

### 6.3 Probability and Odds

Theoretical Probability

Likelihood that an event will occur

$$P(E) = \frac{\text{favorable outcomes}}{\text{total outcomes}}$$

$$P(H) = \frac{1}{2}$$

$$P(\square) = \frac{1}{6}$$

$$P(\text{face card}) = \frac{12}{52} = \frac{3}{13}$$

OR

$$P(1 \text{ or } 3) = \frac{2}{6} = \frac{1}{3}$$

mutually Exclusive

Events that have nothing in common

Result on one cannot affect the result of the other

$P(\text{Jack or Spade})$

Not mutually exclusive

$$P(\text{face card or } 2) = P(\text{face card}) + P(2)$$

$$= \frac{3}{13} + \frac{1}{13} = \frac{4}{13}$$

$$P(\text{not } E) = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} \text{ or } \frac{1}{3}$$

### Complimentary Events

Two events that cover all possible outcomes but share no outcomes

red cards    black cards

odd          even

E          not E

$$P(E) + P(\text{Not } E) = 1$$

$$P(\text{odd}) + P(\text{even}) = \frac{3}{6} + \frac{3}{6} = \frac{6}{6} = 1$$

$$P(\text{Not } E) = 1 - P(E)$$

$$P(\text{Not an Ace}) = 1 - \frac{4}{52} = \frac{52}{52} - \frac{4}{52} = \frac{48}{52} = \frac{12}{13}$$

What is the Probability that  
5 people will not have the  
same birthday?  
(counting problem)

$$\frac{365 \cdot 364 \cdot 363 \cdot 362 \cdot 361}{365^5} \approx 0.95$$

Odds describe the  
relationship between  
favorable and unfavorable

odds for an event  
odds against an event

Odds of 3:1

for

$$\text{Odds}(E) = \frac{\text{favorable}}{\text{unfavorable}} = \frac{P(E)}{P(\text{not } E)}$$

$$\text{Odds}(E) = \frac{\frac{1}{6}}{\frac{5}{6}} = \frac{1}{5} \quad 1:5$$

against

$$\text{Odds}(E) = \frac{\text{unfavorable}}{\text{favorable}}$$

$$\text{odds}(mt \uparrow) = \frac{13}{39} = \frac{1}{3} \quad 1 \text{ to } 3$$

$$1:3$$

Odds in the Kentucky Derby

13:1 payouts  
35:1 every 1 dollar that  
if I win I get 35

7:1

5:1

→ 5:7 odds closest to 1  
 $\frac{5}{7} = \frac{35}{49}$   
 $\frac{5}{7} = \frac{35}{49}$   
 $25 + 35 = 60$

1:3.918

every \$4 you spend  
you might earn \$1

every 5 tickets is a winner  
No