Structural Reliability
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Lecture –47
Common Probability Distributions (Part - 18)

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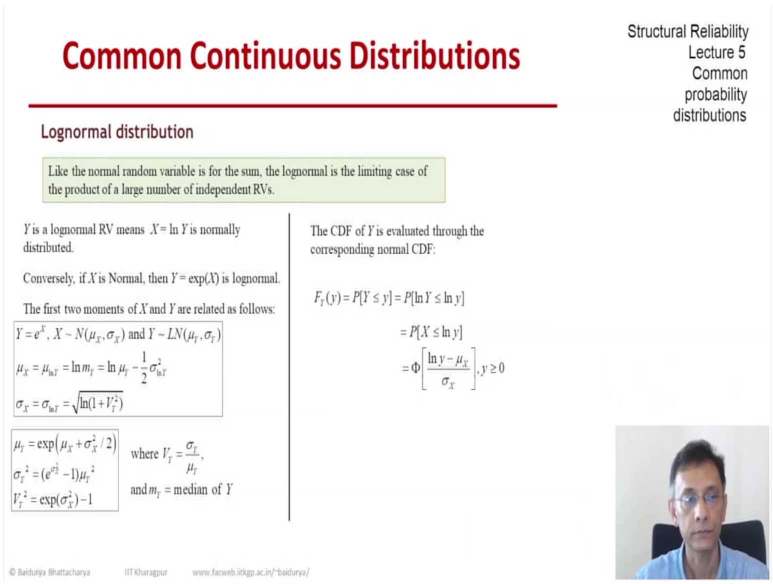

The Lognormal distribution is very popular in structure reliability not only because the log normal is the limiting form of the product of a number of independent random variables just like the normal is the limiting form of the sum. But unlike the normal the Lognormal distribution is defined only for positive values and for quantities like yield strength and compressive strength it is the natural choice.

So, if x is normally distributed exponential of X is lognormal. So, that is how the two are related. And it is useful to be able to relate the moments of one with the other. So, mean of X and sigma of x and mean of Y and sigma of Y or equivalently the COV of Y they are related as you see here and it will be good to remember them when we will solve problems involving the Lognormal distribution.

And that is because the CDF of the Lognormal Y requires the normal distribution function and which in turn requires the mean and sigma of the underlying X. Let us solve the problem and it will be clear.

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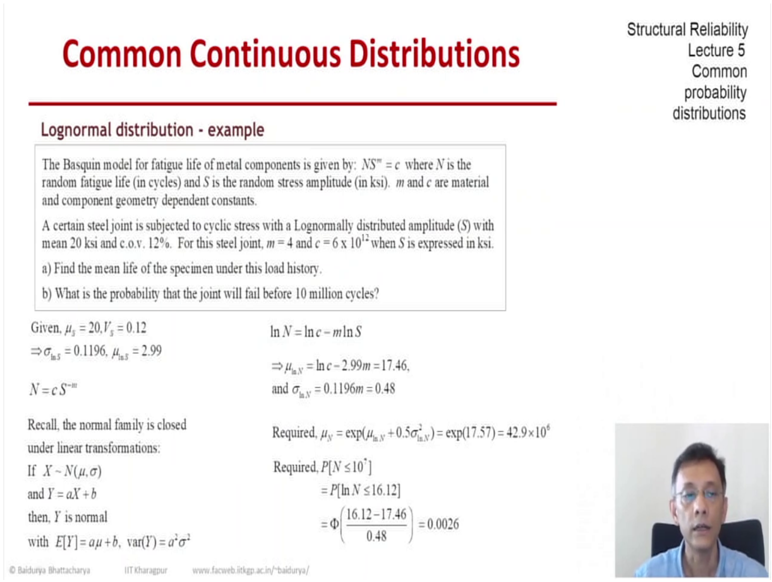

So here we have a fatigue life problem and let us just spend a minute to read it and then we will start solving. So, S is the Lognormal stress amplitude and given its mean and COV we can find the sigma and mu of the underlying log of S and then we can invert the Basquin model and write the random fatigue life the number of cycles n in terms of S and because S is Lognormal it is easy to see that n is Lognormal as well because the normal distribution normal family is closed under linear transformations.

So, if we take log on both sides it becomes clear that log of N is log of c - m time's log of S and c and m are constants. So, we can find the mean and standard deviation of log n in terms of c m and the mean and standard deviation of log S and here are the values. And once we have the mean and standard deviation of log of n we can find the corresponding values for N and that is exactly what we do next.

So, what is required is the mean of n and we can plug in the values and the mean of N is about 43 million cycles. And to answer part b we just go back to the definition of the CDF uh. So, p of N less than or equal to 10 million comes down to the normal CDF evaluated at what you see on the screen and the answer is about 0.0026 that the joint will fail before 10 million cycles.