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The joint distribution of the sum and maximum of exponential random variables with applications to biology

We consider the joint distribution of the maximum Y and sum X of n iid exponential random variables. We present the exact joint distribution of the vector (X, Y) together with its marginals and conditionals. Further, we extend our result to stochastic number of terms, and present the exact joint distribution of the random vector (N, X, Y), when N has a geometric distribution. Then, X is the random sum and Y is the random maximum of N iid exponential random variables. We illustrate the modeling potential of these distributions using applications in biology.