

NAME: _____

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

1. 010229b, P.I. A2.S.15

Team *A* and team *B* are playing in a league. They will play each other five times. If the probability that team *A* wins a game is $\frac{1}{3}$, what is the probability that team *A* will win *at least* three of the five games?

2. 060331b, P.I. A2.S.15

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.

3. 080430b, P.I. A2.S.15

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?

4. 060529b, P.I. A2.S.15

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.

5. 080630b, P.I. A2.S.15

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?

6. 060830b, P.I. A2.S.15

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?

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7. 080830b, P.I. A2.S.15

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*.

8. 010731b, P.I. A2.S.15

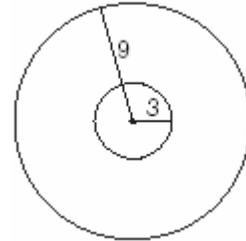
Dr. Glendon, the school physician in charge of giving sports physicals, has compiled his information and has determined that the probability a student will be on a team is 0.39. Yesterday, Dr. Glendon examined five students chosen at random. Find, to the *nearest hundredth*, the probability that *at least* four of the five students will be on a team. Find, to the *nearest hundredth*, the probability that *exactly* one of the five students will *not* be on a team.

9. 080334b, P.I. A2.S.15

When Joe bowls, he can get a strike (knock down all the pins) 60% of the time. How many times more likely is it for Joe to bowl *at least* three strikes out of four tries as it is for him to bowl zero strikes out of four tries? Round your answer to the *nearest whole number*.

10. 080128b, P.I. A2.S.15

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?



11. 060930b, P.I. A2.S.15

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.

12. 010428b, P.I. A2.S.15

A board game has a spinner on a circle that has five equal sectors, numbered 1, 2, 3, 4, and 5, respectively. If a player has four spins, find the probability that the player spins an even number *no more than* two times on those four spins.

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

[4] $\frac{51}{243}$, and appropriate work is shown.

[3] Appropriate work is shown, but one computational error is made.

[2] Appropriate work is shown, but the probabilities for the teams are switched.

or [2] Correct substitution is made, but no further work is shown.

or [2] Correct substitution is made, but an incorrect mathematical operation is used, such as multiplication instead of addition.

or [2] The probability for “at most three” or “more than 3” is found, but appropriate work is shown.

[1] $\frac{40}{243}$, and exactly three games are shown.

or [1] $\frac{51}{243}$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[1] incorrect procedure.

[4] $\frac{1,472}{78,125}$, and appropriate work is shown,

such as ${}_7C_6\left(\frac{2}{5}\right)^6\left(\frac{3}{5}\right)^1 + {}_7C_7\left(\frac{2}{5}\right)^7\left(\frac{3}{5}\right)^0$.

[3] Appropriate work is shown, but one computational error is made.

or [3] The probabilities for exactly six times and exactly seven times are calculated correctly, but they are not added.

or [3] The probability for at most six times is calculated correctly.

[2] Appropriate work is shown, but more than one computational error is made.

or [2] Appropriate work is shown, but one conceptual error is made, such as multiplying the probabilities.

[1] A correct expression is written for finding the probability, but no further correct work is shown.

or [1] The probability for exactly six times is calculated correctly.

or [1] $\frac{1,472}{78,125}$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[2] incorrect procedure.

[4] .00046 or $\frac{46}{100,000}$ or an equivalent

answer, and appropriate work is shown.

[3] Appropriate work is shown, but one computational error is made.

or [3] Appropriate work is shown, but the probability of hitting at most four home runs is found.

[2] Appropriate work is shown, but two or more computational errors are made.

or [2] Appropriate work is shown, but one conceptual error is made.

or [2] The probabilities of hitting exactly four and exactly five home runs are found, but the probabilities are not added.

[1] Appropriate work is shown, but the probability of hitting exactly four home runs is found.

or [1] Correct substitution into the Bernoulli equation for exactly four and exactly five home runs is made, but no further correct work is shown.

or [1] .00046 or $\frac{46}{100,000}$ or an equivalent

answer, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[3] incorrect procedure.

[4] .7564 or an equivalent answer, and appropriate work is shown, such as finding the sum of the exact probabilities that five, six, or seven seeds will sprout.

[3] Appropriate work is shown, but one computational or rounding error is made.

or [3] The probability that at most five seeds will sprout is calculated correctly, and appropriate work is shown.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or [2] Appropriate work is shown, but one conceptual error is made.

or [2] The three exact probabilities are found correctly, but they are not added.

or [2] The sum of only two of the three probabilities is found correctly, such as exactly six plus exactly seven, and appropriate work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or [1] The probability that exactly five seeds will sprout is determined appropriately.

or [1] The substitution for the sum of the three probabilities is indicated, but no further correct work is shown.

or [1] .7564 or an equivalent answer, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[4] incorrect procedure.

- [4] $\frac{51}{243}$ or an equivalent answer, and appropriate work is shown.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- [2] Appropriate work is shown, but two or more computational or rounding errors are made.
- or [2] Appropriate work is shown, but one conceptual error is made, such as finding the probability for *at most* three times.
- [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- or [1] An incorrect expression of a lesser degree of difficulty is evaluated appropriately, such as finding the probability for *exactly* three times.
- or [1] $\frac{51}{243}$ or an equivalent answer, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [5] incorrect procedure.

- [4] .8503056 or an equivalent answer, and appropriate work is shown, such as ${}_7C_6(.9)^6(.1)^1 + {}_7C_7(.9)^7(.1)^0$.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- or [3] The two individual probabilities are calculated correctly, but they are not added.
- [2] Appropriate work is shown, but two or more computational or rounding errors are made.
- or [2] Appropriate work is shown, but one conceptual error is made, such as finding the probability of at most 6 days.
- or [2] The expression ${}_7C_6(.9)^6(.1)^1 + {}_7C_7(.9)^7(.1)^0$ is written, but no further correct work is shown.
- [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- or [1] Appropriate work is shown to find .3720087, the probability of exactly 6 days, but no further correct work is shown.
- or [1] .8503056 or an equivalent answer, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [6] incorrect procedure.

- [4] .994, and appropriate work is shown.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] The probabilities are calculated correctly, but they are not added.
[2] Appropriate work is shown, but two or more computational or rounding errors are made.
or [2] Appropriate work is shown, but one conceptual error is made, such as finding the probability that at most three flights will be on time.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] Appropriate work is shown to find exactly three flights will be on time.
or [1] .994, but no work is shown.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
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- [4] .08 and .07, and appropriate work is shown.
[3] Appropriate work is shown, but one computational or rounding error is made.
or [3] The probability that at least four students will be on a team is found correctly, and appropriate work is shown, but the probability that exactly one student will not be on a team is not found or is found incorrectly.
[2] Appropriate work is shown, but two or more computational or rounding errors are made.
or [2] Appropriate work is shown, but one conceptual error is made, such as finding the probability that at most four or exactly four students will be on the team.
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
or [1] The probability that at least one student will not be on a team is found correctly, and appropriate work is shown, but the probability that at least four students will be on a team is not found.
or [1] .08 and .07, but no work is shown.
[0] .08 or .07, but no work is shown.
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
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[6] 19, and appropriate work is shown, such as $P(\text{at least three}) =$

$${}_4C_3(0.6)^3(0.4) + {}_4C_4(0.6)^4 \text{ and } P(0) = (0.4)^4.$$

[5] Appropriate work is shown, but one computational error is made.

or [5] Correct probabilities are computed, but no answer or an incorrect answer is found.

[4] Appropriate work is shown, but two or more computational errors are made.

or [4] Only the probability for at least three strikes is found correctly, but an appropriate ratio is determined.

[3] The probability for at least three strikes is found correctly, and no further correct work is shown.

or [3] Only the probability for zero strikes is found correctly, but an appropriate ratio is determined.

[2] Only the probability for zero strikes is found correctly, and no further correct work is shown.

or [2] Only the equation for the probability for at least three strikes is written, and it is not solved.

[1] Conceptual errors are made in finding the probabilities, but an appropriate ratio is determined, based on the incorrect probabilities.

or [1] 19, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[9] incorrect procedure.

[4] $\frac{41}{59,049}$, and appropriate work is shown,

$$\text{such as } {}_5C_5\left(\frac{1}{9}\right)^5 + {}_5C_4\left(\frac{1}{9}\right)^4\left(\frac{8}{9}\right)^1.$$

[3] Appropriate work is shown, but one computational error is made.

or [3] The combination includes an incorrect setup for determining the probability of hitting the bull's-eye five times but a correct setup for determining the probability of hitting the bull's-eye four times, but an appropriate probability is found.

[2] The probability of "exactly 4" is found.

or [2] The probability of "at most 3" is found.

[1] A probability of $\frac{1}{9}$ is found, based on the area of the two circles.

or [1] $\frac{41}{59,049}$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[10] incorrect procedure.

[4] $\frac{918}{1024}$ or an equivalent answer, and

appropriate work is shown, such as

$${}_5C_0\left(\frac{1}{4}\right)^0\left(\frac{3}{4}\right)^5 + {}_5C_1\left(\frac{1}{4}\right)^1\left(\frac{3}{4}\right)^4 + {}_5C_2\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3.$$

[3] Appropriate work is shown, but one computational or rounding error is made.

or [3] ${}_5C_0\left(\frac{1}{4}\right)^0\left(\frac{3}{4}\right)^5$, ${}_5C_1\left(\frac{1}{4}\right)^1\left(\frac{3}{4}\right)^4$, and

${}_5C_2\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3$ are evaluated, but the values are not added.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or [2] Appropriate work is shown, but one conceptual error is made, such as finding the probability of "not telling the truth at most twice" or the probability of "telling the truth at least twice."

or [2]

$${}_5C_0\left(\frac{1}{4}\right)^0\left(\frac{3}{4}\right)^5 + {}_5C_1\left(\frac{1}{4}\right)^1\left(\frac{3}{4}\right)^4 + {}_5C_2\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3,$$

but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or [1] Appropriate work is shown to find $\frac{270}{1024}$, the probability of telling the truth

exactly twice out of five times.

or [1] $\frac{918}{1024}$ or an equivalent answer, but no

work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[11] incorrect procedure.

[4] $\frac{513}{625}$ or 0.821 or an equivalent answer,

and appropriate work is shown, such as

$${}_4C_2\left(\frac{2}{5}\right)^2\left(\frac{3}{5}\right)^2 + {}_4C_1\left(\frac{2}{5}\right)^1\left(\frac{3}{5}\right)^3 + {}_4C_0\left(\frac{2}{5}\right)^0\left(\frac{3}{5}\right)^4.$$

[3] Appropriate work is shown, but one computational error is made.

or [3] Appropriate work is shown, but a value for at least two, $\frac{328}{625}$, is found.

[2] Appropriate work is shown, but two or more computational errors are made.

or [2] An appropriate answer is found, but one conceptual error is made, such as multiplying the probabilities or using five as the number of spins.

or [2] Appropriate work is shown, but a value for less than two, $\frac{297}{625}$, is found.

[1] Appropriate work is shown, but a value

for exactly two, $\frac{216}{625}$, is found.

or [1] $\frac{513}{625}$ or 0.821 or an equivalent answer,

but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[12] incorrect procedure.