**MD-Vol. 94, Proceedings of the ASME Materials Division — 2000**
**Book of Abstracts**
**ASME 2000**



# CAUTIONARY ASPECTS OF APPLIED PROBABILISTICS

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Presented at the
**Symposium on Probabilistic Approaches to Fracture and Fatigue**
ASME Winter Annual Meeting 7 November 2000 Orlando, Florida

***"It ain't what you don't know that gets you in trouble, it's what you know for sure that ain't so."***
***— attributed to Mark Twain***

The idea of probabilistic engineering analysis - replacing fixed values for important parameters with their probability densities - seems almost self-evident. With the arrival of increasingly inexpensive computing capacity the past decade has witnessed a great proliferation of such analysis. Regrettably, however, much of this is unwittingly constructed on untenable statistical premises. Engineers, sure of their subsequent logic, can arrive at grossly erroneous conclusions, not always because their engineering is flawed, but because they relied on statistical assumptions that do not hold in their situation, or overlooked statistical results that do.

Thus, much of the debate among probabilists centers on the comparative performance of algorithms for estimating probability of failure, or alternatively, defining those collective conditions of demand and capacity that produce a given level of risk (probability of structural failure). What is almost universally ignored, or equivalently, accepted as given, are their myriad implicit conditions of validity. In other words, probabilistic analyses are often performed using elegant mathematics, correct in form and execution, but based on dubious suppositions, and thus producing estimates of probability wildly in error. Experience suggests that this is most likely the result of ignorance, rather than inattention - it is difficult to be assiduous concerning details of which one is unaware.

This paper will address some of the unspoken suppositions upon which much probabilistic analysis is based, and sadly, ignored. While the examples are drawn from the aeropropulsion industry, the lessons are universally applicable. For example, a large fraction of probabilistic methods, FORM/ SORM/ AMV, and others, are predicated on the existence of a joint distribution of demand and capacity, bisected by some function, ***g***, into safe and unsafe regions, each being defined by some probability of occurrence. For non-trivial problems this is very seldom a reasonable presumption. But even given that this were an acceptable premise, a further, unspoken and unappreciated, assumption is made, *viz.* that the resulting distribution is multivariate normal. There are many practitioners who would disagree with this statement, not because it is incorrect, but because they believe that it doesn't apply in their case. While these oversights are among the most common, they are not unique. The obvious nature of the errors illustrated in the included examples will likely stretch the reader's credulity. Sadly, all these mistakes are observed in current (2000) practice.