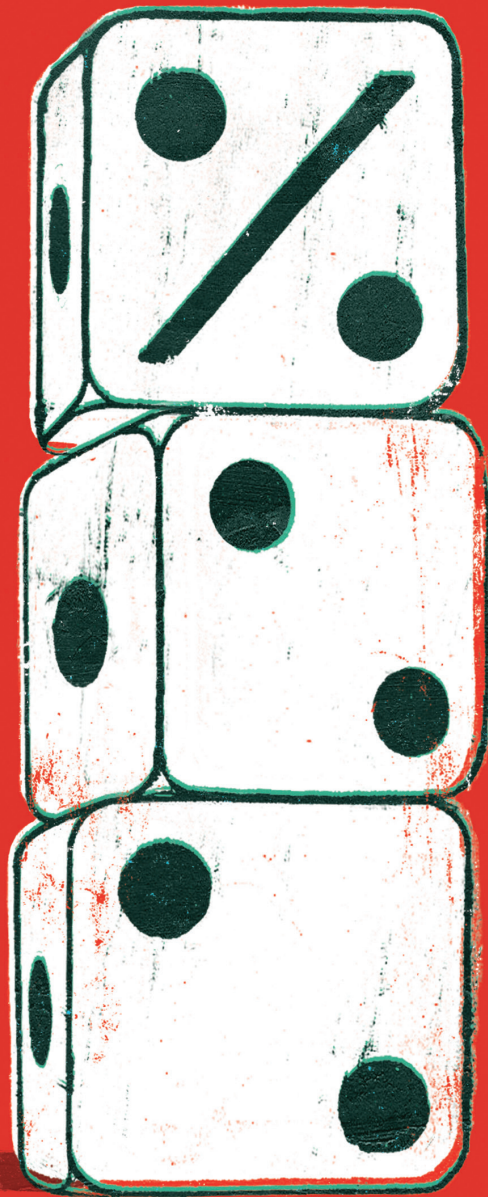


Q&A

WITH
SAM
SAVAGE

Sam Savage is the executive director of ProbabilityManagement.org, a nonprofit devoted to the communication and calculation of uncertainty—which is certainly a thing that many finance officers are dealing with. Sam is a consulting professor at Stanford University, and he may be best known for his book *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty*. Sam has also been a visiting professor at Northwestern University's Kellogg School of Business and the Naval Postgraduate School in Monterey. He was also a fellow of the Judge Business School at the University of Cambridge. GFOA Senior Manager of Research **Shayne Kavanagh** spoke to him about the danger of basing plans on uncertain assumptions and gaining a better understanding of risk.



Your book is called *The Flaw of Averages*. Can you explain to our readers what the “flaw of averages” is?

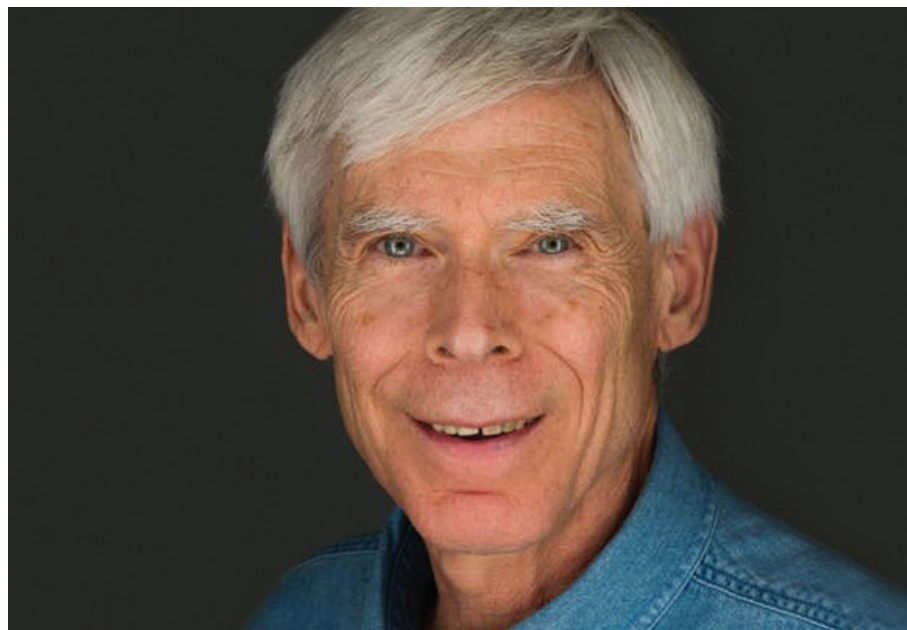
Sam Savage: Put simply, plans that are based on averages are, on average, wrong. We deal with statistical uncertainties every day and try to replace that uncertainty with a number—an average—to help us make our decisions. We plug that number into a spreadsheet to represent an uncertain future outcome, and doing that causes us to make systematic errors. For example, if you were in a room with Bill Gates and eight others, on average you would all be billionaires. But if you were to select one person at random, there is 90 percent chance that that person is *not* a billionaire. This is the flaw of averages, and it explains why forecasts can easily be wrong.

There’s a joke about a statistician who drowns while fording a river that he calculated to be, on *average*, only three feet deep. The point is that you can’t really represent an uncertainty by its average.

You’ve talked about projects being over budget and behind schedule, and I think it’s in your rule of thumb that a typical project will succeed 20 percent of the time. Can you say a bit more about that rule of thumb and where it comes from?

SS: If you have to give an estimate, start out assuming that there’s one chance in five that it’ll work.

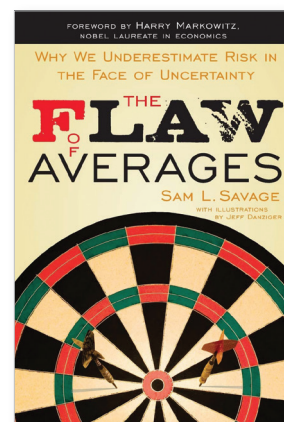
Let’s assume that a public-private partnership development requires a developer to get 10 permits by a certain date to keep the project on time and on budget, and each permit takes six weeks, on average, to process. Construction is scheduled to start in six



weeks, and your boss wants to know if there will be any problems with that. You don’t want to be the project manager who says, “On average, these permits will be done in six weeks, so there shouldn’t be any problems.” Looking at things differently, there is really only one chance in a thousand that you’re actually going to start construction in six weeks.

Why? If we assume that on average, a permit takes six weeks, there’s a 50 percent chance that any single permit will take less than 6 weeks, and a 50 percent chance it will take longer than six weeks. It’s like flipping a coin ten times—it’s a new flip of the coin each time. Getting each one of your permits in less than six weeks would be like flipping a coin and getting heads ten times in a row, and the odds of that are roughly one in a thousand.

READ MORE by Sam Savage



The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty describes common avoidable mistakes in assessing risk in the face of uncertainty.

To learn more, visit flawofaverages.com

I have another example that seems to come up often with local government budgeting. Departments build slack into their operating budgets in case something bad happens. Let's say the government has 10 departments, and each department has a 10 percent chance of incurring unexpected costs of \$1 million, so each department builds \$1 million of padding into its budget, for a total of \$10 million. The chance that all ten will experience \$1 million in the extra costs in a given year is very low, so the government has built in much more padding than it actually needs.

So, if \$10 million is too much padding, what is the right amount? Based on your earlier point, I'm assuming that using an average of \$1 million isn't the right answer either.

SS: Yes. To determine how much money to budget as padding, a government has to determine what kind of risk it's comfortable with. By running a simulation of the ten departments, each with a 10 percent chance of incurring additional costs of \$1 million, we can calculate the probability that we would need \$1 million, \$2 million, \$3 million, or any other dollar amount in padding. In this example, keeping \$1 million in reserve would give you a 73 percent chance of covering all your losses; \$2 million would give you a 93 percent chance; and \$3 million would give you a 99 percent chance.

Exactly. This shows how we can manage that risk across multiple departments and help the overall budget of the government. GFOA has seen local governments save a lot of money by coming to this realization and essentially pooling the risk across these departments in a centralized, but smaller, contingency that the departments have access to. So there are definitely real-life implications to the flaw of averages within public finance.

Your book, *The Flaw of Averages*, is about how to make better decisions under uncertainty and recognizing risk—it requires us to see the world differently. In your view, what skills



or practices separate the risk-aware managers from everybody else?

SS: First of all, the concept of risk is usually very poorly defined and misunderstood. You need to be able to differentiate risk, which is the chance that certain outcomes will occur, from uncertainty, which is not knowing or having data on what outcomes are likely to occur. Once you understand risk, you can quantify what outcomes are likely and make decisions based on your level of confidence in the outcome. Risk-aware managers are able to determine risks and make appropriate decisions based on appropriate tolerances. The real world is complex, and many factors might influence an outcome. The key is determining the most influential factors, looking at the probability of various outcomes, and quickly identifying a model to support decision making that describes the situation.

That's a good point. So to discuss risk properly, we need to get into probability. Risk is specific and involves more than just identifying success vs. failure. You need to be able to describe likely outcomes and the chance that each will occur. Can you say a bit more about that?

SS: This is what I call the arithmetic of uncertainty. Basic arithmetic tells us that X plus Y equals Z. However, given that X and Y are both unknown and can change, the arithmetic of uncertainty asks, "What are the chances that Z is above or below a certain number? We can then analyze the "risks" associated with X and Y to better understand the uncertainty of Z and answer the question. We can then use computers to simulate that uncertainty many times, record the results, and arrive at the probability of certain outcomes.

We've been using some of these same concepts at GFOA in our consulting work to help governments model risk associated with establishing financial policies or look at uncertainty in budgeting. It has been a very powerful tool and really provides some great insights into the cities that we've worked with.

For example, let's consider the scenario where a government is looking to budget for the replacement of vehicles and needs to determine how much money to set aside for capital vehicle

“THE CONCEPT OF RISK IS USUALLY VERY POORLY DEFINED AND MISUNDERSTOOD. YOU NEED TO BE ABLE TO DIFFERENTIATE RISK, WHICH IS THE CHANCE THAT CERTAIN OUTCOMES WILL OCCUR, FROM UNCERTAINTY, WHICH IS NOT KNOWING OR HAVING DATA ON WHAT OUTCOMES ARE LIKELY TO OCCUR.”

purchases. The department plans to use each vehicle until it reaches the end of its useful life and needs to identify a savings rate so it will have enough to purchase a new vehicle when the time comes. Of course, not every vehicle lasts exactly the same as this predetermined lifespan. Wear and tear on the vehicle would vary, accidents happen, and the replacement price may be different, as well. If the finance officer is thinking in terms of probabilities, they'd realize they could easily prepare a risk model that quantifies the chances that the vehicle will be used more or less than expected, the chance of wrecking the vehicle, and a range of future replacement costs.

SS: I'm an Excel user, so I like to view everything from the point of view of Excel. It's easy to write a model in Excel that shows potential scenarios for usage, risk of crash, and expectations on inflation. This model then gets simulated many times in the spreadsheet, creating thousands of parallel universes and different scenarios for the required savings rate necessary to be able to replace the government's vehicle fleet. We can then use a "COUNTIF" function to calculate the overall probability that our

vehicle replacement budget will have sufficient funds. If we calculate how much is contributed each year, and the amount we spend on new vehicles based on our simulated model, we can count the simulations where the fund would go below zero based on different rates of contribution.

I think many GFOA members are familiar with the idea of having an Excel model that shows the baseline situation, a pessimistic view, and an optimistic view—three scenarios. Looking at 1,000 or more scenarios simultaneously provides much more perspective on what could possibly happen and your chances are of success or failure.

SS: With thousands of scenarios and the results combining the impact from several variables, it allows us to look at outcomes in a way that is closer to the real world. For example, instead of pessimistic versus optimistic, we can look at different assumptions on interest rates, stock market changes, tax revenues, operating costs, and more that potentially would behave differently.

This is a very useful approach, but it has to be communicated, particularly to elected officials, who may not be used to thinking that way and might not really be able to grasp it initially. What are some of the best ways explain uncertainty and use an approach like this for decision making?

SS: The best way is to put a spreadsheet model into their hands and have them adjust things. Have them look at different scenarios. I would also suggest that elected officials learn how to ask questions that best incorporate a risk-based approach. If someone says "Give me a number," you want to flip that on its head. That person should be giving you a number, and you can then tell them the chances of hitting it.

One of our GFOA members successfully communicated this kind of uncertainty to her board.

In her case, it was tax revenues. She was asked what the revenues would be for the next year. She had calculated a whole range of possible revenues, and rather than saying, "Here's 1,000 different outcomes, city council—chew on that," she said, "Here's my best guess, and here's a picture of that range." She then pointed out a few different points on this range and focused the council on those particular points, saying things like, "If you want a 90 percent chance of meeting the budget projection, you pick this point. If you pick this higher level of budgeted revenue, you should know your chances of meeting it go down to 60 percent." By showing just a few points on this along the continuum of possibilities, she was able to engage council members in the conversation in a productive way, while also taking into account this full range of possibility.

SS: This takes you back to the notion that acceptable risk is in the eye of the beholder, and everyone has a different attitude. She told the council that the expenditure chosen implied a 60 percent chance that the city would fail to meet the target budget and asked if they were comfortable with that. And they were not. Then at a 90 percent probability, they were much more comfortable.

Before we finish, let's get specific on the topic of computer simulation and using the computerized tools you've alluded to so far. Can we take a look at some of these open-source, free tools you use?

SS: Until very recently, it took specialized software to do this, but now native Excel can do wonderful simulations. It's available at ProbabilityManagement.org, including a bunch of Excel models you can play with.

That's great. Well, Sam, I appreciate you taking the time here to chat with us today. ☺