5.

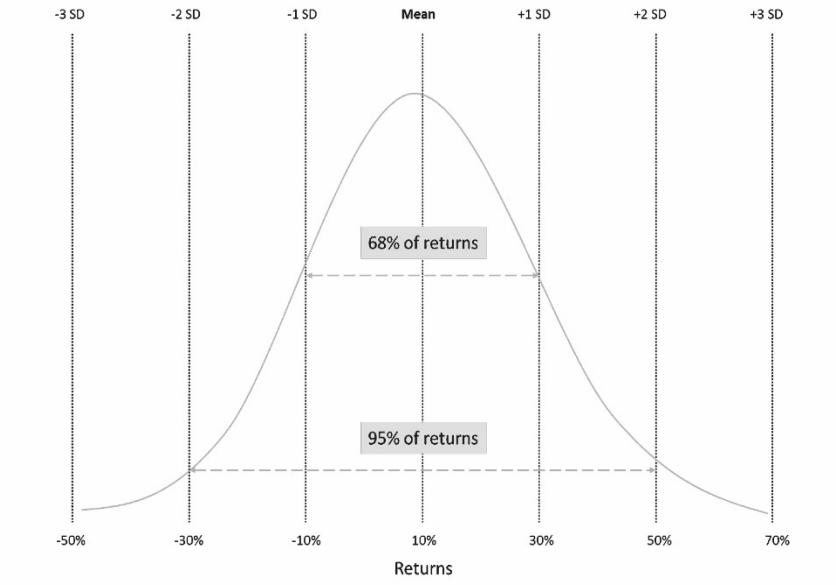
Maths: The Solution Or The Problem?

We saw how child genius Carl Gauss did some clever, and useful, things with maths. We saw how his bell curve could help us organise, and make sense of, a jumble of statistics from day-to-day life and in nature.

But when you try and apply this to investment, it gets very difficult. Look at the following bell curve, similar in look to the one shown earlier. This is very elegant maths in a seductive picture.

Chart 2: The normal distribution of investment returns

In this case, the line down the middle tells us that the average growth rate is 10% per annum, which is about right for the UK stock market.[15] The bell curve has organised the jumble of annual returns since 1900 to tell us that in 68% of individual years the return was within 20% of this average, so between 10% *down* and 30% *up*. (These are approximate numbers for illustration).



Taken a step further, it tells us that 95% of the time the price moved 40% either side of that average (so between -30% and +50%).

This is probability, guided by what happened in the past.

This is a useful guide when combined with other useful information: e.g. that over 18 years, you have a 99% probability of generating more growth than leaving your money on deposit. But it is only a guide.

You also need to factor in the bumps along the way in that 18-year journey, something to which I will return.

The problem is that many believe this bell curve has *predictive ability* – **it doesn't**, at least

not in the context of financial markets. It is predictive in the context of the height of men driven by thousands of years of evolution. But not in the context of financial markets driven by the behaviour and idiosyncrasies of human beings.

Nonetheless, the (bad) idea that investment returns can be predicted in this way became the building block for very significant developments in the finance industry. At its simplest, it appeared that armed with a good sample of past results, statisticians could predict future results with some confidence.

This laid the foundations for significant advances such as the Black-Scholes equation (1973) and VaR or value-at-risk (1994).

Black-Scholes "opened up a new world of ever-more-com- plex investments, blossoming into a gigantic global industry",[16] and underpinned massive economic growth. It was even called the *Midas Formula,* as it seemed to be a recipe for making everything turn to gold.

But the combination of muddled maths, complexity, greed, and leverage (debt) meant the finance industry was out of control.

The scale of this was only truly apparent in 2007/8 with the sub-prime mortgage debacle,17 the failure of Lehman Brothers, and the world moving to the brink of Great Depression II.

VaR was used by banks (and regulators) to measure risks being taken by banks, and, hopefully, to enable them to limit those risks. In the jargon, someone assessing risk could say "with 95% confidence" how much they might lose – or even with 99.7% confidence if required to appease regulators and shareholders.

But this created a false sense of security, even complacency.

The problem is that extremes occur commonly in financial markets. And this was not allowed for in the bell curve, the Black-Scholes equation, or VaR.

What this maths suggested was improbable was actually happening all the time! The maths disregarded the big market moves – but it was big market moves that would bring the banks and the whole system down.

For example, the sharp fall in the UK stock market in 1974 (down 57% after inflation) should only happen once in 1,400 years according to the maths. The 97% real return in 1975 should only happen once in 30,000 years.

It gets worse. The U.S. stock market's one-day fall in August 1997 had a probability of one in 50 billion. A week of steep falls in July 2002 had a probability of one in four trillion.

When the U.S. stock market fell 23% in a single day in 1987 this was, according to bell curve analysis, something which should only happen "once in several billion years" (or, for those still following the maths, a 22 standard deviation event – that is odds of 100 quindecillion, which is 100 followed by 48 zeros).

Or "odds so small they have no meaning", at least mathematically.[18]

Yet in the real world, such events have real meaning. They can have a dramatic and lifelong negative impact om your finances.

And sometimes they bring the whole global system to the brink, as when the maths models didn't anticipate the extraordinary crisis of 2008, which brought the world to the brink of Great Depression II. Even Queen Elizabeth felt obliged to ask: "why did nobody see it coming?" when she visited the London School of Economics (LSE) in November 2008.

Buckingham Palace, England. 2009

An A-list of academics and practitioners was convened to provide a considered opinion for the Queen, and it was published on 22nd July 2009. I have to admit that I tittered reading it. There are only two pages, and it mostly falls into the category of "the bleeding obvious". (There is a third full page, but this is just a list of the 33 worthies who contributed – that's an average of two-and-half lines each.) Here's a flavour:

> *Most believed the financial wizards had found new and clever ways of managing risks…. There was a belief too that financial markets had changed… It was a cycle fueled not by virtue but by delusion…The psychology of herding and the mantra of financial and policy gurus led to a dangerous recipe… The failure was principally a failure of the imagination of many bright people to understand the risks to the system as a whole"*

To be fair, these guys (there were no lady "experts") were remarkably frank – they realised that the Queen would not tolerate bluff and waffle.

Yet this could be a description of most financial crises of the last 300 years – which Mackay wrote about in 1841, and Kindleberger chronicled in detail from 1978 – both widely read books to this day. These lessons of history had never been taken on board by such bankers, governments and regulators – and they were of no interest to those who saw an opportunity to line their pockets, and damn the consequences.

Centuries of crises were fueled by greed, deception, delusion, herding, and easy availability of debt – oh, and on this occasion, bonkers maths.

The motion of the planets is a scientific matter, measurable with mathematical precision. The height range of males is dictated by millions of years of evolution, to maximise the chances of survival. In sharp contrast, financial markets (a very new development in the context of human evolution) are driven by human behaviour, which is not measurable with precision by any mathematical formula (bell curve or otherwise).

Investments are not "normal" in a way which can usefully be measured or represented by the bell curve. You can disregard the possibility of someone growing a mile high – it isn't even a possibility. But you can't disregard even a remote possibility in financial markets – in fact you have to allow for possibilities which have never been seen before, the acutely abnormal (a possibility which we build into your plan later in the book).

The problem was that investment models built on this kind of maths were (and are still) not just wrong, "they are dangerously wrong".

Here was laid the seed of an angry debate which still rages.

These theories bear no relationship to the real world of investing. They merely describe the past, and only a slither of the past, and cannot predict the future. Or in the case of the Efficient Market Theory, it doesn't even describe the real world, past present or future.

Some critics admit that these ideas have a degree of value, but it is limited – the numbers provide a useful guide but not more. The problem is that many were, and remain, seduced by the elegant maths and take these theories too far.

The critics tell us that these clever theorists might have extraordinary IQs, but have little common sense.

To be fair to Gauss, he never said that the bell curve had applicability to the stock market – it was in modern times that many people (and too many bright people) became seduced by his elegant maths.

Or as Keynes put it, as early as 1936:

> *Too large a proportion of recent 'mathematical' economics are merely concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in* ***a maze of pretentious and unhelpful symbols.***

And in the context of investment funds, which is our focus, these "concoctions" have led many investors just like you to adopt index trackers (or worse) and do themselves a huge injustice – you must avoid this trap.

CLUES

- Mathematical models take no account of irrational investors and emotion-driven markets.
- Mathematical models take no account of extremes which are quite commonplace.
- Mathematical models encourage complacency.
- Elegant maths is seductive (even when wrong).
- The role of common sense and experience is considerably, and continually, under-estimated.

NEXT STEPS

By accident, "mad maths" shone a light on what did work.