Strategic Investment Analysis

[1]:

```
import matplotlib.pyplot as plt import
matplotlib.ticker as ticker import numpy as
np
import pandas as pd
import pandas_datareader as pdr import
seaborn as sns
import yfinance as yf
```

[2]:

```
sns.set_theme()
```

[3]:

```
investment = 10_000
```

[4]:

```
strategies = ['RF', 'S1', 'S2', 'S3', 'S4a', 'S4b', 'S4c']
```

[5]:

```
def get_decade(x, d):
    return x.loc[str(d): str(d+9)].copy()
```

[6]:

```
def calc_strat_4(r, n=1): r_all = []
    for y in r.index.year.unique(): r_year =
        r.loc[str(y)].copy()
        nsmallest_indices = r_year.nsmallest(n=n).index
        nlargest_indices = r_year.nlargest(n=n).index
        r_year.loc[nsmallest_indices] = 0
        r_year.loc[nlargest_indices] = 0
        r_all.append(r_year)

    return pd.concat(r_all)
```

[7]:

```
def calc_stats(x):
    x_rf = x.sub(x['RF'], axis=0)
    return pd.concat(
        objs=[
            x.mean().mul(252),
            x.std().mul(np.sqrt(252)),
            np.sqrt(252) * x_rf.mean() / x_rf.std()
        ],
        keys=['mean', 'std', 'sharpe'],
            names=['Statistic'], axis=1
        )
```

[8]:

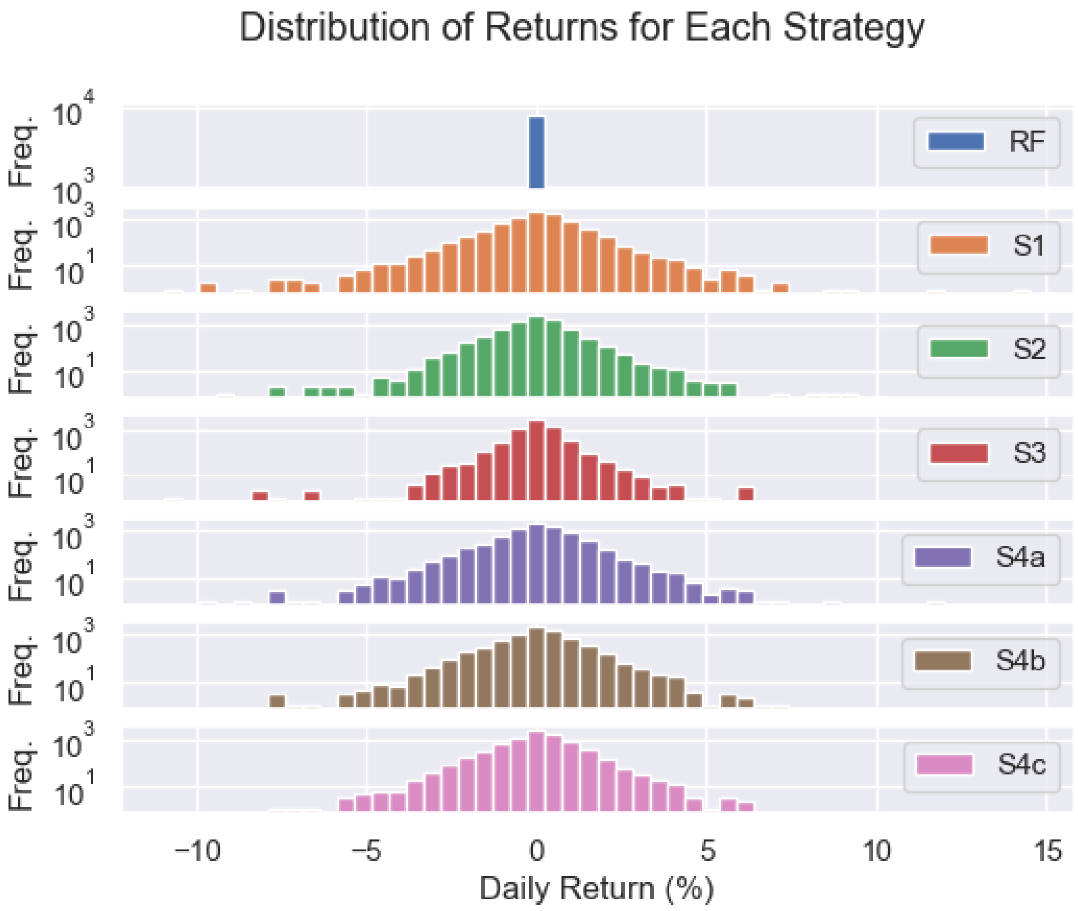
```
import warnings
with warnings.catch_warnings(): warnings.simplefilter(action='ignore',
        category=FutureWarning)

        df = (
                yf.download(tickers='SPY')
                .join(pdr.DataReader(
                                name='F-F_Research_Data_Factors_daily',
                                data_source='famafrench',
                                start='1900'
                        ) [0]
                        .div(100)
                )
                .assign(
                        r=lambda x: x['Adj Close'].pct_change(), S1=lambda x: x['r'],
                        S2=lambda x: x['Close'] / x['Open'] - 1,
                        S3=lambda x: (1 + x['r']) / (1 + x['S2']) - 1, S4a=lambda x:
                        calc_strat_4(r=x['r'], n=1), S4b=lambda x: calc_strat_4(r=x['r'],
                        n=2), S4c=lambda x: calc_strat_4(r=x['r'], n=3),
                )
        )
```

[9]:

```
returns = df[strategies].dropna().rename_axis(columns='Strategy') returns_tot =
returns.add(1).prod().sub(1)
returns_cum = returns.add(1).cumprod().sub(1)

stats = returns.pipe(calc_stats)
decades = ((returns.index.year // 10 ) * 10).unique().to_list() stats_dec = pd.concat(
        objs=[returns.pipe(get_decade, d=d).pipe(calc_stats) for d in decades], keys=decades,
        names=['Decade']
)
```

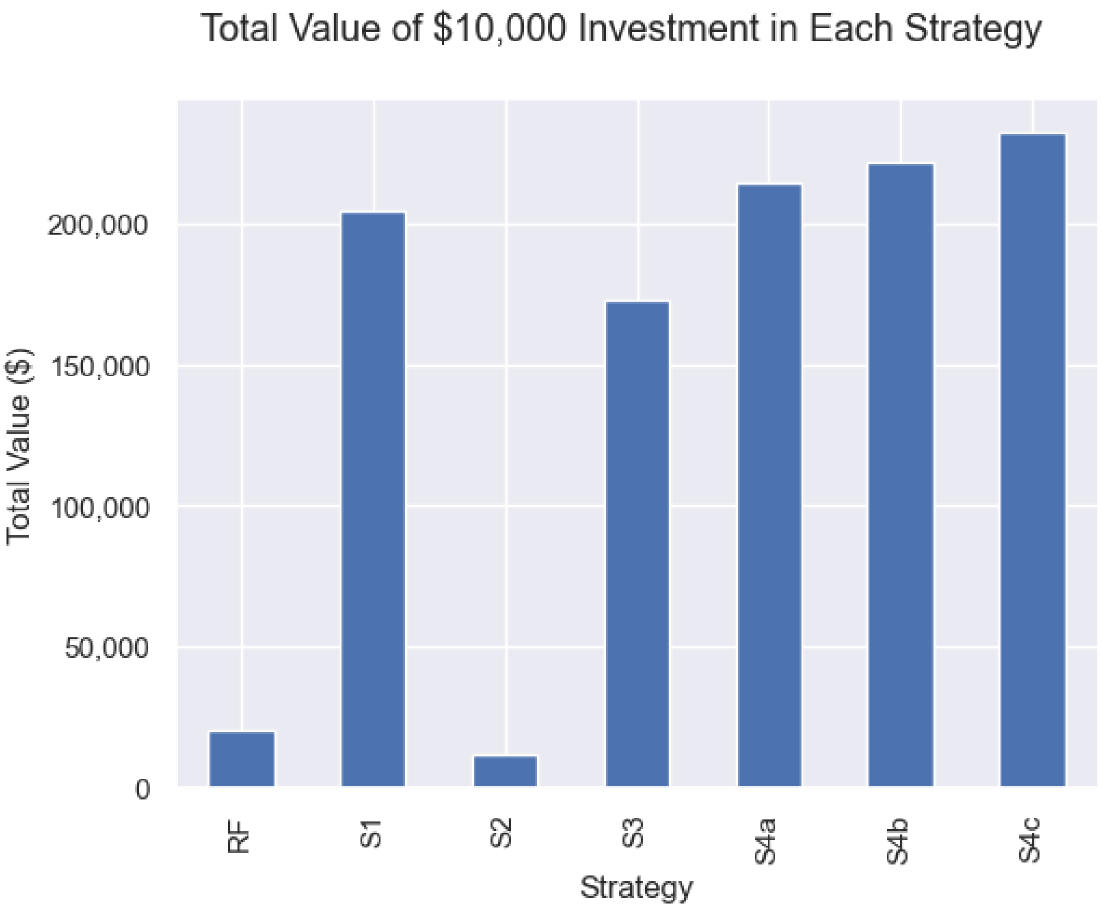
[10]:

```
axes = returns.mul(100).plot(kind='hist', bins=50, logy=True, subplots=True)
for ax in axes: ax.set_ylabel('Freq.')
plt.xlabel('Daily Return (%)')
plt.suptitle('Distribution of Returns for Each Strategy')
plt.show()
```



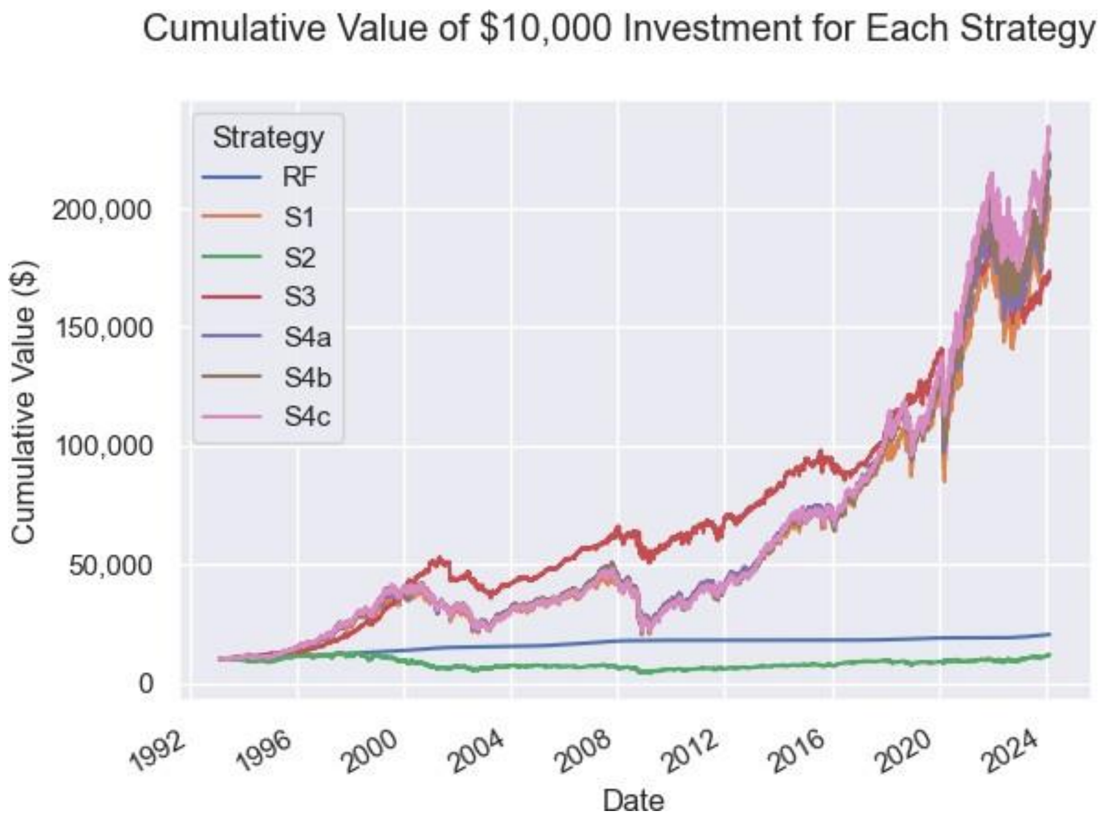
[11]:

```
returns_tot.add(1).mul(investment).plot(kind='bar')
plt.gca().yaxis.set_major_formatter(ticker.FuncFormatter(lambda x, p: ␣
  ↪format(int(x), ','))) plt.ylabel('Total Value ($)')
plt.suptitle(f'Total Value of ${investment:,.0f} Investment in Each Strategy') plt.show()
```

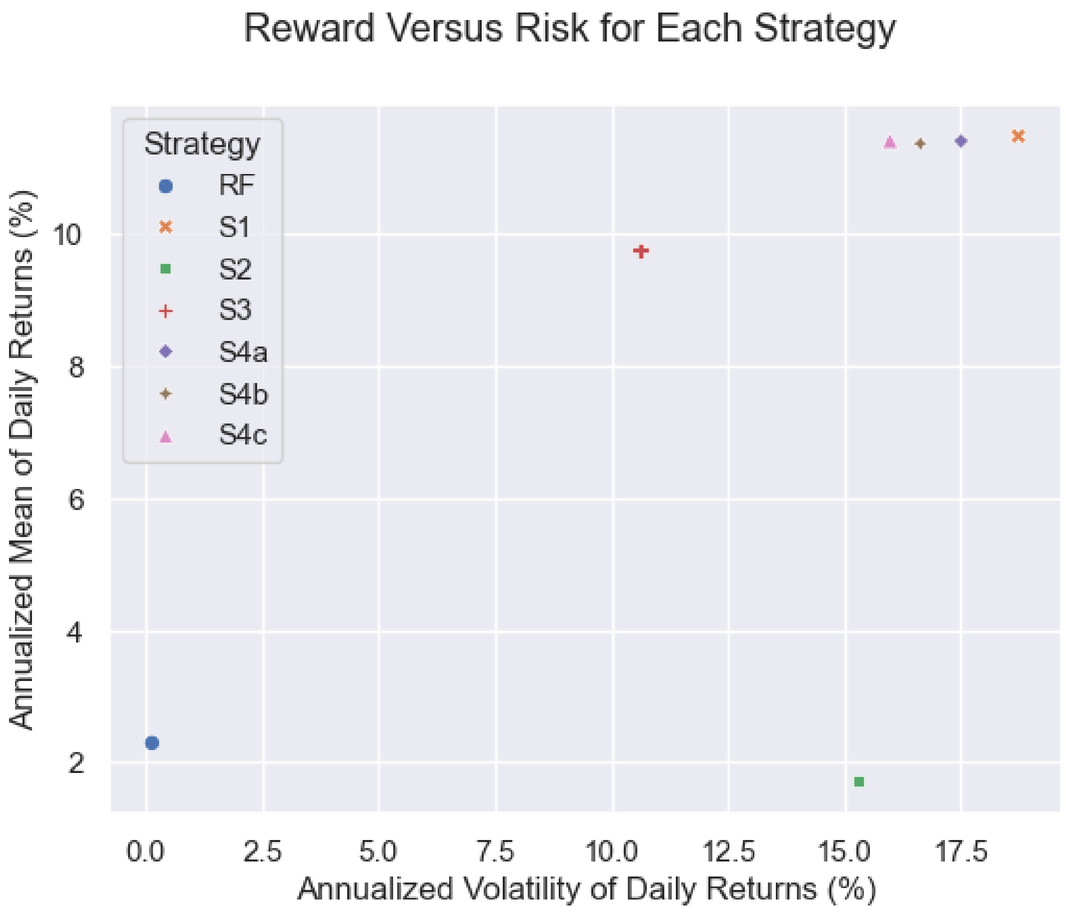


[12]:

```
returns_cum.add(1).mul(investment).plot()
plt.gca().yaxis.set_major_formatter(ticker.FuncFormatter(lambda x, p: ␣
↪format(int(x), ','))) plt.ylabel('Cumulative
Value ($)')
plt.suptitle(f'Cumulative Value of ${investment:,.0f} Investment for Each ␣

↪Strategy')
plt.show()
```

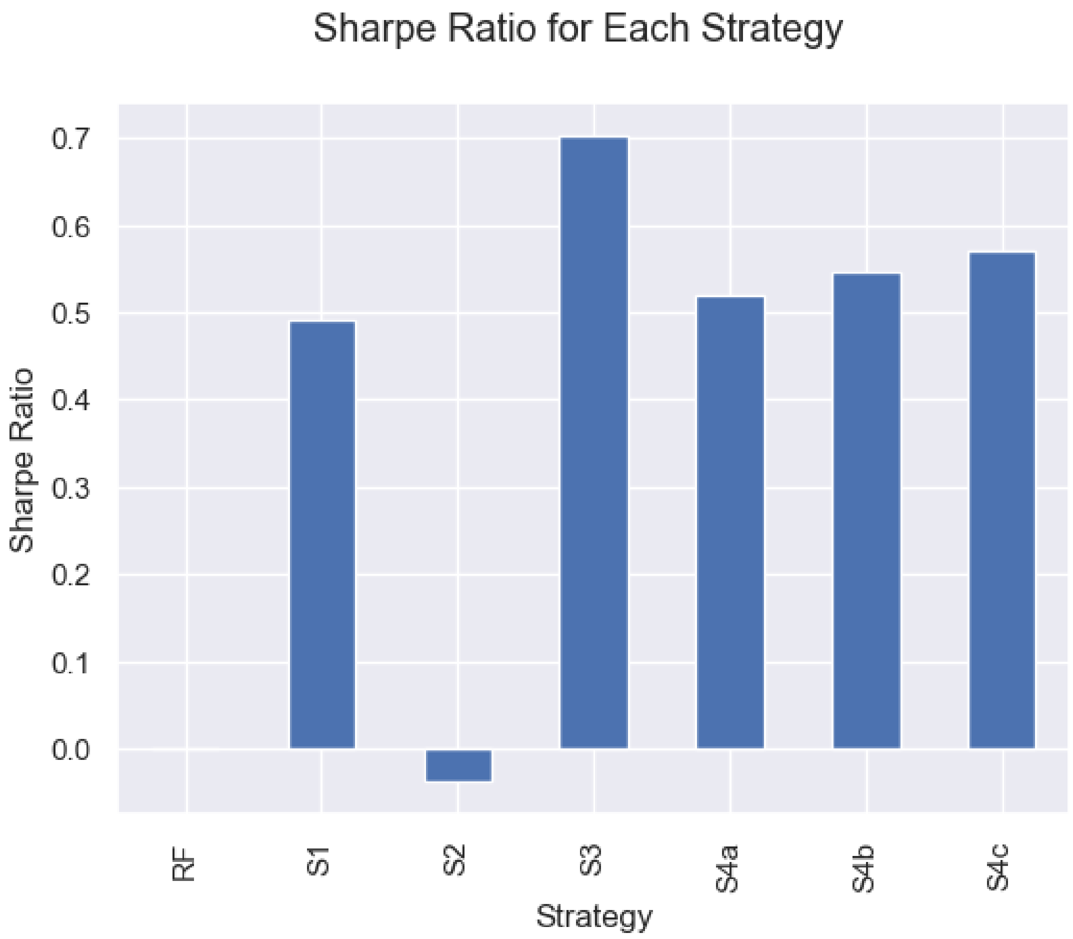


```
[13]:   (
            returns
            .pipe(calc_stats)
            .mul(100)
            .reset_index()
            .pipe(
                sns.scatterplot, x='std',
                y='mean', hue='Strategy',
                style='Strategy',
            )
        )

        plt.xlabel('Annualized Volatility of Daily Returns (%)') plt.ylabel('Annualized
        Mean of Daily Returns (%)') plt.suptitle('Reward Versus Risk for Each Strategy')
        plt.show()
```


Reward Versus Risk for Each Strategy

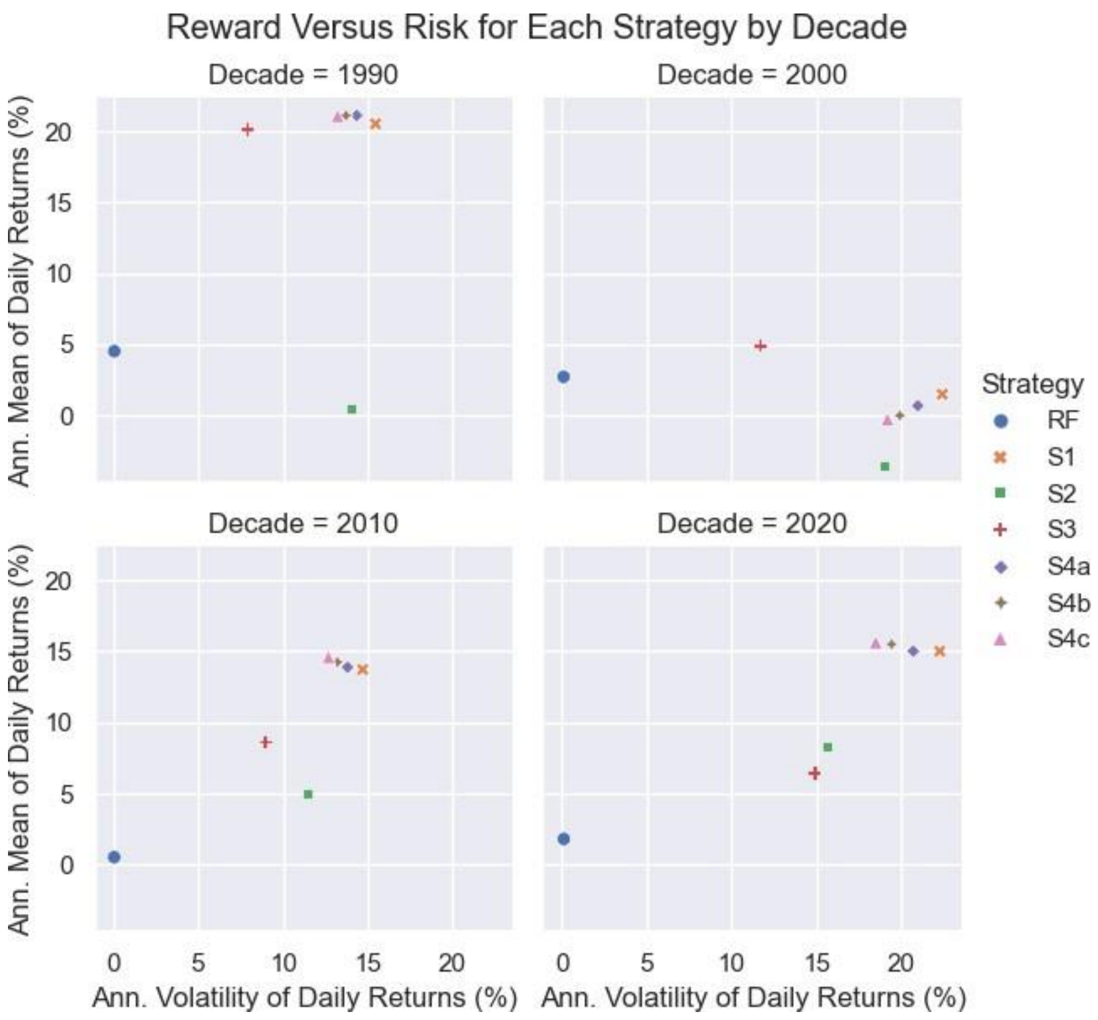
[14]:

```
stats['sharpe'].plot(kind='bar') plt.ylabel('Sharpe Ratio')
plt.suptitle(f'Sharpe Ratio for Each Strategy') plt.show()
```



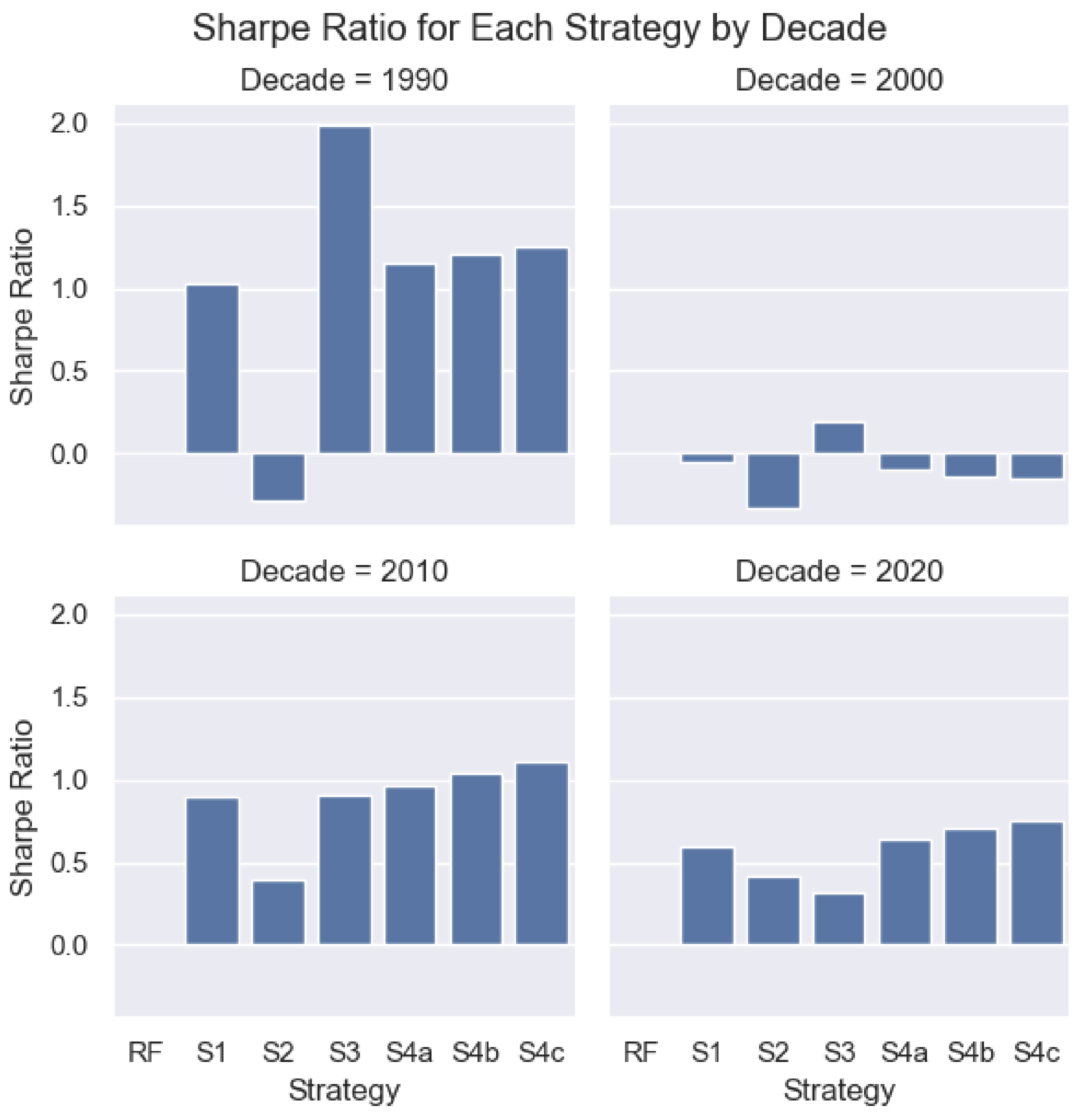
[15]:

```
(
    stats_dec
    .mul(100)
    .reset_index()
    .rename(columns={
        'mean': 'Ann. Mean of Daily Returns (%)', 'std': 'Ann.
        Volatility of Daily Returns (%)'
    })
    .pipe(
        sns.relplot,
        x='Ann. Volatility of Daily Returns (%)', y='Ann. Mean of Daily
        Returns (%)', hue='Strategy',
        style='Strategy',
        col='Decade',
        col_wrap=2, height=3
        )
)

plt.suptitle('Reward Versus Risk for Each Strategy by Decade', y=1.02) plt.show()
```



[16]:

```
(
        stats_dec
        .reset_index()
        .rename(columns={'sharpe': 'Sharpe Ratio'})
        .pipe(
                sns.catplot, y='Sharpe
                Ratio', x='Strategy',
                col='Decade',
            col_wrap=2,
            kind='bar',
            height=3
      )
)

plt.suptitle('Sharpe Ratio for Each Strategy by Decade', y=1.02) plt.show()
```


Sharpe Ratio for Each Strategy by Decade
Decade = 1990
Decade = 2000
Decade = 2010
Decade = 2020
Sharpe Ratio
Sharpe Ratio
RF
S1
S2
S3
S4a
S4b
S4c
RF
S1
S2
S3
S4a
S4b
S4c
Strategy
Strategy