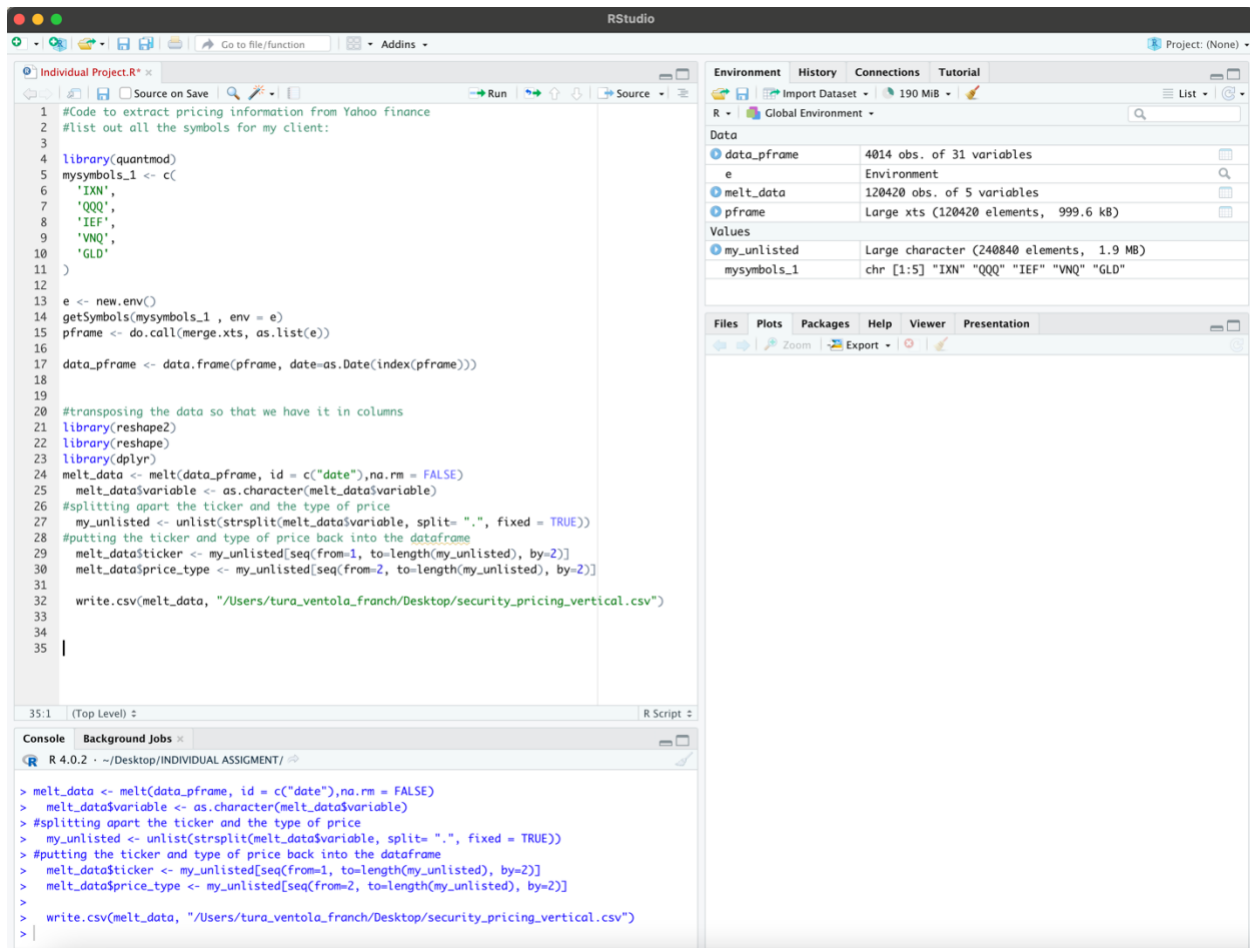


## STEP 1: Downloading the data

Using the library “quantmod” in R, we are able to extract the daily prices from Yahoo Finance about the tickers our client has in his portfolio.



The screenshot shows the RStudio interface with a script editor on the left and the Environment pane on the right. The script editor contains R code that uses the 'quantmod' library to extract daily prices from Yahoo Finance for tickers 'IXN', 'QQQ', 'IEF', 'VNQ', and 'GLD'. The code involves creating a new environment, getting symbols, merging xts objects, and writing the resulting data to a CSV file. The Environment pane on the right shows the objects created in the script: 'data\_pframe' (4014 obs. of 31 variables), 'e' (Environment), 'melt\_data' (120420 obs. of 5 variables), 'pframe' (Large xts (120420 elements, 999.6 kB)), 'my\_unlisted' (Large character (240840 elements, 1.9 MB)), and 'mysymbols\_1' (chr [1:5] "IXN" "QQQ" "IEF" "VNQ" "GLD").

```
1 #Code to extract pricing information from Yahoo finance
2 #list out all the symbols for my client:
3
4 library(quantmod)
5 mysymbols_1 <- c(
6   'IXN',
7   'QQQ',
8   'IEF',
9   'VNQ',
10  'GLD'
11 )
12
13 e <- new.env()
14 getSymbols(mysymbols_1, env = e)
15 pframe <- do.call(merge.xts, as.list(e))
16
17 data_pframe <- data.frame(pframe, date=as.Date(index(pframe)))
18
19
20 #transposing the data so that we have it in columns
21 library(reshape2)
22 library(reshape)
23 library(dplyr)
24 melt_data <- melt(data_pframe, id = c("date"),na.rm = FALSE)
25 melt_data$variable <- as.character(melt_data$variable)
26 #splitting apart the ticker and the type of price
27 my_unlisted <- unlist(strsplit(melt_data$variable, split=".", fixed = TRUE))
28 #putting the ticker and type of price back into the dataframe
29 melt_data$ ticker <- my_unlisted[seq(from=1, to=length(my_unlisted), by=2)]
30 melt_data$price_type <- my_unlisted[seq(from=2, to=length(my_unlisted), by=2)]
31
32 write.csv(melt_data, "/Users/tura_ventola_franch/Desktop/security_pricing_vertical.csv")
33
34
35 |
```

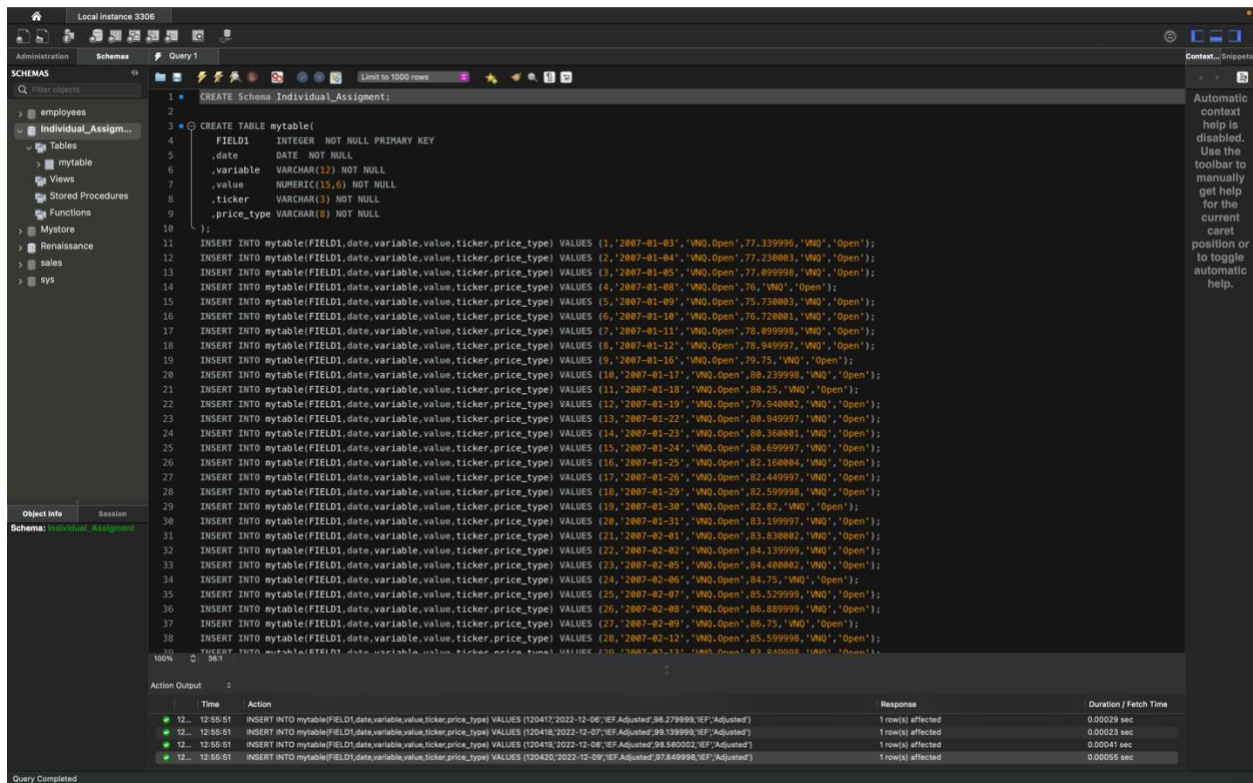
Environment

Object	Value
data_pframe	4014 obs. of 31 variables
e	Environment
melt_data	120420 obs. of 5 variables
pframe	Large xts (120420 elements, 999.6 kB)
my_unlisted	Large character (240840 elements, 1.9 MB)
mysymbols_1	chr [1:5] "IXN" "QQQ" "IEF" "VNQ" "GLD"

With this code we obtain a csv file with all the pricing data.

## STEP 2: Loading the data

We use the following page: “<https://www.convertcsv.com/csv-to-sql.htm>” to convert the csv file obtained in step 1 to an SQL code that will create a table with the data.



The screenshot shows the SQL Server Enterprise Manager interface. The left pane displays the 'Schemas' tree with 'Individual\_Assign...' expanded. The central query window contains the following SQL code:

```
1 CREATE Schema Individual_Assign;
2
3 CREATE TABLE mytable(
4     FIELD1 INT NOT NULL PRIMARY KEY
5     ,date DATE NOT NULL
6     ,variable VARCHAR(12) NOT NULL
7     ,value NUMERIC(15,6) NOT NULL
8     ,ticker VARCHAR(3) NOT NULL
9     ,price_type VARCHAR(8) NOT NULL
10 );
11
12 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (1,'2007-01-03','VNO','Open',77.339996,'VNO','Open');
13 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (2,'2007-01-04','VNO','Open',77.230003,'VNO','Open');
14 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (3,'2007-01-05','VNO','Open',77.099998,'VNO','Open');
15 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (4,'2007-01-08','VNO','Open',76,'VNO','Open');
16 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (5,'2007-01-09','VNO','Open',75.730003,'VNO','Open');
17 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (6,'2007-01-10','VNO','Open',76.720003,'VNO','Open');
18 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (7,'2007-01-11','VNO','Open',76.099998,'VNO','Open');
19 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (8,'2007-01-12','VNO','Open',76.949997,'VNO','Open');
20 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (9,'2007-01-16','VNO','Open',79.75,'VNO','Open');
21 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (10,'2007-01-17','VNO','Open',80.239998,'VNO','Open');
22 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (11,'2007-01-18','VNO','Open',80.25,'VNO','Open');
23 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (12,'2007-01-19','VNO','Open',79.940002,'VNO','Open');
24 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (13,'2007-01-22','VNO','Open',80.949997,'VNO','Open');
25 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (14,'2007-01-23','VNO','Open',80.360001,'VNO','Open');
26 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (15,'2007-01-24','VNO','Open',80.699997,'VNO','Open');
27 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (16,'2007-01-25','VNO','Open',82.160004,'VNO','Open');
28 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (17,'2007-01-26','VNO','Open',82.449997,'VNO','Open');
29 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (18,'2007-01-29','VNO','Open',82.599998,'VNO','Open');
30 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (19,'2007-01-30','VNO','Open',82.82,'VNO','Open');
31 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (20,'2007-01-31','VNO','Open',83.199997,'VNO','Open');
32 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (21,'2007-02-01','VNO','Open',83.830002,'VNO','Open');
33 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (22,'2007-02-02','VNO','Open',84.139999,'VNO','Open');
34 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (23,'2007-02-05','VNO','Open',84.480002,'VNO','Open');
35 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (24,'2007-02-06','VNO','Open',84.75,'VNO','Open');
36 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (25,'2007-02-07','VNO','Open',85.529999,'VNO','Open');
37 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (26,'2007-02-08','VNO','Open',86.099999,'VNO','Open');
38 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (27,'2007-02-09','VNO','Open',86.75,'VNO','Open');
39 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (28,'2007-02-12','VNO','Open',85.599998,'VNO','Open');
40 INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (29,'2007-02-13','VNO','Open',85.840002,'VNO','Open');
```

The bottom pane shows the 'Action Output' table with the following data:

Time	Action	Response	Duration / Fetch Time
12:56:51	INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (20417,2022-12-06,'EF Adjusted',98.579999,'EF','Adjusted')	1 row(s) affected	0.00033 sec
12:56:51	INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (20418,2022-12-07,'EF Adjusted',98.139999,'EF','Adjusted')	1 row(s) affected	0.00023 sec
12:56:51	INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (20419,2022-12-08,'EF Adjusted',98.840002,'EF','Adjusted')	1 row(s) affected	0.00041 sec
12:56:51	INSERT INTO mytable(FIELD1,date,variable,value,ticker,price_type) VALUES (20420,2022-12-09,'EF Adjusted',97.849998,'EF','Adjusted')	1 row(s) affected	0.00055 sec

First we need to create a schema to have a structure for our database. Once its created, we paste the code from the website and we obtain our first table.

We renamed the table as prices for convenience.

Below we can see the results of our table:

# Individual Final Assessment

## SQL and Data Management

Tura Ventola Franch

MySQL Workbench

Local Instance 3306

Administration Schemas Individual Assignment\*

SCHEMAS

Filter objects

employees

Individual\_Assign...

Tables

accounts

customers

Columns

customer\_id

row\_names

full\_name

first\_name

last\_name

email

customer\_l...

Indexes

Foreign Keys

Triggers

holdings

prices

securities

Views

Object Info Session

Schema: Individual\_Assignment

Result Grid

Filter Rows: Search Edit: Export/Import: Fetch rows:

FIELDID date variable value ticker price\_type

1 2007-01-03 VNO Open 77.339996 VNO Open

2 2007-01-04 VNO Open 77.230003 VNO Open

3 2007-01-05 VNO Open 77.599998 VNO Open

4 2007-01-08 VNO Open 76.000000 VNO Open

5 2007-01-09 VNO Open 75.730003 VNO Open

6 2007-01-10 VNO Open 76.700001 VNO Open

7 2007-01-11 VNO Open 76.099998 VNO Open

8 2007-01-12 VNO Open 76.949997 VNO Open

9 2007-01-16 VNO Open 76.700000 VNO Open

10 2007-01-17 VNO Open 80.239996 VNO Open

11 2007-01-18 VNO Open 80.250000 VNO Open

12 2007-01-19 VNO Open 79.840002 VNO Open

13 2007-01-22 VNO Open 80.949997 VNO Open

14 2007-01-23 VNO Open 80.360001 VNO Open

15 2007-01-24 VNO Open 80.999997 VNO Open

16 2007-01-25 VNO Open 82.160004 VNO Open

17 2007-01-26 VNO Open 82.449997 VNO Open

18 2007-01-29 VNO Open 82.599996 VNO Open

19 2007-01-30 VNO Open 82.800000 VNO Open

20 2007-01-31 VNO Open 83.199997 VNO Open

21 2007-02-01 VNO Open 83.800002 VNO Open

22 2007-02-02 VNO Open 84.139999 VNO Open

23 2007-02-05 VNO Open 84.400002 VNO Open

24 2007-02-06 VNO Open 84.750000 VNO Open

25 2007-02-07 VNO Open 85.329999 VNO Open

26 2007-02-08 VNO Open 86.889999 VNO Open

27 2007-02-09 VNO Open 86.750000 VNO Open

28 2007-02-12 VNO Open 85.599996 VNO Open

29 2007-02-13 VNO Open 83.949998 VNO Open

30 2007-02-14 VNO Open 85.800003 VNO Open

31 2007-02-15 VNO Open 85.250000 VNO Open

32 2007-02-16 VNO Open 85.540001 VNO Open

33 2007-02-20 VNO Open 85.339996 VNO Open

34 2007-02-21 VNO Open 85.940002 VNO Open

35 2007-02-22 VNO Open 85.949997 VNO Open

36 2007-02-23 VNO Open 85.250000 VNO Open

37 2007-02-26 VNO Open 84.099998 VNO Open

38 2007-02-27 VNO Open 83.339999 VNO Open

39 2007-02-28 VNO Open 80.910004 VNO Open

40 2007-03-01 VNO Open 80.400002 VNO Open

41 2007-03-02 VNO Open 82.279999 VNO Open

42 2007-03-05 VNO Open 78.440002 VNO Open

43 2007-03-06 VNO Open 77.299998 VNO Open

44 2007-03-07 VNO Open 78.680000 VNO Open

45 2007-03-08 VNO Open 78.099998 VNO Open

46 2007-03-09 VNO Open 80.199997 VNO Open

47 2007-03-12 VNO Open 80.290001 VNO Open

prices B

Action Output

Time Action Response Duration / Fetch Time

12... 14:36:36 INSERT into customers values ('L1,UHRI High Net Worth Client','Ultra High','Net Worth Client','ultrahighnetworthclient@gmail.com','Palo Alto, CA') 1 row(s) affected 0.0017 sec

Query Completed

Automatic context help is disabled. Use the toolbar to manually get help for the current caret position or to toggle automatic help.

We created the other tables needed with the data provided for our investor.

Apply SQL Script to Database

Review the SQL Script to be Applied on the Database

Review SQL Script

Apply SQL Script

Please review the following SQL script that will be applied to the database. Note that once applied, these statements may not be revertible without losing some of the data. You can also manually change the SQL statements before execution.

Online DDL

Algorithm: Default Lock Type: Default

```
1 CREATE TABLE `Individual_Assignment`.`securities` (  
2   `Ticker` VARCHAR(10) NOT NULL,  
3   `row_names` INT NULL,  
4   `security_name` TEXT NULL,  
5   `sec_type` VARCHAR(100) NULL,  
6   `major_asset_class` VARCHAR(100) NULL,  
7   `minor_asset_class` VARCHAR(100) NULL,  
8   PRIMARY KEY (`Ticker`));  
9
```

### STEP 3:

#### **3.1) Returns**

First, we need to confirm the last date available for data coincides with the date the data was downloaded.

```
#Find max date
SELECT MAX(date)
from prices;
```

MAX(date)
2022-12-09

To find the returns for each of the securities, we are going to use the continuous return. This can be calculated by doing the natural logarithm ( $\ln$ ) of the current value ( $P_1$ ) divided by the initial price ( $P_0$ ).

In order to get the initial value in our case denominated as lagged price, we use the lag value. Since we're trying to obtain the returns for the most recent 12, 18 and 24 months, we use the number of market days in a month (approximately 21 days) and multiply it by the number of months we want the value for. Hence, we obtain 250 market days in 12 months, 375 for 18 months and 500 for 24 months. We put this numbers in the lag function, that looks back the number of days described before, and accesses the data of that row from the current one.

In the lag function we include partition by ticker and we order by date to indicate when to reset the computation.

```
#Q1
SELECT a.date, a.ticker,
       LN(a.value / a.price_12m) AS continuous_return_12M,
       LN(a.value / a.price_18m) AS continuous_return_18M,
       LN(a.value / a.price_24m) AS continuous_return_24M
FROM
  (SELECT *,
    LAG(value, 250)
    OVER(PARTITION BY ticker
    ORDER BY date)
    AS price_12M,
    LAG(value, 375)
    OVER(PARTITION BY ticker
    ORDER BY date)
    AS price_18M,
    LAG(value, 500)
    OVER(PARTITION BY ticker
    ORDER BY date)
    AS price_24M
  FROM prices
  WHERE price_type = "Adjusted") a
WHERE date = '2022-12-09';
```

Below we can see the continuous results for each ticker divided into three columns for the three periods.

	date	ticker	continuous_return_12M	continuous_return_18M	continuous_return_24M
►	2022-12-09	GLD	0.00035920493925841216	-0.02395361303205936	-0.0403574063038234
	2022-12-09	IEF	-0.15169992088880946	-0.13530110708982013	-0.17822754980757352
	2022-12-09	IXN	-0.2887366945406856	-0.1322661024330806	-0.012971960014385994
	2022-12-09	QQQ	-0.32364815513247364	-0.1813676148724042	-0.07417474413871572
	2022-12-09	VNQ	-0.23241215050821176	-0.14373763333679157	0.06804483732183311

As we can see, most of the returns are negative, which means the investments are not profitable. In the past year only gold (GLD) has been profitable and QQQ was the worst, closely followed by IEF that are both categorized as Equity as an Asset Class. This makes sense from a macroeconomics perspective since in a situation of insecurity, equity tends to go down and the safest investments are commodities.

Moreover, year and a half ago no securities had positive returns, and two years ago only Vanguard (VNQ).

In order to take a look at the return of the portfolio as a whole, we need to take into account the weight of each asset in the portfolio. To do so, we sum the  $\ln(P1/P0)$  multiplied by % of each asset (named quantity in our table) and we use a left join (in this case an inner join would produce the same outcome), to join the table holdings which contains the quantity. We unite both tables by ticker.

```
#Q1
#Portfolio's Return
SELECT a.date,
       SUM(LN(a.value / a.price_12M)*(b.quantity)) as portfolio_return_12M,
       SUM(LN(a.value / a.price_18M)*(b.quantity)) as portfolio_return_18M,
       SUM(LN(a.value / a.price_24M)*(b.quantity)) as portfolio_return_24M
FROM
  (SELECT *,
   LAG(value, 250)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_12M,
   LAG(value, 375)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_18M,
   LAG(value, 500)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_24M
  FROM prices
  WHERE price_type = "Adjusted") a
  left join holdings as b
  on a.ticker=b.ticker
  WHERE date = '2022-12-09';
```

If we look at the returns of the portfolio as a whole, we can see that the results are not only negative, but have been decreasing even more from 2 years ago until now.

	date	portfolio_return_12M	portfolio_return_18M	portfolio_return_24M
▶	2022-12-09	-0.18589170554140877	-0.12009160669753728	-0.07268377608056842

### 3.2) Correlation

The most current MySQL environment does not allow to compute the correlation. Hence, we are going to compare the variances from each asset.

We decided to use a period of 6 months since it seemed neither too short not to have enough data for the calculation, nor too long to be influenced by macroeconomic events.

To calculate the variance, we just have to use the `VARIANCE` code with the continuous returns computed as before but lagged over the new period length. In order to compute the variance, we need more than one date to properly measure the fluctuation, if we had it like before (`= '2022-12-09'`), we wouldn't be able to see any difference since we are only considering one day.

```
#Q2
SELECT z.ticker,
       VARIANCE(z.continuous_returns) AS variance
FROM
  (SELECT a.*, (a.value - a.lagged_price)/a.lagged_price as discrete_returns,
           LN(a.value/a.lagged_price) as continuous_returns
   FROM
     (SELECT *, LAG(value, 125) OVER(
                                PARTITION BY ticker
                                ORDER BY date)
      AS lagged_price
     FROM prices
     WHERE price_type = 'Adjusted'
     AND date >= '2022-06-09') a
   ) as z
GROUP BY z.ticker;
```

	ticker	variance
▶	GLD	0.00015465325717295514
	IEF	0.00003826386564737793
	IXN	0.001416349665533533
	QQQ	0.0013191562087886965
	VNQ	0.0010582174037093595

Not surprisingly, the lowest return corresponds to IEF, which is Fixed Income. F.I. is the known for giving steady returns and low risk. On the other hand, equity is completely the opposite, returns

tend to be more spread compared to the mean, which is why IXN and QQQ have the highest variance.

Overall, we can speculate that the variances are not significantly high but need more information to answer it properly.

### **3.3) Risk**

To calculate the risk you can simply use the `STD()` function on the continuous return calculated as the previous sections (we wrote the risk as sigma). Since they ask us for the most recent 12 months, we only need to lag for 250.

In investing standard deviation is used to measure the security's volatility. Generally, we want a lower sigma since a higher one means that there's more volatility thus higher risk, however this depends on the risk aversion of the investor.

Risk move in line with the variation. The lowest risk corresponds to the Fixed Income security since as explained before it characterizes with steady returns and low risk, while equity has the highest risk since it also generates higher returns when the market is prosperous.

If the risk of a security seems pretty high, this can be complemented by less aggressive securities in the same portfolio. Thus we cannot make a proper conclusion of the volatility of our portfolio without looking at the risk as a whole.



```
#Q3
SELECT z.ticker,
       AVG(z.continuous_return) AS mu,
       STD(z.continuous_return) AS sigma
FROM
  (SELECT a.*,
         LN(a.value / a.lagged_price) AS continuous_return
   FROM
     (SELECT *,
          LAG(value, 250)
            OVER(PARTITION BY ticker
                 ORDER BY date)
            AS lagged_price
      FROM prices
      WHERE price_type = "Adjusted") a
   WHERE a.date >= '2021-12-09') z
GROUP BY z.ticker;
```

	ticker	mu	sigma
▶	GLD	-0.005674923964952649	0.06204730296444215
	IEF	-0.10073517532761872	0.05154652514539344
	IXN	-0.06947022436259903	0.17837489208544322
	QQQ	-0.08963771385168648	0.18271758496207646
	VNQ	0.00610628987535463	0.1881938091807592

Calculating the risk of the portfolio is not as simple as before. The standard deviation of a portfolio is a function of how each holding in the portfolio moves in relation to the other holdings in the portfolio. Mostly because if the securities are correlated, when one performs badly, its highly likely than the other one will as well.

Hence, in order to calculate it we need the relationship between the securities. The formula to calculate the portfolio's risk is as following:

$$\sigma_p = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 Cov_{1,2}}$$

Where:

$\sigma$  is the standard deviation

w is the weight of a security in the portfolio

$Cov_{1,2}$  is the covariance between two assets

Since as correlation, MySQL does not allow to compute the Covariance, for simplicity and to at least have an idea of the general risk, we calculate the risk of the portfolio as before, multiplying sigma (the risk) by the quantity (weight of each asset) and adding it up.

```
#Portfolio
SELECT SUM(sigma*(b.quantity)) as sigma_portfolio
FROM (
  SELECT z.ticker,
         AVG(z.continuous_return) AS mu,
         STD(z.continuous_return) AS sigma,
         (AVG(z.continuous_return) / STD(z.continuous_return)) AS risk_adj_return
  FROM
    (SELECT a.*,
            LN(a.value / a.lagged_price) AS continuous_return
     FROM
        (SELECT *,
            LAG(value, 250)
            OVER(PARTITION BY ticker
                ORDER BY date)
            AS lagged_price
         FROM prices
         WHERE price_type = "Adjusted") a
        WHERE a.date >= '2021-12-09') z
     GROUP BY z.ticker) s
  left join holdings as b
  on s.ticker=b.ticker;
```

sigma_portfolio
0.11730708075691787

Even though this doesn't represent the real portfolio risk, it is a good indicator of it to compare it with other portfolios or to see the change if we were to modify (buy or sell) our current portfolio.

### 3.4) Recommendation

As seen in section 3.1, the returns of this portfolio are negative, which means our client is losing money and has been for the past two years. Since the negative returns have lingered over 2 years, we would recommend a drastic restructure of the portfolio.

Assuming he wants to maintain a similar structure regarding the asset classes of the portfolio, we did a bit of research on the highest performing securities for each asset class.

With that research we repeated the first two steps and step 3.1 to see if these new securities were indeed profitable. However, in the first tries, we still got a lot of negative returns in at least one period. (*\*can see some of the references at the end*)

After numerous tries, we finally got securities with positive returns for all asset classes except for Real Assets. The specific security our investor currently has, is a REIT (real estate investment trust). However, when putting the top performing REITs on the SQL and calculating the result, we couldn't find any that has a positive return and out of those, VNQ, which is the one our investor currently has in his portfolio, had the highest performance.

Since we are basing our new portfolio in a similar structure as the current one, we decided to leave that security but with a lower weight since according to research the REITs market is not projected to improve in the immediate time.

Finally, although GLD had a positive return, we decided to take a look to other Commodities to see if there was a better option. We found out numerous alternatives with higher returns than gold which is why we decide to sell it as well.

Overall we recommended to sell all holdings except for VNQ (with a lower percentage). As for our buying recommendations, as said previously, we tried to maintain a similar structure as before, giving more weight to commodities since they have the highest returns and increasing diversity in equity.

New recommendations:

Equity: (34.6% compared to previous 39.6%)

First Investors Growth & Income A (FGINX) 10.7%

Federated Strategic Value Dividend A (SVAAX) 8.9%

Hennessy Cornerstone Value Inv (HFCVX) 15%

Fixed income: (22% compared to previous 28.5%)

SPDR Bloomberg 1-3 Month T-Bill ETF (BIL)

Real assets: (maintain) (2.4% compared to previous 8.9%)

Vanguard Real Estate ETF (VNQ)

Commodities: (41% compared to previous 23%)

Abrdn Bloomberg All Commodity ETF (BCD) 15%

United States 12-Month Natural Gas ETF (UNL) 26%

### 3.5) Change in risk and returns

We placed the data from the securities from 3.4 into a new table (*mytable*) and created a new table with the % each ticker represents (from *holdings\_new*).

To see the changes in the portfolio we repeated the same procedures as sections 3.1 and 3.3 with the new tables.

We checked the data for the tickers separately first to ensure all returns are positive (excluding VNQ that we already knew was negative).

```
#Q5
SELECT a.date, a.ticker,
       LN(a.value / a.price_12m) AS new_return_12M,
       LN(a.value / a.price_18m) AS new_return_18M,
       LN(a.value / a.price_24m) AS new_return_24M
FROM
  (SELECT *,
   LAG(value, 250)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_12M,
   LAG(value, 375)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_18M,
   LAG(value, 500)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_24M
  FROM mytable
  WHERE price_type = "Adjusted") a
WHERE date = '2022-12-09';
```

```
SELECT z.ticker,
       AVG(z.continuous_return) AS new_mu,
       STD(z.continuous_return) AS new_sigma
FROM
  (SELECT a.*,
         LN(a.value / a.lagged_price) AS continuous_return
   FROM
     (SELECT *,
          LAG(value, 250)
            OVER(PARTITION BY ticker
                 ORDER BY date)
            AS lagged_price
      FROM mytable
     WHERE price_type = "Adjusted") a
    WHERE a.date >= '2021-12-09') z
GROUP BY z.ticker;
```

	date	ticker	new_return_12M	new_return_18M	new_return_24M
▶	2022-12-09	BCD	0.17487917506003123	0.2544882413893595	0.4601116894183653
	2022-12-09	BIL	0.011530904458340454	0.011093547401315284	0.01076574067926539
	2022-12-09	FGINX	0.06515434257839148	0.07854907364202494	0.23077852770477497
	2022-12-09	HFCVX	0.021772303811624646	0.04580191141471556	0.2417118232876759
	2022-12-09	SVAAX	0.05353840720620112	0.0643415468492381	0.20656000575083233
	2022-12-09	UNL	0.5730736701905823	0.8415296629300482	0.9839611064955202
	2022-12-09	VNQ	-0.2324121505082119	-0.1437376333367917	0.06804493709238682

	ticker	new_mu	new_sigma
▶	BCD	0.28311824927115053	0.09676063082358806
	BIL	0.001903027399710003	0.003537078726836019
	FGINX	0.07030855154975779	0.07762357118705979
	HFCVX	0.13182574984006268	0.07762492657565045
	SVAAX	0.1277693885906032	0.05771223314533619
	UNL	0.6720283260635826	0.23264176975732148
	VNQ	0.005248081318067928	0.18831838612752144

```
#Portfolio's Return
SELECT a.date,
       SUM(LN(a.value / a.price_12M)*(b.quantity)) as return_new_portfolio_12M,
       SUM(LN(a.value / a.price_18M)*(b.quantity)) as return_new_portfolio_18M,
       SUM(LN(a.value / a.price_24M)*(b.quantity)) as return_new_portfolio_24M
FROM
  (SELECT *,
   LAG(value, 250)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_12M,
   LAG(value, 375)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_18M,
   LAG(value, 500)
   OVER(PARTITION BY ticker
        ORDER BY date)
   AS price_24M
  FROM mytable
  WHERE price_type = "Adjusted") a
  left join holdings_new as b
  on a.ticker=b.ticker
  WHERE date = '2022-12-09';
```

```
SELECT sum(sigma*(b.quantity)) as sigma_portfolio,
       SUM(risk_adj_return*b.quantity) as risk_adj_return_portfolio
FROM (
  SELECT z.ticker,
         AVG(z.continuous_return) AS mu,
         STD(z.continuous_return) AS sigma
  FROM
    (SELECT a.*,
     LN(a.value / a.lagged_price) AS continuous_return
    FROM
      (SELECT *,
       LAG(value, 250)
       OVER(PARTITION BY ticker
            ORDER BY date)
       AS lagged_price
      FROM mytable
      WHERE price_type = "Adjusted") a
      WHERE a.date >= '2021-12-09') z
    GROUP BY z.ticker) s
  left join holdings_new as b
  on s.ticker=b.ticker;
```

If we take a look at the new portfolio returns, we can see that they are not only all positive, but have a way higher return compared with the previous one (going from a return -0.1859 to 0.1872 in the most recent 12 months, from -0.12 to 0.2769 in the most recent 18 months, and -0.07 to 0.408 in the past year).

	date	return_new_portfolio_1...	return_new_portfolio_1...	return_new_portfolio_2...	
▶	2022-12-09	0.1871922163461774	0.27696326105990904	0.40818209901063207	

Usually holdings with higher returns present higher risk. However we are getting a way higher return than before, with a portfolio with a higher weight on non-constant securities, and we obtained a lower portfolio risk, going from 0.1173 to 0.1054 with the new securities.

An explanation for that could be that our new portfolio is more diverse and diversity reduces risk.

	sigma_portfolio	
▶	0.10538460320070413	

## References

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