**Econ 4400 section A**

**Assignment 1**

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The rationalinvestor relys on time series data to analyze the performance of their companies and make predictions about its expected return and risky in the future. In this report, our goal is to measure each type of the US stock price index fluctuation from 1985 to 2018 by calculating standard deviation for risk (by calculating VaR, skewness, kurtosis and sharp ratio, etc.), and expected return (by Arithmetic average return and Geometric average rate of return), etc. The four types of the US stocks that we have chosen, respectively S&P500 (GSPC), NASDAQ Composite (IXIC), Dow Jones Industrial Average (DJI) and Modine Manufacturing Company (MOD).

First of all, after getting the data from Yahoo Finance, we analyze some financial ratios and computing some returns (rate of return and excess return) as can be seen in the Excel named “output of Group Reports”.

Starting from the Value at Risk (VaR). One year 5% Value at Risk estimates there is a 5% probability that GSPC, IXIC, DJI, and MOD will fall in return by 17.62%, 28.22%, 16.27% and 76.93% within a year respectively. The VaR in MOD is the biggest, which is greater than 70%, so this stock is the riskiest in terms of VaR.

Secondly, it comes to the arithmetic average, which is accurate if there is no volatility, but each successive term is dependent on the previous outcome through compounding, so the geometric average is more accurate for calculating investment return. MOD has the highest geometric average return,106.48%, while GSPC has the lowest return of 8.30%.

Thirdly, the Sharpe ratio is a measurement of risk-adjustment return, while the Sortino ratio is more appropriate for asymmetric return since the semi-standard deviation measures the variability of those returns which fall below the minimum acceptable return. In DJI, the Sharpe ratio and the Sortino ratio are really high, which is 1,504% and 1,274% respectively, and there is a huge gap, nearly 45% difference, in these two ratios in MOD. The riskiest stock is MOD if the Sharpe ratio is taken as consideration, but the GSPC is the riskiest stock if the Sortino ratio is taken consideration.

Fourthly, According to the Computation and wealth indexes over the period from 1985 to 2018,

GSPC: HPR= =14.05

IXIC: HPR= =25.12

DJI: HPR= =18.43

MOD: HPR= =7.46

According to the HPR, we can conclude that IXIC has the highest HPR and has the highest wealth index from 1985 to 2019. However, in the same period, MOD has the lowest HPR and the lowest wealth index. Therefore, based on the result, the GSPC has better expectation among four stocks.

Lastly, to check whether returns are normally distributed or not, we are using t-test to do the hypothesis test, the calculation of stocks are as follow:

**t =**

**GSPC:**

H0: µ=0

H1: µ ≠0

t = = 3.39

t0.025=2.042

therefore: 3.39>2.042

we can reject null hypothesis that µ=0

**IXIC:**

H0: µ=0

H1: µ ≠0

t = = 3.026

t0.025=2.042

3.026>2.042

We can reject null hypothesis test that µ=0.

**DJI:**

H0: µ=0

H1: µ ≠0

t = = 3.72

t0.025=2.042

3.72> 2.042

We reject null hypothesis test that µ=0.

**MOD**

H0: µ=0

H1: µ ≠0

t = = 1.90

t0.025=2.042

1.90< 2.042

We **cannot** reject null hypothesis test that µ=0.

H0: = 1

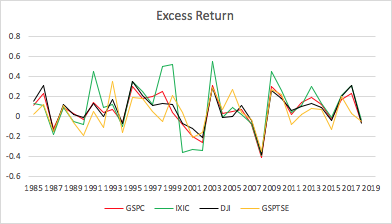
H1: 1

== =11.14

11.14< 43.773

we do reject H0 null hypothesis test that = 1.

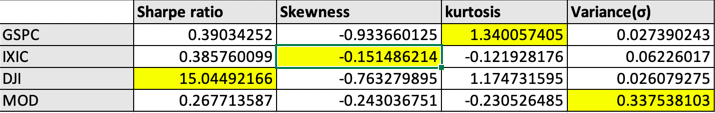
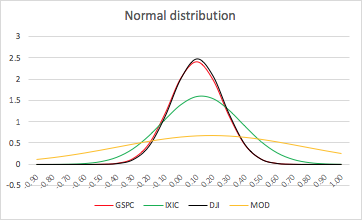
MOD’s mean is equal to 0, but standard deviation is not equal to 1, therefore MOD is not normal distributed. The mean of other stocks are not equal 0, so they are not normal distributed either.

Then, we have all the data above to do the risks and returns analysis for the investor. 

As can be seen from the line chart, there are two significant highest points, the year 2000 and the year 2008 respectively. The first Federal Reserve cut the interest rate benchmark by the chairman, Alan Greenspan at 2000. These four stocks fall rapidly, starting from IXIC, this stock fell at excess return -0.36% (nominal rate of return: -0.29%) in 2000, however, other stocks only drop -0.36% (GSPC) and -0.06% (DJI). Reversely, for MOD, this stock increased by 0.02% (nominal rate of return: 0.08%) in 2000. One year later, in 2002, these four stocks continually dropped, and the instrument affects GSPC most significantly. After the US stock investors experienced the bear market in 2000-2002, the stock price went up in 2003 but the adj close price still did not bound back to the stock price in 2000. After some small fluctuations, the Great Recession came because of the Subprime Mortgage crisis in the States. In this period, thousands of people lost their jobs and even real estate, which could be the investors' nightmare. Absolutely, these four stocks fell sharply during this period. MOD was affected dramatically and its stock dropped by -0.81% rate of return, other stocks dropped average -0.4% of their rate of return. In 2008, every stock has the lowest point in the line graph and also hit its lowest price. However, the bull market happened in 2009, MOD is the stock that had a sharp rise after the subprime mortgage crisis, which reached its highest return in these 34 years. Other stocks, such as GSPC, IXIC and DJI have the relatively high return. After 2010, the stock that experienced most fluctuation also was MOD, the rest of stock have the relatively steady trend but still had the ups and downs.

In financial econometrics, people use variance (standard deviation) to measure the risk when the excess return has the normal distribution. With these four US stocks, no one has the normal distribution, so we cannot say variance is the complete ratio to measure the risk in this situation. However, MOD has the biggest variance difference with others (Var(MOD)=0.337538103) and the DJI has the lowest variance comparing with GSPC, IXIC and MOD.

The Sharpe ratio can be used to analyze the performance of the portfolio.

As can be seen from the table, DJI can beat other stocks and it has the highest Sharpe ratio, which may have the highest expected rate of return; in contrast, MOD has the lowest value in Sharpe ratio, so the investor may have the lowest expectation. 

We consider the statistic measurement: skewness. The skewness in four stocks are negative and left-skewed, which can underline that the standard deviation will understate the downside risk. Thus, we could be skepitcal that DJI may not be the highest return stock. Also, the kurtosis in GSPC (kurtosis=1.340057405) and DJI (kurtosis=1.174731595) is not a normal distribution because the kurtosis of GSPC and DJI smaller than 3. GSPC and DJI show the fat-tailed distribution which are more risk.

It can be concluded that the investor may choose DJI and avoid MOD that are most risk stock. However, if the investor chooses the DJI, he will still suffer some risks during the recessions in the business cycles, which means he can maximize his return by investing more stocks.

In sum, we can conclude this four stocks’ price index in terms of risk and rate of returns from 1985-2018 respectively. From the risk aspects, the MOD stock has the biggest VaR and is greater than 7%. According to the skewness of four stock price, we noticed that the risk of IXIC and MOD are underestimated and DJI are overestimated. Moreover, based on the data of kurtosis, GSPC and DJI are fat-tailed distribution, but IXIC and GSPTSE are negative. Besides, the MOD has the highest geometric average return but GSPC has the lowest return.

       Combining the return of four stocks, since they are not all normal distribution so we cannot say variance is the complete ratio to measure the risk in this situation. However, based on the above analysis table from Sharpe ratio, skewness, kurtosis and variance among the four stock price index, we could believe that DJI has more opportunity to overcome other stocks since  it has the highest Sharpe ratio, hence it has the highest expected rate of return; in contrast, MOD has the lowest value in Sharpe ratio and the highest variance (standard deviation)- the more risky. Therefore, the investor may have the highest expectation on DJI rather than MOD.

**Reference list**

[**https://ca.finance.yahoo.com/quote/MOD?p=MOD&.tsrc=fin-srch**](https://ca.finance.yahoo.com/quote/MOD?p=MOD&.tsrc=fin-srch)

[**https://ca.finance.yahoo.com/quote/%5EGSPC?p=%5EGSPC**](https://ca.finance.yahoo.com/quote/%5EGSPC?p=%5EGSPC)

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