KU LEUVEN

Performance of candlestick patterns on intraday market data

Seminar

Wout Notermans

Faculty of Science
Department of Mathematics
Section of Statistics and Risk

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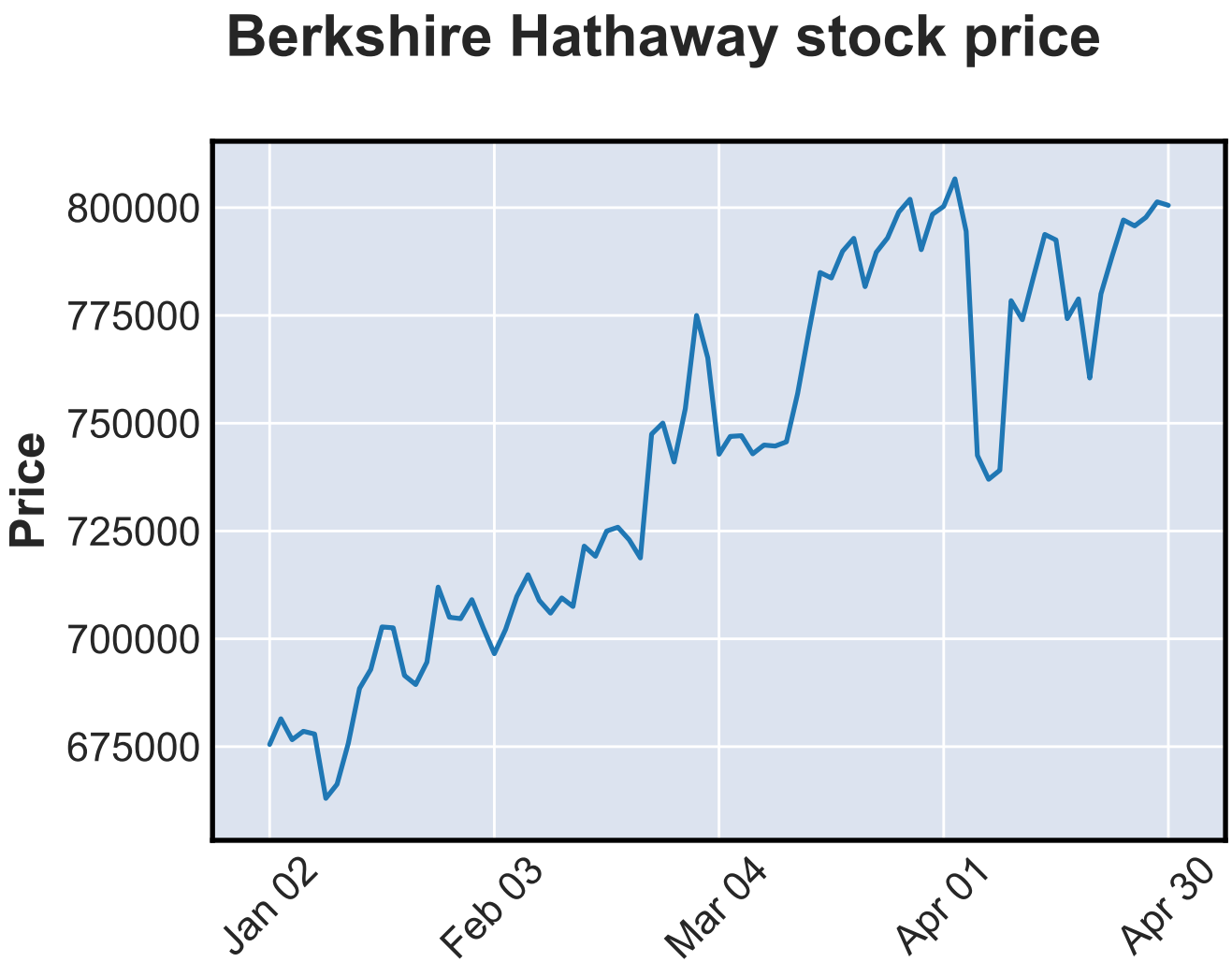
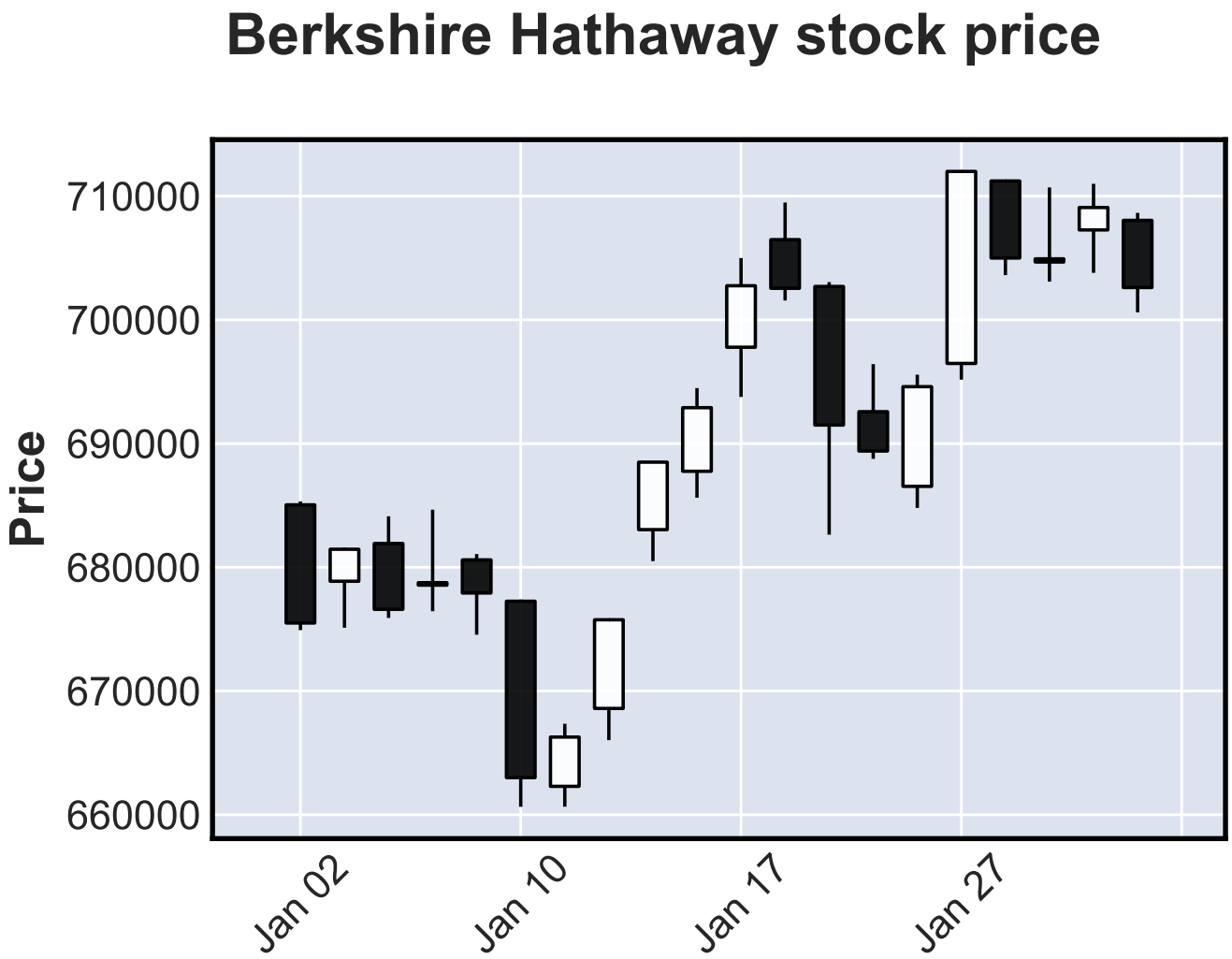
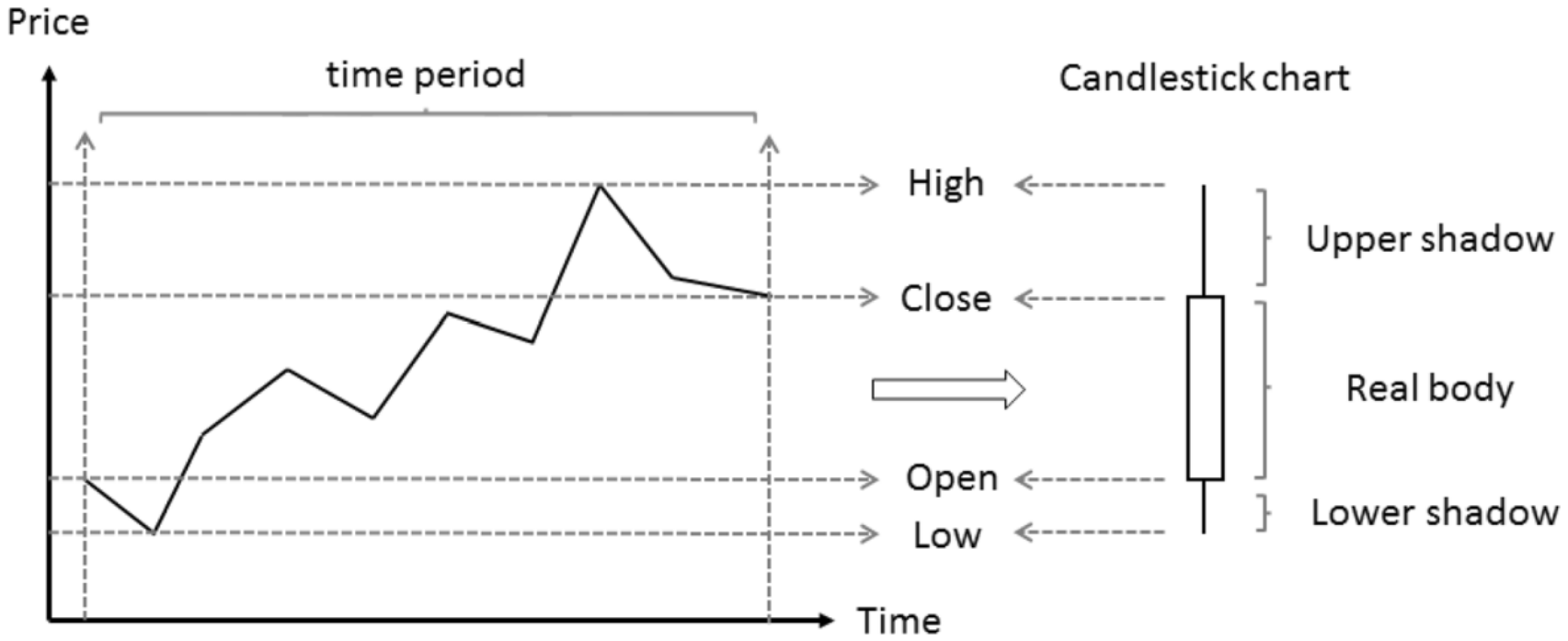
Stock price [1]



Stock price [1]



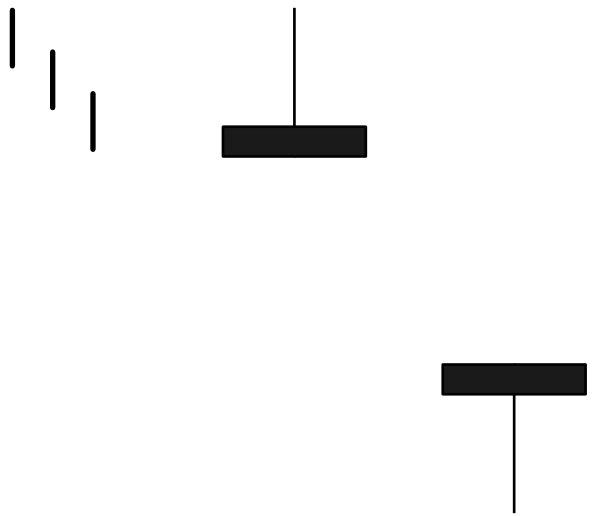
Candlestick construction



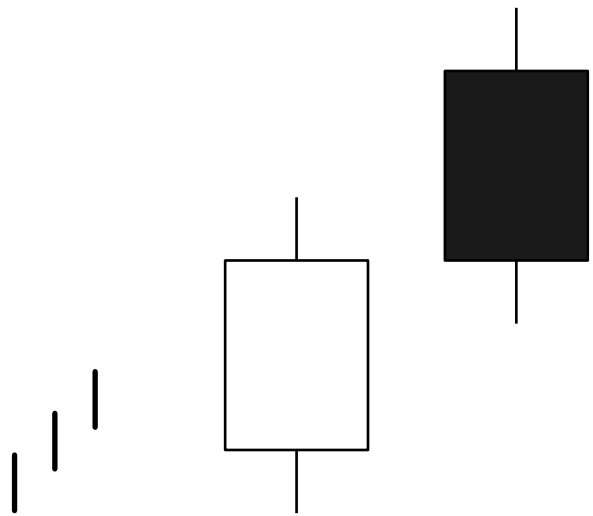
Construction of a candlestick [2].

Candlestick pattern examples

Window, falling



Meeting lines, bearish



History

- Developed in the 1700s in Japan.
- Remained exclusive to the East until 1991.
- This is reflected in the literature.
- Quite well-known technical analysis technique.

Literature

- Literature split between machine learning and rule based approach.
- Results are very split.
- Very few publications about intraday market data.

Research question

Do candlestick patterns possess any predictive power on intraday market data?

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Overview

- Selection of data sets.
- Preprocessing of the data.
- Trends and technical indicators.
- Pattern detection.
- Pattern evaluation.

Data sets

- BND: Bonds.
- GLD: Gold.
- QQQ: Stocks.
- SPY: Stocks.
- Wiener: Generated.

Preprocessing

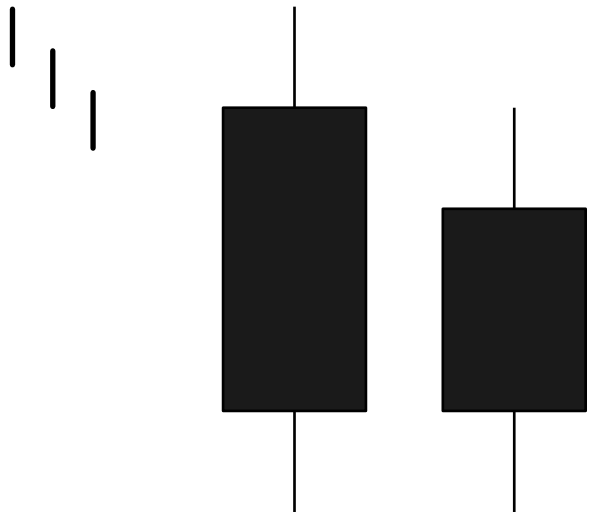
- Filter pre/after-market and economic news.
- Missing data $\rightarrow$ interpolation.
- Aggregation.
- Splitting of the data set for calibration.

Preprocessing: calibration

	Doji	Short	Normal	Tall	Extremely tall
Real body	[0 – 10)	[10 – 30)	[30 – 70)	[70 – 100]	
Shadow	[0 – 10)	[10 – 30)	[30 – 70)	[70 – 90)	[90 – 100]

Percentiles of real bodies and shadows [3].

Matching low



Preprocessing: calibration

- Assumes length and color candle independent.
- Has to be checked $\rightarrow$ Kolmogorov-Smirnov test.

$$H_0 : W = B \qquad H_1 : W \neq B.$$

- Reject at 5% significance.

Trend

- Many patterns are only valid when the correct trend is present.
- Multiple ways of defining the trend in the literature.
- Example: count in/decreases in the moving average.

Technical indicators

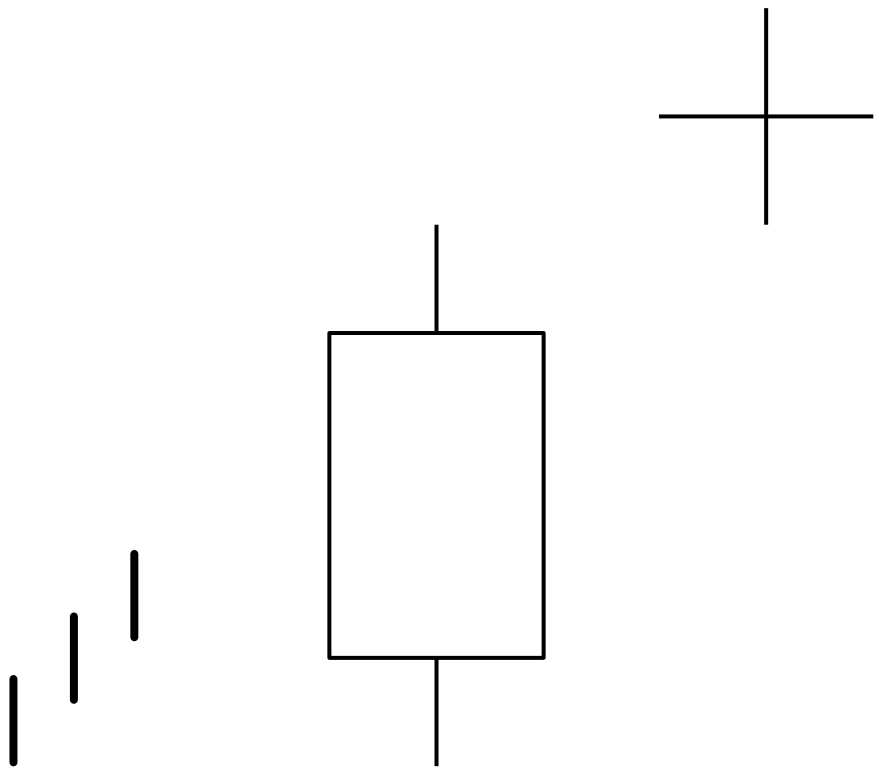
- Values calculated from asset prices and volume.
- Some publications only find significant patterns when combining them with technical indicators.
- Quite a number found in the literature.
- Example: triple exponential (TRIX).

Pattern detection

- Patterns are vaguely defined at best: a rigid classification is necessary.
- The paper “A formal approach to candlestick pattern classification in financial time series” does exactly this [4].
- Define 103 candlestick patterns with strict conditions.

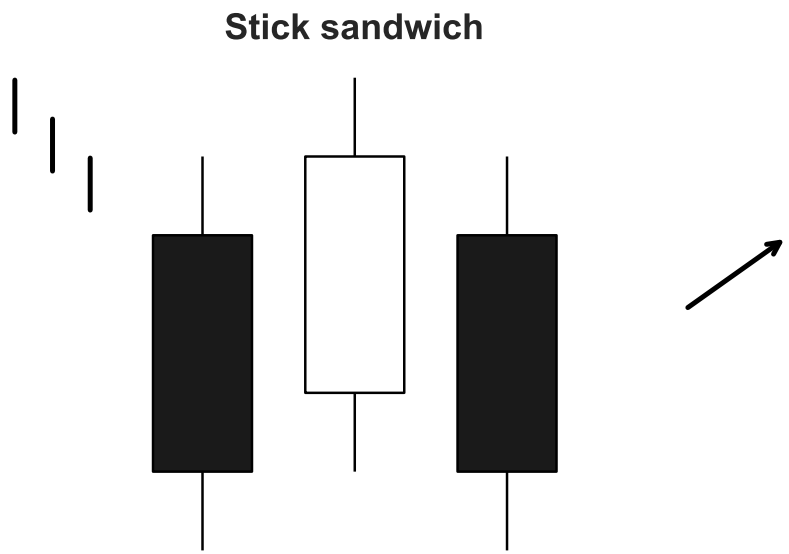
Pattern detection: example

Doji star, bearish



Pattern detection: prediction

- Typically classified as buy/sell signal.
- Look at the results themselves instead of the predictions.

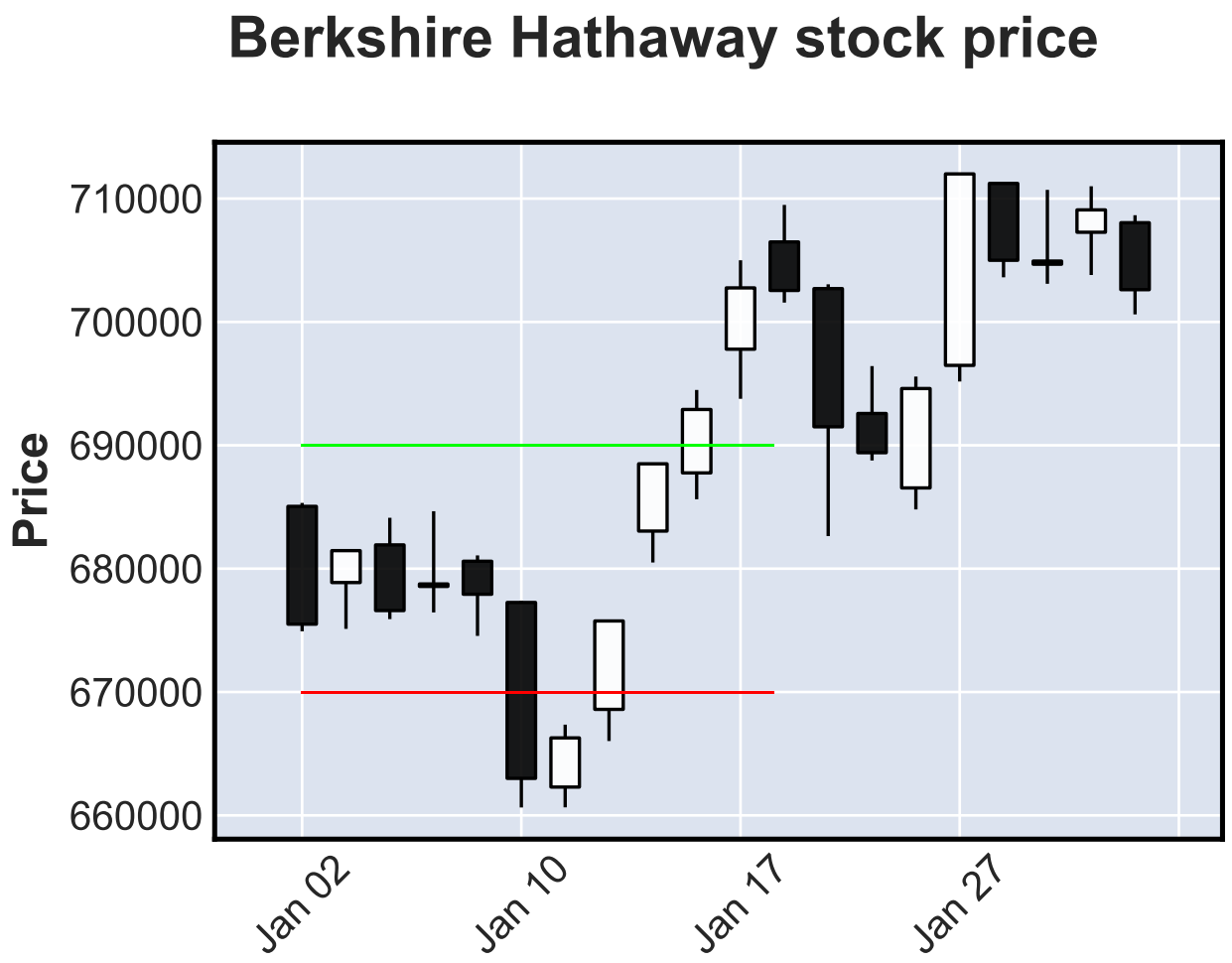


Pattern evaluation

- Buy/sell after pattern is detected.
- Make use of stop loss/take profit margins.
- This gives us a winning rate.
- Test significance with binomial test.

$$H_0 : \pi = 0.5 \qquad H_1 : \pi > 0.5$$

Pattern evaluation: stop loss/take profit [1]



Pattern evaluation: profitability score

Quantify profitability score with three factors:

1. The number of detected patterns.

$$\max\left(\frac{200}{1+\exp\left(-\frac{n-100}{100}\right)}-100,0\right)$$

2. The win rate (deviation from 50%).
3. The significance.

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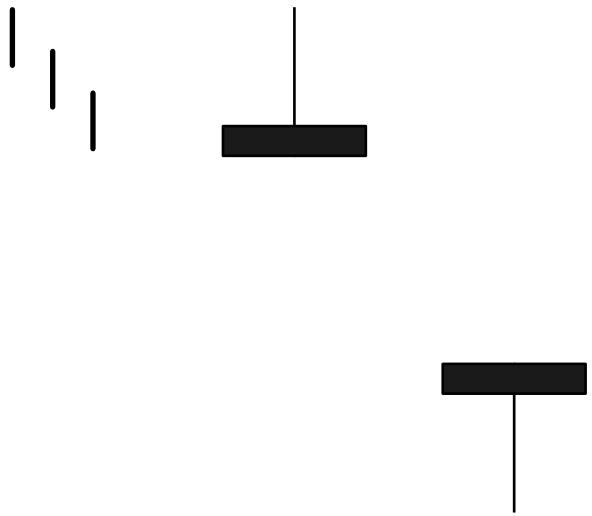
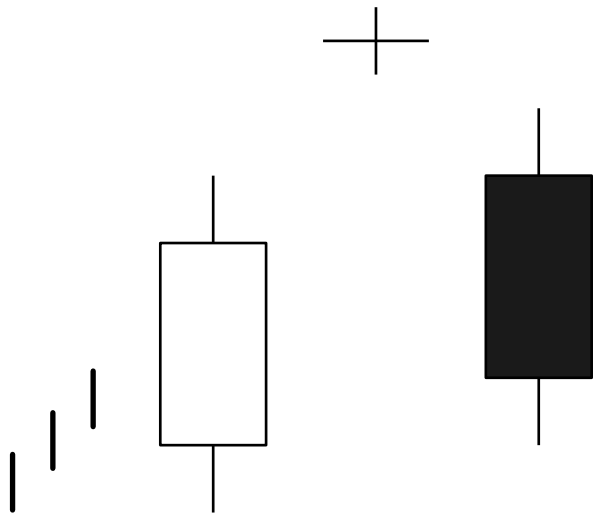
Detection results

- Not many “gapping” patterns.
- Some patterns are rare due to stringent conditions.

Window, falling



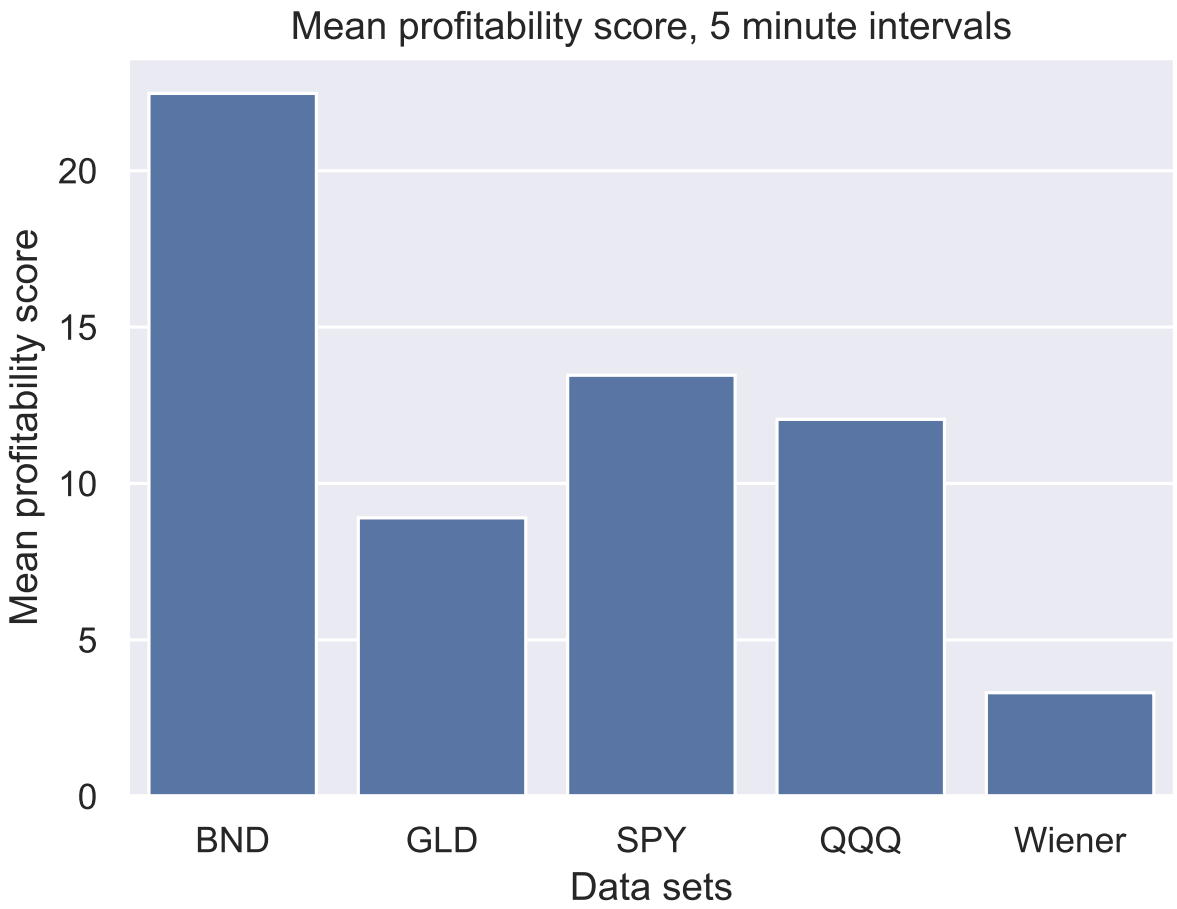
Evening doji star



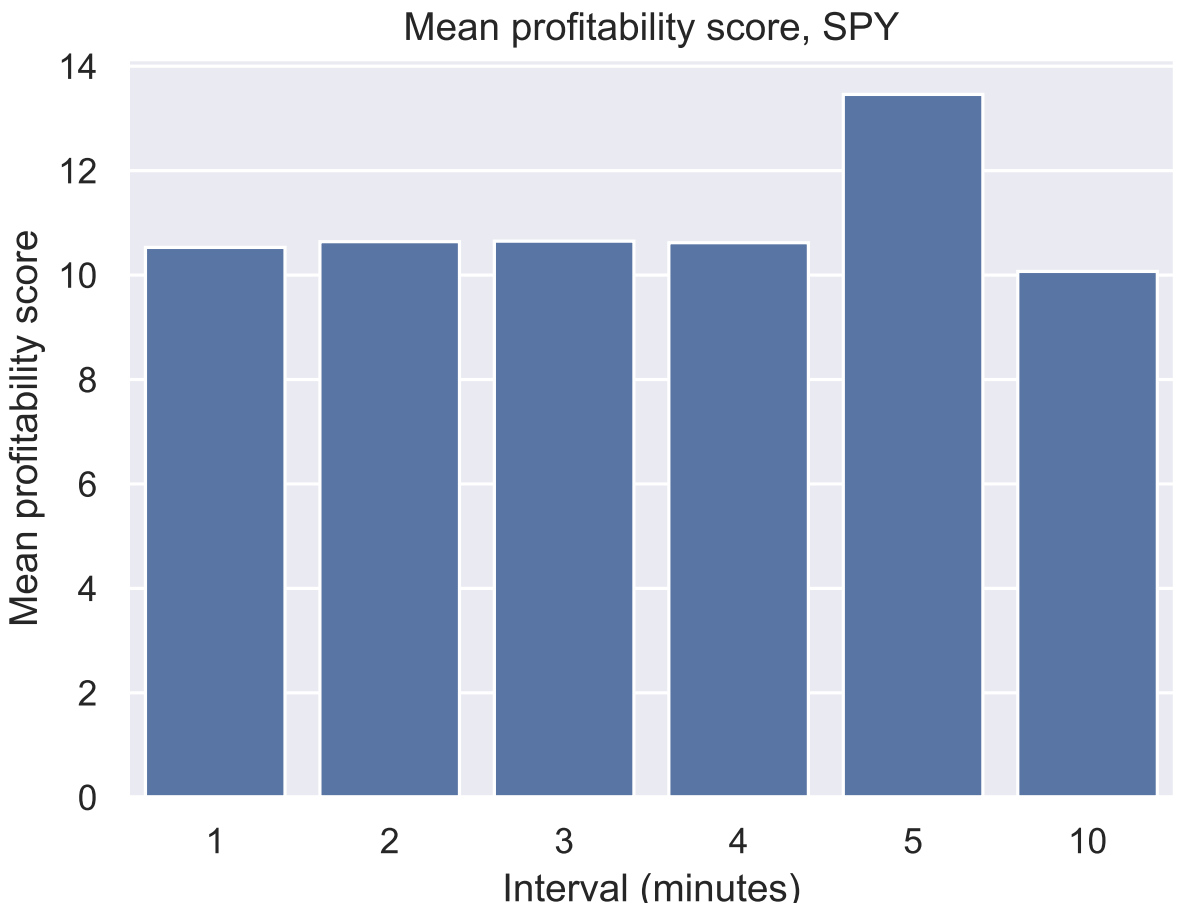
Evaluation results: significance

- Significant patterns are found.
- Many more significant buy than sell signals.
- A lot of variance between data sets/asset types.
- Aggregation decreases significance but not profitability.

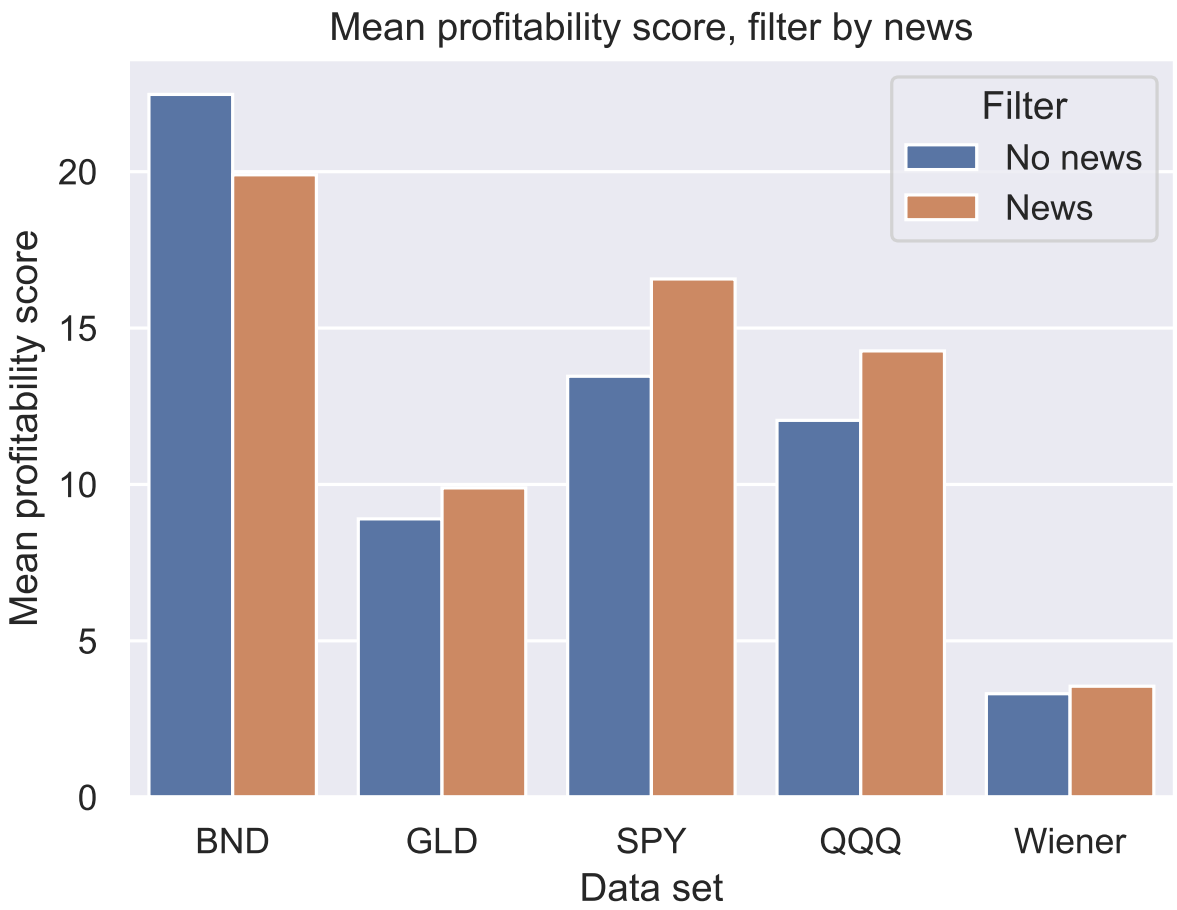
Evaluation results: effect of data set



Evaluation results: effect of time interval



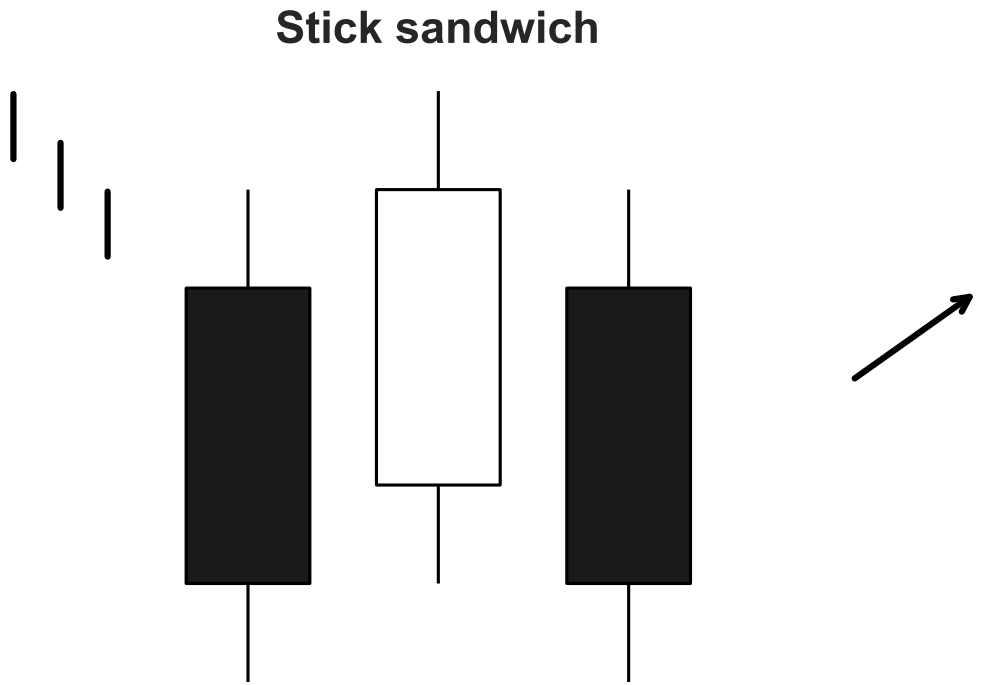
Evaluation results: effect of news



Evaluation results: no effect

- Different start and end times.
- Filtering based on technical indicators.
- Averaging methods: SMA, WMA, EMA.
- Trend defining methods.

Evaluation results: MVP



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Research question

Do candlestick patterns possess any predictive power on intraday market data?

Conclusion

- Some patterns do appear to possess (consistent) significant predictive power.
- This mainly holds true for buy signals.
- There is a lot of variance to these results.

Further research

- Machine learning-based approach to detection.
- Fuzzy rules for detection.
- “Evolving margins” evaluation.

[1] finance.yahoo.com.
https://finance.yahoo.com/quote/BRK-A/.
[Accessed 10-05-2025].

[2] Jun-Hao Chen and Yun-Cheng Tsai. "Encoding candlesticks as images for pattern classification using convolutional neural networks". In: Financial Innovation 6.1 (June 4, 2020). DOI: 10.1186/s40854-020-00187-0. URL: http://dx.doi.org/10.1186/s40854-020-00187-0.

[3] Stefan Etschberger et al. "The classification of candlestick charts: laying the foundation for further empirical research". In:
From Data and Information Analysis to Knowledge Engineering:
Springer. 2006, pp. 526–533.

[4] Weilong Hu et al. “A formal approach to candlestick pattern classification in financial time series”. In: Applied Soft Computing 84 (Nov. 2019), p. 105700. DOI: 10.1016/j.asoc.2019.105700. URL: http://dx.doi.org/10.1016/j.asoc.2019.105700.

Questions?