# 2.3 – Multiplying Probabilities

**Probability of Two Independent Events** → "AND" means to multiply

If two events, A and B, are independent (one event does not affect the next event),

then the probability of both events occurring is $P(A \text{ and } B) = P(A) \cdot P(B)$

**Example 1: Complete each problem about finding the probability of independent events.**

a.) At a picnic, Julio reaches into an ice-filled cooler containing 8 regular soft drinks and 5 diet soft drinks. He removes a can, then decides he is not really thirsty, and puts it back. Find the probability that Julio and the next person to reach into the cooler to get…

i.) Make a tree diagram of the situation stated above.

Julio: $\frac{8}{13}$ R, D $\frac{5}{13}$

Matt Ryan: $\frac{8}{13}$ R, D $\frac{5}{13}$; $\frac{8}{13}$ R, D $\frac{5}{13}$

* b/c Julio replaced the drink; the Probability does not change

ii.) P (R , R)
$= \frac{8}{13} \cdot \frac{8}{13}$
$\frac{64}{169} = 37.9\%$

iii.) P (D , R)
$= \frac{5}{13} \cdot \frac{8}{13}$
$= \frac{40}{169} = 23.7\%$

iv.) P (D , D)
$= \frac{5}{13} \cdot \frac{5}{13}$
$= \frac{25}{169} = 14.8\%$

b.) In a board game, three dice are rolled to determine the number of moves for the players. Find the probability of each given situation.

* A typical die has #'s 1-6 *

i.) P (6 , 6 , 5)
$= \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6}$ .5%
$= 1/216$

ii.) P (4 , 4 , not 4)
$= \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{5}{6}$ 2.3%
$= 5/216$

iii.) P (no 3's)
$= \frac{5}{6} \cdot \frac{5}{6} \cdot \frac{5}{6}$ 57.9%
$= 125/216$

iv.) P (5 , 6 , 7)
$= 1/6 \cdot 1/6 \cdot 0/6$ 0%
$= 0/216$

v.) P (three 5's)
$= 1/6 \cdot 1/6 \cdot 1/6$ 0.5%
$= 1/216$

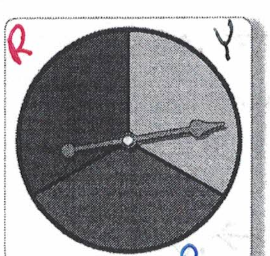
vi.) P (any # , any # , not 2)
$= \frac{6}{6} \cdot \frac{6}{6} \cdot \frac{5}{6}$ 83.3%
$= 180/216$

vii.) P (1 , 2 , 3 , not 4)
* Only 3 dice! *
0%

viii.) P (not 3 , not 4 , 1)
$= \frac{5}{6} \cdot \frac{5}{6} \cdot \frac{1}{6}$ 11.6%
$= 25/216$

**Example 2: You have a spinner that you will spin two times. Complete each problem.**

a.)




i.) Draw a diagram to show the probabilities.

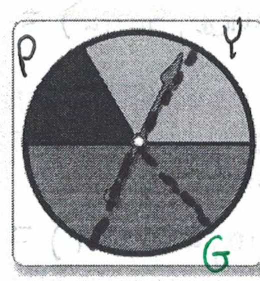
$\frac{1}{3}$ R, $\frac{1}{3}$ Y, $\frac{1}{3}$ B

R Y B ($\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$); R Y B ($\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$); R Y B ($\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$)

ii.) P (red , blue)
$= 1/3 \cdot 1/3$
$= 1/9$ 11.1%

iii.) P (yellow, not red)
$= 1/3 \cdot 2/3$
$= 2/9$ 22.2%

b.)




i.) Draw a diagram to show the probabilities.

* 6 total pieces *

$1/6$ P, Y $2/6$, G $3/6$

P Y G ($1/6$ $2/6$ $3/6$); P Y G ($1/6$ $2/6$ $3/6$); P Y G ($1/6$ $2/6$ $3/6$)

ii.) P (purple , yellow)
$= \frac{1}{6} \cdot \frac{2}{6}$
$= 2/36$ 5.6%

iii.) P (green , not purple)
$= \frac{3}{6} \cdot \frac{5}{6}$
$= 15/36$ 41.7%

Probability of Two Dependent Events →

If two events, A and B, are dependent (one event affects the next event),

then the probability of both events occurring is $P(A \text{ and } B) = P(A) \cdot P(B \text{ following } A)$

**Example 3: Complete each problem about finding the probability of dependent events.**

| a.) The host of a game show is drawing chips from a bag to determine the prizes for which contestants will play. Of the 10 chips in the bag, 6 show TELEVISION, 3 show VACATION, and 1 shows CAR. If the host draws the chips at random and does not replace them, then find each probability. (means dependent!) | | | b.) Three cards are drawn from a standard deck of cards without replacement. Find each probability. (means "dependent") 52 cards, 13 cards per suit, 4 suits, RED, BLACK | |
|---|---|---|---|---|
| i.) P (V , then C) $= \frac{3}{10} \cdot \frac{1}{9} = \frac{3}{90}$ 3.3% | ii.) P (T, then T) $= \frac{6}{10} \cdot \frac{5}{9} = \frac{30}{90}$ 33.3% | P (C , then A) $= \frac{1}{10} \cdot \frac{0}{9} = 0$ 0% | i.) P (D , C , D) $= \frac{13}{52} \cdot \frac{13}{51} \cdot \frac{12}{50}$ $\frac{2028}{132600} = 1.5\%$ | ii.) P (H , H , H) $= \frac{13}{52} \cdot \frac{12}{51} \cdot \frac{11}{50}$ $= \frac{1716}{132600} = 1.3\%$ |

**Example 4: Determine whether the events are independent or dependent. Then find the probability.**

a.) Yana has 7 blue pens, 3 black pens, and 2 red pens in his desk drawer. If he selects three pens at random with no replacement, what is the probability that he will first select a blue pen, then a black pen, and then a red pen? * 12 pens total *

Dependent $P(\text{Blue, Black, Red}) = \frac{7}{12} \cdot \frac{3}{11} \cdot \frac{2}{10} = \frac{42}{1320}$ 3.2% → .032

b.) A black die and a white die are rolled. What is the probability that a 3 shows on the black die and a 5 shows on the white die? (two different dice)

Independent $P(\text{Black 3, White 5}) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ 2.8% → .028

c.) Tami, Sonia, Michael, and Roger are the four candidates for student council president. If their names are placed in random order on the ballot, what is the probability that Michael's name will be first on the ballot followed by Sonia's name second? (can only use ~~a~~ name once)

Dependent $P(\text{Mike, Sonia}) = \frac{1}{4} \cdot \frac{1}{3} = \frac{1}{12}$ 8.3% → .083

d.) Joe's wallet contains three \$1 bills, four \$5 bills, and two \$10 bills. If he selects three bills in succession, find the probability of selecting a \$10 bill, then a \$5 bill, and then a \$1 bill if the bills are not replaced. 9 bills total

Dependent $P(\$10, \$5, \$1) = \frac{2}{9} \cdot \frac{4}{8} \cdot \frac{3}{7} = \frac{24}{504}$ 4.8% → .048

e.) A bag contains 6 green marbles and 8 yellow marbles. Carlos randomly selects one, puts it back, and then randomly selects another. What is the probability that Carlos selected one of each marble?

Independent 14 total marbles

$P(\text{Green, Yellow}) = \frac{6}{14} \cdot \frac{8}{14} = \frac{48}{196}$ 24.5%