Risk, Uncertainty, and Volatility

Shareholder Value Implications for Finance, Operations, & Investment Decision-Makers

Housekeeping

Slides, detailed seminar notes, and the spreadsheets available at
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Plan

- **Concept Definitions**
- **Some Theory to Handle More Complex Situations**
- **Operations**
- **Finance**
- **Investing**

My purpose

For you

- **Reduce the chances of blowing up your organization, career, or personal finances due to a misunderstanding of risk**

For me

- **Get feedback from business people on the strengths and weaknesses of my reasoning**

Risk, Uncertainty, Volatility

From a business perspective

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Risk, Uncertainty, and Volatility

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- **What is risk and how does it vary by time horizon and financial status and how do you manage your exposure to it**
  - **Bearing in mind that some risk is largely unavoidable regardless of the definition you use**
- **I wish I had been taught this at business school**

These concepts feed into Shareholder Value

- **Directly into calculations of Net Present Value (NPV)**
  - **Sum of the cash flows discounted by the appropriate risk factor and time value of money**
- **Indirectly via asset deployment (ex: inventory levels and factory flow), order fulfillment and backlog, and major project implementation (ERP…)**

Different ways of looking at Risk, Uncertainty, Volatility

- **Frank Knight 1921 <u>Risk, Uncertainty and Profit</u>**
  - **Risk – Randomness with known probability (even if not chance of loss)**
    - ***In business it is rare to really have a good estimate of the probabilities***

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Risk, Uncertainty, and Volatility

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- **Uncertainty – Randomness with unknown probability**
- **Volatility not explicitly defined**

Modern Finance

- **For examples of how this is usually taught I'm referring to the standard text by Brealey, Myers, and Allen (BM&A or B&M) Principles of Corporate Finance**
- **Risk often not explicitly defined (BM&A)**
  - ***However, "standard deviation and variance are the correct measures of risk if the returns are normally distributed"***
    - **Notice that this does not explicitly discuss the chance of loss**
    - **In practice, standard deviation often used for any and all distributions**
  - ***Often associated with the short term randomness of security prices (volatility)***
  - ***Thus, upside risk***
    - **The jumbo shrimp of finance**
  - ***No risk to jumping out of an airplane @20,000 feet without a parachute***
- **Sometimes Risk means safety, not variance**
  - ***"risk-free" rate***
    - **BM&A… ""These investments offer different degrees of risk. Treasury bills are about as safe an investment as you can make"**

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Most texts slip between definitions as convenient without being explicit

Harry Markowitz and Portfolio Theory

Nuanced view of risk lost by many of his successors-his 1952 paper

[Nobel Prize speech] "Semivariance seems more plausible than variance as a measure of risk, since it is concerned only with adverse deviations."

Most of his successors seem to a bit embarrassed by Markowitz' declarations regarding semi-variance

A fundamental theory of Modern Finance is CAPM (Capital Asset Pricing Model)

explicitly ties appropriate discount rate (and thus risk) to Beta (the volatility of share prices vs. the general market)

Thus, Risk is independent of the person taking it on

Single period time horizon

No capital constraints

Taught because it is elegant, not because it works

Fama/French 2004 (well respected bastions of academic Finance)

"But we also warn students that despite its seductive simplicity, the CAPM's

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empirical problems probably invalidate its use in applications."

Project Management Institute

Project Risk: "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective"

Similar to New Finance definition

Donald Rumsfeld

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

—Feb. 12, 2002, Department of Defense news briefing

Often ridiculed, but actually quite wise

Definitions I find most useful

Risk - a combination of the probability, nature, and severity of an adverse event

tweaking definition provided by National Academy of Science

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This has the advantage is being consistent with common usage

Uncertainty – perceived randomness, regardless of whether randomness is inherent in the process or only due to our ignorance and regardless of whether we know the probabilities

Hidden variables:

The Wizard of Oz syndrome: "Pay no attention to that man behind the curtain"

Just because the probabilities are not known, doesn't mean we can't draw some conclusions

Volatility – short term uncertainty

Ex: Brownian motion

seemingly random movement of particles suspended in a fluid

short term stock price fluctuations

Some hypotheticals

Is the risk of Russian roulette the same for a 90 year old and a 10 year old?

The same odds of death

The same severe consequences (death)?

Suppose the reward for Russian roulette were high enough to convince you to play once, despite the risk. Would you be willing to play 10 times in a row?

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Play once =>83% survival rate (5/6)
Play 10 times =>16% survival rate (5/6)^{10}
Paul Samuelson

Main Points

What is risk and what makes it so risky ?
http://www.youtube.com/watch?v=mI4WH8bBpPk
Make sure you understand what time horizon and definitions are being used

Gambler's Ruin

Risk is associated with the concept of Gambler's Ruin
Even in a game where the odds are in your favor (you have an edge) and the 'coin has no memory', if you start with a finite bankroll and cannot borrow money, there is a chance you will eventually lose your bankroll, especially if the casino has unlimited money and the game goes on long enough.
If the odds are not in your favor, the chance of eventually losing your bankroll is 100%
It may still make sense to gamble

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- Especially if the odds are in you favor
  - if you are only gambling part of your wealth
  - for a limited time
- Thus, money management and liquidity are key
  - What is the correct amount to risk each period?
- This is a pretty important thing to know for
  - R&D Projects
  - Capital Budgeting
  - Pension Fund management
  - Venture Capital
- We all know the general concept of Gambler's Ruin but how do we figure out the percentage of wealth to put at risk since 100% may not make sense
  - What's the right definition of wealth

Geometric vs. Arithmetic Mean (Average)

- Understanding the difference between these will help us resolve the question
- Neither type of mean is always appropriate

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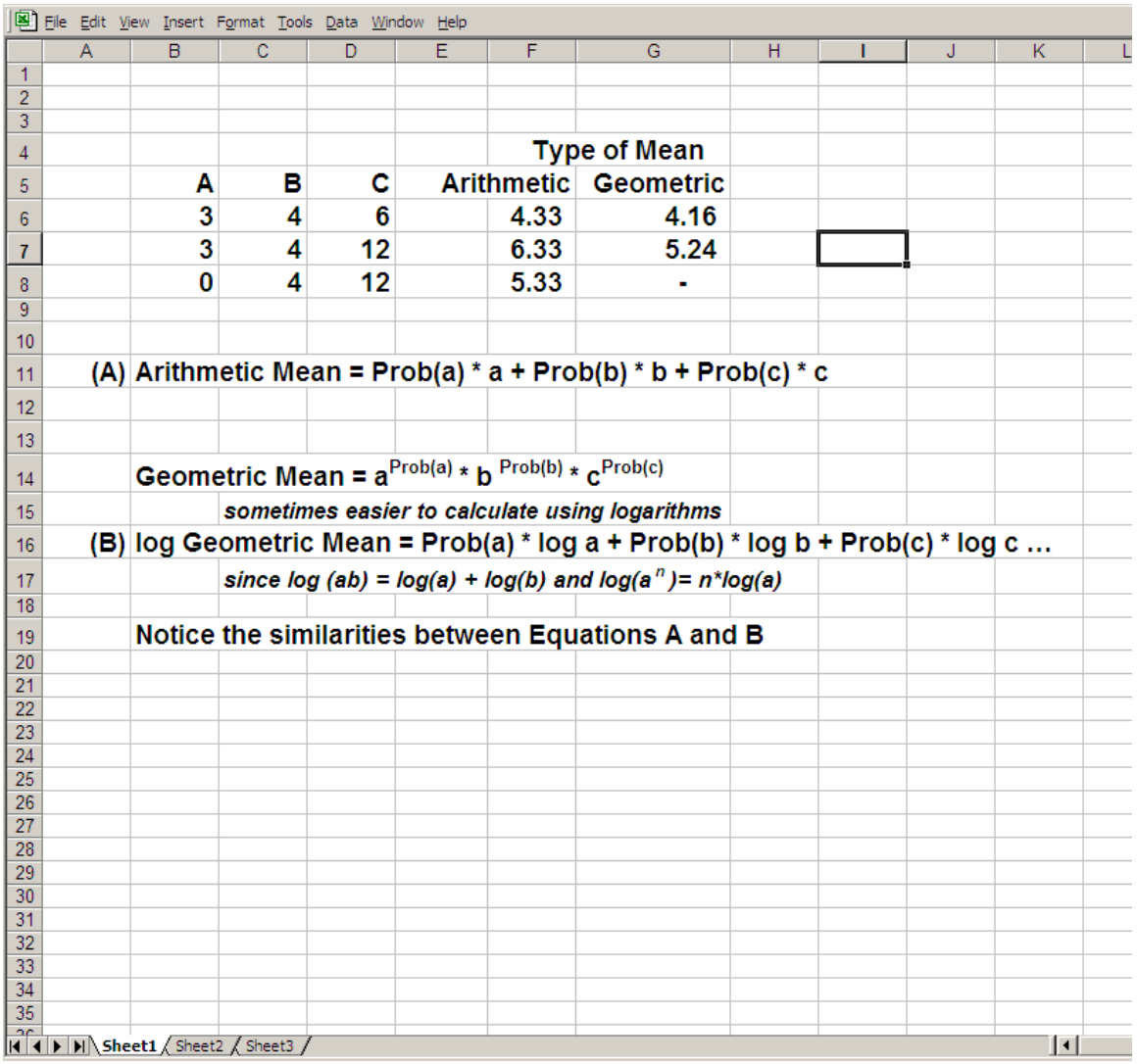

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3												
4						Type of Mean						
5		A	B	C		Arithmetic	Geometric					
6		3	4	6		4.33	4.16					
7		3	4	12		6.33	5.24					
8		0	4	12		5.33	-					
9												
10												
11	(A) Arithmetic Mean = Prob(a) * a + Prob(b) * b + Prob(c) * c											
12												
13												
14	Geometric Mean = $a^{Prob(a)} * b^{Prob(b)} * c^{Prob(c)}$											
15	*sometimes easier to calculate using logarithms*											
16	(B) log Geometric Mean = Prob(a) * log a + Prob(b) * log b + Prob(c) * log c …											
17	*since log (ab) = log(a) + log(b) and log(a^n)= n*log(a)*											
18												
19	Notice the similarities between Equations A and B											
20												
21												
22												
23												
24												
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26												
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Sheet1 Sheet2 Sheet3

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- **Arithmetic mean**
  - **What we normally mean by average**
  - **(a + b + c + …) / n**
    - ***(assuming all equally weighted)***
  - **If we weight each factor by its probability, then this is just the normal Expected Value calculation that we all know and love**
  - **Mean = a*Prob(a) + b* Prob(b) + c*Prob(c)**
    - ***normalized for 100***
    - ***If we use this, we are trying to maximize the expected value***
- **Geometric mean**
  - **Equal to compounded rate of return**
    - ***Which is one reason it is important***
  - **While not that well known, it has a distinguished pedigree**
    - ***Bernoulli (discussed later)***
    - ***Keynes***
      - **"The Arithmetic Mean occupies therefore no unique position"**
      - **"The truth is that at all times the arithmetic mean has had simplicity to recommend it. It is always easier to add than to multiply. But simplicity is a dangerous criterion."**
    - ***B&M***
      - **Only briefly mentions geometric mean**

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(a * b * c * …) ^ (1/n)

(assuming all equally weighted)

If we weight each factor by its probability

Mean = $a^{Prob(a)} * b^{Prob(b)} * c^{Prob(c)}$

sometimes easier to calculate using logarithms

log Mean = Prob(a) * log a + Prob(b) * log b + Prob(c) * log c …

since log (ab) = log(a) + log(b) and log(a^n)= n*log(a)

If we use Geometric Mean, we are trying to maximize the expected value of the logarithms

much greater impact of small numbers

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Sometimes the mathematics drives you to one or the other

- **Example 1: If you are investing in a hedge fund that doubles your money in each of the first four years and then loses 100%, your investment is worth zero (geometric mean) if you had let your investment ride**
  - ***2*2*2*2*0 = 0***
  - ***The sequence doesn't matter***
  - ***Assuming these results were representative of true probabilities***
    - **Expected Value was 80% * 2 + 20% * 0 = 1.6=>160 % (60% return)**
    - **Having a good EV won't do you much good!**
  - ***Suppose each year you had added or withdrew money from the fund to keep a constant percentage of your total wealth invested***
  - ***How do you determine what the right percentage is to maximize your compounded annual return, if 100% isn't appropriate?***

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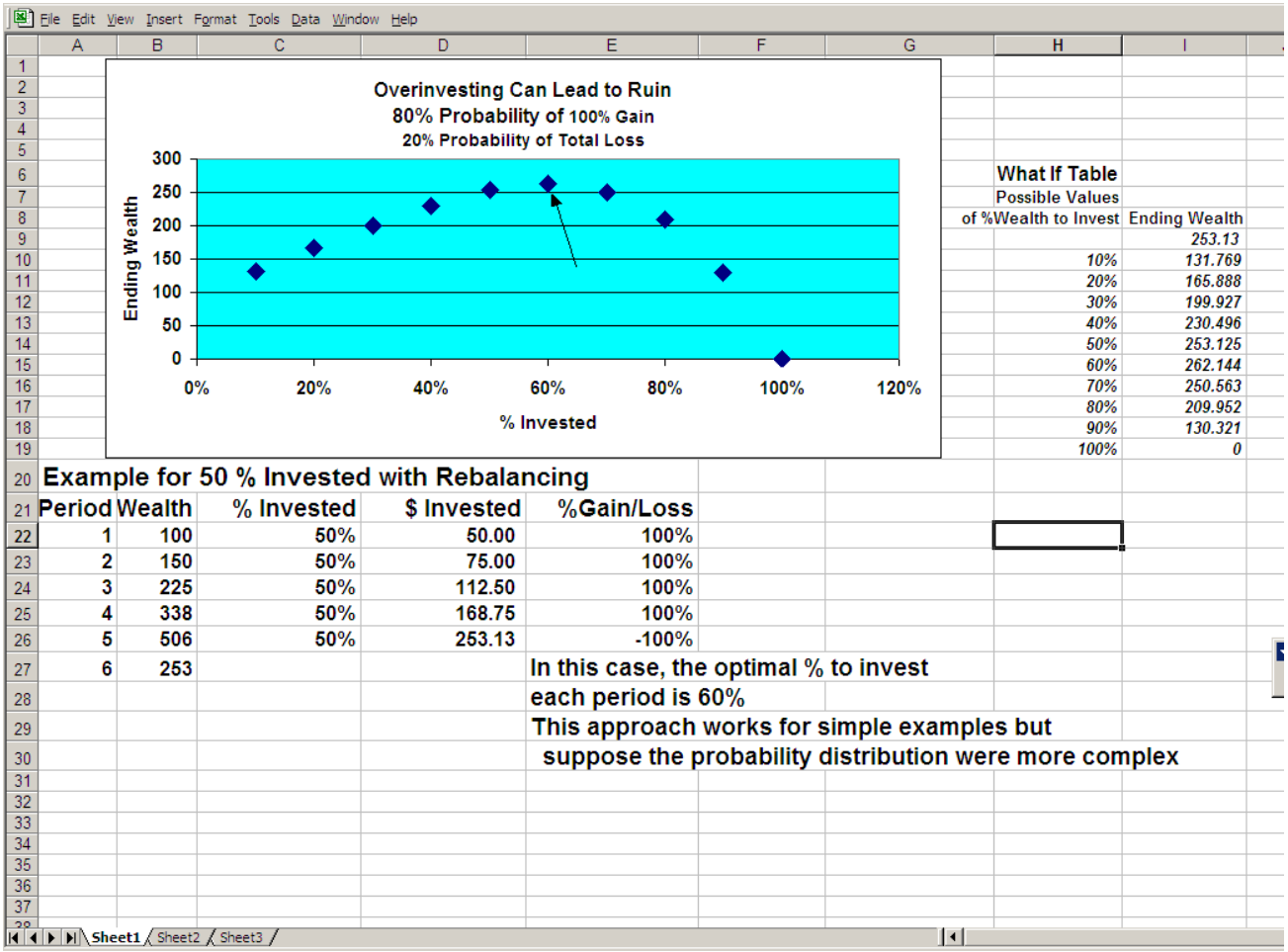

File: 'Overbetting can lead to ruin.xls'

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This approach works for simple problems and is easy to generate without any theory

If you invest or bet too much, you can be worse off even when the expected value is high!

Normal Expected Value and Portfolio Theory calculations don't adequately capture the risk of ruin.

Especially over more than one period

Example 2: If you have invested in five uncorrelated hedge funds, four of which double your money in the year, and one loses 100%, your investment is worth 160% (arithmetic mean)

(2*4)/5 + (0*1)/5 = 1.6

Assuming these results were representative of true probabilities

Expected value the same

Chance of Ruin = 0.2^5 = 0.03%

Multi-period is much different than one period

When calculating Geometric Mean

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The gains and losses should be based upon percentage of "wealth"

Wealth could be personal wealth, capital budget, divisional budget, etc…
Otherwise, geometric mean would cause you to avoid all projects/investments with any chance of 100% loss, no matter how small

Some Theory to Handle More Complex Situations

Daniel Bernoulli

Exposition of a New Theory on the Measurement of Risk (1738)

Famous family of scientists and mathematicians
"one of the most profound documents ever written" – Peter Bernstein
very readable
first translated into English in 1956; however some of the conclusions were well known to economists

St. Petersburg paradox

"the determination of the value of an item must not be determined by its price, but rather on the utility it yields"

suppose the utility is proportional to the percentage of the person's wealth

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$1000 is as important to a person whose wealth is $10,000 as $10,000 is to a person whose wealth is $100,000

- **Reasonably consistent with reality**
- **BTW, Most valuable portion of wealth is usually 'productive capacity'**

Slope of utility/wealth curve = k / wealth

- **The exact slope may be different than this but the general shape of the curve seems reasonable**

Because of the slope, a loss of $1000 will always decrease utility more than a gain of $1000 will increase utility for a given starting wealth

- **Thus, risk aversion**
  - Losing hurts more than winning feels good

The math of this assumption drives him to use the geometric mean instead of arithmetic mean to determine expected value of utility

Even if two equally rational business people have the same utility curve and totally agree on the risks and rewards of a business venture, they will come to different conclusions regarding the value of that venture if they start with different wealth levels.

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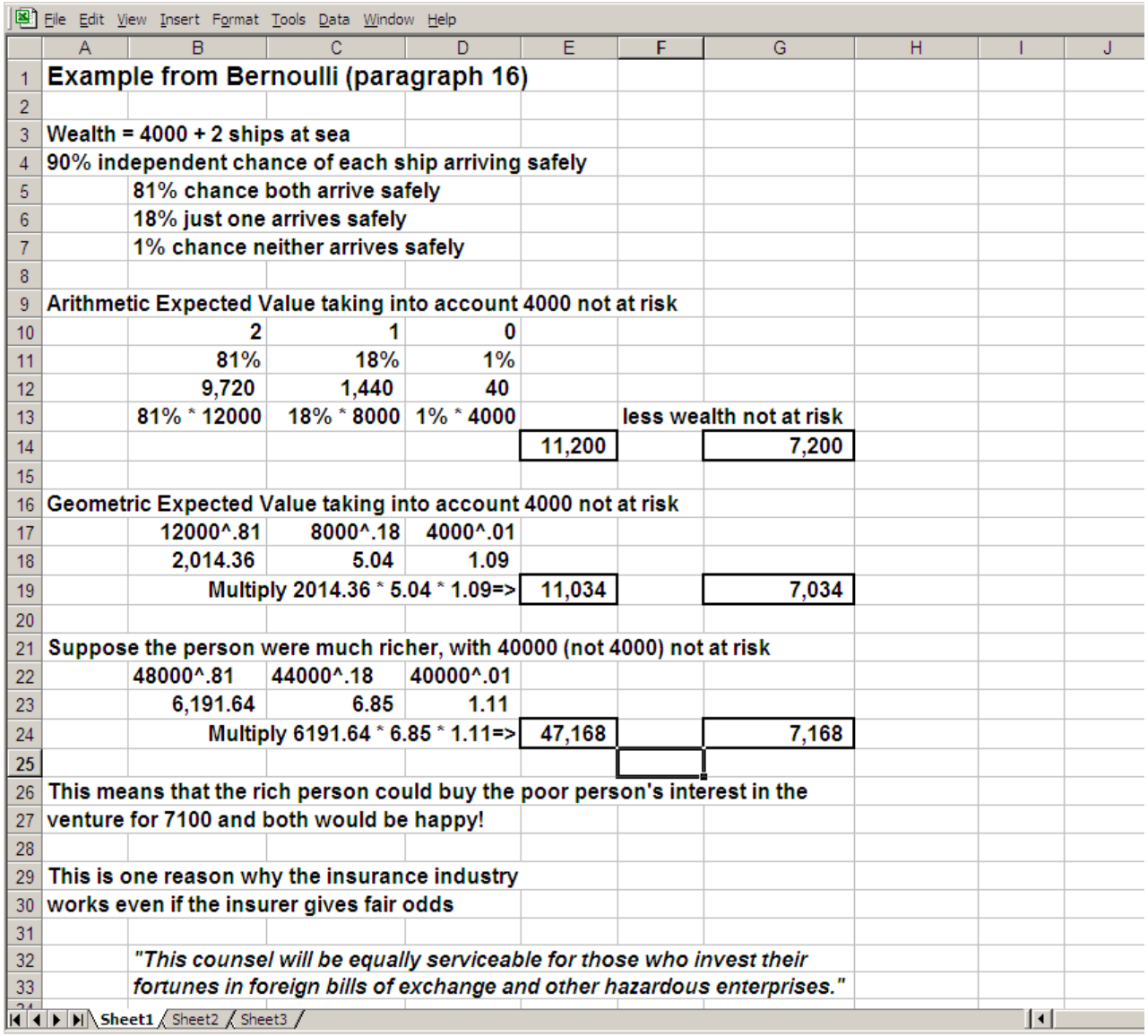

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	A	B	C	D	E	F	G	H	I	J
1	Example from Bernoulli (paragraph 16)									
2										
3	Wealth = 4000 + 2 ships at sea									
4	90% independent chance of each ship arriving safely									
5		81% chance both arrive safely								
6		18% just one arrives safely								
7		1% chance neither arrives safely								
8										
9	Arithmetic Expected Value taking into account 4000 not at risk									
10		2	1	0						
11		81%	18%	1%						
12		9,720	1,440	40						
13		81% * 12000	18% * 8000	1% * 4000		less wealth not at risk				
14					11,200		7,200			
15										
16	Geometric Expected Value taking into account 4000 not at risk									
17		12000^.81	8000^.18	4000^.01						
18		2,014.36	5.04	1.09						
19		Multiply 2014.36 * 5.04 * 1.09=>			11,034		7,034			
20										
21	Suppose the person were much richer, with 40000 (not 4000) not at risk									
22		48000^.81	44000^.18	40000^.01						
23		6,191.64	6.85	1.11						
24		Multiply 6191.64 * 6.85 * 1.11=>			47,168		7,168			
25										
26	This means that the rich person could buy the poor person's interest in the									
27	venture for 7100 and both would be happy!									
28										
29	This is one reason why the insurance industry									
30	works even if the insurer gives fair odds									
31										
32		*"This counsel will be equally serviceable for those who invest their*								
33		*fortunes in foreign bills of exchange and other hazardous enterprises."*								

Sheet1 Sheet2 Sheet3

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The higher your existing wealth, the closer the Geometric Mean will be to the standard Aritmetic Mean

John Kelly

1956 paper based on Shannon's Information Theory

You can think about the outcome of a coin toss as providing information

Suppose you flipped the coin many times in a row

sequential, not simultaneous coin tosses

If you rebalance your bet each period in the same proportion (x%) to total capital/wealth then

maximize the expected value of <u>logarithm</u> of capital

this is similar to the hedge fund example we looked at earlier

the example before was 60%

Kelly came to same mathematical conclusions as Bernoulli independently of Utility Theory

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This implies that perhaps there is something fundamental about using the expected value of the logarithms, which is the same as geometric mean

Kelly theory has become trendy in investing circles over past ten years

understanding typically superficial except for finance quants

with minor exceptions, the resources available are either too simple to be useful or too complex to be understandable

Thorp made lots of money using this

Introduced to Kelly's work by Shannon

Fractional Kelly

If you invest more than the Kelly # your risk of ruin goes up and your return goes down. You are not rewarded for the extra risk

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	A	B	C	D	E	F	G
2							
3	**Investment 1**	**Probability**	**Gain / (Loss)**	**Weighted Value of %Wealth Increase**			
4		16.7%	-100.0%	-16.7%			
5		50.0%	100.0%	50.0%			
6		16.7%	0.0%	0.0%			
7		16.7%	200.0%	33.3%			
8		0.0%	0.0%	0.0%			
9		0.0%	0.0%	0.0%			
10							
12		100%	Expected Val	67%			
13			Std Dev	94%			
14							
15	**Investment 2**	**Probability**	**Gain / (Loss)**	**Weighted Value of %Wealth Increase**			
16		50.0%	-50.0%	-25.0%			
17		16.7%	150.0%	25.0%			
18		33.3%	200.0%	66.7%			
19		0.0%	0.0%	0.0%			
20		0.0%	0.0%	0.0%			
21		0.0%	0.0%	0.0%			
23		100%	Expected Val	67%			
24			Std Dev	118%			
25	Assume these are 100% correlated (no advantage to diversification)						
26	Using standard Expected Values, Investment 1 is better.						
27	(the same Expected Value with less Std Deviation)						
28	Does it matter that you have a chance of losing everything in Investment 1?						
29							
30							
31							
32							
33							
34							
35							

Summary Normal Expected Value | Summary GeoMean Chart | Summary GeoMean | Scenario1 | scenario2

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	A	B	C	D	E	F
1	Using the Geometric Mean and investing 100%, Investment 2 is better					
2						
3	Investment 1	percentage of wealth invested=>		100	99.90	
4		Probability	Gain / (Loss)	Weighted Value of %Wealth Increase	Weighted Value of Log of %Wealth Increase	
5		16.7%	-100.0%	-16.7%	(1.15)	
6		50.0%	100.0%	50.0%	0.35	
7		16.7%	0.0%	0.0%	-	
8		16.7%	200.0%	33.3%	0.18	
9		0.0%	0.0%	0.0%	-	
10		0.0%	0.0%	0.0%	-	
11						
13		100%	Expected Val	66.7%	(0.62)	
14			Std Dev	94%		
15						
16	Investment 2	percentage of wealth invested=>		100	99.90	
17		Probability	Gain / (Loss)	Weighted Value of %Wealth Increase	Weighted Value of Log of %Wealth Increase	
18		50.0%	-50.0%	-25.0%	(0.35)	
19		16.7%	150.0%	25.0%	0.15	
20		33.3%	200.0%	66.7%	0.37	
21		0.0%	0.0%	0.0%	-	
22		0.0%	0.0%	0.0%	-	
23		0.0%	0.0%	0.0%	-	
24						
25		100%	Expected Val	66.7%	0.17	
26			Std Dev	117.9%		
27						
28						
29						

Summary Normal Expected Value | Summary GeoMean Chart | Summary GeoMean | Scenario1 | scenario2

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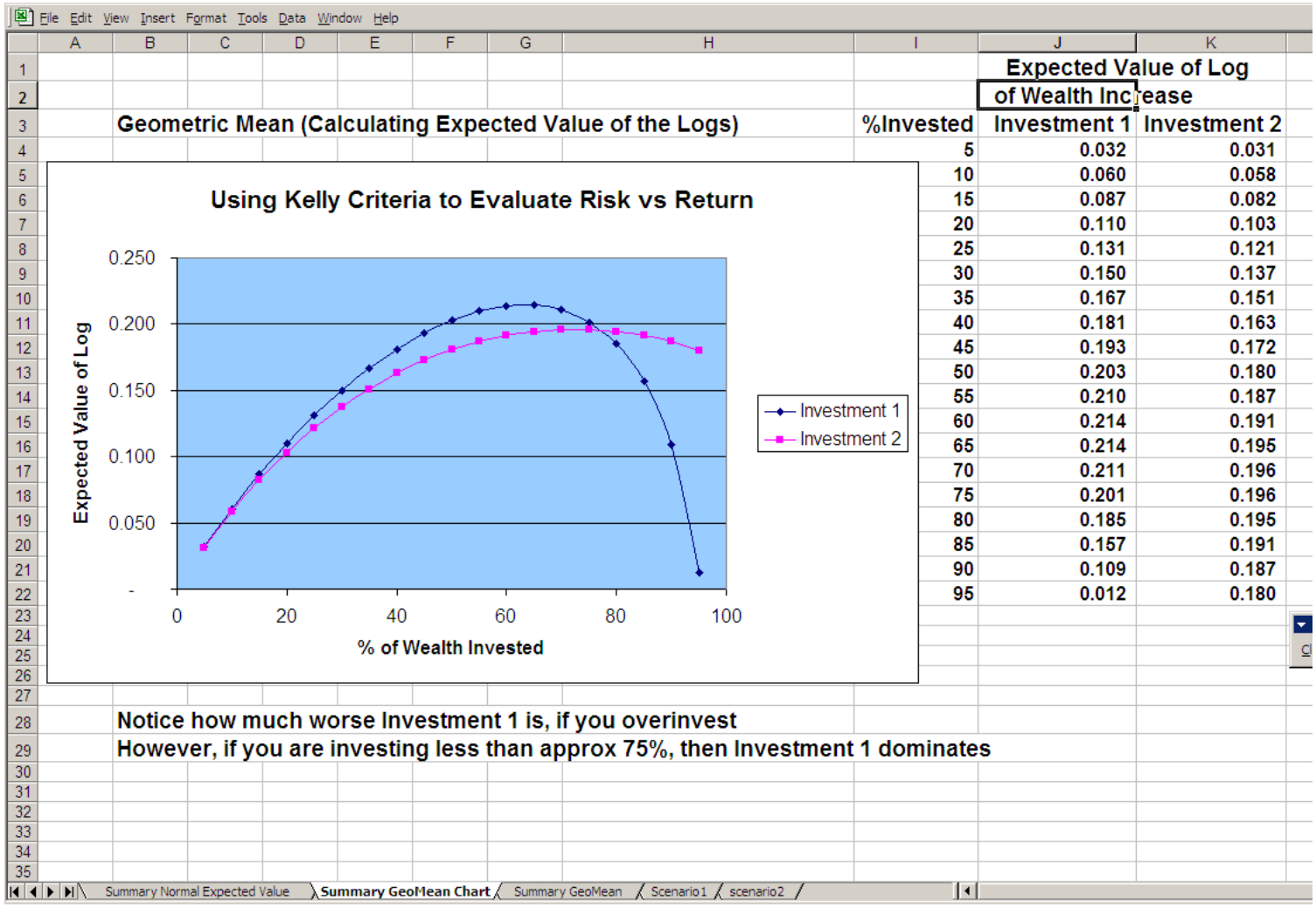

%Invested	Investment 1	Investment 2
5	0.032	0.031
10	0.060	0.058
15	0.087	0.082
20	0.110	0.103
25	0.131	0.121
30	0.150	0.137
35	0.167	0.151
40	0.181	0.163
45	0.193	0.172
50	0.203	0.180
55	0.210	0.187
60	0.214	0.191
65	0.214	0.195
70	0.211	0.196
75	0.201	0.196
80	0.185	0.195
85	0.157	0.191
90	0.109	0.187
95	0.012	0.180

file 'kelly geomean.xls' for above 3 screen prints

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provides mechanism to determine the appropriate % of wealth to maximize compounded annual return

- **except in special cases, plug and chug an Excel Data Table ("what if") can be used to find the "best" X%**
- **if you bet more than X%, your compounded return will go down and eventually go negative**
  - the danger of too much leverage and too little diversification

Even if individual projects are only 1 period each, this analysis is applicable if you repeatedly do projects with similar characteristics

If you put more than ¼Kelly, you are playing Russian Roulette

- **People routinely overestimate their abilities**
- **Unknown unknowns**
- **More is too scary for most people**
  - big drawdowns

More is perhaps appropriate for a start-up, but not for a going concern

Use something like this as an additional way to rank projects

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You can use this for evaluating

- ***Major customer risk***
- ***Super cat insurance***
- ***Large projects***
- ***Investments***
- ***Leverage***
- ***R&D projects***

Main Points

- **We need a methodology useful in balancing long term compounded return vs risk of blowing up**

Operations

More than most fields, Operations is a constant struggle against randomness
Still, predictions and statistics regarding the randomness of physical processes (such as quality and breakdowns) are probably more reliable than those associated with human emotion

- **Sir Isaac Newton "I can calculate the movement of the stars, but not the madness of men".**
- **Correlations less likely to change quickly but still subject to regime changes**

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- **Example: a new machine may be less reliable during its "break-in" period and near end-of-life than in between.**
- **Know what regime you are in**

The question of Geometric vs. Arithmetic mean also applies to Operations

- **Line Layout**
  - **In a sequential assembly line you want to maximize the geometric mean of uptime**
  - **In bottleneck analysis, you need to look at more than just the standard deviation and mean of uptime.**
    - ***What is the <u>risk</u> of extended downtime***
    - ***Sometimes better to have 2 slow, but reliable, machines in parallel instead of 1 fast, but unreliable machine***
    - ***Or, keep your old 'obsolete' machine in condition to be quickly brought on-line***
    - ***Obviously depends on industry and assumes acceptable quality etc***

Risk often associated with stockouts, quality issues, obsolescence

- **With common assumptions (such as constant Lead Time), safety stock (used to reduce risk of stockouts) often considered to be proportional to Std Deviation of Demand**

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- **When looking at demand data, account for stockouts and double orders**
  - ***EDI feeds from distributors often include backlog info, which allows you to adjust demand for change in backlog***
    - **usually ignored**
    - **key piece of data when stocked out**
- **In practice, safety stock typically set proportional to Demand**
  - **Ex: keep safety stock = 2 weeks of demand**
  - **Doing this means that safety stock goes up and down linearly with demand estimate (either past or forecast)**
- **However, Std Deviation of Demand usually changes less rapidly than Demand**
  - **Typically closer to Square Root of Demand**
    - ***Not linear***
  - **Simple example: Product stocked at representative 10% of Walmart stores**
    - ***500 units per week to factory***
    - ***2 weeks of safety stock (1000) at factory deemed appropriate***
    - ***Product is a success; ramped up to 100% of stores***
    - ***Now, 5000 units per week to factory***
    - ***The standard deviation of demand probably has gone up by less than 10x***

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Variation goes up by 10x, but
Std Deviation = square root of Variation
= 3.16

Appropriate safety stock probably closer to 0.6 weeks, not 2 weeks!

3,160 units, not 10,000 units!

While the relationship is not so clean as above, seasonality also has impact

More days of safety stock required when demand is low than high

Similar mathematics (variability pooling) says you should try to forecast and stock at the "neck" of the Bill of Materials hourglass, not at Finished Goods or components

Design for commonality of parts

Safety Lead Time

The higher the variability of Lead Time (especially the tail) and the more parts required, the more safety stock required to ensure you have all parts available.

Impact on quoted lead times

Often the part with the long Lead Time tail will arrive close to the mean, but you can't count on it.

Balancing Risks of Obsolescence vs Stockouts

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- When a product has high gross margin, the lost profit due to a stockout is high
- When a product has low gross margin, the lost profit of due to a stockout is low
- In high gross margin businesses, it makes more sense to have much more inventory even when obsolescence is a risk
    - Cisco, ten years ago
- Inventory policies should vary by product
    - Gross margin important input

IT Project Risk

- Virtues of Small, Frequent, Incremental Change
    - Opportunity costs associated with freezes and diverted resources
    - You often lose capabilities in big upgrades
    - If even half the money and effort is spent on improving the old system, you might have better results with less risk
        - *Cap Ex vs. Expense*
        - *Not sexy*
    - The new system will always be declared a success, regardless of the reality, because so many high-level careers are dependent on it
        - *3Com, post-merger conversion to SAP*
            - draining the channel

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Finance

Capital Budgeting

Implications for Net Present Value

- **Most agree that some variation of NPV is appropriate under normal conditions**
- **According to B&M, Shareholders "…give the manager one simple instruction: maximize net present value"**
  - ***Without blowing up?***
- **NPV doesn't explicitly account for the probability distribution and risk of ruin even though the discount rates are adjusted for uncertainty and/or volatility**
  - ***Remember the definitions I am using***
  - ***Remember Investments 1 and 2 earlier***
- **In fact, it encourages you to go for the project with the highest NPV without explicitly looking at the risk factor**
- **B&M: Risk just taken into account by appropriate discount rate in isolation for that project, unrelated to other projects**
  - ***but start with company cost of capital as first approximation***
    - **Even if you accept the assumptions of CAPM on its own terms (definition of risk), CAPM underestimates cost of**

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- **equity for low beta and value stocks (Fama/French 2004)**
- **Sometimes NPV calculated for different scenarios**
  - ***Often, results are collapsed into a single Expected Value using the probabilities of each scenario***
  - ***you don't get a feel for the repeated risks you may be taking in the long run***
    - **remember Russian Roulette**

If NPV > 0, shouldn't you beg, borrow, or steal to invest as much as you can

In theory, capital constraints are rare

> **From B&M: "Hard capital rationing always reflects a market imperfection-a barrier between the firm and capital markets. If that barrier also implies that the firm's shareholders lack free access to a well-functioning capital market, the very foundations of net present value crumble. Fortunately, hard rationing is rare for corporations in the United States."**

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Yogi Berra (now teamed with the AFLAC duck) "In theory there is no difference between theory and practice. In practice there is."

Also attributed to Einstein

Great minds think alike?

Capital constraints are only soft when you least need capital. You can't get credit when you most need it.

Theoretically, some sort of simulation (ex: Monte Carlo) may be appropriate

In the real world this is often complex, time-consuming, and expensive

Even these are typically used to get better estimate of Mean and Std. Deviation, not the question of how much to invest or the relationship over time or the relationship to other projects

The real problem with Monte Carlo is in organizations that are not action oriented.

The analysis is likely to become an additional bottleneck for decision making

More staff

Analysis Paralysis

Parkinson's 'Abominable No Man'

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- ***HP used to have the reputation of having great analytical methodologies but could never translate these into results***
- **In organizations that are likely to shoot from the hip, delays can be very useful**
  - ***A $50 million project is often easier to get approved than a $50,000 project!***
- **EVA® and similar approaches to adding Shareholder Value can be useful**
  - **Evaluate projects based on cash flow, not accounting profit**
  - **Only do projects that earn more than cost of capital**
  - **There are problems**
    - ***Joel Stern: "If you want to know where a herd of cattle is heading, you need not interview every steer in the herd, just the lead steer"***
      - **Suppose the herd is lemmings, not cattle**
      - **Suppose the lead steer isn't smarter or wiser, just prettier or more charismatic!**
    - ***Tends to push companies to take too much financial risk and they blow up when the economy weakens***

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Pension assumptions have big impact on shareholder value for many companies

- **Companies tend to raise return assumptions when recent returns have been good and lower them when they have been poor**
  - **The reverse is probably more appropriate, but probably would be questioned by auditors etc**
    - ***Regression to the mean***

Main Points

- **We need "quick and dirty" methods to help us size risk**
- **Additional risk metrics should take minutes, not days**
  - **I'm exaggerating, but not by much**
  - **Which measurement is less important than having one**
    - ***Semivariance***
    - ***Geometric mean***
    - ***Kelly***

Investing

Buffett's rules

- **Rule #1: Don't lose money**
- **Rule #2: Don't forget Rule #1**

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- **Obviously exaggerating to make a point; otherwise you'd only own Treasuries**
- **The importance of not blowing up**
  - **LTCM forgot this, perhaps because their Nobel Prize advisors were using an inappropriate definition of risk**

When you buy shares, ask yourself, why is there a seller at this price? Perhaps the seller knows more than you. Perhaps not.

- **Remember Bernoulli**
  - **It is quite possible that a buyer of company's shares can be just as rational as the seller of the shares, even when they both have the same opinion of the value and prospects of the shares**
    - ***The utility curve for a money manager may not be the same as yours***
      - **Asset Under Management**
      - **Keeping his job**
        - Keynes: "Worldly wisdom teaches that it is better for the reputation to fail conventionally than to succeed unconventionally."
        - Index hugging

Uncertainty and Risk don't necessarily increase with time

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While in Random Walk, average distance increases with square root of time, compare to:

"Will I be alive 50 days from now?" vs
"Will I be alive 50 years from now?"
Which is easier to answer

Volatility (short term randomness) is not necessarily related to Uncertainty

Volatility can be harnessed

Dollar cost averaging is useful
If most investors are focused on volatility, there are likely to be inefficiencies relating to long term valuations
Time Arbitrage

Human Beings see patterns where they don't exist

Clouds
Constellations
Astrology
Charting

Consider 200 coin tosses. The chances of a run of at least 5H or 5T is >99.9%; Chances of 6 are >96%
If a human being were asked to write down a "random" sequence of 200 tosses, the

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- **sequence would probably look at lot more random than the truly random sequence!**
- **Even if the past does repeat itself, we draw conclusions based on inadequate sample sizes.**
  - **Such and such happened 20 years ago and 40 years ago.**
    - ***Therefore, this happens every 20 years, or circumstances were slightly similar then so we use the past to project the future.***
- **We pick and choose the examples that confirm our biases, especially when there are political implications**

Diversification is useful, but understand what the correlations are. In particular, remember that in a panic

- **Most securities are correlated**
- **Normal correlations may vanish**

Main Points

- **Coincidence does not imply causation**
  - **Understand uncertainty**
- **Understand what definition of risk is most useful to you**

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If someone tells you that you need to take on more risk to get more reward, be sure you understand
What their definition of risk is, and
Remember the Geometric Mean

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Reading List (sorted by Author)

Risk Aversion or Myopia ***by Shlomo Benartzi and Richard Thaler***
http://independent401kadvisors.com/library_articles/RiskAversionorMyopia.pdf

Exposition of a New Theory on the Measurement of Risk ***(1738) by Daniel Bernoulli***
http://www.econ.ucsb.edu/~tedb/Courses/GraduateTheoryUCSB/Bernoulli.pdf

Against the Gods ***by Peter Bernstein***

Principles of Corporate Finance ***by Richard Brealey, Stewart Myers, and Franklin Allen***

Strategic Risk Taking by Aswath Damodaran
http://pages.stern.nyu.edu/~adamodar/New_Home_Page/valrisk/book.htm

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***The Capital Asset Pricing Model: Theory and Evidence* by Eugene F. Fama and Kenneth R. French**
http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID440920_code998.pdf?abstractid=440920

***Factory Physics* by Wallace Hopp and Mark Spearman**

***The Failure of Risk Management* by Douglas Hubbard**

***A New Interpretation of Information Rate* by John Kelly**
http://www.bjmath.com/bjmath/kelly/kelly.pdf

***A Treatise on Probability* by John Maynard Keynes**

***Risk, Uncertainty, and Profit* by Frank Knight**

***Normal Accidents* by Charles Perrow**

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***Fortune's Formula* by William Poundstone**

***The "Fallacy" of Maximizing the Geometric Mean in Long Sequences of Investing or Gambling* by Paul Samuelson**
http://www.pnas.org/content/68/10/2493.full.pdf+html

***Principles of Inventory and Materials Management* by Richard Tersine**

Misc Articles by Edward Thorp
http://edwardothorp.com/

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Biography

Rob Bresticker is President of Brigadoon Bay Asset Management, LLC. Rob has over 20 years experience in Finance, Accounting, Consulting, Operations, Engineering, and General Management with the US Navy, Arthur Young, General Mills, Motorola, US Robotics, 3Com, and others. In 1992, he wrote the book: 'American Manufacturing and Logistics in the Year 2001'. He is registered in Illinois as a CPA. Rob graduated from Dartmouth College with a BA in Physics. He also earned an MBA in Operations and Accounting from Dartmouth's Amos Tuck School of Business and a Masters in Manufacturing Engineering from Northwestern University.

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About Brigadoon Bay

Brigadoon Bay Asset Management, LLC ("Brigadoon Bay", "Brigadoon", or the "Firm") is an investment manager specializing in value investing through equity investments.

Brigadoon Bay looks for undervalued companies with:
- **High Returns on Equity**
- **Strong Balance Sheets**
- **Positive Free Cash Flows**
- **Understandable Business Models**

On occasion, we find undervalued companies that are Special Situations and do not fit the above model. Stock selection is not limited by size and portfolios may be invested in companies of any size, from larger well-established companies to smaller companies. In general, we invest in companies based in the United States or Canada.

Only a few stocks make the final cut in this investing methodology and therefore we concentrate investments in just those few stocks. Brigadoon Bay believes that over-diversification within an asset class is a recipe for mediocrity. Thus there may be occasions when Brigadoon Bay believes that there are only limited investment opportunities that meet its parameters. In that event, holdings of cash and cash equivalents may be substantial. We believe that volatility is often not a valid measure of risk and that the most appropriate measures of risk relate to the chance of a permanent loss of capital.

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