

A Guide To:
Gambling, Investment, and Speculation

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Hon 342R: Gambling and Risk

By the time I was fifteen years old, I had saved about two thousand dollars that I wanted to invest in hopes of making enough money to pay for a future education. My next-door neighbor and good friend Bob was a stockbroker who suggested that I put my money in a company called First Pacific Networks. I was, again, only fifteen years old, and it sounded like a sure win for me: a company on the frontier of providing broadband service into the home for all applications including phone, TV, Internet, and even utilities management such as a refrigerator inventory tracking and food ordering. “It’s a sure thing, Mikey,” Bob said. The next year the company went bankrupt and I would have lost everything had I made the suggested investment. Over the years I have thought about this situation and have posed two questions that I hope to answer in this paper: What is a “sure thing,” and how can you tell?

Gambling

To understand what gambling is one must first define it. Gambling can be defined in many ways depending on your source. One on-line casino defines gambling as “To bet on an uncertain outcome, as of a contest.” I cannot use this definition as a reference because no outcome is absolutely certain. Even the U.S. Treasury bonds do not have a certain outcome because the U.S. government may default on a treasury bond if it collapses. Anything from placing money in the stock market to betting on a roulette wheel fulfills this definition of gambling. Utah state law defines gambling as follows: 1. Pay to play 2. There is risk involved 3. There is money or value as a reward.¹ Although this definition is closer to my desired definition, it does not quantify risk, or expected values.

¹ Utah Code and Constitution. Title 76-Utah Criminal Code. Title 76, chapter 10-Offenses Against Public Health, Safety, Welfare, and Morals. 76-10-1101 Definitions.

To encompass all of my desired elements in a definition of gambling, I have defined the word in my own terms. **Gambling** (see Appendix 1: Definitions for a glossary of all terms in **bold**) is a **game** with an **expected value** less than or equal to the **cost**, definable expected values, quantifiable **risk**, and a nominal aversion to risk.

Risk, as used throughout this paper, means the standard deviation of the probability function. It is common to use the word risk to mean the degree to which the expected value is below zero. I have chosen not to use this definition of risk in my paper because any game with an expected value greater than zero would not involve risk. I feel that all gambling, investing, and speculation have some degree of risk involved.

There are many ways in which a person can gamble. *Often people fail to realize in gambling that one can compute the expected value of whatever game one is playing. There is a deterministic value for all these games: probabilities, expected values, and risk are all determinate beforehand, but most people tend to ignore this.* A fair coin toss, roulette, the Pick-3 Lotto, and the Kit Kat promotional sweepstakes all fall into the category of gambling (see Appendices 4 through Appendix 7 for a computation of the expected value of each of these games).

Nothing can preclude a bad outcome in gambling or in **investing**. The difference between the two types of losses is the cost of a bad outcome. Investing in a mutual fund that has a small negative return is often better than a losing lottery ticket that has a 100% negative return. A Blackjack player who can remember every card played and compute the changing probabilities with each card played is an investor (see **Investment** heading), whereas one who cannot is a gambler. One who plays blackjack and has no idea of the cards that have been played believes

his chances are (4, 3, 2, or 1) in (52 – the cards face-up) of getting the card he wants. That is why card counting is grounds for being removed from a casino.

Investment

As with gambling, investment has a variety of definitions. InvestorWords.com is a web site sponsored by Forbes Magazine that offers definitions of certain words associated with business. This web site defines investment as “an item of value purchased for income or capital appreciation.”² This definition may be acceptable to certain people in certain situations, but I find it to be incomplete and vague. It is very important for this paper to distinguish between investment, speculation, and gambling, and this definition does not provide enough separation between the mentioned words. Webster’s Dictionary defines investment as “To put (money) to use, by purchase or expenditure, in something offering potential profitable returns.”³ This definition is also incomplete because it does not draw the line between buying a lotto ticket or a treasury bond, a line I intend to draw.

Because of the ambiguity offered by the many definitions of investment, I felt it necessary to define investment in terms of how it will be used in this paper. An **investment** is a game where the expected value is greater than the cost of the game. Expected value is the integral of all possible outcomes times the likelihood of the outcome. An investment has definable expected values, and a minimum risk. Investors have a nominal aversion to risk. Using this as our base for investment, I will offer examples to show what this definition means.

² *Investor Words*, retrieved March 11, 2003, from <http://www.investorwords.com/cgi-bin/searchTerms.cgi?2599&investment>.

³ *Random House Webster’s College Dictionary*. Random House Inc., New York (1999). Pg. 695.

We will analyze two investments in US Treasury securities (see Appendix 2: Treasury Bond Examples). I have presented here two types of investments that have a guaranteed positive return. We will engage in these analyses in terms of games: an activity whereby you pay money for the right to receive money based on certain outcomes, an action occurs, and you receive money in the event of a positive outcome and lose money in the event of a negative outcome.

Game 1 presents the opportunity to invest for the remaining 27 years of a 30-year zero coupon bond receiving an annual yield to maturity of 5.36%. As stated, this bond has virtually no standard deviation because the **proceeds** to be received in the year 2030 have already been set. There is no reinvestment risk. Game 2 differs slightly from Game 1. The investor is entering the remaining 27 years of a 30-year bond that was originally paying the interest rate twice a year at 6.25% per annum. The yield to maturity at 4.99% assumes the cash intermediate payments can be reinvested at 4.99% until maturity. If interest rates change, reinvestments change and there is risk in the final proceeds. The expected value of this game is based on the assumption that interest rates will remain at 4.99% on the reinvested money that is paid twice a year. The interest rate for reinvestment has a possibility of increasing or decreasing, hence there is risk in this investment greater than the risk in Game 1. This bond offers a small amount of risk. While payments are guaranteed, they might not be worth as much. Therefore, risk is greater than zero.

We have heard the argument that an investment in gold is a better investment than the US Treasury because the government could collapse and not fulfill its obligation, but gold will always keep its value. However, there is no guarantee as to what the value of gold will be in May 2030. The idea will be further explored later when discussing **speculation**. Thus, it has been shown how an investment in US Treasury bonds has a determinate expected value that is greater

than the cost with very minimal risk; the main risk being the collapse of the U.S. government or any other event causing the government not to comply with its obligation.

As an investor moves away from bonds issued by the US Treasury, the risk involved increases (see Appendix 3: Investment Spectrum). For example, investing in AAA Corporate Bonds still has an expected value greater than zero. However, the probability that an AAA bond will default is greater than that of the US Treasury. Thus, the investor incorporates a greater element of risk. Even though Enron and WorldCom have both recently experienced scandalous activities causing their companies to declare bankruptcy, it is possible to buy bonds at a very low price with a high proceeds, but a low expected value in receiving these proceeds. However, the risk involved is quite high. As one moves farther down the investment spectrum the risk assessments become harder and harder, but superior analysts can determine them. There is a broad range of bad outcomes as one moves farther from Treasury credit, but expected values are surprisingly determinate. As one moves farther from US Treasury credit, investors are compensated for increased risk by requiring a higher return on their investment. Investors require a higher return because they are averse to taking this risk.

Each investor has a different profile of risk aversion called his **risk preference**. An investor's belief about the market determines whether the investor is a buyer or a seller. If the investor thinks interest rates will decrease, then he will buy the US Treasury bonds with fixed interest rates. If he believes the interest rates will fall, then he will sell. The addition of risk preference, namely that an individual assumes a higher probability of a negative outcome than the actual probability, makes one person's investment another's speculation.

Investing one's money in individual stocks in the US stock market provides a much greater risk than investing in US Treasury bonds. However, placing one's money in a diversified

portfolio of stocks eliminates the risk inherent in owning an individual stock. The mathematics of diversification are extremely complicated and beyond the scope of this paper, but suffice it to say William Sharpe, a professor from Stanford University, won a Nobel Prize for defining investment strategies based on the mathematics of diversification (the Capital Asset Pricing Model). The concept of diversification can be understood as “spreading your bets.” Mathematically it means that you are increasing your expected value and decreasing your risk. (In Appendix 4 & 5 you can see that since 1900 the stock market has positive rates of return and are hence investments by our definition.)

Speculation

Random House Webster’s Dictionary defines speculation as “Taking large risks, especially with respect to trying to predict the future; gambling, in hopes of making quick, large gains.”⁴ The main problem I have with this definition is that the word “gambling” is used to define the word “speculation”. I have carefully and deliberately distinguished the definitions of gambling and speculation, and they are not the same.

I will define speculation in terms of how it is used in this paper. **Speculation** is a game where the expected value is indeterminate, the risk is indeterminate, and there is a high aversion to risk. As stated earlier, some people believe that purchasing gold is a better use of money than investing in the US Treasury securities. However, purchasing gold is definitely speculation. There is no way of calculating the probability of the various outcomes for all values of gold for any period of time.

⁴ Ibid.

Placing money in the Asian Stock Market is another form of speculation. The factors that give rise to the inability to calculate the probability function and the standard deviation of the probability function (expected value, risk) include: limited insider trading rules, limited liquidity, limited oversight, and limited regulations of the type that make the US capital markets fair.⁵

There are other forms of speculation. Purchasing a home in Silicon Valley has no guarantees or even predictions as to the value of that home. This can also correspond to speculation in the dotcom industry. Many of the dotcom startup companies were located in Silicon Valley. One day everyone thought these companies were the investment of the future, and the next day, many were bankrupt.

Crossing Boundaries

Often the only boundary between investment, speculation, and gambling is the knowledge that a person has. As we have shown, the accomplishments of William Sharpe now enable the expected value of placing money in the stock market to be positive through mutual funds. Mutual funds allow investors to diversify, thereby negating the risks associated with individual stocks. It is interesting to note that there are now more mutual funds than there are individual stocks.

There is a growing fear among some people, however, that when a small investor decides to purchase individual stocks in the stock market, his investment changes to gambling or even speculation. Arthur Levitt, chairman of the Securities and Exchange Commission, raised concerns about small investors being scammed in the stock market by the “web of dysfunctional relationships among investment banks, their biggest investors, and the companies whose stocks

⁵ McMurdy, Deirdre. (1994). A Game of Chance. *Maclean's*, 107 (34), pg. 26.

Wall Street promotes.”⁶ He pointed to an increase in selective disclosure, in which companies whisper inside information about themselves to favored stock analysts, who then can alert their firm’s biggest clients of any danger before it impacts the company’s stock. Levitt also noted the virtual absence of “sell” recommendations from Wall Street, which suggests that if investment banks cannot say anything nice about a stock, they say nothing at all.⁷ These activities prevent a small investor from properly knowing or calculating expected values or risk.

Others acknowledge that all activity mentioned previously is illegal. Ralph Severson, senior partner with Goldman, Sacks, and Company, believes the US capital markets are the most efficient markets in the world. They are a place “where, generally, willing buyers and willing sellers can make investment decisions with equal access to information and different risk assessment.”⁸

U.S. Stock Market

Today, the U.S. stock market influences not only nearly every American citizen, but also a large percent of the world. Whether it is personal portfolios, retirement plans, or interest rates, the stock market affects everyone. Thus, understanding the boundaries between gambling, investment, and speculation in the U.S. stock market is an extremely important issue of analysis. I have directed the focus of research toward discovering whether placing money in the stock market is gambling, investing, or speculation. Although there are many different ways in which one can place money in the stock market, I will probe the consequences of choosing individual stocks, having a broker choose individual stocks for you, mutual funds, and day trading.

⁶ Wirth, Gregg (2000). Small Online Investors Are Gambling in A Rigged Casino. *Dollars & Sense*, Issue 228 (3), pg.7

⁷ Ibid.

⁸ Bunder, Paul N. (2001). Ambient on Wall Street. *Business Week*, Issue 3749, pg.28.

Purchasing Individual Stock Investments without Professional Advice

On January 18, 2003 I asked seven college students and myself to choose three individual stocks that I would follow for two months. I told them they could read any newspaper, look up any internet information, or access any information through other methods they desired excluding only the direct verbal advice from any stock broker, investment banker, money manager, or any similar profession. I began tracking the stocks on January 23, 2003, and continued until April 4, 2003. This would be one way to analyze whether the average person is able to predict the trends of the stock market and, in turn, perform better, the same, or worse than the market. The results varied amongst the eight subjects. Only one subject performed better than the stock market, while three performed within one percent of the market. Also, of the 24 stocks chosen, seven stocks followed the trends of the stock market within one percent. Collectively, we performed 1.6% worse than the Dow Jones Industrial Average.⁹ This indicates that eight college students, searching for information on companies that will perform well in the stock market, lack the ability to outperform the market.

Purchasing Individual Stock with Professional Advice

On the same date, I asked four stockbrokers from different companies to do the same thing I asked of the college students. Two of the brokers outperformed the stock market while the other two did not. However, cumulatively the brokers performed within 0.3 percent of the stock market. It would seem from the data acquired that the stockbrokers had the ability to judge the market better than the college students.

In addition to the stockbrokers performing better than the average college student in the example above, other studies have been done to show that the advice of professional market analysts does not necessarily perform better than the stock market. In the 1968 Institutional

⁹ see Appendix 10: Stock Market Picks.

Investor conference, one irate money manager insisted that what he and other analysts did for other investors had to be worth more than throwing darts at the Wall Street Journal.¹⁰ In 1990, 22 years later, the comments made by the money manager in 1968 inspired the Wall Street Journal to see if his comments were warranted. The newspaper then began a column in which four investment professionals were each invited to choose one stock to be watched for the following six months. An employee from the Wall Street Journal would then throw four darts against a board that had been customized by showing all of the stocks on the New York Stock Exchange (NYSE), the Nasdaq, and the American Stock Exchange (AMEX). The four stocks of the analysts were then compared to the four stocks chosen by the darts. In 94 contests since July 1990, the professional analysts hold a comfortable lead over the darts with a score of 56 to 38.¹¹ However, against the Dow Jones Industrial Average, the analysts hold only a narrow lead of 49 to 45.¹² Even though the analysts can outperform darts, the market trends seem to perform as well as the professionals.

In another game played by ABC News correspondent John Stossel, the darts seemed to perform considerably better than professional analysts. In 1992, the Wall Street Journal paid Zach's Investment Resources of Chicago to gather recommendations from ten of the biggest brokerage firms. Mr. Stossel then picked 20 stocks by throwing 20 darts at a wall-sized dartboard containing all of the NYSE, Nasdaq, and AMEX stocks. Over the next twelve months, Stossel's stocks were up 17%, better than 9 of the brokerage firms' recommendations. In this example, professional advice would not be to the investor's advantage.¹³

¹⁰ Active Investors Anonymous. *12-Step Program to Index Funds*. Index Fund Advisors Inc. (2003), ch.10: Nobel Laureates, pg. 33.

¹¹ Jasen, Georgette (1998). Winds of Chance Blow Cold on the Pros. *Wall Street Journal*, April 9, section B-1.

¹² *ibid*

¹³ *ibid*

There is no way to know whether the stock market will rise or fall on any given day, but a close look at the history of the market will show that trends point to a long term profit on a stock market investment. From the brief study that I conducted, and the study performed by the Wall Street Journal for the past decade, it seems evident that an investment in single stocks is not the best way to follow the trends of the stock market. In nearly all of the cases, the individual stocks have performed much worse than the market. When the market performs poorly, as it has over the past three years, investing in individual stocks approaches speculation rather than gambling or investment. Expected values are incalculable in most cases, the risk involved is often much greater than the stock market trends, and the participant tends to have a high aversion to risk. When the market performs well, as historical trends show for the entire existence of the stock market, purchasing individual stocks falls into the investment category. The Wall Street Journal studies show that although investing in individual stocks does not perform as well as the market, trends still point to a definable expected value greater than cost. Risk is at a minimum, as shown by historical trends, and the investor has a nominal aversion to risk.

Seeking the advice of professional analysts changes the circumstances we find while investing in individual stocks. Professional advice has been shown to follow the trends of the market. This means that while the market performs poorly, placing money in the market is no longer speculation, but rather a gamble. One can feel confident that the advice received will cause their money to follow the same trends as the market. Expected values in this case are determinate and less than the cost. If one decides to invest for a longer period of time to avoid the fluctuations of a short period, then one can rely on the historical trends of the market and money placed in the market becomes an investment with a return higher than that of placing one's money in individual stocks without professional help. Therefore, depending on the length

of one's investment and the trends of the stock market at that time, placing money in the stock market with the guidance of professional analysts leads to either a gamble, or an investment.

Mutual Funds

Another way to place money on the stock market is through a mutual fund. The mutual fund is based on the Capital Asset Pricing Model theory that won William Sharpe a Nobel Prize in Economic Sciences in 1990. This theory eliminates the risk involved with individual stocks by diversifying one's portfolio over many stocks in the market. Thus, a mutual fund will follow the trends of the market without the risk of individual stocks. If the market is increasing, as it has since 1920, then placing your money in mutual funds will be an investment. Expected values are greater than cost, and trends are increasing, allowing for minimal risk and nominal aversion to risk. In the case of a short-term investment when the market trends are down, mutual funds become a gamble because the same situations apply, but the expected value is less than the cost. Under most circumstances, mutual funds fall into the category of an investment.

Day Trading

Day trading is the final method of placing money in the stock market I wish to approach. Day trading is the practice of buying and selling securities during a one-day period, closing out all positions at the end of the day. After purchasing stock, day traders often wait for changes in stock prices that are just a few pennies before selling.

I would like to discuss the results of a comprehensive study, the Washington Study¹⁴, done by the U.S. Securities and Exchange Committee (SEC) in joint collaboration with the North American Securities Administrators Association (NASAA) in 1999. This study was ordered by

¹⁴ USLaw.com staff. *SEC, NASAA Release Day Trading Reports*. Retrieved March 22, 2003, from <http://www.USLaw.com>.

the SEC in response to a study performed by the NASAA in 1998 that reported that 90% of day traders lose money.

Beginning in October of 1999, the Washington Study followed 124 day trading accounts for the span of 25 months. There results showed that 77% of the accounts showed an average loss of \$36,043, with the greatest loss of \$641,000. 23% of the accounts showed an average profit of \$21,983 with the greatest profit at \$160,100. As a result of this study, the SEC published a list of seven general risks warnings that every prospective day trader should be aware of prior to engaging in day trading. Included in the list are the following:

- Day traders do not “invest.”
- Do not believe claims of easy profits.
- Watch out for “hot tips” and “expert advice” from newsletters and Web sites catering to day traders.
- Remember that “educational” seminars, classes, and books about day trading may not be objective.¹⁵

It is important to note also that day trading requires considerable costs because of commission, trading costs, and charges for additional services such as RealTick III data feeds which allow for real time stock quotes. A day trader who makes 50 trades a day with moderate transaction fees must generate \$16,700 a month in trading profits to recoup the costs of trades.¹⁶

With the data acquired from the Washington Study, day trading certainly falls under speculation. There is no way to calculate an expected value and day trading involves extreme risk. There is no way of knowing what the results of day trading will be. This type of trader must certainly have a high aversion to risk.

Investor Suitability

¹⁵ Day-Trading: Your Dollars at Risk. Office of Compliance Inspections and Examinations. U.S. Securities and Exchange Commission, February 25, 2000, section IV, E, 1.

¹⁶ *ibid*

One of the most important guides to where money should be placed by someone has to do with the investor suitability. One must consider when and how much money will be needed. If one is planning to buy a home in five years, it is not appropriate to purchase a 30-year US Treasury bond or high-risk stocks. If he needs to house his family, he will invest his money where risk is lowest, perhaps a savings account. As individuals acquire more wealth, they can afford to lose the amount of their investment, or cost, without sacrificing lifestyle. In that case, then maybe paying for the entertainment of Las Vegas or the intrigue of the Asian Stock Market might be the right place. Risk is higher, expected value is low or even negative, but the loss of the investment is of less concern. One's ability to assess risk is another major factor in investor suitability. An equity analyst for Payne Webber covering large banks will understand better the risks of investing in certain stocks than a math student at Brigham Young University. This brings us back to the Blackjack player who can count cards and calculate probabilities as each card is played. Before one decides where to place his money, one must acquire all knowledge possible about personal situations and all information available about where the money is going. There is a very fine line between what makes something an investment, a gamble, or speculation.

Appendix 1: Definitions

Expected Value:	The integral of all possible outcomes times the likelihood of the outcome
Risk:	The standard deviation of the probability function
Systematic Risk:	Risks that can be avoided by diversification
Unsystematic Risk:	Risks that can't
Risk preference:	An individual's aversion to risk
Game:	An activity whereby (i) you pay money for the right to receive money based on certain outcomes, (ii) an action occurs, and (iii) you receive money in the event of a positive outcome and lose money in the event of a negative outcome.
Cost:	The amount of money required to participate in the game (sometimes called "investment," "down payment," or "bet")
Proceeds:	The amount you get paid based on the outcome of the game
Investment:	$E.V. > \text{Cost}$; definable expected values; minimum risk; nominal aversion to risk
Gambling:	$E.V. < \text{Cost}$; definable expected values; minimum risk; nominal aversion to risk
Speculation:	Indeterminate $E.V.$; indeterminate risk; high aversion to risk

Appendix 2: Treasury Bond Examples

Game 1: Buy a US Treasury Zero Coupon Bond¹⁷ due May 2030

Analysis: Cost = \$100, exclusive transaction costs
P (payment) = 100% (it's the US Treasury)
Standard deviation = epsilon
Risk = epsilon
E.V. = \$420.17
Annual yield to maturity = 5.36%

Game 2: Buy a US Treasury 6.25% Bond¹⁸ due May 2030

Analysis: The cost has been normalized to \$100
Cost = \$100, exclusive of transaction costs
P (payment) = 100% (it's the US Treasury)
Standard Deviation = greater than epsilon
Risk = epsilon
E.V. = \$232.07 plus reinvestment
Annual yield to maturity = 4.99%

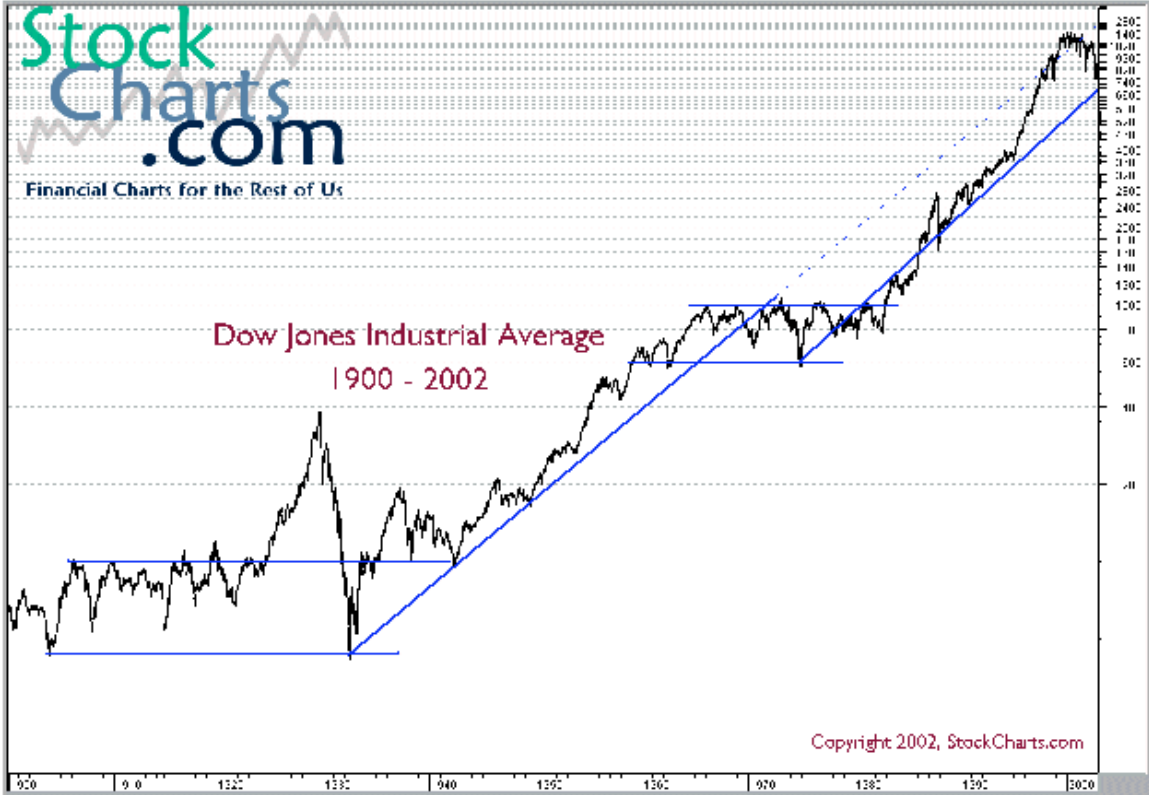
¹⁷ Business Section. (2003, Feb 13). *New York Times*, C10.

¹⁸ *ibid.*

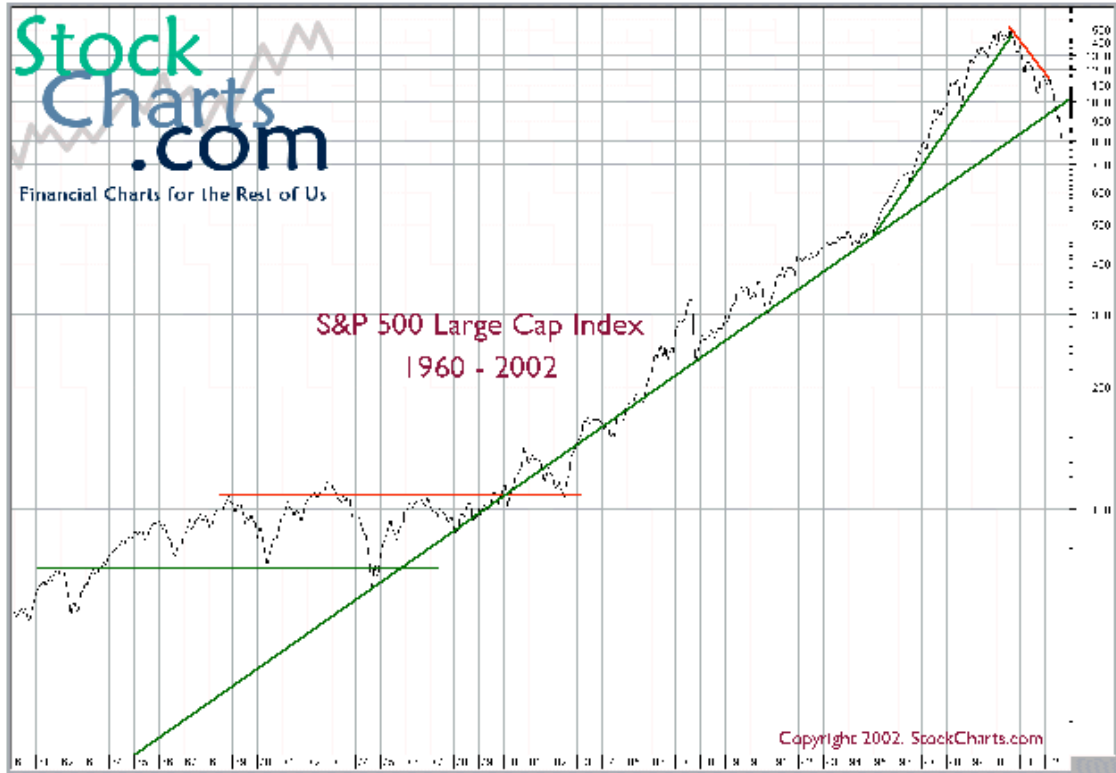
Appendix 3: Investment Spectrum

US Treasury	$p(\text{payment}) = 100\%$	$p(\text{default}) = 0\%$
AAA Corporate Bonds	$p(\text{payment}) < 100\%$	$p(\text{default}) > 0\%$
Enron, WorldCom	$p(\text{payment}) \ll 100\%$	$p(\text{default}) \gg 0\%$
Dow Jones Average	see Appendix 4: Dow Jones Industrial Average	
S&P 500	see Appendix 5: S&P 500 Large Cap Index	
Your House	??????	

Appendix 4: Dow Jones Industrial Average



Appendix 5: S&P 500 Large Cap Index



Appendix 6: Fair Coin Toss

Expected Value:

$$\text{E.V.} = (\text{winnings for A}) P(A) + \dots + (\text{winnings for n}) P(n)$$

Expected Value for a fair coin toss:

if heads: win \$1.00

if tails: pay \$1.00

$$\begin{aligned}\text{E.V.} &= (\text{winnings for heads}) P(\text{heads}) + (\text{winnings for tails}) P(\text{tails}) \\ &= (1)(0.5) + (-1)(0.5) \\ &= 0.5 - 0.5 \\ &= 0\end{aligned}$$

Appendix 7: American Roulette

Expected Value for Russian Roulette (when betting on a single number):

Board consists of the numbers: 0,00,1-36

- Rules:
- i) you choose a number
 - ii) place your monetary bet on the number (let's say \$1)
 - ii) if your number is picked, you get \$36 on a \$1 bet
 - iii) otherwise, you lose your \$1

$$\begin{aligned} \text{E.V.} &= (\text{winnings if your number is picked}) P(\text{win}) + (\text{losings if not picked}) P(\text{lose}) \\ &= (36)(1/38) + (-1)(37/38) \\ &= (18/19) - (37/38) \\ &= -1/38 \end{aligned}$$

Appendix 8: Pick-3 Lottery

Expected Value of the Pick-3 Lotto:

- Rules:
- i) purchase a ticket for \$1
 - ii) pick 3 separate single digit numbers (0-10)
 - iii) if all 3 of your numbers are picked, you win \$500
 - iv) if your number is not picked, you lose your \$1

$$\begin{aligned} \text{E.V.} &= (\text{winnings if 3 numbers picked}) P(\text{win}) + (\text{losings if not picked}) P(\text{lose}) \\ &= (499)(1/1000) + (-1)(999/1000) \\ &= (499/1000) - (999/1000) \\ &= -(500/1000) \\ &= -1/2 \end{aligned}$$

Appendix 9: Kit Kat Sweepstakes

Expected Value of Kit Kat sweepstakes¹⁹:

- Rules: i) pay \$0.65
ii) open the Kit Kat wrapper
iii) if the inside says you win, you win
iv) if it says you don't win, you enjoy your \$0.65 Kit Kat

$$\begin{aligned} \text{E.V.} &= (\text{grand prize}) P(\text{win}_{\text{gp}}) + (2^{\text{nd}} \text{ prize}) P(\text{win}_{2\text{nd}}) + (3^{\text{rd}} \text{ prize}) P(\text{win}_{3\text{rd}}) + (4^{\text{th}} \\ &\quad \text{prize}) P(\text{win}_{4\text{th}}) + (-0.65) P(\text{play}) \\ &= (\$22,900)(1/25,000,000) + (\$7,500)(1/12,500,000) + (\$300)(1/50,000) + (\$0.65)(1/10) \\ &\quad + (-\$0.65)(1) \\ &= (22,900/25,000,000) + (7,500/12,500,000) + (300/50,000) + (.65/10) - (0.65) \\ &= -0.577 \end{aligned}$$

¹⁹ all information acquired from a Kit Kat wrapper