PSEDYS | TECHNICAL REFERENCE MANUAL V3.0

StdDev — Standard Deviation

StdDev — Standard Deviation

Technical Reference Manual v1.0

PSEDYS | Complete Edition
Population (ddof=0) vs Sample (ddof=1) · Rolling Window · Statistical Volatility · Z-Score · MTF · Bot vs TradingView

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1. What is StdDev? Concept

Standard Deviation measures the **dispersion of Closes from the mean** over a window of N bars. It is the mathematical foundation of Bollinger Bands and a direct indicator of statistical volatility.

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Difference from ATR: StdDev measures the variability of Closes; ATR measures the range of True Range (includes High/Low/gap). StdDev does not directly capture overnight gaps.

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2. Calculation Formula — Complete

2.1 Population vs Sample StdDev

Population StdDev (ddof=0) — TradingView default:

```
Mean = SMA(Close, period)
Variance = Σ(Close[j] - Mean)² / period
StdDev = √Variance
```

Sample StdDev (ddof=1) — pandas default:

```
Variance = Σ(Close[j] - Mean)² / (period - 1)
StdDev_sample = √Variance_sample
```

Relationship:

```
StdDev_sample = StdDev_population × √(N/(N-1))

For N=20: factor = √(20/19) = 1.0260
Difference: ~2.6% → significant for BB and other StdDev-based calculations
```

TradingView uses ddof=0 (population). Numpy `np.std(ddof=0)`, pandas `std(ddof=1)` — ensure ddof=0 explicitly.

2.2 Rolling StdDev

```
StdDev[i] = √(Σ(Close[j] - Mean[i])² / period)   for j = i-period+1..i
```

Calculated over the same rolling window as SMA. First value at bar `period`.

2.3 Complete Numeric Example — period=20, 50 bars

Verification bar 20 (first value):

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```
Close[1..20] = [100.00, 100.74, 99.33, ..., 98.69]
Mean = 98.7735

Squared deviations:
  (100.00 - 98.7735)² = 1.5044
  (100.74 - 98.7735)² = 3.8660
  (99.33 - 98.7735)²  = 0.3096
  ...

Variance = Σ / 20 = 2.0303
StdDev   = √2.0303 = 1.4249   (ddof=0) ✓

StdDev_sample = 1.4249 × √(20/19) = 1.4249 × 1.0260 = 1.4620  (ddof=1)
Difference: 0.0371 → ~2.6%
```

StdDev table bars 20–50:

Bar	SMA	StdDev(pop)	StdDev(sample)	Interpretation
20	98.774	**1.4249**	1.4620	Low volatility
25	98.556	1.3592	1.3946	Slightly decreasing
30	98.201	1.0114	1.0381	Minimal (tight range)
35	99.155	1.8679	1.9168	Increasing volatility
40	101.206	**3.1201**	3.2022	Active trend → high vol
45	103.596	**3.7472**	3.8460	High volatility
50	104.964	2.6100	2.6788	Slight normalization

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3. Range and Interpretation

StdDev is expressed in **absolute price units**:
- StdDev(BTC/USDT, 20 bars 4H) ≈ 500–2000 USD in normal market
- High StdDev → price dispersed from mean → high volatility
- Low StdDev → price clustered near mean → consolidation / low vol

StdDev% = StdDev / Close × 100 for cross-instrument comparisons.

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4. Lag and Warm-up

```
First value: bar period = bar 20
Warm-up: period bars
Lag: (period-1)/2 = 9.5 bars (rolling window)
No additional smoothing → reactive to spikes
```

5. Uses of StdDev in Trading

5.1 Comparative Volatility

```
StdDev increases: expanding volatility (breakout, spike, new trend)
StdDev decreases: contracting volatility (consolidation, pre-squeeze)
StdDev at local minimum: analogous to Bollinger Squeeze → imminent explosion
```

5.2 Normalized Z-Score

```
Z-Score[i] = (Close[i] - SMA[i]) / StdDev[i]

Interpretation:
  Z > +2: Close at +2σ from mean → statistically rare → possible reversal
  Z > +3: extreme → statistically extreme OB
  Z < -2: Close at -2σ → possible OS
  -1 < Z < +1: normal (68% of the time if normal distribution)
```

Z-Score is useful for **statistical mean reversion systems** and identifying extreme spikes.

5.3 Volatility Filter

```
# Normal / high / low volatility
vol_normal = stddev_avg * 0.7 < stddev < stddev_avg * 1.3
vol_high   = stddev > stddev_avg * 1.5   # high volatility → widen SL
vol_low    = stddev < stddev_avg * 0.6   # compression → reduce SL / pre-breakout

# Adjust sizing based on volatility
position_size = base_size * (target_vol / current_vol)
```

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6. StdDev vs ATR — Comparison

Aspect	StdDev	ATR
Basis	Deviation of Close from SMA	True Range (H/L/PC)
Includes gaps	Indirectly (via Close)	Yes (
Smoothing	None	Wilder RMA (K=1/N)
Reaction to spike	Immediate (calculated directly)	Gradual (Wilder smooths)
Primary use	BB, Z-Score, statistical volatility	SL/TP sizing, trailing
Units	Close dispersion from mean	Absolute range per bar
Log returns	No (absolute prices)	No

When to choose StdDev vs ATR:
- StdDev: statistical analysis, BB, Z-Score
- ATR: SL/TP sizing (includes overnight gaps, more operationally robust)

7. StdDev in Different Regimes

Sideways: Low and stable StdDev. Price moves little from the mean.

Active trend: StdDev increases — price "moves away" from the mean (exits normal distribution). Sustained high level = walk the band.

Post-trend / reversal: StdDev decreases rapidly after spike — volatility normalizes.

8. MTF

Level	Timeframe	StdDev Use
Macro	4H	StdDev 4H for SL calibration (ATR alternative)
Meso	1H	Compare current StdDev vs average → volatility regime
Entry	5M	Z-Score for entry at statistical extremes

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9. PSEDYS — StdDev as a Basis for Volatility

```
# Normalized volatility
stddev_pct = stddev / close * 100

# Z-Score for mean reversion
z_score = (close - sma) / stddev

# Entry filter
entry_ok_vol = stddev < stddev_20bar_avg * 1.3   # not in extreme spikes
squeeze = stddev < stddev_125bar_min * 1.05       # StdDev at 125-bar minimum

# Internal Bollinger %B
pct_b = (close - (sma - 2*stddev)) / (4*stddev)  # identical to BB %B
```

10. Bot vs TradingView Validation

```
□ ddof=0 (population): StdDev = √(Σ(x-mean)²/N)
□ NOT ddof=1 (sample): √(Σ(x-mean)²/(N-1)) → ~2.6% higher
□ Mean = SMA(Close, period) over the same window
□ Window: [i-period+1:i+1] including current bar
□ Tolerance: < 0.001
```

Python Script:

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```
def stddev(closes, period=20):
    import math
    n = len(closes)
    sd = [None]*n
    for i in range(period-1, n):
        w = closes[i-period+1:i+1]
        m = sum(w)/period
        sd[i] = math.sqrt(sum((x-m)**2 for x in w)/period)  # ddof=0
    return sd

def zscore(closes, period=20):
    n = len(closes); z = [None]*n
    sd = stddev(closes, period)
    for i in range(period-1, n):
        m = sum(closes[i-period+1:i+1])/period
        if sd[i] and sd[i] != 0:
            z[i] = (closes[i]-m)/sd[i]
    return z
```

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11. Practical Exercises

Exercise 1: StdDev at 125-bar minimum — what does it mean?

Situation: On 4H, StdDev(20) at minimum from the last 125 bars. Price sideways for 18 days. ADX = 10.

Answer: Extreme volatility compression — pre-breakout. Analogous to Bollinger Squeeze. Direction unknown. Set alerts at Close > Upper_BB or < Lower_BB. Reduced sizing at initial entry (direction confirmed by volume and bars). TP = 2×average StdDev from entry.

Exercise 2: Z-Score = +2.8 in bullish trend

Situation: On 1H, Z-Score = +2.8 (Close at +2.8σ from SMA). Active 4H bullish trend (CHOP=35, ADX=32).

Answer: Tighten trailing SL, do not force exit. Z-Score = +2.8 in trend = price at statistical extreme but in trending context (not mean reversion). Tighten trailing to 1×ATR. Do not Short — in active trend Z-Score can remain > +2 for a long time (walk the band). Exit on decreasing ADX or EMA breakdown.

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12. Cheat Sheet — Quick Summary

Concept	Value / Formula
Formula (pop)	`√(Σ(Close-SMA)²/N)` — **ddof=0**
Formula (sample)	`√(Σ(Close-SMA)²/(N-1))` — ddof=1 (pandas default)
TradingView	**ddof=0** (population)
Standard period	20
Warm-up	period bars
Lag	~N/2 bars
Increasing StdDev	Expanding volatility
Decreasing StdDev	Compression → pre-breakout
Z-Score	`(Close - SMA) / StdDev`
Z > +2	Statistically extreme bullish (~2.5% probability)
Z < -2	Statistically extreme bearish
StdDev%	`StdDev / Close × 100` (cross-instrument)
vs ATR	StdDev: Close dispersion; ATR: absolute range (TR)
Cause #1 divergence	ddof=1 (sample) vs ddof=0 (population)
ddof difference	factor √(N/(N-1)) ≈ 2.6% for N=20

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