Structural Reliability
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Lecture –68
Joint Probability Distributions (Part - 19)

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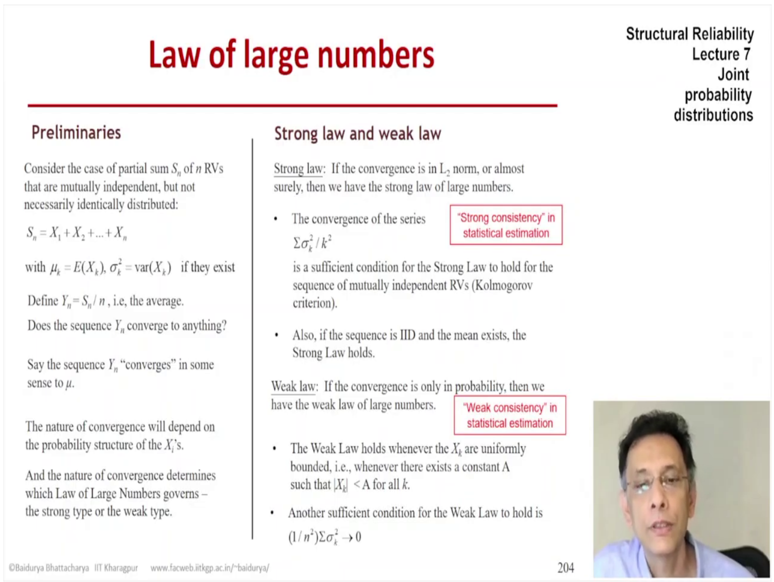

The law of large numbers in the previous slide we gave an example of where a sequence of random variables can naturally occur and give the example of a sequence of sample means with increasing sample size. So, we broke that concept further here consider the partial sum of n such random variables with the means and variances as you see on the screen and then define the average. So, define the sum divided by the number of such terms.

And the question we already posed is does the sequence of these averages converge to anything. And now if the sequence Y n converges to some number mu then the nature of the convergence depends on the probability structure of the individual random variables and that determines in term which law of large numbers governs whether it is the strong law or the weak law. So, the strong law states that if the convergence of that average to that particular number mu is in L 2 norm in mean square or almost surely then we have the strong law of large numbers.

Now there are two very useful sufficient conditions for the strong law the first one is the Kolmogorov Criterion and the second law is that the sequence has to be IID and the means the mean must exist which is the common for all the random variables then the strong law would hold the strong law of large numbers. The weak law is relevant when the convergence is only in probability.

So, which we discussed in the previous slide that it is a much weaker condition of convergence. So, that is the weak law of large numbers and there are also two sufficient conditions for the weak law the first one is that the random variables are uniformly bounded and the second one involves the sum of the variances. Now in statistical estimation theory which we did mention an estimator is said to be consistent if it approaches the true the population value as the sample size grows.

So, mu here would be the population mean now the estimator itself is a random variable obviously because of the sample size being finite. Now in that context of estimation and an estimator being consistent weak consistency implies the convergence is in probability and strong consistency it implies that it is almost sure converges.