**Q.1.** A chicken lays n eggs. Each egg independently does or doesn’t hatch, with probability p of hatching. For each egg that hatches, the chick does or doesn’t survive (independently of the other eggs), with probability s of survival. Let N ⇠ Bin(n, p) be the number of eggs which hatch, X be the number of chicks which survive, and Y be the number of chicks which hatch but don’t survive (so X + Y = N). Find the marginal PMF of X, and the joint PMF of X and Y . Are they independent?

**Solution :**

Marginally we have X ~ Bin(n, ps) (the eggs can be thought of as independent Bernoulli trials with probability ps of success for each) Here X and Y are not independent. Because if X = n, then clearly Y = 0. So they are not independent: P(Y = 0) < 1, while P(Y = 0|X = n) = 1

