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$\psi(x)$: un-normalized "probability"

$\psi_0 = \int_a^b \psi(x)\,dx$ — normalization factor

Binomial Distribution Functions

Requirements: ① composite events (e.g., a series of coin flips)
② each elementary event (e.g., each coin flip) is an IE. and it has only 2 possible outcomes.
③ CE events.

ex: 3 coin flips.
each coin: ● ○
so ○○○, ●○○, ...

let $N \equiv$ total # of trial.
$m \equiv$ get ●
$\therefore N-m \equiv$ get ○

$$\boxed{P(m,N) = p^m (1-p)^{N-m} \frac{N!}{m!(N-m)!}}$$ binomial distribution

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$$\sum_{m=0}^{N} P(m,N) = (1-p)^N + Np(1-p)^{N-1} + \frac{N(N-1)}{2}p^2(1-p)^{N-2} + \cdots$$

$$+ Np^{(N-1)}(1-p) + p^N = (p+1-p)^N = 1$$

$\Rightarrow$ binomial is nomalized

$\frac{N!}{m!(N-m)!}$: binomial coefficient

↓ shown in Pascal triangle.

$N=0 \leftarrow$ 1

$N=1 \leftarrow$ 1 1

$N=2 \leftarrow$ 1 2 1

...... 1 3 3 1

1 4 6 4 1

1 5 10 10 5 1

......

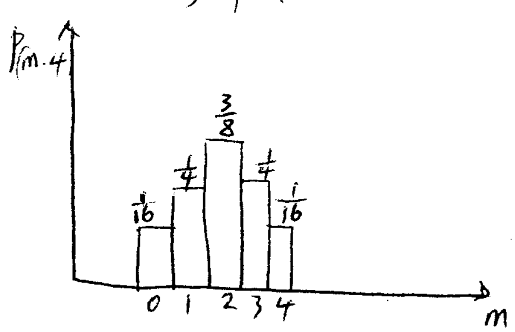
ex $N=4$.

$$\sum_{m=0}^{4} P(m,4) = [p+(1-p)]^4$$

$$= 1\cdot p^4(1-p)^0 + 4p^3(1-p)^1 + 6\cdot p^2(1-p)^2 + 4p(1-p)^3$$

$$+ 1\cdot p^0(1-p)^4$$

For 4 coin flips:



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Multiple outcomes (possible) & IE

Multinomial prob. distribution function:

$$P(m_1, m_2, \ldots m_t, N) = p_1^{m_1} p_2^{m_2} \cdots p_t^{m_t} \frac{N!}{m_1! \, m_2! \cdots m_t!}$$

Average & Variances