

IC252 Lab 4

March 14, 2020

1. **Independence and conditional probability.** Let $X1$ and $X2$ be independent random variables, taking values from the set $\{0, 1\}$, such that both outcomes are equally likely. Define $Z = X1 + X2$. Note that Z can take values $\{0, 1, 2\}$. Do the following.
 - Demonstrate by counting, that the $X1$ and $X2$ are independent. Generate $X1$ and $X2$ a large number of times (call this N). Count the number of times $X1$ takes the value 1, $X2$ takes the value 1, and the number of times both $X1$ and $X2$ take the value 1. This should be approximately equal. Compute the probability by hand and compare with the result of the simulation. $X1$ and $X2$ can be stored in two arrays.
 - Now generate Z , using the already computed values of $X1$ and $X2$. Is Z independent of $X1$? Determine using counting, and by hand.
 - Now condition $X1$ and $X2$ on $Z = 1$. Is $X1$ conditioned on Z , independent of $X2$ conditioned on Z ? In other words, is $P(X1 = 1, X2 = 1|Z = 1) = P(X1 = 1|Z = 1)P(X2 = 1|Z = 1)$? Demonstrate by counting and calculate by hand.
2. Simulate the number of heads obtained in N independent throws of a coin with $p(H) = p$. Accept N and p from the user. Run the experiment 10,000 times and plot the histograms of the number of heads obtained, for various values of N and p . Each N, p will need a separate histogram.
3. Count the number of times a message needs to be transmitted until it reaches correctly at the destination. The probability for a successful transmission is p . Repeat the experiment 10,000 times and plot the histograms of the count for various values of p . Each p will need a separate histogram.
Hint: Generate a random bit b with $P(b = 1) = p$. Keep adding to the count until you generate a 1. A successful transmission at the 4th try (ie. count = 4) corresponds to the binary string 0001.
4. The other questions are on CodeRunner. Please access them here: [Link](#)
The submission will open on 18 March 2 pm and close on 20 March 5 pm. See the document Tips for using CodeRunner for correct usage (uploaded on ExamMoodle.)