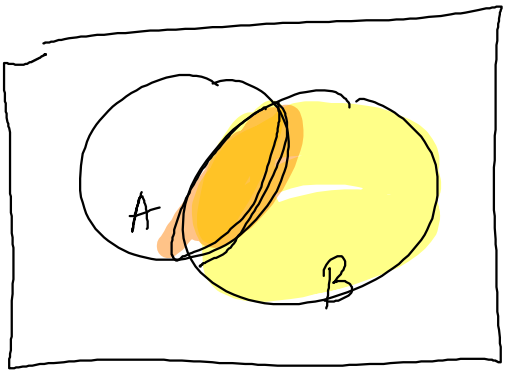
$$cov(X,X) = var(X) \neq 1$$

$cov(X,X) =$ $\frac{cov(X,X)}{SD(X) \cdot SD(X)} = 1$ b/c

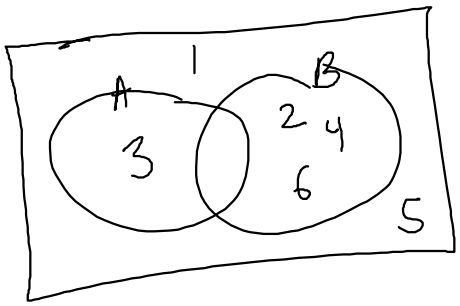
$\rightarrow \frac{var(X)}{var(X)}$

$$Pr[A|B] = \frac{Pr[A \cap B]}{Pr[B]}$$

$Pr[B] > 0$



$Pr[\underset{A}{\text{roll a 3}} \mid \underset{B}{\text{die is even}}] = \frac{0}{3/6} = 0$



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ex)

x	0	1	2	3	4
$Pr(X=x)$	.05	.15	.5	.2	.1

$$Pr[X \geq 2 \mid X \leq 3] = \frac{Pr[x=2 \text{ or } 3]}{Pr[X \leq 3]}$$

$$= \frac{.5+.2}{.9} = \frac{7}{9}$$

FACT $\Pr[A|B] \neq \Pr[B|A]$

(except for some specific examples.)

roll of die

$\Pr[X=2 \mid X \text{ is even}] = 1/3$

$\Pr[X \text{ is even} \mid X=2] = 1$

Suppose in the population 1 out of 5000 have a particular mutation on chrm 21.

We have a saliva test if the mutation is present, → the test is positive 92% of the time.

True positive rate

If mutation is not then the test is pos. 6% of the time.

False pos rate.

$Pr(M) = \frac{1}{5000}$

$Pr(Pos \mid M) = .92$

$Pr(Pos \mid not M) = .06$

Question: If a person takes the test and gets pos what is the probability they have the mutation?

$$Pr(M \mid Pos)$$

$$= \frac{Pr(M \cap Pos)}{Pr(Pos)} = \frac{Pr(M) \cdot P(Pos \mid M)}{Pr(M \cap Pos) + Pr(not M \cap Pos)}$$

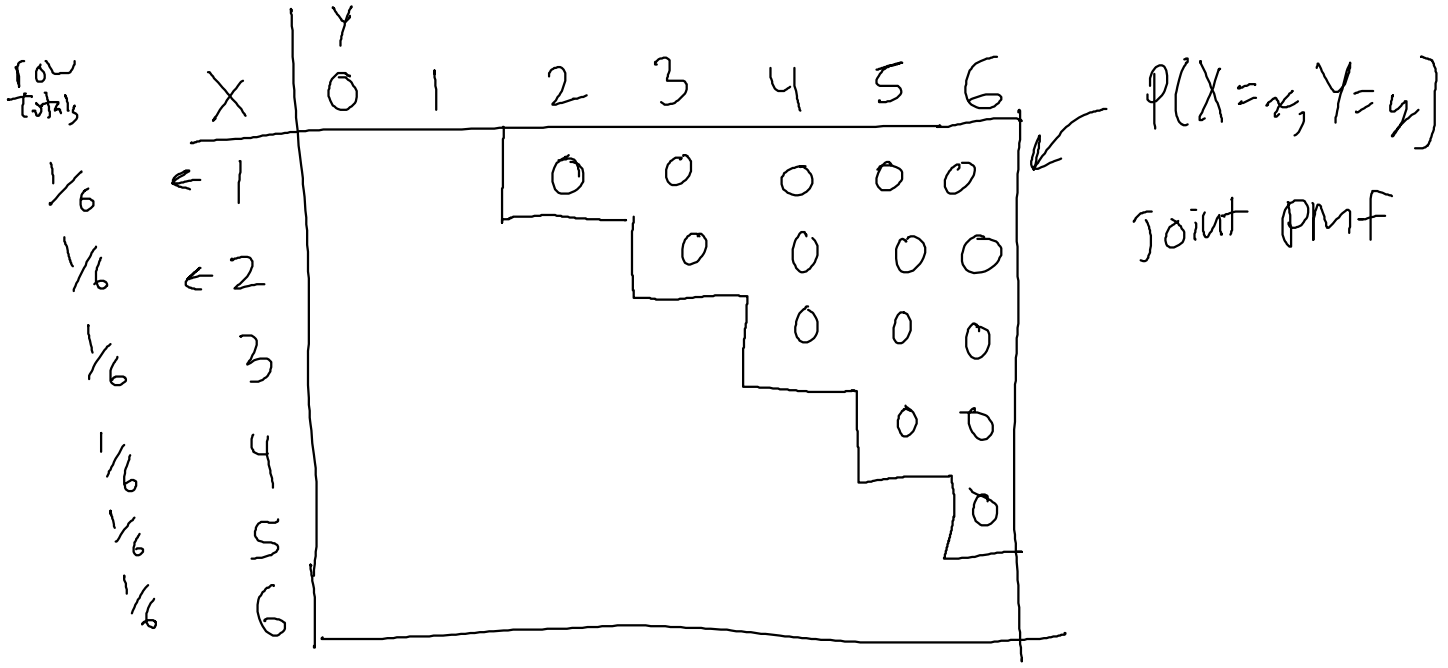
★ we need to expand these.

$$= \frac{Pr(M) \cdot P(Pos \mid M)}{Pr(M) \cdot Pr(Pos \mid M) + Pr(not M) \cdot Pr(Pos \mid not M)}$$

$$= \frac{\left(\frac{1}{5000}\right)(.92)}{\left(\frac{1}{5000}\right)(.92) + \left(\frac{4999}{5000}\right)(.06)} \approx .003$$

In General

$$Pr[A \mid B] = \frac{Pr(A) Pr(B \mid A)}{Pr(A) Pr(B \mid A) + Pr(A') \cdot Pr(B \mid A')}$$ ★


Y
row totals
X
0 1 2 3 4 5 6
1/6 ← 1
1/6 ← 2
1/6 3
1/6 4
1/6 5
1/6 6
0 0 0 0 0
0 0 0 0
0 0 0
0 0
0
P(X=x, Y=y)
joint PMF