Plan for Analyzing the Trading Range Break-Out (TRB) Strategy  
  
**1. The chosen strategy** for analysis is the Trading Range Break-Out (TRB) strategy. This strategy involves making buy and sell decisions based on the breakout of local maximums (resistance levels) and local minimums (support levels) in the price data.  
  
Buy Signal Condition:

* A buy signal is generated when the price, denoted as P, penetrates the resistance level, which is defined as the local maximum, i.e. P() > MAXP(i)
* Local Maximum (R\_max) is calculated as the highest price observed in the previous days: R\_max = max(P(-1), P(-2), ..., P(- (+1))

P(-1), P(-2), ..., P(- (+1)): Prices observed on each of the previous days, going back in time from today () to -1, -2, and so on, up to - (+1)

* The buy signal condition can be expressed as: Buy = P() > MAXP(i), - (+1) i -1

P() represents the current price at time (today)

MAXP(i), - (+1) i -1 represents the maximum price observed in the previous days

* It is important to set . This choice is made to ensure that the local maximum R\_max is based on a sufficiently robust historical price range.

Sell Signal Condition:

* A sell signal is generated when the price penetrates the support level, which is the local minimum, i.e. P() < MINP(i)
* Local Minimum (S\_min) is calculated as the lowest price observed in the previous days: S\_min = min(P(-1), P(-2), ..., P(- (+1))

P( -1), P(-2), ..., P(- (+1)): Prices observed on each of the previous days, going back in time from today () to -1, -2, and so on, up to - (+1)

* The sell signal condition can be expressed as: Sell = P() < MINP(i), - (+1) i -1

P() represents the current price at time (today)

MINP(i), - (+1) i -1 represents the minimum price observed in the previous days

* It is important to set . This choice is made to ensure that the local minimum S\_min is based on a sufficiently robust historical price range.

Additional Band Technique:

* To enhance the strategy, a percent band technique can be applied. This means that for a buy signal, the price must exceed the local maximum by a certain percentage :

Buy = (P() > R\_max \* (1 + ))

* For a sell signal, the price must fall below the local minimum by the same percentage : Sell = (P() < S\_min \* (1 - ))

**2. Hypothesis to Test**

1. Buy (Sell) Strategy Comparison

Null Hypothesis (): The conditional mean buy (Sell) returns based on the TRB signal is equal to the unconditional mean buy (Sell) returns at a 5% significance level.

Alternative Hypothesis (): The conditional mean buy (Sell) returns based on the TRB signal is significantly different from the unconditional mean buy (Sell) returns at a 5% significance level.

if the p-value () from the t-test is less than 0.05 (5%): < 0.05, we would reject the null hypothesis in favor of the alternative hypothesis.

= , where and are the mean return and number of

signals for the buys (Sells), and and are the unconditional mean and number

of observation. is the estimated variance for the entire sample.

(Mean return) = , where = 1 if it's a buy day (as determined by the TRB signal) and = -1 if it's a sell day, otherwise = 0

(Unconditional mean) =

(Return at time ) = log(P(+1)) - log(P()), where P(t) represents the price of the asset at time t and P(t+1) represents the price of the same asset at the next time point, which is one day ahead of t.

1. Overall TRB Strategy Profitability

The primary hypothesis to test is whether the TRB strategy is profitable in generating buy and sell signals

Null Hypothesis (H0): The buy-sell difference in returns using the TRB strategy is equal to zero: - = 0, indicating that the TRB strategy is not profitable.

Alternative Hypothesis (Ha): The buy-sell difference in returns using the TRB strategy is significantly different from zero: - > 0, indicating that the TRB strategy is profitable.

and represents the mean buy return and mean sell return using the TRB strategy respectively

Furthermore, to test this hypothesis, we can conduct a t-test on the buy-sell difference

If the p-value () from the t-test is less than 0.05 (5%): < 0.5, indicating that the TRB strategy is profitable and statistically different from 0.

= , where and are the mean buy return and number of

signals for the buys and and are the mean sell return and number

signals for the sells.

**3. Data Requirement**

1. Price Data

* Daily prices (P()): It is essential for calculating local maximums (resistance levels) and local minimums (support levels) and determining buy and sell signals.
* Daily Volumes (V()): Volume data can be useful for assessing the liquidity of the asset and confirming the validity of price movements.
* High Prices: To identify the highest price observed in the previous days (R\_max) for resistance level calculation.
* Low prices: To identify the lowest price observed in the previous days for calculating support levels (S\_min).

1. Time Series Data

* Timestamps or dates associated with each data point are essential for chronological ordering and aligning price and volume data with the specific trading days.

1. Historical Data

* Sufficient historical data is required to calculate local maximums (R\_max) and local minimums (S\_min) over the previous days.

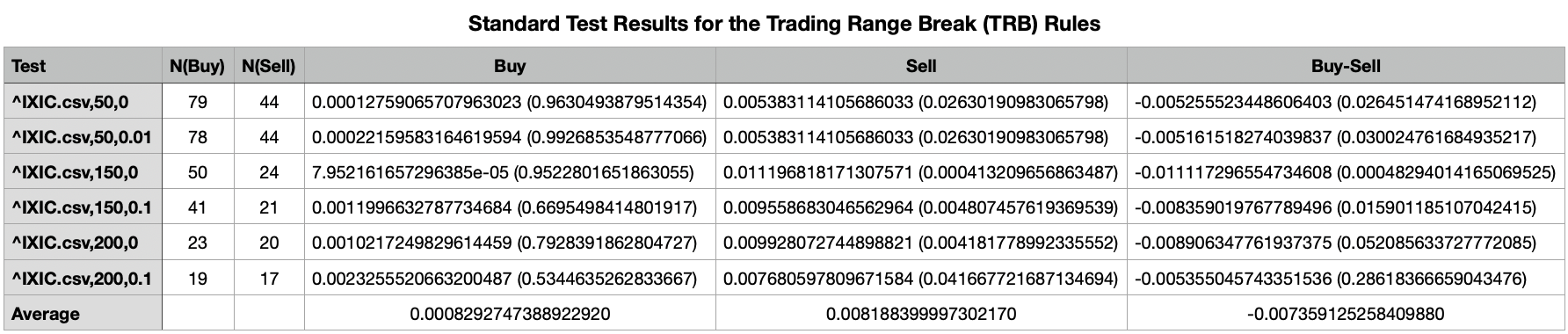
1. Asset Selection

* Specify the financial asset or instrument we intend to analyze (e.g., stocks, commodities, currencies) and ensure we have access to the relevant data for that asset.

1. Market Selection

* Specify the markets we intend to analyze using the TRB strategy (e.g., Hong Kong, the United States, Europe). Determine which markets are relevant to our analysis based on our trading goals and asset preferences.

**4. Implementation results**

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Results for daily data of Nasdaq Composite Index (^IXIC) from 2020 - 2023. The Nasdaq Composite is an index that includes all the stocks listed on the Nasdaq stock exchange. It's known for its focus on technology and internet-related companies, making it a key indicator of the performance of the tech sector.

Rules are identified as (period, band) where period is the time window for computing local maximums and local minimums and band is the percentage difference that is needed to generate a signal. “N(Buy)” and “N(Sell)” are the number of buy and sell signals reported during the sample. Numbers in parentheses are standard p-values testing the difference of the mean buy and mean sell from the unconditional mean, and buy-sell from zero. The last row reports averages across all 6 rules.

**5. Conclusion**

For the Buy strategy comparison, null hypothesis is accepted as the p-values of all the 6 rules are greater than 0.05. The conditional mean buy returns based on the TRB signal is equal to the unconditional mean buy returns at a 5% significance level.

For the Sell strategy comparison, we reject the null hypothesis in favor of the alternative hypothesis as the p-values of all the 6 rules are smaller than 0.05. The conditional mean Sell returns based on the TRB signal is significantly different from the unconditional mean sell returns at a 5% significance level.

The average buy-sell difference in returns using the TRB strategy of the 6 rules are smaller than zero. For the individual rules, all buy-sell differences in returns are also smaller than zero. Overall, the analysis indicates that the TRB strategy is not profitable.