Pascal's Triangle

1. If you add the numbers in any row together you get **the total number of possible outcomes**

2. If you pick a number from a row, then the nCr(row, position) will tell you **the number of ways you can get r heads in n flips or r boys in a n child family**

3. The first 1 in the any row represents getting **NONE of what you wanted** in the coin flip scenario

4. The last 1 in the any row represents **ALL of what you wanted** in the coin flip scenario

5. Using the fourth row {1, 4, 6, 4, 1} explain how you can determine each of the following

{1, 4, 6, 4, 1} =

number of ways to get { 0 heads, 1 head, 2 heads, 3 heads, 4 heads} in four coin flips

number of ways to get { 0 boys, 1 boy, 2 boys, 3 boys, 4 boys} in a four child family

a. The number of ways that one can flip exactly 2 heads in four coin flips

6 ways out of the 16 total ways

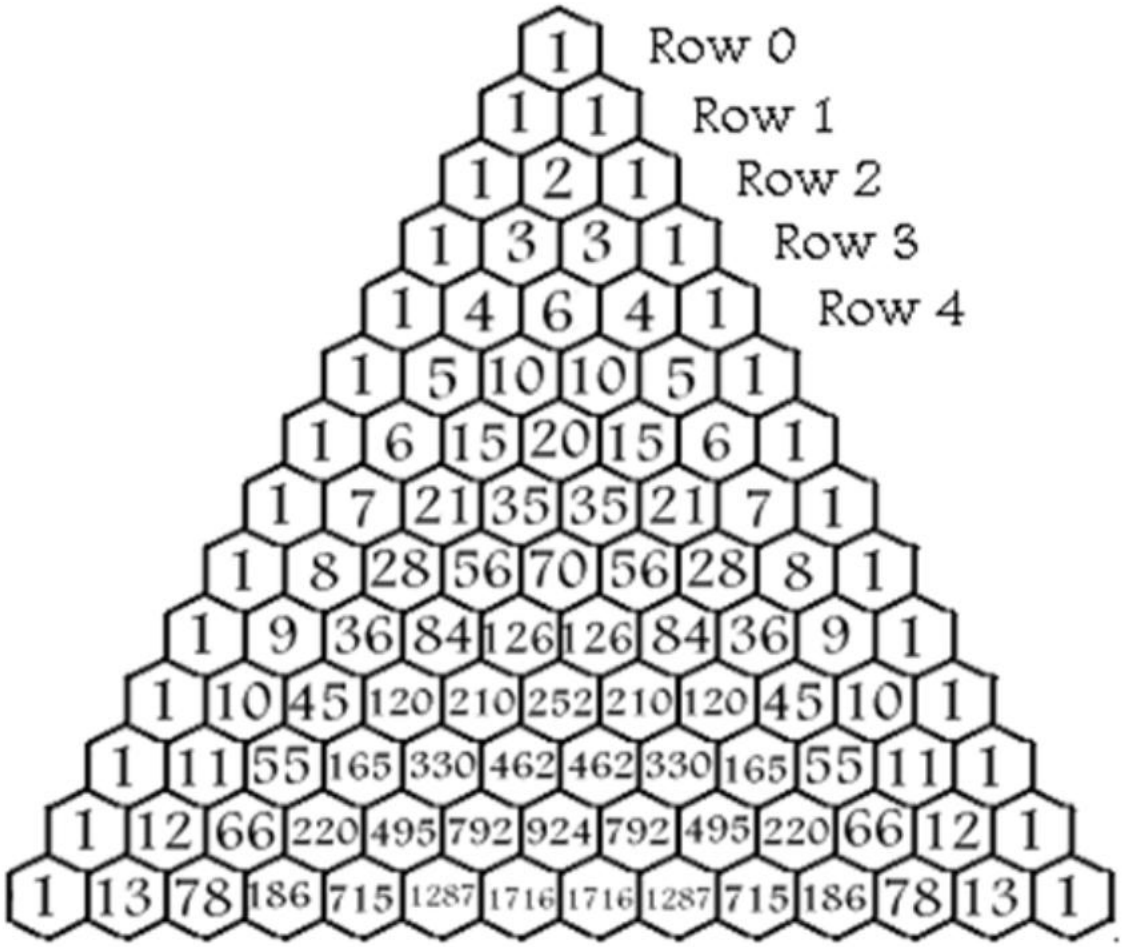
b. The number of possible ways you could have a family with 3 girls and one boy

4 ways out of the 16 total ways

c. Your friend asked you to write a probability question based on the idea that you only used the 4, 6, and 4 in your probability question's answer

Determine the probability that you flipped at least one of head in four coin flips

Determine the probability that your family includes at least one boy and one girl



Row 12 { 1, 12, 66, 220, 495, 792, 924, 792, 495, 220, 66, 12, 1}

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6. What does adding all of the numbers to the right of 66 in row 12 tell us about coin flips?

{ 1, 12, 66, **220, 495, 792, 924, 792, 495, 220, 66, 12, 1}**

220+495+792+924+792+495+220+66+12+1 = 4017

There are 4017 ways to NOT have 0, 1, or 2 heads in 12 coin flips

There are 4017 ways to HAVE more than 2 heads in 12 coin flips

There are 4017 ways to HAVE AT LEAST 3 heads in 12 coin flips

There are 4017 ways to NOT have 0, 1, or 2 boys in 12 child family

There are 4017 ways to HAVE more than 2 boys in 12 child family

There are 4017 ways to HAVE AT LEAST 3 boys in 12 child family

There are 4017 ways to HAVE NO LESS THAN 3 boys in 12 child family

Row 12 { 1, 12, 66, 220, 495, 792, 924, 792, 495, 220, 66, 12, 1}

7. What does adding all of the numbers to the left of 66 in row 12 tell us about coin flips?

{ **1, 12,** 66, 220, 495, 792, 924, 792, 495, 220, 66, 12, 1}

1+12 = 13

There are 13 ways to have 0 or 1 heads in 12 coin flips

There are 13 ways to HAVE less than 2 heads in 12 coin flips

There are 13 ways to HAVE AT MOST 1 heads in 12 coin flips

There are 13 ways to NOT have 3, 4, 5, 6, 7, 8, 9, 10, 11,or 12 boys in 12 child family

There are 13 ways to HAVE less than 2 boys in 12 child family

There are 13 ways to HAVE AT MOST 1 boys in 12 child family

There are 13 ways to HAVE NO MORE THAN 1 boys in 12 child family

8. What does the number 66 in row 12 tell us about coin flips?

{ 1, 12, **66**, 220, 495, 792, 924, 792, 495, 220, **66**, 12, 1}

There are 66 ways to get 3 heads and 9 tails

there are 66 ways to get 9 tails and 3 heads

9. How could you determine the number of different types of families possible if a woman had 15 children?

$2^{15} = 32768$

10. What means the same thing as

P(x> 2heads in five coin flips)?

a) Use binomial pdf

$$P(x \geq 3 \text{ in } 5 \text{ coin flips}) = \text{binomPdf}\left(5,\frac{1}{2},3\right)+\text{binomPdf}\left(5,\frac{1}{2},4\right)+\text{binomPdf}\left(5,\frac{1}{2},5\right) = 0.5$$

b) Use binomial cdf

$$P(x \geq 3 \text{ in } 5 \text{ coin flips}) = \text{binomCdf}\left(5,\frac{1}{2},3,5\right) = 0.5$$

c) Rewrite using ≥ symbol $P(x \geq 3 \text{ in } 5 \text{ coin flips})$

d) Rewrite in WORDS

Determine the probability of getting more than 2 heads in five coin flips

Determine the probability of getting at least 3 heads in five coin flips

11. What means the same thing as

P(x< 5heads in eight coin flips)?

a) Use binomial pdf

$$P(x \le 4 \text{ in } 8 \text{ coin flips}) = \text{binomPdf}\left(8,\frac{1}{2},0\right)+\text{binomPdf}\left(8,\frac{1}{2},1\right)+\text{binomPdf}\left(8,\frac{1}{2},2\right)+$$
$$\text{binomPdf}\left(8,\frac{1}{2},3\right)+\text{binomPdf}\left(8,\frac{1}{2},4\right)$$

b) Use binomial cdf

$$P(x \le 4 \text{ in } 8 \text{ coin flips}) = \text{binomCdf}\left(8,\frac{1}{2},0,4\right) = 0.636719$$

c) Rewrite using ≤ symbol $P(x \le 4 \text{ in } 8 \text{ coin flips})$

d) Rewrite in WORDS

Determine the probability of getting less than 5 heads in eight coin flips

Determine the probability of getting no more than 4 heads in eight coin flips

12. What means the same thing as

P(1< x≤ 15 heads in twenty coin flips)?

a) Use binomial pdf

$$P(2 \le x \le 15 \text{ in } 20 \text{ coin flips}) = \text{binomPdf}\left(20, \frac{1}{2}, 2\right) + \text{binomPdf}\left(20, \frac{1}{2}, 3\right) + \text{binomPdf}\left(20, \frac{1}{2}, 3\right) +$$

$$\ldots\ldots \quad \text{binomPdf}\left(20, \frac{1}{2}, 14\right) + \text{binomPdf}\left(20, \frac{1}{2}, 15\right)$$

b) Use binomial cdf

$$P(2 \le x \le 15 \text{ in } 20 \text{ coin flips}) = \text{binomCdf}\left(20, \frac{1}{2}, 2, 15\right) = 0.994071$$

c) Rewrite using ≤ symbol $P(2 \le x \le 15 \text{ in } 20 \text{ coin flips})$

d) Rewrite in WORDS

Determine the probability of getting between 2 and 15 heads, inclusive in 20 coin flips

Determine the probability of getting between 1and 16 heads 20 coin flips

13. What means the same thing as

P(5≤ x< 20 heads in thirty coin flips)?

a) Use binomial pdf

$$P(5 \le x \le 19 \text{ in } 30 \text{ coin flips}) = \text{binomPdf}\left(30, \frac{1}{2}, 5\right) + \text{binomPdf}\left(30, \frac{1}{2}, 6\right) + \text{binomPdf}\left(30, \frac{1}{2}, 7\right) +$$

$$\ldots\ldots \quad \text{binomPdf}\left(30, \frac{1}{2}, 18\right) + \text{binomPdf}\left(30, \frac{1}{2}, 19\right)$$

b) Use binomial cdf

$$P(5 \le x \le 19 \text{ in } 30 \text{ coin flips}) = \text{binomCdf}\left(30, \frac{1}{2}, 5, 19\right) = 0.950602$$

c) Rewrite using ≤ symbol $P(5 \le x \le 19 \text{ in } 30 \text{ coin flips})$

d) Rewrite in WORDS

Determine the probability of getting between 5 and 19 heads, inclusive in 30 coin flips

Determine the probability of getting between 4 and 20 heads 30 coin flips