PROJECT ALPHA-GEN v5.0

Quantitative Strategy for GBP/USD

Non-Stationary Predictive Framework & Actuarial Risk Engine

PROPRIETARY DOCUMENT K-Quant Analytics | Systematic Trading Division

Confidentiality Level: Institutional Grade

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SYSTEM ARCHITECTURE & EXECUTION STRATEGY]

1. THE OPERATIONAL WORKFLOW: HOW WE BUILD THE EDGE

To achieve institutional-grade results, we do not follow price; we decode it. You are required to execute the following three-stage pipeline:

STAGE 1: Regime Classification (The "Why": To Filter Noise)

- Markets alternate between "Stationary" (sideways) and "Non-Stationary" (trending) states. We use Hidden Markov Models (HMM) to identify the "Hidden State" of the GBP/USD pair.

- How: By analyzing price transitions, we only activate the signal engine when the probability of a "Trending State" is >0.7. This eliminates the losses usually incurred during market "chop.

STAGE 2: Signal Extraction (The "Why": To Eliminate Lag)

- Standard indicators are reactive. We need to be predictive.

- How: Implement a Kalman Filter to estimate the "True Price" vector. This is then layered with Fourier Spectral Analysis to detect the underlying frequency of the market cycle. By entering at the cycle's "trough" (low point), we maximize the Reward-to-Risk ratio.

STAGE 3: Actuarial Risk Engineering (The "Why": To Prevent Ruin)

- Most strategies fail due to poor sizing, not poor entries How: You will apply the Cramer-Lundberg Ruin Theory. Instead of static lots, you will calculate the Probability of Ruin for every trade based on current account volatility. Using Expected Shortfall (ES), the system will dynamically scale down during high-entropy periods to protect the principal.

2. DATA ENGINEERING: REQUIRED CSV COLUMNS

New Column Header	Mathematical Tool	Strategic Purpose
Log_Ret	$\ln(P_t / P_{t-1})$	Why: To make the data stationary for statistical modeling.
Hurst_Exp	Rescaled Range Analysis	Why: To verify if the trend is persistent (H > 0.5) or random.
Kalman_State	Recursive Estimation	Why: To provide a lag-free baseline for entry/exit signals.
Shannon_Entropy	Information Theory	Why: To measure the "Complexity" of the signal and avoid trading noise.
VaR_95	Value-at-Risk	Why: To calculate the maximum potential loss per candle for lot-sizing.
Z_Vol	Z-Score Normalization	Why: To standardize volatility and set statistically sound Stop Losses.

The raw OHLC data is insufficient. You must enrich the CSV with the following engineered features to provide the model with "Mathematical Sight":

3. SYSTEM VALIDATION (THE BENCHMARK)

Before we go live, the strategy must pass these two rigorous stress tests:

- Monte Carlo Simulation: Run 10,000 iterations of randomized price paths. The equity curve must show positive drift in at least 95% of scenarios.
- Walk-Forward Optimization (WFO): Perform rolling-window testing. Train on 12 months, validate on 3 months "unseen" data. This ensures we have not "overfitted" the model to past history.

DIRECTIVE FOR THE LEAD QUANT:

Our target is a win rate exceeding 60% with a Sharpe Ratio > 2.0. Focus your efforts on Feature Stationarity and Adaptive Kalman Gain. I expect the mathematical whitepaper for the Regime-Switcher by the end of this week.

ADVANCED TECHNICAL ADDENDUM

1. OPTIMIZING SYSTEM ACCURACY (THE 60%+ EDGE)

To guarantee a win rate exceeding 60% and ensure the longevity of the Alpha-Gen v5.0 engine, the following advanced mathematical layers are to be integrated into the final build:

- **Fractional Differencing (Memory Preservation): While standard Log-Returns achieve stationarity, they often erase the "memory" of the price series. You are directed to apply Fractional Differencing to the GBP/USD data. This ensures the series is statistically stationary while preserving the long-range dependencies required for accurate Hurst Exponent calculations.**

- **Adaptive Kalman Gain (Dynamic Responsiveness): Standard Kalman filters can suffer from "oversmoothing" during high-volatility events (e.g., BoE news). You must implement an Adaptive Gain logic. When market volatility (Z-Vol) spikes, the filter must automatically increase its sensitivity to price action to prevent entry/exit lag.**

- Bayesian Optimization for HMM States: Rather than using fixed transition probabilities, utilize Bayesian Optimization to tune the Hidden Markov Model. This allows the system to self-adjust the "Trending" vs. "Mean-Reverting" probability thresholds based on real-time market decay.

2. SUPPLEMENTARY CSV DATA ENGINEERING

The following two columns must be added to the final enriched CSV to provide a secondary layer of validation:

New Column Header	Mathematical Tool	Strategic Purpose
Fractal_Dim	Box-Counting Dim	To cross-verify the Hurst Exponent and measure the "roughness" of the trend.
Tail_Risk_Idx	Cornish-Fisher Expansion	To refine the VaR_95 metric by accounting for "Fat-Tail" events and sudden market crashes.

3. FINAL STRESS-TESTING PROTOCOL

In addition to Monte Carlo simulations, perform a Sensitivity Analysis on the Kalman Gain and Fourier Window size. The strategy must remain profitable even if these parameters are adjusted by +/- 10%. This ensures the model is not "fragile" or over-optimized to specific historical noise.

K-QUANT ANALYTICS

Where Mathematics Meets Market Liquidity.