Recitation Class Topics

Ve401 Probabilistic Methods in Engineering

Spring 2021

Week 2: Elementary Probability

- Ask students to discuss the *Two-Envelope Problem* and its philosophical implications.

  `https://en.wikipedia.org/wiki/Two_envelopes_problem`

- Also, the Banach Matchbox problem is a straightforward application of counting and probability. Don't do anything fancy like using the negative binomial distribution, you can solve it in an elementary way, as done here: `https://math.stackexchange.com/questions/1011354/banach-matchbox-problem`

Week 3: Discrete Random Variables

- Share the following article, *The Application of the Negative Binomial Distribution to Stock Control Problems* by C.J. Taylor:

  `https://www.jstor.org/stable/3007410`

  Introduce the problem discussed in the paper, discuss Assumptions 1 and 2, then derive formula (1) for the probability of obtaining orders for replacement parts. (Ignore the "risk level" discussion!)

  The comment that there are few tables for the negative binomial distribution is historically interesting but not relevant nowadays. It's good to mention it to the students, though, to emphasize the problems people had to deal with not so long ago!

  Also emphasize to the students that the theoretical derivation is only the starting point; the major part of the article also concerns fitting the model to the actual data, which is something that falls into statistics.

Week 4: Continuous and Multivariate Random Variables

- Find by hand the distribution of the square of a uniform distribution on the interval $[0, 1]$. Discuss first with the students what the "square of a uniform distribution" actually means.

- Show by hand that the square of a satndard normal distribution follows a chi-squared (gamma) distribution. Discuss with students: if $\mathrm{E}[X] = 0$, does $\mathrm{E}[X^2] = 0$? Why or why not?

- To illustrate that the correlation coefficient only measures *linear* relationships, consider the following example:

  `https://math.stackexchange.com/questions/1040298/covariance-of-uniform-distributi`

- To illustrate that uncorrelated does not mean independent, consider the following example:

  `https://en.wikipedia.org/wiki/Normally_distributed_and_uncorrelated_does_not_imply_independent#A_symmetric_example`