

```
In [1]: import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

```
In [2]: # Load the Excel file
excel_file = pd.ExcelFile('E:\Derivatives Trading\TAIEX derivatives trading record

# Get the sheet you want to read
sheet_name = 'ForPython' # Replace with the name of the sheet you want to read
df = excel_file.parse(sheet_name)
```

```
In [3]: # Output data information
print(df.head())
```

	Date	PnL Index	TAIEX	VIX	Returns	Unnamed: 5	Unnamed: 6	\
0	2022-07-01	100.000000	14343.08	27.01	0.000000	NaN	NaN	
1	2022-07-04	95.577858	14217.06	27.56	-0.044221	NaN	NaN	
2	2022-07-05	93.953178	14349.20	27.18	-0.016998	NaN	NaN	
3	2022-07-06	92.057052	13985.51	29.40	-0.020182	NaN	NaN	
4	2022-07-07	92.698962	14335.27	28.26	0.006973	NaN	NaN	

	Base
0	100.0
1	NaN
2	NaN
3	NaN
4	NaN

```
In [4]: #*****Plotting setup*****#
# Generate some data
Date = df["Date"]
Date
y1 =df["PnL Index"]
y1
y2 = df["TAIEX"]
y2
```

```
Out[4]: 0      14343.08
1      14217.06
2      14349.20
3      13985.51
4      14335.27
...
282    16719.82
283    16634.51
284    16644.94
285    16789.69
286    16791.61
Name: TAIEX, Length: 287, dtype: float64
```

```
In [5]: # Get the maximum PnL value
max_pnl = df['PnL Index'].max()
max_pnl_date = df.loc[df['PnL Index']==max_pnl, 'Date'].values[0]
```

```
In [6]: # Create the plot and set the first y-axis (left)
fig, ax1 = plt.subplots()
plt.xticks(rotation=90)
ax1.plot(Date, y1, 'b-')
ax1.scatter(max_pnl_date, max_pnl, color='red', marker='*')
ax1.set_xlabel('Date')
ax1.set_ylabel('PnL Index (Base = 100)', color='b')
ax1.tick_params('y', colors='b')
```

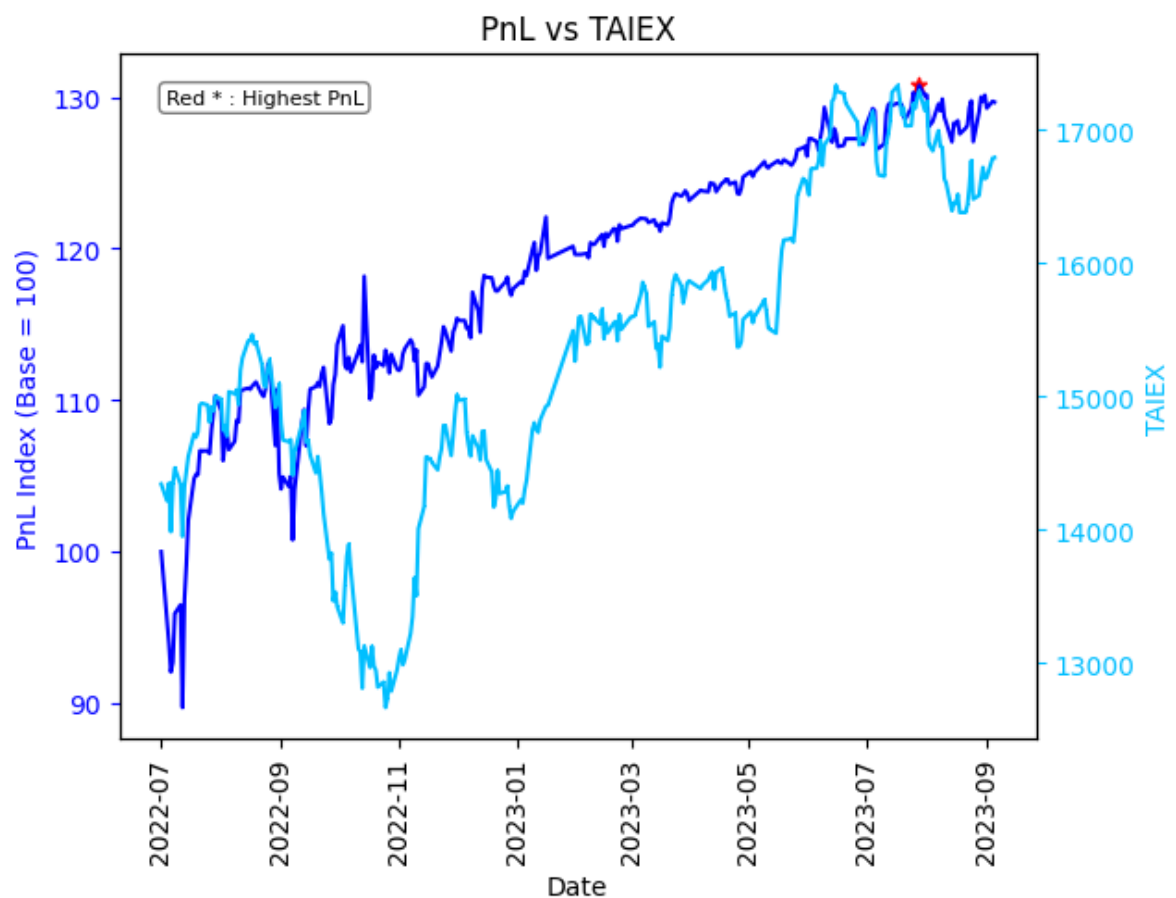
```

# Set the second y-axis (right)
ax2 = ax1.twinx()
ax2.plot(Date, y2, color='deepskyblue', marker=',')
ax2.set_ylabel('TAIEX', color='deepskyblue')
ax2.tick_params('y', colors='deepskyblue')

# Add message box
msg = "Red * : Highest PnL"
props = dict(boxstyle='round', facecolor='white', alpha=0.5)
ax1.text(0.05, 0.95, msg, transform=ax1.transAxes, fontsize=8,
         verticalalignment='top', bbox=props)

# Show the plot
plt.title('PnL vs TAIEX')
plt.show()

```



```

In [7]: #PnL vs VIX
y3 = df["VIX"]
y3

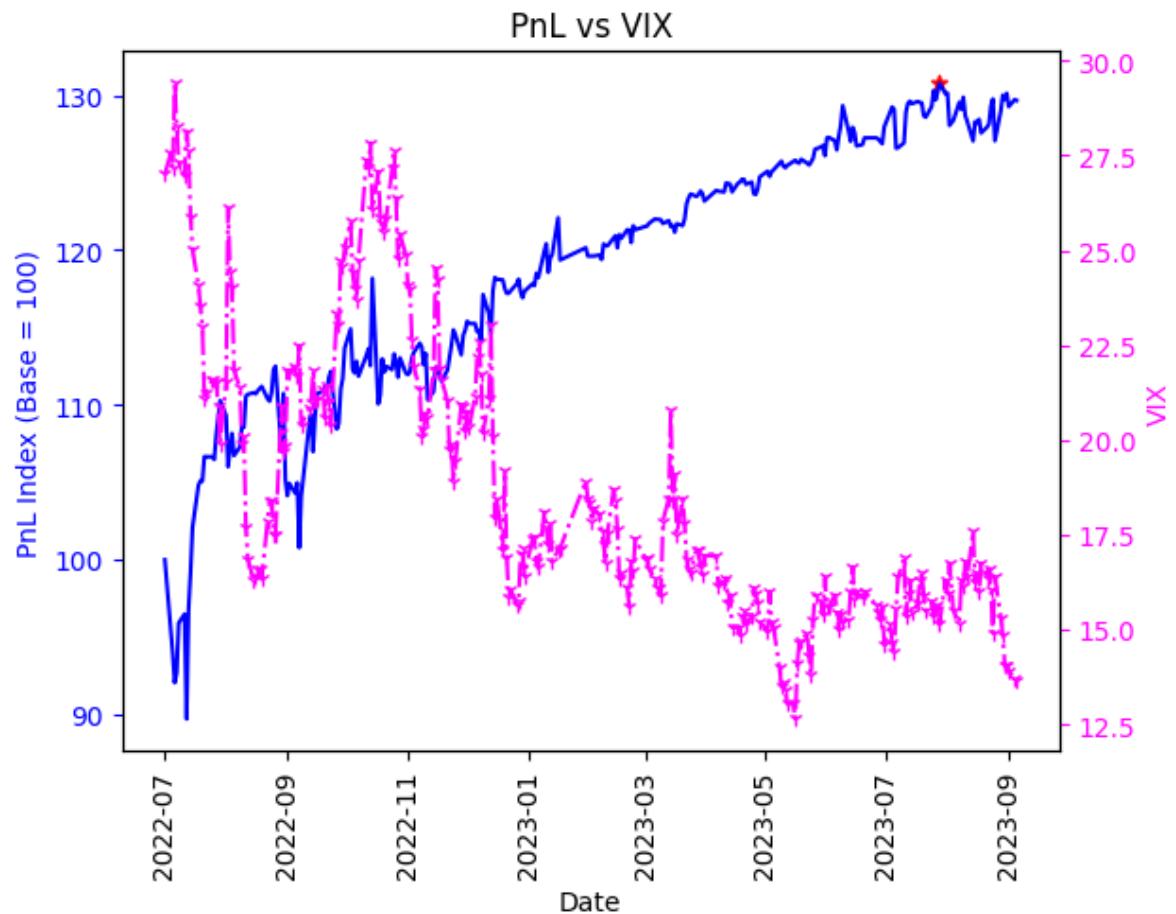
# Create the plot and set the first y-axis (left)
fig, ax1 = plt.subplots()
plt.xticks(rotation=90)
ax1.plot(Date, y1, 'b-')
ax1.scatter(max_pnl_date, max_pnl, color='red', marker='*')
ax1.set_xlabel('Date')
ax1.set_ylabel('PnL Index (Base = 100)', color='b')
ax1.tick_params('y', colors='b')

# Set the second y-axis (right)
ax3 = ax1.twinx()
ax3.plot(Date, y3, 'fuchsia', marker='1', linestyle='-.')
ax3.set_ylabel('VIX', color='fuchsia')

```

```
ax3.tick_params('y', colors='fuchsia')
```

```
# Show the plot
plt.title('PnL vs VIX')
plt.show()
```

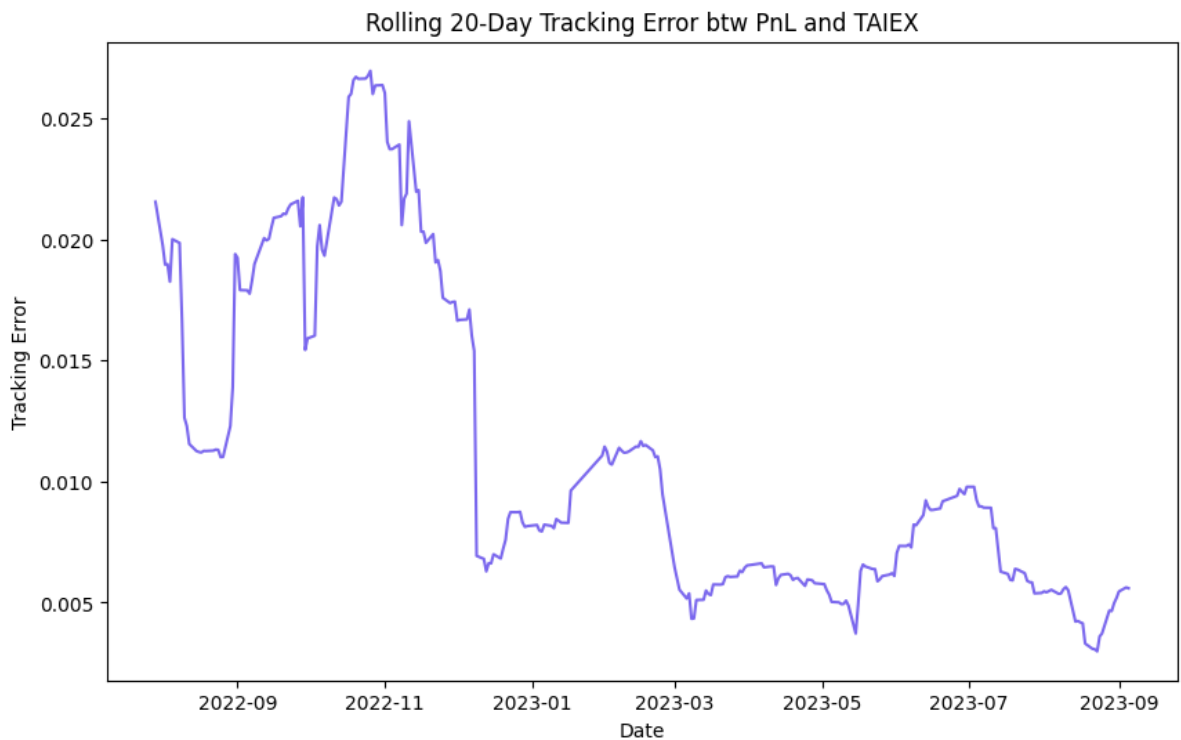


```
In [8]: #Tracking error between PnL and TAIEX
PNL_returns = df['PnL Index'].pct_change()
TAIEX_returns = df['TAIEX'].pct_change()
diff_returns = PNL_returns - TAIEX_returns
tracking_error = diff_returns.std()

roll_te = diff_returns.rolling(20).std()

plt.figure(figsize=(10, 6))
plt.title('Rolling 20-Day Tracking Error btw PnL and TAIEX')
plt.plot(df['Date'], roll_te, color='mediumslateblue')
plt.xlabel('Date')
plt.ylabel('Tracking Error')
plt.show()

#Comment
#Apparently, when market is in turmoil, tracking error will be widen, and vice versa
#Due to the fact that my derivatives position is well hedged against the market shock
```



```
In [9]: #Historical volatility
#GARCH model volatility

from arch import arch_model
from scipy.stats import mstats

# Calculate log returns
log_returns = np.log(y2/y2.shift(1))

# Remove NaN values
log_returns = log_returns.dropna()

# Winsorize outliers
log_returns = mstats.winsorize(log_returns, limits=0.1)

# Fit GARCH model
garch = arch_model(log_returns, p=1, q=1, dist='StudentsT')
garch_fit = garch.fit(update_freq=10)

# Extract volatility
sigma = garch_fit.conditional_volatility
annual_vol = sigma.mean()*np.sqrt(250)*100

print(annual_vol)
```

```
Iteration:    10,   Func. Count:    103,   Neg. LLF: 1467.7068297678709
Iteration:    20,   Func. Count:    181,   Neg. LLF: 1454.462163334124
Optimization terminated successfully   (Exit mode 0)
      Current function value: -795.4532810632127
      Iterations: 25
      Function evaluations: 190
      Gradient evaluations: 21
40.65404999895397
```

C:\Users\sigma\anaconda3\lib\site-packages\arch\univariate\base.py:309: DataScaleWarning: y is poorly scaled, which may affect convergence of the optimizer when estimating the model parameters. The scale of y is 6.2e-05. Parameter estimation work better when this value is between 1 and 1000. The recommended rescaling is 100 * y.

This warning can be disabled by either rescaling y before initializing the model or by setting rescale=False.

```
warnings.warn(
```

```
In [10]: #####Scientific experiment#####
#Least Squares algo
from scipy.optimize import least_squares

# Set lower and upper bounds
bounds = (10, 45)

# Objective function
def f(vix, PNL_returns, TAIEX_returns):
    diff = (TAIEX_returns* annual_vol.std() )-(PNL_returns*vix.std())
    return diff.std()

# Set initial guess within bounds
x0 = [15.0]

# By using Trust Region Reflective (bounded)
result1 = least_squares(f, x0, bounds=bounds, method='trf', args=(TAIEX_returns, PNL_returns))
optimal_vix = result1.x[0]

print("Optimal VIX:", optimal_vix)
print("Minimum Tracking Error:", f(optimal_vix, TAIEX_returns, PNL_returns))

# By using Levenberg-Marquardt algo (unbounded)
result2 = least_squares(f, x0, method='lm', args=(TAIEX_returns, PNL_returns))
optimal_vix = result2.x[0]

print("Optimal VIX:", optimal_vix)
print("Minimum Tracking Error:", f(optimal_vix, TAIEX_returns, PNL_returns))

#Source: https://github.com/scipy/scipy/blob/v1.9.1/scipy/optimize/_lsq/least_squares.py
## 'lm' : Levenberg-Marquardt algorithm as implemented in MINPACK.
# Doesn't handle bounds and sparse Jacobians. Usually the most
# efficient method for small unconstrained problems.
## 'trf' : Trust Region Reflective algorithm, particularly suitable
# for large sparse problems with bounds. Generally robust method.

Optimal VIX: 15.0
Minimum Tracking Error: 0.0
Optimal VIX: 15.0
Minimum Tracking Error: 0.0
```

```
In [11]: #####Performance#####
#Sharpe ratio
# Read in the portfolio returns data from a CSV file
R_first=df["PnL Index"].iloc[0,]
R_first
R_last = df["PnL Index"].iloc[-1] #Always excel's actual row-2
R_last
```

Out[11]: 129.66605407331133

```
In [12]: portfolio_returns=(R_last-R_first)/R_first
portfolio_returns
```

Out[12]: 0.2966605407331133

```
In [13]: daily_returns=df["Returns"]
daily_returns
```

Out[13]:

0	0.000000
1	-0.044221
2	-0.016998
3	-0.020182
4	0.006973
...	
282	-0.001958
283	0.002878
284	-0.006605
285	0.003504
286	-0.000442

Name: Returns, Length: 287, dtype: float64

```
In [14]: # Max Drawdown Calculation for PnL Index
cumulative_returns = (1 + df["Returns"]).cumprod()
cumulative_max = cumulative_returns.cummax()
drawdown = (cumulative_returns / cumulative_max) - 1
max_drawdown = drawdown.min()

print("Max Drawdown:", max_drawdown)
```

Max Drawdown: -0.10420949154156467

```
In [15]: # Calculate the Profit Factor
positive_returns = daily_returns[daily_returns > 0].sum()
negative_returns = daily_returns[daily_returns < 0].sum()

# Avoid division by zero
if negative_returns != 0:
    profit_factor = abs(positive_returns / negative_returns)
else:
    profit_factor = float('inf')

print("Profit Factor:", profit_factor)
```

Profit Factor: 1.2998278207888705

```
In [16]: # Calculate the excess returns and standard deviation
risk_free_rate = 0.0145 # Taiwan savings rate
excess_returns = portfolio_returns - risk_free_rate
std_dev = np.std(daily_returns)
print("Standard Deviation of Daily Return:", std_dev)
```

Standard Deviation of Daily Return: 0.013488427373292436

```
In [17]: # Calculate the Sharpe ratio
Sharpe_Ratio = excess_returns / std_dev
print("Sharpe Ratio:", Sharpe_Ratio)
```

Sharpe Ratio: 20.918712977007324

```
In [18]: #Annualized Sharpe ratio
risk_free_rate_daily = (1 + risk_free_rate) ** (1/250) - 1
risk_free_rate_daily
```

```

average_daily_returns = daily_returns.sum()/250
average_daily_returns
excess_daily_return=average_daily_returns-risk_free_rate_daily
excess_daily_return

Annualized_Sharpe_Ratio=excess_daily_return/std_dev*np.sqrt(250)
print("Annualized Sharpe Ratio:", Annualized_Sharpe_Ratio)

```

Annualized Sharpe Ratio: 1.274208304218116

```

In [19]: #Portfolio Alpha
# Compute the mean returns
mean_PNL = PNL_returns.mean()
mean_TAIEX = TAIEX_returns.mean()

# Compute beta
covariance = PNL_returns.cov(TAIEX_returns)
variance = TAIEX_returns.var()
beta = covariance / variance
beta

# Compute alpha (assuming risk-free rate is 0)
alpha = (mean_PNL - (risk_free_rate_daily +beta * mean_TAIEX))*np.sqrt(250)

# Print alpha
print("Alpha: ", alpha)

```

Alpha: 0.010165158483364418

In []:

In []: