WAITE FIRST SECURITIES

TO: Alex Lee
FROM: Team 4
DATE: October 19th, 2022
SUBJECT: Risk Evaluation | Apple, Intel, or Kroger

Lee, after talking over the phone about adding a stock to your investment portfolio, we've analyzed the stock's performance between 2015 and 2020. The table below summarizes the calculated statistics of the three stocks you were interested in adding to your portfolio. We will discuss in depth to determine which stocks are suitable to add to your portfolio.

Particulars	S&P 500	Apple	Intel Corp	Kroger
Arithmetic Mean	0.9%	2.7%	0.9%	0.4%
Geometric Mean	0.8%	2.3%	0.7%	0.1%
Standard Deviation	4.3%	8.4%	7.1%	7.9%
Coefficients of Variation	4.6	3.1	7.7	17.9
Estimated Investment Beta	1.0	1.3	0.8	0.3
Coefficient of Determination R^2s	100%	42.9%	20.9%	3.4%

Before we begin, let us briefly explain each term in the table. Arithmetic mean is the average return of an investment, whereas the geometric mean gives the compounded rate of return over a certain period. Standard deviation measures the investment's overall risk of variation from its mean, whereas the coefficient of variation measures the investment's risk per unit of return. Estimated beta indicates the change in the stock return relative to the movement in the overall market and the correlation between the individual stock & overall market. A beta higher than 1.0 means that the stock is more volatile than the market, whereas a beta of less than 1.0 indicates that the stock is less volatile. R^2s measure the proportion of variation of individual stock affected by the changes in the overall market. (i.e., systematic risk).

After analyzing each stock, we want to discuss two key findings. Kroger, traditional consumer staples stock, has an unexpectedly low compounded annual growth rate of 0.1%, with a CV of 17.9. Traditionally, stocks in the consumer staples sector are considered defensive stocks that do not follow a business cycle and have the advantage of stability, low risk, and outperformance in periods of economic decline; therefore, having a 0.1% of annual growth return rate with an unusually high risk per unit for 72 months period is an unanticipated outcome in our analysis. Secondly, in contrast to Kroger, Apple belongs to the IT sector, which offers the highest returns but is the most volatile and risky. However, from the perspective of our analysis, Apple has shown a much lower risk per unit with a higher return than the defensive stock, Kroger. It was interesting to note that consumer staples stocks exhibit higher risk per unit than IT stock and yield 23x lower annual compounded growth return.

Our team compared the performance of each stock to the market to provide our intuition behind the relative magnitudes of the statistical findings across stocks. Comparing the geometric mean of each stock to the market return of 0.8%, Apple has a return of 2.3%, which is 3x higher than Intel's and 23x higher than Kroger's. Although Apple shows a high return compared to other stocks and the market, the SD shows the stock's volatility exhibits approximately 1.95x, 1.18x, and 1.06x higher than the market, Intel, and Kroger, respectively. While Apple shows the highest volatility, its coefficient of variation (risk-to-return ratio) exhibits a markedly different result with 3.1, which is 1.48x, 2.48x, and 5.77x lower than the market, Intel, and Kroger. R^2 is a statistical measurement that is explained by the market's movement. Thus, R^2 of 42.9% means that the market influences 42.9% of the variation in Apple's stock, which is higher than Intel and Kroger's, and the same is explained by Apple's strong positive correlation of 0.7 with the market. Lastly, with a beta of 1.3, Apple stock is more volatile than Intel and Kroger compared to the market return.

Apple is our recommended stock for your portfolio after considering your investment objectives for the following reasons. Despite Apple being riskier among the three stocks with its volatility, Apple has the most significant return of 2.3% among the other stocks. Apple appears reasonably well-defended even during the 2020 pandemic while stock prices dropped. Besides this, Apple has a relatively low risk-to-return ratio, with a beta of 1.3, compared to other stocks, and that makes Apple more attractive for long-term investment.

However, since risks are fundamental to investors, we would like to discuss potential caveats or limitations regarding your investment. One caveat for Apple is that the products are becoming too expensive for an average customer, and that causes difficulties for consumers to purchase. Therefore, the sales growth of Apple products might be lower in the future. Another limitation comes from the statistical analysis. Since the above statistics are based on the data from 72 months, it is impossible to predict the accurate returns of an individual stock. Thus, we must keep an eye out for where Apple heads in the future.

TECHNICAL REPORT ON WAITE FIRST SECURITIES

Source of the data: Yahoo Finance
Variables: Descriptive Statistics, Coefficient of Variation, Estimated Investment Betas, R^2s
Sample size: 72 months
Sample Timeframe: 2015 - 2020

Estimated Capital Asset Pricing Model for Apple Computer based on 2015-2020 data:

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Residuals:
        Min              1Q        Median              3Q            Max
-0.2216895674   -0.0335654204   -0.0063796789    0.0414136990    0.1427839442

Coefficients:
              Estimate       Std.   Error    t   value        Pr(>|t|)
(Intercept)   0.0149876204   0.0076808831    1.95129          0.055025    .
sr_sp500      1.2682651949   0.1749535234    7.24915    4.3797e-10    ***
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Signif.  codes:    0  '***'  0.001  '**'  0.01  '*'  0.05  '.'  0.1  ' '  1

Residual   standard   error:   0.0636926886   on   70   degrees   of   freedom
Multiple  R-squared:    0.428805721,      Adjusted  R-squared:    0.420645803
F-statistic: 52.5502471 on 1 and 70 DF,  p-value: 4.3796721e-10
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Estimated Capital Asset Pricing Model for Intel Corp based on 2015-2020 data:

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Residuals:
        Min              1Q        Median              3Q            Max
-0.24607515562   -0.04570837593    0.00860884898    0.04211293625    0.17559204748

Coefficients:
              Estimate        Std.   Error    t   value        Pr(>|t|)
(Intercept)   0.00222825924   0.00771542967    0.28881          0.77358
sr_sp500      0.75584203962   0.17574041773    4.30090    5.4087e-05    ***
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Signif.  codes:    0  '***'  0.001  '**'  0.01  '*'  0.05  '.'  0.1  ' '  1

Residual   standard   error:   0.0639791614   on   70   degrees   of   freedom
Multiple  R-squared:     0.20901939,  Adjusted  R-squared:    0.197719667
F-statistic: 18.4977446 on 1 and 70 DF,  p-value: 5.40868469e-05
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Estimated Capital Asset Pricing Model for Kroger based on 2015-2020 data:

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Residuals:
       Min                1Q       Median                3Q              Max
-0.2167179760  -0.0630031863   0.0042010129   0.0504073963   0.2385575218

Coefficients:
             Estimate          Std.    Error    t    value    Pr(>|t|)
(Intercept)    0.0013060614   0.0094576841    0.13810             0.89056
sr_sp500          0.3358155462   0.2154251190   1.55885             0.12354

Residual   standard   error:   0.0784265716   on   70   degrees   of   freedom
Multiple  R-squared:    0.0335498311,      Adjusted  R-squared:    0.0197434001
F-statistic: 2.43001476 on 1 and 70 DF,  p-value: 0.123541764
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Conducting Hypothesis test:

Null Hypothesis(H_0): $\beta_1 = 1$
Alternative hypothesis(H_a): $\beta_1 \neq 1$

t-statistic(t) = (b_1 - β_1)/s_{b1}
where b_1 = Estimated beta of the stock
     $\beta_1 = 1$
   Sb1 = Standard error of the stock

Hypothesis test about the estimated beta of Apple:

t = (1.2683 – 1) / 0.1750 = 1.5331, 70 df
p-value = 0.06488 * 2 = 0.1298

Since the p-value is greater than 0.05, the estimated investment beta of Apple is not statistically significantly different from 1 at the 5% significance level. Hence, we reject the null hypothesis test at a 5% significance level.

Hypothesis test about the estimated beta of Intel:

t = (0.7558 – 1) / 0.1757 = -1.3899, 70 df
p-value = 0.0845 * 2 = 0.169

Since the p-value is greater than 0.05, the estimated investment beta of Intel is not statistically significantly different from 1 at the 5% significance level. Hence, we reject the null hypothesis test at a 5% significance level.

<u>Hypothesis test about the estimated beta of Kroger</u>:

t = (0.3358 – 1) / 0.2154 = -3.0836, 70 df
p-value = 0.00146 * 2 = 0.003

Since the p-value is greater than 0.001, the estimated investment beta of Kroger is statistically significantly different from 1 at the 1% significance level.

Beta measures the systematic risk that compares the volatility of the stock and its correlation to the overall stock market. A stock with a 'beta of 0' means that there is zero systematic risk (i.e., no market exposure) and is a risk-free asset, whereas the investments in our interest have systematic risk. Hence, it is more appropriate to test whether each estimated beta differs from 1 instead of 0.

Comparing our findings with previous data, the market's return was arithmetically and geometrically close to zero, indicating that the stock market didn't perform well from 1999 to 2004. Besides, looking at the SD, the volatility of Apple, Intel, and Kroger seems significantly higher than the recent data, while Apple has less systematic risk. When comparing the beta values, Intel's beta has come down significantly compared to the past, indicating that the stock has become less sensitive to events that affect the market. Lastly, in conducting hypothesis testing to see whether beta differs from one, p-values of the past data indicate that Apple's and Intel's beta are statistically significantly different from 1 at 0.1% and 1%, respectively. In contrast, the p-values of the current data indicate that these stocks are not statistically significantly different from 1 at the 5% significance level.

Word Count, excluding the table and R outputs, is 1192.