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Problem 5: LLMS estimation with random sums

(4/4 points)

Let N be a geometric r.v. with mean $1/p$; let $A_1, A_2, \ldots$ be a sequence of i.i.d. random variables, all independent of N, with mean 1 and variance 1; let $B_1, B_2, \ldots$ be another sequence of i.i.d. random variable, all independent of N and of $A_1, A_2, \ldots$, also with mean 1 and variance 1. Let $A = \sum_{i=1}^{N} A_i$ and $B = \sum_{i=1}^{N} B_i$.

1. Find the following expectations using the law of iterated expectations. Express each answer in terms of p using standard notation .

$\mathbf{E}[AB] =$ (2-p)/p^2 ✔

$\mathbf{E}[NA] =$ (2-p)/p^2 ✔

2. Let $\hat{N} = c_1 A + c_2$ be the LLMS estimator of N given A. Find c_1 and c_2 in terms of p.

$c_1 =$ 1-p ✔

$c_2 =$ 1 ✔

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