Analyzing Thanksgiving Holiday effect on Retail Stocks

SIEO 4150

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Abstract

This study examines the effect of Thanksgiving Holiday on the stock returns of six retail companies. Statistical tests were performed to analyze log-returns of individual stocks and check the pre-holiday effect on these stocks just before the Thanksgiving Holiday. Tests were also carried out on two stocks at a time to investigate if they had similar log-returns during Thanksgiving Holiday and if there were any correlations between them.

Data Set

The data set used in this project consists of daily stock prices of six retail companies from Jan 1998 to Dec 2017. The stocks and the companies they represent are as below:

KSS – Kohl's Corporation
TGT – Target Corporation
JCP – J. C. Penney Company Inc.
WMT – Walmart Inc.
M – Macy's Inc.
AMZN – Amazon.com Inc

The stock data for the above companies was collected from Yahoo Finance. The total number of data points collected for each stock was around 5031 observations. To further test the Holiday effect on these retail stocks, a subset of stock data for dates around Thanksgiving (1st week of November to 8th December for 20 years) was extracted from the original observation of 20 years. The Pre-Holiday Data consists of stock returns of 5 days before the Thanksgiving Date for each year and the Post-Holiday Data consists of stock returns of 5 days after the Thanksgiving Date for each year.

Project Goals

It is believed that share prices often rally ahead of Thanksgiving weekend attributed to simple optimism and high spirits among traders. There is also a more fundamental basis, as consumers tend to spend more during Thanksgiving sales, as this can push up the share prices of retail stocks in particular.

This study was based on large retail stocks and their stock returns were compared before thanksgiving and after the thanksgiving period. The daily log returns for each of the stocks was collected for 20 years (1998 -2017). To perform statistical tests to check correlations, the individual stock log-returns were first tested for randomness and their histograms and normal probability plots were inspected to check if the data was normally distributed. Even if the observed data didn't suggest normal distribution, the correlation tests were performed assuming normality due to the large number of sample points in the data. For all the tests, the confidence interval used was 95%.

To test the Pre-Holiday effect on the stock log-returns, the mean of Pre-Holiday period (-5 days from Thanksgiving Date) was compared against that of Post-Holiday period (+5 days after Thanksgiving Date)

For two-stock analysis, regression of the log-returns of each of stocks during the Holiday Period was performed against each other to check for correlation.

Analysis and Test Results

Test for Randomness – Single Stock Analysis

The first step in single stock analysis involved checking if the stock log-returns were consistent with a random sample. The runs test is used to determine randomness of the stock log-returns data. The null hypothesis for this test is that the elements in the sample are mutually independent and consistent with a random sample. The alternative hypothesis is that the elements are mutually dependent and are not consistent with a random sample.

Run Tests Results for Randomness (Stock Log-Returns 1998-2017)

The below results are for Log-Returns of Stocks from 1998-2017. It was observed that for the all the stocks except WMT(Walmart), p-value was greater than 0.05, suggesting that there is no evidence to reject the null-hypothesis, which means all these stocks data except WMT are consistent with a random sample.

Stock	P-Value
KSS	0.6204
TGT	0.0588
JCP	0.2252
WMT	0.0013
M	0.9619
AMZN	0.167

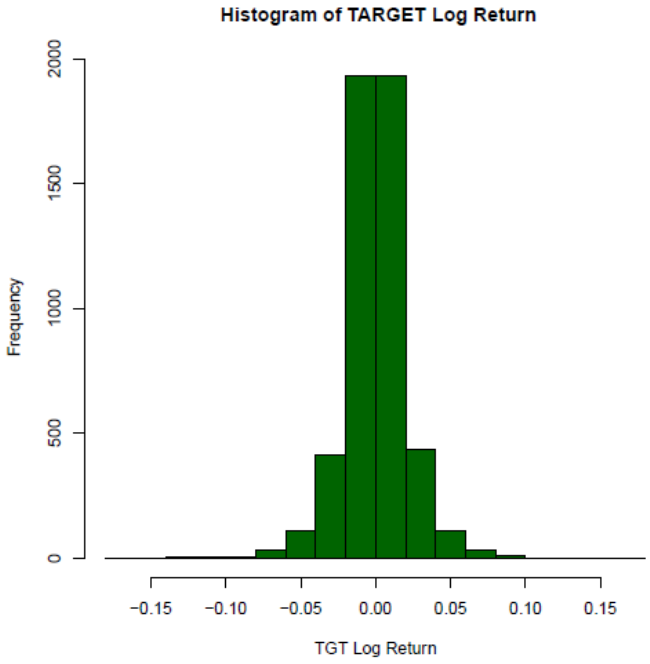
Run Tests Results for Randomness (Holiday Log-Returns 1998-2017)

The runs test was repeated for the holiday period sample of these stocks and the results were different from those of the original log-Return data. For the Holiday period log-Returns of all stocks were consistent with a random sample except that of TGT, whose p-value was less than 0.05

Stock	P-Value
KSS	0.8611
TGT	0.0051
JCP	0.5371
WMT	0.6
M	0.3361
AMZN	0.6

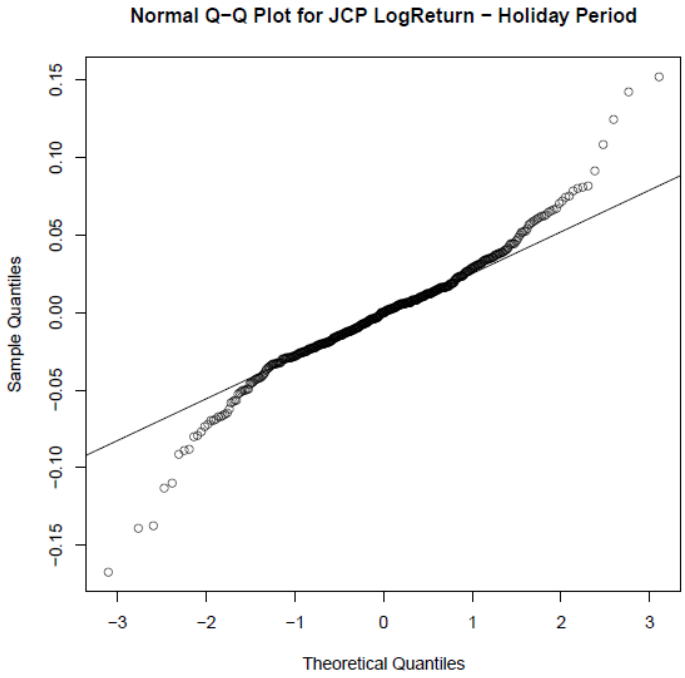
Test for Normality – Plotting Histograms

The histograms of log-returns presented a frequency distribution that looked centered and approximately normal. The histograms were plotted for both the original data (1998-2017) and for the Holiday Period separately.



Test for Normality – Normal Q-Q Plots

The Normal Q-Q Plots is another method to graphically inspect if the data is consistent with normal sample. The normal Q-Q plots for the stock log-returns showed only deviations at the tails and provided strong evidence to conclude that the log-returns data of the samples were consistent with a normal distribution.



Confidence Intervals for Mean and Variance

The 95% confidence intervals for mean, μ, and the variance, σ^2, were calculated for the log-returns of the samples. The population variance for the normal distributions of the stock log-return data was unknown, so t-distribution with (n-1) degrees of freedom was utilized to calculate confidence interval for mean(μ). For the confidence interval for variance (σ^2), chi-square distribution with (n-1) degrees of freedom was used.

95% Confidence interval for Mean and Variance (1998 – 2017)

Stock	Confidence Interval for Mean	Confidence Interval for Variance
KSS	[0.00022 , 0.00025]	[0.00054 , 0.00050]
TGT	[0.00025 , 0.00028]	[0.00046 , 0.00043]
JCP	[-0.00061 , -0.00056]	[0.00095 , 0.00088]
WMT	[0.00031 , 0.00033]	[0.00027 , 0.00025]
M	[$1.6e^{-05}$, $5.3e^{-05}$]	[0.00071 , 0.00066]
AMZN	[0.00105 , 0.001125]	[0.00145 , 0.00134]

95% Confidence interval for Mean and Variance – Holiday Stock returns

Stock	Confidence Interval for Mean	Confidence Interval for Variance
KSS	[0.00052 , 0.00064]	[0.00077 , 0.00060]
TGT	[0.00143 , 0.00154]	[0.00073 , 0.00057]
JCP	[-0.00077 , -0.00057]	[0.00134 , 0.00097]
WMT	[0.00128 , 0.00133]	[0.00029 , 0.00023]
M	[0.00082 , 0.00097]	[0.00102 , 0.00080]
AMZN	[0.00267 , 0.00293]	[0.00175 , 0.00137]

The 95% confidence interval for μ were small and showed that the mean log-return of all of the stocks were around zero. Similarly, the 95% confidence interval for σ^2 displayed an interval that was extremely small, suggesting that the log-returns of all the stocks demonstrated little variability. It is also observed that the limits of the confidence interval of the mean of log-returns during Holiday period is greater than that of the confidence interval of mean of log-returns of the whole sample.

Linear Regression against Time

Linear regression of stock log-returns against time was plotted for each of the stock data to check dependency on time.

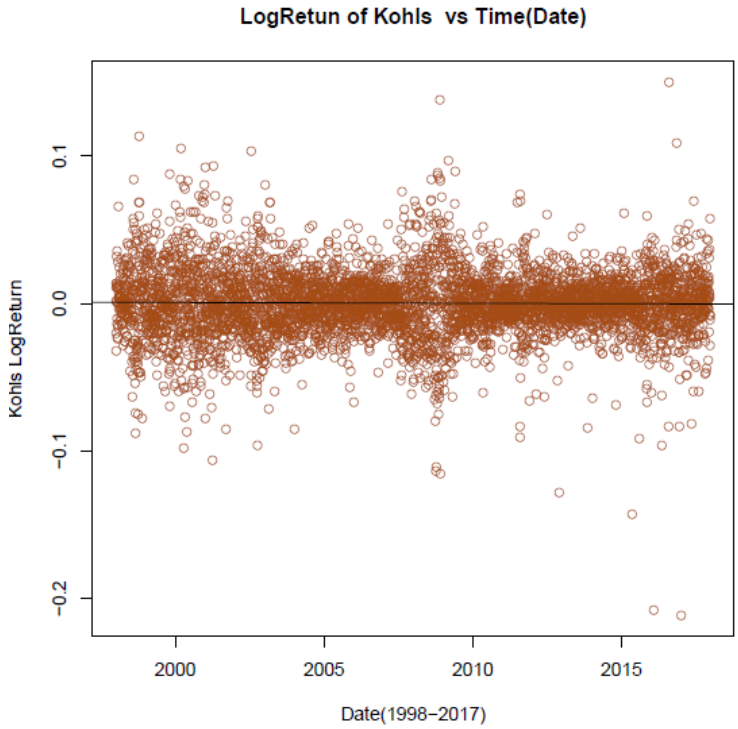
Regression of Stock Log-Returns vs Time (1998-2017)

Stock	Intercept	Slope	R^2	P-Value
KSS	0.00239	-1.55E-07	0.00021	0.3099
TGT	0.00184	-1.13E-07	0.00013	0.4209
JCP	0.00173	-1.67E-07	0.00014	0.4094
WMT	0.00138	-7.60E-08	9.89E-05	0.4805
M	0.00076	-5.19E-08	1.76E-05	0.766
AMZN	0.0018	-5.13E-08	8.38E-06	0.8373

Regression of Stock Holiday Log-Returns vs Time (1998-2017)

Stock	Intercept	Slope	R^2	P-Value
KSS	0.00560	4.42E-07	0.00128	0.4138
TGT	0.00767	-4.42E-07	0.00135	0.401
JCP	-0.00036	-2.21E-08	1.85E-06	0.9752
WMT	0.00183	-3.76E-08	2.44E-05	0.9102
M	0.00189	1.99E-07	2.00E-04	0.7502
AMZN	0.00171	-1.02E-06	3.00E-03	0.2075

The results indicated there is no relationship between the stocks log-returns and time. It is observed that the R^2 values are very close to zero and suggest no correlation between the log-returns and time for both the regular sample and the holiday period.



The scatter plots of log-returns vs time also confirm lack of correlation between the two variables. The residual plots do not provide any additional information on the dependencies either.

Test for Holiday Effect

To check the pre-holiday effect on the stock log-returns, the means of the pre-holiday sample (-5 days before Thanksgiving Date) was tested against that of the post-holiday sample (+5 days after Thanksgiving Date). Since the mean and variance of the log-return population was unknown, t.test was used to perform this comparison. The null-hypothesis being “the two sample means are equal”.

To use t.test, the atternate hypothesis can be chosen either for a two-sided test or one-tailed test. Both tests were performed and the results were examined. For using one-sided test, in R, an additional argument (alternate =”greater”) was used, which means the alternate hypothesis suggests, mean of first sample is greater than that of second sample. In this scenario, which would mean, pre-holiday mean is greater than post-holiday mean suggesting Thanksgiving has an effect on pre-holiday stock prices.

Test Results for Pre-Holiday Mean vs Post-Holiday Mean t-test

Stock	Pre-Hol Mean	Post-Hol Mean	Test Statistic	P-Value 2-sided	P-Value 1-sided
KSS	0.0033	-0.003	1.64	0.103	0.051
TGT	0.0054	0.0021	0.9838	0.326	0.163
JCP	0.0052	-0.003	1.84	0.067	0.033
WMT	0.0012	-0.001	0.927	0.355	0.177
M	0.0048	-0.0013	1.502	0.135	0.067
AMZN	0.0078	0.0026	0.857	0.393	0.196

It is observed that for all the six retail stocks the average Pre-Holiday Mean was greater than the Post-Holiday Mean. First, the t test for 2-sided 95 confidence interval was performed and it was found that the Test Statistic for all the stocks was less than 1.96 and the p-values were greater than 0.05 (95% confidence interval) . However, when the same test was carried out as a one-sided test using alternative = “greater” argument, it was observed that the p-value for JCP was 0.033 which is less than 0.05 providing evidence to reject the null-hypothesis. In this case, the test-statistic which is 1.84, is greater than 1.645 (95% 1-sided) suggesting alternative hypothesis that the pre-Holiday Mean is greater than Post-Holiday Mean. On inspecting the Kohls(KSS) t test results, it is observed that the results are almost on border for the one side t-test with p-value of 0.051 and Test Statistic of 1.64(~=1.645) Apart from JCP and Kohls, other retail stocks do not show any effect of Thanksgiving on Pre-Holiday Mean vs Post-Holiday Mean

Two-Stock Analysis

To compare and check the equality between means of each of the stock log-returns with each other, t-test with unknown and unequal variance was performed. The regression of one stock’s log-return on another was done to check if there exists any correlation between the stock’s log-returns. All samples used for two stock tests were that of the holiday period to check correlation between the stocks during Thanksgiving period.

The results of the t-tests suggest that there is no evidence to reject the null-hypothesis that the stock log-returns means are equal. It is fairly obvious that the sample means of log-returns are similar as all these stocks belong to the retail industry and expect to have similar deviations during the Thanksgiving Holiday period.

The results of linear regression of one stock’s log-return on the other, does not suggest any pattern for strong correlation between the stocks. Even though it had very low p-values, the R^2 values for these tests were not high enough to suggest correlation.

Kohls(KSS) Two-Sample t-test and Linear Regression

Stock	P-Value (t-test)	Intercept	Slope	R^2	P-Value (regression)
TGT	0.574	-0.0003	0.571	0.309	8.50E-44
JCP	0.504	0.0009	0.441	0.338	1.20E-48
WMT	0.591	-0.0003	0.64	0.156	5.30E-21
M	0.856	0.0001	0.529	0.373	8.40E-55
AMZN	0.283	8.01E-05	0.181	0.074	2.30E-10

The R^2 values obtained from the two-stock regression analysis of retail stocks were around 0.062 to 0.373. For a strong correlation between the stocks, it was expected to have R^2 values close to 0.9 and above, however lower R^2 values suggest no evidence of correlation between these stocks. The slopes ranged from 0.167 to 1.81

Conclusion

Based on the statistical tests performed on the log-returns of these retail stocks, the following conclusions were derived

- Almost all log-returns of these six retail stocks were consistent with a random sample and cleared the graphical inspection of the test of normality
- For the single regression analysis of these stock log-returns with time, there was no evidence suggesting any linear relationship between time and log-returns
- Comparing two stocks using t-test, it was observed that the means of the stocks during the Thanksgiving Holiday period was equal to each other suggesting they had identical patterns of returns, however the regression analysis between the stock log-returns did not provide any strong evidence of correlation between these stocks.
- For all stocks except JCP and Kohls, there was no evidence of Thanksgiving Holiday effect on the Pre-Holiday Log-Returns when tested on 95% confidence interval one-tailed test. The same test returned no evidence of Thanksgiving effect when tested on a 95% confidence interval 2 tailed-test

  The belief that there exists a Thanksgiving Holiday effect on the Pre-holiday Log-returns could not be proven based on the results obtained from the statistical tests performed on these sets of retail stock data.

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