A2.S.15: Binomial Probability 7: Know and apply the binomial probability formula to events involving the terms exactly, at least, and at most

1 The members of a men's club have a choice of wearing black or red vests to their club meetings. A study done over a period of many years determined that the percentage of black vests worn is 60%. If there are 10 men at a club meeting on a given night, what is the probability, to the *nearest thousandth*, that *at least* 8 of the vests worn will be black?

2 The probability of rain on the last day of July is 90%. If the probability remains constant for the first seven days of August, what is the probability that it will rain *at least* six of those seven days in August?

3 East West Airlines has a good reputation for being on time. The probability that one of its flights will be on time is .91. If Mrs. Williams flies East West for her next five flights, what is the probability that at least three of them will be on time? Round your answer to the *nearest thousandth*.

4 Because Sam's backyard gets very little sunlight, the probability that a geranium planted there will flower is 0.28. Sam planted five geraniums. Determine the probability, to the *nearest thousandth*, that *at least* four geraniums will flower.

5 Dave is the manager of a construction supply warehouse and notes that 60% of the items purchased are heating items, 25% are electrical items, and 15% are plumbing items. Find the probability that *at least* three out of the next five items purchased are heating items.

6 On any given day, the probability that the entire Watson family eats dinner together is $\frac{2}{5}$. Find the probability that, during any 7-day period, the Watsons eat dinner together *at least* six times.

7 The probability that the Stormville Sluggers will win a baseball game is $\frac{2}{3}$. Determine the probability, to the *nearest thousandth*, that the Stormville Sluggers will win *at least* 6 of their next 8 games.

8 Tim Parker, a star baseball player, hits one home run for every ten times he is at bat. If Parker goes to bat five times during tonight's game, what is the probability that he will hit *at least* four home runs?

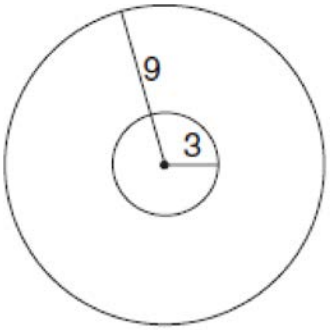
9 On mornings when school is in session in January, Sara notices that her school bus is late one-third of the time. What is the probability that during a 5-day school week in January her bus will be late *at least* three times?

10 The probability that a planted watermelon seed will sprout is $\frac{3}{4}$. If Peyton plants seven seeds from a slice of watermelon, find, to the *nearest ten thousandth*, the probability that *at least* five will sprout.

11 The probability that a professional baseball player will get a hit is $\frac{1}{3}$. Calculate the exact probability that he will get *at least* 3 hits in 5 attempts.

12 A study shows that 35% of the fish caught in a local lake had high levels of mercury. Suppose that 10 fish were caught from this lake. Find, to the *nearest tenth of a percent,* the probability that *at least* 8 of the 10 fish caught did *not* contain high levels of mercury.

13 As shown in the accompanying diagram, a circular target with a radius of 9 inches has a bull's-eye that has a radius of 3 inches. If five arrows randomly hit the target, what is the probability that *at least* four hit the bull's-eye?



14 According to a federal agency, when a lie detector test is given to a truthful person, the probability that the test will show that the person is not telling the truth is 20%. If a company interviews five truthful candidates for a job and asks about thefts from prior employers, what is the probability a lie detector test will show that *at most* one candidate is *not* telling the truth?

15 Whenever Sara rents a movie, the probability that it is a horror movie is 0.57. Of the next five movies she rents, determine the probability, to the *nearest hundredth*, that *no more than* two of these rentals are horror movies.

16 Dave does *not* tell the truth $\frac{3}{4}$ of the time. Find the probability that he will tell the truth *at most* twice out of the next five times.

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Answer Section

1 ANS:
0.167. ${}_{10}C_8 \cdot 0.6^8 \cdot 0.4^2 + {}_{10}C_9 \cdot 0.6^9 \cdot 0.4^1 + {}_{10}C_{10} \cdot 0.6^{10} \cdot 0.4^0 \approx 0.167$

REF: 061036a2
2 ANS:
0.8503056

REF: 060830b
3 ANS:
0.994

REF: 080830b
4 ANS:
${}_5C_4 \cdot 0.28^4 \cdot 0.72^1 + {}_5C_5 \cdot 0.28^5 \cdot 0.72^0 \approx 0.024$

REF: 011437a2
5 ANS:
0.68256

REF: 080928b
6 ANS:
$\frac{1472}{78125}$

REF: 060331b
7 ANS:
0.468. ${}_8C_6\left(\frac{2}{3}\right)^6\left(\frac{1}{3}\right)^2 \approx 0.27313$. ${}_8C_7\left(\frac{2}{3}\right)^7\left(\frac{1}{3}\right)^1 \approx 0.15607$. ${}_8C_8\left(\frac{2}{3}\right)^8\left(\frac{1}{3}\right)^0 \approx 0.03902$.

REF: 011138a2
8 ANS:
0.00046

REF: 080430b
9 ANS:
$\frac{51}{243}$

REF: 080630b

10 ANS:
0.7564

REF: 060529b

11 ANS:

$$\frac{51}{243} \cdot {}_5C_3\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^2 = \frac{40}{243}$$

$${}_5C_4\left(\frac{1}{3}\right)^4\left(\frac{2}{3}\right)^1 = \frac{10}{243}$$

$${}_5C_3\left(\frac{1}{3}\right)^5\left(\frac{2}{3}\right)^0 = \frac{1}{243}$$

REF: 061138a2

12 ANS:
26.2%. ${}_{10}C_8 \cdot 0.65^8 \cdot 0.35^2 + {}_{10}C_9 \cdot 0.65^9 \cdot 0.35^1 + {}_{10}C_{10} \cdot 0.65^{10} \cdot 0.35^0 \approx 0.262$

REF: 081038a2

13 ANS:
$\frac{41}{59049}$

REF: 080128b

14 ANS:
$\frac{2304}{3125}$

REF: 011030b

15 ANS:
${}_5C_0 \cdot 0.57^0 \cdot 0.43^5 + {}_5C_1 \cdot 0.57^1 \cdot 0.43^4 + {}_5C_2 \cdot 0.57^2 \cdot 0.43^3 \approx 0.37$

REF: 061438a2

16 ANS:
$\frac{918}{1024}$

REF: 060930b