

Lab 8 Intern Task — Uncertainty Sizing Experiment

Context

Lab 8 tested 6 position sizing schemes using the 4-state HMM regime posteriors $\gamma_k(i)$. The current best config is **flat binary** (Bull+SoftBull = full size, Bear = zero).

The open question: what happens when we sit out during uncertain bars instead of using Kelly? Does avoiding uncertain entries give better yield?

The Logic We Want to Test

```
If HMM is confident (low entropy, clear Bull signal)
    → Go binary – full size

If HMM is uncertain (high entropy, mixed posteriors)
    → Sit out – zero size

Bear ( $\gamma_{\text{Bear}} > 0.50$ )
    → Always zero
```

Compare this against:

- Current flat binary (always in during Bull+SoftBull)
 - Kelly-when-uncertain (what Lab 8 already tested)
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Your Task

Add a new scheme `f_sitout` to `lab8_position_sizing.py`:

```
CONFIDENCE_THRESHOLD = 0.75    # tune this

def sitout(row):
    if row[bear_col] > 0.50:
        return 0.0                # Bear veto
    if row["hmm_confusion"] < (1 - CONFIDENCE_THRESHOLD):
        return 1.0                # Confident → full size
    return 0.0                    # Uncertain → sit out
```

`hmm_confusion` is already computed in the script (normalised HMM entropy, 0=certain, 1=confused).

What to Report

Run the backtest and add `f_sitout` to the results table. Report:

Metric	Flat Binary	Kelly-Uncertain	Sit-Out
Sharpe			
CAGR			
Calmar			
Max DD			
Avg Exposure			

Also print the average position size by regime (same format as existing output).

Try at least 3 values of `CONFIDENCE_THRESHOLD` : 0.60, 0.75, 0.90 — report all three.

Key Question to Answer

*Does sitting out uncertain bars give better yield than Kelly-sizing them down?
At what confidence threshold does sit-out start to outperform flat binary on Calmar?*

Report your findings in a short paragraph at the bottom of the file.

Bonus Task — Max Drawdown Cap at ~30%

Firms care about drawdown limits. The current flat binary hits -60.7% max DD which is too steep for institutional appetite. The Linear scheme got it down to -41.9% just by scaling exposure — we think we can get it to ~30% with the right combination.

Test whether a hard DD cap + position sizing can achieve:

- Max DD capped at ~30%
- Sharpe still above +0.80
- Calmar ratio competitive with flat binary (+2.07)

One approach to try:

```
# Track rolling drawdown – if approaching cap, scale position down
def dd_scaled(row, current_dd, cap=0.30):
    if abs(current_dd) > cap * 0.80: # within 20% of cap → start scaling
        scale = 1 - (abs(current_dd) - cap * 0.80) / (cap * 0.20)
        return base_signal * max(scale, 0)
    return base_signal
```

This is a key selling point for any firm or fund — being able to say

"our strategy targets a 30% max drawdown with +1.0 Sharpe" is a strong pitch.