Forecast bullish/ bearish trading days by implementing clustering and classification

First step: Clustering

- Clustered U.S. sector ETF daily prices
  - Downside deviation
  - Average returns
  - Sortino ratio
- Time Series K-Means model clusters trading days:
  - Bullish: high returns & SR, low deviation
  - Bearish: low returns & SR, high deviation

Result: each trading day in our training set is labeled either bullish or bearish

Second step: Classification

- Features calculated for every trading day:
  - Sector downside dev., returns, Sortino
  - S&P 500 VIX price
  - Yield curve slope (10y-3m spread)
  - Stock-bond rolling correlation
- Train Gradient Boosting Classifier:
  - Regularization and binning (avoid overfit)
  - Separate model for every sector

Result: every out-of-sample trading day is labeled either bullish or bearish

Asset allocation based on model forecasts achieves higher-than-market risk adjusted returns

- Daily identify sectors predicted bullish on the next day.
  - If bullish sectors < 3, allocate everything to risk free asset.
  - If bullish sectors > 3, equal allocation among bullish sectors or create MinVar portfolio.
- Calculate Sharpe ratios: model achieves higher risk adjusted returns than benchmark.