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Exam 2

Justify your answers!

Numerical expressions may be left unsimplified.

1. [10 pt.s] Suppose that X is a R.V. with the uniform distribution on $\{0, 1, 2, \ldots, 10\}$. Once the value of X is known, 20 independent Bernoulli trials are performed, each with probability of success $X/10$. Let Y be the total number of successes in the Bernoulli trials.

   (a) Find $\mathrm{E}(Y|X)$ in terms of X.

   (b) Find $\mathrm{E}(Y)$.

2. [10 pt.s] Suppose that X and Y are independent R.V.s with

$$\begin{aligned} \mathrm{E}(X) &= 1 & \mathrm{E}(Y) &= 2 \\ \mathrm{Var}(X) &= 1 & \mathrm{Var}(Y) &= 4. \end{aligned}$$

   (a) Find $\mathrm{E}(2X - 3Y)$.

   (b) Find $\mathrm{Var}(2X - 3Y)$.

3. [10 pt.s] The Keebler elves are baking chocolate chip cookies and need to ensure the uncommon goodness of each bag they sell. How many chocolate chips must there be on average in each cookie if no more than 0.1% of cookies are to have no chips at all? Assume the number of chips in each cookie are i.i.d. Poisson R.V.s with fixed parameter μ; you must find μ.

4. [10 pt.s] Eight fair dice are rolled. Let X be the number of results which do *not* appear on any of the ~~ten~~ dice. For example, if the ~~ten~~ dice show 3, 1, 6, 1, 2, 3, 1, 6, then $X = 2$. Find $\mathrm{E}(X)$. 4, 5

   Hint: This is similar to the elevator problem from the hw.

5. [10 pt.s] Let X be the number of hours that a light bulb works before burning out; note that X is nonegative. Estimate $\mathrm{P}(X \geqslant 1,200)$ under the following assumptions.

   (a) $E(X) = 1,000$ (upper estimate)

   (b) $E(X) = 1,000$ and $\mathrm{Var}(X) = 10^4$ (upper estimate)

   (c) $E(X) = 1,000$, $\mathrm{Var}(X) = 10^4$, and the distribution is approximately symmetric about the mean (upper estimate).

   (d) X is approximately normal.