

Algebra 2 Honors

Binomial Distributions

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Tree Diagrams

can use a tree diagram to analyze binomial probabilities.

#2: A store is giving away scratch-off cards with prizes. A prize will appear on 40% of the cards. Suppose you have three cards. Find the probability that exactly two of the three cards will contain a prize.

$r=2$
 $p=0.4$
 $q=0.6$

3 paths

PPP
PPN
PNP
PNN
NPP
NPN
NNP
NNN

Completely Editable

13.4

Lesson 13.4: Binomial Distributions

BINOMIAL EXPERIMENT – has four important features: **B.I.N.S.**

- ☐ Binary? The possible outcomes of a trial is success or failure.
- ☐ Independent? Trials must be independent of each other.
- ☐ Number? The number of trials, n must be fixed in advance.
- ☐ Success? The probability of success, p on each trial remains constant.

Pascal's Triangle

Pascal's Triangle	Combinations (Binomial Coefficients)	Binomial Expansion
1	${}_0C_0$	$(x + y)^0 = 1$
1 1	${}_1C_0$ ${}_1C_1$	$(x + y)^1 = x + y$
1 2 1	${}_2C_0$ ${}_2C_1$ ${}_2C_2$	$(x + y)^2 = x^2 + xy + y^2$
1 3 3 1	${}_3C_0$ ${}_3C_1$ ${}_3C_2$ ${}_3C_3$	$(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$

BINOMIAL THEOREM

EX #1: Use the Binomial Theorem to expand each binomial.

A. $(x + y)^4$

B. $(2m + n)^3$

C. $(a - 2b)^4$

EX #3: Complete the tree diagram for all prize levels. Verify your work by adding the probabilities. What answer should you get?

A Binomial Experiment

A **binomial experiment** consists of n independent trials whose outcomes are either success or failures; the probability of success p is the same for each trial, and the probability of failure q is the same for each trial. Because there are only two outcomes, $p + q = 1$ or $q = 1 - p$.

EX #4: Complete the table below with the given experiments.

Experiment	Success	Failure	P (success) p	P (failure) $q = 1 - p$
10 coin flips	Heads	Tails		
100 rolls of a single die	Roll a 4	Roll any other number		

Binomial Probability on the Calculator

Two helpful commands on the TI-83/84 or TI-Nspire for finding binomial probabilities are binompdf and binomcdf.

2nd

VAR



A or B

1. Use binompdf to find $P(r) = k$

SYNTAX: binompdf (n, p, r)

2. Use binomcdf to find $P(r) \leq k$

SYNTAX: binomcdf (n, p, r)

3. Use the complement rule to find $P(r) \geq k$

$1 - \text{binomcdf} (n, p, r)$

EX #6: A study shows that 45% of the families in a community watch television during dinner. Suppose you select 10 families at random from the population. Find each probability.

A. P (6 families watch TV during dinner)



Finding Binomial Probabilities

EX #7: A calculator contains four batteries. With normal use, each battery has a 95% chance of lasting for one year. What is the probability that all four batteries will last for a full year?

$$P(r) = {}_nC_r \cdot p^r \cdot q^{n-r}$$

1. Find n, r, p, q

2. Find $P(r)$

EX #8: A bent coin has the probability of heads on any one flip is 55%.

A. Find all the terms in the probability distribution.

B. Find the probability that the coin lands heads up at least two of the five times.

Real-World Connection

EX #9: A company ships bananas from Central America to the United States and guarantees that 80% of the fruit will be ripe within four days. Find each probability for a case containing 12 bunches of bananas.

A. All 12 bunches are ripe within four days.

B. At least ten bunches are ripe within four days.

C. No more than 8 bunches are ripe within four days.

EX #10: NASA wants to launch a satellite on one of the next three mornings. For each morning there is a 45% chance of suitable weather. What is the probability that there will be at least one morning with suitable weather?

NOTES

Name _____ Date _____

13.4

Binomial Distributions Practice

Problems 1 – 2, You sell sandwiches at a fast-food restaurant where 65% of your customers choose burgers and 35% choose chicken. Use a tree diagram to find each probability.

1. What is the probability that you sell 2 chicken sandwiches to the next 3 customers?
2. What is the probability that you sell 1 burger, 1 chicken, and then another burger?

Problems 3 – 6, Use the Binomial Theorem to expand each binomial.

3. $(x + 2)^4$

4. $(y - 3)^5$

5. $(2x + 3)^3$

6. $(x - 2y)^6$

Problems 7 – 10, Suppose you guess on a true-or-false test. Use a tree diagram to find each probability.

7. $P(2 \text{ correct in 3 guesses})$

8. $P(1 \text{ correct in 3 guesses})$

9. $P(4 \text{ correct in 3 guesses})$

10. $P(3 \text{ correct in 3 guesses})$

Problems 11 – 14, Find the probability of x success in n trials for the given probability of success p on each trial.

11. $x = 4, n = 9, p = 0.3$

12. $x = 5, n = 10, p = 0.4$

13. $x = 6, n = 12, p = 0.5$

14. $x = 3, n = 8, p = 0.2$

Problems 15 – 16, Use the binomial expansion of $(p + 1)^n$ to calculate and graph each binomial distribution.

15. $n = 5, p = 0.3$

16. $n = 6, p = 0.4$

Problems 17 – 19, Your sociology project requires a survey of 20 families in your neighborhood related to dinnertime and TV. Based on a study that was shared in class, 60% of families watch TV while eating dinner. Find each probability.

17. $P(10 \text{ of the 20 families watch TV during dinner})$

18. $P(15 \text{ of the 20 families watch TV during dinner})$

19. $P(\text{at least 8 of the 20 families watch TV during dinner})$

Problems 20 – 22, Solve.

20. A skateboard company claims that 90% of its skateboards pass final inspection, while 10% need some minor repairs before being ready for sale. In the next 5 inspections, what is the probability that all 5 skateboards pass inspection?

22. There is a 60% chance of rain near a theme park for the next 5 days. Find the probability that there will be rain at least 3 of the next 5 days. Round to the nearest percent.

Practice Sets

Lesson Warm-Ups

of drawing a marble, replacing it and then drawing a second marble.
 $P(\text{blue}) = \frac{3}{5}$ and $P(\text{yellow}) = \frac{2}{5}$

2. Show the outcome for each event on the node (pathway) of the diagram.

3. Find the probability that you draw two blue marbles.

Name _____ Date _____ Period _____

Lesson 13.4 Binomial Distributions

Warm-Up #2

A bag of 12 marbles contains 4 blue marbles and 8 yellow marbles.

1. Use a tree diagram to show the possible outcome of drawing a marble, replacing it and then drawing a second marble.
 $P(\text{blue}) = \frac{1}{3}$ and $P(\text{yellow}) = \frac{2}{3}$

2. Show the outcome for each event on the node (pathway) of the diagram.

3. Find the probability that you draw two blue marbles.

Form A

by elk has a adulthood. suppose 7 baby follow. Let x = adulthood. Use the binomial probability formula to find $P(x = 4)$

2. Explain the meaning of your results from question #1.

A bank of track lights contains 5 bulbs. Each bulb has a 92% chance of lasting two years, with normal use.

3. Find the probability that all five bulbs will last for two years.

4. Find the probability that at least three will last the full two years.

13.4 Binomial Distributions

Form B

Name _____

Date _____ Period _____

1. Each child from the Barton family has a 25% chance of having type O blood. Assuming this is accurate, suppose the Barton's have 5 children. Let x = the number of children with type O blood. Use the binomial probability formula to find $P(x = 3)$

2. Explain the meaning of your results from question #1.

A dozen flash drives are sent to an office supply store. Each flash drive has a 94% chance of lasting for a year, with normal use.

3. Find the probability that all 12 flash drives will last for one year.

4. Find the probability that at least eight will last the full year.

Daily Lesson Quiz

Grade: _____

Grade: _____