

MSFT Stock and NASDAQ Composite Index Analysis

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Introduction

In this analysis, we will examine Microsoft's (MSFT) stock and the NASDAQ Composite index (IXIC). We will convert price data into daily returns, perform linear regressions on minimum, maximum, and closing prices, and calculate beta coefficients and confidence intervals.

Analysis Steps

1. Data Retrieval

First, we will download the data for MSFT stock and the IXIC index using the quantmod library.

```
# Download data for MSFT and IXIC from Yahoo Finance  
getSymbols(c("MSFT", "^IXIC"), src = "yahoo", from = "2023-01-01", to = "2023-12-31")
```

```
## [1] "MSFT" "IXIC"
```

```
# Display the first rows of the data for verification  
head(MSFT)
```

```
##      MSFT.Open MSFT.High MSFT.Low MSFT.Close MSFT.Volume MSFT.Adjusted  
## 2023-01-03  243.08  245.75  237.40  239.58  25740000  236.6092  
## 2023-01-04  232.28  232.87  225.96  229.10  50623400  226.2592  
## 2023-01-05  227.20  227.55  221.76  222.31  39585600  219.5534  
## 2023-01-06  223.00  225.76  219.35  224.93  43613600  222.1409  
## 2023-01-09  226.45  231.24  226.41  227.12  27369800  224.3037  
## 2023-01-10  227.76  231.31  227.33  228.85  27033900  226.0123
```

```
head(IXIC)
```

```
##      IXIC.Open IXIC.High IXIC.Low IXIC.Close IXIC.Volume IXIC.Adjusted  
## 2023-01-03 10562.06 10613.06 10309.16 10386.98 4780650000 10386.98  
## 2023-01-04 10467.82 10515.22 10337.64 10458.76 5085380000 10458.76  
## 2023-01-05 10390.31 10393.22 10295.25 10305.24 4764270000 10305.24  
## 2023-01-06 10363.96 10604.14 10265.04 10569.29 5199780000 10569.29  
## 2023-01-09 10662.10 10807.26 10619.12 10635.65 5132190000 10635.65  
## 2023-01-10 10607.72 10743.67 10589.59 10742.63 4710680000 10742.63
```

2. Convert Data to Returns

We will convert closing, minimum, and maximum prices into daily returns.

```
# Convert data to returns
returns_MSFT <- data.frame(
  Date = index(MSFT),
  MSFT.Low = ROC(Lo(MSFT), type = "discrete"),
  MSFT.High = ROC(Hi(MSFT), type = "discrete"),
  MSFT.Close = ROC(CI(MSFT), type = "discrete")
)

# Calculate returns for the index
returns_IXIC <- data.frame(
  Date = index(IXIC),
  IXIC.Close = ROC(CI(IXIC), type = "discrete")
)

# Remove NA values
returns_MSFT <- na.omit(returns_MSFT)
returns_IXIC <- na.omit(returns_IXIC)

# Synchronize dates
merged_data <- merge(returns_MSFT, returns_IXIC, by = "Date")

# Remove infinite and non-numeric values
merged_data <- merged_data[is.finite(rowSums(merged_data[, -1])), ]

# Display the first rows of the returns
head(merged_data)
```

```
##      Date  MSFT.Low  MSFT.High  MSFT.Close  IXIC.Close
## 1 2023-01-04 -0.048188658 -0.0524110066 -0.043743199  0.006910507
## 2 2023-01-05 -0.018587414 -0.0228453308 -0.029637749 -0.014678560
## 3 2023-01-06 -0.010867553 -0.0078664404  0.011785323  0.025622867
## 4 2023-01-09  0.032185992  0.0242736141  0.009736374  0.006278601
## 5 2023-01-10  0.004063417  0.0003026815  0.007617167  0.010058575
## 6 2023-01-11  0.016627804  0.0200596578  0.030238138  0.017597184
```

3. Linear Regressions

Perform linear regressions and calculate beta coefficients and confidence intervals.

```
# Regression with Minimum Prices
lm_low <- lm(MSFT.Low ~ IXIC.Close, data = merged_data)

# Regression with Maximum Prices
lm_high <- lm(MSFT.High ~ IXIC.Close, data = merged_data)

# Regression with Closing Prices
lm_close <- lm(MSFT.Close ~ IXIC.Close, data = merged_data)

# Calculate beta coefficients and confidence intervals
```

```

beta_low <- coef(lm_low)[2]
beta_high <- coef(lm_high)[2]
beta_close <- coef(lm_close)[2]

confint_low <- confint(lm_low, level = 0.95)[2,]
confint_high <- confint(lm_high, level = 0.95)[2,]
confint_close <- confint(lm_close, level = 0.95)[2,]

list(
  beta_low = beta_low,
  confint_low = confint_low,
  beta_high = beta_high,
  confint_high = confint_high,
  beta_close = beta_close,
  confint_close = confint_close
)

```

```

## $beta_low
## IXIC.Close
## 0.6169899
##
## $confint_low
## 2.5 % 97.5 %
## 0.4736877 0.7602920
##
## $beta_high
## IXIC.Close
## 0.552049
##
## $confint_high
## 2.5 % 97.5 %
## 0.3980052 0.7060928
##
## $beta_close
## IXIC.Close
## 1.039172
##
## $confint_close
## 2.5 % 97.5 %
## 0.9133786 1.1649663

```

4. Results

Beta Coefficients and Confidence Intervals:

Minimum Prices: Beta = 0.6169899 , 95% CI = 0.4736877 0.760292

Maximum Prices: Beta = 0.552049 , 95% CI = 0.3980052 0.7060928

Closing Prices: Beta = 1.039172 , 95% CI = 0.9133786 1.164966

##

Comments:

```
## The regression of minimum prices shows that the beta coefficient is 0.6169899 with a confidence interval 0.4736877 0.760292 . This means th
## of MSFT stock have a beta coefficient of 0.6169899 relative to the IXIC index. Since the beta
## coefficient is less than 1, this indicates that the minimum price of the stock is less
## sensitive to fluctuations in the overall index. Therefore, the stock has lower risk
## relative to the market as a whole when considering minimum prices.
```

```
## The regression of maximum prices shows that the beta coefficient is 0.552049 with a confidence interval 0.3980052 0.7060928 . The beta coe
## is also less than 1, indicating that the maximum prices of MSFT stock react less
## sensitively to changes in the IXIC index. This also indicates lower risk when considering
## maximum prices relative to the market.
```

```
## The regression of closing prices shows that the beta coefficient is 1.039172 with a confidence interval 0.9133786 1.164966 . The beta coeffici
## is slightly above 1, indicating that the closing price of MSFT stock has slightly greater
## sensitivity relative to fluctuations in the IXIC index. This means that the MSFT stock
## may be more profitable for investment but presents higher risk, given that it moves
## more closely with the overall market.
```

5. Graphs

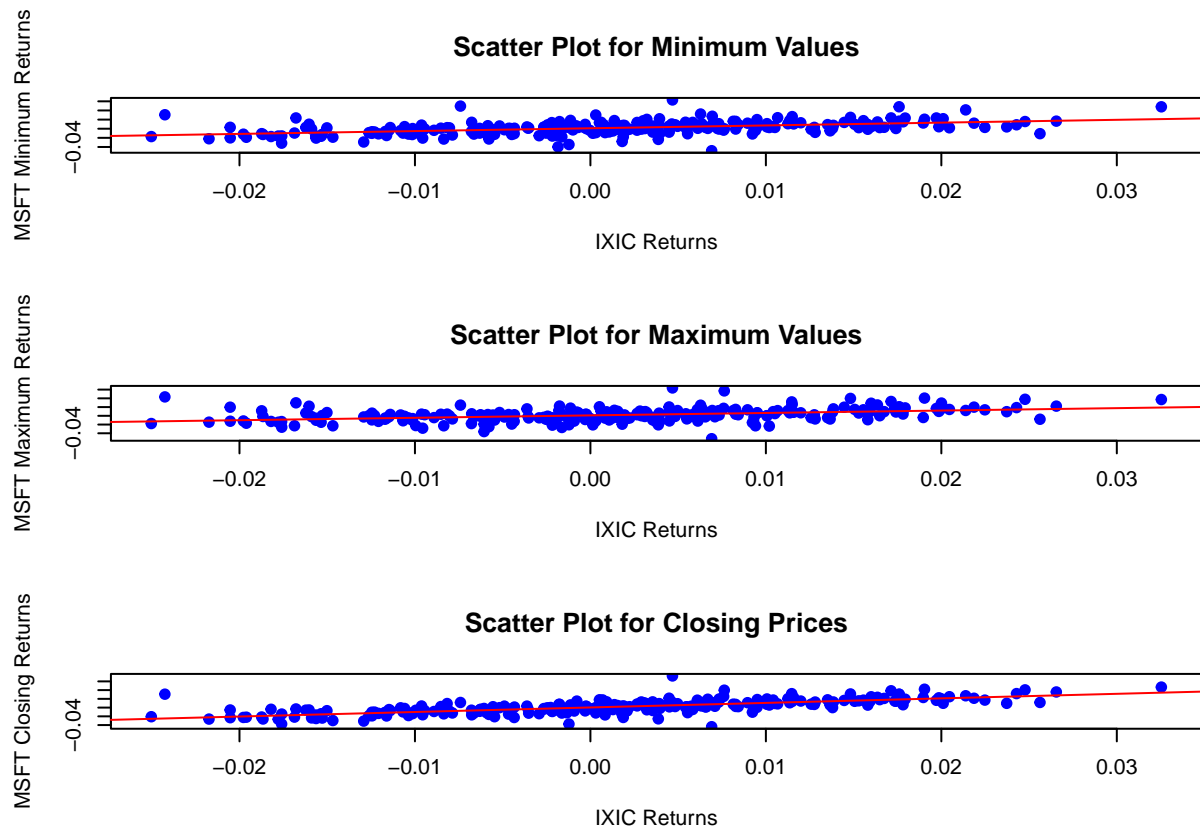
Create scatter plots for returns.

```
# Scatter plots for returns
par(mfrow = c(3, 1)) # Set plots in 3 rows

# Scatter plot for minimum values
plot(merged_data$IXIC.Close, merged_data$MSFT.Low,
     main = "Scatter Plot for Minimum Values",
     xlab = "IXIC Returns",
     ylab = "MSFT Minimum Returns", pch = 19, col = "blue")
abline(lm_low, col = "red")

# Scatter plot for maximum values
plot(merged_data$IXIC.Close, merged_data$MSFT.High,
     main = "Scatter Plot for Maximum Values",
     xlab = "IXIC Returns",
     ylab = "MSFT Maximum Returns", pch = 19, col = "blue")
abline(lm_high, col = "red")

# Scatter plot for closing prices
plot(merged_data$IXIC.Close, merged_data$MSFT.Close,
     main = "Scatter Plot for Closing Prices",
     xlab = "IXIC Returns",
     ylab = "MSFT Closing Returns", pch = 19, col = "blue")
abline(lm_close, col = "red")
```



```
# Reset the plot layout to single row
```

```
par(mfrow = c(1, 1))
```

```
# Change locale to English
```

```
invisible(Sys.setlocale("LC_TIME", "C"))
```

```
msft_returns_xts <- xts(merged_data[, c("MSFT.Low", "MSFT.High", "MSFT.Close")],
```

```
  order.by = merged_data$Date)
```

```
nasdaq_returns_xts <- xts(merged_data$IXIC.Close, order.by = merged_data$Date)
```

```
# Create return charts
```

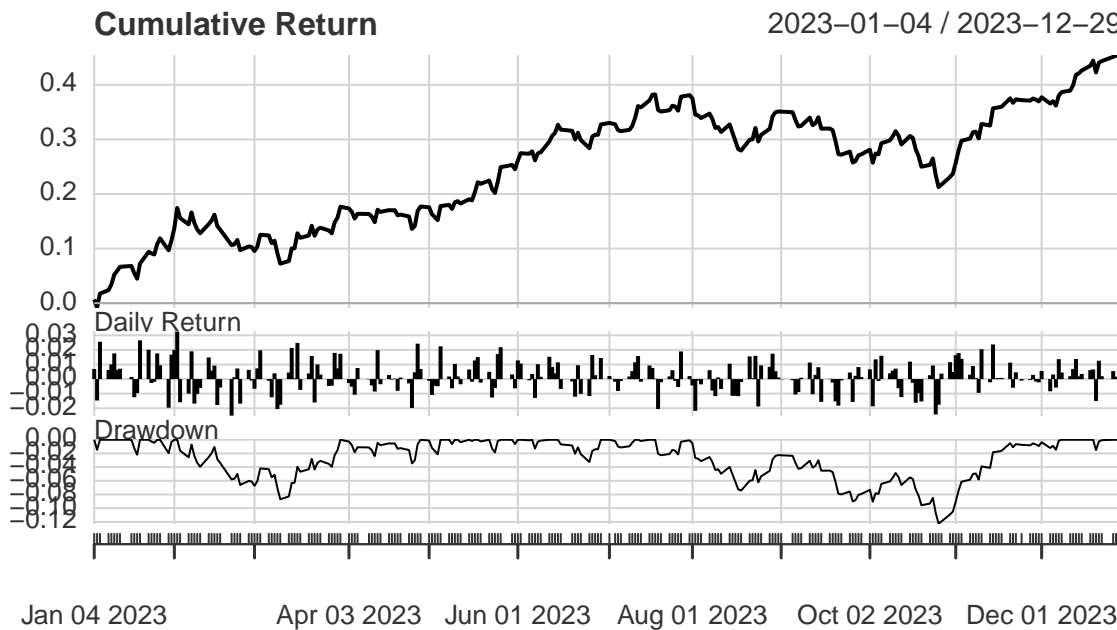
```
charts.PerformanceSummary(msft_returns_xts,  
  main = "Microsoft Stock Returns")
```

Microsoft Stock Returns



```
charts.PerformanceSummary(nasdaq_returns_xts,  
    main = "Nasdaq Composite Index Returns")
```

Nasdaq Composite Index Returns



```
# Reset locale to original if necessary
invisible(Sys.setlocale("LC_TIME", "eI_GR.UTF-8"))
```

Analysis of Charts

1. **Scatter Plot for Minimum Prices:** This chart shows the daily change (return) of MSFT's minimum prices compared to the daily change of the Nasdaq Composite Index (IXIC). MSFT's prices show significant volatility. Its performance fluctuates around zero, indicating that the minimum prices of the stock did not have a clear upward or downward trend but experienced days with large fluctuations.
2. **Scatter Plot for Maximum Prices:** This chart shows the daily change (return) of MSFT's maximum prices compared to the daily change of IXIC. Like the previous chart, MSFT's maximum prices also show volatility around zero, indicating that the maximum prices of the stock also had fluctuations without a clear long-term trend.
3. **Scatter Plot for Closing Prices:**

This plot shows the daily change (return) of MSFT's closing prices compared to the daily change of the IXIC index. The returns of MSFT's closing prices exhibit a similar pattern to the previous plots, with significant volatility around zero.

Conclusions

Minimum Prices: The beta coefficient for the minimum prices of MSFT (0.617) indicates that the stock is less sensitive to changes in the IXIC index. This means that when the NASDAQ Composite index increases or decreases by 1%, the minimum price of MSFT changes by approximately 0.617%.

Maximum Prices: The beta coefficient for the maximum prices of MSFT (0.552) also suggests low sensitivity to the index. This indicates that the maximum price of MSFT has less volatility compared to the performance of the IXIC index.

Closing Prices: The beta coefficient for MSFT's closing prices (1.039) shows that Microsoft's stock is almost as sensitive as the NASDAQ Composite index. That is, when the index changes by 1%, MSFT's closing price tends to change by about 1.039%, indicating a high correlation with the index's performance.

The minimum and maximum prices of MSFT show low sensitivity to changes in the IXIC index, suggesting that the stock's extreme prices are not heavily influenced by overall market trends. The closing prices of MSFT, however, show a higher correlation with changes in the IXIC index, indicating that the overall performance of the stock is more sensitive to general market trends. According to portfolio theory, Microsoft's stock exhibits different levels of risk and return depending on the type of price (minimum, maximum, closing), with closing prices showing higher correlation and sensitivity to changes in the NASDAQ Composite index.