Random Selection

np.random.choice

- Selects at random
- with replacement
- from an array
- a specified number of times

np.random.choice(some_array, sample_size)

(Demo)
Discussion Question

\[ d = \text{np.arange}(6) + 1 \]

What results from evaluating the following 2 expressions? Are they the same? Do they describe the same process?

\[ \text{np.random.choice}(d, 1000) + \text{np.random.choice}(d, 1000) \]

\[ 2 * \text{np.random.choice}(d, 1000) \]
Comparison Operators

The result of a comparison expression is a bool value

\[
\begin{align*}
&x = 2 & y = 3 \\
&x > 1 & x > y & y >= 3 \\
&x == y & x != 2 & 2 < x < 5
\end{align*}
\]
Combining Comparisons

Boolean operators can be applied to `bool` values

\[
\begin{align*}
a &= \text{True} & b &= \text{False} \\
\text{not } b & & a \text{ or } b & & a \text{ and not } b \\
\text{Evaluate to True} \\
a \text{ and } b & & \text{not (a or b)} & & b \text{ and } b \\
\text{Evaluate to False}
\end{align*}
\]

(Demo)
Aggregating Comparisons

Summing an array or list of bool values will count the True values only.

\[
1 + 0 + 1 \quad == \quad 2 \\
\text{True + False + True} \quad == \quad 2 \\
\text{sum([1, 0, 1])} \quad == \quad 2 \\
\text{sum([True, False, True])} \quad == \quad 2 \\
\text{np.count_nonzero([True, False, True])} \quad == \quad ?
\]

(Demo)
More Python Commands

● Printing
  ○ Use `print` to display the value of a variable

● Control Statements
  ○ The purpose of `if` is to define functions that choose different behavior based on their arguments
  ○ The purpose of `for` is to perform a computation for every element in a list or array

(Demo)
Probability

- Lowest value: 0
  - Chance of event that is impossible
- Highest value: 1 (or 100%)
  - Chance of event that is certain

- If an event has chance 70%, then the chance that it doesn’t happen is
  - $100\% - 70\% = 30\%$
  - $1 - 0.7 = 0.3$ (Demo)
Equally Likely Outcomes

Assuming all outcomes are equally likely, the chance of an event A is:

\[ P(A) = \frac{\text{number of outcomes that make A happen}}{\text{total number of outcomes}} \]
Simulating Monty Hall

x 1,000
Multiplication Rule

Chance that two events $A$ and $B$ both happen

$$= P(A \text{ happens}) \times P(B \text{ happens given that } A \text{ has happened})$$

- The answer is less than or equal to each of the two chances being multiplied
- The more conditions you have to satisfy, the less likely you are to satisfy them all

(Demo)
Addition Rule

If event $A$ can happen in exactly one of two ways, then

$$P(A) = P(\text{first way}) + P(\text{second way})$$

- The answer is \textit{greater than or equal to} the chance of each individual way.
Example: At Least One Head

- In 3 tosses:
  - Any outcome except TTT
  - $P(TTT) = \left(\frac{1}{2}\right) \times \left(\frac{1}{2}\right) \times \left(\frac{1}{2}\right) = \frac{1}{8}$
  - $P(\text{at least one head}) = 1 - P(TTT) = \frac{7}{8} = 87.5\%$

- In 10 tosses:
  - $1 - \left(\frac{1}{2}\right)^{10}$
  - $99.9\%$
Test 1 Results

- Median: 68

Test 1 75.0 points

- Minimum: 62.67%
- Median: 91.0%
- Maximum: 98.67%
- Mean: 87.0%
- STD DEV: 9.99%