Portfolio Allocation & Performance Evaluation

May 26, 2025

Import Data From yfinance

[23]:
```
import yfinance as yf
import pandas as pd
from datetime import datetime
tickers=['SPY','TLT','GLD','VNQ']
start_date='2018-01-01'
end_date='2025-01-01'
data=yf.download(tickers,start=start_date,end=end_date)['Close']
data.to_csv('/users/soniazhai/desktop/asset_close_price.csv')

data.head()
```

```
[**********************100%**********************]  4 of 4 completed
```

[23]:

Ticker	GLD	SPY	TLT	VNQ
Date				
2018-01-02	125.150002	239.273987	103.591774	62.563908
2018-01-03	124.820000	240.787445	104.087082	62.382263
2018-01-04	125.459999	241.802292	104.070557	61.307625
2018-01-05	125.330002	243.413712	103.773392	61.337914
2018-01-08	125.309998	243.858856	103.707390	61.655743

#Check data and clean data #The data is clean

[24]:
```
data.isnull().sum()
data.info()
data.describe()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 1761 entries, 2018-01-02 to 2024-12-31
Data columns (total 4 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   GLD     1761 non-null   float64
 1   SPY     1761 non-null   float64
 2   TLT     1761 non-null   float64
 3   VNQ     1761 non-null   float64
dtypes: float64(4)
memory usage: 68.8 KB
```

[24]:
Ticker	GLD	SPY	TLT	VNQ
count	1761.000000	1761.000000	1761.000000	1761.000000
mean	165.166576	365.752641	109.834736	76.199338
std	32.427607	98.033405	18.673818	11.155881
min	111.099998	207.294266	77.636787	47.022488
25%	140.110001	267.920837	94.888489	67.940277
50%	167.789993	372.791199	102.873604	75.611725
75%	180.649994	427.104279	125.363045	83.519974
max	257.500000	603.954346	150.316620	101.984337

Daily/Monthly Return Calculation and Visualization

[25]:
```
returns=data.pct_change().dropna()
monthly_return=data.resample('ME').ffill().pct_change().dropna()
print(monthly_return.head())
returns.head()
```

Ticker	GLD	SPY	TLT	VNQ
Date				
2018-02-28	-0.020760	-0.036360	-0.030415	-0.076778
2018-03-31	0.006320	-0.027411	0.028596	0.038908
2018-04-30	-0.009540	0.005168	-0.020881	0.008215
2018-05-31	-0.011959	0.024309	0.020044	0.036799
2018-06-30	-0.036149	0.005751	0.006458	0.042022

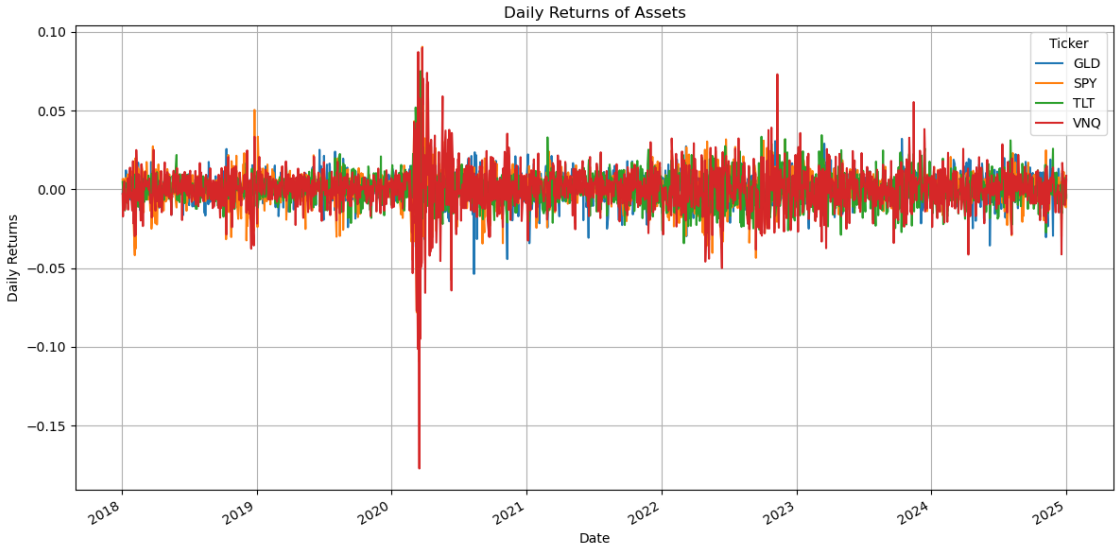
[25]:
Ticker	GLD	SPY	TLT	VNQ
Date				
2018-01-03	-0.002637	0.006325	0.004781	-0.002903
2018-01-04	0.005127	0.004215	-0.000159	-0.017227
2018-01-05	-0.001036	0.006664	-0.002855	0.000494
2018-01-08	-0.000160	0.001829	-0.000636	0.005182
2018-01-09	-0.004628	0.002263	-0.013373	-0.012888

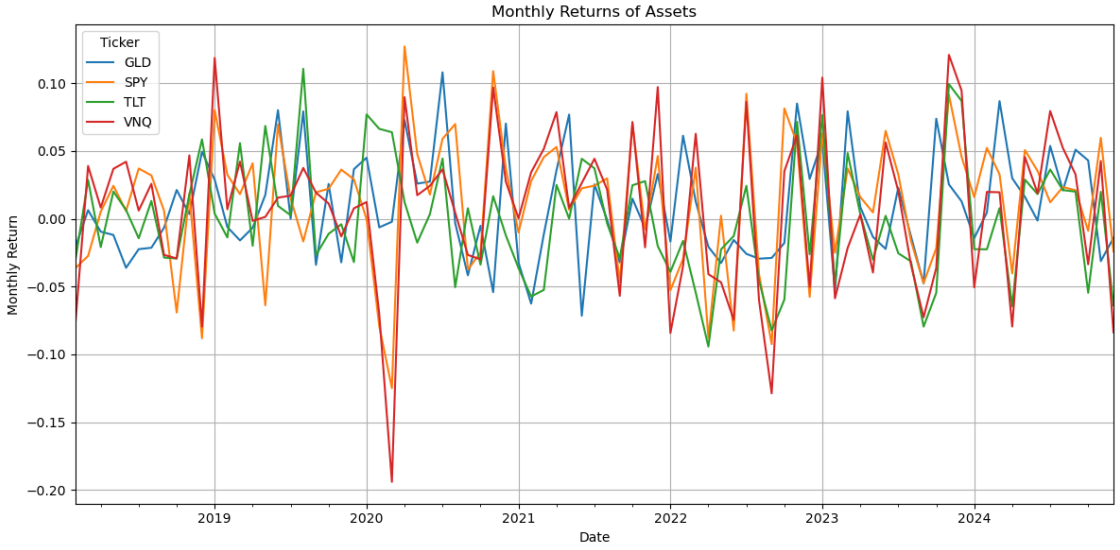
[26]:
```
import matplotlib.pyplot as plt

returns.plot(figsize=(12,6))
plt.title('Daily Returns of Assets')
plt.xlabel('Date')
plt.ylabel('Daily Returns')
plt.grid(True)
plt.tight_layout()
plt.show()

monthly_return.plot(figsize=(12,6))
plt.title('Monthly Returns of Assets')
plt.xlabel('Date')
plt.ylabel('Monthly Return')
plt.grid(True)
```

```
plt.tight_layout()
plt.show()
```





Portfolio Total Return & Cumulative Return

[27]:
```
weight_dict={'Aggressive':[0.6,0.1,0.2,0.1],'Balanced':[0.4,0.3,0.2,0.
  ↪1],'Conservative':[0.2,0.5,0.2,0.1]}
weight_portfolio=pd.DataFrame(weight_dict,index=tickers)
print(weight_portfolio)
print(returns)
```

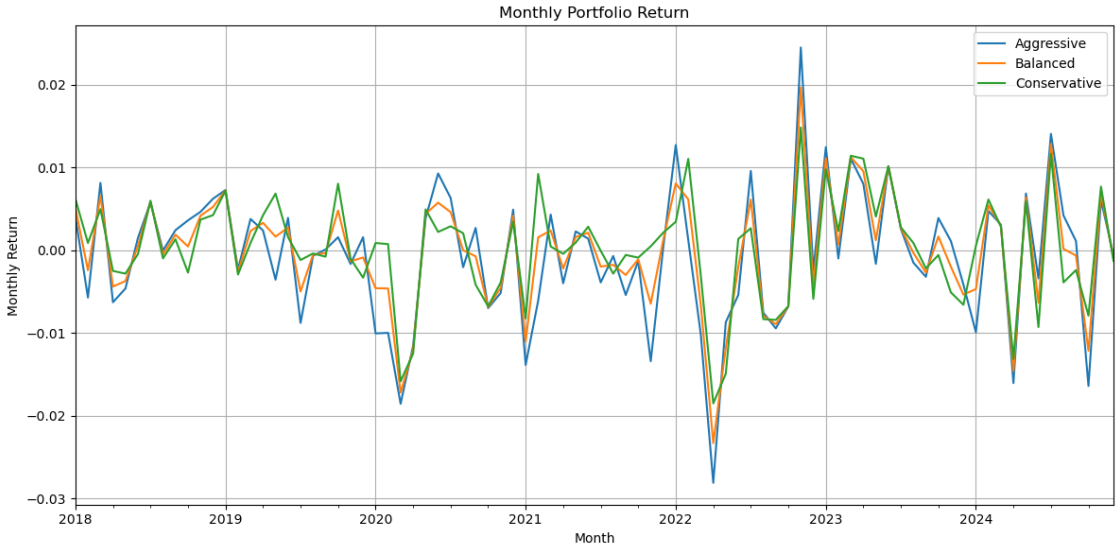
```
portfolio_returns=pd.DataFrame(index=returns.index)
for name in weight_portfolio.columns:
    weight=weight_portfolio[name]
    portfolio_returns[name]=(returns*weight).sum(axis=1)
cum_portfolio_return=(1+portfolio_returns).cumprod()
print(portfolio_returns.head())
print(cum_portfolio_return.head())
```

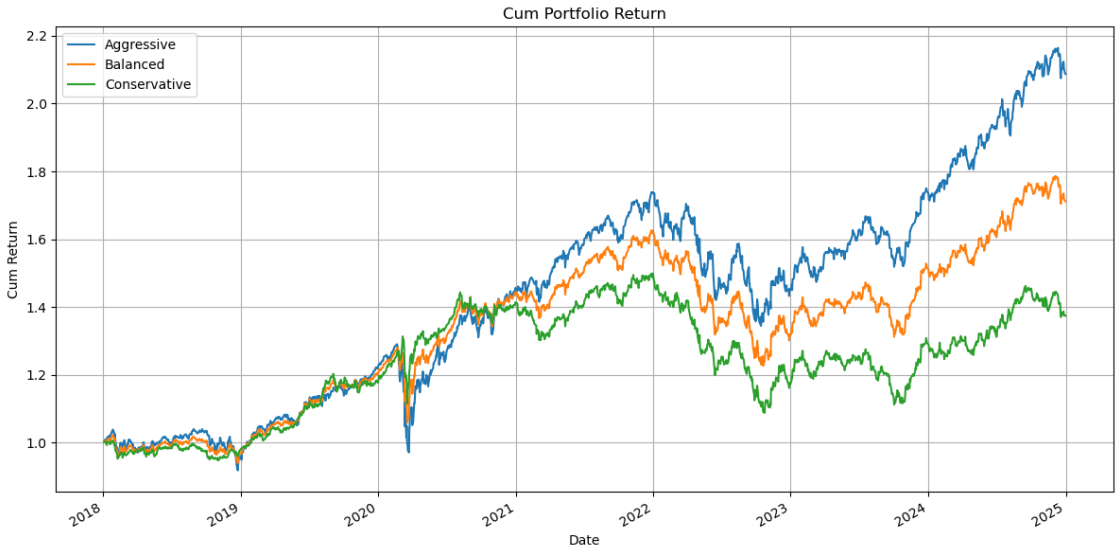
```
     Aggressive  Balanced  Conservative
SPY         0.6       0.4           0.2
TLT         0.1       0.3           0.5
GLD         0.2       0.2           0.2
VNQ         0.1       0.1           0.1
Ticker           GLD       SPY       TLT       VNQ
Date
2018-01-03 -0.002637  0.006325  0.004781 -0.002903
2018-01-04  0.005127  0.004215 -0.000159 -0.017227
2018-01-05 -0.001036  0.006664 -0.002855  0.000494
2018-01-08 -0.000160  0.001829 -0.000636  0.005182
2018-01-09 -0.004628  0.002263 -0.013373 -0.012888
…               …       …       …       …
2024-12-24  0.001992  0.011115  0.004229  0.006643
2024-12-26  0.006751  0.000067 -0.000569  0.002684
2024-12-27 -0.006871 -0.010527 -0.008199 -0.010039
2024-12-30 -0.003190 -0.011412  0.008037 -0.004958
2024-12-31  0.006234 -0.003638 -0.005353  0.008719

[1760 rows x 4 columns]
            Aggressive  Balanced  Conservative
Date
2018-01-03    0.003456  0.003147      0.002838
2018-01-04    0.001816  0.000941      0.000066
2018-01-05    0.003555  0.001651     -0.000253
2018-01-08    0.001520  0.001027      0.000534
2018-01-09   -0.002194 -0.005321     -0.008448
            Aggressive  Balanced  Conservative
Date
2018-01-03    1.003456  1.003147      1.002838
2018-01-04    1.005278  1.004091      1.002905
2018-01-05    1.008851  1.005749      1.002651
2018-01-08    1.010385  1.006782      1.003187
2018-01-09    1.008168  1.001425      0.994711
```

[28]:
```
monthly_portfolio_return=portfolio_returns.resample('ME').ffill().dropna()
monthly_portfolio_return.plot(figsize=(12,6))
plt.title('Monthly Portfolio Return')
plt.xlabel('Month')
```

```
plt.ylabel('Monthly Return')
plt.grid(True)
plt.tight_layout()
plt.show()
cum_portfolio_return_plot=cum_portfolio_return.plot(figsize=(12,6))
plt.title('Cum Portfolio Return')
plt.xlabel('Date')
plt.ylabel('Cum Return')
plt.grid(True)
plt.tight_layout()
plt.show()
```





Annualized Volatility

[29]:
```
import numpy as np
aggresive_return=portfolio_returns['Aggressive']
balanced_return=portfolio_returns['Balanced']
conservation_return=portfolio_returns['Conservative']
Volatility={'aggresive':aggresive_return.std()*np.sqrt(252),'balanced':
 ↪balanced_return.std()*np.sqrt(252),'conservation':conservation_return.
 ↪std()*np.sqrt(252)}
Annualized_volatility=pd.Series(Volatility,name='Annualized Volatility')
print(Annualized_volatility)
```

```
aggresive       0.140839
balanced        0.112333
conservation    0.106934
Name: Annualized Volatility, dtype: float64
```

Sharpe Ratio

[30]:
```
risk_free_rate=0.02
annual_returns={'aggresive':aggresive_return.mean()*252,'balanced':
 ↪balanced_return.mean()*252,'conservation':conservation_return.mean()*252}
sharpe_ratio={k:(annual_returns[k]-risk_free_rate)/Volatility[k]
              for k in annual_returns}
sharpe_df=pd.Series(sharpe_ratio,name='Sharpe Ratio')
print(sharpe_df)
```

```
aggresive       0.676813
balanced        0.563333
conservation    0.292147
Name: Sharpe Ratio, dtype: float64
```

Max Drawdown

[31]:
```
def max_drawdown(return_series):
    cum_portfolio_return=(1+return_series).cumprod()
    max_cum_return=cum_portfolio_return.cummax()
    dropdown=(cum_portfolio_return-max_cum_return)/max_cum_return
    return dropdown.min()
dropdowns={'aggresive':max_drawdown(aggresive_return),'balanced':
 ↪max_drawdown(balanced_return),'conservation':
 ↪max_drawdown(conservation_return)}
max_drawdowns=pd.Series(dropdowns,name='Max Drawdown')
print(max_drawdowns)
```

```
aggresive      -0.247356
balanced       -0.245569
conservation   -0.274322
```

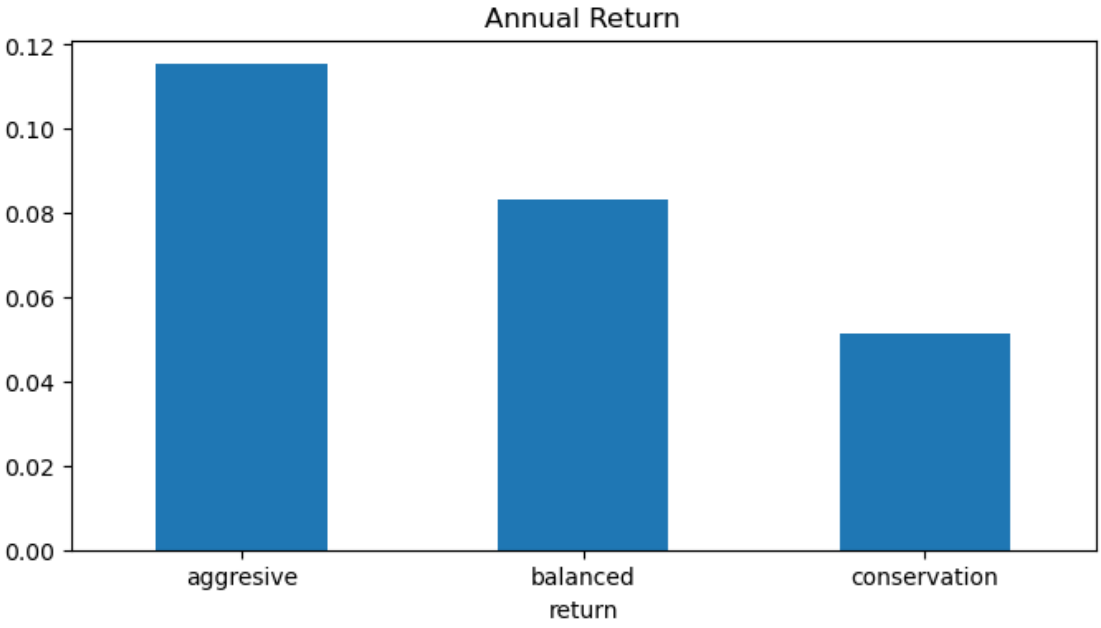
```
Name: Max Drawdown, dtype: float64
```

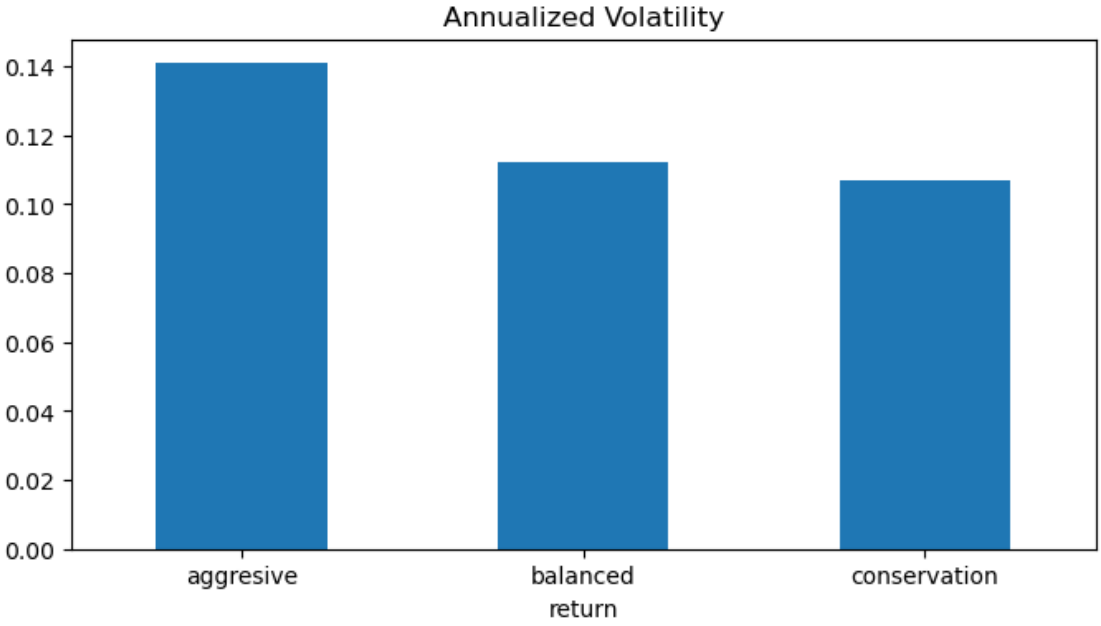
[32]:
```
merge_ratio=pd.concat([pd.Series(annual_returns,name='Annual␣
↪Return'),Annualized_volatility,sharpe_df,max_drawdowns],axis=1)
merge_ratio.head()
```

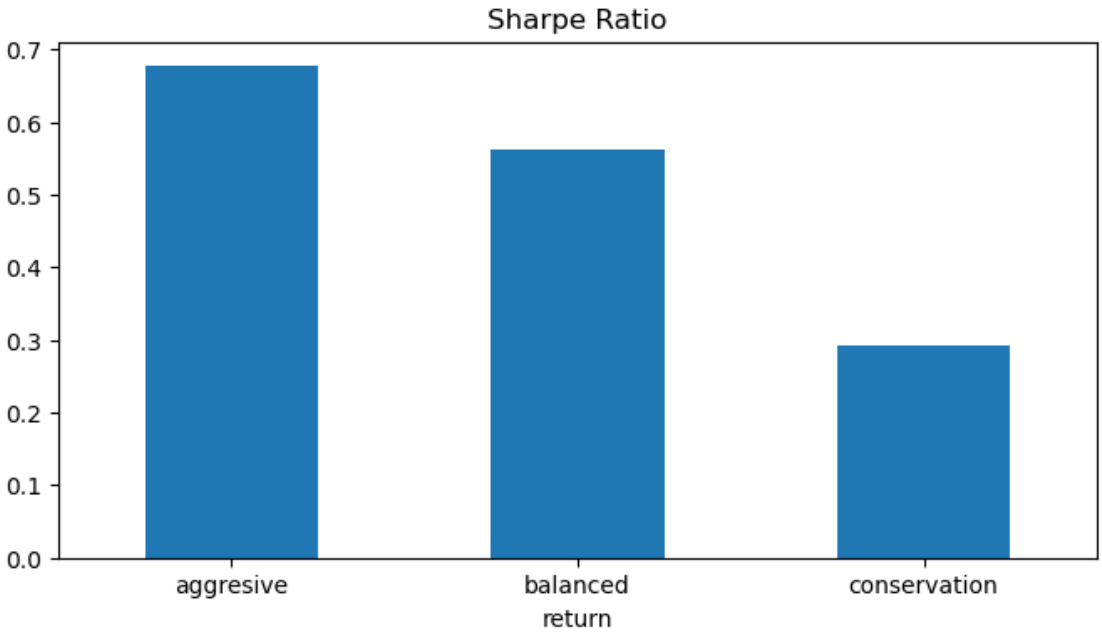
[32]:

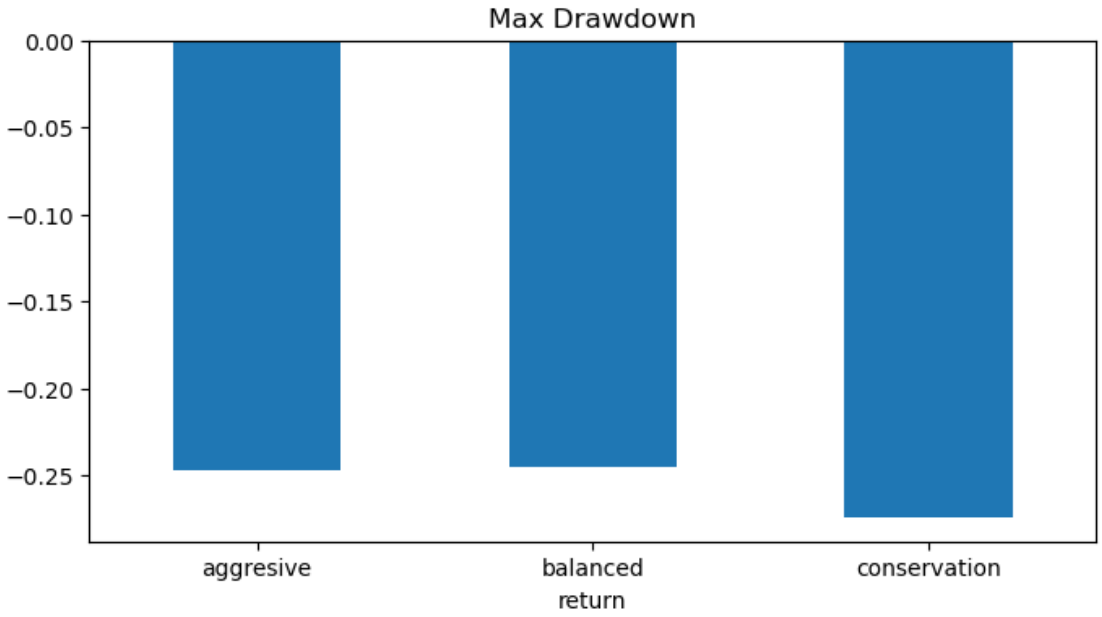
	Annual Return	Annualized Volatility	Sharpe Ratio	Max Drawdown
aggresive	0.115321	0.140839	0.676813	-0.247356
balanced	0.083281	0.112333	0.563333	-0.245569
conservation	0.051240	0.106934	0.292147	-0.274322

[33]:
```
import matplotlib.pyplot as plt
merge_ratio['Annual Return'].plot(kind='bar',figsize=(8,4))
plt.title('Annual Return')
plt.xlabel('return')
plt.xticks(rotation=360)
plt.show()
merge_ratio['Annualized Volatility'].plot(kind='bar',figsize=(8,4))
plt.title('Annualized Volatility')
plt.xlabel('return')
plt.xticks(rotation=360)
plt.show()
merge_ratio['Sharpe Ratio'].plot(kind='bar',figsize=(8,4))
plt.title('Sharpe Ratio')
plt.xlabel('return')
plt.xticks(rotation=360)
plt.show()
merge_ratio['Max Drawdown'].plot(kind='bar',figsize=(8,4))
plt.title('Max Drawdown')
plt.xlabel('return')
plt.xticks(rotation=360)
plt.show()
```


Annual Return
0.12
0.10
0.08
0.06
0.04
0.02
0.00
aggresive
balanced
conservation
return


Annualized Volatility
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
aggresive
balanced
conservation
return

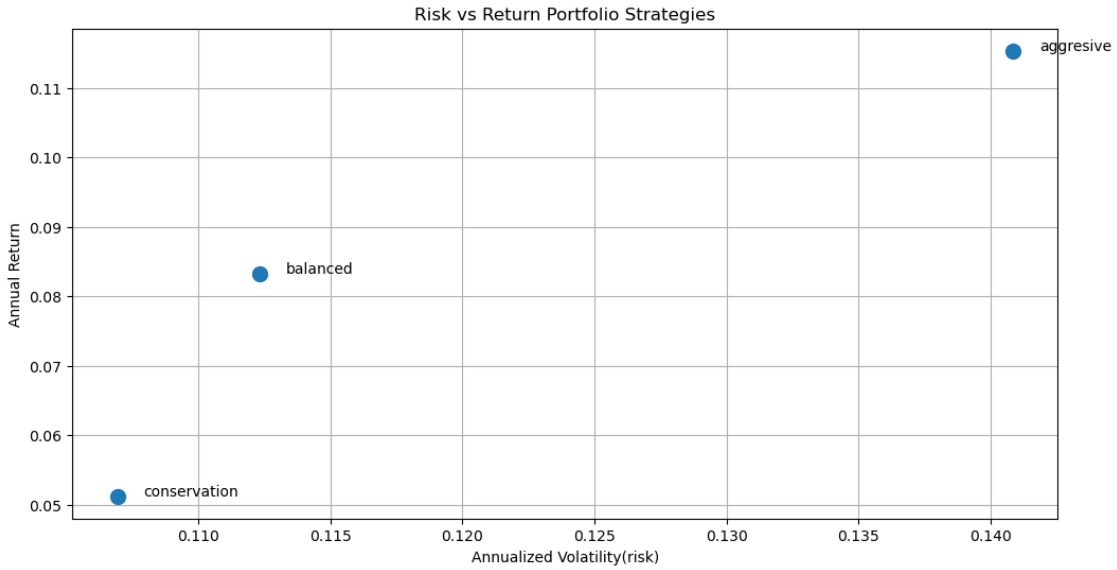




Risk vs Return Portfolio Strategies Scatter Plot

[34]:
```
plt.figure(figsize=(12,6))
plt.scatter(merge_ratio['Annualized Volatility'],merge_ratio['Annual␣
↪Return'],s=100)
```

```
for i in merge_ratio.index:
    plt.text(x=merge_ratio.loc[i,'Annualized Volatility']+0.001,y=merge_ratio.
 ↪loc[i,'Annual Return'],s=i)
plt.xlabel('Annualized Volatility(risk)')
plt.ylabel('Annual Return')
plt.title('Risk vs Return Portfolio Strategies')
plt.grid(True)
plt.show()
```



[ ]: