The Edge of Doom Distribution

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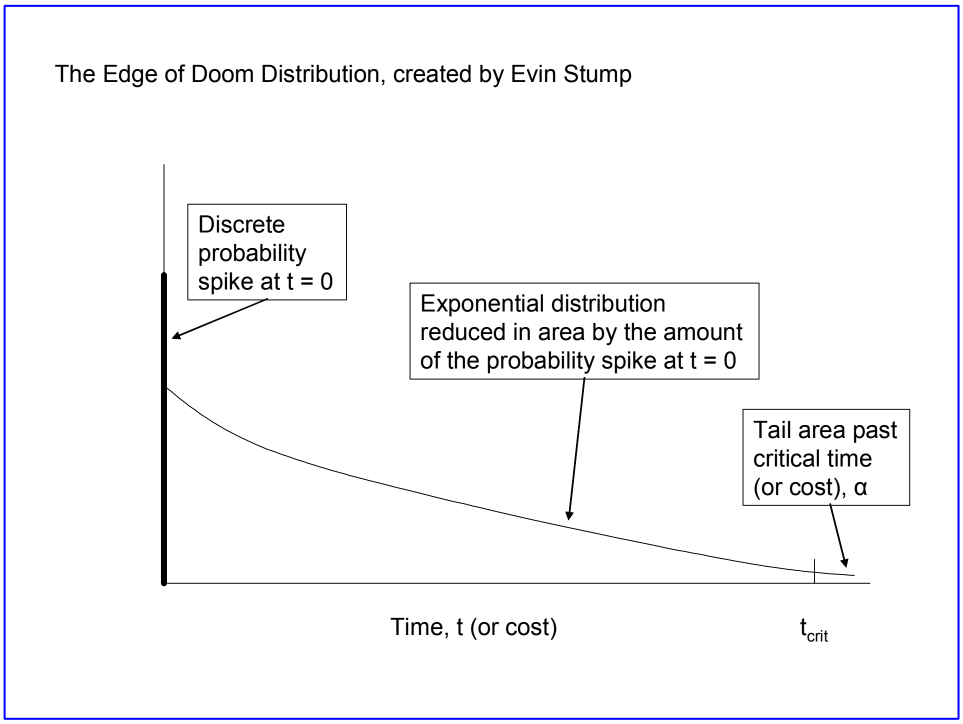
Many distributions have been proposed for use in Monte Carlo simulation of project cost or duration risks. To that fascinating and not always coherent collection, I hereby add one that I believe has obvious merit. I call it the "edge of doom" distribution. Here is a picture of it:



The distribution has the shape of an exponential distribution, but is reduced in area by the amount of a discrete probability spoke occurring at t = 0. Also, a time (or cost) point is arbitrarily set on the t axis, identified as t_{crit}. Let P = the probability of the spike. The probability lying under the exponential distribution out to infinity is therefore 1 – P. The area under the exponential curve between t = 0 and t = t_{crit} is therefore 1 – P – α. The exponential distribution has the general form:

$$f(t) = a\exp(-bt)$$

It can be shown that:

$$b = -\left(\frac{1}{t_{crit}}\right)\ln\left(\frac{\alpha}{1-P}\right)$$

Also:

$$a = b(1-P)$$

Note that what the distribution actually portrays is overruns. P is the probability of no overrun. 1 – P is the probability of some amount of overrun. Spreading 1 – P according to the exponential distribution is a way of saying that a small overrun is more likely than a large one, but there is really no upper bound to possible overruns. The time t_{crit} is set such that the probability of exceeding it is small.

Here is an example of the application of this distribution. Suppose that you have a task to be performed. As a part of the evaluation of the risk to the program which includes your task, you are asked the following questions:

- From the time you have everything you need to perform this task, how much time do you need to do the task? Establish this estimate such that you have a 50% chance of meeting the schedule.
- If you should overrun this estimate, what is the maximum additional time you will need to complete the job? Set this time so you have a 95% chance of making it.

The first question establishes P = 0.5, i.e., you have a 50% chance of no overrun. You also have a 50% chance of an overrun of some size. The second question establishes t_{crit}. Note that t_{crit} is measured from the time of nominal completion. It also establishes α = 0.05.

We can also postulate a t_{nom}, namely the nominal time at which you expect to complete. We can write:

$$b = -\left(\frac{1}{t_{crit}}\right)\ln\left(\frac{0.05}{0.5}\right) = \frac{2.3}{t_{crit}}$$

$$a = \frac{1.15}{t_{crit}}$$

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In Monte Carlo simulation, for P = 0.5, we draw a U(0, 1) random number, R. If $R \leq 0.5$, then $t = t_{nom}$. Otherwise:

$$t = t_{nom} + (-1/b)\ln(1-2R)$$

I believe that two things recommend the EOD distribution. One is that it emphasizes commitment to a certain estimate, namely the estimate with probability P. It is a motivator, while the three point method of estimating a distribution is not. The other is that it is easy to simulate.

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