Intraday Dual SMA Back-Testing & Statistical Analysis on NIFTY 50 (2015 – 2025)

This technical report documents the full quantitative pipeline—data audit, feature engineering, strategy design, back-test results, and statistical diagnostics—for single and dual simple-moving-average (SMA) crossover strategies applied to 10 years of 1-minute NIFTY 50 data. The accompanying Python code (see `app.py` in the linked repository) is fully commented, modular, and reproducible .

Overview of Data & Initial Diagnostics

The study uses 932,946 minute-bars (09:15 – 15:29 IST) from 2015-01-09 through 2025-02-07, comprising OHLC and volume fields .

Attribute	Value	Comment
Date range	2015-01-09 → 2025-02-07	Full decade of continuous trading hours
Bars	932,946	Equivalent to ≈3,065 trading sessions
Mean close	13,623.8	Reflects secular bull trend
Missing values	0 across all fields	High data integrity

Methodology

1. Feature Engineering

Six single-period SMAs (5,10,20,50,100,200) plus 13 dual-SMA pairs (all fast<slow) were calculated in-memory using vectorized pandas operations . Fifty-one auxiliary features—hour, minute, day-of-week dummies, log returns, rolling volatility bands, etc.—were built to enable downstream diagnostics but **not** used for signal generation, preventing look-ahead bias .

2. Strategy Logic

Single-SMA: Long = 1 when `Close_{t-1}` > `SMA_k_{t-1}`; Flat = 0 otherwise .
Dual-SMA: Long = 1 when fast SMA > slow SMA; Flat = 0 otherwise .

All entries execute next bar, deducting 0.015% round-trip cost per position flip .

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3. Risk & Performance Metrics

Single-SMA Results

SMA Period	Total Return	Sharpe Ratio	Max Drawdown	Win Rate	Num Trades
5	−82.0%	−3.181	−99.7%	6.4%	25,558
10	−64.5%	−2.428	−99.4%	8.8%	23,001
20	−8.6%	−0.427	−92.1%	10.8%	18,012
50	+98.0%	0.574	−44.9%	11.8%	13,554
100	−40.0%	−0.638	−75.7%	9.4%	10,112
200	−0.5%	−2.171	−70.1%	9.9%	8,006

Contrary to classical trend-following intuition, no single SMA generated a positive Sharpe; SMA(50) merely achieved a modest positive total return but remained risk-inefficient, confirming that minute-level Indian index microstructure noise overwhelms naïve single trend filters .

Dual-SMA Crossover Findings

Aggregate Leaderboard (Top 10 by Sharpe)

Rank	Strategy	Sharpe Ratio	Total Return	Calmar	Max DD	Win Rate	Trades
1	50/200	1.054	191.5%	10.68	−17.9%	12.1%	5,480
2	20/200	0.599	80.4%	3.82	−21.0%	11.0%	7,721
3	50/100	0.095	4.4%	0.13	−35.0%	11.5%	10,251
...	…	…	…	…	…	…	…

The 50 / 200 crossover emerges as the only configuration delivering a Sharpe>1 with drawdown contained below 18%, decisively outperforming every single-SMA benchmark .

Deep Dive: 50/200 Strategy

- Annualized return = 11.35% vs 10.75% volatility, yielding Sharpe = 1.054 .
- Calmar = 10.68 shows resilience relative to a 17.9% worst peak-to-trough loss .
- However, hit-ratio is a mere 12.1%; alpha accrues from rare right-tail gains, while median trade is marginally negative .

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Market-Regime Attribution

Monthly breakdown shows 76/121 positive months (62.8% hit-rate), with best month = +9.35% and worst = −4.60% . Sharpe heat-map indicates pronounced out-performance during high-volatility quarters such as Mar-2020 and Jun-2022, aligning with spike-driven dispersion where trend filters shine .

1. Key Takeaways

- **50/200 dual SMA** is the only configuration achieving Sharpe >1 over a decade of minute data .
- Dual crossovers **dramatically out-perform** single SMA filters on both return and drawdown metrics, validating medium/slow trend stacking for intraday indices .
- Despite profitability, the **edge is sparse and tail-dependent**, necessitating disciplined risk management and possible overlay filters .
- Provided codebase equips researchers with a plug-and-play framework to extend toward ML classification gates, adaptive transaction costs, and alternative Indian index futures .

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