

Exploring the applicability of Seq2Seq architecture to Intraday Technical trading

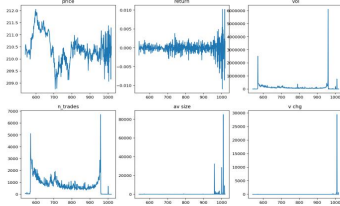
1

The problem: Knowing the behavior of a stock price or portfolio in a window of 60 – 100 minutes, can we predict returns in 5 – 60 minute window?



2

We start with price data and develop minutely features: price, volume, volume change, returns, number of trades, maximum price



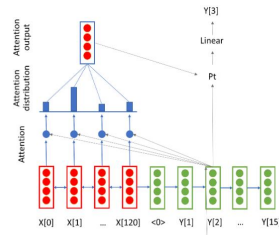
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And create a dataset with 34 features using 7 stocks and an index

Time	SPY	GOOGL	MSFT	AMZN	FB	DIS	IBM
2018-01-01 00:00:00	270.00	1100.00	120.00	1700.00	180.00	130.00	160.00
2018-01-01 00:05:00	270.05	1100.50	120.05	1700.50	180.05	130.05	160.05
2018-01-01 00:10:00	270.10	1101.00	120.10	1701.00	180.10	130.10	160.10
2018-01-01 00:15:00	270.15	1101.50	120.15	1701.50	180.15	130.15	160.15
2018-01-01 00:20:00	270.20	1102.00	120.20	1702.00	180.20	130.20	160.20
2018-01-01 00:25:00	270.25	1102.50	120.25	1702.50	180.25	130.25	160.25
2018-01-01 00:30:00	270.30	1103.00	120.30	1703.00	180.30	130.30	160.30
2018-01-01 00:35:00	270.35	1103.50	120.35	1703.50	180.35	130.35	160.35
2018-01-01 00:40:00	270.40	1104.00	120.40	1704.00	180.40	130.40	160.40
2018-01-01 00:45:00	270.45	1104.50	120.45	1704.50	180.45	130.45	160.45
2018-01-01 00:50:00	270.50	1105.00	120.50	1705.00	180.50	130.50	160.50
2018-01-01 00:55:00	270.55	1105.50	120.55	1705.50	180.55	130.55	160.55
2018-01-01 01:00:00	270.60	1106.00	120.60	1706.00	180.60	130.60	160.60
2018-01-01 01:05:00	270.65	1106.50	120.65	1706.50	180.65	130.65	160.65
2018-01-01 01:10:00	270.70	1107.00	120.70	1707.00	180.70	130.70	160.70
2018-01-01 01:15:00	270.75	1107.50	120.75	1707.50	180.75	130.75	160.75
2018-01-01 01:20:00	270.80	1108.00	120.80	1708.00	180.80	130.80	160.80
2018-01-01 01:25:00	270.85	1108.50	120.85	1708.50	180.85	130.85	160.85
2018-01-01 01:30:00	270.90	1109.00	120.90	1709.00	180.90	130.90	160.90
2018-01-01 01:35:00	270.95	1109.50	120.95	1709.50	180.95	130.95	160.95
2018-01-01 01:40:00	271.00	1110.00	121.00	1710.00	181.00	131.00	161.00
2018-01-01 01:45:00	271.05	1110.50	121.05	1710.50	181.05	131.05	161.05
2018-01-01 01:50:00	271.10	1111.00	121.10	1711.00	181.10	131.10	161.10
2018-01-01 01:55:00	271.15	1111.50	121.15	1711.50	181.15	131.15	161.15
2018-01-01 02:00:00	271.20	1112.00	121.20	1712.00	181.20	131.20	161.20
2018-01-01 02:05:00	271.25	1112.50	121.25	1712.50	181.25	131.25	161.25
2018-01-01 02:10:00	271.30	1113.00	121.30	1713.00	181.30	131.30	161.30
2018-01-01 02:15:00	271.35	1113.50	121.35	1713.50	181.35	131.35	161.35
2018-01-01 02:20:00	271.40	1114.00	121.40	1714.00	181.40	131.40	161.40
2018-01-01 02:25:00	271.45	1114.50	121.45	1714.50	181.45	131.45	161.45
2018-01-01 02:30:00	271.50	1115.00	121.50	1715.00	181.50	131.50	161.50
2018-01-01 02:35:00	271.55	1115.50	121.55	1715.50	181.55	131.55	161.55
2018-01-01 02:40:00	271.60	1116.00	121.60	1716.00	181.60	131.60	161.60
2018-01-01 02:45:00	271.65	1116.50	121.65	1716.50	181.65	131.65	161.65
2018-01-01 02:50:00	271.70	1117.00	121.70	1717.00	181.70	131.70	161.70
2018-01-01 02:55:00	271.75	1117.50	121.75	1717.50	181.75	131.75	161.75
2018-01-01 03:00:00	271.80	1118.00	121.80	1718.00	181.80	131.80	161.80
2018-01-01 03:05:00	271.85	1118.50	121.85	1718.50	181.85	131.85	161.85
2018-01-01 03:10:00	271.90	1119.00	121.90	1719.00	181.90	131.90	161.90
2018-01-01 03:15:00	271.95	1119.50	121.95	1719.50	181.95	131.95	161.95
2018-01-01 03:20:00	272.00	1120.00	122.00	1720.00	182.00	132.00	162.00
2018-01-01 03:25:00	272.05	1120.50	122.05	1720.50	182.05	132.05	162.05
2018-01-01 03:30:00	272.10	1121.00	122.10	1721.00	182.10	132.10	162.10
2018-01-01 03:35:00	272.15	1121.50	122.15	1721.50	182.15	132.15	162.15
2018-01-01 03:40:00	272.20	1122.00	122.20	1722.00	182.20	132.20	162.20
2018-01-01 03:45:00	272.25	1122.50	122.25	1722.50	182.25	132.25	162.25
2018-01-01 03:50:00	272.30	1123.00	122.30	1723.00	182.30	132.30	162.30
2018-01-01 03:55:00	272.35	1123.50	122.35	1723.50	182.35	132.35	162.35
2018-01-01 04:00:00	272.40	1124.00	122.40	1724.00	182.40	132.40	162.40
2018-01-01 04:05:00	272.45	1124.50	122.45	1724.50	182.45	132.45	162.45
2018-01-01 04:10:00	272.50	1125.00	122.50	1725.00	182.50	132.50	162.50
2018-01-01 04:15:00	272.55	1125.50	122.55	1725.50	182.55	132.55	162.55
2018-01-01 04:20:00	272.60	1126.00	122.60	1726.00	182.60	132.60	162.60
2018-01-01 04:25:00	272.65	1126.50	122.65	1726.50	182.65	132.65	162.65
2018-01-01 04:30:00	272.70	1127.00	122.70	1727.00	182.70	132.70	162.70
2018-01-01 04:35:00	272.75	1127.50	122.75	1727.50	182.75	132.75	162.75
2018-01-01 04:40:00	272.80	1128.00	122.80	1728.00	182.80	132.80	162.80
2018-01-01 04:45:00	272.85	1128.50	122.85	1728.50	182.85	132.85	162.85
2018-01-01 04:50:00	272.90	1129.00	122.90	1729.00	182.90	132.90	162.90
2018-01-01 04:55:00	272.95	1129.50	122.95	1729.50	182.95	132.95	162.95
2018-01-01 05:00:00	273.00	1130.00	123.00	1730.00	183.00	133.00	163.00

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We use a seq2seq architecture with attention, like what is used for language modelling



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Hyperparameters tested:

- All Linear layers with Bias, no bias
- Encode window: 60 – 120 minutes
- Decode window: 5 – 60 minutes
- Loss: Mean Squared Error
- Hidden size: 128, 256, 512, and 1024 (256 was best)
- Layers: 1 – 4 (2-3 layer did best on loss)
- Adam Optimizer
- Dropout 0 – 0.3 (did not seem to affect results)

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Future work:

- more data, bigger dev set -> get loss curves to look better
- Vary batch sizes to smooth performance
- Error analysis: does system perform equally in all days of week? hours of day
- Add 1d convolutions to develop additional features
- Develop portfolio selection criteria

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Experiments

Predict a sequence

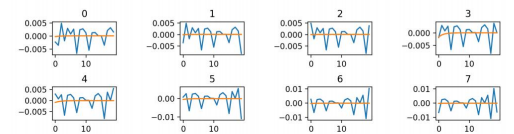
Experiment 1: Predict a sequence



Encode data: sequence of 120, 100, or 60 minutes of feature set Decode data (predict): sequence of 5, 10, 15, 60 minutes of TTD returns

System did not learn! Predicted flat line...

batch_size 8 x_len 120 y_len 20 h_size 10 n_layers 1 lr 1.00e-03 train_terminations 100



Predict cumulative return

Experiment 2: Predict a value – the cumulative return



Encode data: sequence of 120, 100, or 60 minutes of feature set Decode data (predict): cumulative return 5, 10, 15, 60 minutes of TTD returns

System did not do well – 48% chance of predicting return sign correctly

Loss and Dev Loss: MSE with train and dev sets, 100 iterations, 10000



Loss did not fall smoothly

Seemed to predict return sign correctly only 48% of time