Dealing with Materials Data

Professor M P Gururajan
Professor Hina A Gokhale
Department of Metallurgical Engineering and Materials Science
Indian Institute of Technology, Bombay

Lecture 58

Distributions from Statistical Mechanics

So, welcome to Dealing with Materials Data, in this course, we are looking at the analysis, collection and interpretation of data from material science and engineering. And, we have looked at several probability distributions and we are continuing with probability distributions module.

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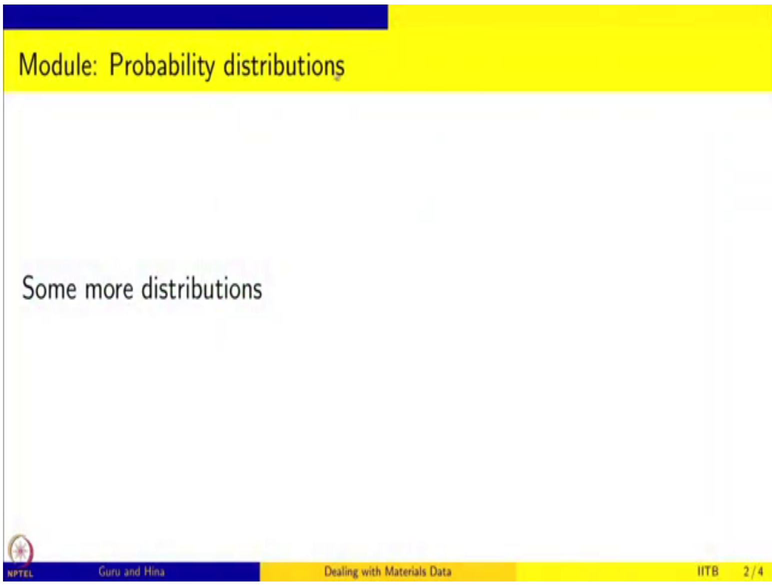

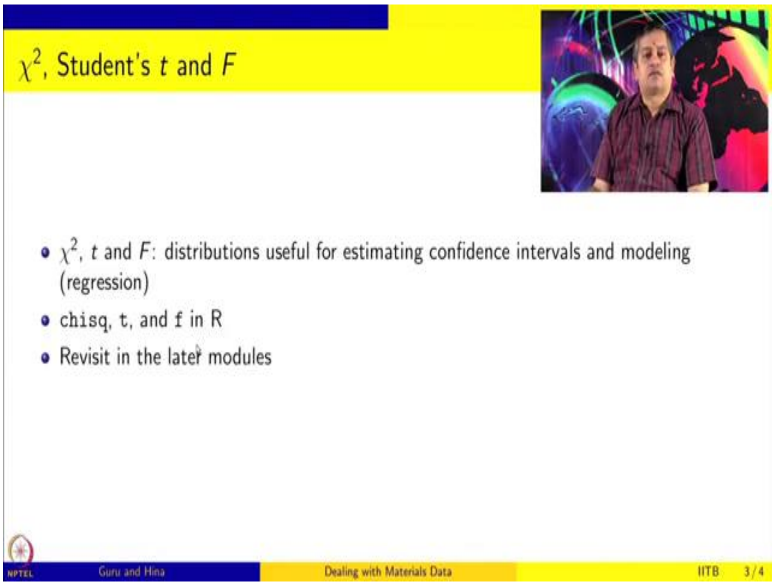

And now, I want to describe a few more distributions which are of importance to us. And one bunch of distributions which are very useful for us is the chi-square, students t and F distributions and they are very useful for estimating confidence intervals and for doing modeling that is for doing regression.

And chi-square, t and f are the commands in R for dealing with these distributions. And, we are not going to do any tutorial with them right away, but when we do the estimation of confidence intervals and the regression and (())(01:14) and things like that, we will come back and look at these distributions and how they are useful in analyzing data in material science and engineering. So, that we are going to do.

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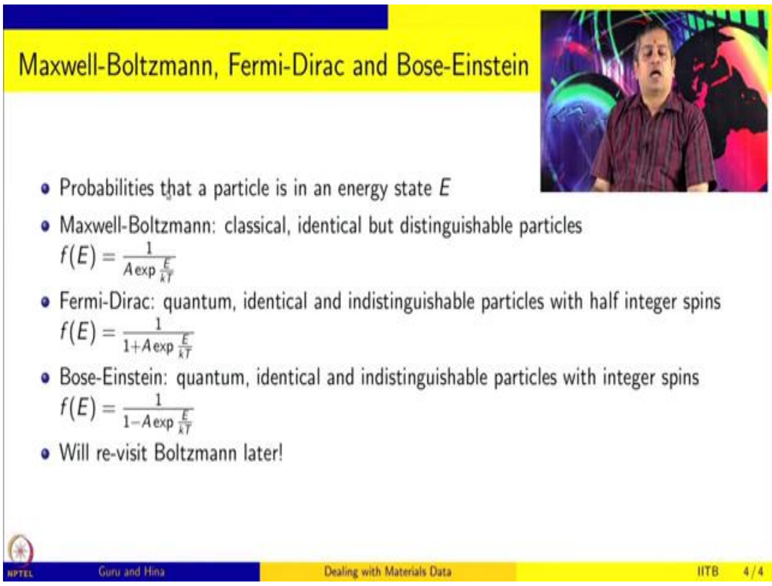

One more class of distributions which are very important and some of you might have heard some of these is the Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distributions. These give probabilities that a particle is in an energy state E. A Maxwell-Boltzmann is a classical statistics and it looks at identical but distinguishable particles.

$$f(E) = \frac{1}{Aexp(\frac{E}{kT})}$$

Fermi-Dirac: quantum, identical and indistinguishable particles with half integer spins

$$f(E) = \frac{1}{1+Aexp(\frac{E}{kT})}$$

And Bose-Einstein is also a quantum distribution and it looks at identical and indistinguishable particles, but the spins are integer spin. So, things like radiation then has to be described using this distribution and the probability distribution function

$$f(E) = \frac{1}{1-Aexp(\frac{E}{kT})}$$

So, it is 1 plus and 1 minus and here there is no one. So, that is the difference and we will come back and look at Boltzmann distribution in this course, in one of the modules to understand some of the simulations that are done and the calculations that are done based on these simulations in statistical thermodynamics and mechanics. So, I am going to stop this session here.

So, we just mentioned a few more distributions. 3 of them are very useful for doing data analysis, hypothesis, testing, regression and things like that. 3 of them are very important in statistical mechanics, classical and quantum statistical mechanics.

So, because they are also probability distributions, so in this session, we have also looked at them. And, we will continue with the probability distribution session, we are almost at the end of this probability distribution module. And, we still have not looked at uniform probability distribution, which can be both discrete and continuous. So, that will be the last probability distribution we will look at before we conclude this session on probability distributions. Thank you.