Annual Total Return Table for the S&P 500 Index of Stocks

Floyd Vest (Preliminary Version)

We are looking for a complete annual total return table for the S&P 500 Index of stocks. According to Wikipedia.org, Search S&P 500, the index was first introduced in 1923 as the S&P 90. The S&P 500 Index in its present form began on March 4, 1957.

In our search for such a table we tried Standard and Poors, Wikipedia, Morningstar, google, etc. and didn’t find one. We are reporting on what we found, which in itself is educational. We will report on 1Stock1.com, Wikipedia.org, Search S&P 500; and Measuringworth.com.

Measuringworth.com comes close in that it has a long term Total Return table for a S&P portfolio dating back to 1871 utilizing proxy portfolios and a S&P 500 portfolio. The following Comparison Table 1 gives an example of the data available for the year 1975 in all three sources.

<table>
<thead>
<tr>
<th>Beginning Price</th>
<th>Ending Price</th>
<th>Gain</th>
<th>Percent</th>
<th>Dividend Yield</th>
<th>Annual Total Return Rate</th>
<th>Accumulated Total Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975 $68.56</td>
<td>1975 $90.19</td>
<td>$21.63</td>
<td>31.55%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Stock1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wikipedia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$.89 end 1974</td>
<td>$3258.45 at Jan. 76</td>
</tr>
<tr>
<td>Measuringworth-</td>
<td>Jan. 75</td>
<td>Jan. 76</td>
<td>$24.30</td>
<td>33.49%</td>
<td>5.07%</td>
<td>$2351.63 at Jan. 75</td>
</tr>
<tr>
<td>worth</td>
<td>$72.56</td>
<td>$96.86</td>
<td>$24.30</td>
<td>33.49%</td>
<td>5.07%</td>
<td>$2351.63 at Jan. 75</td>
</tr>
</tbody>
</table>

Table 1 - Comparison Table for 1975.

In Table 1, the letter “C” means calculated by the author. We are assuming that 1Stock1 and Wikipedia give actual S&P 500 Index numbers. The Measuringworth table is more complete and goes back to before the beginning of the S&P 500 Index. 1Stock1 goes back through 1975. Table 1 has seven columns and we request a column headed Total Dividends for the year. (See the Side Bar Note “Using measuringworth.com” for instructions for getting its S&P 500 portfolio total return table.)

Measuringworth calculates the average price during January of each year. The dividends earned during the year are assumed to be reinvested at the price of stocks in the composite in January of the next year. Dividends are often paid quarterly and can be reinvested immediately. Measuringworth’s treatment of dividends misses this feature.
Measuringworth seems to be using the formula

(1)  \[ \text{Total value of dividends} = \text{Dividend Yield} \times \text{Total value of portfolio at beginning of year}, \]
which gives

(2)  \[ \text{Dividend Yield} = \frac{\text{Total value of dividends}}{\text{Total value of portfolio at beginning of year}}. \]

A common formula for Total Return rate for the year is

(2)  \[ \text{Total Return rate for the year} = \text{Percent Gain or Loss for the year} + \text{Dividend Yield}. \]

This formula can slightly underestimate the Total Return rate for the year because it ignores the reinvestment of dividends during the year as soon as they are paid. Dividend Yield is often estimated by dividing total dividends for the year divided by stock price at the end of the year.

Example 1. We will walk through the reinvestment process for 1975 with measuringworth. In Jan. 1975, they invested $23,516.3 in stocks priced at $72.56 per share acquiring 32.409 shares. The price increased to $96.86 per share. The 32.309 shares are now at $96.86 per share, giving a total value of $3,139.136. For Dividend yield, \(5.07\% \times 23,516.3 = 1,192.28\). (a) \(1,192.28 \div 96.86 = 12.31\) shares. The 12.31 shares at $96.86 = $1,192.28. (b) Value of dividends plus $3,139.136 gives $1,192.28 + $3,139.136 = $3,258.364. The table value for January 1976 = $3,258.45. The steps from (a) to (b) could be compressed to the above “\(5.07\% \times 23,516.3 = 1,192.28\)” (See measuringworth for instructions for the above steps.)

Example 2. For 1975 from the Table 1, for Annual Total Return rate \(TR\), we have

\[ 2531.63(1 + TR) = 3258.45 \]

giving \(TR = 38.56\%\) compared to \(38.56\%\) calculated in the table, by other methods. From Wikipedia, we solve \(.89(1 + TR) = 1.22\) to get \(TR = 37.08\%\). Wikipedia also gives \(TR = 37.20\%\). Measuringworth seems to provide a proxy for the S&P 500 Index.

Example 3. Wikipedia reports that for 1988, the total annual percent change in the index was \(12.40\%\) and the Total Annual Return was \(16.61\%\), and $1.00 invested at the start of 1988 gives $1.17 (Page 8, top of the page). We will compare this to calculations with measuringworth. Price change = Price at beginning of 1989 – Price at the beginning of 1988 = $285.41 – $250.48 = $34.93. The $34.93 = 13.945\% of $250.48. Wikipedia said 12.40\%. For Annual Total Return rate, \(14,203.54(1 + TR) = 16,735.99\), \(TR = 17.83\%\). Wikipedia said the total return rate was 16.61\%. Measuringworth seems to be a proxy for the S&P 500 Index.

Example 4. We will use the Accumulated Total Return in measuringworth to calculate the average Annual Total Return rate from the beginning of 1975 to the beginning of 1985, a total of ten years. For the Jan. of 1975, measuringworth gives 2351.83. For Jan. of 1985 it gives 8781.97. We calculate \(2351.83(1 + TR)^{10} = 8781.97\). This gives average \(TR = 14.08\%\) per year. During these optimistic years, many investors thought these returns would last indefinitely. Many were caught in a bear market, just before retirement, and had to postpone their retirement for many years.

Example 5. Reading fund reports. According to Morningstar, the Large Growth Category Peer Average for ten years was 7.28\% and the cumulative return for ten years was 103.86\% (Fidelity Growth Company Fund, Update, May 31, 2013). We could try to check the
average annual Total return with \((1 + TR)^{10} = 1+1.0386\) and get \(TR = .073824 = 7.38\%\). This doesn’t agree with Morningstar’s reported 7.28% ten year average. An investor should keep this problem in mind when comparing a ten year average annual Total Return reported by a fund and the ten year average annual return reported by Morningstar for the peer group of funds. To lean about Morningstar, go to Morningstar.com. For a certain fund, you can put in for example, Morningstar.com/Fidelity Growth Company Fund or Morningstar.com/FDGRX. See the article in this course “Evaluating Investments, irr, mirr, npv, AM, TR, and HM.”

We will check the numbers given by Fidelity. They say that Average Annual Total Return for the past ten years ending May 31, 2013 = 10.70%. The Cumulative Total Return is 176.37\%. We check:

\[(1 + .1070)^{10} = 2.7636065 = 1 + 1.7636065\] which gives Cumulative Total Return of 176.36\% which agrees with Fidelity. This tells us how Fidelity calculates. We are still not sure how Morningstar calculates.

A person could check these Total Return figures against the S&P 500.

Example 6. Retirement withdrawal risks. The years 2007 through 2011 included difficult years. One balanced fund (60%stocks, 40% bonds) started with $1 million at the beginning of 2007 and ended 2011 with $760,361 without any withdrawals. If $40,000 had been withdrawn at the end of each year, it would have ended with $580,648. At this rate how much longer would the money last with withdrawals? This simplified scenario approximates an actual scenario (Scott Burns, “Using play money to figure market change,” Denton Record Chronicle, May 15, 2011, assetbuilder.com/ScottBurns). We calculate

\[
$1M(1 + r)^{5} = 760,361. \quad r = -.0533 = -5.33\%. \quad 580,648=40,000 \left[\frac{1-(1+.0533)^{-N}}{.0533}\right] \text{ we solve for } N. \quad \text{TI 83/84 code: } PMT = 40,000 \quad PV = -580,648 \quad I\% = -5.33 \quad \text{Solve for } N, \quad \text{ALPHA SOLVE} \quad \text{and get } N = 10.46 \text{ years. The }$1M \text{ lasted 15.46 years with }$40,000 \text{ withdrawn each year. This gives } 15.46(40,000) = $618,400 \text{ received from the }$1M. \quad \text{Use measuringworth and Wikipedia to compare this fund’s performance to the S&P 500 and to interest rates. Scott said this fund still had }$1 \text{ billion in assets. If you like, show how to use logs to solve for } N. \quad \text{Scott says that a Bear Market does more damage when you are taking out regular distributions. See the following Side Bar Note, Sequence of returns risk. What is one problem with using this average for the remaining years?}

Side Bar Notes:


Proxies for the S&P 500 Index. Morningstar seems to be using the ETF: iShares S&P 500 Index. For Another proxy, see Vanguard.com for Vanguard 500 Index Investors Shares,
VFINX. Expense ratio .17%, Inception 8/31/1976; and its benchmark, the S&P 500 Index Total Returns.

Four meanings of the term Total Return. The term Total Return has four meanings. Starting with the first year, how are they defined and calculated? Even more depending on how dividends are treated and how indexes are calculated. Read in Wikipedia on how indexes are calculated.

Happier workers. Workers making $150,000 per year are twice as likely to say they are happy as people making $20,000 or less (Time, July 8-15, 2013, p. 30).

Test your financial smarts. Go to the new MoneyQuiz section of the congressionally chartered MyMoney.gov website. Answer questions on investing and borrowing. If you get anything wrong, you can follow links.

Keep the S&P 500 in mind. To help keep your future focus, post a chart near your computer showing the S&P 500 Index over the past 50-plus years. Look back to the dark days following the October 1987 crash when stocks lost 30% in five days. Had you put $100,000 in the S&P 500 then, you’d have $1.2 million today (Money, Aug. 2012, p. 73). Check this against measuringworth.

Buying a home can be a good investment. According to the Federal Reserve, two-thirds of U.S. families own a home, and their home is typically two thirds of their assets. According to the Center for Economic Policy, home prices are close to a fair value when the price-to-rent ratio is about 15 times gross annual rent (Smart Money, April 2012, p. 24). See the articles about real estate investing in this course.

Unemployment, by education in February 2012. High school grads 8.3%; Some college 7.3%; College graduates 4.2% (Money, May 2012). For college graduates, which majors have the highest unemployment rate?

The S&P 500 surges. Value Added columnist Steve Goldberg reminds investors that the stock market has surged following every midterm election since 1942 (Kiplinger’s Personal Finance, 12/2010, p. 6). Check this against measuringworth or 1Stock1.

Sequence of returns risk for retirement portfolios is illustrated at fidelity.com. For two $100,000 Portfolios with $7000 withdrawn each year and both having the same annual returns but in different sequences: For twenty years of returns, both suffered five negative returns. Portfolio A suffered the negative returns early in the first seven years and was broke after twelve years. Portfolio B with negative returns beginning with the fifteenth year, ended with a balance of $351,295. Formulas depending on averages don’t tell the whole story. Financial mathematics should include spreadsheet code. (From “Safeguard your retirement income,” Fidelity.com)
Exercises: Show your work. Label answers, variables, and numbers.

#1. Use measuringworth.com to calculate for 1952 the end of year Accumulated Total Return: (a) In Jan. 1952, how many shares were owned in the portfolio? (b) In Jan. 1953, what was the value of these shares? (c) What was the value of the newly purchased shares using 1952 dividends? (d) Calculate the Total Accumulated value of the portfolio at the end of 1952.

(e) Calculate the Annual Total Return rate for 1952.

#2. Use the share prices in measuringworth.com to calculate for 1951 the rate of increase in the index. Calculate the Total Return rate for the year.

#3. From Wikipedia in Table 1, estimate the Dividend percent Yield. Compare to Dividend Yield in measuringworth.

#4. From Wikipedia.org and other sources: (a) Describe what stocks are in the S&P 500 Index? Name some of them. (b) What is the market capitalization of the Index? (c) Estimate the current average dividend yield. (d) What are some periods of higher dividend yields and what were the high yields on average? (e) Trace the ups and downs of the Index for the “lost decade” beginning in March 2000. When did it recover its former high and hold it for a period of time? (f) Does the Index include non – U.S. companies? (g) What are some S&P 500 Index funds? Give some information about them. Are they popular among investors?

#5. Go to finance.yahoo.com and put in ^GSPC for the S&P 500 Index. Click on 5 yr and play with the interactive chart. Describe the volatility. Estimate the average yearly compounded gain. Is this an average yearly Total Return?

#6. From morningstar.com: “For a vertical log scale for portfolio values, the vertical distance between $10,000 and $20,000 is the same as the distance between $20,000 and $40,000. Usually the full length of the vertical axis represents a ten fold increase.” Use you knowledge of logs to verify these figures. For logs to the base ten, what is the top number? For base e, what is the top number. See the article in this course “Logarithmic Scales Used in Finance,” Fall 2012.

#7. In measuringworth, when and how long did it take the S&P 500 portfolio prices take to recover the Jan. 1929 high? What was the Average Annual Total Return rate? Explain. When did the Accumulated Total Return recover its former high.

#8. Calculating the number of years: Notice that in Example 4, from the beginning of 1975 to the beginning of 1985 was 10 years = 1985 – 1975 . We call this period of years beg to beg. Give rules for calculating for year n to year k, a rule for beg to end, a rule for end to beg, and rule for end to end. See the article in this course “Using USInflationcalculator.com.”

#9. Use the Total Annual Returns Including Dividends column in Wikipedia to calculate the fortunes of investors who were depending on the stock market for retirement after the beginning of year 2000. Build and label a table to 2012 or later. If they needed a 10% Annual Total Return rate, did they ever get there. Discuss. Actually, the older you get, up to a point, the more it costs to retire. See “The Mathematics of Financial and Social Responsibility” in this course.

#10. The optimistic years, 25 years, were from the beginning of 1975 through 1999. This history was all that some investors knew. Study the Total Annual Return Including Dividends
column in Wikipedia to verify this. Discuss. Consult measuringworth for an estimate of the Average Annual Total Return rate $TR$ for this period. Calculate and discuss.

#11. In Wikipedia.org, Search S&P 500, click on the graph for the S&P 500 Index from 1950 to 2012, to enlarge it. Notice that the 19% loss in 1971 hardly shows. Calculate some other losses to see how they show on the graph. What kind of graph would improve this lack of showing.


#13. Try the Calculator in measuringworth: Click Savings Growth-US $ and under How Much Would U. S. Savings Have Grown, put in 1 for one dollar. Put in some dates. Click Calculate. Write down or print the results. Using the S&P total return table, check the number you get for “if saved in a S&P portfolio … “. Look up in measuringworth what they mean by short-term assets, long-term assets. What was the annual return on gold? Compare the Annual Total Return rate to the growth rate of the Index.


#15. In measuringworth, work with Purchasing Power-US $ and Inflation Rates. Select US. Put in the same dates for each. For Purchasing Power put in $1. For Inflation Rates you will get an annual table and Annualized Inflation Rate. The question is what years are included in the Annualized Inflation Rate? They are from the end of the first year to the end of the last year. Put in some dates to verify this. For Purchasing Power you will get various numbers and interpretations. What does measuringworth mean by Purchasing Power? Which interpretations are close to the Inflation table? See the article in this course “Living and Investing with Inflation, Fisher’s Effect”. Find some years of deflation (negative inflation)? Try the years of the “great depression.” Give several years of highest inflation and the rates. Give some periods of high inflation and the average rates. At these rates, how long does it take the cost of living to double?


#17. The Life of Riley Index (June 30, 2013) Scott Burns has been publishing the Life of Riley Index for 28 years (assetbuilder.com/ScottBurns). It reports how much money you need to live at the upper 25th percentile of income of US households according to the IRS (2010, $69,126; 2012, $74,002, IRS changed its methodology). It reports how much is required in a 50/50 portfolio of stocks and bonds to live off the interest and dividends which currently was
1.77% per year. The current value of the Index is $4,192,720 according to Scott. If you dare to draw 4%, which would require taking some principal, you’ll need a mere $1,850,000. If 40% of your income is Social Security you’ll need $1,110,000. He says that if interest returns to a normal 5% and dividends to 3%, it requires less than half as much. (a) Check Scott’s figures. (b) Scott alluded to inflation. A common formula for needed retirement funds considering inflation is

\[ P = R \left[ \frac{1 - (1 + y)^{-n}}{y} \right] \]

where \( y = \frac{r - I}{1 + I} \). You probably know this formula. (For a derivation of this formula, see “The Mathematics of Financial and Social Responsibility” in this course.) Using the 4% rule where the first withdrawal is $74,020, which is 4% of retirement assets, how much is recommended for the retirement fund? With withdrawals increasing each year at the long term rate of inflation of 3.2%, what rate of return is required from age 65 to age 100? (c) There have been long periods of high inflation such as 6.1% from the end of 1968 through 1991. According to measuring worth, is this figure correct? What was the Average Total Return rate for the S&P 500 during this period? How much is required in a 35 year retirement fund under these circumstances? (d) With a long term average annual Total Return of 9%, how much is required with 6.1% inflation? (e) Do some retirement calculations for someone your age, from age 70 to age 100. Do you think an investor would earn less than the S&P 500? Why and what is your estimate?

#18. For the above Side Bar Note, Sequence of returns, start with $100,000 and withdraw $7000 at the beginning of each year. Show that the fund is broke in twelve years after the sequence of returns: -.1839, -.1914, -.0459, .1847, .0679, .1430, -.1539, .1459, .0895, .1952, .2072, .1621. Describe your calculating device and code. Show a record for each year of the balance numbers from the calculation steps.

#19. For Example 1, use general algebra to demonstrate that the equations between (a) and (b) give the answer (product) in the equation above. State the definition of \( x \div y = z \).

Answers.

#1. See Table 1.

#10. For Wikipedia, use the Value of $1 Invested on 1/1/1097 column. The 1970 figure is for the end of 1970. For the beginning of 1975, use the 1974 figure of $.89. For the end of 1999, use $47.44. Solve .89(1 + TR)^{25} = 47.44 to get annual average Total Return = 17.24%. For measuring worth, use Jan. 1975 of $2351.63. For the end of 1999, use Jan 2000 of $108,585.52. Solve for annual average Total Return = 16.57%. Measuring worth is a proxy for the S&P 500 Index.
References:

Articles in this course:

“Logarithmic Scales Used on Graphs in Finance,” Fall, 2012. Introduces students to the advantages and disadvantages of semi logarithmic scales used for graphs of the historical values of the S&P 500 and DJIA. Uses and proves properties of logarithms.

“High Dividend Yields on Stocks and Low Interest Rates on CDs and Bonds,” Jan. 2013, Presents a stock pricing model, historical performance of selected stocks, and estimates of possible future appreciation and dividend growth, with reinvestment.

And other articles in this course, including those cited above. Also the web sites used. Reports from Fidelity cited above. Articles by Scott Burns cited above.

For a free course in financial mathematics with emphasis on personal finance, see COMAP.com. Click on the box for the free financial mathematics course, register, and COMAP will e-mail you a password. Simply click on an article in the annotated bibliography, download it, and teach it.

Unit 1: The Basics of Mathematics of Finance  Unit 2: Managing Your Money  Unit 3: Long-Term Financial Planning  Unit 4: Investing in Bonds and Stocks  Unit 5: Investing in Real Estate  Unit 6: Solving Financial Formulas for i, iteration programs  Unit 7: Related Topics  Unit 8: More Advanced or Technical Topics  The course has around sixty articles at this time, all related to this article.