 2.7480	− 0.3760
Outside the band	15m	9,268	890	10.4135	− 3.2830	0.0574
Outside the band	1h	2,310	692	3.3382	− 3.2502	1.7219

Calculation 3.2 Observations per day by bar size

Bar size	Median observations per day
5m	227.9935
15m	76.0392
1h	19.0390

Observation 3.3: five-minute and hourly bars differ by a factor of 11.9751 in observations per day.

The span looked at is the same 24 hours and the signal is the same.

Observation 3.4: ⚠️ the naive t moves a great deal with the bar size. For the moving-average cross on USDJPY it is **8.0036** on five-minute bars and **2.2359** on hourly ones. **More than threefold, for the same signal over the same 24 hours.**

Observation 3.5: ⚠️ the daily t at the same place is **1.8794** and **1.1385**, moving far less. ★ The naive t is the one that is sensitive to the bar size.

Observation 3.6: ⚠️ for the band signal on USDJPY fifteen-minute bars, the naive t is **−3.2830** while the daily t is **0.0574**. The sign changes. ⚠️ That is the difference between "significantly negative" and "nothing can be said" — not a small difference.

4. The within-day correlation and the inflation of the standard error

Calculation 4.1 Correlation and the ratio of standard errors (XAUUSD, evaluation period)

Signal	Bar size	Per day	Within-day correlation	Ratio of standard errors	Upper bound
Last bar's sign	5m	227.7614	0.0051	1.4654	
Last bar's sign	15m	76.0011	0.0131	1.4087	
Last bar's sign	1h	19.0261	0.1143	1.7495	
Moving-average cross	5m	228.2255	0.1225	5.3695	
Moving-average cross	15m	76.0773	0.2148	4.1387	
Moving-average cross	1h	19.0316	0.3939	2.8465	
RSI at 50	5m	228.2255	0.1607	6.1256	
RSI at 50	15m	76.0773	0.2696	4.6089	

RSI at 50	1h	19.0316	0.4178	2.9213	
Outside the band	5m	27.7052	0.1866	2.4462	
Outside the band	15m	10.9698	0.3134	2.0310	
Outside the band	1h	3.3523	0.6348	1.5790	

Observation 4.2: the median within-day correlation is 0.1430, ranging from +0.0010 to +0.6348. ⚠️
It is not zero. This is not a setting in which independence may be assumed.

Observation 4.3: the median ratio of standard errors is 2.5265, ranging from 1.1070 to 6.1256. ⚠️
The denominator alone changes the standard error by a factor of two and a half.

Observation 4.4: ⚠️ ★ that this ratio equals the square root of $1 + (m - 1)$ times the correlation is an identity, since the correlation is solved from that relation. **This paper does not test the formula.**
What it measured are the actual values of the correlation and of m .

Observation 4.5: the ratio divided by the upper bound $\sqrt{m}$ has a median of 0.4055. ⚠️ **It stays at about four tenths of the bound** (the case of perfect within-day correlation). So **discounting by $\sqrt{m}$ as a rule of thumb discounts too much.**

Observation 4.6: ⚠️ **the correlation is larger on coarser bars** (for the band signal on XAUUSD: 0.1866, 0.3134, 0.6348). Coarse bars hold fewer observations a day, and what remains is more strongly correlated. **The total inflation is set by how m and the correlation combine.**

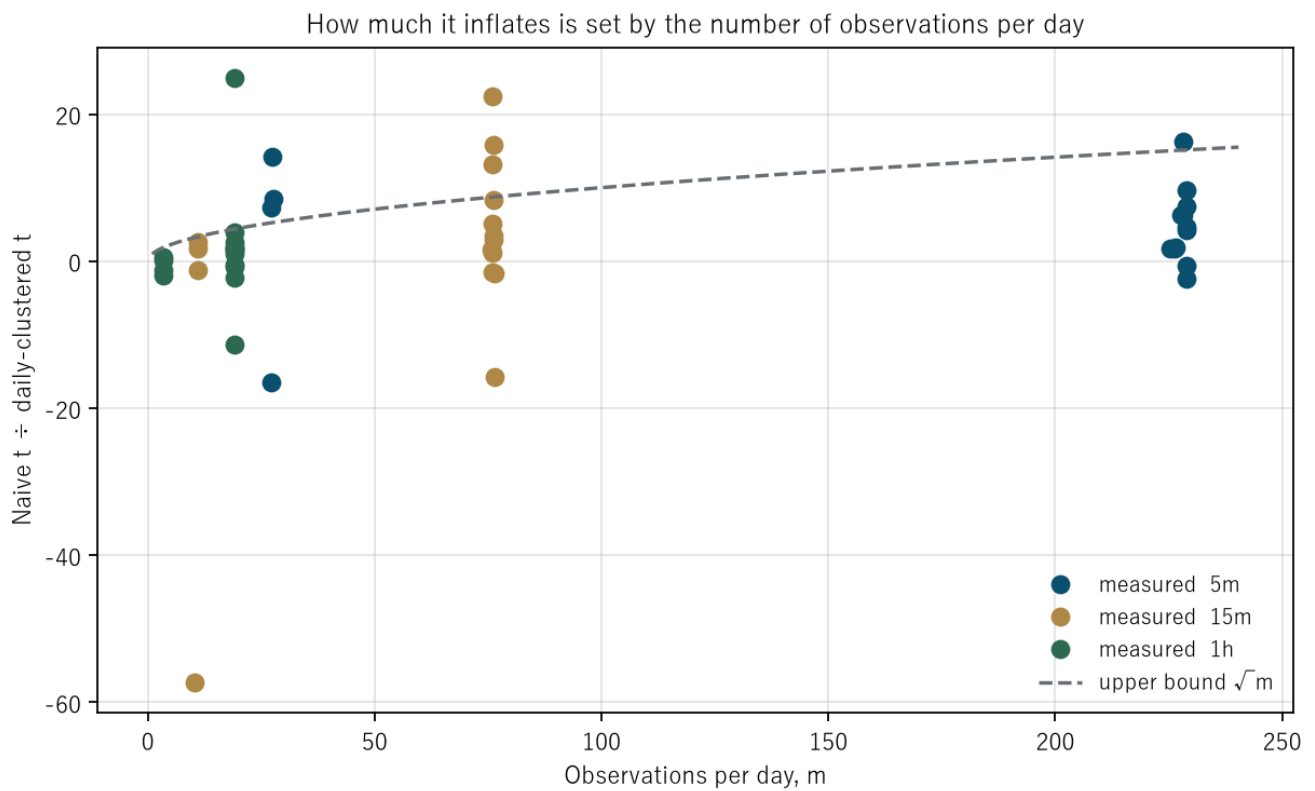


Figure 1: observations per day across, naive t divided by daily t up. **The dashed line is the upper bound $\sqrt{m}$.**

5. The number of significant cells changes with the denominator alone

Calculation 5.1 Same data, same signals, only the way t is built (evaluation period)

Bar size	Cells	Absolute naive t at or above 2	Absolute daily t at or above 2	Median naive t
5m	16	8 / 16	1 / 16	2.0
15m	16	7 / 16	2 / 16	1.8
1h	16	4 / 16	3 / 16	1.2

Observation 5.2: over all 48 cells, the naive t reaches 2 in absolute value in 19, the daily-clustered t in 6. The medians are 1.8046 and 0.7218.

Observation 5.3: ⚠ the content is the same. The data, the signals, the period and the horizon are unchanged. Only the denominator was changed.

Observation 5.4: ⚠ the gap is larger on finer bars. On five-minute bars $8 / 16$ falls to $1 / 16$, while on hourly bars $4 / 16$ falls only to $3 / 16$. The more observations a method produces, the more the naive t inflates.

Observation 5.5: ★ therefore the t values of a high-count method and a low-count method must not be compared while both are naive. The former comes out ahead not because it is right but because it counts the same day many times.

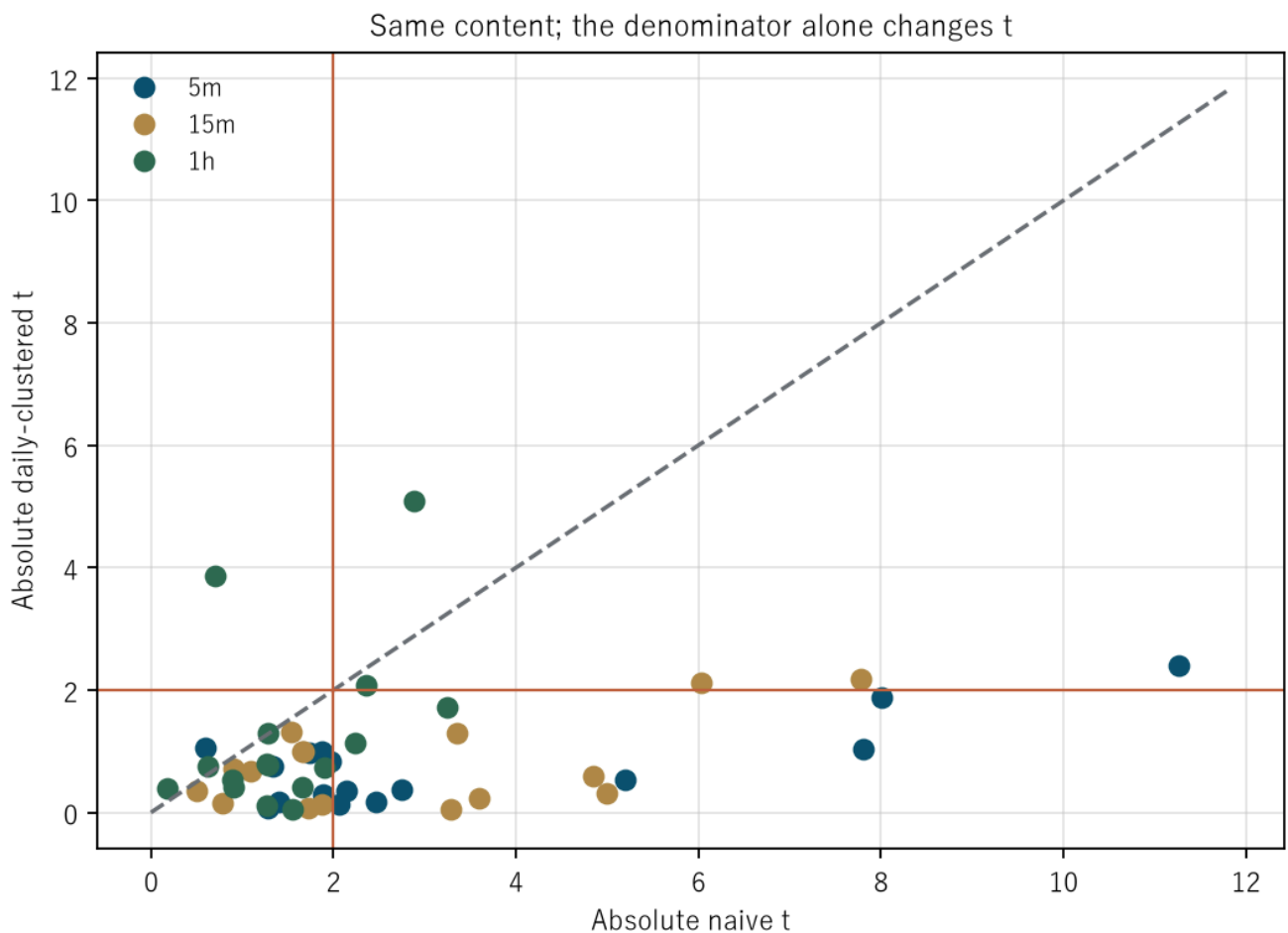


Figure 2: absolute naive t across, absolute daily t up. The points fall below the diagonal, and the two red lines mark 2.

6. The baseline — the naive t exceeds 2 even where no edge exists

Calculation 6.1 Synthetic series whose within-bar movement is also random (10 realisations, evaluation period)

Bar size	Per day	Median absolute naive t	Median absolute daily t	Share with naive t > 2
5m	228.8802	2.0893	0.8516	0.5437
15m	76.3166	0.8718	0.7512	0.2687
1h	19.0813	1.6494	1.3530	0.2687



Observation 6.2: ★ this is the core of the paper. On a series known by construction to carry zero directional information, the median absolute naive t on five-minute bars is 2.0893, and the share exceeding 2 is 0.5437.

Observation 6.3: ⚠ more than half the cells look "significant". Not because anything is right. The naive t is not measuring whether anything is right.

Observation 6.4: ⚠ ★ and daily clustering is not enough either. On the same synthetic series, the median absolute daily t on hourly bars is 1.3530, larger than the 0.8516 of five-minute bars.

Observation 6.5: ⚠ the reason is the 24-hour horizon. Neighbouring observations overlap, and daily clustering folds only the overlap within a day. The part that crosses days remains.

Observation 6.6: ⚠ the fifteen-minute row alone is small (naive 0.8718, share 0.2687). The three bar sizes are not monotone. ⚠ This paper cannot explain that non-monotonicity. It is a limitation in Section 7.

7. Limitations

1. ★ **The formula is not tested.** That the ratio of standard errors equals the square root of $1 + (m - 1)$ times the correlation is an identity following from the definition. **What this paper measured are the actual values of the correlation and of m.**
2. ★ **The overlap is not removed.** The horizon is 24 hours, so observations overlap; daily clustering leaves the part that crosses days, and **the median absolute daily t of 1.3530 on the synthetic series is the evidence.** ⚠ **This paper does not say that daily clustering is sufficient.**
3. **The three bar sizes are not monotone on the synthetic series.** The paper cannot explain why the fifteen-minute row is small. **That is the gap to fill next.**
4. **Four signal families are fixed.** Other families give other figures. ⚠ But that the correlation is non-zero and that m moves by a factor of 12 do not depend on the family.
5. **The correlation is measured under one definition,** an intraclass correlation with days as groups. Other groups (weeks, sessions) give other values.
6. **The synthetic baseline uses independent normal increments.** Volatility clustering is not included.
7. **Four instruments over three years.** Nothing is said about other markets or other periods.

Conclusion

Measuring the same signal over the same 24 hours ahead, changing only the bar size moves the observations per day from **19.0390** to **227.9935** — a factor of **11.9751**.

The within-day correlation has a median of **0.1430** and is not zero, so the daily standard error exceeds the naive one by a median factor of **2.5265**. As a result the naive t reaches 2 in absolute value in **19 of 48** cells while the daily-clustered t does so in **6 of 48**. **The content is the same; only the denominator changed.**

And on a synthetic series known by construction to carry zero directional information, the median absolute naive t on five-minute bars is **2.0893**, with **0.5437** of cells exceeding 2.

The naive t is not measuring whether anything is right. It is measuring how many times the same day was counted.

And daily clustering is not enough. On the same synthetic series the median absolute daily t on hourly bars is 1.3530. With a 24-hour horizon, the overlap across days remains. ⚠️ What this paper could show is that the naive version is insufficient, not that the daily version suffices.

Data and reproduction

Data	Currency ticks from Dukascopy (agreement to the millisecond, bid and ask, verified from 2019 onward). Gold from Dukascopy
Period	2019–2024 (six years). Evaluation 2022–2024
Instruments	USDJPY, EURUSD, GBPUSD, XAUUSD
Bars	Five-minute, fifteen-minute and hourly. Mid price, closing value of completed bars only. Bars with no ticks are not created
Horizon	24 hours for all three (288, 96 and 24 bars)
Verification	<code>検算/F014.py</code> (with <code>--zu</code> it also writes the figures). Every number in the text is taken from <code>検算/F014_output.txt</code>
Figures	<code>図/F014_zu1</code> , <code>図/F014_zu2</code> (png, svg, English versions)
Random seeds	Fixed at 0–9. Re-running gives the same values
Audit of the foundation	<code>_ツール/audit_bars.py</code> (look-ahead in the bars, daylight saving, the day boundary). The record is <code>_土台の検査.txt</code>

References

- Yamagishi, Y. (2026). Inside One Phenomenon Live a Number That Moves with the Lattice and a Number That Does Not [Paper 264]. Zenodo. 10.5281/zenodo.22169720
- Yamagishi, Y. (2026). The Table Is Right and the Trade Still Loses [Paper 423]. Zenodo. 10.5281/zenodo.22700114
- Yamagishi, Y. (2026). The Period a Moving-Average Crossover Finds Is Made by the Ratio of the Two Periods [F001]. Zenodo. 10.5281/zenodo.22880428
- Yamagishi, Y. (2026). The Ichimoku Cloud Is a Past Drawn Twenty-Six Bars Ahead [F002]. Zenodo. 10.5281/zenodo.22880552
- Yamagishi, Y. (2026). The Multiplier of a Bollinger Band Changes How Often Price Leaves It, Not Which Way Price Goes [F003]. Zenodo. 10.5281/zenodo.22881085
- Yamagishi, Y. (2026). The "Overbought 70" of RSI Belongs to the Bar Size You Chose [F004]. Zenodo. 10.5281/zenodo.22881156
- Yamagishi, Y. (2026). The Zero Cross of MACD Is the Same Thing as a Moving-Average Cross [F005]. Zenodo. 10.5281/zenodo.22881227
- Yamagishi, Y. (2026). The %K of Stochastics Is the Position in the Range Itself [F006]. Zenodo. 10.5281/zenodo.22881505
- Yamagishi, Y. (2026). ADX Carries No Direction, So It Cannot Tell You Which Way [F007]. Zenodo. 10.5281/zenodo.22881623
- Yamagishi, Y. (2026). The Fibonacci Ratios Carry No Privilege [F008]. Zenodo. 10.5281/zenodo.22881668
- Yamagishi, Y. (2026). The Probability of Touching a Pivot Level Is a Restatement of the Distance to It [F009]. Zenodo. 10.5281/zenodo.22881708
- Yamagishi, Y. (2026). Aligning Timeframes Only Reduces the Count by as Much as You Aligned [F010]. Zenodo. 10.5281/zenodo.22891380
- Yamagishi, Y. (2026). Round Numbers Do Not Attract Price [F011]. Zenodo. 10.5281/zenodo.22891487
- Yamagishi, Y. (2026). Placing the Take Profit and Stop Loss Forty-Nine Ways Does Not Move the Expectation [F012]. Zenodo. 10.5281/zenodo.22891608

- Yamagishi, Y. (2026). A Sweep over Thresholds Cannot Produce a Plateau in Principle [F013]. Zenodo. 10.5281/zenodo.22891660