Safety Corner

How to Apply Probability Distributions in Risk Analysis?

We often apply probability distributions in risk analyses to model the probability of stochastic processes in terms of special analytical forms of probability density functions and cumulative density functions. Several common probability distributions are often used: Binomial Distribution, Geometric Distribution, Poisson Distribution, Weibull Distribution, etc. Each of these distributions has its own dedicated use, and their application should be selected carefully.

Binomial Distribution is used to model events that have two possible outcomes. Suppose we use a discrete random variable *Y* to describe a *Bernoulli* process, e.g., success or failure of "*n*" independent trials, with probability of p (for success) and 1-p (for failure).

We let *X* be the discrete random variable describing the number of success out of the *n* trials. The sequence with which the successes appear does not matter, and *X* would then comprises all discrete values from 0 (nil success from *n* trails) to *n* (all *n* trials come out with X is the result). The random variable *X* is then related to the random variable Y_i, *I* = 1, 2, *…, n, describing the individual Bernoulli trials as* $X = \sum Y_i$

The distribution of *X* is called Binomial with a probability mass function typically registered as *b(k; n, p)*, which gives the probability of obtaining k successes out of n Bernoulli trials when the probability of success in the individual trail is *p*. Then, $b(k; n, p) = {}_nC_k\ p^k (1 - p)^{n-k}$, where k = 1, 2*, …, n.* The expected value (or mean) and variance of the distribution are: $E[X] = np$; and $Var[X] = np(1-p)$

In the upcoming issues of the Safety Corner, we will discuss the common distributions and their applications.

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The Safety Corner is contributed by Ir Dr. Vincent Ho, who can be contacted at vsho.hkarms@gmail.com