Flip two coins

- Let's say we have two coins X and Y with

$$\mathbb{P}(X = 1) = \mathbb{P}(X = 0) = 1/2, \qquad \mathbb{P}(Y = 1) = \mathbb{P}(Y = 0) = 1/2.$$

- If they are independent, then

$$\mathbb{P}(X = 1 \wedge Y = 1) = \mathbb{P}(X = 1)\mathbb{P}(Y = 1) = \frac{1}{4}.$$

- But in general, we can have anything in the range

$$0 \leq \mathbb{P}(X = 1 \wedge Y = 1) \leq 1/2.$$

Question

Where does the upper bound come from?