Chance behavior is unpredictable in the short run, but has a regular/predictable pattern in long run.

Vocab: random = a phenomenon is random if individual outcomes are uncertain but there is regular distribution of outcomes in large # of repetitions.
probability of an outcome = proportion of times outcome would occur in a very long series of repetitions

Sample space $S$: set of all possible outcomes
Event: subset of sample space (usually denoted by capital letter)

Probability model: 1 a sample space
2 a way of assigning probabilities to events

Probability Rules
\[
\begin{align*}
&1 \quad 0 \leq P(A) \leq 1 \\
&2 \quad P(S) = 1 \\
&3 \quad P(A \text{ or } B) = P(A) + P(B) \quad \text{if } A \text{ and } B \text{ disjoint} \\
&4 \quad P(A \text{ does not occur}) = 1 - P(A) \\
&\quad \text{i.e. } P(\overline{A}) = 1 - P(A)
\end{align*}
\]

(a) discrete prob. model: finite sample space
(b) continuous prob. model: continuous sample space
(to find these probabilities, you'd find area under density curve)

Random variable: variable whose value is numerical outcome of random phenomenon
Ex 1

Match these probabilities to the statements.

- 0 (a) event is impossible
- 0.01 (b) event is certain (it occurs on every try)
- 0.3 (c) event is unlikely, but will occur sometimes
- 0.6 (d) event will occur frequently
- 0.99
- 1

Ex 2

Choose a student at random. Describe sample space S for each of these: (discrete or continuous)

(a) Is student male or female?
(b) Student's height (in inches)?
(c) How much money (in cents) student has with him/her?
(d) Student's letter grade for this course.
Ex 3 (a) Roll a 6-sided die twice. What is sample space?

(b) Assign probabilities to each outcome.
Ex 4. Choose an American adult at random. Define two events: $A =$ person is obese, $B =$ person is overweight, but not obese.

According to NCHS (Natl Ctr for Health Stats), $P(A) = 0.32$ and $P(B) = 0.34$.

(a) Are $A$ & $B$ disjoint? Why or why not?

(b) What is $P(A \text{ or } B)$?

(c) $P(C) =$? If $C =$ person has normal weight.
Chp 10 (cont)

Ex 5 Which are legitimate probability models for an unfair die? Why?

<table>
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<tr>
<th>outcome</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
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</tbody>
</table>

For model 2, what is $P(A)$, if $A = \text{roll a # at least 3 or more}$?

uniform distribution (everything is equally likely)

density curve: area between $X=a$ and $X=b$ is 1.
height is same everywhere

$P(c \leq X \leq d) = \text{area under curve between } X=c \text{ and } X=d.$

Area = $1 = (b-a)y \implies y = \frac{1}{b-a}$
(a) Is this a probability model?

(b) What is $P(X \geq B)$? What is $P(X = B)$?

(c) Write this event: "student got grade below C" in terms of rv $X$. What is probability of this event?