CA2 – Sample Project 1 – SUMMARY

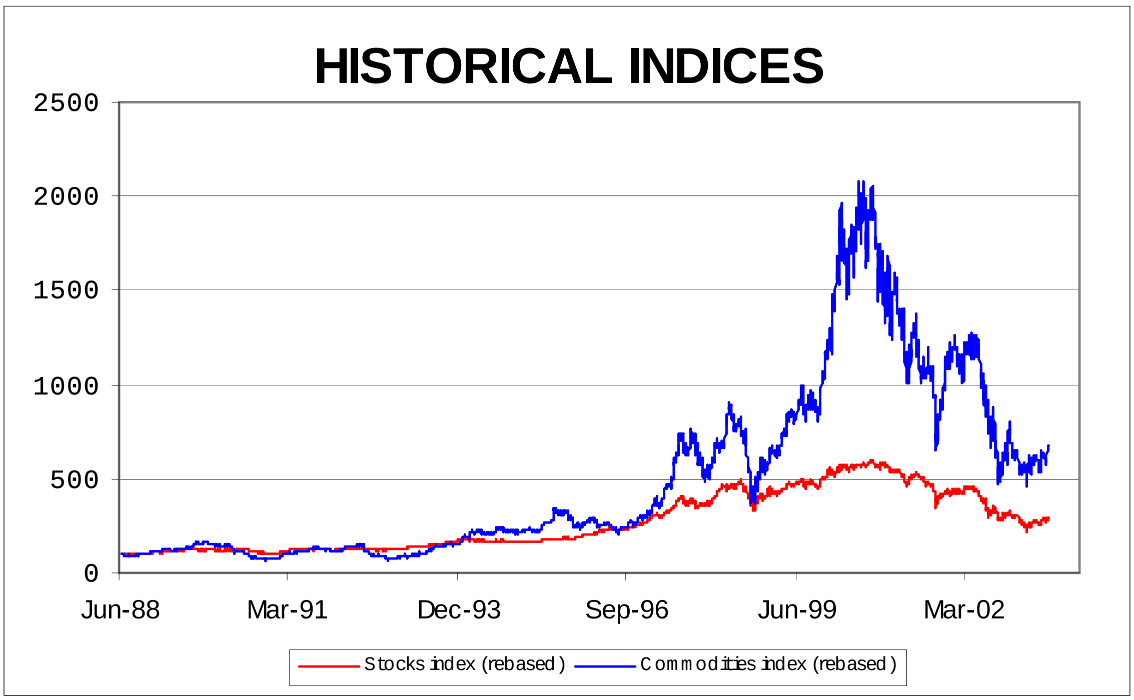
SIMULATIONS OF INDEX RETURNS

PURPOSE OF PROJECT

- To analyse historical index data in respect of two market indices: Stocks and Commodities.
- To simulate future index return paths for these two indices, using normal distribution random variables.

DATA

Historical daily data on the two indices was provided from 15 July 1988 and this was rebased for each index to start from 100 at that date.



Comments:

- Non-trading days not included.
- No extreme outliers, suggesting data is accurate.
- Commodities much more volatile and went very high.

INDEX RETURNS

- Geometric daily returns were calculated on each index, using the approach:

  Index return for Day X = LN (Index on Day X / Index on Day X-1)

- Assumption: the index relates to prices as at the end of each day.
- Note: around non-trading periods, the index on the previously available date was used rather than Day X-1.

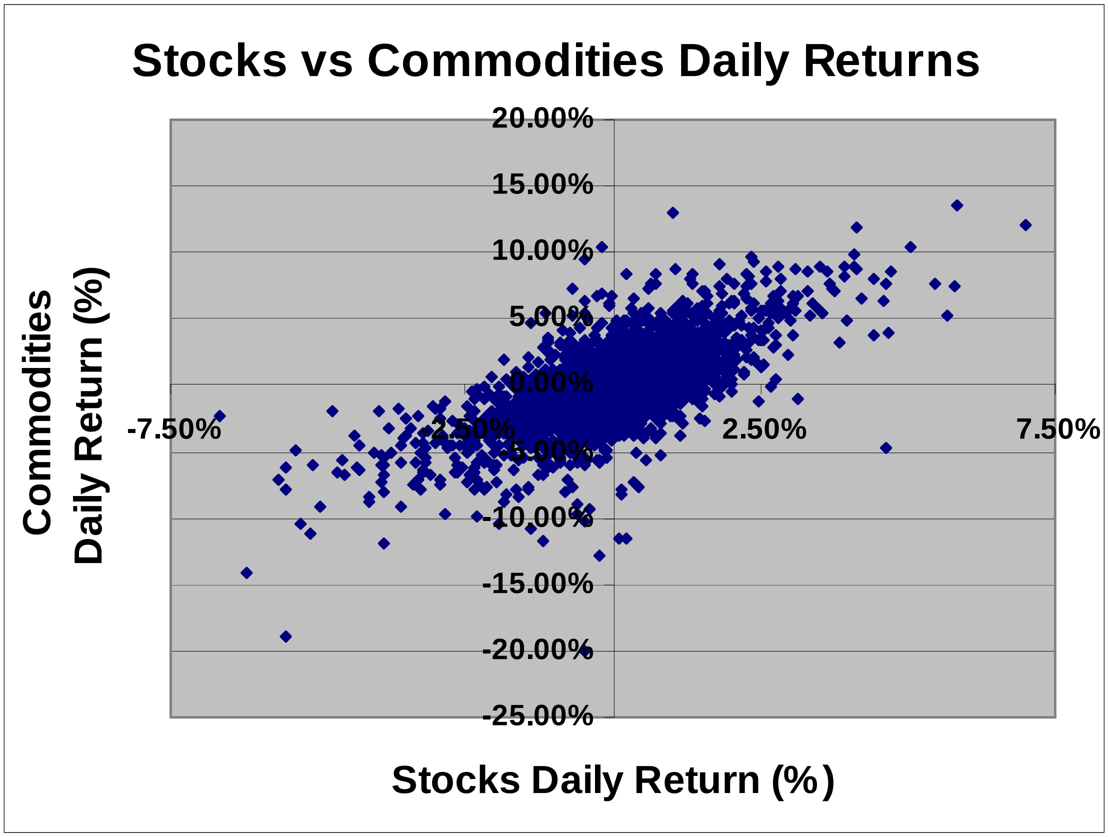
Summary statistics for the daily returns on the two indices:

STATISTICS		
	Stocks	**Commodities**
Mean	0.03%	0.05%
Standard deviation	1.14%	2.61%
Variance	1.30%%	6.83%%
Skewness	-0.244	-0.264
Kurtosis (excess)	4.102	4.312

Comments:

- Both means are close to zero since they are in respect of daily returns over a long period and both finish close to start point.
- Average return is higher for Commodities – this is consistent with the graph on page 1.
- Standard deviation and variance much higher for Commodities – this is also consistent with the previous graph.
- Negative skewness indicates a disproportionate number of large falls.
- Kurtosis is high, indicating thick tails and a peaked centre for the geometric returns.

COMPARISON OF RETURNS BETWEEN INDICES

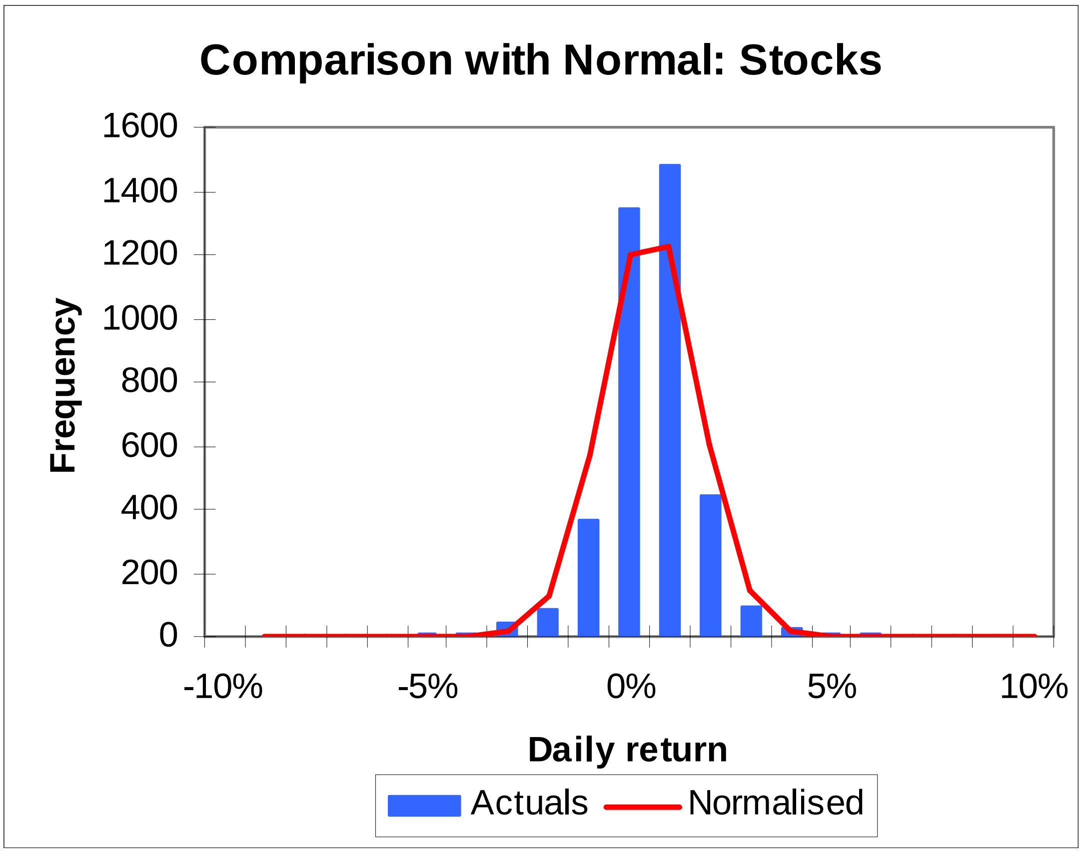


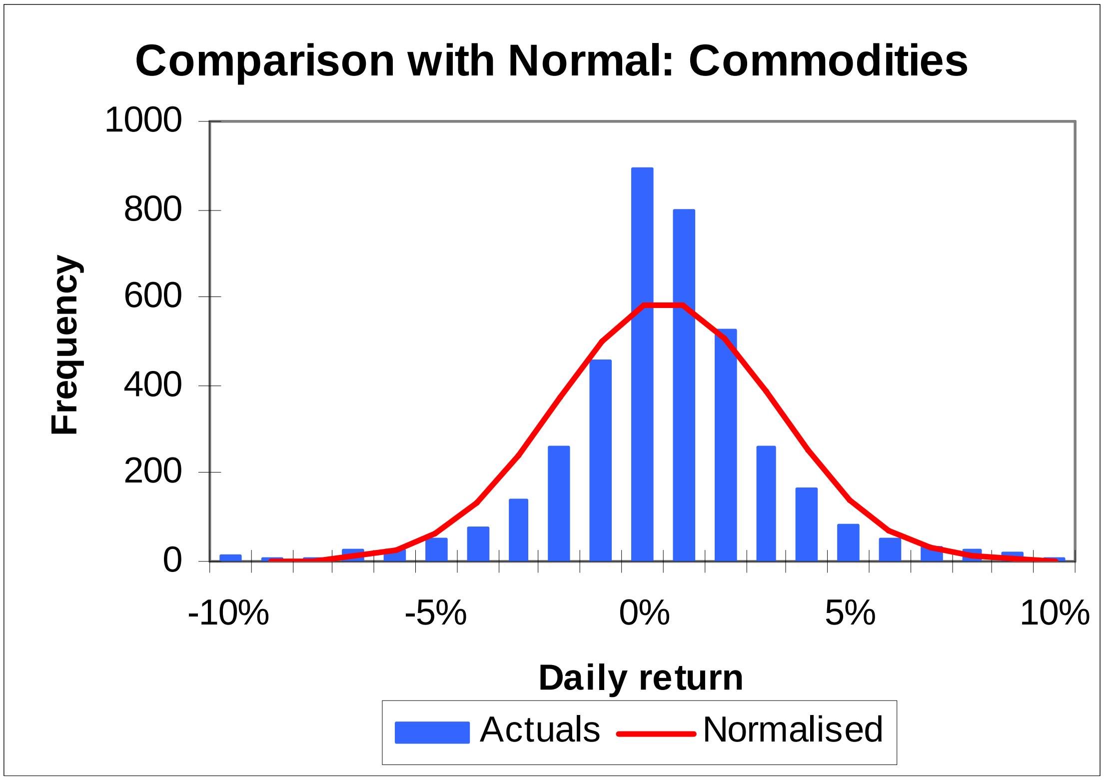
Comments:

- The correlation coefficient between the daily geometric returns for the Stocks and the Commodities is 0.669.
- This means the returns are quite strongly positively correlated.
- The scatter plot of the returns confirms this.
- This is equivalent to the commodities having a positive beta – they tend to move with the stocks index.

COMPARISON WITH NORMAL DISTRIBUTION

- The frequency of each observed daily return was determined in 1% steps for each index, in the range -10% to +10%.
- A small number of outliers for Commodities were therefore omitted.
- The expected frequency of each daily return was also determined, assuming that the returns were normally distributed and have the same mean and variance as each set of actual observations.
- The actual and normalized results were then compared:





Comments:

- Graphs confirm that distribution of returns is more peaked than normal.
- This is consistent with the kurtosis result noted on page 2.

SIMULATIONS AND CONCLUSIONS

Using the normal distribution and the Box-Muller approach to perform 100 simulations of an additional year of returns gives the following:

Statistical analysis of simulated index prices at end of projected year:

	Stocks	Commodities
Mean	312.99	838.37
Standard deviation	63.94	352.09
Skewness	0.99	0.68
Kurtosis (excess)	2.26	-0.18
Min	168.12	204.60
Lower Quartile	269.14	551.15
Upper Quartile	311.28	758.88
Max	570.18	1794.14

Comments:

- The projected end points can vary dramatically.
- The returns are not normally distributed.

Overall Conclusions:

- Commodities index is much more volatile.
- The two indices have quite strongly positively correlated returns.
- The distribution of returns is more peaked than normal.
- Simulation of future prices assuming normal returns is therefore unlikely to be appropriate.

Suggested Next Steps:

- Fit the historical data to a more appropriate statistical distribution.
- If available, obtain more years' worth of historical data.
- Use alternative simulation approaches.
- Could attempt retrofitting of simulation methodology.
- Perform more than 100 simulations.
- Test the sensitivity of the results to the assumed mean and variance.
- Assess whether there are other indices available that could be more easily simulated.