**Title:** A deep learning model to forecast government bonds yields and a trading strategy

**Background and motivation:** Interest rates are one of the most important aspects in modern economic systems. They influence the cost of borrowing, the return on savings, and are an important component of the total return and price of many investments. Moreover, certain interest rates provide insight into future economic and financial market activity.

**Project objectives:** The goal of this project will be to investigate whether a deep learning model can be used to forecast the swiss treasury yield curve one day. First, using an autoencoder, we will design a model that enable to fit a curve to the observed yield, similarly to the Nelson-Siegel model. This will enable us to denoise the yield curve. We will use as features past days yields and economic indicators provided by the Swiss economic institute. We will compare our model to an econometric model named VARMA which is far less computationally costly than neural nets. Finally, we will backtest a simple long-short investment strategy on our yields forecasts.

**Raw data:**

* Bonds yields and remaining period to maturity of individual Swiss Confederation bond issues, maturity: m
  + Dates: 01/01/1991 – 30/10/2020, daily data
  + Sources: Swiss national bank [https://data.snb.ch/en/topics/ziredev#!/cube/rendoblid](https://data.snb.ch/en/topics/ziredev" \l "!/cube/rendoblid)
* KOF Economic Sentiment Indicator
  + Dates: 01/1991 monthly data
  + Sources: KOF Swiss Economic Institute
* KOF Economic Barometer
  + Dates:01/1991 monthly data

Sources: KOF Swiss Economic Institute

<https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-economic-barometer.html>

* KOF monetary policy communicator
  + Dates: 01/1991, monthly data

Source: KOF Swiss Economic Institute

<https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-monetary-policy-communicator.html>

**Data wrangling:­**

Features:

* + past 10 days yields
  + KOF indicators growth (1-month, 3-month, 6-month)
  + The yields will be denoise using an autoencoder

**Modeling approach:**

* + We will use 2 sets of features containing the 5 past days yields /10 days
  + We will also vary the learning period
  + Benchmark: VARMA
  + LSTM model for future yields prediction 1day ahead 1week ahead 1 month ahead
  + GRU model for future yields prediction 1day ahead
  + If unsuccessful tries a 3 class classifications

**Model evaluation and selection:**

* CPCV with purging and embargo/metrics: MSE, MAE, R2
* Strategy backtesting:
  + benchmark models: Long/short Investment strategy using the VARMA forecasts, long bond when we expect interest rates to drop / short bond we expect interest rates to rise (for a given bond maturity).
  + Long/short Investment strategy using the LTSM / GRU models forecasts, long bond when we expect interest rates to drop / short bond when we expect interest rates to rise (for a given bond maturity)

<https://en.wikipedia.org/wiki/Sovereign_default>

inflation and real interest rate: https://www.journals.uchicago.edu/doi/10.1086/258771