Module 1

Alternative Approaches to Valuation and Investment

Measuring Stand-Alone Risk
(Just the same old standard deviations)

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Defining risk

Common perceptions of risk:

- The chance of losing money
- The possibility that something will go wrong
- The likelihood that a project will fail.

These are generally negative connotations.

But in finance, we tend to define risk much more broadly as simply:

The chance that things might turn out other than expected.

Defining risk: An illustration

Let’s assume that you are the CFO of a large listed company – and you have three division heads that have come to you asking for funding for three different projects.

You send them away and ask them to come back with some data relating to the past performance of similar projects when undertaken by the firm.

Specifically you demand information on the rates of return generated **each and every** time a similar project was funded.

Defining risk: An illustration

They arrive back with the following information regarding returns and the history of them occurring:

Return Achieved	Project One	Project Two	Project Three
-40%	0%	0%	2%
-30%	0%	0%	3%
-20%	0%	0%	5%
-10%	0%	10%	10%
0%	20%	20%	15%
10%	60%	40%	30%
20%	20%	20%	15%
30%	0%	10%	10%
40%	0%	0%	5%
50%	0%	0%	3%
60%	0%	0%	2%

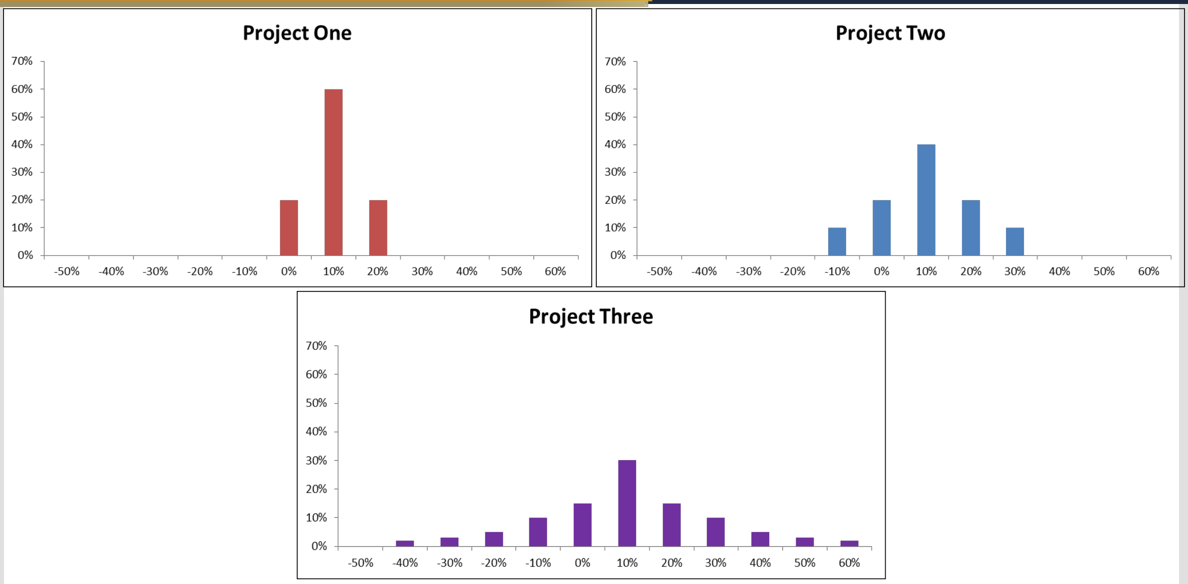
Defining risk: An illustration

So – if we assume that past return distributions are a fair indication of what future distributions might look like then we can estimate two measures from the previous data:

1. Expected Return (E(R)) of each project
   • This is a measure of what we **expect** to get out of the project before commencement.

2. The Standard Deviation of returns (σ = Greek letter sigma)
   • This is a measure of the variability of the returns of the project **relative** to the expected return of the project.

Defining risk: An illustration



Defining risk: An illustration

1. Expected Return

- We calculate expected return – as simply the **sum** of the **products** of each return that could occur and the likelihood (frequency) of it occurring.

Return Achieved (1)	Project One (2)	(1) × (2)
-40%	0%	0%
-30%	0%	0%
-20%	0%	0%
-10%	0%	0%
0%	20%	0%
10%	60%	6%
20%	20%	4%
30%	0%	0%
40%	0%	0%
50%	0%	0%
60%	0%	0%
Total		10%

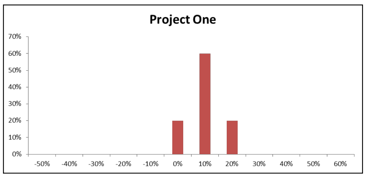
Defining risk: An illustration

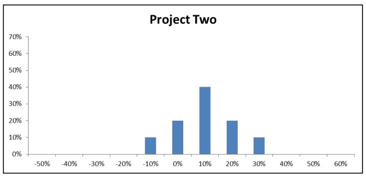
Return Achieved (1)	Project Two (2)	(1) × (2)
-40%	0%	0%
-30%	0%	0%
-20%	0%	0%
-10%	10%	-1%
0%	20%	0%
10%	40%	4%
20%	20%	4%
30%	10%	3%
40%	0%	0%
50%	0%	0%
60%	0%	0%
Total		10%

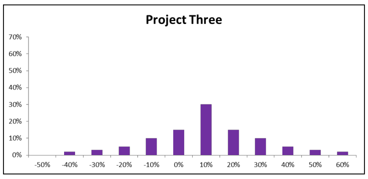
Return Achieved (1)	Project Three (2)	(1) × (2)
-40%	2%	-0.8%
-30%	3%	-0.9%
-20%	5%	-1%
-10%	10%	-1%
0%	15%	0%
10%	30%	3%
20%	15%	3%
30%	10%	3%
40%	5%	2%
50%	3%	1.5%
60%	2%	1.2%
Total		10%

Defining risk: An illustration

So – all three assets have the same expected return:







…but what about risk?

Defining risk: An illustration

2. Standard Deviation (σ : "Sigma")

- We calculate **standard deviation** by firstly measuring the distance from expected return of each possible return, we **square** that distance and then **multiply** by the likelihood of that return occurring
- We then **add** up those products
  - This gives us **variance (σ^2)**
- We then take the **square root** of the result.
  - **Standard Deviation (σ)**

Return Achieved (1)	Prob. (2)	E(R) (3)	$[(1)-(3)]^2 \times (2)$ (4)*
-40%	0%	10%	0
-30%	0%	10%	0
-20%	0%	10%	0
-10%	0%	10%	0
0%	20%	10%	0.002
10%	60%	10%	0
20%	20%	10%	0.002
30%	0%	10%	0
40%	0%	10%	0
50%	0%	10%	0
60%	0%	10%	0
Variance (σ^2)		Total	0.004
Standard deviation (σ)		Square root	6.32%

* Units of measurement in the fourth column are in percentage squared ($\%^2$) – except for the final row

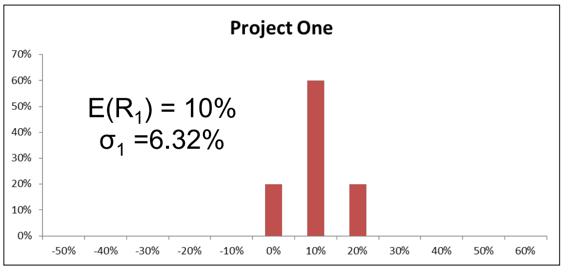
Defining risk: An illustration

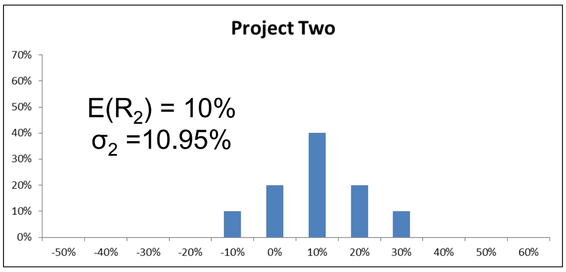
Return Achieved (1)	Prob. (2)	E(R) (3)	[(1)-(3)]²×(2) (4)*
-40%	0%	10%	0
-30%	0%	10%	0
-20%	0%	10%	0
-10%	10%	10%	0.004
0%	20%	10%	0.002
10%	40%	10%	0
20%	20%	10%	0.002
30%	10%	10%	0.004
40%	0%	10%	0
50%	0%	10%	0
60%	0%	10%	0
Total			0.012
Square root			10.95%

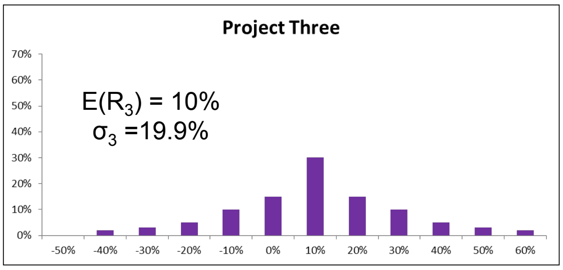
Return Achieved (1)	Prob. (2)	E(R) (3)	[(1)-(3)]²×(2) (4)*
-40%	2%	10%	0.005
-30%	3%	10%	0.0048
-20%	5%	10%	0.0045
-10%	10%	10%	0.0040
0%	15%	10%	0.0015
10%	30%	10%	0
20%	15%	10%	0.0015
30%	10%	10%	0.0040
40%	5%	10%	0.0045
50%	3%	10%	0.0048
60%	2%	10%	0.0050
Total			0.0396
Square root			19.90

* Units of measurement in the fourth column in each table are in percentage squared ($\%^2$) – except for the final row

Defining risk: An illustration







Operationalizing this for company stock returns

It is even easier to measure standard deviation of returns when dealing with returns on a stock.

1. Download the price file for the stock

2. Convert daily prices into daily returns

3. Use an **excel spreadsheet** to calculate standard deviation of returns using the STDEV function – this will give you a measure of daily standard deviation
4. Scale up daily standard deviation into an **annual standard deviation.**

Operationalizing this for company stock returns

Let's try this for Kellogg's stock returns for the calendar year 2014:

1. Download the price file for the stock

- I used Yahoo Finance to download the price file for Kellogg's – but there are lots of other free databases around
- The prices that I am interested in are the **Adjusted Close** prices as these take account of dividends – alternatively you could use closing prices and add back in dividends on the day the share goes ex-dividend.

Operationalizing this for company stock returns

2. Convert daily prices into daily returns

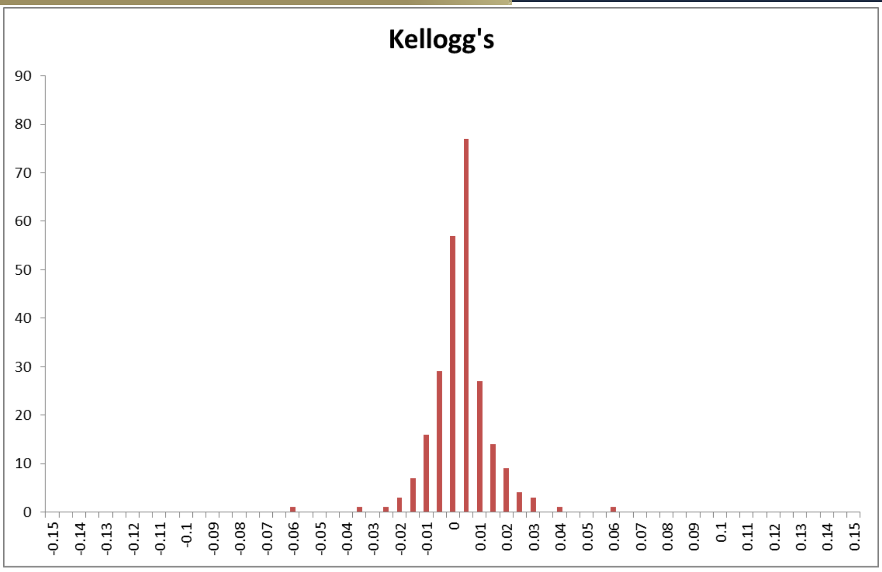
- If you use prices to estimate standard deviation then your final estimate will be influenced by the magnitude of the share price
- We use returns to take out the impact of share price magnitude
- Simply calculate the return on day *t* as:

$$Return_t = \frac{Closing\ Price_t - Closing\ Price_{t-1}}{Closing\ Price_{t-1}}$$

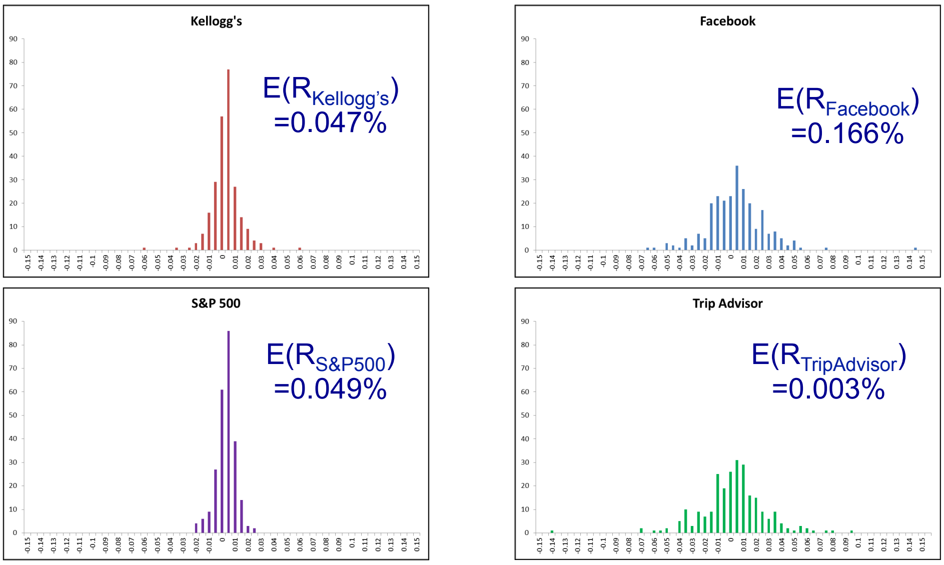
- So the return on Kellogg's shares on January 3 2014 was:

$$Return_t = \frac{\$57.92 - \$58.14}{\$58.14} = -0.00378 = -0.378\%$$

Histograms of daily returns: Kellogg's



Histograms of daily returns: With average daily returns



Operationalizing this for company stock returns

3. Excel Spreadsheet

- Use an excel spreadsheet to calculate standard deviation of returns using the STDEV function – this will give you a measure of daily standard deviation
- As I have 252 prices for Kellogg's in 2014 – I will be able to calculate 251 returns
- I then calculate the **daily** standard deviation of returns by inserting the range of daily returns into the following function =STDEV(Range)
- In this case I end up with a daily standard deviation figure of 0.010816 or 1.0816%.

Operationalizing this for company stock returns

4. Convert to Annual Standard Deviation

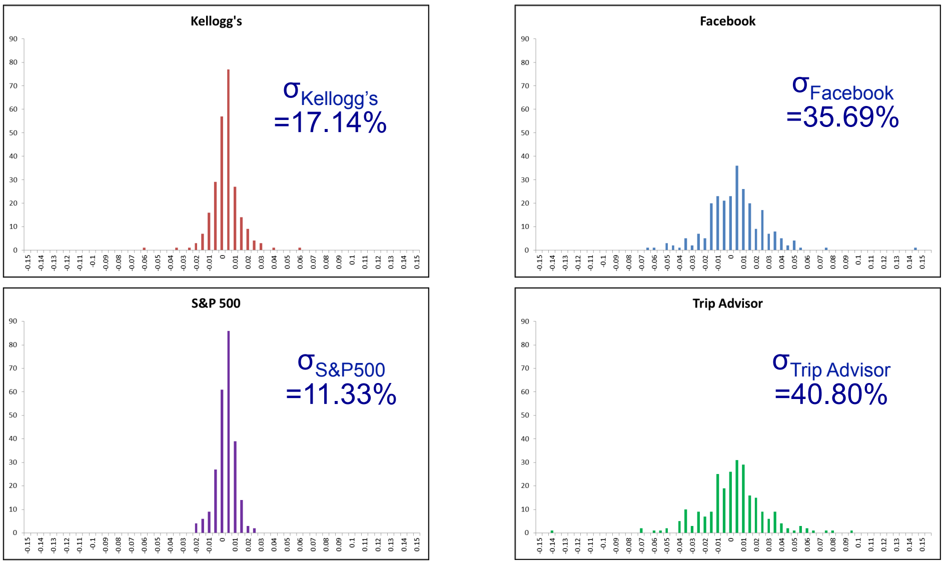
A really simple conversion is:

$$\sigma_{Annual} = \sigma_{Daily} \times \sqrt{Number\ of\ daily\ returns\ used\ in\ a\ year}$$

And so for Kellogg's:

$$\sigma_{Annual} = 1.0816 \times \sqrt{251}$$
$$\sigma_{Annual} = 17.14\%\ per\ annum$$

Histograms of daily returns with annualized standard deviations



Summary

We have defined the concepts of:

- Expected return
- Standard deviation of return.

We have demonstrated how to measure standard deviation using either:

- Historical returns and probabilities
- Historical returns on their own.

Next up – we need to turn our attention to how investors regard risk and return – and therefore how they rank projects with different risk and return profiles.

Source list

Slide 2:

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Slides 4, 6 - 12:

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