MULTIPLICATION RULE:

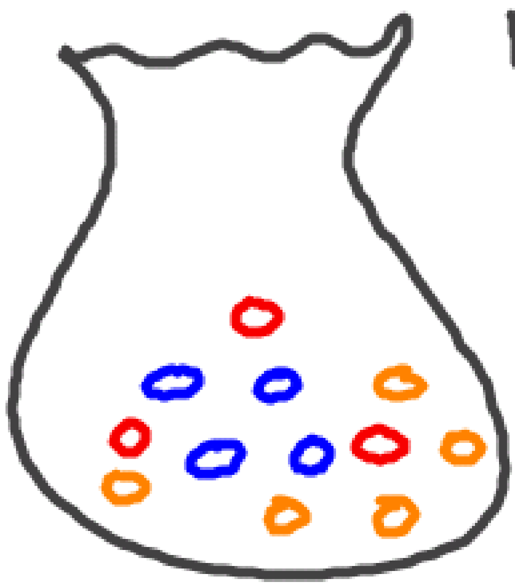
- find the probability that something will happen <u>and then</u> something else will happen.

"AND" "BOTH"

- WITH REPLACEMENT (PUT IT BACK?) (INDEPENDENT)
- WITH OUT REPLACEMENT (KEEP IT) (DEPENDENT)

RULE:

$$P(A \text{ and } B) = P(A) \cdot P(B \text{ after } A \text{ has occured})$$



12 TOTAL MARBLES

$P(\text{RED and then BLUE})$

WITH REPLACEMENT:

$P(\text{RED})$ $\quad$ $P(\text{BLUE after getting a RED})$

$\frac{3}{12} = \frac{1}{4}$ $\quad$ $\frac{4}{12} = \frac{1}{3}$

$P(\text{RED, then BLUE}): \frac{1}{4} \cdot \frac{1}{3} = \frac{1}{12}$

WITHOUT REPLACEMENT:

$P(\text{RED})$ $\quad$ $P(\text{BLUE after getting RED})$

$\frac{3}{12} = \frac{1}{4}$ $\quad$ $\frac{4}{11}$

$P(\text{RED, then BLUE}) = \frac{1}{4} \cdot \frac{4}{11} = \frac{4}{44} = \frac{1}{11}$

Roll a die twice

$P(2\ 6\text{'s}) = \underset{1^{st}\text{ Roll}}{P(6)} \quad \overset{2^{nd}}{P(6 \text{ after getting the } 1^{st}\ 6)}$

$$\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$$

$P(10 \text{ and then an ACE}) =$

$\underset{\text{first card}}{P(10)} \quad P(\text{ACE after already getting a } 10)$

$$\frac{4}{52} = \frac{1}{13} \qquad \frac{4}{51}$$

only 51 left because we ? the 10 already

$P(10 \text{ and then ACE})$

$$\frac{1}{13} \cdot \frac{4}{51} = \frac{4}{663}$$

ADDITION RULE:

- when we want to know the probability that at least one of the events occurs.
- Have to avoid counting things more than once.
- "EITHER" "OR"

P(Rolling an EVEN or a number ≤ 4)

P(EVEN) P(≤ 4)

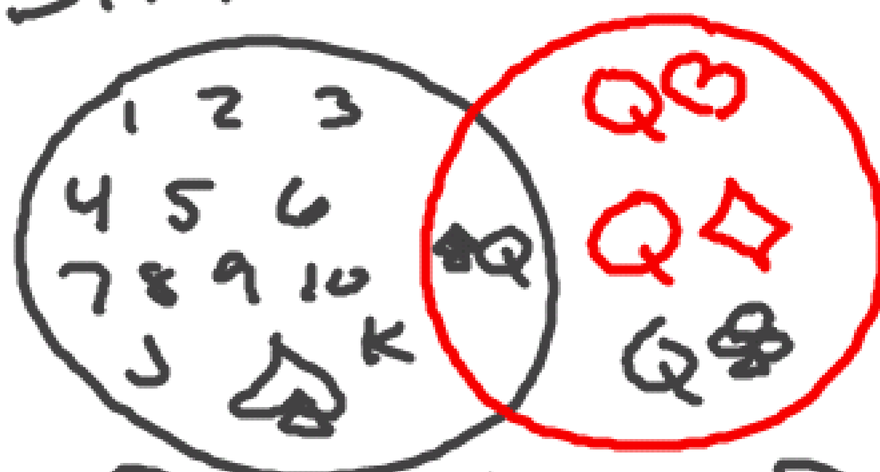
$\frac{3}{6} + \frac{4}{6}$ − BOTH $\frac{2}{6}$

2, 4, 6 1, $\cancel{2}$, 3, $\cancel{4}$ $= \frac{5}{6}$

RULE:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$P(\text{SPADE or a QUEEN})$



$P(\text{SPADE})$ $\quad \frac{13}{52} = \frac{1}{4}$

$P(\text{QUEEN})$ $\quad \frac{4}{52}$

$P(\text{SPADE and QUEEN})$ $\quad \frac{1}{52}$

spade queen spade and queen

$$\frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{16}{52}$$

IF TWO CAN NOT HAPPEN AT THE SAME TIME THEY ARE called <u>MUTUALLY EXCLUSIVE</u>.

IF TWO EVENTS CAN HAPPEN AT THE SAME TIME THE ARE CALLED <u>INCLUSIVE</u>

7 girls & 6 boys

5 saleswomen

First people helped are:
1st 2nd 3rd 4th

$$P(4\ \text{girls}) = \frac{7}{13} \cdot \frac{\cancel{6}^{\,1}}{\cancel{12}_{\,2}} \cdot \frac{\cancel{5}^{\,1}}{11} \cdot \frac{\cancel{4}^{\,2}}{\cancel{10}\,\cancel{5}\,1} = \frac{14}{286}$$

$$= \frac{7}{143}$$

$$P(4\ \text{boys}) = \frac{\cancel{6}^{\,2}}{13} \cdot \frac{\cancel{5}^{\,1}}{\cancel{12}_{\,2}} \cdot \frac{\cancel{4}^{\,1}}{11} \cdot \frac{3}{\cancel{10}\,\cancel{2}} = \frac{3}{143}$$

P(4 girls <u>or</u> 4 boys)

$$\frac{7}{143} + \frac{3}{143} = \frac{10}{143}$$

ADD.

$P(\underbrace{\text{both kings}}_{\text{multiplication}}$ or $\underbrace{\text{both black}}_{\text{mult. rule}})$

both kings $P(\text{KING}) \cdot P(\text{KING after King})$

$\frac{4}{52} \quad \frac{3}{51} = \frac{12}{2652}$

$\frac{1}{13} \cdot \frac{3}{51} = \frac{3}{663}$

both black $P(\text{BLACK}) \cdot P(\text{BLACK after BLACK})$

$\frac{26}{52} \quad \frac{25}{51} = \frac{650}{2652}$

overlap= both cards are kings and black $P(\text{Both Blacks } \& \text{ Kings})$ $\frac{12}{2652} \cdot \frac{650}{2652} = .00111$

both kings | both black | overlap

$\frac{12}{2652} + \frac{650}{2652} - .0011 = .2495$

555: 22-32E
561: 18-28E