Discussion dude: SL405, desk is at the end

"Ω" is the total sample space
$P(A \cap B) = P(A) * P(B)$
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
X^c "compliment", what is in sample space but NOT in X
Bayes rule: $P(A|B) = \frac{P(A \cap B)}{P(B)}$
2 caes:
1. $P(A \cap B) = 0$
2. A and B are indep, $P(A \cap B) = P(A) * P(B)$
3.

Discussion:
- Toss a coin 2 times, size of sample space = 4
- Toss a die 5 times, size of sample space = 6^5

Prove that $P(D^C \cap E^C) = P(D^C) * P(E^C)$, note:
$P(D^C \cap E^C) = P(D \cup E)^C$ <- De Morgan

$P(D \cup E)^C = 1 - P(D \cup E) = 1 - (P(D) + P(E) - P(D \cap E))$
$= 1 - P(D) - P(E) + P(D \cap E)$
$= 1 - P(D) - P(E) + P(D) * P(E)$
$= 1 - P(D) - P(E)(1 - P(D))$
$= 1(1 - P(D)) - P(E)(1 - P(D))$
$= (1 - P(E))(1 - P(D))$

A random variable has $P(X = x) = x/15$ for x = 1,2,3,4,5, and 0 otherwise. Find the mean and variance of X.
- PMF = $P(X = x)$
- Mean = $E(X)$
- Variance = $Var(X)$

$E(X) = \sum_x xp(X = x)$
$= p(X = 1) + 2p(X = 2) + 3p(X = 3) + 4p(X = 4) + 5p(X = 5)$
$= 1/15 + 4/15 + 9/15 + 16/15 + 25/15$
$= 55/15 = 3.67$

$Var(X) = E(X^2) - (E(X))^2$
$= E(X^2) = \sum_x x^2 p(X = x)$
$= 1/15 + 4 * 2/15 + 9 * 3/15 + 16 * 4/15 + 25 * 5/15$
$= 225/15 = 15$

Suppose we roll 3 tetrahedral dice (4-side) with 1,2,3,4 on the sides. Find the probability distribution of the sum of the 3 of them.
- Sample space size = 64

=x	4	4	4	64	64	64	64	4	4	4

A we have 2 green balls, 3 red balls. 2 balls will be drawn WITHOUT replacement
a. Find the probability of:
A=green first time, Ans: 2/5
B=green 2nd time, Ans: 1.4/4 = 35%

RR = ⅗ * ¾ = 6 / 20
RG = ⅗ * 2/4 = 6 / 20
GR=⅖ * ¾ = 6 / 20
GG=⅖ * ¼ = 2 / 20
GR + GG = 8 / 20 = 2 / 5 = green first time
b. Are they independent:
No

HW problem #3: M = Men, F = women. E^C = Unemployment.
a. Selecting random worker, what are the probabilities of M and F
P(M)=60%, P(F)=40%
$P(E^C|M) = 0.051, P(E^C|F) = 0.043$
b. What is the overal rate of unemployment
$P(E^C) = P(M) * P(F) + P(E) * P(E^C|F)$
$= (0.6 * 0.051) + (0.4 * 0.$ <- TODO 2026-2-4

Independent (VERY IMPORTANT) probabilities
$A = 0.9, B = 0.89, C = 0.75$, calculate P_N with $N = 0, 1, 2, 3$
- $P_3 = ABC = 0.60075$
- $P_2 = AB + AC + BC - 3ABC = 0.34125$ (cube geometry method)
- $P_1 = (A - (AB + AC - ABC)) + (B - (BA + BC - ABC)) + (C - (CB +$

$= (A - (AB + AC)) + (B - (BA + BC)) + (C - (CB + CA)) + 3ABC$
$= A + B + C - 2(AB + AC + BC) + 3ABC$
$= 0.05525$
- $P_0 = A^C B^C C^C = 0.00275$

Distribution

$P(X = x) = p^x(1 - p)^x$
- Expected value (mean)
- Variance
- Moment generating function

$Ex = \sum_x xP(x = x)$ <- first moment

$var(x) = Ex^2 - (Ex)^2$ <- 2nd moment
CAsE is important
$Ex = (something\ like\ "p"\ or\ "\phi"\ idk)$ Fuck this what?

Moment generating function (MGF) $E(e^{lx}) = \sum_x e^{lx} P(X = x)$

Geometric distribution:
Keep trying until **first** success.
Binomial = fixed number of trials

Normal distribution:
Notation: $X \sim N(\mu, \sigma^2)$, μ = mean, $\sigma^2 =$ variance
Standard normal dist.: $\mu = 0, \sigma^2 = 1$
PDF: $f(x)$, Probability density function, when integrated over all reals = 1
CDF: $F(x)$, Cumulative density function
$\frac{d}{df} F_x(x) = f_x(x)$

PDF of $N(\mu, \sigma^2)$: $f_x(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$, $- \infty < x < \infty$

$e^{-x^2/2}$, $u = - x^2/2,\ du = - x$