Will implement cointegration arbitrage strategy using Johansen Test (Pairs Trading). Eigenvalues are very small theefore this pair is not the best. Will update later.

In [1]:
```
import numpy as np
import pandas as pd
import statsmodels.api as sm
from statsmodels.tsa.vector_ar.vecm import coint_johansen
import matplotlib.pyplot as plt
import yfinance as yf
```

In [14]:
```
start_date = '2020-01-01'
KO = yf.download('KO', start=start_date)['Close']
PEP = yf.download('PEP', start=start_date)['Close']

data = pd.DataFrame({'Coca-Cola': KO, 'Pepsi': PEP})
```

```
[*********************100%***********************]  1 of 1 completed
[*********************100%***********************]  1 of 1 completed
```

In [15]:
```
data.head(5)
```

Out[15]:

Date	Coca-Cola	Pepsi
2020-01-02	54.990002	135.820007
2020-01-03	54.689999	135.630005
2020-01-06	54.669998	136.149994
2020-01-07	54.250000	134.009995
2020-01-08	54.349998	134.699997

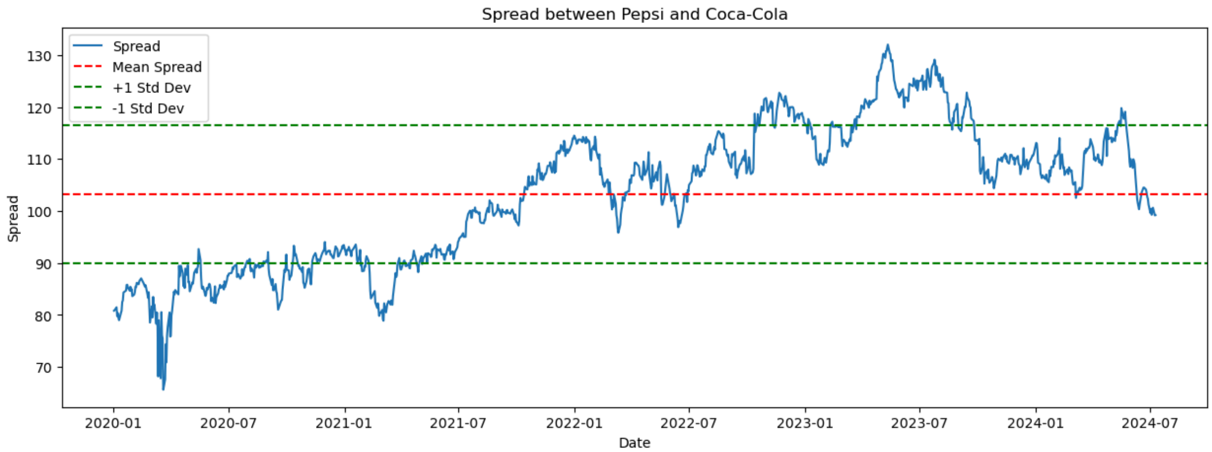
In [16]:
```
def johansen_test(data, det_order=-1, k_ar_diff=1):
    result = coint_johansen(data, det_order, k_ar_diff)
    return result

johansen_result = johansen_test(data)
print("Eigenvalues:", johansen_result.eig)
print("Critical values:", johansen_result.cvt)
```

```
Eigenvalues: [7.32757397e-03 4.79145737e-05]
Critical values: [[10.4741 12.3212 16.364 ]
 [ 2.9762  4.1296  6.9406]]
```

In [18]:
```
data['Spread'] = data['Pepsi'] - data['Coca-Cola']
plt.figure(figsize=(15, 5))
plt.plot(data.index, data['Spread'], label='Spread')
plt.axhline(data['Spread'].mean(), color='red', linestyle='--', label='Mean
plt.axhline(data['Spread'].mean() + data['Spread'].std(), color='green', lin
plt.axhline(data['Spread'].mean() - data['Spread'].std(), color='green', lin
plt.title('Spread between Pepsi and Coca-Cola')
plt.xlabel('Date')
```

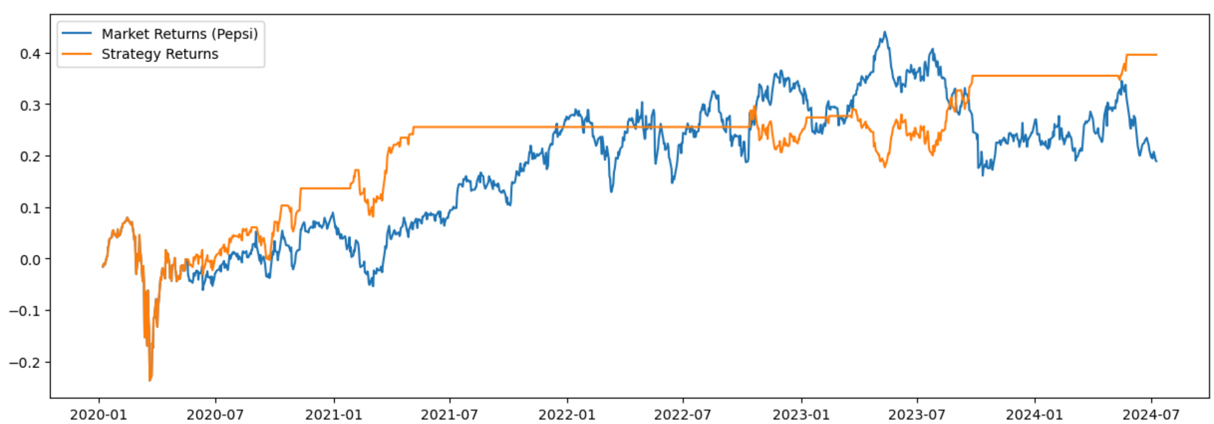
```
plt.ylabel('Spread')
plt.legend()
plt.show()
```



In [19]:
```
mean_spread = data['Spread'].mean()
std_spread = data['Spread'].std()
data['Signal'] = 0
data.loc[data['Spread'] > mean_spread + std_spread, 'Signal'] = -1
data.loc[data['Spread'] < mean_spread - std_spread, 'Signal'] = 1
```

In [21]:
```
data['Position'] = data['Signal'].shift()
data.dropna(inplace=True)
data['Returns'] = data['Pepsi'].pct_change()
data['Strategy'] = data['Position'] * data['Returns']
data['Cumulative Market Returns'] = (1 + data['Returns']).cumprod() - 1
data['Cumulative Strategy Returns'] = (1 + data['Strategy']).cumprod() - 1
```

In [22]:
```
plt.figure(figsize=(15, 5))
plt.plot(data['Cumulative Market Returns'], label='Market Returns (Pepsi)')
plt.plot(data['Cumulative Strategy Returns'], label='Strategy Returns')
plt.legend()
plt.show()
```



In [23]:
```
def evaluate_performance(data):
    total_return = data['Cumulative Strategy Returns'].iloc[-1]
    annualized_return = ((1 + total_return) ** (252.0 / len(data))) - 1
    annualized_volatility = data['Strategy'].std() * np.sqrt(252)
    sharpe_ratio = annualized_return / annualized_volatility
```

```
    print(f"Total Return: {total_return:.2f}")
    print(f"Annualized Return: {annualized_return:.2f}")
    print(f"Annualized Volatility: {annualized_volatility:.2f}")
    print(f"Sharpe Ratio: {sharpe_ratio:.2f}")

evaluate_performance(data)
```

```
Total Return: 0.40
Annualized Return: 0.08
Annualized Volatility: 0.18
Sharpe Ratio: 0.42
```

In [ ]: