

The Binomial Distribution

AP Statistics | Unit 2 | BINS, formula, mean and standard deviation

1. The binomial setting: BINS

Four conditions

Binary: each trial is a success or a failure.

Independent: one trial does not affect another.

Number fixed: the number of trials n is set in advance.

Same probability: p is the same on every trial.

Then X = the number of successes in n trials is a binomial random variable.

2. The binomial formula

A 70% free-throw shooter takes 10 shots. One specific order with 9 makes has probability $0.7^9 \times 0.3$. The miss can be in any of $\binom{10}{9} = 10$ places, so $P(X = 9) = 10 \times 0.7^9 \times 0.3 \approx 0.121$.

$$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

(number of ways) $\times$ (k successes) $\times$ ($n - k$ failures).

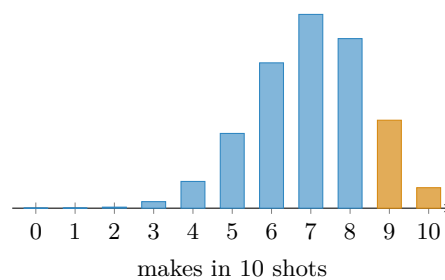
$$P(X \geq 9) = P(X = 9) + P(X = 10) = 0.121 + 0.028 = 0.149.$$

Calculator. `binompdf(n,p,k)` gives $P(X = k)$; `binomcdf(n,p,k)` gives $P(X \leq k)$. So “at least 9” is $1 - \text{binomcdf}(10,0.7,8)$. On the free response also write the distribution and its parameters: *binomial*, $n = 10$, $p = 0.7$.

3. Mean and standard deviation

$$\mu_X = np, \quad \sigma_X = \sqrt{np(1 - p)}.$$

Here $\mu_X = 10(0.7) = 7$ makes and $\sigma_X = \sqrt{10(0.7)(0.3)} \approx 1.45$: in 10 shots the number of makes typically varies by about 1.45 from 7.



Where students lose points

1. Not naming the distribution and its parameters (a calculator command alone earns nothing).
2. `binompdf` when `binomcdf` is needed.
3. “At least 9” computed as $1 - \text{binomcdf}(10,0.7,9)$ (it must be 8).
4. Using the binomial when the number of trials is not fixed.
5. Forgetting the binomial coefficient $\binom{n}{k}$.

Now practise it

Theory sticks once you use it. On **sad-academy.com** you'll find practice questions for this exact subtopic in the AP format, and an AI that grades your free-response answers against the scoring guidelines, the way an AP reader would.

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