

Backtesting Library.ipynb

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Q [1] !pip install backtesting

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting backtesting
  Downloading Backtesting-0.3.3.tar.gz (175 kB)
    Preparing metadata (setup.py) ... done
Requirement already satisfied: numpy<1.17.0,!=1.17.0 in /usr/local/lib/python3.9/dist-packages (from backtesting) (1.22.4)
Requirement already satisfied: pandas<=0.25.0,>=0.25.0 in /usr/local/lib/python3.9/dist-packages (from backtesting) (1.5.3)
Requirement already satisfied: bokeh>=1.4.0 in /usr/local/lib/python3.9/dist-packages (from backtesting) (2.4.3)
Requirement already satisfied: pyYAML<3.10 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (6.0)
Requirement already satisfied: tornado>=5.1 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (6.2)
Requirement already satisfied: packaging>=16.8 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (23.1)
Requirement already satisfied: Jinja2>=2.9 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (3.1.2)
Requirement already satisfied: pillow>=7.1.0 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (4.0)
Requirement already satisfied: requests>=2.25.0 in /usr/local/lib/python3.9/dist-packages (from bokeh>=1.4.0->backtesting) (4.5.0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.9/dist-packages (from pandas<0.25.0,>=0.25.0->backtesting) (2022.7.1)
Requirement already satisfied: python-dateutil>=2.8.1 in /usr/local/lib/python3.9/dist-packages (from pandas<0.25.0,>=0.25.0->backtesting) (2.8.2)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.9/dist-packages (from Jinja2>=2.9->bokeh>=1.4.0->backtesting) (2.1.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.9/dist-packages (from python-dateutil>=2.8.1->pandas<0.25.0,>=0.25.0->backtesting) (1.16.0)
Building wheels for collected packages backtesting
  Building wheel for backtesting (setup.py) ... done
  Created wheel for backtesting: filename=backtesting-0.3.3-py3-none-any.whl size=173817 sha256=7d792b653d0e7f6363e18676f5c26e873ecd21337d3685a8fea95a044a21b05
  Stored in directory: /root/.cache/pip/wheels/3f/7c/24/e8816cd8539acce5e0bb023badf1e98592f11528ed26e6
Successfully built backtesting
Installing collected packages: backtesting
Successfully installed backtesting-0.3.3
```

Q [2] !pip install ta

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting ta
  Downloading ta-0.10.2.tar.gz (25 kB)
    Preparing metadata (setup.py) ... done
Requirement already satisfied: numpy in /usr/local/lib/python3.9/dist-packages (from ta) (1.22.4)
Requirement already satisfied: pandas in /usr/local/lib/python3.9/dist-packages (from ta) (1.5.3)
Requirement already satisfied: dateutil>=2.8.1 in /usr/local/lib/python3.9/dist-packages (from pandas->ta) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.9/dist-packages (from pandas->ta) (2022.7.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.9/dist-packages (from python-dateutil>=2.8.1->pandas->ta) (1.16.0)
Building wheels for collected packages: ta
  Building wheel for ta (setup.py) ... done
  Created wheel for ta: filename=ta-0.10.2-py3-none-any.whl size=29103 sha256=b87ee36a0c4787762e6008f752af9b17c155f0a8ff84a95ed27c933a089ee3
  Stored in directory: /root/.cache/pip/wheels/6a/76/03/f785aaa50b9c6ec7e3fd1a62c1b2c45a034512d51e024a9
Successfully built ta
Installing collected packages: ta
Successfully installed ta-0.10.2
```

Q [3] !pip install yfinance

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: yfinance in /usr/local/lib/python3.9/dist-packages (from yfinance) (0.0.11)
Requirement already satisfied: beautifulsoup4>=4.11.1 in /usr/local/lib/python3.9/dist-packages (from yfinance) (4.11.2)
Requirement already satisfied: pandas>=1.3.0 in /usr/local/lib/python3.9/dist-packages (from yfinance) (1.5.3)
Requirement already satisfied: appdirs>=1.4.4 in /usr/local/lib/python3.9/dist-packages (from yfinance) (1.4.4)
Requirement already satisfied: numpy>=1.16.5 in /usr/local/lib/python3.9/dist-packages (from yfinance) (1.22.4)
Requirement already satisfied: requests>=2.26 in /usr/local/lib/python3.9/dist-packages (from yfinance) (2.27.1)
Requirement already satisfied: pytz>=2022.5 in /usr/local/lib/python3.9/dist-packages (from yfinance) (2022.7.1)
Requirement already satisfied: cryptography>=3.3.2 in /usr/local/lib/python3.9/dist-packages (from yfinance) (40.0.2)
Requirement already satisfied: requests[security]>=2.26 in /usr/local/lib/python3.9/dist-packages (from yfinance) (2.3.1)
Requirement already satisfied: lmfit>=0.9.1 in /usr/local/lib/python3.9/dist-packages (from yfinance) (4.9.2)
Requirement already satisfied: html5lib>=1.1 in /usr/local/lib/python3.9/dist-packages (from yfinance) (1.1)
Requirement already satisfied: soupsieve>=1.2 in /usr/local/lib/python3.9/dist-packages (from beautifulsoup4>=4.11.1->yfinance) (2.4.1)
Requirement already satisfied: cffi>=1.12 in /usr/local/lib/python3.9/dist-packages (from cryptography>=3.3.2->yfinance) (1.15.1)
Requirement already satisfied: webencodings in /usr/local/lib/python3.9/dist-packages (from html5lib>=1.1-yfinance) (0.5.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.9/dist-packages (from html5lib>=1.1-yfinance) (1.16.0)
Requirement already satisfied: requests[certifi]>=2.26 in /usr/local/lib/python3.9/dist-packages (from yfinance) (2.8.2)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /usr/local/lib/python3.9/dist-packages (from requests>=2.26->yfinance) (1.26.15)
Requirement already satisfied: idna>=2.5 in /usr/local/lib/python3.9/dist-packages (from requests>=2.26->yfinance) (3.4)
Requirement already satisfied: charset-normalizer>=2.0.0 in /usr/local/lib/python3.9/dist-packages (from requests>=2.26->yfinance) (2.0.12)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.9/dist-packages (from requests>=2.26->yfinance) (2022.12.7)
Requirement already satisfied: pycparser in /usr/local/lib/python3.9/dist-packages (from cffi>=1.12->cryptography>=3.3.2->yfinance) (2.21)
```

Q [8] import yfinance as yf
import ta
import pandas as pd
from backtesting import Backtest, Strategy
from backtesting.lib import crossover

Q [12] class SMACross(Strategy):
short term window
n1 = 50
long term window
n2 = 100

def init(self):
close = self.data.Close
self.sma1 = self.I(ta.trend.sma_indicator, pd.Series(close), self.n1)
self.sma2 = self.I(ta.trend.sma_indicator, pd.Series(close), self.n2)

def next(self):
if crossover(self.sma1, self.sma2):
self.buy()
elif crossover(self.sma2, self.sma1):
self.sell()

Q [14] df = yf.download('BTC-USD', start = '2018-01-01')
[*****100*****] 1 of 1 completed

Q [15] bt = Backtest(df, SMACross, cash = 100000, commission = 0.002, exclusive_orders = True)

Q [16] output = bt.run()
output

	Start	2018-01-01 00:00:00	End	2023-04-23 00:00:00	Duration	1938 days 00:00:00
Exposure Time [%]		91.847265				
Equity Final [\$]		171978.302833				
Equity Peak [\$]		451241.245956				
Return [%]		71.78303				
Buy & Hold Return [%]		1.532661				
Return (Ann.) [%]		10.75128				
Volatility (Ann.) [%]		77.520875				
Sharpe Ratio		0.138689				
Sortino Ratio		0.241606				
Calmar Ratio		0.146433				
Max. Drawdown [%]		-73.472866				
Avg. Drawdown [%]		-12.787293				
Max. Drawdown Duration		740 days 00:00:00				
Avg. Drawdown Duration		71 days 00:00:00				
# Trades		19				
Win Rate [%]		47.368421				
Best Trade [%]		160.225878				
Worst Trade [%]		-47.540579				
Avg. Trade [%]		2.975816				
Max. Trade Duration		208 days 00:00:00				
Avg. Trade Duration		94 days 00:00:00				
Profit Factor		2.107172				
Expectancy [%]		12.671089				
SQN		0.249794				
_strategy		SMACross				
_equity_curve		...				
_trades		Size Entry...				
dtype:	object					

Q [17] bt.plot()



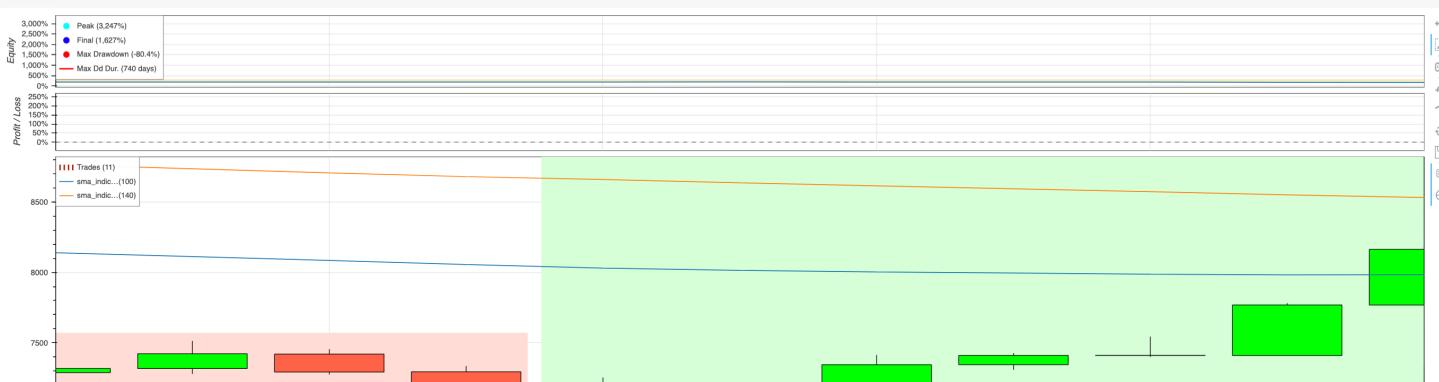
optimization

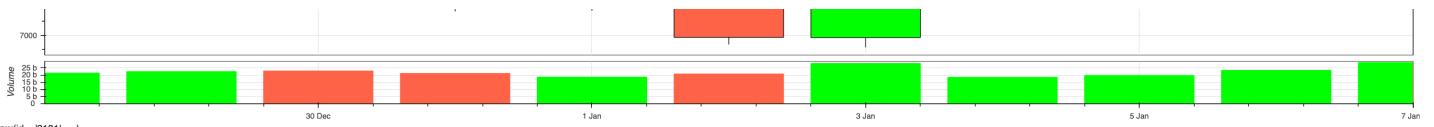
```
✓ [22] optim = bt.optimize(n1 = range(50, 160, 10),
    n2 = range(50, 160, 10),
    constraint = lambda x: x.n2 - x.n1 > 20,
    maximize = 'Win Rate [%]')
bt.plot()
```



```
✓ [23] optim
Start          2018-01-01 00:00:00
End            2023-04-23 00:00:00
Duration       1938 days 00:00:00
Exposure Time [%]      85.03612
Equity Final [$]   1627404.74879
Equity Peak [$]    3247125.00076
Return (%)        151.493749
Buy & Hold Return [%] 101.533861
Return (Ann.) [%]   69.110764
Volatility (Ann.) [%] 126.565586
Sharp Ratio        0.546047
Sortino Ratio     1.684796
Calmness Ratio    0.859912
Max Drawdown [%]   -0.3949
Avg. Drawdown [%]  -8.251832
Max. Drawdown Duration 740 days 00:00:00
Avg. Drawdown Duration 34 days 00:00:00
# Trades           11
Win Rate [%]       72.727273
Best Trade [%]     255.040582
Worst Trade [%]    -31.650937
Avg. Trade [%]    10.000076
Max. Trade Duration 388 days 00:00:00
Avg. Trade Duration 150 days 00:00:00
Profit Factor      11.517181
Expectancy [%]     42.375209
SQN                1.105255
_strategy          SMAcross(n1=100, ...
_equity_curve       ...
_irades             Size EntryB...
dtype: object
```

```
✓ [20] optim = bt.optimize(n1 = range(50, 160, 10),
    n2 = range(50, 160, 10),
    constraint = lambda x: x.n2 - x.n1 > 20,
    maximize = 'Return [%]')
bt.plot()
```





Row(id = '2181', ...)

```
✓ [21] optim
0s
Start      2018-01-01 00:00:00
End        2023-04-23 00:00:00
Duration   1938 days 00:00:00
Exposure Time [%]  72.727273
Equity Final [$]  1627404.74379
Equity Peak [$]  3247125.694376
Return [%]    1527.404749
Buy & Hold Return [%] 101.533861
Return (Ann.) [%]  69.110764
Volatility (Ann.) [%] 126.565386
Sharpe Ratio    0.546047
Sortino Ratio   0.546047
Calmar Ratio   0.859912
Max. Drawdown [%] -80.369549
Avg. Drawdown [%] -8.251832
Max. Drawdown Duration 740 days 00:00:00
Avg. Drawdown Duration 34 days 00:00:00
# Trades       11
Win Rate [%]  72.727273
Best Trade [%] 255.040692
Worst Trade [%] -31.650937
Avg. Trade [%] 29.172878
Max. Trade Duration 388 days 00:00:00
Avg. Trade Duration 150 days 00:00:00
Profit Factor  11.517181
Expectancy [%] 42.375209
SQN           1.105255
_strategy     SMAcross(n1=100, ...
_equity_curve ...
_trades       Size EntryB...
dtype: object
```

```
✓ [22] optim = bt.optimize(n1 = range(50, 160, 10),
                           n2 = range(50, 160, 10),
                           constraint = lambda x: x.n2 - x.n1 > 20,
                           maximize = 'Sharpe Ratio')
bt.plot()
```



Row(id = '3645', ...)

```
✓ [25] optim
0s
Start      2018-01-01 00:00:00
End        2023-04-23 00:00:00
Duration   1938 days 00:00:00
Exposure Time [%]  84.468524
Equity Final [$]  1246783.547479
Equity Peak [$]  286613.000000
Return [%]    1146.78347
Buy & Hold Return [%] 101.533861
Return (Ann.) [%]  60.834657
Volatility (Ann.) [%] 108.961921
Sharpe Ratio    0.558311
Sortino Ratio   1.562081
Calmar Ratio   0.764263
Max. Drawdown [%] -80.399086
Avg. Drawdown [%] -8.294943
Max. Drawdown Duration 740 days 00:00:00
Avg. Drawdown Duration 35 days 00:00:00
# Trades       11
Win Rate [%]  72.727273
Best Trade [%] 255.140614
Worst Trade [%] -31.650937
Avg. Trade [%] 24.125106
Max. Trade Duration 387 days 00:00:00
Avg. Trade Duration 149 days 00:00:00
Profit Factor  8.5846
Expectancy [%] 40.960204
SQN           0.828641
_strategy     SMAcross(n1=110, ...
_equity_curve ...
_trades       Size EntryB...
dtype: object
```