

*Please write* ***Your name:*** \_\_\_\_\_

**Show all work.** You should either write at a sentence explaining your reasoning, or annotate your math work with brief explanations. There is no need to simplify, and no calculators are needed.

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Consider random variables  $X$  and  $Y$  given by the joint density

$$f(x, y) = \begin{cases} x + y & \text{if } 0 \leq x \leq 1 \text{ and } 0 \leq y \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

Find  $\text{Cov}(X, Y)$

In the same situation, find  $\mathbb{E}(X|Y)$ .

[(*optional question for extra credit*)]: If  $Z_1, Z_2$  are independent standard normal random variables, and  $X = 3Z_1 + 4Z_2$ ,  $Y = 3Z_1 - 4Z_2$ , find  $\rho(X, Y)$ . Do not use any integrals or derivatives.