Quiz #1

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1 Question 1

Assuming the joint p.m.f below, are X_1 and X_2 independent? Justify your answer

	0	1	Total
0	0.45	0.1	0.55
1	0.25	0.2	0.45
Total	0.7	0.3	1

By Bayes Rule, if X_1 and X_2 are independent, then

$$f(X_1|X_2) = \frac{f(X_1, X_2)}{f_{X_2}(X_2)} = \frac{f_{X_1}(X_1)f_{X_2}(X_2)}{f_{X_2}(X_2)} = f_{X_1}(X_1)$$

$$\begin{aligned} P(X_1 = 0) &= 0.7 \\ P(X_2 = 0) &= 0.55 \\ P(X_1 = 0, X_2 = 0) &= 0.45 \\ \frac{0.45}{0.55} &= 0.8182 \neq 0.7 \end{aligned} \tag{1}$$

Thus X_1 and X_2 are dependent.

2 Question 2

To test a new pesticide, experimenters will spray a field and record the number of moths caught in a trap placed in the center of the field for a week after spraying as the outcome variable of the study.

2.1 a

> What is the appropriate parametric family of distributions for the outcome variable? Justify your answer

The appropriate distribution to represent the outcome variable is the **Binomial** distribution. The statistic of interest is the number of moths caught in the trap which can be modeled as a number of *successes* which is best modeled by the Binomial Distribution.

2.2 b

> The parameter of interest is the mean number of moths. What is an appropriate parametric family of distributions for this parameter? Justify your answer.

With repeated sampling of the number of moths caught in the trap, a **Normal** distribution could be used to estimate the mean number of moths since the sampling distribution converges to a Normal distribution per the Central Limit Theorem.

3 Question 3

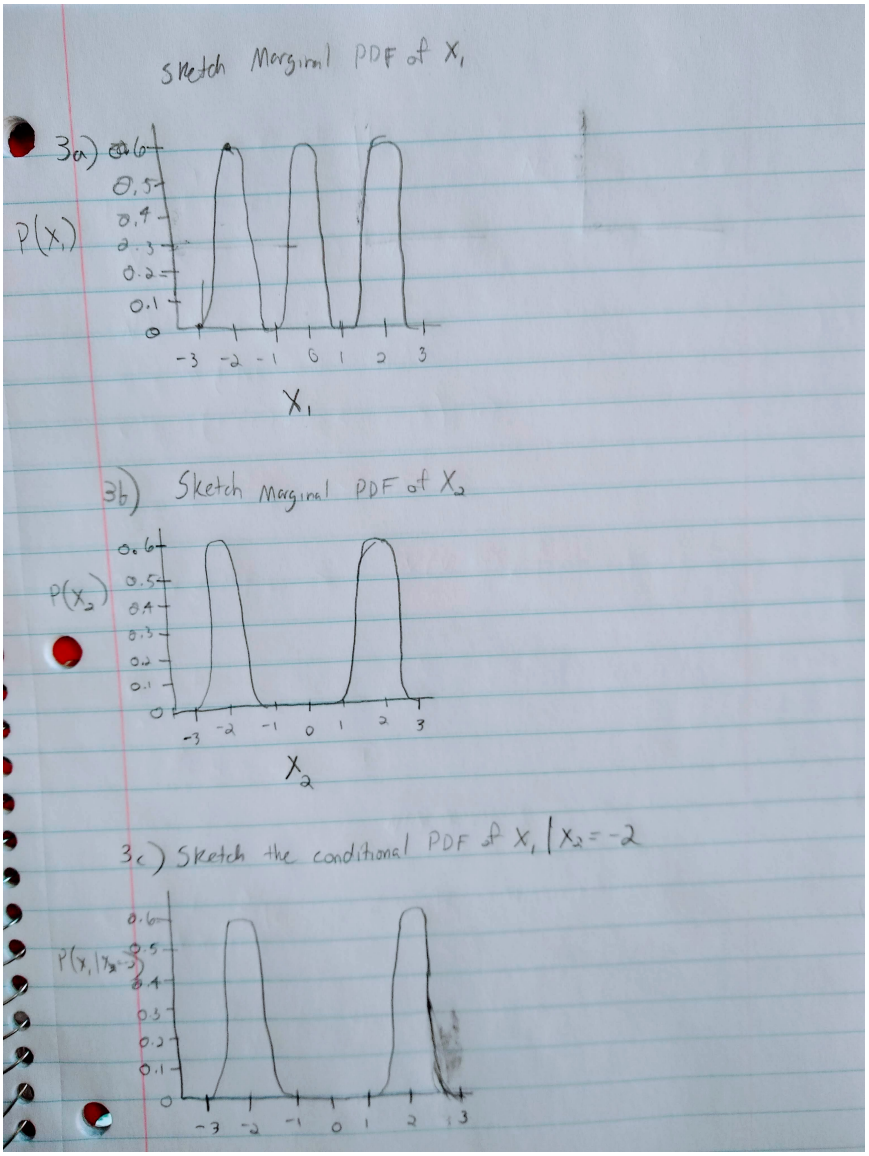

Figure 1: Problem 3