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The Hidden Mathematics- Counterintuitive

We make roughly 35,000 decisions a day. What to eat. Whether to reply to that email now or later. Take the highway or side streets. Accept the job offer or negotiate. Hold the stock or sell. I spent 3 months deciding whether to move to US for education by making pro/con lists in my head at 2am. Never wrote anything down. Just vibes. Moved. Hated it within a week (but still completed the course). And for small stuff: what to have for lunch, which Netflix show to watch, vibes are fine. Who cares. But for the decisions that actually shape your life? Career moves, investments, relationships, health? Vibes are a disaster. And it's all mathematics.

(A) Expected Value- The one formula that runs everything

Any decision you make has possible outcomes. Each outcome has a probability and a payoff. Multiply them together, add them up, and you get the expected value.

$$EV = \Sigma(\text{ probability x pay off})$$

That's it. That's the formula.

Let us go through an example: Your friend offers you a bet. Flip a coin. Heads, he pays you $150. Tails, you pay him $100. Most people hesitate. "I could lose $100!" And yeah, you could. But run the math:

$$EV = (50\% \times \$150) + (50\% \times -\$100) = \$75 - \$50 = +\$25$$

Every time you take this bet, you make $25 on average. If someone offered you this 100 times, you'd be insane to say no. You'd make roughly $2,500. But here's the weird thing - in studies, most people reject this bet. Even when the math screams YES. Because humans feel losses about 2x more than equivalent gains. Losing $100 hurts way more than winning $150 feels good. Psychologists call this loss aversion and it screws up almost every decision you make.

Real world example. Your boss offers you two paths:

Option A: Stay in your current role. Guaranteed $120K salary.

Option B: Take a riskier role at a startup (just an example). 60% chance it works and you make $250K in 2 years (equity + salary). 40% chance it fails and you make $70K for the same period.

Most people pick A. Feels safe. Let's check:

$$EV\ of\ A = \$120K\ (guaranteed)\ EV\ of\ B = (0.60 \times \$350K) + (0.40 \times \$70K) = \$150K + \$28K = \$178K$$

Option B is worth $58K more. But 40% chance of "only" $70K feels terrifying so people don't take it. That does not mean blindly chase every positive EV opportunity. Variance matters. If losing the bet means you can't pay rent, don't take it even if EV is positive. But at least KNOW the EV before you decide. Most people don't even calculate it. They just go with their gut and wonder why they're stuck.

(B) Base Rate Neglect

Let's say there's a disease that affects 1 in 1,000 people. You take a test that's 99% accurate. It comes back positive. What's the probability you actually have the disease? If you said 99%... you're wrong. And you're in good company- most doctors get this wrong too. Let's think about it. Out of 1,000 people:

- 1 actually has the disease. The test catches them (99% accurate). That's 1 true positive.
- 999 don't have it. But the test has a 1% false positive rate. That's ~10 false positives.

So, there are 11 positive results total- considering true positive & false positive. Only 1 is real.

$$P(\text{actually sick} \mid \text{positive test}) = 1/11 \sim 9\%$$

Real world example:

- My Start up idea is great. Look at how well uber did!
  Base rate of startup success= 6%, Base rate of becoming a unicorn= 0.00006%
- "This investment returned 40% last year, I should buy more." Base rate of any fund beating the market 3 years in a row: ~15%.
- "This guy on Twitter predicted the crash, he must be a genius." Base rate: if 10,000 people make random predictions, ~100 will nail it perfectly. They are not geniuses. They're survivors of a large sample.

Bottom line is this Whenever someone tells you about a specific success story, ask yourself: what's the base rate? How often does this type of thing actually work? If the answer is "rarely" — be very skeptical, no matter how convincing the story sounds.

(C) Sunk cost fallacy
You bought a movie ticket for \$15. Thirty minutes in, the movie is terrible. Do you leave or stay? Economically, the answer is obvious: leave. The \$15 is gone either way- staying doesn't get it back. The only question is: "Will the next 90 minutes be better spent watching this bad movie or doing literally anything else?" But almost everyone stays. "I already paid for it." That's the sunk cost fallacy. And it wrecks people's lives in ways far worse than bad movies.

- Staying in a dead-end job for 3 more years because "I already invested 5 years here." Those 5 years are gone. The only question is: what's the best use of the NEXT 3?
- Holding a losing stock because "Already down 50%, I can't sell now." The stock doesn't know your entry. The market doesn't care what you paid. The only question is: if you had cash right now, would you buy this stock at today's price?
- Staying in a relationship because "we've been together for 6 years." Those 6 years happened. The only question is whether the NEXT 6 will be good.

The fix is aggressively simple: when making any decision, pretend you're starting from scratch right now. Ignore everything you've already spent - time, money, emotion. Only look forward. Would you choose this path today, knowing what you know? If the answer is no, get out. The past is not coming back regardless.

(D) Bayesian thinking- updating beliefs like a scientist not a politician
Most people form an opinion and then defend it forever. New evidence comes in? Doesn't matter - they already decided. This is the opposite of how you should think. Bayes' theorem gives you the mathematically correct way to change your mind:

$$P(belief|new\ evidence)= P(evidence|belief) \times P(belief)/ P(evidence)$$

In words, it simply means- Your updated belief = how well the evidence fits your theory × how likely your theory was before ÷ how common the evidence is in general.

<u>Example.</u>
You think this stock is going to go up. Before any evidence, based on the random chart pattern (typical lagging technical analysis), you'd say there's a 20% chance. That's your prior.
Then you notice, that the promoter himself/ herself is buying the stock in the market.

- If the stock is about to go up, what's the probability that the promoter will buy the stock himself/herself from the open market? Pretty high — say 70%.
- If the stock is not about to go up, what's the probability that the promoter will buy the stock himself/herself from the open market? People do it randomly but still not so high — say 15%.

$$P(Stock\ going\ up\ |promoter\ buying) = (0.70 \times 0.20) / ((0.70 \times 0.20) + (0.15 \times 0.80)) = 0.14 / 0.26 \approx 54\%$$

So, this one piece of evidence moved your probability from 20% to 54%. Not to 90% -that would be overreacting. Not staying at 10% - that would be ignoring evidence. 54% is the mathematically rational update.

One piece of evidence moved you from 10% to 34%. Not to 90% -that would be overreacting. Not staying at 10% - that would be ignoring evidence. 34% is the mathematically rational update.
Now the company announces new capex giving enormous future profitability- a step towards improved earnings. Another update. Now the 54% becomes the new prior.

- If the stock is about to go up, what's the probability that the capex is announced? Pretty above avg — say 55%.
- If the stock is not about to go up, what's the probability that the capex is announced? Some companies do it randomly but still not so high — say 25%.

$$P(Stock\ going\ up\ |capex\ announced)= (0.55 \times 0.54)/((0.55 \times 0.54) + (0.25 \times 0.46))= 0.297/0.412 \approx 72\%$$

Now with this new evidence the stock has a 72% chance of going up. The takeaway: hold opinions loosely. Update them constantly. The strength of your update should be proportional to the strength of the evidence. Most people either ignore evidence entirely or overcorrect wildly. Both are wrong.

(E) Survivorship bias- only seeing winners
All our childhood we have heard of Bill gates, Mark Zuckerberg and Dhirubhai Ambani being dropouts. You read about a college dropout who built a billion-dollar company. Inspiring, right? Maybe college is a waste of time?

Except you never hear about the 10,000 other dropouts who are broke. They don't get magazine covers. They don't get podcast interviews. They just quietly struggle while one survivor gets all the attention. This is survivorship bias. You only see the winners, so you massively overestimate the probability of winning.

Real life examples:

- Stock market bros on twitter. Everyone posting gains. Nobody posting losses. The guy who turned $500 into $50K gets 200K likes. The 500 guys who turned $500 into $0 deleted their accounts. Your feed makes it look like everyone's winning. They're not. 95% of stock market participants done beat the index over a 5 year period. You just never see them post about it.
- Restaurant advice. "Just follow your passion and open a restaurant!" 60% of restaurants close within the first year. 80% close within five. The ones that survive become your favorite spots. The dead ones are invisible. Following your passion is great advice if you ignore the graveyard.
- Music industry. "Just upload to Spotify and go viral!" 90,000 tracks are uploaded to Spotify every single day. The median track gets 30 plays total. You hear about the ones that go viral because... they went viral. The other 89,990 are silence.

The fix: whenever someone shows you a success story as proof that something works, look for the denominator. How many people tried this? What percentage succeeded? If you can't find the denominator, assume the success rate is very low. Because the world only shows you numerators.

(F) Kelly Criterion- How much to bet when you have an edge

You calculated the EV. Checked the base rate. Updated your beliefs with Bayes. Accounted for survivorship bias. And you've found a genuinely good opportunity. How much should you bet? Most people have two modes: too much or too little. Either they yolo everything because they're "confident" or they put in a tiny amount because they're scared. Both are wrong and there's a formula for exactly the right amount.

$$f = \frac{bp - q}{b}$$

f= fraction of your capital to bet
b= odds received on the bet (net profit per unit staked) for e.g.: if you double your money its 1:1 i.e. 1
p= probability of winning
q= probability of losing i.e. (1-p)

Let’s take the above example itself.
How much of your funds to bet on (also called the Kelly %) = {[probability of winning x payout (i.e. how much will you get on this bet)] – [probability of losing]}/ payout
Assume we expect the stock to go up by 75% over our purchase price.

Thus f= (0.75x 0.72- 0.28)/ 0.75= 0.35

According to Kelly criterion, you should bet 35% of your capital to this bet. But here's what 50 years of real-world application has taught us: full Kelly is way too aggressive for humans. The variance will destroy you emotionally long before the math pays off. Every professional gambler and trader I've studied uses quarter-Kelly to half-Kelly.
So in this case, half Kelly= 17.5% (say 18%) and quarter Kelly= 8.75% (say 9%). So instead of 35%, you bet 9-18% of your capital. You won't get rich tomorrow. But you also won't blow up next week. This applies to everything btw. Not just money:

- Career: Don't quit your job to go all-in on a side project. Reduce to 4 days/week and spend 1 day on the project. That's ~quarter-Kelly.
- Learning: Don't try to learn 5 new skills at once. Pick the one with the highest EV and go deep.
- Relationships: Don't spread yourself thin across 20 shallow friendships. Invest deeply in 4-5 people who actually matter.

The principle: when you have edge, concentrate. But not too much. Leave room to be wrong.

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