

Candlestick Analysis: Prediction of Hong Kong and Korean Stock Market Trend

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A large, light gray geometric shape, resembling a stylized arrow or a series of connected line segments, pointing towards the right. It is located on the left side of the slide.

Introduction

Data preparation

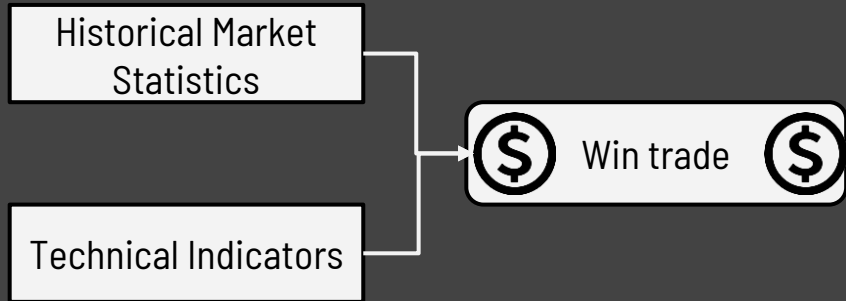
Hypothesis Testing

Findings

A solid dark gray vertical bar located on the right side of the slide.

Technical Analysis

- Predict price movement
- Identify trading opportunities



Moving Average (MA)



Trading Rule (Example)

50-MA > 200-MA Crossover → Buy

200-MA > 50-MA Crossover → Sell

Technical Analysis

Support & Resistance

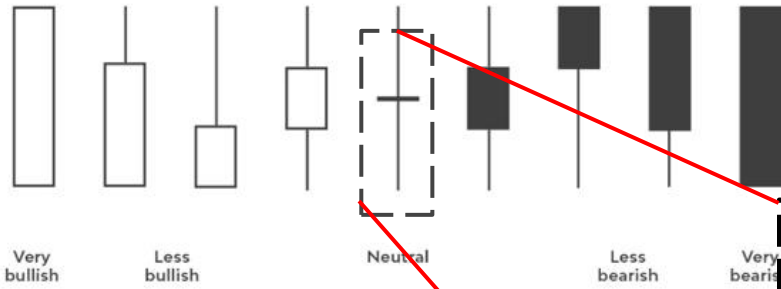


Candlestick Pattern

Long Green Candle	Long Red Candle	Short Green Candle	Short Red Candle	Green Marubozu	Red Marubozu	Bullish Closing Marubozu	Bearish Closing Marubozu	Bullish Opening Marubozu	Bearish Opening Marubozu	Spinning Top	Spinning Top
Doji	Doji	Long Legged Doji	Long Legged Doji	Cross Doji	Inverted Cross Doji	Dragonfly Doji	Gravestone Doji	Hammer	Hanging Man	Inverted Hammer	Shooting Star
Bullish Engulfing	Bearish Engulfing	Piercing Pattern	Dark Cloud Cover	Bullish Harami	Bearish Harami	Bullish Kicker	Bearish Kicker	Morning Star	Evening Star	Bullish Abandoned Baby	Bearish Abandoned Baby
Bullish 3x Star	Bearish 3x Star	Three White Soldiers	Three Black Crows	Upside Gap Two Crows	Two Crows	Three Inside Up	Three Inside Down	Three Outside Up	Three Outside Down	Bullish Meeting Line	Bearish Meeting Line
Bullish 3x Bullish	Bearish 3x Bullish	Three Stars In The South	Advance Block	Bullish 3x Sawsick	Bearish 3x Sawsick	Matching Low	Matching High	Tweezer Bottom	Tweezer Top		
Bullish Breakaway	Bearish Breakaway	Downside Tasuki Gap	Upside Tasuki Gap	Falling Three Method	Rising Three Method	Bullish Separating Lines	Bearish Separating Lines	Bullish Side-By-Side White Lines	Bearish Side-By-Side White Lines		

Candlestick

Bullish and bearish strength



Highest price for the day

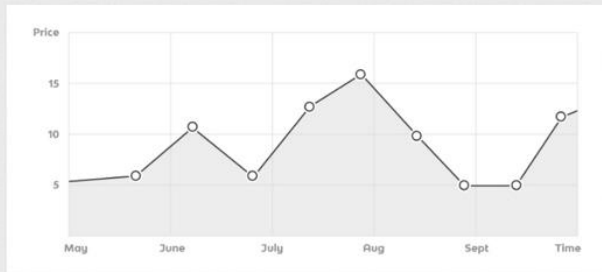
Opening or closing price

Opening or closing price

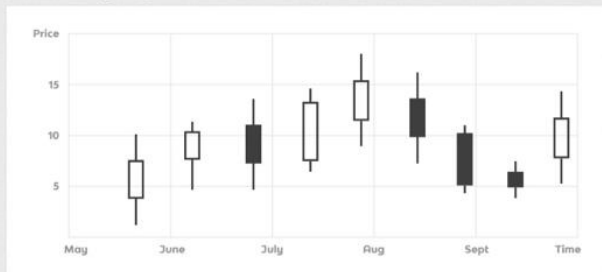
Lowest price for the day

Body is black (or red) if stock closed lower. Body is white (or green) if it closed higher.

Line graph



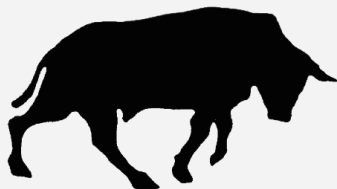
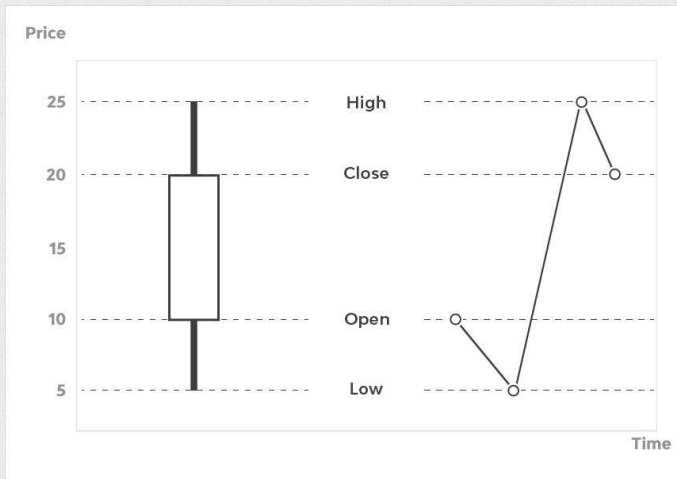
Candle graph



Candlestick

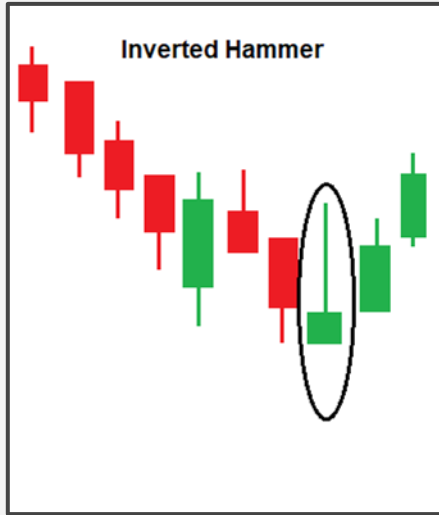


Path of price



Candlestick Patterns

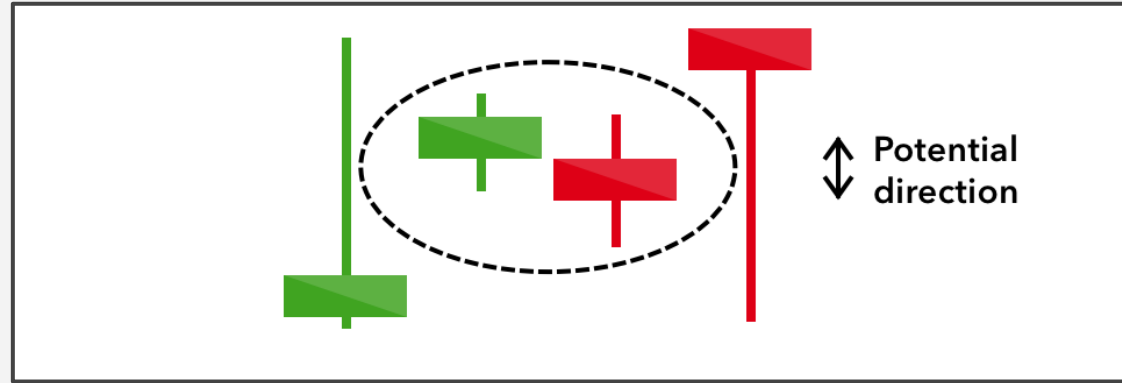
Hammer/ Inverted Hammer



Trading Rule (Example)

An Inverted Hammer observed → Buy
A Hammer observed → Sell / Short sell

Short Line Candle



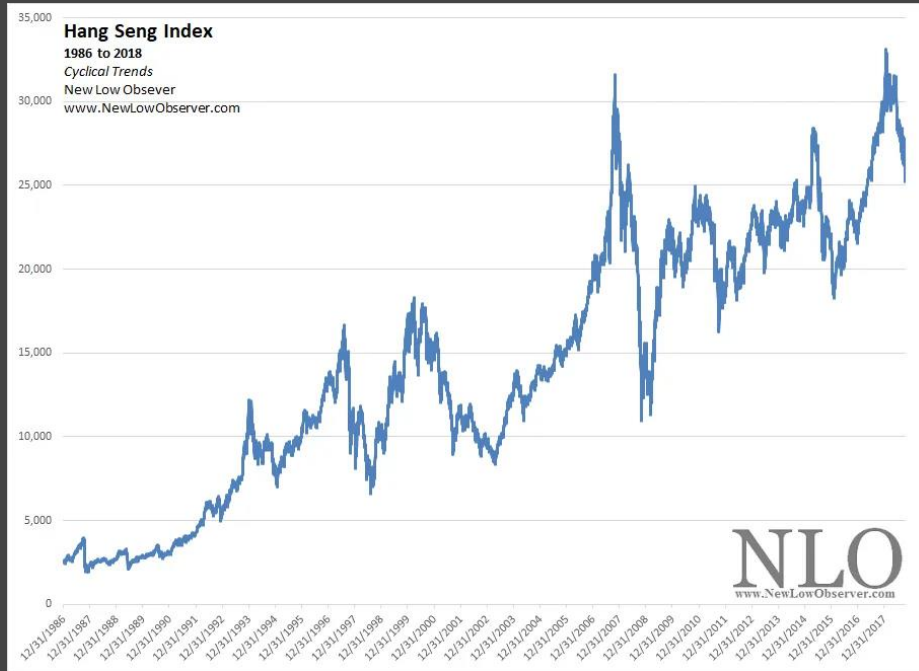
Trading Rule (Example)

Low Volatility

Derivatives:

Short straddles / Butterfly Spread

Hang Seng Index (HSI)



Hang Seng Index from December 1986 to December 2017

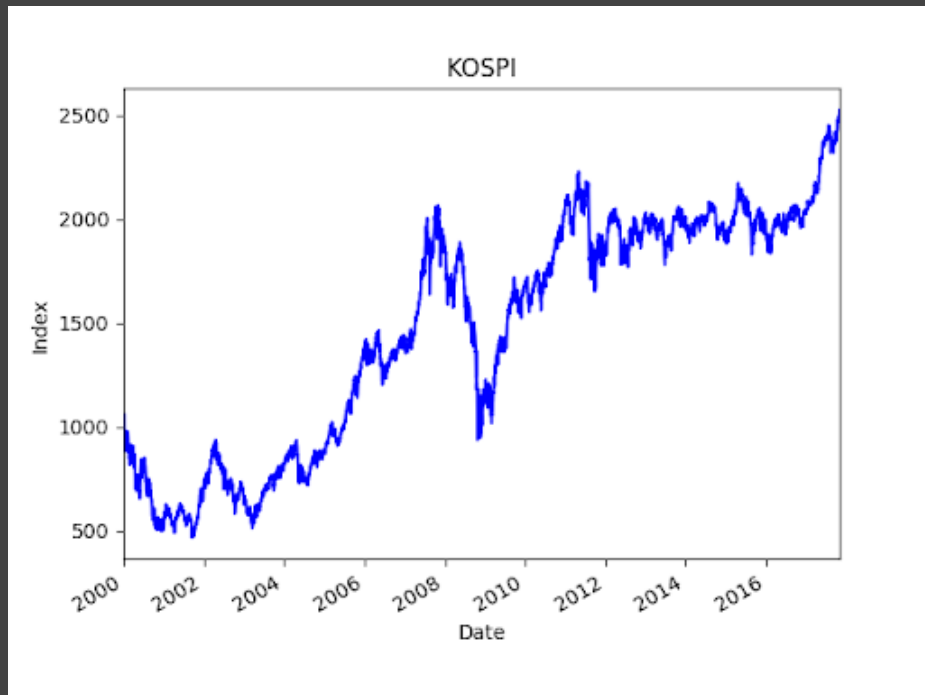
- market-value-weighted index
- record and monitor daily changes of the largest companies of the Hong Kong stock market
- Stock examples:



Tencent 腾讯



KOSPI 50 (코스피지수)



KOSPI 50 from December 2000 to December 2016

- Korea Composite Stock Price Index 50
- market-value-weighted index
- representative stock market index of South Korea
- Stock Examples:





□ Dataframe of each index

□ Candlestick Chart

□ Candlestick Pattern

Recognition

Data Preparation



Base Dataframe of each Index

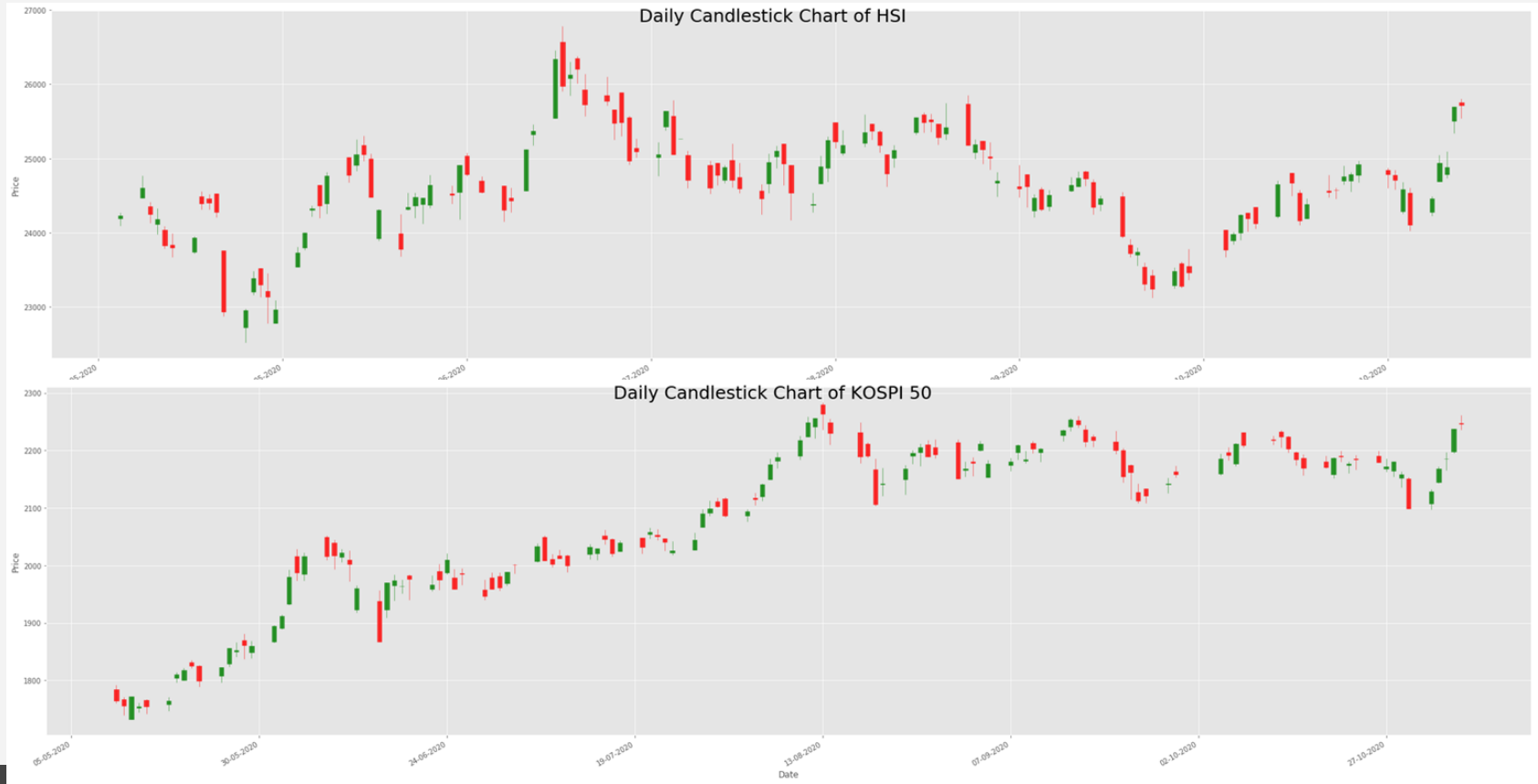
Dataframe 'hsi'

Date	Open	High	Low	Close
2020-11-06	25750.78	25799.97	25540.98	25712.97
2020-11-05	25500.91	25695.92	25343.44	25695.92
2020-11-04	24790.00	25093.72	24733.23	24886.14
2020-11-03	24689.56	25048.53	24689.51	24939.73
...

Dataframe 'kospı'

Date	Open	High	Low	Close
2020-11-06	2247.32	2260.89	2236.10	2246.10
2020-11-05	2198.19	2237.42	2195.18	2237.42
2020-11-04	2185.13	2196.21	2166.28	2185.34
2020-11-03	2107.50	2132.09	2097.53	2128.86
...

Candlestick Charts



Candlestick Pattern Recognition

index_test

Date	Pattern_1	Pattern_2	Pattern_3	...
date_1	NaN	-100	100	...
date_2	100	NaN	NaN	...
date_3	-100	-100	NaN	...
date_4	NaN	-100	NaN	...
...

Bullish

Bearish

index_bull

Date	Pattern_1	Pattern_3	...
date_1	NaN	100	...
date_2	100	NaN	...
date_4	NaN	NaN	...
...

>25 occurrence

index_bear

Date	Pattern_1	Pattern_2	...
date_1	NaN	-100	...
date_3	-100	-100	...
date_4	NaN	-100	...
...

Sample Size

Threshold: $n > 25$

HSI (Bull)

CDLBELTHOLD	56
CDLCLOSINGMARUBOZU	68
CDLDOJI	94
CDLENGULFING	46
CDLHAMMER	29
CDLHARAMI	33
CDLHIGHWAVE	34
CDLHIKKAKE	92
CDLLONGLEGGEDDOJI	88
CDLLONGLINE	77
CDLRICKSHAWMAN	64
CDLSHORTLINE	45
CDLSPINNINGTOP	75

HSI (Bear)

CDLBELTHOLD	103
CDLCLOSINGMARUBOZU	47
CDLENGULFING	100
CDLHIGHWAVE	40
CDLHIKKAKE	93
CDLLONGLINE	81
CDLSHORTLINE	40
CDLSPINNINGTOP	77

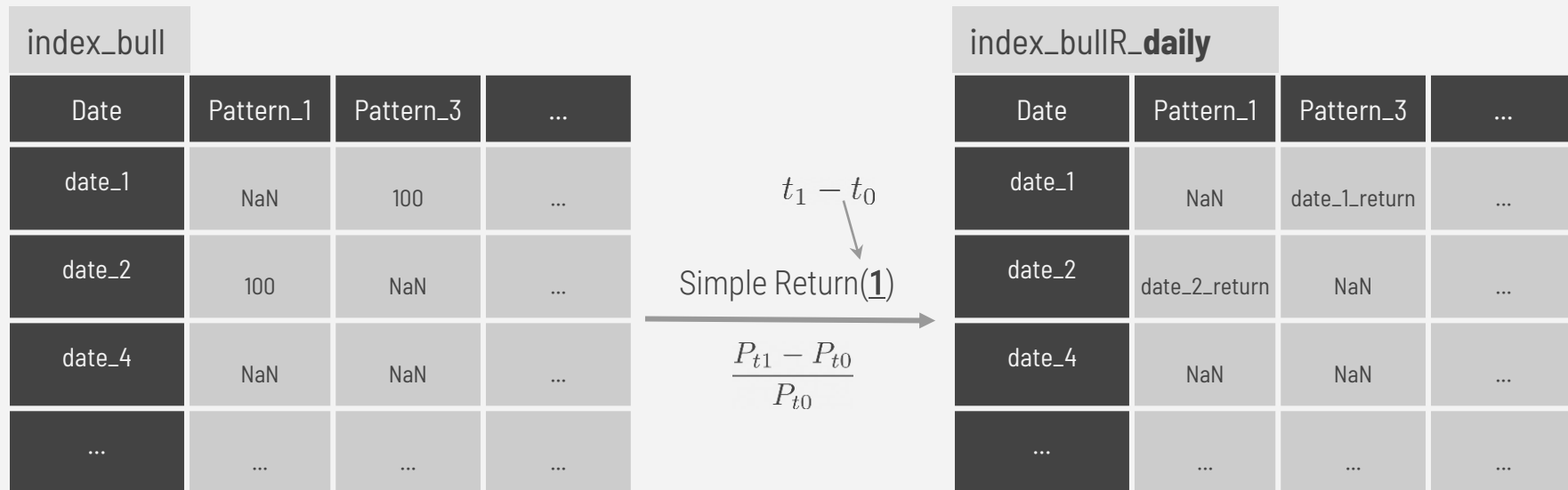
KOSPI (Bull)

CDLBELTHOLD	193
CDLCLOSINGMARUBOZU	207
CDLDOJI	293
CDLDragonFLYDOJI	28
CDLENGULFING	61
CDLHAMMER	62
CDLHARAMI	93
CDLHARAMICROSS	32
CDLHIGHWAVE	132
CDLHIKKAKE	105
CDLHOMINGPIGEON	45
CDLINVERTEDHAMMER	41
CDLLONGLEGGEDDOJI	277
CDLLONGLINE	242
CDLMARUBOZU	75
CDLMATCHINGLOW	44
CDLRICKSHAWMAN	221
CDLSHORTLINE	110
CDLSPINNINGTOP	216
CDLTAKURI	28

KOSPI (Bear)

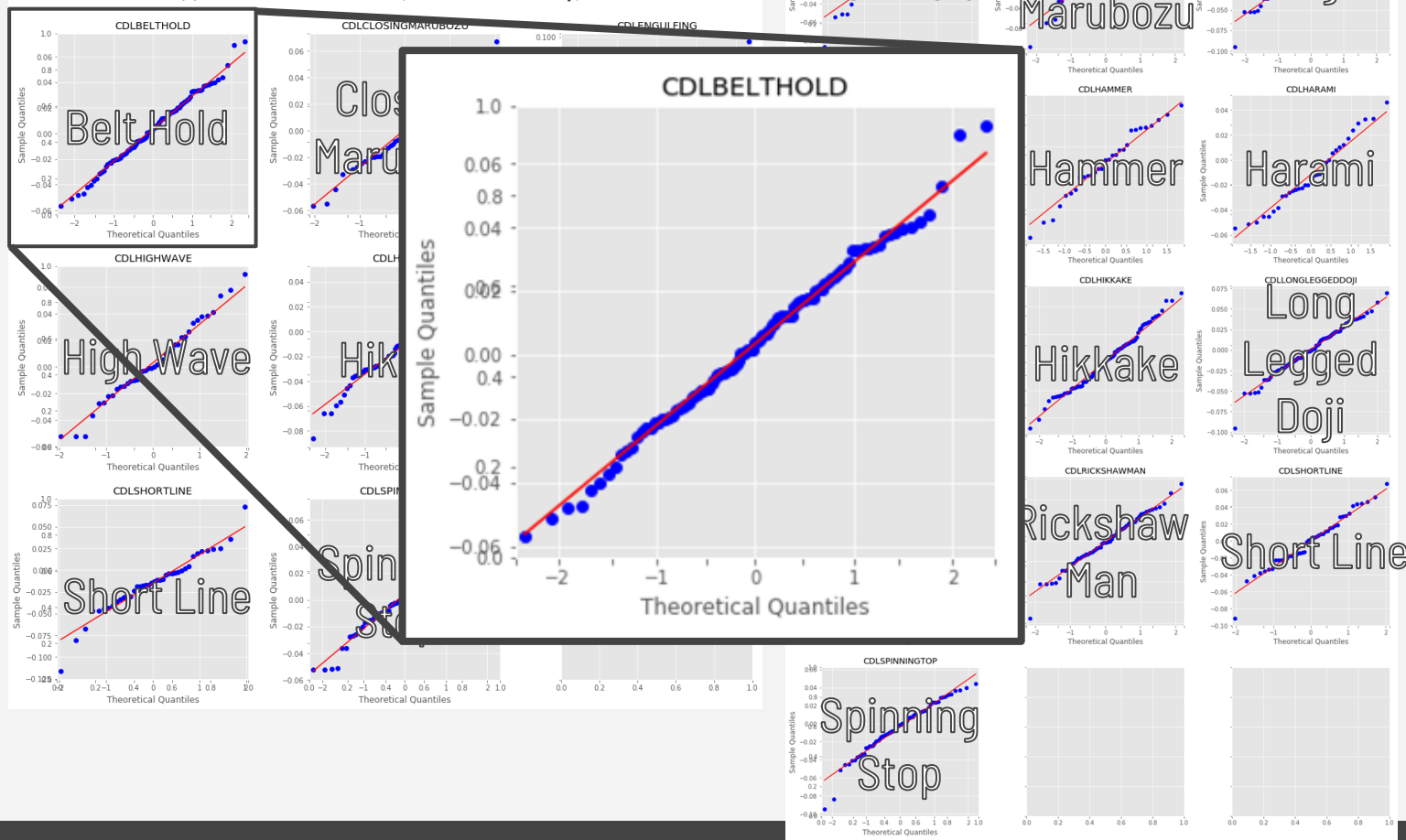
CDLBELTHOLD	228
CDLCLOSINGMARUBOZU	182
CDLENGULFING	95
CDLHANGINGMAN	62
CDLHARAMI	67
CDLHIGHWAVE	142
CDLHIKKAKE	87
CDLLONGLINE	224
CDLMARUBOZU	78
CDLSHORTLINE	117
CDLSPINNINGTOP	225

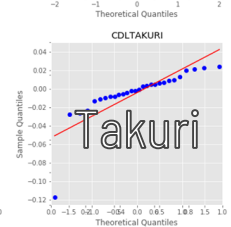
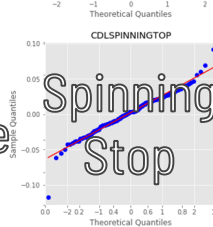
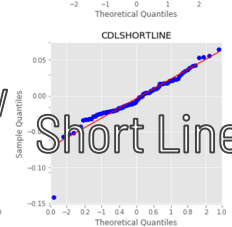
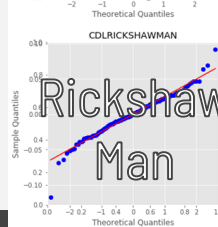
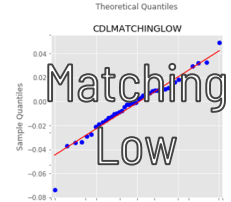
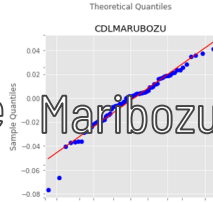
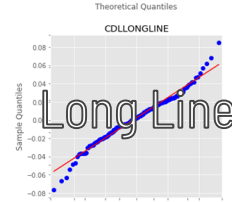
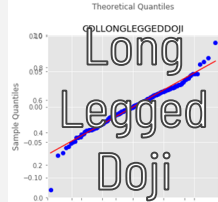
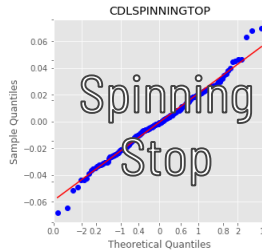
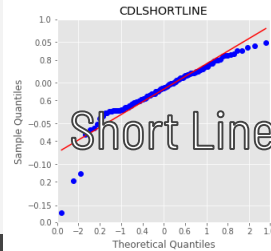
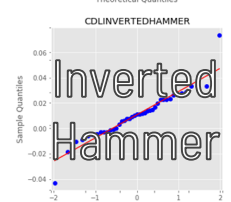
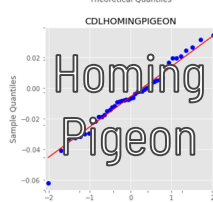
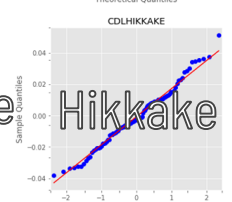
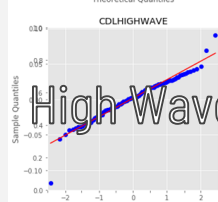
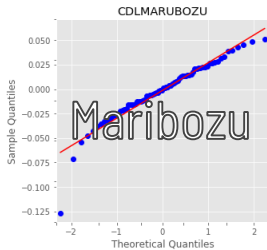
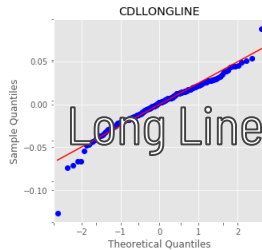
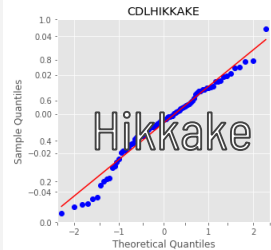
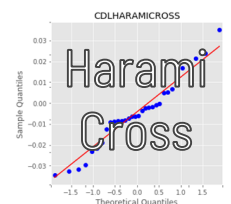
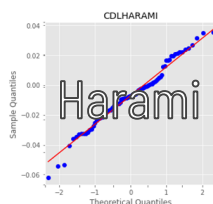
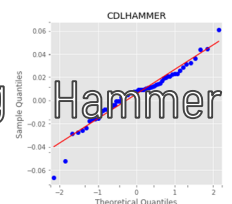
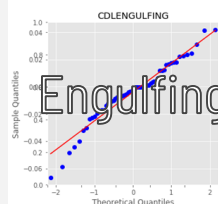
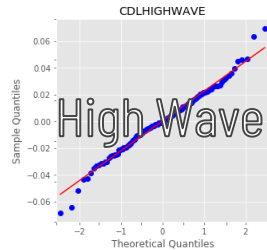
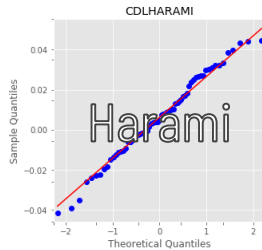
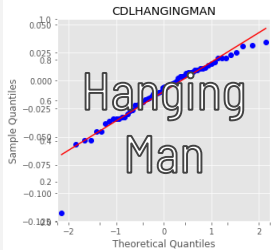
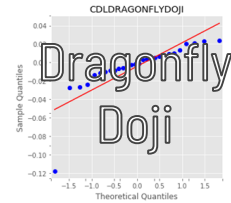
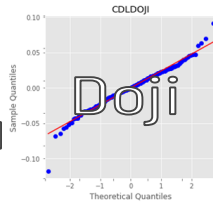
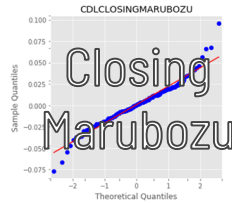
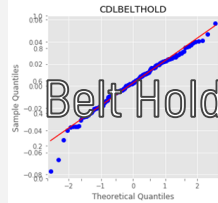
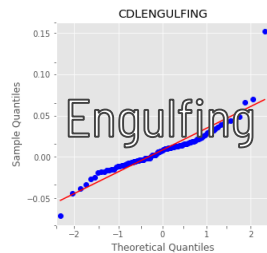
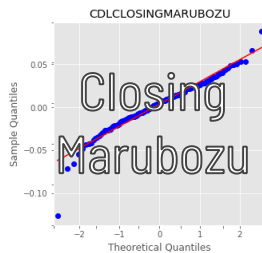
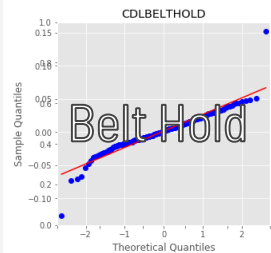
Candlestick Pattern Recognition



HSI weekly return

QQ test on Return Ratio of HSI (Bearish Patterns, 5-day)







- ❏ Declarations
- ❏ One Sample T-Test
- ❏ Limitations

Hypothesis Testing

One Sample T-Test

One tailed



Bullish

$$H_0 : R = \mu$$

$$H_1 : R > \mu$$

Short term

$$t = \frac{\bar{R} - 0.001}{s/\sqrt{n}}$$

Long term

$$t = \frac{\bar{R} - 0.05}{s/\sqrt{n}}$$

$t > t_{1-\alpha, df=n-1} \Rightarrow \text{Reject } H_0$



Bearish

$$H_0 : R = -\mu$$

$$H_1 : R < -\mu$$

Short term

$$t = \frac{\bar{R} - (-0.001)}{s/\sqrt{n}}$$

Long term

$$t = \frac{\bar{R} - (-0.05)}{s/\sqrt{n}}$$

$t < -t_{1-\alpha, df=n-1} \Rightarrow \text{Reject } H_0$

T-test : Assumptions

Continuous

Simple return ratios must be continuous dependent variables



Normality

Return ratios of each pattern must be approximately normally distributed



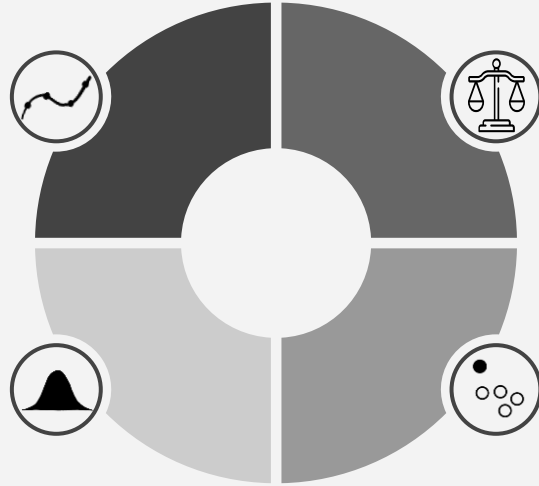
Independent

Each return ratio of specific date must be independent to each other



No outliers

There should be no outliers in the data



Bearish Candlestick : HSI

Short Term: 5 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	103	0.003478	102	0.025580	0.002520	1.776688	-1.659930
CDLCLOSINGMARUBOZU	47	0.000790	46	0.028368	0.004138	0.432642	-1.678660
CDLENGULFING	100	0.004087	99	0.026270	0.002627	1.936635	-1.660391
CDLHIGHWAVE	40	0.002984	39	0.029388	0.004647	0.857309	-1.684875
CDLHIKKAKE	93	-0.010012	92	0.024509	0.002541	-3.545858	-1.661585
CDLLONGLINE	81	-0.000533	80	0.026295	0.002922	0.159714	-1.664125
CDLSHORTLINE	40	-0.014959	39	0.033277	0.005262	-2.653045	-1.684875
CDLSPINNINGTOP	77	0.004357	76	0.026181	0.002984	1.795336	-1.665151



Hikkake pattern, Shortline candle

Long Term: 250 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	67	-0.046756	66	0.065218	0.007968	0.407172	-1.668271
CDLCLOSINGMARUBOZU	34	-0.044867	33	0.069792	0.011969	0.428860	-1.692360
CDLENGULFING	84	0.039796	83	0.145922	0.015921	5.639935	-1.663420
CDLHIGHWAVE	26	-0.068436	25	0.071158	0.013955	-1.321062	-1.708141
CDLHIKKAKE	88	0.035519	87	0.133707	0.014253	5.999987	-1.662557
CDLLONGLINE	54	-0.050959	53	0.066336	0.009027	-0.106185	-1.674116
CDLSHORTLINE	29	-0.074793	28	0.069251	0.012860	-1.928013	-1.701131
CDLSPINNINGTOP	56	-0.070470	55	0.079352	0.010604	-1.930387	-1.673034



Shortline candle, Spinning top

Bearish Candlestick : KOSPI 50

Short Term: 5 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	228	0.001504	227	0.024939	0.001652	1.515840	-1.651594
CDLCLOSINGMARUBOZU	182	0.003686	181	0.025924	0.001922	2.438657	-1.653316
CDLENGULFING	95	0.008234	94	0.026557	0.002725	3.388918	-1.661226
CDLHANGINGMAN	62	-0.009676	61	0.026350	0.003346	-2.592591	-1.670219
CDLHARAMI	67	0.006236	66	0.020482	0.002502	2.892016	-1.668271
CDLHIGHWAVE	142	0.000271	141	0.022386	0.001879	0.676688	-1.655732
CDLHIKKAKE	87	-0.004628	86	0.018865	0.002023	-1.794003	-1.662765
CDLLONGLINE	224	-0.000075	223	0.024881	0.001662	0.556307	-1.651715
CDLMARUBOZU	78	-0.001377	77	0.028460	0.003222	-0.117082	-1.664885
CDLSHORTLINE	117	-0.008144	116	0.031257	0.002890	-2.472274	-1.658096
CDLSPINNINGTOP	225	-0.000411	224	0.021650	0.001443	0.407934	-1.651685



Hanging man, Hikkake pattern,
Shortline candle

Long Term: 250 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	208	0.017062	207	0.124947	0.008663	7.740800	-1.652248
CDLCLOSINGMARUBOZU	163	0.025740	162	0.135523	0.010615	7.135187	-1.654314
CDLENGULFING	83	0.027172	82	0.142679	0.015661	4.927661	-1.663649
CDLHANGINGMAN	54	0.025010	53	0.151821	0.020660	3.630659	-1.674116
CDLHARAMI	58	0.038528	57	0.141609	0.018594	4.761081	-1.672029
CDLHIGHWAVE	124	0.047239	123	0.135920	0.012206	7.966536	-1.657336
CDLHIKKAKE	78	0.007846	77	0.142523	0.016138	3.584580	-1.664885
CDLLONGLINE	205	0.008328	204	0.121114	0.008459	6.895347	-1.652357
CDLMARUBOZU	73	0.009246	72	0.103190	0.012077	4.905527	-1.666294
CDLSHORTLINE	106	0.028687	105	0.155927	0.015145	5.195563	-1.659495
CDLSPINNINGTOP	199	0.035653	198	0.140544	0.009963	8.597230	-1.652586



-

Bullish Candlestick : HSI

Short Term: 5 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	56	0.002547	55	0.027237	0.003640	0.425062	1.673034
CDLCLOSINGMARUBOZU	68	-0.001225	67	0.025767	0.003125	-0.711999	1.667916
CDLDOJI	94	0.001018	93	0.028347	0.002924	0.006052	1.661404
CDENGULFING	46	-0.004548	45	0.018779	0.002769	-2.003627	1.679427
CDLHAMMER	29	0.009313	28	0.021541	0.004000	2.078269	1.701131
CDLHARAMI	33	-0.011675	32	0.026996	0.004699	-2.697148	1.693889
CDLHIGHWAVE	34	-0.004660	33	0.024991	0.004286	-1.320704	1.692360
CDLHIKKAKE	92	0.000755	91	0.019727	0.002057	-0.119335	1.661771
CDLLONGLEGGEDDOJI	88	0.000389	87	0.028135	0.002999	-0.203603	1.662557
CDLLONGLINE	77	0.003023	76	0.025219	0.002874	0.703966	1.665151
CDLRICKSHAWMAN	64	-0.001578	63	0.030375	0.003797	-0.678883	1.669402
CDLSHORTLINE	45	-0.000096	44	0.030959	0.004615	-0.237482	1.680230
CDLSPINNINGTOP	75	-0.003815	74	0.026670	0.003080	-1.563429	1.665707



Hammer

Long Term: 250 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	39	-0.073637	38	0.082366	0.013189	-9.374214	1.685954
CDLCLOSINGMARUBOZU	48	-0.070863	47	0.083145	0.012001	-10.071069	1.677927
CDLDOJI	63	-0.069885	62	0.075422	0.009502	-12.616452	1.669804
CDENGULFING	41	0.014671	40	0.142766	0.022296	-1.584536	1.683851
CDLHAMMER	22	-0.085480	21	0.069901	0.014903	-9.090798	1.720743
CDLHARAMI	24	-0.068575	23	0.068559	0.013995	-8.472898	1.713872
CDLHIGHWAVE	27	-0.053955	26	0.081957	0.015773	-6.590898	1.705618
CDLHIKKAKE	82	0.064590	81	0.147929	0.016336	0.893148	1.663884
CDLLONGLEGGEDDOJI	62	-0.067746	61	0.074086	0.009409	-12.514337	1.670219
CDLLONGLINE	55	-0.073057	54	0.072671	0.009799	-12.558293	1.673565
CDLRICKSHAWMAN	44	-0.056404	43	0.074087	0.011169	-9.526673	1.681071
CDLSHORTLINE	26	-0.073366	25	0.085158	0.016701	-7.386816	1.708141
CDLSPINNINGTOP	56	-0.069703	55	0.071403	0.009542	-12.545353	1.673034



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Bullish Candlestick : KOSPI 50

Short Term: 5 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	193	0.002733	192	0.020312	0.001462	1.184973	1.652829
CDLCLOSINGMARUBOZU	207	0.000858	206	0.021615	0.001502	-0.094499	1.652284
CDLDOJI	293	-0.000059	292	0.023916	0.001397	-0.757744	1.650089
CDLDRAGONFLYDOJI	28	-0.004233	27	0.026129	0.004938	-1.059844	1.703288
CDLENGULFING	61	-0.003885	60	0.021358	0.002735	-1.786308	1.670649
CDLHAMMER	62	0.005475	61	0.021291	0.002704	1.654818	1.670219
CDLHARAMI	93	-0.007042	92	0.019278	0.001999	-4.022946	1.661585
CDLHARAMICROSS	32	-0.004218	31	0.017000	0.003005	-1.736472	1.695519
CDLHIGHWAVE	132	0.001829	131	0.026216	0.002282	0.363423	1.656569
CDLHIKKAKE	105	-0.000778	104	0.017958	0.001753	-1.014532	1.659637
CDLHOMINGPIGEON	45	-0.005551	44	0.019911	0.002968	-2.207200	1.680230
CDLINVERTEDHAMMER	41	0.010729	40	0.018530	0.002894	3.361812	1.683851
CDLLONGLEGGEDDOJI	277	-0.000281	276	0.024140	0.001450	-0.882869	1.650393
CDLLONGLINE	242	0.002306	241	0.022171	0.001425	0.916610	1.651201
CDLMARUBOZU	75	-0.001833	74	0.022039	0.002545	-1.113400	1.665707
CDLMATCHINGLOW	44	-0.001218	43	0.021933	0.003307	-0.670789	1.681071
CDLRICKSHAWMAN	221	-0.000171	220	0.024754	0.001665	-0.703506	1.651809
CDLSHORTLINE	110	-0.004013	109	0.027526	0.002624	-1.910126	1.658953
CDLSPINNINGTOP	216	0.002086	215	0.024383	0.001659	0.654724	1.651972
CDLTAKURI	28	-0.004233	27	0.026129	0.004938	-1.059844	1.703288



Inverted Hammer

Long Term: 250 Days

	n	mean	df	std	se	t ratio	t critical
CDLBELTHOLD	171	0.040722	170	0.145065	0.011093	-0.836349	1.653866
CDLCLOSINGMARUBOZU	185	0.039412	184	0.138611	0.010191	-1.038957	1.653177
CDLDOJI	266	0.040073	265	0.132043	0.008096	-1.226205	1.650624
CDLDRAGONFLYDOJI	25	0.004740	24	0.137298	0.027460	-1.648222	1.710882
CDLENGULFING	56	0.036005	55	0.131164	0.017528	-0.798456	1.673034
CDLHAMMER	54	0.016422	53	0.122482	0.016668	-2.014535	1.674116
CDLHARAMI	82	0.016106	81	0.119951	0.013246	-2.558770	1.663884
CDLHARAMICROSS	28	0.014050	27	0.128505	0.024285	-1.480333	1.703288
CDLHIGHWAVE	119	0.032425	118	0.130946	0.012004	-1.464156	1.657870
CDLHIKKAKE	91	0.046700	90	0.146869	0.015396	-0.214365	1.661961
CDLHOMINGPIGEON	38	0.011386	37	0.120644	0.019571	-1.973005	1.687094
CDLINVERTEDHAMMER	36	0.061187	35	0.132020	0.022003	0.508412	1.689572
CDLLONGLEGGEDDOJI	250	0.035694	249	0.134624	0.008514	-1.680241	1.650996
CDLLONGLINE	212	0.039580	211	0.139208	0.009561	-1.089815	1.652107
CDLMARUBOZU	70	0.033700	69	0.153985	0.018405	-0.885656	1.667239
CDLMATCHINGLOW	41	-0.014335	40	0.116886	0.018255	-3.524306	1.683851
CDLRICKSHAWMAN	199	0.039722	198	0.135535	0.009608	-1.069715	1.652586
CDLSHORTLINE	101	0.047990	100	0.128504	0.012787	-0.157169	1.660234
CDLSPINNINGTOP	194	0.024185	193	0.124453	0.008935	-2.889095	1.652787
CDLTAKURI	25	0.004740	24	0.137298	0.027460	-1.648222	1.710882



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Findings

<Bullish>

<Bearish>

	HSI	KOSPI 50	HSI	KOSPI 50
Short term (5 days)	Hammer	Inverted Hammer	Hikkake, short line	Short line, spinning top
Long term (250 days)	---	---	Hanging man, Hikkake, Short line	---

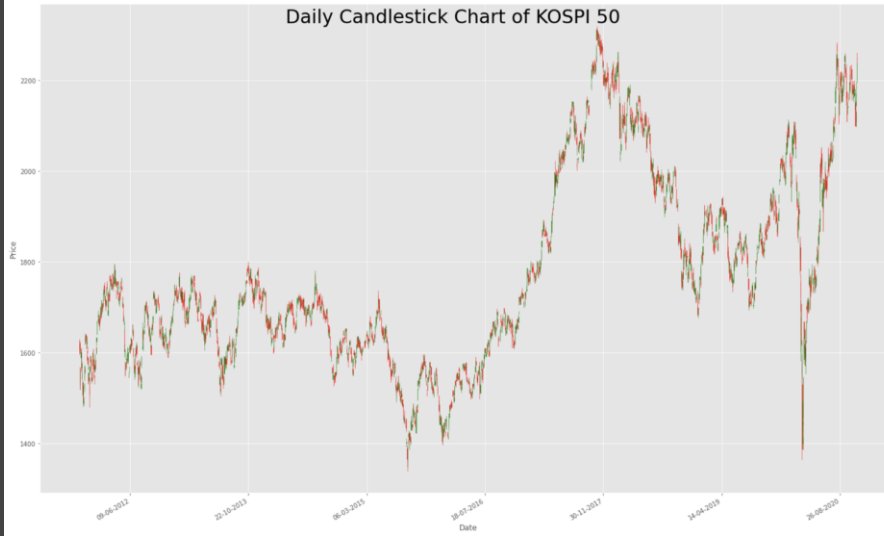
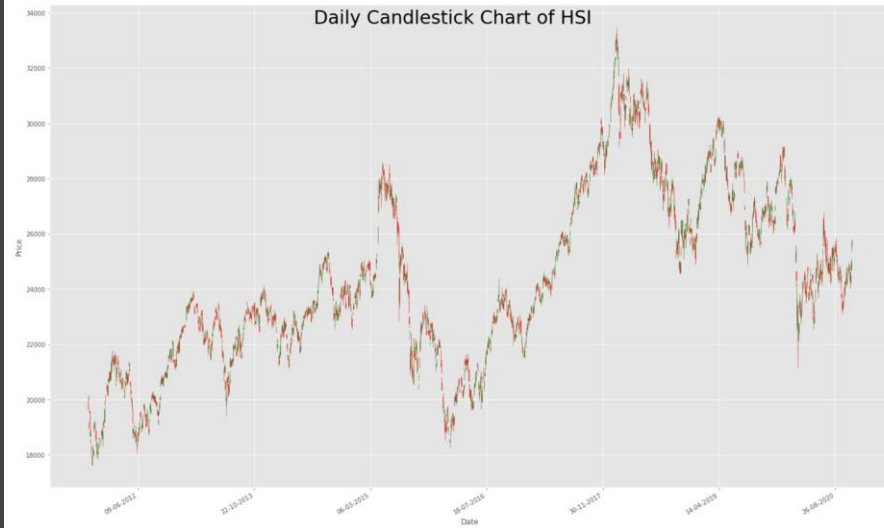


Limitations: Candlestick reliability

Valid for :

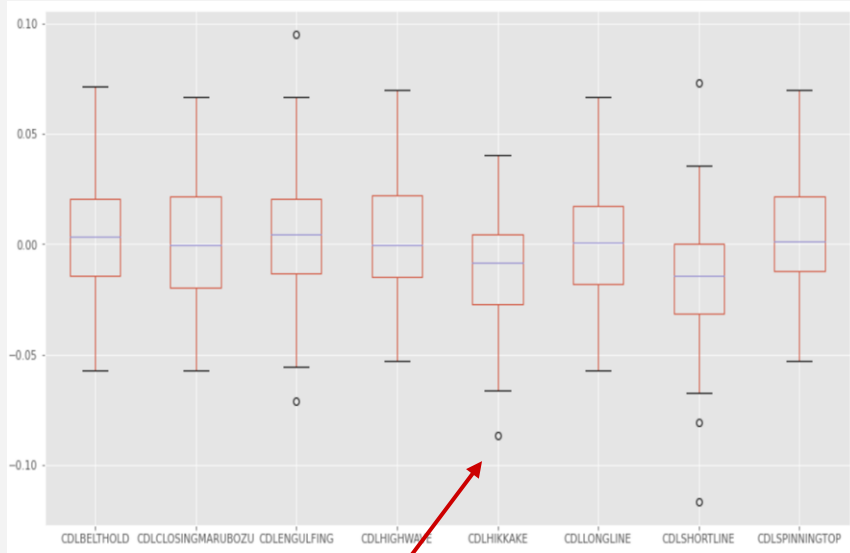
Daily review

3 - 5 bars



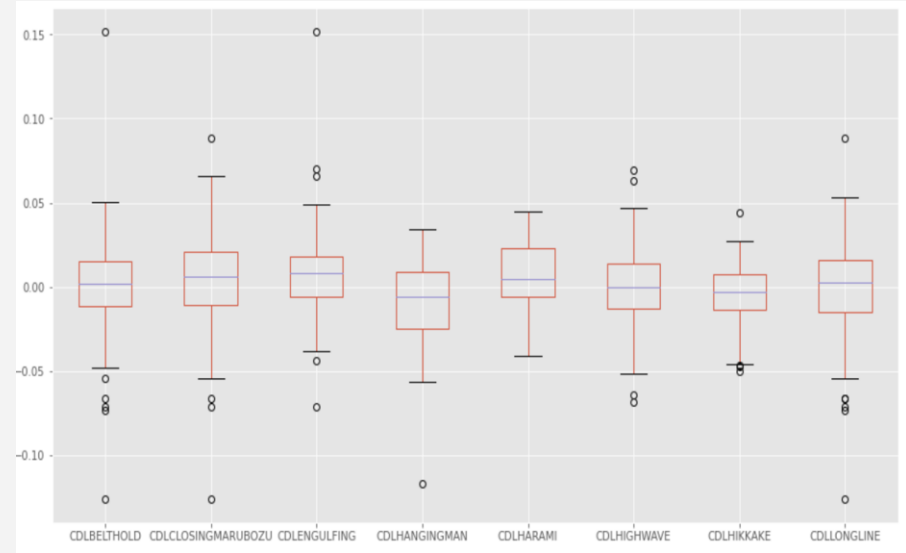
Limitations : Outliers

HSI (Bearish) - Short Term



Outlier

KOSPI 50 (Bearish) - Short Term



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Other technical indicators or theories
(eg. Elliott wave theory)

Quantitative analysis

Fundamental Analysis



Other Tools for Market Trend Prediction



QnA