

Machine Learning for Trading

Project 4: Manual Strategy

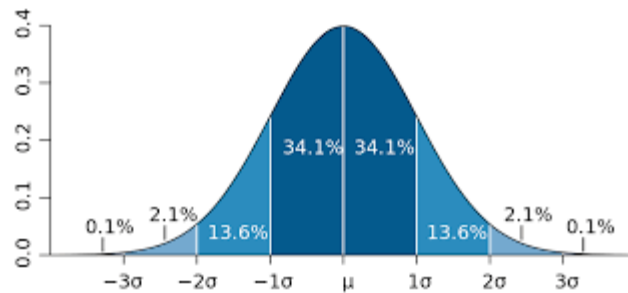
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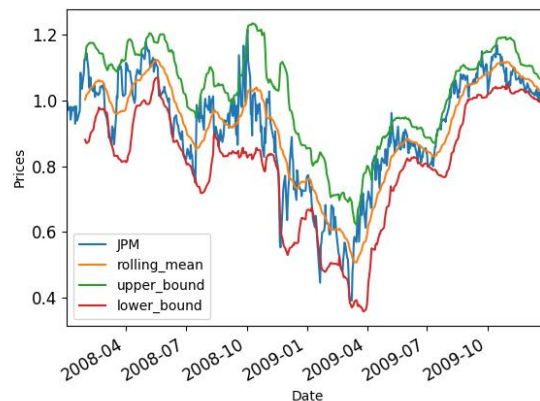
Part 1: Technical Indicators: (20 points)

1. Bollinger Bands® (BB):

- Formula: $BB[t] = (price[t] - SMA[t]) / (2 * std[t])$
- Meaning: Assume stock price is a normal distribution, our strategy is to buy/sell our stocks only if we observe its price rising/falling out of its normal range and returns. More specifically, if we see its price was falling out of Bollinger band® and rising back, this is a buy signal. On the other hand, if we see its price was rising out of Bollinger band® and failing back, it's a short signal.

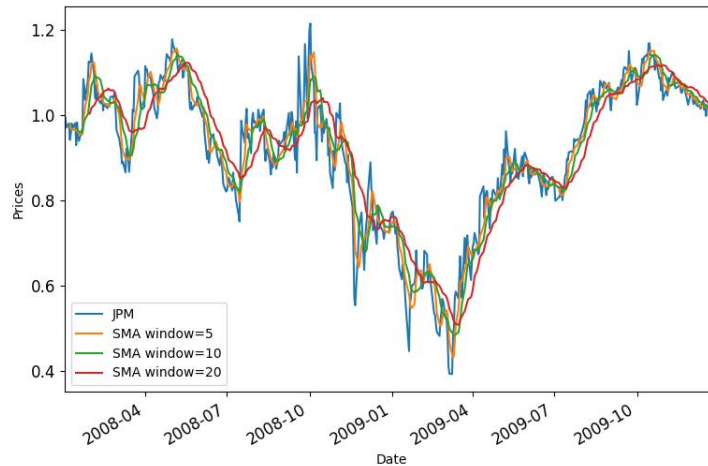


- Demonstration: Bollinger Bands with window size 20 days.



2. Simple Moving Average (SMA):

- Formula: $SMA(t,n) = price[t-n:t].mean()$
- Meaning: By using SMA, we can get a smoother price. In this case, our manual strategy would not influence by temporal fluctuation. With window=1, we will get the original stock price. If we set our window too large, we might lose too much information and miss the optimum trading point.
- Demonstration: SMA with different window size.



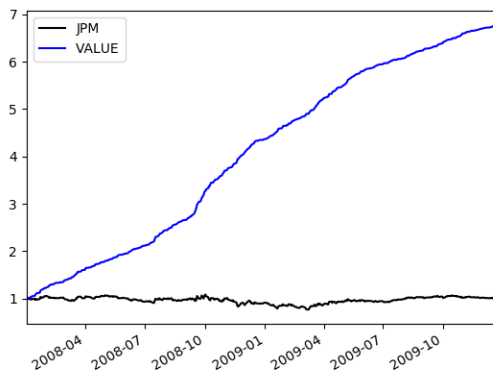
3. Momentum:

- Formula: $(\text{price}[t]/\text{price}[t-N]) - 1$
- Meaning: if we observe stock price with appropriate window size, we can find that stock price seldom has abrupt rise or drop. In this case, if we can control momentum size N carefully, I believe it's a good indicator to earn profit.

Part 2: Best Possible Strategy (20 points):

	Bench Mark	Best Possible Strategy
Cumulative Return	0.0123	5.7861
Standard Deviation	0.0170	0.0045
Mean	0.0001	0.0038

- Best Possible Strategy: Because we can see into the future, we will only buy stocks when its next day price is raising, and sell stocks when its price is falling.
- Assumptions:
 - No Transaction Cost
 - No Market Impact
 - Can only buy at closing price
 - Long or Short up to 1,000 shares
 - Only trade with JPM
 - Bench Mark is buying 1,000 JPM and hold to the end
- Solution: Find each rising point, invest and calculate its result.
- Experimental Result:



Part 3: Manual Rule-Based Trader (50 points):

1. My Buying/Shorting Strategy:

I combine Bollinger Band and Momentum to create my strategy. If the stock price is out of Bollinger band or have absolute momentum ≥ 0.25 , I will buy or sell this stock. Specifically, out of Bollinger band means if it's lower than $2\text{-}\sigma$ and return, or higher than $2\text{-}\sigma$ and return, which indicates buying and selling signal. In addition, if the stock has momentum larger than 0.25, I will purchase, and if its momentum is smaller than -0.25, I will short it.

2. My stop points:

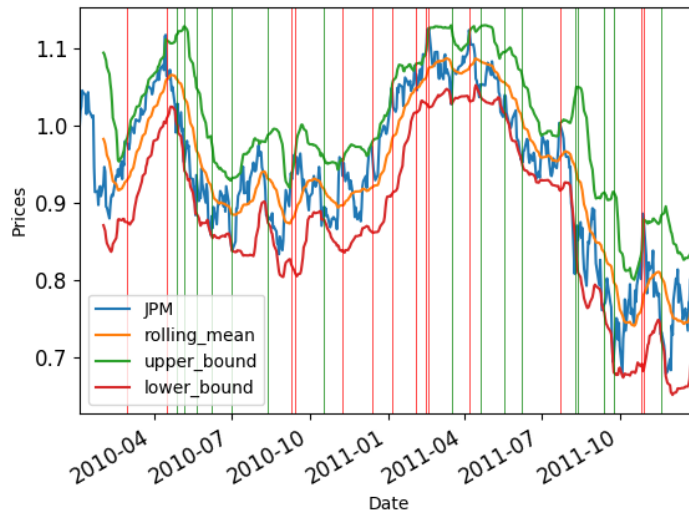
If I bought this stock, and its value return to SMA, I will sell it. On the other hand, if I short this stock, then I found its value is falling back to SMA, then I will sell my short position.

a. Demonstration:

i. In Sample:



ii. Out of Sample:



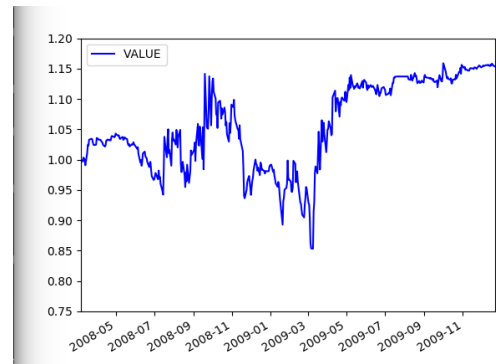
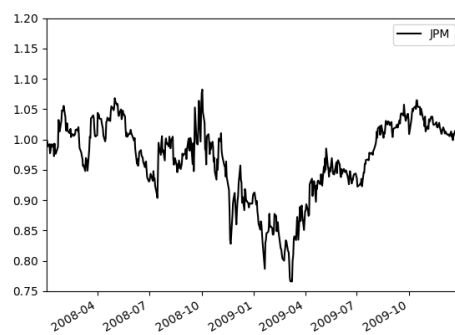
b. Experimental Result:

	In Sample	Out of Sample
Sharp Ratio	0.5919	0.7535
Cumulative Return	0.0772	0.0285
Standard Deviation	0.0046	0.0013
Average Daily Return	0.0001	6.36×10^{-5}
Manual Portfolio Value	107729	102850

	Manual	Bench Mark
In Sample	1.0772	1.0123
Out of Sample	1.0285	0.9166

c. Demonstration:

In Sample Figure:



Out of Sample Figure:

