# Learning to Beat the Random Walk:
# Using Machine Learning to Predict Changes in Exchange Rates

Abdul Tawab Ajmal Safi, Advisor: Ph.D. Julieta Yung

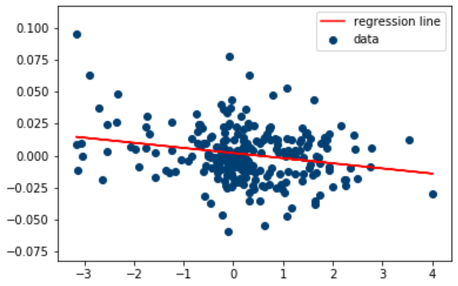
Department of Economics, Bates College

## FX Theory Failure

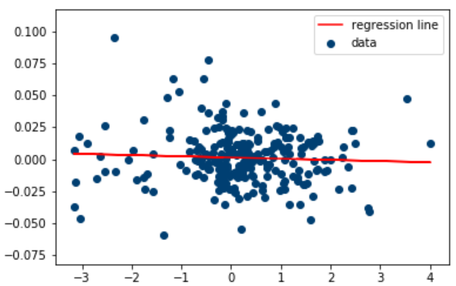
$$\Delta FX_{t+1} = \alpha + \beta(i_t - i_t^*) + RP_t + \varepsilon_{t+1}$$

Interest Rate Differential | Risk Premium

- UIP $H_0$: $\beta$ = 1 and $\alpha = RP_t = 0$
- UIP fails to hold over the short and long run.
- Fama Puzzle: $\beta < 0$




1-Month FX




1-Year FX

In reality, UIP does not hold. Currency Risk Premium is important for understanding changes in exchange rates. However, it is extremely difficult to measure. For this reason, Random Walk model best forecasts changes in FX.

$$\hat{y}_{t+h} = y_t + \varepsilon_{t+h}$$

Random Walk model sets all forecasts to be the value of last observation.

## Research Question

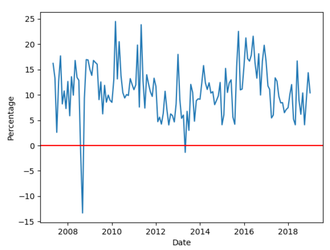
Can we use the latest Machine Learning technology to forecast FX better than Random Walk?

## What I do

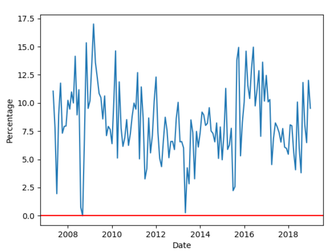
- Analyze excess returns in Carry Trade
- Use PCA to extract level, slope, and curvature of yield curve and its expectation and term premium component.
- Use Support Vector Machines (SVM) and Artificial Neural Networks (ANN) to predict directional change in FX excess returns.
- Use Sentiment Analysis to construct a variable for Risk Premium and market expectation to predict directional change in FX.

## 1. Carry Trade

It is a popular currency trading strategy that invests in high interest currencies by borrowing from low interest currencies.

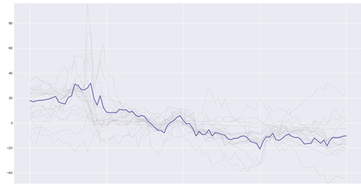



- Portfolio Weight: 100%
- Average Profit: 10.89%



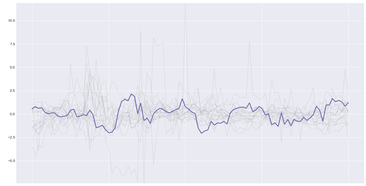

- Portfolio Weight: 40% & 30% & 30%
- Average Profit: : 8.29%

## 2. Principal Component Analysis



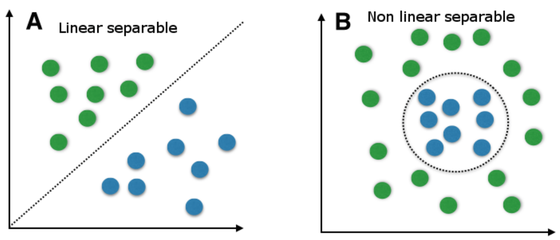
Mexico Yield Curve Level

Mexico Yield Curve Slope

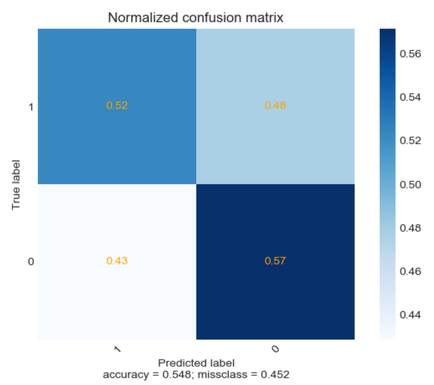


Mexico Yield Curve Curvature

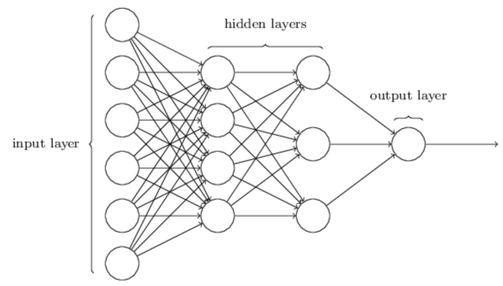
## 3. Support Vector Machines



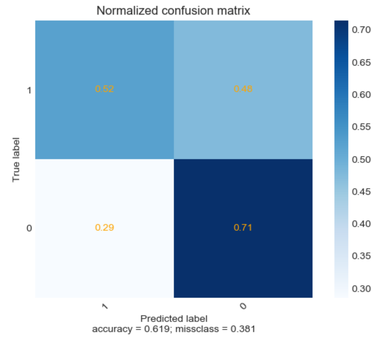

Mexico




## 4. Artificial Neural Network




Mexico




## 5. Sentiment Analysis

**Steps:**

- Feature Engineering
- Text Preprocessing
- Sorting Text by Country
- Sentiment Analysis

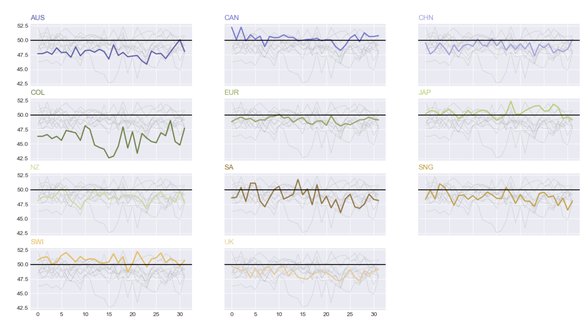



Fig. Accuracy of VADER Sentiment Model at Varying Lagged Intervals