A MAN *— for —* ALL MARKETS

From Las Vegas to Wall Street,
How I Beat the Dealer and the Market

Edward O. Thorp

BONUS MATERIALS

Table 1: Effect of Removing One Card from One Deck and the Ultimate (Point-Count) Strategy

Card	2	3	4	5	6	7	8	9	10	A
Change In Edge	0.36	0.48	0.59	0.82	0.47	0.34	0.03	-0.23	-0.54	-0.68
Points	5	6	8	11	6	4	0	-3	-7	-9

Table 2: Total Return of Berkshire Hathaway A Stock Compared to the S&P 500 for Three Successive Periods*

Date	Price $ BRKA	Elapsed Time	Annualized Return	Price $ S&P 500	Annualized Return	BRKA Edge Per Year
08/10/83	980.50	———	———	161.54	———	———
01/31/90	7,455	6.48 years	36.8 %	329.08	11.6 %	+25.2 %
04/30/99	76,400	9.25 years	28.6 %	1335.18	16.3 %	+12.3 %
01/23/09	86,250	9.73 years	1.3 %	831.95	–4.7 %	+6.0 %
04/12/16	215,360	7.22 years	13.5 %	2061.72	13.4 %	+0.1%

Table 3: Classifications of Wealth

	Income	Wealth
Superrich	$15 million+	$150 million+
Rich	$1.5–15 million	$15 million–150 million
Upper-middle	$112,000–1.5 million	$750,000–15 million
Middle	$50,000–112,000	$82,000–750,000
Lower-middle	$22,000–50,000	$15,000–82,000
Poor	$0–22,000	$0–15,000

Table 4: Estimated Numbers of Wealthiest Households, United States, Year 2014

Wealth Level W: This Amount or More	Formula Estimate of Number N of US Households Having This Much or More
$1 million	9,300,000
$5 million	1,030,000
$10 million	400,000
$20 million	155,000
$50 million	44,000
$100 million	17,000
$250 million	4,900
$500 million	1,900
$1 billion	730
$1.55 billion	400

Table 5: Estimating a Household's Net Worth

Assets (Thousands)			
Real estate			
Principal residence	875		
Vacation home	220		
		Subtotal	1,095
Personal property			
Auto 1			35
Auto 2			21
Furniture			30
Art			10
Jewelry			35
		Subtotal	131
Securities, publicly traded			
Stocks			1,400
Bonds			830
Mutual funds			775
Other			25
		Subtotal	3,030
Securities, privately held			
Start-up technology company			10
Limited Partnership interest (hedge fund)			725
Cash			
Checking			11
Savings/money market account			23
		Subtotal	759
		TOTAL ASSETS	5,015
Liabilities (Thousands)			
Real estate			
Mortgage, principal residence			750
Other loans			
Credit cards			2
Brokers, margin accounts			55
Taxes owed but not yet paid			22
		TOTAL LIABILITIES	829
Net Worth (Thousands)			
Assets			5,015
Liabilities			829
		NET WORTH	4,186

Table 6: With an Investment Making 8%, Paying Tax Every Year at 35%, at 20%, and Paying 20% at the End

	Value of Investment		
Investment Ends at Year	Pay 35% Tax Every Year	Pay 20% Tax Every Year	Pay 20% Tax at End
0	1,000	1,000	1,000
1	1,052	1,064	1,064
10	1,660	1,860	1,927
20	2,756	3,458	3,929
30	4,576	6,431	8,250

Table 7: Comparison of Passive Versus Active Investing

	Index	Passives	Actives
Before costs	10.1%	10.1%	10.1%
After costs	—	9.7%	7.7%
After inflation	7.1%	6.7%	4.7%
Tax-exempt after inflation	—	6.7%	4.7%
After taxes	—	4.8%	2.0%

Table 8: Major Asset Classes and Subdivisions

- EQUITIES
  - Common Stock
  - Preferred Stock
  - Warrants and Convertibles
  - Private Equity
- INTEREST RATE SECURITIES
  - Bonds
    - US Government
    - Corporate
    - Municipal
    - Convertibles
  - Cash
    - US Treasury Bills
    - Savings Accounts
    - Certificates of Deposit
  - Mortgage-Backed Securities
- REAL ESTATE
  - Residential
  - Commercial
- COMMODITIES
  - Agricultural
  - Industrial
  - Currencies
  - Precious metals
- COLLECTIBLES (Art, gems, coins, autos, etc.)
- MISCELLANEOUS (MARKETABLE) PERSONAL PROPERTY
  - Motor vehicles, planes, boats, jewelry, etc.

Appendix A

THE IMPACT OF INFLATION ON THE DOLLAR

This table indicates how the buying power of a dollar has changed.* To see what my $11,000 win at blackjack in 1961 with Manny Kimmel and Eddie Hand was equal to in 2013, we multiply $11,000 by the 2013 index and divide by the 1961 index: $11,000 × 233.0 ÷ 29.9 = $85,719. To convert dollars in year A to dollars in year B, multiply by the index for B and divide by the index for A.

Overall, the index has increased by about 3.6 percent a year, but there are some unusual variations. The index falls (deflation!) after the 1929 crash and stays at a reduced level for the next decade. Then it increases rapidly during World War II and the first postwar years.

Although inflation has been moderate in the United States and in most first-world countries most of the time, it is occasionally cata-

* For an insightful discussion of why the inflation index from the 1970s may be much too low as a result of a series of government revisions in the method of calculation, and the consequences to investors and consumers, see "Fooling with Inflation" by Bill Gross (June 2008) at www.pimco.com.
For updated Consumer Price Index numbers and for month-by-month values, go to ftp://ftp.bls.gov/pub/specialrequests/cpi or do the usual Google search.

strophic. During the German hyperinflation of 1919–23, the currency declined to one hundred billionth of its starting value (divide by 100,000,000,000). Debtors were freed and lenders were ruined. This level of inflation would reduce the $18 trillion or so US national debt of 2015 to the equivalent of $180. In 2009, the African nation of Zimbabwe experienced a hyperinflation comparable to the German one, with Z-one-trillion bills commonplace.

From its peak in 1929, the S&P 500 total return index (dividends reinvested) had, at its low in 1932, fallen by 89 percent. However, these were deflationary times, so the nation had the cold comfort of knowing that after adjusting for inflation, the index had lost only 85 percent.

Table 9: Consumer Price Index

Year	Index	Year	Index	Year	Index
1913	9.9	1934	13.4	1955	26.8
1914	10.0	1935	13.7	1956	27.2
1915	10.1	1936	13.9	1957	28.1
1916	10.9	1937	14.4	1958	28.9
1917	12.8	1938	14.1	1959	29.2
1918	15.0	1939	13.9	1960	29.6
1919	17.3	1940	14.0	1961	29.9
1920	20.0	1941	14.7	1962	30.3
1921	17.9	1942	16.3	1963	30.6
1922	16.8	1943	17.3	1964	31.0
1923	17.1	1944	17.6	1965	31.5
1924	17.1	1945	18.0	1966	32.5
1925	17.5	1946	19.5	1967	33.4
1926	17.7	1947	22.3	1968	34.8
1927	17.4	1948	24.0	1969	36.7
1928	17.2	1949	23.8	1970	38.8
1929	17.2	1950	24.1	1971	40.5
1930	16.7	1951	26.0	1972	41.8
1931	15.2	1952	26.6	1973	44.4
1932	13.6	1953	26.8	1974	49.3
1933	12.9	1954	26.9	1975	53.8

APPENDIX A

Year	Index	Year	Index	Year	Index
1976	56.9	1989	124.0	2002	179.9
1977	60.6	1990	130.7	2003	184.0
1978	65.2	1991	136.2	2004	188.9
1979	72.6	1992	140.3	2005	195.3
1980	82.4	1993	144.5	2006	201.6
1981	90.9	1994	148.2	2007	207.3
1982	96.5	1995	152.4	2008	215.3
1983	99.6	1996	156.9	2009	214.5
1984	103.9	1997	160.5	2010	218.1
1985	107.6	1998	163.0	2011	224.9
1986	109.6	1999	166.6	2012	229.6
1987	113.6	2000	172.2	2013	233.0
1988	118.3	2001	177.1		

US Department of Labor
Bureau of Labor Statistics
Washington, DC 20212
Consumer Price Index
All Urban Consumers—(CPI-U)
US City Average
All Items
1982–84=100

Appendix B

HISTORICAL RETURNS

Table 10: Historical Returns on Asset Classes, 1926–2013

Series	Compound Annual Return*	Average Annual Return**	Standard Deviation	Real (after inflation) Compound Annual Return*	Sharpe Ratio†
Large Company Stocks	10.1%	12.1%	20.2%	6.9%	0.43
Small Company Stocks	12.3%	16.9%	32.3%	9.1%	0.41
Long-Term Corporate Bonds	6.0%	6.3%	8.4%	2.9%	0.33
Long-Term Government Bonds	5.5%	5.9%	9.8%	2.4%	0.24
Intermediate-Term Government Bonds	5.3%	5.4%	5.7%	2.3%	0.33
US Treasury Bills	3.5%	3.5%	3.1%	0.5%	–––
Inflation	3.0%	3.0%	4.1%	–––	–––

* Geometric Mean
** Arithmetic Mean
† Arithmetic

From: Ibbotson, *Stocks, Bonds, Bills and Inflation,* Yearbook, Morningstar, 2014. Siegal's *Stocks for the Long Run* gives US returns from 1801. Dimson et al. give returns for sixteen countries and an analysis. The return series depends on the time period and on the specific index chosen. I've used Ibbotson as my standard because detailed annually updated statistics have been readily available.

APPENDIX B **Table**

11: Historical Returns (%) to Investors, 1926–2013

		Deduct Management Costs		Before Tax; Deduct Trading Losses		After Tax		Real (After Inflation) Tax-Exempt		Taxable	
Series	Compound Annual Return*	Passive	Active	Passive	Active	Passive	Active	Passive	Active	Passive	Active
Large Company Stocks	10.1	9.9	8.9	9.7	7.7	7.8	5.0	6.7	4.7	4.8	2.0
Small Company Stocks	12.3	12.1	11.1	11.9	9.9	9.5	6.4	8.9	6.9	6.5	3.4
Long-Term Corporate Bonds	6.0	5.8	5.3	5.7	5.0	3.7	3.3	2.7	2.0	0.7	0.3
Long-Term Government Bonds	5.5	5.3	4.8	5.2	4.5	3.4	2.9	2.2	1.5	0.4	-0.1
Intermediate-Term Government Bonds	5.3	5.1	4.6	5.0	4.3	3.3	2.8	2.0	1.3	0.3	-0.2
US Treasury Bills	3.5	3.3	2.8	3.2	2.7	2.1	1.8	0.2	-0.3	-0.9	-1.2
Inflation	3.0	-	-	-	-	-	-	-	-	-	-

* Geometric Mean

From: Ibbotson, *Stocks, Bonds, Bills and Inflation,* Yearbook, Morningstar, 2014. Siegal's *Stocks for the Long Run* gives US returns from 1801. Dimson et al. give returns for sixteen countries and an analysis. The return series depends on the time period and on the specific index chosen. I have again used Ibbotson as my standard.

Table 12: Schedule of Assumed Costs Which Reduce Historical Returns (%)

	Stocks		Bonds		Bills	
	Passive	Active	Passive	Active	Passive	Active
Management Costs	0.2	1.2	0.2	0.7	0.2	0.7
Trading Costs	0.2	1.2	0.1	0.3	0.1	0.1
Estimated Tax Rate on Remainder	20.0	35.0	35.0	35.0	35.0	35.0

Table 13: Annual Returns (%), 1972–2013

	Compound Annual Return*	Average Annual Return**	Standard Deviation
Equity REITs	11.9	13.5	18.4
Large Company Stocks	10.5	12.1	18.0
Small Company Stocks	13.7	16.1	23.2
Long-Term Corporate Bonds	8.4	8.9	10.3
Long-Term Government Bonds	8.2	8.9	12.4
Intermediate-Term Government Bonds	7.5	7.7	6.6
US Treasury Bills	5.2	5.2	3.4
Inflation	4.2	4.3	3.1

* Geometric Mean

** Arithmetic Mean

Comparative historical returns from investing in income-generating real estate are indicated in table 13, which lists total returns from publicly traded Real Estate Investment Trusts for the period 1972–2013.

From: Ibbotson, *Stocks, Bonds, Bills and Inflation,* Yearbook, Morningstar, 2014. Siegal's *Stocks for the Long Run* gives US returns from 1801. Dimson et al. give returns for sixteen countries and an analysis. The return series depends on the time period and on the specific index chosen.

Appendix C

THE RULE OF 72 AND MORE

The rule of 72 gives quick approximate answers to compound interest and compound growth problems. The rule tells us how many periods it takes for wealth to double with a specified rate of return, and is exact for a rate of 7.85 percent. For smaller rates, doubling is a little quicker than what the rule calculates; for greater rates, it takes a little longer. The table compares the rule in column 2 with the exact value in column 3. The "exact rule" column shows the number that should replace 72 to calculate each rate of return. For an 8 percent return, the number, rounded to two decimal places, is 72.05, which shows how close the rule of 72 is. Notice that the number in column 4 for the exact rule should equal the column 1 return per period multiplied by the corresponding values in column 3 (actual number of periods to double), but that the column 4 figures don't quite agree with this. That's because the numbers in columns 3 and 4 are rounded off from the exact figures, correct to two decimal places.

The mental calculator may notice that the exact rule changes by about one-third for each 1 percent change in the return per period; so an easy approximation to the exact rule is 72 + (R–8%)/3. For 1 percent this

gives 69.67 compared with the exact 69.66, and for 20 percent we get 76.00 compared with the exact 76.04. The formula fits well for the rest of the table, too.

Table for the Rule of 72

	Number of Periods to Double		
Return Per Period	By Rule of 72	Actual	Exact Rule
1%	72	69.66	69.66
2%	36	35.00	70.01
3%	24	23.45	70.35
4%	18	17.67	70.69
5%	14.4	14.21	71.03
6%	12	11.90	71.37
7%	10.29	10.24	71.71
8%	9	9.01	72.05
9%	8	8.04	72.39
10%	7.2	7.27	72.73
12%	6	6.12	73.40
15%	4.8	4.96	74.39
20%	3.6	3.80	76.04
24%	3	3.22	77.33
30%	2.4	2.64	79.26
36%	2.0	2.25	81.15

The idea behind the rule works for other wealth multiples. For instance, to get a rule for multiplying by 10, divide all the numbers in the table by 0.30103 (which is $\log_{10} 2$). Thus for 8 percent we get approximately 240, so we have a "rule of 240" for multiples of 10. We conclude that a return of 8 percent multiplies wealth by 10 in about 240 ÷ 8 = 30 years.

When Berkshire Hathaway offered to buy Shaw Industries for about $2 billion in cash, one manager mentioned that their earnings were up ten times from sixteen years before. By the rule of 240, we quickly find an approximate growth rate of 240 ÷ 16 = 15%. The actual figure is 15.48 percent.

Appendix D

PERFORMANCE OF PRINCETON NEWPORT PARTNERS, LP

Table 14: Annual Return in Percent

Period Beginning and Ending	Princeton Newport Partners, LP (1)	Princeton Newport Partners, LP (2)	S&P 500 Index (3)	3 Month US T-Bill Total Return
11/01/69—12/31/69	+4.0	+3.2	-4.7	+3.0
01/01/70—12/31/70	+16.3	+13.0	+4.0	+6.2
01/01/71—12/31/71	+33.3	+26.7	+14.3	+4.4
01/01/72—12/31/72	+15.1	+12.1	+19.0	+4.6
01/01/73—12/31/73	+8.1	+6.5	-14.7	+7.5
01/01/74—12/31/74	+11.3	+9.0	-26.5	+7.9
01/01/75—10/31/75*	+13.1	+10.5	+34.3	+5.1
11/01/75—10/31/76	+20.2	+16.1	+20.1	+5.2

APPENDIX D

Period Beginning and Ending	Princeton Newport Partners, LP (1)	Princeton Newport Partners, LP (2)	S&P 500 Index (3)	3 Month US T-Bill Total Return
11/01/76—10/31/77	+18.1	+14.1	-6.2	+5.5
11/01/77—10/31/78	+15.5	+12.4	+6.4	+7.4
11/01/78—10/31/79	+19.1	+15.3	+15.3	+10.9
11/01/79—10/31/80	+26.7	+21.4	+32.1	+12.0
11/01/80—10/31/81	+28.3	+22.6	+0.5	+16.0
11/01/81—10/31/82	+27.3	+21.8	+16.2	+12.1
11/01/82—10/31/83	+13.1	+10.5	+27.9	+9.1
11/01/83—10/31/84	+14.5	+11.6	+6.5	+10.4
11/01/84—10/31/85	+14.3	+11.4	+19.6	+8.0
11/01/85—10/31/86	+29.5	+24.5	+33.1	+6.3
11/01/86—12/31/87**	+33.3	+26.7	+5.1	+7.1
01/01/88—12/31/88	+4.0	+3.2	+16.8	+7.4
Total Percentage Increase[1]	2,734%	+1,382%	545%	345%
Annual Compound Rate of Return[1]	19.1%	15.1%	10.2%	8.1%

* Fiscal year changed to November 1 start date from January 1 start date.

** Fiscal year changed back to January 1 start date.

[1] These figures are for the period from inception through 12/31/88.

The period 01/01/89 through 05/15/89 is omitted because:

(a) the partnership was liquidating and distributing its capital in a series of payments,

(b) it was no longer engaged in its traditional business and the return on capital was complex to calculate,

(c) available figures are estimates.

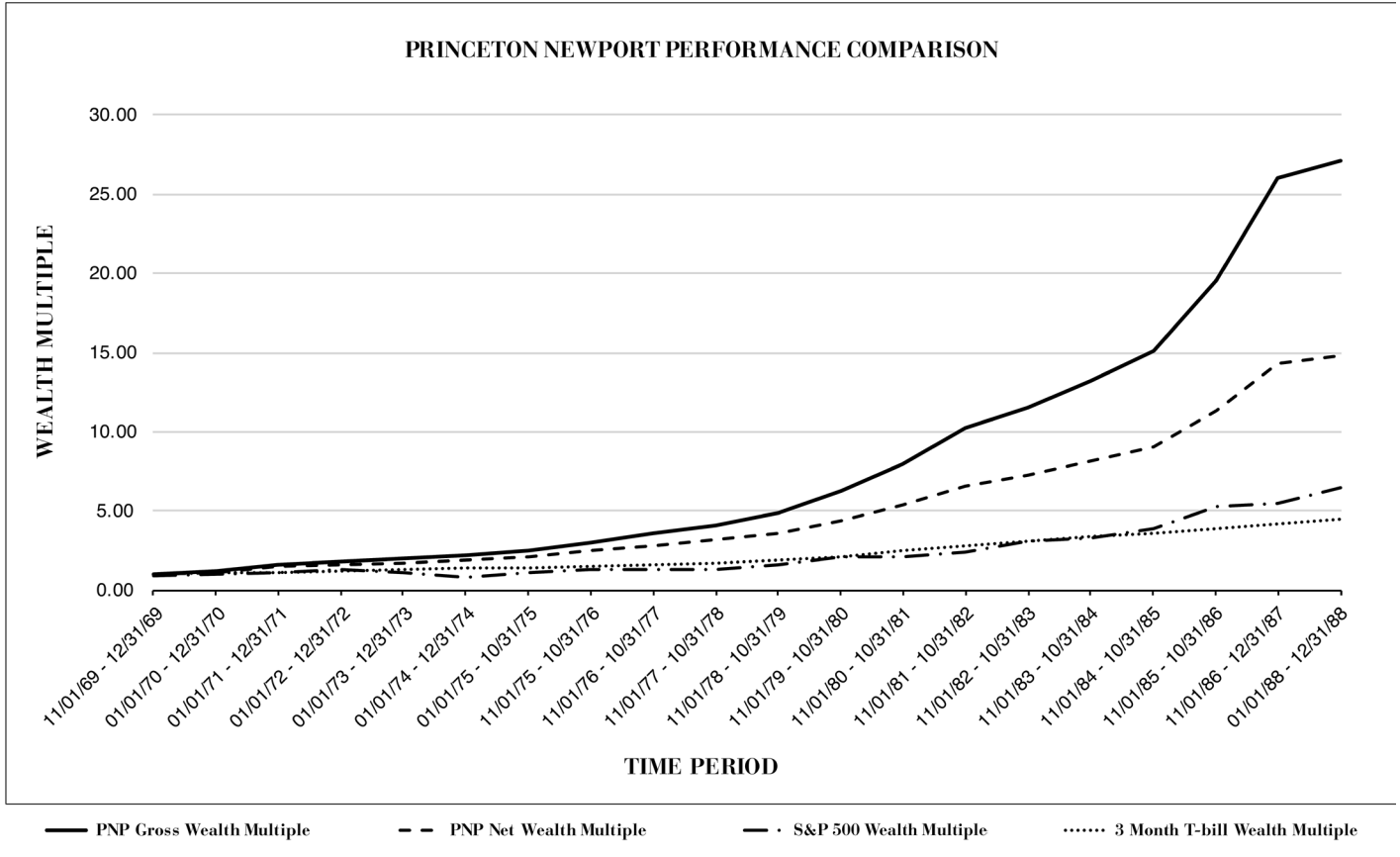
The partnership was originally called Convertible Hedge Associates and changed its name to Princeton Newport Partners as of 11/01/75.

(1) Before allocation to general partners, including managing general partners

(2) Net to limited partners

(3) Including dividends

Table 15: Princeton Newport Performance Comparison



Appendix E

OUR STATISTICAL ARBITRAGE RESULTS FOR A FORTUNE 100 COMPANY

The table XYZ Performance Summary gives basic statistics for just over ten years. These results are without the use of leverage and before fees. The actual returns were better for the investor because gains from using leverage exceeded the fees we charged.

The graph XYZ Performance Comparison shows the cumulative wealth relatives for XYZ, the S&P 500, and T-bills + 2 percent. From the end of 1994 until about August 1, 2000, we see one of the great bull markets of all time. The S&P 500 exploded at an average rate of 26 percent per year, multiplying wealth by 3.7 during those 5.6 years.

The graph indicates a distinct increase in variability from August 1, 1998, through the middle of February 2002. Some contributors may have been the LTCM disaster, which began in August 1998; the dot-com collapse in March 2000; and the destruction of the Twin Towers of the World Trade Center on September 11, 2001.

Table 16: XYZ Statistical Arbitrage Results

	Start Date End Date Months Traded	08/12/1992 09/13/2002 122
	XYZ	S&P 500
Annualized Rate of Return	18.2%	7.77%
Annualized Standard Deviation (Risk)	6.68%	15.07%
Return/Risk	2.73	0.52
One Dollar Becomes	5.48	2.14

Table 17: XYZ Performance Comparison