

Why Humans Struggle to Understand Exponential Growth

Human intuition works well with steady change. If a road extends one kilometer every year, most people can easily imagine its length after ten years. Exponential growth follows a different rule. Each increase builds on the previous one, which causes numbers to accelerate rapidly. This pattern appears in finance, technology, and biology, yet people consistently underestimate it. A well-known example comes from the “rice and chessboard” problem. According to the legend, a king agreed to reward a chess inventor with rice placed on a chessboard. One grain sat on the first square, two grains on the second, four on the third, doubling each time. By the sixty-fourth square, the amount exceeds 18 quintillion grains of rice. The number appears absurd because the human mind rarely anticipates such explosive growth.

Psychological research has documented this limitation for decades. Studies in cognitive science describe the “exponential growth bias,” a tendency to assume that growth continues at a steady linear pace even when it accelerates. Economists have observed this bias in financial decision making. Many people underestimate how quickly compound interest accumulates over long periods. Health researchers noticed the same misunderstanding during disease outbreaks. Early stages of infection spread may appear slow because the numbers remain small. Once exponential growth begins to compound, case counts rise dramatically in a short time. This misjudgment occurred repeatedly during early COVID-19 projections, when many observers expected gradual increases rather than sharp surges.

The difficulty arises because exponential processes remain quiet at first and then accelerate suddenly. For many steps the change looks small. Then the curve rises sharply and overwhelms

intuition. Technology industries provide a clear illustration. Computing power doubled roughly every two years for decades under Moore's Law. Early improvements seemed modest, yet the accumulated effect transformed entire industries. Smartphones now carry more processing power than supercomputers from the 1990s. The pattern did not change. The numbers simply compounded. Human intuition still expects gradual change, which explains why exponential growth continues to surprise people even when the mathematics is widely understood.