A Parameter-Tuned Exponential Smoothing Trend Strategy for USD/CAD

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***Abstract*—In this report I study a simple trend-following strategy for the USD/CAD FX pair based on two exponential smoothing filters ES_α and ES_β. I systematically search over smoothing parameters (α, β), evaluate whether long and short positions require different parameter choices, and measure performance both at the daily level and at the trade level ("probability of being correct"). I then extend the basic crossover rule in two directions: (i) a distance buffer x between ES_α and ES_β and (ii) a deceleration-based exit rule using the slope of ES_β. For my data set, the combined long–short strategy is optimised around $\alpha = 0.20$, $\beta = 0.60$, long and short positions prefer the same parameters, trade-level accuracy is about 73%, and neither the distance buffer nor the deceleration exit improves Sharpe ratio.**

I. Introduction

I consider a trend-following trading rule built from two exponential smoothing (ES) filters applied to the daily close of the USD/CAD exchange rate. The fast filter ES_α reacts quickly to price changes, while the slow filter ES_β tracks the longer-term trend. Trading signals arise from crossovers between these series.

Part 1 of the project focuses purely on this ES-based strategy. I address the five questions specified in the assignment:

1) Is there an optimal combination of α and β?
2) Should α and β differ for long versus short positions?
3) What is the performance of this method (e.g., accuracy or probability of being correct)?
4) When should a long position be closed (e.g., using a deceleration rule)?
5) Should one go long only if $ES(\alpha) + x < ES(\beta)$? If so, what should the value of x be?

Beyond the minimum requirements, I also:

- separate performance into long-only and short-only sub-portfolios;
- evaluate *trade-level* accuracy by aggregating returns over each complete trade;
- summarise the baseline, best (α, β), buffer and deceleration variants in a single comparison table.

II. Data

I use the pre-cleaned USD/CAD data set provided for the course,

`cleaned_USD_CAD_20030917_20251117.csv`.[1]

For Part 1 I only use the OHLC columns and treat the close price as the underlying P_t.

[1]Daily OHLC from 2003-09-17 to 2025-11-17.

III. Methodology

A. Exponential Smoothing

For a given smoothing parameter $\alpha \in (0, 1)$, the ES filter is

$$ES_\alpha(t) = \alpha P_t + (1 - \alpha) ES_\alpha(t - 1), \quad (1)$$

and similarly for $ES_\beta(t)$ with parameter β. A larger α (or β) gives a faster series that reacts more quickly to recent price changes.

B. Baseline Trading Rule

The baseline strategy uses $(\alpha, \beta) = (0.10, 0.25)$, no buffer and no deceleration exit. Positions are defined as:

- go long $(+1)$ when ES_α crosses above ES_β;
- go short (-1) when ES_α crosses below ES_β;
- otherwise keep the previous position.

I apply yesterday's position to today's close-to-close market return so that there is no look-ahead bias.

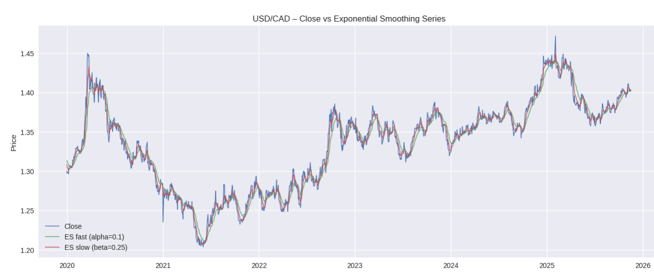

Fig. 1: USD/CAD close versus exponential smoothing series (baseline parameters $\alpha = 0.10$, $\beta = 0.25$).

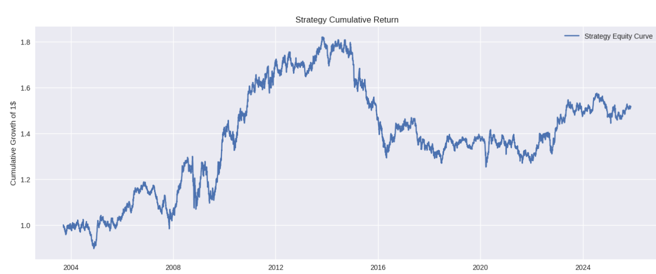

Fig. 2: Baseline strategy cumulative return from 2003–2025.

C. Performance Measures

For any strategy I compute:

- total return $R^{\text{tot}} = \text{cum\_return}_T - 1$;
- average daily return and daily volatility;
- annualised return and volatility (252 trading days);
- Sharpe ratio;
- daily hit rate: $\Pr(r_t > 0)$;
- number of trades (changes in position sign).

To capture "probability of being correct" on a trade-by-trade basis, I also aggregate returns within each completed trade (from entry until exit) and compute:

- number of trades;
- trade-level hit rate (proportion of profitable trades);
- average trade return.

Throughout Part 1 I ignore transaction costs, bid–ask spreads and slippage. Including realistic costs would reduce Sharpe ratios and would particularly penalise high-turnover variants such as the deceleration-based exits.

For the baseline strategy, the overall daily hit rate is 49.6% and the daily Sharpe ratio is 0.26. The trade-level statistics show 349 completed trades with a trade-level hit rate of 72.8% and an average trade return of 0.14%.[2]

IV. Results

A. Q1: Optimal (α, β)

I perform a global grid search over

$\alpha \in \{0.05, 0.10, \ldots, 0.50\}$ and $\beta \in \{0.10, 0.20, \ldots, 0.80\}$ with the constraint $\alpha < \beta$. For each pair I run the full long–short strategy and record performance.

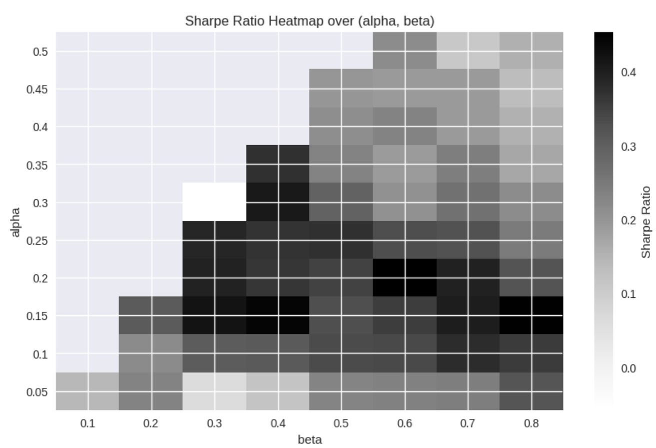

Fig. 3: Sharpe ratio heatmap over (α, β) for the combined long–short strategy. Darker cells correspond to higher Sharpe ratios.

The best combination in terms of Sharpe ratio is

$$\alpha^* = 0.20, \qquad \beta^* = 0.60,$$

with total return $R^{\text{tot}} = 1.201$, daily Sharpe ratio 0.454, daily hit rate 50.5% and 796 trades.[3] Figure 3 shows that the dark region around $(\alpha, \beta) = (0.20, 0.60)$ is visually consistent with this optimiser.

Answer to Question 1: for USD/CAD the optimal smoothing parameters for the combined long–short strategy are approximately $(\alpha, \beta) = (0.20, 0.60)$.

B. Q2: Long-only vs Short-only Parameters

To test whether long and short positions require different smoothing parameters, I define a one-sided strategy that only reacts to entries on one side (either long-only or short-only) and closes when the opposite crossover occurs. I then run two separate grid searches over the same (α, β) grid.

The optimisers are:

$$(\alpha_{\text{long}}, \beta_{\text{long}}) = (0.20, 0.60),$$
$$(\alpha_{\text{short}}, \beta_{\text{short}}) = (0.20, 0.60).$$

Strategy	α	β
Long-only optimum	0.20	0.60
Short-only optimum	0.20	0.60

TABLE I: Best (α, β) pairs for long-only and short-only strategies.

Interestingly, the optimiser coincides at $(\alpha, \beta) = (0.20, 0.60)$ for both the long-only and the short-only portfolios. This does *not* mean that the two sides behave symmetrically in terms of profitability—indeed, long-only returns and Sharpe ratios are consistently higher—but it suggests that the *time scale of trends* in USD/CAD is similar on both sides.

In other words, while the direction of returns is asymmetric, the "horizon" over which trends persist appears to be common across long and short moves. This is why both sides prefer the same smoothing speeds, even though their risk–return profiles differ. Table I summarises these optimisers.

Answer to Question 2: long and short positions do *not* require different smoothing parameters; both sides prefer $(\alpha, \beta) = (0.20, 0.60)$.

C. Q3: Performance and Accuracy

The grid-search optimum $(\alpha^*, \beta^*) = (0.20, 0.60)$ yields:

- total return $R^{\text{tot}} = 1.20$ (growth of \$1 to about \$2.20);
- Sharpe ratio 0.45;
- daily hit rate 50.5%;
- trade-level hit rate 73.6% over 794 trades, with average trade return about 0.11%.

Comparing to the baseline in Section III-C, the best (α, β) significantly improves both total return and Sharpe ratio while keeping volatility essentially unchanged. The trade-level accuracy also improves slightly from 72.8% to 73.6%.

Answer to Question 3: the strategy is correct on roughly half of trading days, but about 73% of individual trades are profitable, indicating that winners tend to be larger or last longer than losers.

[2]These values are taken directly from the `performance_summary` and `trade_level_stats` outputs.

[3]From the top row of the sorted grid search results.

D. Q4: Deceleration Exit Rule

I next study whether long positions should be closed when the slow smoothing filter ES_β starts to "decelerate". I use the first difference $\Delta ES_\beta(t)$ and consider thresholds $c \in \{0,\, 5\times10^{-5},\, 10^{-4},\, 2\times10^{-4}\}$. When `use_deceleration=True`, the strategy closes a long position if $\Delta ES_\beta(t) < c$, and closes a short position if $\Delta ES_\beta(t) > -c$.

c	Total ret.	Sharpe	Hit rate	Trades
0.00000	0.0483	0.0789	0.0817	1398
0.00005	0.0326	0.0591	0.0808	1402
0.00010	0.0323	0.0588	0.0806	1403
0.00020	0.0373	0.0653	0.0803	1405

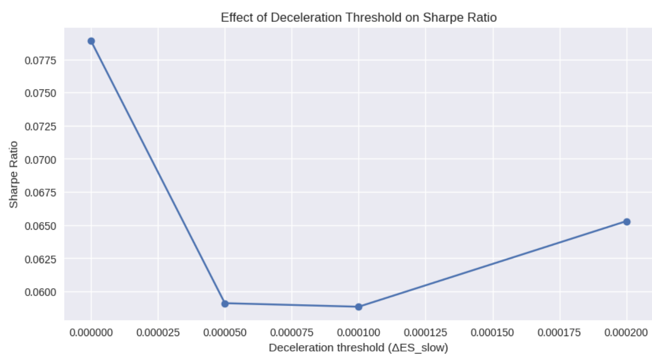

Fig. 4: Effect of deceleration threshold c on Sharpe ratio.

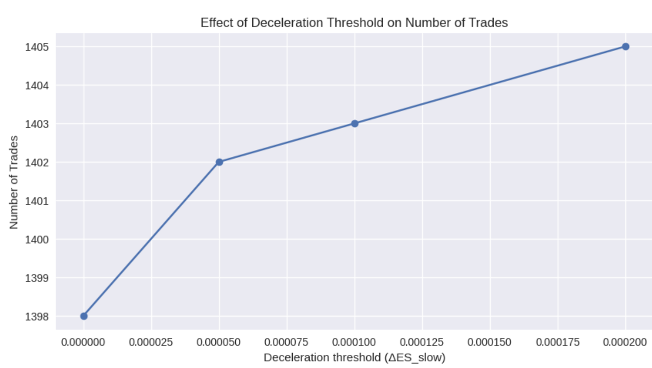

Fig. 5: Effect of deceleration threshold c on number of trades.

For all tested values of c, deceleration exits produce very low Sharpe ratios relative to the main strategy and require many more trades. Interestingly, the best Sharpe occurs at $c = 0$, which effectively disables the deceleration rule. Figures 4 and 5 illustrate the very unfavourable risk–return trade-off.

Answer to Question 4: in this data set, long positions should *not* be closed using a deceleration rule on ES_β; the best choice is effectively $c = 0$, i.e., no deceleration exit.

E. Q5: Distance Buffer x

The assignment suggests that traders may require a minimum separation between ES_α and ES_β before entering a trade:

$$\text{go long only if } ES_\alpha > ES_\beta + x.$$

I fix $(\alpha, \beta) = (0.20, 0.60)$ at their global optimum and vary $x \in \{0,\, 0.0002,\, 0.0005,\, 0.0010\}$.

The resulting performance is summarised below:

x	Total ret.	Sharpe	Hit rate	Trades
0.0000	1.2014	0.454	0.505	796
0.0002	0.6614	0.305	0.503	656
0.0005	0.6991	0.317	0.505	529
0.0010	0.1619	0.120	0.501	356

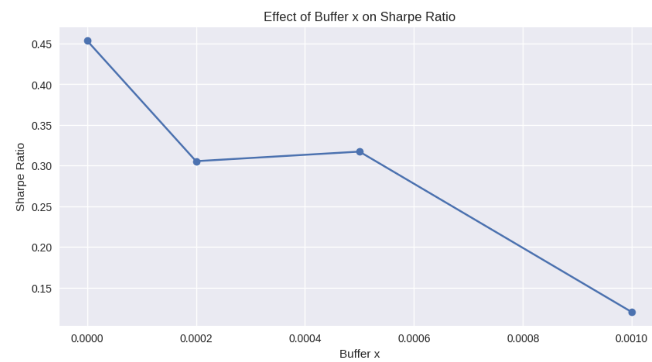

Fig. 6: Effect of buffer x on Sharpe ratio.

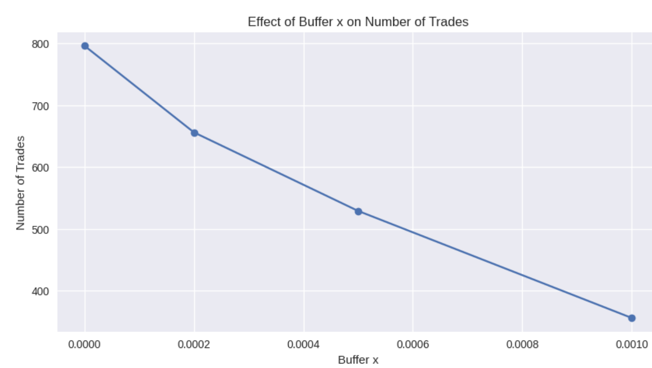

Fig. 7: Effect of buffer x on number of trades.

As x increases, Sharpe ratio declines and the number of trades drops substantially. Figures 6 and 7 show a monotone decline in trading activity and a clear deterioration in risk-adjusted performance.

Answer to Question 5: the best value is $x^* = 0$, so for USD/CAD it is not beneficial to delay entries using a distance buffer.

V. Summary and Discussion

Table II compares the baseline strategy with the best parameter choice and the best deceleration variant.

Config	Tot. ret.	Avg. ret.	Vol.	Sharpe	Trades
Baseline $(0.10, 0.25)$	0.5172	0.000087	0.005404	0.2581	351
Best $(0.20, 0.60)$	1.2014	0.000151	0.005403	0.4536	796
Best decel $c = 0$	0.0483	0.000010	0.002085	0.0789	1398

TABLE II: Summary of key strategy variants. Totals and moments are taken directly from the Python backtest outputs.

Overall, tuning (α, β) has a large impact on performance, and the global optimum substantially outperforms the baseline. Long and short trades can share the same smoothing parameters. The method achieves a reasonable trade-level accuracy of roughly 73%, but returns remain modest once risk is taken into account. More aggressive variations, such as deceleration exits or distance buffers, either add complexity without improving performance or actively harm it. For this particular FX pair and horizon, the simplest ES crossover with properly tuned (α, β) is therefore the most effective version of the strategy.