Crypto Perpetual Futures Funding Rate Carry

A Bidirectional Delta-Neutral Strategy for Harvesting Funding Rate Dislocations

Contents

1. The Strategy Idea

Imagine two assets that are, in theory, the same thing. One is the actual cryptocurrency sitting in a wallet — the spot asset. The other is a perpetual futures contract on that cryptocurrency, traded on an exchange like Binance. Because the contract never expires, its price can drift away from spot for extended periods. When it drifts above spot, the market is in **contango.** When it drifts below, the market is in **backwardation.** In either case, something must force the two prices back together. That mechanism is the **funding rate** — and it is the engine of this strategy.

Our hypothesis: funding rate dislocations in both directions represent a compensated risk premium that can be harvested mechanically via a fully bidirectional, delta-neutral strategy. Specifically:

- **Contango leg (perp > spot, positive funding rate):** Short the perpetual, long the spot asset in equal notional size. Longs pay shorts the funding rate every 8 hours, so we collect income while mechanical pressure pulls the perp back down toward spot. P&L = funding collected + basis convergence gain.
- **Backwardation leg (perp < spot, negative funding rate):** Long the perpetual, short the spot asset in equal notional size. Shorts now pay longs — we collect income on the opposite side while the perp is pushed upward. This leg activates during panic-driven crashes when spot is bid up relative to the perp.

In both cases the position is **delta-neutral:** equal and opposite notional in perp and spot means directional price moves cancel out. Our P&L comes entirely from (a) funding payments received at each 8-hour settlement and (b) basis convergence as the two prices reconverge. We are not making a directional bet on any asset — we are monetising the mispricing between two instruments that should trade identically.

The key challenge is not the execution — it is *when* to enter and exit. A funding rate that looks attractive may persist for weeks (good) or explode wider before converging (bad, a basis trap). Separating these cases is the signal design problem, and it is where the three-signal comparison lives.

2. Background: Perpetual Futures, Funding Rates, and Basis Mechanics

What is a perpetual futures contract?

A standard futures contract has an expiry date — at expiry, the contract price converges to spot by construction. A perpetual futures contract has no expiry. It trades continuously, like a stock. Without the convergence anchor of an expiry date, exchanges use a different mechanism: the **funding rate.**

How does the funding rate work?

Every 8 hours (on Binance and most major exchanges), a payment is made between all open long and short positions. The size and direction of this payment is determined by the **premium index** — the difference between the perpetual mark price and the spot index price, averaged over the 8-hour window.

- **Positive funding rate** (perp > spot): Longs pay shorts. This makes holding the long position costly and incentivises traders to close longs or open shorts, pushing the perp price down toward spot.
- **Negative funding rate** (perp < spot): Shorts pay longs. This makes holding the short position costly and incentivises traders to close shorts or open longs, pushing the perp price up toward spot.
- **Zero funding rate**: Perp and spot are at parity. No payment is made; neither side has an incentive to change positions on funding grounds alone.

The funding rate is publicly observable in real time and has a full historical record on exchanges like Binance, with settlement at 00:00, 08:00, and 16:00 UTC. During the 2021 bull market, BTC funding rates averaged 0.10% per 8 hours, equivalent to **approximately 109% annualised** — an extreme case, not the norm.

The basis and why it creates opportunity

The **basis** is defined as: Basis = Perp Price − Spot Price. When basis is significantly non-zero, the market is offering a premium to one side of the trade. The strategy collects this premium while holding a hedge. The risk is that the basis *widens* further before converging — this is **basis risk,** the primary risk of the strategy, entirely distinct from directional price risk.

Two types of funding dislocation — and why both matter

- **Regime-driven funding (transient):** The market is in a bull run and everyone wants long exposure. Funding is high but is likely to normalise as sentiment cools. The signal looks attractive but the convergence may be slow and uncertain.
- **Structural dislocation (our target):** Funding is anomalously high or low *relative to its own recent history* for this specific asset. The current level is a genuine statistical outlier. Mean reversion back toward the asset's normal funding level is more predictable.

This distinction — raw level vs. anomaly vs. trajectory — motivates our three-signal comparison in Analysis 2. The z-score signal captures structural dislocation; the raw level signal captures regime-driven funding; the momentum signal tests whether a rising funding rate predicts persistence.

3. Step-by-Step: What We Do Each Rebalance

The strategy rebalances at each 8-hour funding settlement window (00:00, 08:00, 16:00 UTC). The following recipe is fully mechanical and could be executed by anyone given the data and code.

Step 1: Define the universe

Take the top 15 perpetual futures pairs on Binance by 30-day average open interest: BTC, ETH, SOL, BNB, XRP, DOGE, AVAX, MATIC, LINK, ADA, DOT, ATOM, LTC, UNI, ARB. Reconstitute monthly — if a pair drops out of the top 15 by OI, it is replaced at the next monthly rebalance. This ensures we always trade liquid markets with sufficient depth.

Step 2: Compute the entry signal

For each of the 15 pairs, compute the chosen signal (see Analysis 2 for all three variants). The primary signal (Signal A) is the funding rate z-score: take the current 8-hour funding rate, subtract its 90-day rolling mean, and divide by its 90-day rolling standard deviation. A positive z-score indicates the perp is anomalously expensive (contango entry). A negative z-score indicates anomalously cheap (backwardation entry). The magnitude indicates conviction.

Step 3: Rank and filter

Sort all 15 pairs by absolute signal magnitude. Enter a new position only in the top quartile (roughly 3–4 pairs at any given window). This prevents over-trading marginal opportunities where funding barely exceeds transaction costs. Existing positions are held until exit criteria are triggered.

Step 4: Enter positions

For each selected pair: if signal > 0 (contango), short the perpetual and long the spot in equal notional. If signal < 0 (backwardation), long the perpetual and short the spot in equal notional. Position size is proportional to absolute signal magnitude, subject to a per-asset cap of 20% of total gross notional. The portfolio runs at 200% gross exposure (100% long + 100% short). Margin is posted at 20% of notional per leg.

Step 5: Apply open interest filter

Before entering, check the current open interest for the pair as a ratio of its 90-day average OI. If OI is greater than 2x its trailing average (extremely crowded positioning), reduce the position size by 50%. Crowded trades have worse exit liquidity and are more prone to violent basis explosions during liquidation cascades.

Step 6: Apply macro gating signal

Before entering any new positions, check the VIX level and the 5-day SPY return from Bloomberg/Databento. If VIX > 35 or SPY 5-day return < -5%, enter no new positions and reduce all existing positions by 50%. During TradFi stress events, crypto basis trades have historically blown out due to cross-margin liquidations and forced deleveraging.

Step 7: Exit criteria

Close a position when any of the following trigger: (a) the signal crosses zero — the dislocation has fully reverted, (b) the absolute signal drops below 0.5 standard deviations for 3 consecutive windows — the opportunity has faded, (c) the basis moves adversely by more than 3 standard deviations of its trailing 30-day distribution — a stop-loss against a basis explosion, or (d) the macro gate activates — reduce by 50%.

Step 8: Record P&L and repeat

At each 8-hour window, record: funding payments received/paid, unrealised basis P&L on each open position, and any realised P&L from closed positions. Net return = funding income + basis convergence gain − transaction costs. Then go back to Step 1.

4. What We Analyse and Why

Building the strategy is only half the project. The other half is analysing it rigorously and honestly. Here are the seven analyses we run, and why each matters.

Analysis 1: Basic Performance (Costless and With Costs)

We compute the strategy's returns assuming zero trading costs (the idealised upper bound), then add realistic costs: 5 basis points (0.05%) taker fee per leg on Binance (VIP0 rate), plus estimated bid-ask spread of 1–2 bps for BTC/ETH and up to 10 bps for smaller altcoin perps. We report:

- Annualised return, volatility, and Sharpe ratio (using FRED risk-free rate as denominator)
- Maximum drawdown and average drawdown duration
- Skewness and excess kurtosis of daily returns
- Monthly turnover and the breakeven cost level (what cost per trade reduces the Sharpe to zero)
- Average number of simultaneously open positions (must be 5+ to satisfy assignment requirement)
- Funding income vs. basis P&L decomposition — how much of total return comes from each source

Analysis 2: Three-Signal Comparison — The Centrepiece

We run the identical backtest engine three times, each using a different operationalisation of funding attractiveness. This tests two questions: does adjusting for an asset's own funding history improve the signal (A vs. B)? And does a momentum framing beat a static level measure (C vs. A or B)?

Signal	Definition	Intuition	Expected Strength
A — Funding Z-Score (Primary)	8h rate minus 90-day rolling mean, divided by 90-day rolling std dev. Sign gives direction; magnitude gives conviction.	Measures how anomalous the current funding rate is relative to this asset's own normal level. Adjusts for structural differences across assets.	Expected best performer: accounts for cross-asset differences in baseline funding and identifies genuine outliers.
B — Raw Funding Level	The raw 8h funding rate in basis points. Sign gives direction; absolute value gives conviction.	Simple level threshold. The approach most practitioners use. Ignores whether this level is normal or unusual for this asset.	Should work but noisier: may flag altcoins as always attractive even when their funding is structurally elevated.
C — Funding Momentum	3-day exponential moving average of the change in the 8h funding rate. Sign of level gives direction.	Tests whether a funding rate moving away from zero predicts that the dislocation will persist long enough to be profitable.	Tests a different hypothesis: is it better to enter early in a developing dislocation, or at the peak?

Analysis 3: Open Interest Filter — Does Crowding Predict Basis Explosions?

Open interest (the total value of outstanding contracts) measures how crowded a trade is. When OI is at extreme highs relative to its own history, the risk of a violent basis explosion is elevated. We test whether filtering out entries when OI exceeds 2x its trailing 90-day average improves risk-adjusted returns.

- Strategy A: No OI filter (baseline)
- Strategy B: Full position size when OI < 1.5x trailing average, half size when OI is 1.5–2x, no entry when OI > 2x
- Strategy C: OI as a continuous scaling factor — position size inversely proportional to the OI ratio

Analysis 4: Macro Gating Signal — TradFi Stress and Basis Risk

During major TradFi risk-off events (March 2020 COVID crash), crypto basis trades have historically blown out. We use Databento equity data to construct a simple macro stress indicator and test whether gating the strategy during these events improves performance. The gate triggers when either condition is met:

- **VIX level > 35** (sourced from Bloomberg): Signals acute equity market stress. Historically, crypto-TradFi correlation spikes during these episodes.
- **SPY 5-day return < -5%** (sourced from Databento NASDAQ feed): Rapid equity drawdown, consistent with forced deleveraging across asset classes.

When the gate activates: no new entries, existing positions scaled to 50% notional. We compare: ungated vs. gated strategy across the full sample and specifically during the five largest TradFi drawdown episodes in our sample period.

Analysis 5: Portfolio-Level Risk — Basis VaR and Funding Income Stability

The primary risk in this strategy is basis risk, not directional price risk. We decompose daily P&L into: funding income received and basis mark-to-market P&L. This shows whether losses come from basis explosions (systematic risk) or from funding income reversals (signal failure). We then compute:

- 1-day 95% and 99% VaR: 'In 99% of days, we lose no more than X%'
- Expected Shortfall (CVaR): 'When we do breach VaR, the average loss is Y%'
- Maximum basis drawdown per asset: worst single intraday basis widening observed
- Liquidation cascade dates: mark the five worst single-day basis P&L events on the return chart

Analysis 6: Regime / Crisis Subperiod Analysis

Funding carry is well-known to practitioners. The honest question is when it fails. We split the sample into five regimes anchored to real crypto market events and state our expectations before seeing the results.

Period	Label	Our Prediction
Jan 2020 – Feb 2020	Pre-COVID Baseline	Strategy earns modest, steady returns. Positive funding prevalent in BTC/ETH.
Mar 2020 – Dec 2020	COVID Crash + Recovery	Contango strategy loses badly in March (basis explosion). Backwardation leg should activate and partially offset. Recovery period (Apr-Dec) should be very profitable — high positive funding.
Jan 2021 – Nov 2021	Crypto Bull Run	Best period for the strategy. Persistently high positive funding across all assets. Both legs active; contango dominates. High Sharpe, low drawdown.
Dec 2021 – Dec 2022	LUNA / FTX Crash	Worst period. Funding goes sharply negative during crashes; backwardation leg activates but basis risk is extreme. Macro gate should reduce losses if it works.
Jan 2023 – Dec 2025	Post-FTX Recovery	Moderate performance. Funding normalises; smaller opportunities but lower risk. Strategy earns carry without the extreme events of 2021-2022.

If the macro gate fires correctly, it should reduce losses specifically in March 2020 and November 2022. If it fires but doesn't help, that tells us basis explosions are too fast for a daily gate to.

Analysis 7: Robustness Checks and Diagnostics

Several design choices involve subjective parameters. We test sensitivity to each:

- Z-score lookback window: 60-day vs. 90-day vs. 180-day rolling window for Signal A. Does the signal require a long history, or does a shorter window adapt faster?
- Top-quartile filter threshold: Top quartile (25%) vs. top tercile (33%) vs. top decile (10%). Does concentrating in highest-conviction trades improve or worsen performance?
- Universe size: Top 10 vs. top 15 vs. top 20 pairs by OI. Does adding smaller altcoins add return or just noise?
- Rebalance frequency: 8-hour (settlement-driven) vs. daily (less turnover). How much Sharpe is sacrificed by reducing trading frequency?
- Stop-loss tightness: 2-sigma vs. 3-sigma vs. no stop on basis widening. Does the stop-loss improve or worsen risk-adjusted returns?
- Signal stability: 8-hour rank autocorrelation for each signal. How often do assets move in/out of the top quartile? High stability = lower turnover.

Why this matters: If the strategy's conclusions hold across all parameter variations, it is robust. If it is sensitive to one specific choice, we report and discuss that honestly.

5. Data, Tools, and Feasibility

Data Sources

Source	What We Pull	Used For	Access
Binance API (ccxt library)	8-hour funding rate history (full since 2020), perp mark price, spot index price, open interest history, OHLC for spot	Primary signal construction, basis series, OI filter, transaction cost modelling	Free, public API. No authentication needed for historical data.
Bloomberg Terminal	VIX daily levels, SPY daily OHLCV, crypto spot cross-reference prices	Macro gating signal, independent price benchmark, correlation analysis	University Bloomberg terminal access.
Databento (NASDAQ feed)	SPY intraday returns for 5-day rolling drawdown calculation	Macro gating signal (non-OHLCV, non-crypto — satisfies assignment requirement)	Databento academic license.
FRED (Federal Reserve)	USD 3-month T-bill rate (risk-free rate)	Excess return calculation, Sharpe ratio denominator	Free public API.

Sample period: January 2020 – December 2025. Full funding rate history is available on Binance for BTC from late 2019 and for most major altcoins from 2020–2021. Universe reconstituted monthly by 30-day average open interest.

Computational Requirements

The strategy is computationally lightweight. There is no model fitting — signal computation is purely arithmetic (rolling means, standard deviations, rate of change). The most intensive step is data ingestion: pulling full 8-hour funding rate history for 15–20 pairs across 6 years yields roughly 65,000 rows per asset, or ~1 million rows total. This is handled in seconds with pandas.

- Data pull (ccxt + Binance API): ~30 minutes one-time, then incremental updates

- Signal computation (all three variants, full history): < 5 seconds
- Backtest engine (8-hour rebalancing, 6 years, 15 pairs): < 30 seconds
- All analyses (robustness, subperiods, VaR): < 5 minutes total
- No parallelisation required — the entire computation runs comfortably on a laptop

Key Python Packages

Package	Purpose
ccxt	Unified crypto exchange API — pulls funding rates, OI, and OHLCV from Binance
pandas, numpy	Data manipulation, rolling calculations, signal construction, portfolio accounting
scipy.stats	Historical simulation VaR, tail distribution fitting for risk analysis
statsmodels	OLS regressions for factor exposure analysis
matplotlib	All plotting — static only, as professor prefers non-interactive plots
blpapi	Bloomberg Python API for VIX and SPY data
databento	Databento Python SDK for NASDAQ/SPY intraday feed

6. Division of Labour and Timeline

Roles

Person	Role	Specific Responsibilities
A	Signal + Risk	Binance API data pipeline (ccxt), all three signal computations (z-score, raw level, momentum), ensemble signal construction. Portfolio-level risk analysis (VaR, ES, P&L decomposition). OI filter construction and testing. Overall technical direction and code review.
B	Data & Universe	Universe construction and monthly reconstitution (top 15 by OI). Bloomberg VIX + SPY pulls. Databento feed setup and intraday SPY return computation. FRED risk-free rate. Basis series construction (perp mark price minus spot index). Data documentation for notebook.
C	Backtest Engine	Portfolio construction, position sizing, and P&L accounting. Transaction cost model (per-leg fees + bid-ask spread by asset tier). Three-signal comparison engine. Macro gating implementation. Builds importable .py source code module. Performance metrics (Sharpe, drawdown, skewness, turnover).
D	Analysis + Write-up	Regime/subperiod analysis with pre-registered predictions. Robustness checks and sensitivity tables. OI filter analysis and macro gate event study. Pitchbook (PDF slides, non-quant audience). Jupyter notebook narrative, markdown cells, section observations, and conclusion.

Timeline

	Person A (Signal + Risk)	Person B (Data)	Person C (Backtest)	Person D (Write-up)
Week 1	Prototype signal pipeline on sample	Pull full funding rate and OI history for all 15	Build backtest engine using dummy signal	Download FF factors + FRED rate. Draft

Days 1–3	Binance data. Test ccxt connection and funding rate pull.	pairs. Bloomberg + Databento setup. Deliver data panel to group.	(random z-scores). Portfolio accounting, cost model, P&L output.	pitchbook outline and notebook structure.
Week 1 Days 4–7	Run all three signals on full panel. Compute OI filter. Deliver signal CSV to C.	Basis series construction. Universe reconstitution logic. Support A with data edge cases.	Integrate real signals. Run costless + realistic cost backtests for all 3 signals. Performance tables.	Begin regime analysis. Draft pitchbook slides 1–5. Subperiod breakdowns.
Week 2 Days 8–10	VaR + ES risk analysis. P&L decomposition (funding vs. basis). Macro gate event study.	Support analysis. Prepare data appendix for notebook. Cross-check all data sources.	Robustness checks (window, threshold, universe size). Signal stability (rank autocorrelation). OI filter comparison.	Macro gate analysis. Finish pitchbook. Begin notebook narrative and observations.
Week 2 Days 11–14	Code review. Technical writing support for D. Final .py module cleanup.	Review all results for data issues. Proofread notebook. Verify data documentation.	Final .py module. Verify all code runs cleanly from imports. Ensemble signal.	Finish all markdown cells. Conclusion. Final review of pitchbook and notebook.

Critical path: Person B's data delivery (by Day 3) unblocks everything else. Person B should start immediately on the Binance API pull.

7. Assignment Compliance Checklist

Assignment Requirement	How We Satisfy It	Where in Notebook
Invent, simulate and analyse a quantitative trading strategy	Bidirectional delta-neutral carry strategy with full 6-year backtest and 7 analyses.	Entire notebook
Recipe for evaluating attractiveness — could be followed by anyone	Mechanical z-score sort on funding rate; top-quartile filter; fully deterministic.	Section: Signal Construction
Recipe for position sizes with risk and capital controls	Notional proportional to signal magnitude; 20% per-asset cap; 200% gross; 3-sigma basis stop; OI scaling; macro gate.	Section: Portfolio Construction
Depends on non-OHLCV, non-price data	Funding rates (exchange settlement data, not price data). OI as filter. Databento SPY drawdown for macro gate. VIX from Bloomberg.	Section: Data + Analyses 3 & 4
Holds 5+ distinct assets simultaneously	Top quartile of 15 pairs = 3–4 per window; full 15-pair history means 5+ open simultaneously across any given day.	Section: Portfolio Construction
40+ trades without excessive clustering	8-hour rebalancing, 15 pairs, 6 years = thousands of entry/exit events, uniformly distributed.	Section: Performance
Leverage with documented assumptions	200% gross (100% long spot + 100% short perp). Margin at 20% per leg. Capital normalised to $1. Hard stop at -15% portfolio drawdown.	Section: Portfolio Construction
Costless AND realistic cost cases	Zero-cost baseline. Realistic: 5 bps taker fee + 1–10 bps spread by asset tier.	Section: Performance (Analysis 1)

Portfolio-level risk analysis	Historical simulation VaR and ES on portfolio P&L. Basis vs. funding P&L decomposition. Worst-event attribution.	Section: Risk Analysis (Analysis 5)
R or Python code	Python. Importable .py module. Notebook imports from it.	Module file in zip
2+ academic paper PDFs	Liu & Tsyvinski (2021); Cong, Tang & Yang (2021); Avellaneda & Stoikov (2008).	Included in zip
Pitchbook + technical paper	PDF pitchbook for non-quant audience; Jupyter notebook for technical study.	Separate PDF + main notebook
Student names and IDs	On first section of both pitchbook and notebook.	Cell 0

8. What Could Go Wrong

Risk 1: The funding premium is too small after costs — Likelihood: Moderate. Impact: Low.

Transaction costs on crypto perps are low (5 bps taker fee) but funding rates can be near zero for long stretches in bear markets. If funding income does not cover costs, the backtest will be unprofitable. This is a real possibility. However, the project is designed to produce valid findings regardless: the three-signal comparison still answers whether z-score beats raw level; the subperiod analysis identifies exactly when the strategy does and does not work; the professor grades on methodology and honest analysis, not on profitability.

Risk 2: Basis explosions overwhelm funding income — Likelihood: Low-Moderate. Impact: High.

During liquidation cascades (March 2020, LUNA May 2022, FTX November 2022), basis spreads can widen by 5–10% intraday — far exceeding months of accumulated funding income. Our 3-sigma stop-loss is designed to limit this, but a fast enough move may gap through the stop. We address this by: (a) reporting the five worst basis events explicitly, (b) showing the P&L decomposition to quantify how much loss comes from basis vs. funding, and (c) testing the macro gate's effectiveness against these specific events.

Risk 3: Binance API data quality issues — Likelihood: Low. Impact: Moderate.

Funding rate history on Binance may have gaps, incorrect timestamps, or missing settlement events during exchange outages. Person B must validate all data: check for gaps, verify funding payments sum to the expected amounts, and cross-reference a sample of BTC funding rates against published historical records from CoinGlass.

Risk 4: Short-selling spot crypto is impractical for retail — Likelihood: Certain. Impact: Low.

Shorting spot crypto requires either a crypto lending market or a spot short-selling facility, neither of which is widely available to retail investors. For the backtest, we assume spot short-selling is available at the risk-free rate plus a 50 bps lending fee — a conservative but documented assumption. We acknowledge this friction explicitly in the notebook.

Risk 5: Scope creep — Likelihood: Moderate. Impact: High.

The project has a well-defined core (strategy + 7 analyses). The temptation will be to add more exchanges, more signal variants, or more robustness checks. The scope defined here is the scope. If time is short, cut from the bottom of this priority list: Core (must have) > Three-signal comparison > Subperiod analysis > OI filter > Macro gate > Robustness checks > Full VaR analysis.

9. Anticipated Questions from the Professor

Q: "Isn't this just textbook arbitrage? Why hasn't it been competed away?"

It is not risk-free arbitrage — it is compensated carry. The position faces basis risk (the spread can widen before converging), liquidation risk (margin calls force exit at the worst time), and counterparty risk (exchange default, as FTX demonstrated). Institutional investors who could scale this trade must hold margin on a 24/7 exchange with no regulatory protection. These frictions prevent full arbitrage and leave a residual premium for those willing to bear them.

Q: "Why 15 pairs? Why not more?"

We trade the top 15 by open interest to ensure sufficient liquidity for realistic entry and exit. Smaller pairs have wide bid-ask spreads and thin order books — the transaction cost model becomes unreliable below this threshold. We test sensitivity: top 10 vs. top 15 vs. top 20. If conclusions hold across all three, we are not curve-fitting to a specific universe size.

Q: "How do you account for exchange risk? FTX showed exchanges can fail."

This is a genuine, unquantifiable risk and we report it honestly as a limitation. In the notebook's risk section, we note that the FTX collapse in November 2022 would have been catastrophic for any strategy holding assets on FTX — and show what returns look like if we include a 100% loss event for any position on a collapsed exchange.

Q: "The backwardation leg — is that really the same strategy, or a different one?"

It is the same strategy with the direction inverted. The economic logic is symmetric: in backwardation, the perp is underpriced and the funding mechanism pushes it higher. We collect the funding payment that shorts make to longs. We report the two legs separately in the subperiod analysis to show how often each activates and which contributes more to total return.

Q: "What's the realistic capacity of this strategy?"

Perpetual futures markets are large — BTC perp OI on Binance alone regularly exceeds $10 billion. However, capacity is limited by margin requirements, bid-ask spread widening as position size increases, and alpha decay as more capital chases the same funding opportunity. We estimate capacity by computing the notional at which transaction costs consume the entire expected funding income.

Q: "Your macro gate uses VIX > 35. How did you choose that threshold?"

VIX = 35 is a widely-used threshold in the academic literature for distinguishing normal from stress regimes. It has also been the approximate level at which crypto-equity correlation historically spikes in our sample. We test robustness to the choice: VIX > 25, > 35, and > 45. If the gate's effectiveness is sensitive to this threshold, we report that honestly.

10. Anticipated Questions from the Group

Q: "I've never traded crypto. How much do I need to know?"

Very little. Person B (data) and Person C (backtest) are building a data pipeline and portfolio engine — both are standard Python/pandas work with no crypto-specific knowledge required. Person D (write-up) needs to understand the idea at a high level: 'we collect a periodic payment by holding two offsetting positions when one instrument is mispriced relative to the other.' Person A handles the signal logic and API connections.

Q: "How does the Binance API work? Is it hard to pull historical data?"

The ccxt library provides a unified interface to most crypto exchanges including Binance. Pulling historical funding rates is about 20 lines of Python: connect, call fetch_funding_rate_history(), paginate over the date range, convert to a DataFrame. The API is free and does not require authentication for historical data. Person A will prototype this and deliver a clean CSV to the rest of the group by Day 3.

Q: "What if funding rates are near zero for most of our sample?"

Funding rates are well-documented to be persistently positive during bull markets and near-zero or negative during bear markets. Our sample (2020–2025) includes both regimes, which is by design — the subperiod analysis specifically tests performance in each. If funding rates average near zero over the full sample, the strategy may be marginal after costs, but the analysis remains valid and informative.

Q: "What goes in the pitchbook vs. the notebook?"

The pitchbook is for a non-quant audience. Use plain language: 'We earn a fee for providing liquidity to leveraged traders.' Never say 'z-score,' 'basis,' or 'perpetual.' Include: strategy description, performance summary, key chart (cumulative P&L), risk section (drawdowns, worst periods), cost analysis, and an honest conclusion. The notebook is for quants: full technical detail, all seven analyses, every parameter choice justified with data.

Q: "Can we use the strategy in both directions simultaneously?"

Yes — this is the design. Different assets can simultaneously be in contango (short perp + long spot) and backwardation (long perp + short spot). The portfolio is always dollar-neutral overall, but individual positions point in opposite directions across assets. The backtest engine handles this naturally — Person C just needs to track the direction flag per position.

Q: "What is the minimum viable version if we run out of time?"

The absolute minimum is: one signal (Signal A, z-score), one direction (contango only), one backtest (costless + realistic costs), basic performance metrics, and the pitchbook. This satisfies all assignment requirements. The three-signal comparison and regime analysis are what push it to A-grade — cut from the bottom of the priority list if needed.

11. Academic References

Liu, Y. & Tsyvinski, A. (2021). 'Risks and Returns of Cryptocurrency.' Review of Financial Studies, 34(6), 2689–2727.

The foundational empirical paper documenting risk premia in crypto assets. Shows that cryptocurrency returns contain a carry component — assets with higher expected returns compensate investors for bearing specific risks. This establishes the core economic premise of our strategy: that funding rate dislocations represent a compensated risk, not a free lunch. Their methodology for measuring crypto risk premia directly informs our performance analysis.

Cong, L. W., Tang, K. & Yang, Z. (2021). 'Crypto Carry.' Working paper, available on SSRN.

The most directly relevant academic work to our strategy. Documents that cryptocurrency carry trades — buying high-yield assets and shorting low-yield ones — earn positive risk-adjusted returns. Their definition of crypto carry closely parallels our funding rate carry, providing direct academic grounding. They also analyse the relationship between carry and market stress, which informs our macro gating analysis.

Avellaneda, M. & Stoikov, S. (2008). 'High-Frequency Trading in a Limit Order Book.' Quantitative Finance, 8(3), 217–224.

While primarily a market microstructure paper, this work establishes the theoretical basis for why persistent mispricings between related instruments (in our case, perp and spot) create exploitable carry opportunities. Their framework for understanding how order flow creates and resolves mispricings is directly relevant to understanding when the funding mechanism succeeds or fails to converge basis to zero.

Summary: *We build a fully bidirectional, delta-neutral carry strategy on crypto perpetual futures. We harvest funding rate dislocations in both directions across 15 liquid pairs, using a z-score signal that identifies anomalies relative to each asset's own funding history. Two extensions — an open interest crowding filter and a TradFi macro gating signal from Databento — test whether the strategy can be protected against its key failure modes. Seven analyses cover performance, signal comparison, risk, regimes, and robustness.*