

Awesome! This is a classic **statistical arbitrage** and **market-making** challenge involving baskets, ETFs, and their components. You'll need to think both like a trader and an engineer. Let's break this down into creative and practical strategies, ranging from simple to more advanced, highlighting common techniques *and* some novel ideas.

Strategy 1: Simple Cross-ETF Arbitrage (Part 1)

Description:

This strategy trades **price mismatches between SEMIS ETF EU and SEMIS ETF US**, which track the same basket.

How it works:

- If $\text{SEMIS_ETF_US} - \text{SEMIS_ETF_EU} > \text{threshold}$, **sell US, buy EU**.
- If $\text{SEMIS_ETF_EU} - \text{SEMIS_ETF_US} > \text{threshold}$, **sell EU, buy US**.
- The **hedge is perfect** because they track the same components.
- Use **mid-prices** or best bid/ask depending on your latency and execution style.

Why it's commonly used:

- It's classic **ETF arbitrage**.
- Very low risk when executed fast.
- Easy to implement.

Risks:

- **Latency**: if you don't execute both legs nearly simultaneously, you might get legged.
 - **Execution cost**: make sure the spread covers fees/slippage.
-

Strategy 2: ETF vs. Basket Arbitrage (Part 2)

Description:

Trade the ETF vs. its **implied value** based on the 3 underlying stocks:

$$\text{basket_price} = \frac{1}{3}(\text{ASML} + \text{NVDA} + \text{AMD})$$

How it works:

- Calculate the **real-time basket value**.
- If ETF trades significantly above/below the basket price:

- **Buy undervalued, sell overvalued.**
- You must hedge by trading the 3 stocks in correct proportions.

✅ **Common but slightly harder:**

- Used by **index arbitrage desks**.
- Incorporates more complexity but better opportunities.

⚠️ **Challenges:**

- You need to get **inventory-balanced**: selling 1 ETF \approx buying $\frac{1}{3}$ of each stock.
 - Different venues = different latencies, spreads, and order books.
-

🎯 **Strategy 3: Market-Making with Dynamic Hedging (Part 3)**

📌 **Description:**

Quote **tight bid/ask spreads** on ETFs, aiming to **earn the spread** and hedge dynamically using other instruments (like the other ETF or the 3 stocks).

🧠 **How it works:**

- Continuously quote on both sides of the market.
- If your order gets hit/lifted, hedge immediately with:
 - the other ETF, or
 - an equivalent basket of stocks.

✅ **Why this is powerful:**

- You provide liquidity (often rewarded in real markets).
- You can **control your exposure** better.
- Profitable even in mean-reverting, flat markets.

⚠️ **Advanced:**

- Inventory risk management needed.
 - Requires good models for **fair value**, **spread setting**, and **inventory decay**.
-



Strategy 4: Implied Volatility Arbitrage (Creative)



Idea:

If you see **frequent fluctuations** or high volatility in one ETF relative to its components or the other ETF, you can **model implied volatility differences** and **fade the extremes**.



How it works:

- Compute **rolling volatility** or variance of each product.
- If ETF volatility diverges from that of the basket, fade the ETF.
- Trade toward the statistically expected mean.



Why it's creative:

- Few will look at **volatility arbitrage** in this challenge.
 - Helps model dynamic pricing & market stress.
-



Strategy 5: Latency Arbitrage Across Venues (Creative)



Idea:

Leverage the **lag** between US and EU instruments.



How it works:

- Assume one ETF reacts faster to news (e.g., SEMIS ETF_US).
- Use **cross-correlation** and **lag analysis** to predict short-term moves in the EU ETF.



Tools to use:

- Sliding windows of returns.
- Cross-correlation lag prediction.
- Execution bots that lead lagging instruments.



Why it's fun:

- Exploits **market microstructure** inefficiencies.
 - Gives a first-mover edge.
-

Strategy 6: Inventory-Based Reinforcement Learning Market Maker (Experimental)

Idea:

Train a **simple RL agent** to quote prices while balancing inventory.

How it works:

- Agent state = current position, market spread, book imbalance.
- Actions = adjust quote prices or hedge inventory.
- Reward = P&L – inventory penalty.

Experimental:

- Much harder to tune.
 - May perform well in unpredictable microstructure.
-

Bonus: Signals to Explore

- **Order book imbalance** (difference in volume on bid/ask sides).
 - **Price momentum** over short windows.
 - **Time of day effects** (simulate if possible).
 - **Moving average of fair basket value** vs. ETF prices.
-

Suggested Starting Order

1. Start with Strategy 1 (ETF arbitrage).
 2. Move to Strategy 2 (ETF vs. basket).
 3. Add Strategy 3 (market-making).
 4. Explore creative add-ons (4–6) once you're stable.
-

Would you like Python pseudocode or a template to kickstart one of these strategies?