NAC Executive Insights

Fat Tails

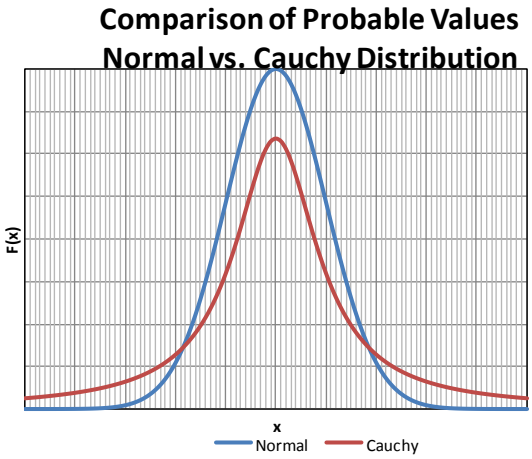
Key Points

1. Do we use the laws of probability effectively in our project risk analysis?
2. The behavior of large complex projects may not be as normal as classical project management theory many believe.

Large projects are complicated and often sophisticated endeavors and we seek to improve the quality of our time and cost estimates by accounting for certain quantitative uncertainties in our estimates. Clearly a step in the right direction, but as the results of large project performance would suggest, not good enough. Perhaps we are unwitting victims to some of the laws of improbability, and maybe even the Law of Selection impacts our best efforts to address the uncertainty of estimates in our own risk analysis.

Consider a given estimated value, where we have assumed a normal distribution around a mean value. Have we selected the data set for calculating the mean in such a way as to dismiss so called “outliers”? Or potentially more common, have we utilized a distribution around a mean that dismisses these outliers without any direct action on our part other than the selection of the probability distribution itself? One place where these distribution assumptions come together with direct impact on our perception of likely vs. actual project performance is in our project risk analysis.

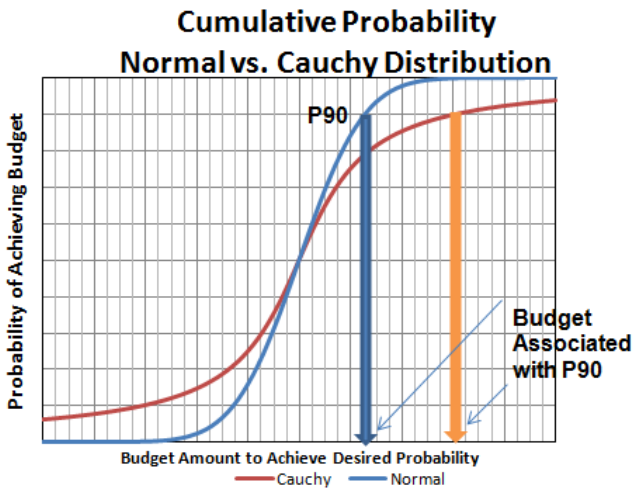
Now consider the very typical case where a Monte Carlo analysis is run utilizing a normal distribution. Implicit is an assumption that extreme outliers are so improbable as to be impossible.



We see the normal distribution's characteristic "thin tails" as contrasted with the thicker tails associated with the Cauchy distribution. It is in these thicker tails that we might expect to see "Black Swans" or even less exotic but extremely significant "off normal" events that combine for project failure in large projects.

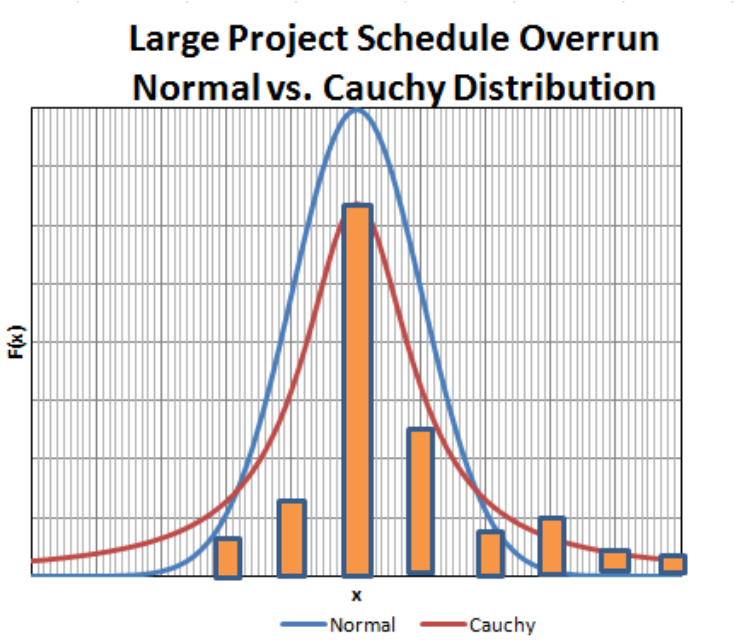
Let's consider these distributions from a slightly different perspective by looking at the cumulative probabilities.

We can see that in order to achieve higher confidence levels (say P90), the Cauchy distribution and its inherent inclusion of the possibility of off normal events would have us include a significantly higher budget amount.



The following figure shows the distribution of project schedule overruns for a sample of large industry projects. Note the better fit of the Cauchy distribution for overruns larger than the mean overrun. The fatter overrun tail better describes the "failed" project performance we see in large projects.

The stark difference in the views of the two distributions as it relates to improbable events should cause us to reconsider the choice of distributions for select parameters in our overall Monte Carlo risk assessments or, at the very least, confirm the parameters we are modeling actually vary as the normal (or other assumed) distribution would suggest. Said another way, the behavior of large complex projects is neither "normal" nor as well bounded as classical project management theory might lead us to believe.



Probability of the Improbable		
	Normal	**Cauchy**
5 sigma event	1 in 3.5 million	1 in 16
10 sigma event	1 in 1.3 x 10^{23}	1 in 32
20 sigma event	1 in 3.6 x 10^{88}	1 in 63
30 sigma event	1 in 2.0 x 10^{197}	1 in 94

About the Author

Bob Prieto has been an NAC member since 2011. Bob is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries.