\[ S = \{ \text{girl}, \text{boy} \} \]

\[ S' = 7! \text{ permutation of } (1,2, \ldots, 7) \]

\[ (2, 3, 1, 6, 5, 4, 7) \]

\[ \therefore \quad S = \{ \text{HH, HT, TH, TT} \} \]

\[ S = \{ (i, j) : i, j = 1, 2, 3, 4, 5, 6 \} \]

\[ E = \{ \text{the outcome of } S \text{ straights with } 3 \} \]

\[ E = \text{the outcome of } S \text{ straights with } 3 \]
(2) \[ E = \{(1,5), (2,4)\} \quad \text{and} \quad F = \{(1,6), (2,5)\} \]

\[ \text{then} \quad E \cap F = \emptyset = \phi \]

\[ \bigcup_{n=1}^{\infty} E_n \quad \text{and} \quad \bigcap_{n=1}^{\infty} E_n \]

\[ E^c \quad \text{and} \quad S = E \cup F \]

\[ E = \{(1,6), (2,5), (3,4), (4,3), (5,2), (6,1)\} \]

\[ S^c = \emptyset \]

\[ EF = E \cap F \]

\[ EUF \]

\[ E^c \]

\[ EF = FE \quad EUF = FUE \]

\[ (EF)G = E(FG) \quad (EUF)VG = EU(FUG) \]

\[ FFUFG = (EUG)(FUG) \quad (EUF)G = E \cup UFG \]
\[(\bigcup_{i=1}^{n} E_i)^c = \bigcap_{i=1}^{n} E_i^c\]

\[(\bigcap_{i=1}^{n} E_i)^c = \bigcup_{i=1}^{n} E_i^c\]
(Relative frequency)

\[
P(E) = \lim_{n \to \infty} \frac{n(E)}{n}
\]

** Proof 1:**

Given that \( n(E)/n \to 0 \) as \( n \to \infty \), let's examine the conditions under which \( P(E) \) exists.

\[
P(E) = 0 \quad \text{if} \quad n(E)/n \to 0
\]

or

\[
P(E) = 1 \quad \text{if} \quad n(E)/n \to 0
\]

Otherwise,

\[
0 \leq P(E) \leq 1
\]

(1)

\[
P(S) = 1
\]

(2)

For any two events \( E_i \) and \( E_j \),

\[
P(E_i \cup E_j) = P(E_i) + P(E_j) - P(E_i \cap E_j)
\]

(3)

**Proof 2:**

Since \( E_1 = S \) and \( E_2 = \phi \),

\[
P(E_1 \cup E_2) = P(S) = P(E_1) + P(E_2) \Rightarrow P(E_2) = P(\phi) = 0
\]

(4)

Therefore, for any \( k \) and \( k' \),

\[
P(\{H^k \}) = P(\{H^{k'} \}) = \frac{1}{2}
\]

(5)

And for any event \( H^{-1} \) and \( H \),

\[
P(H^{-1}) = \frac{2}{3} \Rightarrow P(H) = \frac{1}{3}
\]

(6)

Further, for \( n = 3 \),

\[
P(H_3) = P(S_3) = \ldots = P(H_6) = \frac{1}{6}
\]

(7)

Finally, for the event \( \{2, 4, 6\} \),

\[
P(\{2, 4, 6\}) = P(\{2\}) + P(\{4\}) + P(\{6\}) = \frac{1}{2}
\]

(8)
(5) \[ P(E^c) = 1 - P(E) \]

\[ P(E) \subseteq P(F) \text{ so } EF \subseteq F \]

\[ F = E \cup E^c F \]

\[ P(F) = P(E) + P(E^c F) \]

\[ P(E) \subseteq P(F) \text{ so } P(E^c F) \text{ will be } \]

\[ P(E \cup F) = P(E) + P(F) - P(EF) \]

\[ P(E \cup F) = P(E \cup E^c F) \]

\[ = P(E) + P(E^c F) \]

\[ F = E \cup E^c F \implies P(F) = P(EF) + P(E^c F) \]

\[ P(E^c F) = P(F) - P(EF) \]

\[ P(B_1 \cup B_2) = P(B_1) + P(B_2) - P(B_1 B_2) = 0.5 + 0.4 - 0.3 = 0.6 \]

\[ P(B_1 \cup B_2) \subseteq P(B_1) \text{ and } P(B_1 \cup B_2) \subseteq P(B_2) \text{ so } P(\overline{B_1 \cup B_2}) = 1 - P(B_1 \cup B_2) = 1 - 0.6 = 0.4 \]

\[ P(E \cup F \cup G) = \frac{P(E) + P(F) - P(EF) + P(G) - P(EG \cup F \cup G)}{P(E \cup F)} \]

\[ = P(E) + P(F) - P(EF) + P(G) - P(EG) - P(FG) + P(EGF) \]
\[ P(13) = P(12) = \ldots = P(1N) = \frac{1}{N} \]

3. A long formula written in a natural language.
(7) A box contains 5 red balls, 6 black balls, 1 yellow ball, 8 green balls, and 3 blue balls. How many ways can we draw 3 balls from this box? The answer is 240.

\[
\binom{3}{2} = \frac{240}{1001}
\]

Next question: Which is easier, a 13 ball or a 14 ball? Why?

Let's consider the following:

\[
\binom{n}{k} = \frac{1}{k!} \prod_{i=0}^{k-1} (n-i)
\]

Next question: Which is easier, a 13 ball or a 14 ball? Why?

Our goal is to determine which option is easier. Let's consider the following:

\[
P(\bigcup_{i=1}^{k} A_i) = \sum_{i=1}^{k} P(A_i) = k/n
\]

Finally, let's consider the following:

\[
\text{Straight draw:}
\]

\[
(5, 6, 9, 7, 8, 10)
\]

\[
10 \times 5 \times 4 \times 3 = 120
\]

\[
\frac{120}{52} = 0.004
\]