

# AP Statistics - Binomial and Geometric Distributions - Answer Key

Common Core AP STAT 4.10, AP STAT 4.11, AP STAT 4.12, HSS-MD.A.3, HSS-CP.B.9 · [maths-pdf.fr/en/](https://maths-pdf.fr/en/)

Each solution states the distribution with its parameters, then shows the formula or calculator command and a rounded answer. Probabilities are rounded to four decimals, which matches calculator output.

**AP Statistics** · Common Core State Standards: **AP STAT 4.10, AP STAT 4.11, AP STAT 4.12, HSS-MD.A.3, HSS-CP.B.9**

## Exercise 1 - Check BINS

(a) Yes. (b) No: the number of trials is not fixed (it is geometric-like, and cards are drawn without replacement). (c) Yes: the sample is far less than 10% of the output. (d) No: the trials are not independent.

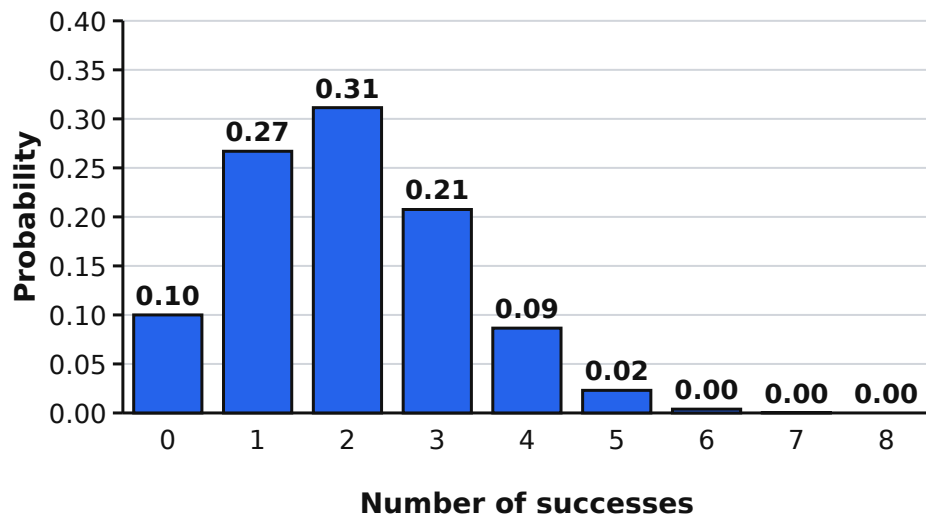
**(a) yes; (b) no; (c) yes; (d) no.**

## Exercise 2 - Binomial formula

$$P(X=3) = \frac{4!}{3!1!}(0.7)^3(0.3)^1 = 4(0.343)(0.3) = 0.4116.$$

**0.4116.**

## Exercise 3 - binompdf



Binomial with  $n = 8$  and  $p = 0.25$ : skewed right, mean 2.

$X$  is binomial with  $n = 8$  and  $p = 0.25$ .

$P(X=2) = \text{binompdf}(8, 0.25, 2) = 0.3115$ .  $P(X=5) = 0.0231$ .

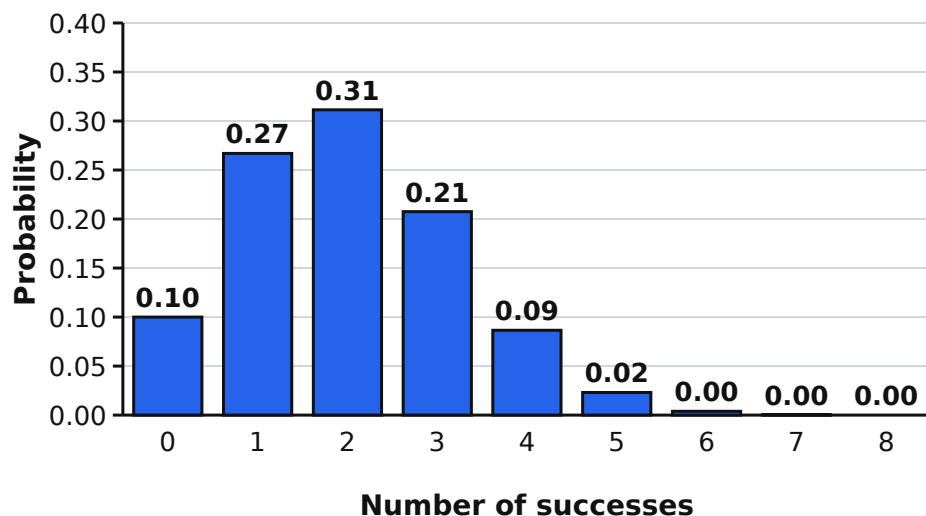
**0.3115 and 0.0231.**

#### Exercise 4 - binomcdf

$P(X \leq 3) = \text{binomcdf}(8, 0.25, 3) = 0.8862$ .

**0.8862.**

#### Exercise 5 - At least



Binomial with  $n = 8$  and  $p = 0.25$ : skewed right, mean 2.

$$P(X \geq 4) = 1 - P(X \leq 3) = 1 - 0.8862 = 0.1138.$$

**0.1138.**

### Exercise 6 - Between

$$P(2 \leq X \leq 4) = P(X \leq 4) - P(X \leq 1) = 0.9727 - 0.3671 = 0.6056.$$

**0.6056.**

### Exercise 7 - Mean and standard deviation

$$\mu = np = 25(0.8) = 20. \quad \sigma = \sqrt{25(0.8)(0.2)} = \sqrt{4} = 2.$$

**Mean 20, standard deviation 2.**

### Exercise 8 - Interpret the mean

The mean is a long-run average.

**Over many sets of 25 attempts, she makes an average of 20 shots per set.**

### Exercise 9 - Shape

With  $p = 0.5$  the distribution is symmetric and mound-shaped, centered at 5.

**Symmetric; with  $p = 0.1$  it is skewed right with its peak at 1.**

### Exercise 10 - Unusual result

$$P(X = 10) = 0.7^{10} = 0.0282.$$

**0.0282, which is less than 5%, so making all ten is unusual.**

### Exercise 11 - 10 percent condition

The sample (4) is more than 10% of the population (30), and the probability changes after each draw.

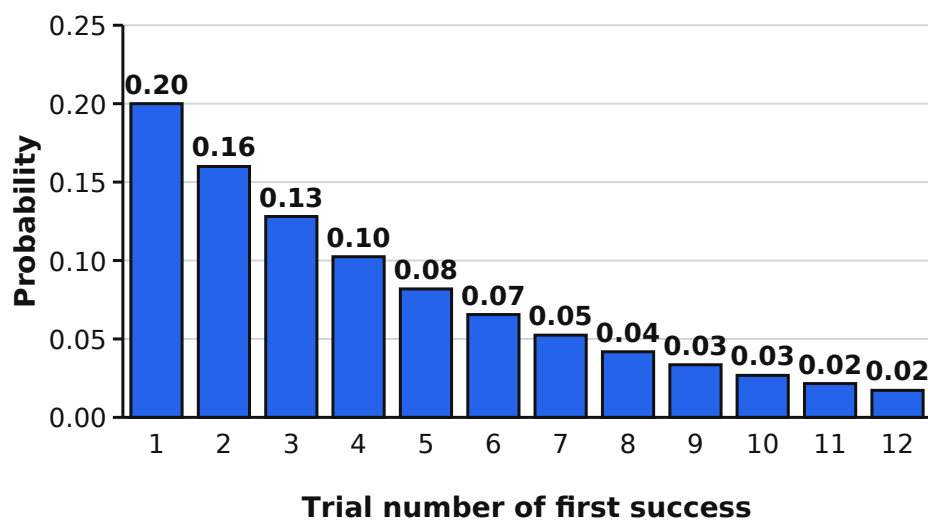
**No: the 10% condition fails (4 is about 13% of 30).**

### Exercise 12 - Geometric setting

(a) Yes. (b) No: fixed number of trials (binomial). (c) No: the probability changes, so trials are not independent.

**(a) geometric; (b) binomial; (c) neither.**

### Exercise 13 - Geometric probability



Geometric with  $p = 0.2$ : always skewed right, with the highest bar at 1.

$$P(X = 4) = (0.8)^3(0.2) = 0.1024.$$

**0.1024.**

### Exercise 14 - More than n trials

More than 5 boxes means the first 5 are failures:  $0.8^5 = 0.3277$ .

**0.3277.**

### Exercise 15 - Geometric cumulative

$$P(X \leq 3) = 1 - 0.8^3 = 1 - 0.512 = 0.488.$$

**0.488.**

### Exercise 16 - Expected trials

$$\mu = \frac{1}{0.125} = 8.$$

**You expect about 8 tests until the first pass; in the long run, it takes an average of 8 trials.**

### Exercise 17 - Geometric sd

$$\sigma = \frac{\sqrt{1-p}}{p} = \frac{\sqrt{0.8}}{0.2} \approx 4.472.$$

**About 4.47 boxes.**

### Exercise 18 - Exactly and at least

$$P(X=0) = 0.95^{20} = 0.3585. \quad P(X \geq 1) = 1 - 0.3585 = 0.6415.$$

**0.3585 and 0.6415.**

### Exercise 19 - Compare binomial and geometric

$$(a) \text{binompdf}(5, 0.6, 3) = 0.3456. \quad (b) 0.4(0.6) = 0.24.$$

**0.3456 and 0.24.**

### Exercise 20 - Multi-step

$$\mu = 12(0.04) = 0.48. \quad \sigma = \sqrt{12(0.04)(0.96)} = 0.679.$$

$$P(X > 2) = 1 - \text{binomcdf}(12, 0.04, 2) = 0.0107.$$

**Mean 0.48; sd 0.679; P = 0.0107.**