
Binomial Probability in Baseball

ID: 11200

Time required
45 minutes

Activity Overview

In this activity, students will explore the link between Pascal's Triangle, the Binomial Theorem, and Binomial Probability Experiments.

Topic: Binomial Probability Experiments

- *Binomial Expansion*
 - *Pascal's Triangle*
 - *Probability*
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Teacher Preparation and Notes

- *This activity is intended for a Precalculus or introductory Statistics class.*
- ***To download the student and solution documents and student worksheet, go to education.ti.com/exchange and enter "11200" in the keyword search box.***

Associated Materials

- *BinomialProbability_Student.doc*

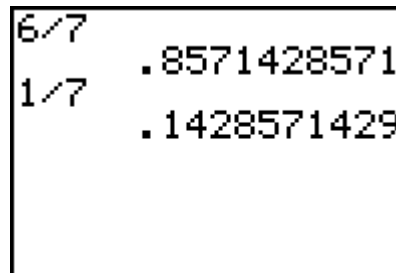
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Binomial Simulation Lab – Using ProbSim App (TI-84 Plus family) — 9620*
- *Binomial Probabilities (TI-84 Plus family) — 10234*

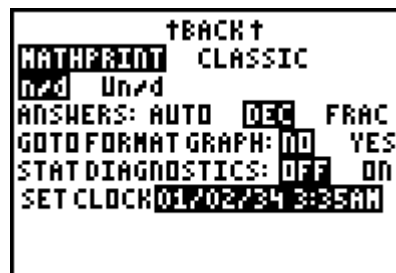
Exploring the Problem

Introduce the activity on the accompanying worksheet. Students will be asked questions regarding p and q in Questions 1 and 2.

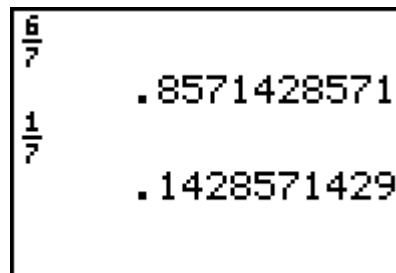


If using Mathprint OS:

To use the fraction template in this activity, students need to change the format of the answers to decimals. To do this, press **MODE** and press **ENTER** on **DEC** next to ANSWERS.



To enter a fraction, students can press **ALPHA** **[F1]** and select **n/d**. Enter the value of the numerator, press **▾** to move to the denominator, and enter the value of the denominator. Then press **▸** to move out of the fraction template.

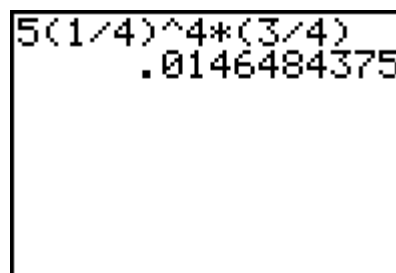


Developing the Pattern

On the accompanying worksheet, the requirements of a binomial experiment are stated and then the variables n and x are defined.

Next, a basic binomial probability situation involving a 5-question multiple choice quiz is described.

Finally, students are instructed to perform the binomial expansion as indicated to help students identify the link between the binomial expansion and both the formula to be used as well as the calculator method used for finding binomial probabilities. Students will need to use Pascal's Triangle to expand the binomial. Since the triangle is symmetrical, the variable x may be shown as either increasing or decreasing in value as one moves from left to right.



If using Mathprint OS:

When students press \square^{\wedge} , the cursor will move to the exponent position. Students should enter the value of the exponent and then press \square^{\rhd} to move out of the exponent position. Then press \square^{ENTER} .

Note: The parentheses were not directly entered using the keys, but rather the calculator automatically adds them when a fraction has an exponent.

5*(1/4)^4*3/4
.0146484375

Question 5 on the accompanying student worksheet introduces the formula ${}_nC_x p^x q^{(n-x)}$, and students are instructed to perform this calculation for the quiz problem in the bottom half of the page. To enter ${}_nC_x$ on the calculator, type the number for n , press \square^{MATH} and under **PRB** select the **nCr** command, then type the number for x .

5(1/4)^4*(3/4)
.0146484375
5 nCr 4*(1/4)^4*(3/4)
.0146484375

On Question 6, students are directed to use the **Binomial Pdf** command to find the probability again. To use this command, press \square^{2nd} $\square^{\text{[DISTR]}}$ and select **binompdf**(. Enter the numbers for n , p , and x separated by commas.

binompdf(5,1/4,4)
.0146484375

Extending the Pattern

The remaining questions of the worksheet direct the student back to the baseball problem introduced at the beginning. Students are to use what they learned to perform calculations and evaluate the results.

binompdf(4,6/7,4)
.5397750937

Student Worksheet Solutions

1. a) $\frac{6}{7}$ b) $\frac{1}{7}$
2. Always
3. $p^5 + 5p^4q + 10p^3q^2 + 10p^2q^3 + 5pq^4 + q^4$
4. $5\left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right) = \frac{15}{1024}$ (approx. 0.014648)
5. ${}_5C_4\left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right) = \frac{15}{1024}$ (approx. 0.014648)
6. $\text{binomPdf}\left(5, \frac{1}{4}, 4\right) = \text{approx } 0.014648$
7. Yes
8. $\text{binomPdf}(4, 6/7, 4) = 0.539775$
9. Sample answer: No. I would have expected the Red Sox to have won the Championship earlier. The probability of them winning in 4 games was higher than 50%, so it would have been very reasonable for them to have won in 5 games if expectations are based on past performance.
10. $\text{binomPdf}\left(7, \frac{6}{7}, 4\right) = 0.055079$
11. No, this isn't the best model. Winning 4 of 7 doesn't explain anything about the order of the wins. The Red Sox could have won the first 4 games, they could have won 2, lost 2, then won 2. The championship games stop once the first team wins 4 games. In the winning four of four games, this order is not a concern, but it is a concern once you go beyond 4 games.
12. Reasonable answers might include 5 or 6 games given that the probability calculated for the Red Sox winning the first 4 games was over 50%.
13. Injured players, team psychology, weather, umpire calls, home field advantage, etc.