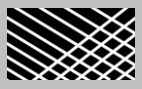


The Latticework:

Mathematics

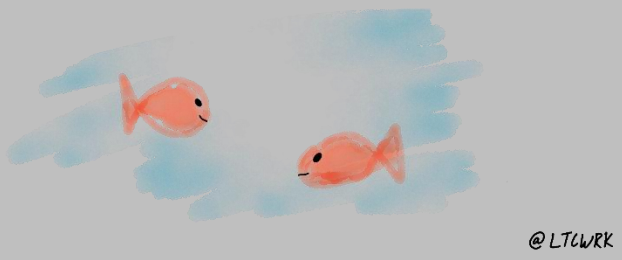
What I noted since the really big ideas carry 95% of the freight, it wasn't at all hard for me to pick up all the big ideas from all the big disciplines and make them a standard part of my mental routines. Once you have the ideas, of course, they are no good if you don't practice – if you don't practice you lose it. So, I went through life constantly practicing this model of the multidisciplinary approach. Well, I can't tell you what that's done for me. It's made life more fun, it's made me more constructive, it's made me more helpful to others, it's made me enormously rich, you name it, that attitude really helps…

…It doesn't help you just to know them enough just so you can give them back on an exam and get an A. You have to learn these things in such a way that they're in a mental latticework in your head and you automatically use them for the rest of your life.

– Charlie Munger,

2007 USC Gould School of Law Commencement Speech

Mathematics



Mathematics is central to our lives and our world, but few people truly take the time to grasp it at a fundamental level. It is like DFW says in This is Water, we are fish unknowingly swimming in water. Similarly, math is all around us, impacting everything and, while we might not understand why math functions so beautifully to describe and navigate the world, it does, and is why it is crucial to have a basic familiarity with these big ideas. As Eugene Wigner said, math is unreasonably effective in describing the natural sciences, making it an effective way to spend our time so that we can come to better understand the universe around us.

Those without a firm grasp of these big ideas may find themselves constantly disadvantaged and easily influenced. The hope is that if the ideas addressed in this discipline are thoroughly understood, that this disadvantage may turn into an advantage.

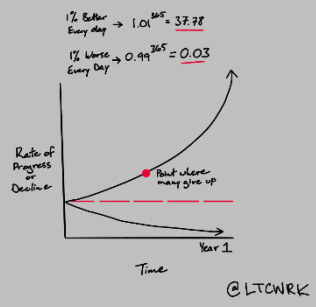
While you may still be skeptical of the impact math can have on your daily life, like the other hard sciences, it is worth studying as it can provide useful metaphors and perspectives to help sharpen your thinking and decision-making. With that, let's dig in…After the meta-learning principles we discussed in Worldly Wisdom, we will be diving into physics.

We have been using Mathematics without ever discussing what it is – most of you have never really thought about it, you just did the Mathematics – but Mathematics plays a central role in science and engineering. Perhaps the favorite definition of Mathematics given by Mathematicians is: "Mathematics is what is done by Mathematicians, and Mathematicians are those who do Mathematics." Coming from a Mathematician its circularity is a source of humor, but it is also a clear admission they do not think Mathematics can be defined adequately. There is a famous book, "What is Mathematics," and in it the authors exhibit Mathematics but do not attempt to define it. Once at a cocktail party a Bell Telephone Laboratories Mathematics department head said three times to a young lady, Mathematics is nothing but clear thinking. I doubt she agreed, but she finally changed the subject; it made an impression on me. You might also say Mathematics is the language of clear thinking.

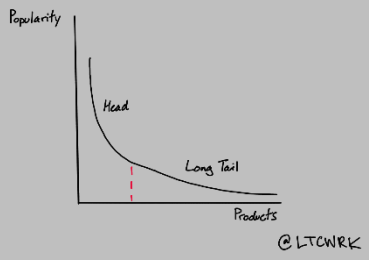
– Richard Hamming, Mathematics

The Big Ideas of Mathematics:

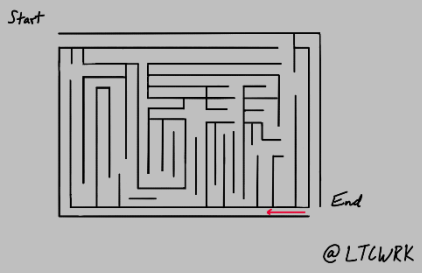
1. Compounding



2. Power Laws



3. Inversion

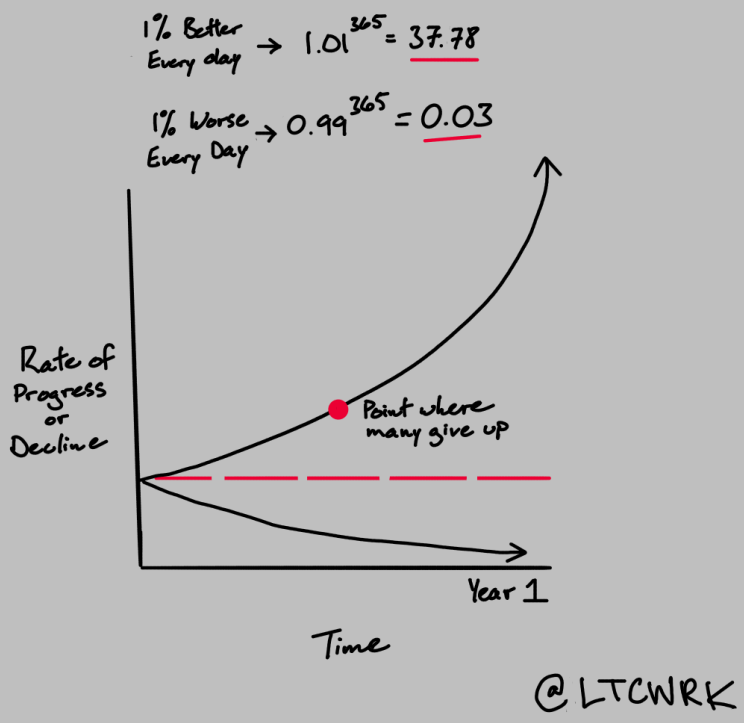


4. Algorithm

Compounding

Compounding occurs when something begins to grow at a faster rate as it gets bigger and has more time. This progression may start deceptively small (and is why many people give up and fall off the exponential curve), but quickly becomes non-linear, improving faster the more time goes on.

While compounding is traditionally thought of as a scientific, mathematical, or financial concept, it is just as important in considering intangibles such as ideas, trust, knowledge, mastery, relationships, and more.



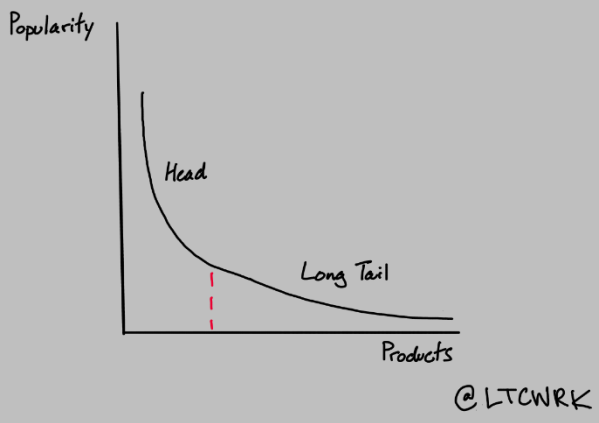
What's the most powerful force in the universe? Compound interest. It builds on itself. Over time, a small amount of money becomes a large amount of money. Persistence is similar. A little bit improves performance, which encourages greater persistence, which improves persistence even more. And on and on it goes.

– *Daniel Pink, The Adventures of Johnny Bunko*

Power Laws

Power laws are mathematical relationships where the frequency of an event varies as a power (exponent) of some trait of that event. For example, the Richter scale describes the power of earthquakes on a power-law distribution scale: an 8 is 10x more destructive than a 7, and a 9 is 10x more destructive than an 8, etc. The larger are inversely proportional to some power of their size. In this case, the central limit theorem does not apply and therefore there is no "average" earthquake. This is true of all power-law distributions.

A key insight that understanding power laws unlocks is that these "black swans" are far more likely to occur than what "normal" bell curves would suggest. This is why we can live through several three standard deviation events in our lifetimes. We've been trying to fit a complex system into a static and "normal" paradigm, leaving us vulnerable and unprepared. However, by replacing these normal models with power law models, we can be better prepared for these likely black swan events.



Most people struggle to understand that we don't live in a normal world, we live under a power law…The biggest secret in venture capital is that the best investment in a successful fund equals or outperforms the entire rest of the fund combined. This implies two very strange rules for VCs. First, only invest in companies that have the potential to return the value of the entire fund. This is a scary rule, because it eliminates the vast majority of possible investments. Even quite successful companies usually succeed on a more humble scale. This leads to rule number two: because rule number one is so restrictive, there can't be any other rules…The power law means that differences between companies will dwarf differences in roles inside companies.

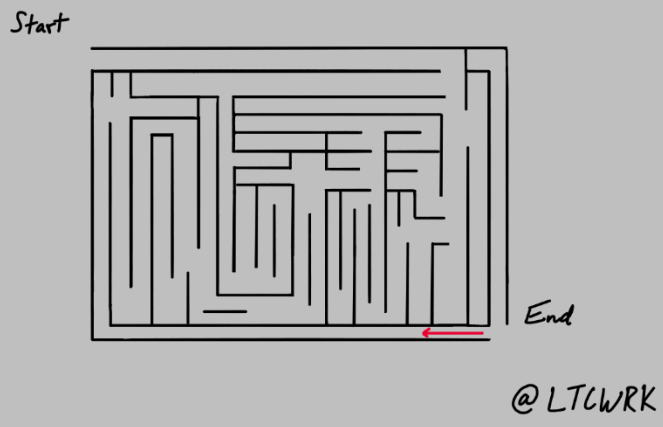
– Peter Thiel, Zero to One

Inversion

Inversion rests on analyzing and solving problems in reverse.

It's almost impossible to know what works a priori, because every situation is unique. It's far easier to understand what causes failure and simply seek to avoid those things.

This can be likened to the Hippocratic Oath. Attributed to Hippocrates, the oath had the doctors of the time vow to "first, do no harm." Much malpractice and heartache would be avoided if this millennia old inversion could be adhered to in various life domains. When trying to improve your diet, your decision making, your relationships, and more, it can be beneficial to first understand how you can harm yourself or those around you, and then do everything possible to avoid doing that. This is a great way to "invert" the problem. Rather than trying to help as much as possible, first understand how you can cause harm.



If you had to compress the top 5 mistakes Bronnie Ware compiled from the dying into a single piece of advice, it might be: don't be a cog. The 5 regrets paint a portrait of post-industrial man, who shrinks himself into a shape that fits his circumstances, then turns dutifully till he stops. The alarming thing is, the mistakes that produce these regrets are all errors of omission. You forget your dreams, ignore your family, suppress your feelings, neglect your friends, and forget to be happy. Errors of omission are a particularly dangerous type of mistake, because you make them by default…I inverted these regrets, yielding a list of 5 commands: don't ignore your dreams, don't work too much, say what you think, cultivate friendships, be happy.

– Paul Graham, The Top of My To-Do List

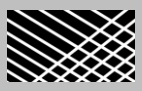
Algorithms

As Pedro Domingos says in *The Master Algorithm*, "An algorithm is a series of instructions telling a computer what to do. No matter how complex, there are 3 options – and, or, not." It can also be thought of as an automated set of rules or a "blueprint" which kickstart a series of steps or actions resulting in a desired outcome, and is often stated in the form of a series of "If ⟶ Then" statements.

You can set up algorithms in your life to help you eliminate the need to make too many decisions. Decision fatigue is real and willpower is more fragile than we like to believe, and that's ok! By developing a series of rules and routines to apply consistently, we can improve our decisions since we have a better structural framework to work with, helping mitigate emotion from our decisions. For example, if you choose that health and exercise are key pillars in your life, it may be worth doing them first thing in the morning. Working out is never fun if you're hung over, so the "algorithm" you can set up is that you will not have more than two alcoholic drinks at night and that you'll be asleep by 11pm. This will give you the rest necessary for a great workout the following morning. This process reduces decision fatigue and helps you be aligned with your priorities, funneling as much of your time and energy into living your ideal life.

The greater the uncertainty, the bigger the gap between what you can measure and what matters, the more you should watch out for overfitting - that is, the more you should prefer simplicity.

– *Tom Griffiths, Algorithms to Live By*



As the African proverb goes, “If you want to go fast, go alone. If you want to go far, go together.”

Thank you for choosing to go together.