

✓ Multiplication Rules and Conditional Probability

Multiplication Rules

The two events A and B are independent events if the occurring of A does not affect the occurring of B.

Multiplication Rule 1

1. When two events are independent, the probability of both occurring is:

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

For example:

A coin is flipped and a die is rolled. Find the probability of getting a head on the coin and a 4 on the die.

```
1 head = 1 #number of head in one coin
2 coin_total = 2 # total number of outcomes in coin
3 die_total = 6 # total number of outcomes in die
4 die_4 = 1 # number of 4 in die
5 P_head = head/coin_total # probability of head in coin
6 P_die = die_4/die_total # probability of getting 4 in die
7
8 # probability of getting head in coin and 4 in die
9 Probability_head_and_die4 = P_head * P_die
10
11 # displaying the result.
12 print(f"Probability of getting a head on the coin and a 4 on the die:
    {Probability_head_and_die4:.3f}")
13
```

➡ Probability of getting a head on the coin and a 4 on the die: 0.083

✓ Question 1

One card is drawn from a deck of card. Second card is drawn from the same deck but only after replacing the first card in it. Find the probability of getting a queen and an ace.

```
1 ## Write Your Code Here ##
```

✓ Dependent events

When the outcome or occurrence of the first event affects the outcome or occurrence of the second event in such a way that the probability is changed, the events are said to be **dependent events**.

Multiplication Rule 2

2. When two events are dependent, the probability of both occurring is:

$$P(A \text{ and } B) = P(A) \cdot P(B|A)$$

For example: World Wide Insurance Company found that 53% of the residents of a city had home owner's insurance (H) with the company. Of these clients, 27% also had automobile insurance (A) with the company. If a resident is selected at random, find the probability that the resident has both homeowner's and automobile insurance with World Wide Insurance Company.

```
1 # Given from the question
2 home_insurance = 0.53
3 auto_insurance = 0.27
4
5 # calculating the probability
6 probability_home_and_auto = home_insurance * auto_insurance
7
8 # displaying the result
9 print(f"The probability that the resident has both homeowner's and automobile insurance is {probability_home_and_auto:.3f}")
10
```

```
11 # interpreting the result
12 print(f"So, there is about a {probability_home_and_auto*100:.1f}% probability that a resident has both the insurance.")
```

→ The probability that the resident has both homeowner's and automobile insurance is 0.143
So, there is about a 14.3% probability that a resident has both the insurance.

Question 2

In a recent survey, 33% of the respondents said that they feel that they are overqualified for the present job. Of these, 24% said that they were looking for a new job. If a person is selected at random, find the probability that the person feels that he or she is overqualified and is also looking for a new job.

```
1 ## Write Your Code Here ##
```

Example:

Three cards are drawn from an ordinary deck and not replaced. Find the probability of getting an ace, a king and a queen in order.

```
1 # from the given question
2 ace_cards = 4
3 total_card_for_ace = 52
4 king_cards = 4
5 total_card_for_king = 51 # the ace card has not put back into the deck
6 queen_cards = 4
7 total_card_for_queen = 50 # the king card has not put back into the deck
8
9 # calculating the probability of each separately
10 probability_ace = ace_cards/total_card_for_ace
11 probability_king = king_cards/total_card_for_king
12 probability_queen = queen_cards/total_card_for_queen
13
14 # calculating the probability of combined cards
15 probability_ace_and_king_and_queen = probability_ace * probability_king * probability_queen
16
17 print(f"The probability of getting an ace, a king and a queen in order is {probability_ace_and_king_and_queen:.4f}")
```

→ The probability of getting an ace, a king and a queen in order is 0.0005

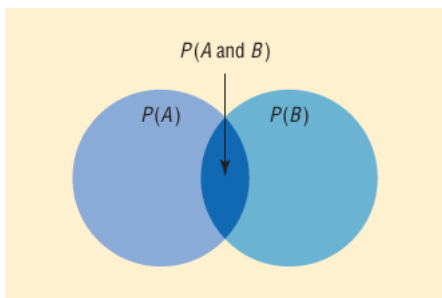
Question 3

Find the probability of getting a club, a spade, and a heart in order when three cards are drawn from an ordinary deck of card and the drawn cards are not replaced back the the same deck.

```
1 ## Write Your Code Here ##
```

Conditional Probability

The probability that the second event B occurs given that the first event A has occurred can be found by dividing the probability that both events occurred by the probability that the first event has occurred. The formula is:



$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$$

For example:

A box contains black chips and white chips. A person selects two chips without replacement. If the probability of selecting a black chip and a white chip is $\frac{15}{56}$ and the probability of selecting a black chip on the first draw is $\frac{3}{8}$, find the probability of selecting the white chip on the second draw, given that the first chip selected was a black chip.

```
1 # Given from the question
2
3 probability_black_and_white = 15/56
4 probability_black = 3/8
5
6 # probability of selecting white chip on second draw, assuming the first chip selected was black
7 probability_white_after_black = probability_black_and_white/probability_black
8
9 print(f"The probability of selecting a white chip on the second draw given that the first chip selected was black is {probability_white_
```

↩ The probability of selecting a white chip on the second draw given that the first chip selected was black is 0.714

▼ Question 4

The probability that Sam parks in a no-parking zone and gets a parking ticket is 0.06, and the probability that Sam cannot find a legal parking space and has to park in the no-parking zone is 0.2. On Tuesday, Sam arrives at school and has to park in a no-parking zone. Find the probability that he will get a parking ticket.

```
1 ## Write Your Code Here ##
```