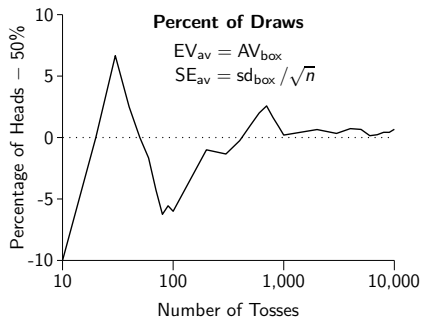
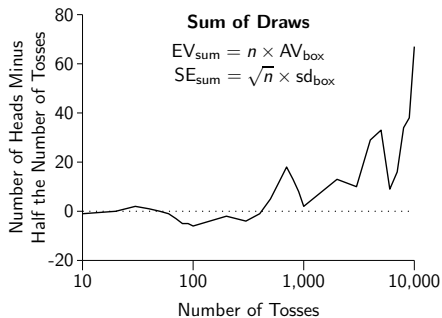


# Math 207: Statistics

## Chapter 16: The Law of Averages



Dr. Ralph Wojtowicz

Mathematics Department



**SHENANDOAH**  
UNIVERSITY

## 1 Law of Averages

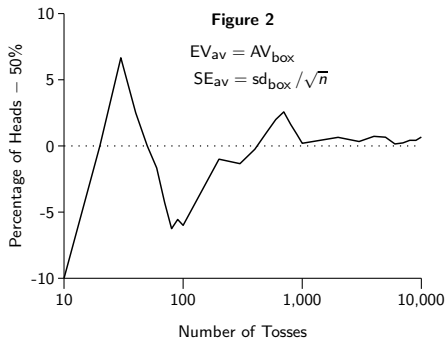
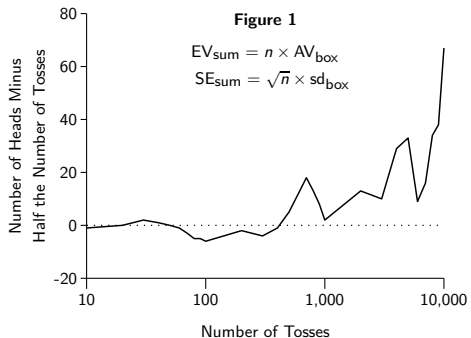
- Law of Averages

## 2 Box Models

- Box Models

# Law of Averages

The Law of Averages says that as the size of a random sample increases, the difference between the expected percentage of an outcome and the observed percentage will get smaller (Figure 2). The difference between the number of occurrences of an outcome and the expected number increases (Figure 1).



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- A coin is tossed and you win \$1 if there are more than 40% heads. Which is better, 10 tosses or 100? 100.
- A coin is tossed and you win \$1 if there are between 49.999% and 50.001% heads. Which is better, 10 tosses or 100? 100.

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- A coin is tossed and you win \$1 if there are between 49.999% and 50.001% heads. Which is better, 10 tosses or 100? 100.
- A coin is tossed and you win \$1 if there are at most 45% heads or more than 55% heads. Which is better, 10 tosses or 100? 10.



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- A coin is tossed and you win \$1 if there are at most 45% heads or more than 55% heads. Which is better, 10 tosses or 100? 10.
- A coin is tossed and you win \$1 if there are exactly 50% heads. Which is better, 10 tosses or 100? 10.

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- A coin is tossed and you win \$1 if there are at most 45% heads or more than 55% heads. Which is better, 10 tosses or 100? 10.
- A coin is tossed and you win \$1 if there are exactly 50% heads. Which is better, 10 tosses or 100? 10.
- A die is rolled and you win \$1 if at least 20% of the rolls are 5s. Which is better, 10 rolls or 100? 10.

# Examples

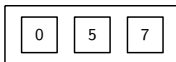
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- A die is rolled and you win \$1 if exactly  $1/6$  of the rolls are 5s. Which is better, 12 rolls or 120? 12.

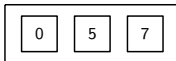
# Box Models

- One hundred draws are made at random with replacement from



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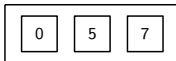
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- What is the smallest that the sum can be? 0

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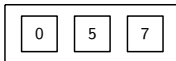
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- What is the smallest that the sum can be? 0
- What is the largest that the sum can be? 700

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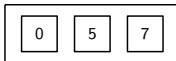
- What is the smallest that the sum can be? 0
- What is the largest that the sum can be? 700
- About what do you expect the sum to be?

Average of the tickets in the box is  $\frac{0+5+7}{2} = 6$  so 600.



# Box Models

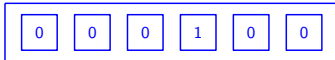
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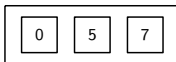
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- You plan to roll 100 dice and count the number of 4s. Make a box model.



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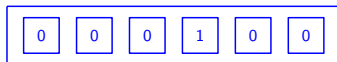
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Average of the tickets in the box is  $\frac{0+5+7}{2} = 6$  so 600.

- You plan to roll 100 dice and count the number of 4s. Make a box model.



- You plan to roll 100,000 dice and count the number of even numbers. Make a box model.

