Tutorial – 6

Conditional Probability, Independent Events, and Permutations & Combinations

In this tutorial, we will cover:

- Conditional Probability
- Independent Events
- Permutations & Combinations

Using Python, we will solve multiple practical problems to illustrate these concepts.

Conditional Probability

Example 1: Probability of Drawing a Red Card Given a Face Card was Drawn

```
def conditional_probability():
    # Total face cards in a deck: 12 (3 face cards in each of the 4 suits)
    # Total red face cards: 6 (3 hearts + 3 diamonds)
    # Probability of drawing a red card given a face card
    P_A_given_B = 6 / 12
    print(f"P(Red | Face Card) = {P_A_given_B:.2f}")

conditional_probability()
```

Example 2: Probability of Getting a Defective Item Given it's from Supplier A

A company gets 60% of its products from Supplier A and 40% from Supplier B. The defect rate is: 5% for Supplier A and 10% for Supplier B. Find the probability that a randomly chosen defective item came from Supplier A.

```
def defective_supplier():
    P_A = 0.6  # Probability of choosing Supplier A
    P_B = 0.4  # Probability of choosing Supplier B
    P_D_given_A = 0.05  # Probability of defect given Supplier A
    P_D_given_B = 0.10  # Probability of defect given Supplier B

    # Total probability of defect (Law of Total Probability)
    P_D = (P_A * P_D_given_A) + (P_B * P_D_given_B)

    # Conditional probability using Bayes' theorem
    P_A_given_D = (P_A * P_D_given_A) / P_D
    print(f"P(Supplier A | Defective) = {P_A_given_D:.2f}")

defective_supplier()
```

Independent Events

Example 3: Coin Toss Independence

```
def coin_toss_independence():
    # Probability of heads in a fair coin
    P_H = 0.5
    # Probability of getting two heads in two flips (independent events)
    P_HH = P_H * P_H
    print(f"P(Heads on both flips) = {P_HH:.2f}")

coin_toss_independence()
```

Example 4: Rolling Two Dice and Getting a Sum of 7

```
def dice_probability():
    count = 0
    total = 0

    for die1 in range(1, 7):
        for die2 in range(1, 7):
            total += 1
            if die1 + die2 == 7:
                count += 1

    probability = count / total
    print(f"P(Sum of 7) = {probability:.2f}")

dice_probability()
```

Permutations and Combinations

Example 5: Arranging Students in a Row

```
from math import factorial

def permutations(n, r):
    return factorial(n) // factorial(n - r)

print("Permutations (3 out of 5):", permutations(5, 3))
```

Example 6: Number of Different 4-Digit PIN Codes

Each digit in a 4-digit PIN can be any number from 0-9. Find the total number of PINs if:

i) Digits can be repeated, ii) Digits cannot be repeated.

```
def pin_codes():
    # Case 1: Repetition allowed (10 choices per digit)
    with_repetition = 10 ** 4

    # Case 2: No repetition (10 choices for first, 9 for second, etc.)
    without_repetition = permutations(10, 4)

    print(f"PIN codes (with repetition): {with_repetition}")
    print(f"PIN codes (without repetition): {without_repetition}")

pin_codes()
```

Example 7: Choosing 2 Team Members from 4 People

```
def combinations(n, r):
    return factorial(n) // (factorial(r) * factorial(n - r))

print("Combinations (2 out of 4):", combinations(4, 2))
```

Example 8: Ways to Select a committee of 3 from 10 People

```
print("Ways to select a committee of 3 from 10 people:", combinations(10, 3))
```