**Spot vs Futures Arbitrage Challenge**

**Overview & Objectives**

This challenge evaluates your ability to:

* **Market Data Acquisition:** Retrieve and analyze BTC & ETH spot and futures prices on OKX.
* **Arbitrage Strategy Implementation:** Detect profitable spot vs futures arbitrage (cash-and-carry) opportunities.
* **Execution Simulation:** Simulate arbitrage trade execution and evaluate performance.

The challenge focuses on identifying arbitrage spreads, designing a trading mechanism, and simulating trade execution.

**Context**

Spot vs futures arbitrage (cash-and-carry) exploits price spreads between the spot and futures markets. Traders buy the asset on the spot market and simultaneously short the corresponding futures contract when the futures price trades at a premium (contango). The profit is locked in and realized at contract expiry when futures and spot prices converge.

**OKX** offers BTC/USDT and ETH/USDT futures (both quarterly and perpetual swaps), enabling traders to execute this strategy on a single platform. You can set up an account with OKX Singapore (it is different to normal OKX) to use the API.

This challenge requires you to detect and simulate arbitrage trades using real or historical data.

**Challenge Description**

The task consists of three parts: **(1) Data Acquisition, (2) Arbitrage Strategy & Signal Generation, and (3) Execution Simulation & Performance Analysis.**

**Part 1: Data Acquisition**

Retrieve real-time or historical price data for BTC and ETH spot and futures on OKX with public API.

* Store data in an efficient format (e.g., Pandas DataFrame, JSON, or a database).
* Extract relevant fields: spot price, futures price, funding rates, expiry date, and trading volume.

**Deliverables:**

* A script that fetches and stores cryptocurrency price data.
* A brief report explaining:
  + The API used and data fields collected.
  + Data storage and retrieval strategy.
  + Any preprocessing steps applied.

**Part 2: Arbitrage Strategy & Signal Generation**

Develop a strategy to detect arbitrage opportunities using methods such as:

* **Basis Spread Calculation:** Measure the premium between spot and futures prices.
* **Threshold-based Arbitrage Detection:** Identify opportunities when the annualized basis exceeds a set threshold (e.g., 10%).
* **Funding Rate Consideration:** Adjust the strategy based on funding rate impacts for perpetual futures.

**Deliverables:**

* A script that:
  + Computes arbitrage signals based on futures-spot spreads.
  + Identifies profitable cash-and-carry opportunities.
* A report summarizing the logic behind the strategy and the signal rules and thresholds.

**Part 3: Execution Simulation & Performance Analysis**

Simulate executing arbitrage trades based on detected opportunities. Track portfolio performance over time.

* Maintain a virtual balance for spot and futures positions.
* Evaluate trade outcomes based on:
  + **Cumulative Returns**
  + **Annualized Basis Capture**
  + **Risk-Adjusted Metrics (Sharpe Ratio, Max Drawdown, etc.)**

**Deliverables:**

* A script that:
  + Simulates arbitrage execution.
  + Tracks portfolio performance over time.
* A report including:
  + Backtest results.
  + Performance metrics.
  + Observations and potential improvements.

**Additional Requirements**

* Use the OKX API for data retrieval. The provided Python file is for your reference for using the API.
* **Work on GitHub and Run all scripts in GitHub Actions** to automate execution and validation.
* Keep function names in the file unchanged but add more functions if necessary to enhance functionality.

**Evaluation Criteria**

🔹 **Correctness** – The tool correctly retrieves market data, generates arbitrage signals, and simulates execution.  
🔹 **Strategy Effectiveness** – The approach should be logical and justifiable based on market conditions.  
🔹 **Efficiency** – Code should be structured, modular, and optimized.  
🔹 **Documentation** – The final submission should include:

1. Well-documented code on GitHub with clear comments.
2. A structured report detailing the methodology, implementation, and findings.
3. A short demo video showcasing data retrieval, arbitrage strategy execution, and performance visualization.

**Additional Notes**

💡 **Creativity is encouraged** – test different approaches for optimizing execution.  
📌 **No real trades required** – this is a simulation-based challenge.  
🛠 **AI tools (e.g., ChatGPT, DeepSeek) can be used** – but document their role in the process.