

```

import random
import numpy as np
import pandas as pd
from scipy.stats import norm
from sklearn import datasets
import matplotlib.pyplot as plt

```

Part - 1

```

def Dice_Stair_1(total_runs):
    Sixty_Plus = []
    for i in range(total_runs):
        step = 0
        for j in range(250):
            dice = random.randint(1, 6)
            # print(dice)
            if step == 0:
                if dice == 1 or dice == 2:
                    continue
            if dice == 1 or dice == 2:
                step -= 1
            elif dice == 3 or dice == 5 or dice == 4:
                step += 1

            while dice == 6:
                dice = random.randint(1, 6)
                # print(dice)
                if step == 0:
                    if dice == 1 or dice == 2:
                        break
                if dice == 1 or dice == 2:
                    step -= 1
                elif dice == 3 or dice == 5 or dice == 4:
                    step += 1
                print("6 Encountered Re-Rolling", end=', ')
            print("Step = ", step, "Dice = ", dice)
        print("Steps Reached At the end of {} Cycle = {}".format(i, step))
        if step > 60:
            Sixty_Plus.append(1)
        else:
            Sixty_Plus.append(0)
    print("We Moved above Sixty Step = ",
          Sixty_Plus.count(1), " AND ", "We are Less Than Sixty Steps = ", Sixty_Plus.count(0))
    print("Probability ({} ) Trials and {} Throws per trial = ".format(total_runs, 250), Sixty_Plus.co

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Dice_Stair_1(1000)



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Step = 56 Dice = 3
Step = 55 Dice = 2
Step = 54 Dice = 1
Step = 55 Dice = 3
Step = 56 Dice = 3
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Steps Reached At the end of 979 Cycle = 56

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Steps Reached At the end of 991 Cycle = 62
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6 Encountered Re-Rolling, Step = 48 Dice = 5
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6 Encountered Re-Rolling, Step = 39 Dice = 4
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Steps Reached At the end of 993 Cycle = 59
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6 Encountered Re-Rolling, Step = 25 Dice = 4
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Step = 2 Dice = 2
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Step = 0 Dice = 1
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Step = 0 Dice = 2
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Step = 7 Dice = 1

Step = 8 Dice = 5

Step = 7 Dice = 1

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Step = 7 Dice = 2

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Step = 7 Dice = 3

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Step = 7 Dice = 5

Step = 8 Dice = 3

Step = 7 Dice = 1

Step = 8 Dice = 5

Step = 7 Dice = 2

Step = 6 Dice = 2

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Step = 7 Dice = 5

Step = 6 Dice = 1

Step = 7 Dice = 3

Step = 8 Dice = 5

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Step = 9 Dice = 4

Step = 8 Dice = 1

Step = 9 Dice = 5

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Step = 9 Dice = 1

Step = 10 Dice = 3

Step = 11 Dice = 4

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Step = 13 Dice = 5

Step = 12 Dice = 1

6 Encountered Re-Rolling, Step = 13 Dice = 3

Step = 14 Dice = 3

Step = 13 Dice = 2

Step = 12 Dice = 2

Step = 11 Dice = 2

Step = 12 Dice = 4

Step = 13 Dice = 5

Step = 12 Dice = 2

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Step = 10 Dice = 2

Step = 11 Dice = 5

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Step = 8 Dice = 1

Step = 9 Dice = 5

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Step = 11 Dice = 5

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Step = 13 Dice = 2

Step = 14 Dice = 3

Step = 13 Dice = 2

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Step = 34 Dice = 1
Step = 35 Dice = 3

Step = 36 Dice = 5

Step = 36 Dice = 5

Step = 35 Dice = 2

Step = 36 Dice = 4

Steps Reached At the end of 999 Cycle = 36

We Moved above Sixty Step = 299 AND We are Less Than Sixty Steps = 701

Probability (1000) Trials and 250 Throws per trial = 0.299


```

# With Custom Number Of Throws
def Dice_Stair_2(throws, total_runs):
    Sixty_Plus = []
    for i in range(total_runs):
        step = 0
        for j in range(throws):
            dice = random.randint(1, 6)
            # print(dice)
            if step == 0:
                if dice == 1 or dice == 2:
                    continue
            if dice == 1 or dice == 2:
                step -= 1
            elif dice == 3 or dice == 5 or dice == 4:
                step += 1

        while dice == 6:
            dice = random.randint(1, 6)
            # print(dice)
            if step == 0:
                if dice == 1 or dice == 2:
                    break
            if dice == 1 or dice == 2:
                step -= 1
            elif dice == 3 or dice == 5 or dice == 4:
                step += 1

```



```

        print("6 Encountered Re-Rolling", end=', ')
        print("Step = ", step, "Dice = ", dice)
    print("Steps Reached At the end of {} Cycle = {}".format(i, step))
    if step > 60:
        Sixty_Plus.append(1)
    else:
        Sixty_Plus.append(0)
    print("We Moved above Sixty Step = ", Sixty_Plus.count(1), " AND ",
          "We are Less Than Sixty Steps = ", Sixty_Plus.count(0))
    print("Probability ({} Trials and {} Throws per trial = ".format(total_runs, throws), Sixty_Plus

```

Dice_Stair_2(250, 1000)



Streaming output truncated to the last 5000 lines.

Step = 5 Dice = 5
Step = 6 Dice = 5
6 Encountered Re-Rolling, Step = 5 Dice = 2
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Step = 7 Dice = 3
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Step = 7 Dice = 4
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Step = 4 Dice = 1
Step = 5 Dice = 3
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6 Encountered Re-Rolling, Step = 61 Dice = 2
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Step = 6 Dice = 5
Step = 7 Dice = 3
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Step = 6 Dice = 2
Step = 7 Dice = 4
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6 Encountered Re-Rolling, Step = 4 Dice = 2
Step = 5 Dice = 5
6 Encountered Re-Rolling, Step = 6 Dice = 3
Step = 7 Dice = 3
6 Encountered Re-Rolling, Step = 8 Dice = 5

6 Encountered Re-Rolling, Step = 9 Dice = 4

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Step = 11 Dice = 3

Step = 10 Dice = 1

Step = 11 Dice = 3

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Step = 11 Dice = 2

Step = 12 Dice = 3

Step = 11 Dice = 2

Step = 12 Dice = 4

Step = 11 Dice = 1

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Step = 14 Dice = 5

Step = 15 Dice = 3

Step = 16 Dice = 4

Step = 15 Dice = 2

Step = 16 Dice = 4

Step = 15 Dice = 2

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Step = 16 Dice = 2

Step = 15 Dice = 1

Step = 16 Dice = 5

Step = 15 Dice = 1

Step = 16 Dice = 4

Step = 17 Dice = 3

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Step = 16 Dice = 5

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Step = 20 Dice = 3

Step = 19 Dice = 2

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Step = 1 Dice = 1
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6 Encountered Re-Rolling, Step = 4 Dice = 5
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Steps Reached At the end of 994 Cycle = 44
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6 Encountered Re-Rolling, Step = 5 Dice = 4
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Step = 41 Dice = 4
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6 Encountered Re-Rolling, Step = 41 Dice = 1
Step = 42 Dice = 4
6 Encountered Re-Rolling, Step = 43 Dice = 4
Step = 42 Dice = 1
Step = 43 Dice = 5
Step = 42 Dice = 1
Step = 43 Dice = 5
Step = 42 Dice = 1
Step = 43 Dice = 4
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Step = 43 Dice = 2
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6 Encountered Re-Rolling, Step = 43 Dice = 2
Step = 42 Dice = 1
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Step = 42 Dice = 4
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Step = 41 Dice = 2

Step = 42 Dice = 5
6 Encountered Re-Rolling, Step = 43 Dice = 4
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 44 Dice = 3
Steps Reached At the end of 999 Cycle = 44
We Moved above Sixty Step = 274 AND We are Less Than Sixty Steps = 726
Probability (1000) Trials and 250 Throws per trial = 0.274


```

# With Probability Distribution
def Dice_Stair_3(throws, weights, total_runs):
    Sixty_Plus = []
    for i in range(total_runs):
        dice_v = []
        step = 0
        for j in range(throws):
            dice = random.choices(range(1, 7), weights=weights)
            dice = dice[0]
            # print(dice)
            if step == 0:
                if dice == 1 or dice == 2:
                    dice_v.append(dice)
                    continue
            if dice == 1 or dice == 2:
                step -= 1
            elif dice == 3 or dice == 5 or dice == 4:
                step += 1

        while dice == 6:
            dice = random.randint(1, 6)
            # print(dice)
            if step == 0:
                if dice == 1 or dice == 2:
                    break
            if dice == 1 or dice == 2:

```



```

        step -= 1
    elif dice == 3 or dice == 5 or dice == 4:
        step += 1
    print("6 Encountered Re-Rolling", end=', ')
    print("Step = ", step, "Dice = ", dice)
    print("Steps Reached At the end of {} Cycle = {}".format(i, step))
    if step > 60:
        Sixty_Plus.append(1)
    else:
        Sixty_Plus.append(0)

print("We Moved above Sixty Step = ", Sixty_Plus.count(1), " AND ",
      "We are Less Than Sixty Steps = ", Sixty_Plus.count(0))
print("Probability ({} ) Trials and {} Throws per trial = {}".format(total_runs, throws), Sixty_Plus

```

```

probabilities = [0.2, 0.3, 0.2, 0.1, 0.1, 0.1]
Dice_Stair_3(250, probabilities, 1000)

```



Streaming output truncated to the last 5000 lines.

Step = 6 Dice = 4

Step = 5 Dice = 1

Step = 6 Dice = 3

Step = 5 Dice = 1

Step = 6 Dice = 4

Step = 5 Dice = 1

Step = 6 Dice = 3

Step = 5 Dice = 2

Step = 4 Dice = 1

Step = 5 Dice = 3

Step = 6 Dice = 4

Step = 5 Dice = 2

Step = 4 Dice = 2

Step = 5 Dice = 5

Step = 4 Dice = 2

Step = 5 Dice = 5

Step = 6 Dice = 4

6 Encountered Re-Rolling, Step = 7 Dice = 3

Step = 8 Dice = 3

Step = 9 Dice = 4

Step = 8 Dice = 2

6 Encountered Re-Rolling, Step = 9 Dice = 4

Step = 10 Dice = 4

Step = 11 Dice = 4

Step = 10 Dice = 1

Step = 9 Dice = 1

Step = 10 Dice = 3

Step = 9 Dice = 2

Step = 8 Dice = 1

Step = 7 Dice = 2

Step = 8 Dice = 4

Step = 9 Dice = 5

Step = 8 Dice = 2

Step = 7 Dice = 2

6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 8 Dice = 4

Step = 7 Dice = 2

Step = 6 Dice = 1

Step = 5 Dice = 2

Step = 6 Dice = 4

Step = 5 Dice = 1

Step = 4 Dice = 2

6 Encountered Re-Rolling, Step = 5 Dice = 4

6 Encountered Re-Rolling, Step = 4 Dice = 2

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Step = 2 Dice = 2

Step = 3 Dice = 3

6 Encountered Re-Rolling, Step = 2 Dice = 2

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Step = 2 Dice = 4

Step = 1 Dice = 2

Step = 2 Dice = 5

Step = 1 Dice = 2

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Step = 1 Dice = 4

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6 Encountered Re-Rolling, Step = 3 Dice = 5
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6 Encountered Re-Rolling, Step = 2 Dice = 1
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6 Encountered Re-Rolling, Step = 2 Dice = 3
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6 Encountered Re-Rolling, Step = 1 Dice = 1
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6 Encountered Re-Rolling, Step = 3 Dice = 4
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Step = 2 Dice = 3

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Step = 4 Dice = 3
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Steps Reached At the end of 979 Cycle = 2
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6 Encountered Re-Rolling, Step = 3 Dice = 3
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Step = 4 Dice = 3
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Step = 3 Dice = 4
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Step = 3 Dice = 3
Step = 4 Dice = 3
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Step = 0 Dice = 2
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6 Encountered Re-Rolling, Step = 2 Dice = 2
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Step = 1 Dice = 3
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Step = 3 Dice = 5
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6 Encountered Re-Rolling, Step = 3 Dice = 4
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Step = 0 Dice = 1

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Step = 3 Dice = 4
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Step = 3 Dice = 4
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Step = 2 Dice = 5
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6 Encountered Re-Rolling, 6 Encountered Re-Rolling, 6 Encountered Re-Rolling, 6 Encountered Re-Rolling
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Steps Reached At the end of 980 Cycle = 0
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6 Encountered Re-Rolling, Step = 1 Dice = 3
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Step = 1 Dice = 3
Step = 0 Dice = 2
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6 Encountered Re-Rolling, Step = 2 Dice = 3
6 Encountered Re-Rolling, Step = 3 Dice = 5
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Step = 5 Dice = 4
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Step = 4 Dice = 2
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Step = 8 Dice = 5
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Step = 8 Dice = 4
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Step = 6 Dice = 2
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Step = 5 Dice = 2
Step = 6 Dice = 3
Step = 5 Dice = 2

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Step = 3 Dice = 3
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Step = 1 Dice = 2
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Step = 4 Dice = 5
6 Encountered Re-Rolling, Step = 5 Dice = 4
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Step = 3 Dice = 2
Step = 4 Dice = 5
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6 Encountered Re-Rolling, Step = 1 Dice = 2
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Step = 1 Dice = 3
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Step = 1 Dice = 2
Step = 2 Dice = 3
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Step = 0 Dice = 1
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 0 Dice = 2
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Step = 2 Dice = 3
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Step = 4 Dice = 3
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Step = 2 Dice = 1
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6 Encountered Re-Rolling, Step = 1 Dice = 2
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6 Encountered Re-Rolling, Step = 3 Dice = 5
6 Encountered Re-Rolling, Step = 4 Dice = 5

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6 Encountered Re-Rolling, Step = 5 Dice = 5
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6 Encountered Re-Rolling, Step = 5 Dice = 2
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6 Encountered Re-Rolling, Step = 4 Dice = 3
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Step = 6 Dice = 3
Step = 5 Dice = 2
Step = 6 Dice = 4
6 Encountered Re-Rolling, Step = 7 Dice = 3
6 Encountered Re-Rolling, Step = 6 Dice = 1
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Step = 7 Dice = 4
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Step = 9 Dice = 4

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Step = 9 Dice = 4
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Step = 5 Dice = 2
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6 Encountered Re-Rolling, Step = 2 Dice = 3
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Step = 5 Dice = 4
Step = 4 Dice = 2
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6 Encountered Re-Rolling, Step = 5 Dice = 5
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Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 2 Dice = 3
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Steps Reached At the end of 981 Cycle = 3
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Step = 5 Dice = 1
Step = 6 Dice = 5
Step = 7 Dice = 4
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Step = 7 Dice = 5
Step = 6 Dice = 2
Step = 7 Dice = 5
Step = 6 Dice = 1
6 Encountered Re-Rolling, Step = 7 Dice = 5
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Step = 5 Dice = 2
Step = 4 Dice = 2
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Step = 2 Dice = 2
Step = 3 Dice = 5
Step = 4 Dice = 3
Step = 5 Dice = 3
Step = 4 Dice = 2

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Step = 4 Dice = 2
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Step = 2 Dice = 5
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Step = 2 Dice = 4
6 Encountered Re-Rolling, Step = 1 Dice = 1
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 2 Dice = 5
Step = 3 Dice = 3
6 Encountered Re-Rolling, Step = 4 Dice = 4
Step = 5 Dice = 3
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Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 3 Dice = 3
Step = 4 Dice = 3
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6 Encountered Re-Rolling, Step = 3 Dice = 5
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Step = 4 Dice = 3
Step = 5 Dice = 3
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Step = 7 Dice = 3
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6 Encountered Re-Rolling, Step = 4 Dice = 2
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6 Encountered Re-Rolling, Step = 1 Dice = 3
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Step = 2 Dice = 3

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Step = 3 Dice = 4

6 Encountered Re-Rolling, Step = 4 Dice = 3

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Step = 2 Dice = 3
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Step = 2 Dice = 4
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Step = 0 Dice = 2
Step = 1 Dice = 4

6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 0 Dice = 2

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Step = 3 Dice = 2
Step = 4 Dice = 3
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Step = 3 Dice = 2

6 Encountered Re-Rolling, Step = 2 Dice = 1

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Step = 4 Dice = 3
Step = 3 Dice = 2
Step = 4 Dice = 3
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Step = 5 Dice = 2
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Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 3 Dice = 3
Step = 2 Dice = 2
Step = 3 Dice = 4

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6 Encountered Re-Rolling, Step = 2 Dice = 1
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6 Encountered Re-Rolling, Step = 2 Dice = 5
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 1 Dice =
6 Encountered Re-Rolling, Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 2 Dice = 5
6 Encountered Re-Rolling, Step = 3 Dice = 4
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Step = 3 Dice = 4
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 0 Dice = 1
Step = 1 Dice = 4
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Step = 1 Dice = 4
Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 5
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Step = 1 Dice = 5
Step = 2 Dice = 4
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 4
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6 Encountered Re-Rolling, Step = 2 Dice = 5
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Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 0 Dice = 1
6 Encountered Re-Rolling, Step = 1 Dice = 4
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Step = 4 Dice = 4
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 3 Dice = 2
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6 Encountered Re-Rolling, Step = 3 Dice = 3
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Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 2 Dice = 5
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Step = 4 Dice = 4
Step = 5 Dice = 3
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Step = 7 Dice = 3
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Step = 7 Dice = 4
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Step = 5 Dice = 2
Step = 4 Dice = 1
Step = 5 Dice = 3
Step = 6 Dice = 4
6 Encountered Re-Rolling, Step = 5 Dice = 2
6 Encountered Re-Rolling, Step = 4 Dice = 2
Step = 5 Dice = 3
Step = 6 Dice = 5
Steps Reached At the end of 982 Cycle = 6

Step = 1 Dice = 4
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 4
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Step = 2 Dice = 2
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 3
6 Encountered Re-Rolling, Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 2 Dice = 4
Step = 3 Dice = 3
Step = 4 Dice = 4
Step = 5 Dice = 3
Step = 4 Dice = 2
Step = 5 Dice = 3
Step = 6 Dice = 3
Step = 5 Dice = 1
Step = 6 Dice = 3
Step = 7 Dice = 3
Step = 6 Dice = 2
Step = 5 Dice = 1
Step = 4 Dice = 2
Step = 3 Dice = 1
Step = 4 Dice = 3
Step = 3 Dice = 1
Step = 4 Dice = 3
Step = 3 Dice = 2
Step = 4 Dice = 4
Step = 5 Dice = 3
Step = 6 Dice = 4
Step = 7 Dice = 5
Step = 6 Dice = 2
Step = 5 Dice = 1
Step = 4 Dice = 1
Step = 5 Dice = 3
Step = 6 Dice = 3
Step = 5 Dice = 1

Step = 6 Dice = 4
Step = 7 Dice = 3
Step = 6 Dice = 1
Step = 5 Dice = 1
Step = 4 Dice = 2
Step = 3 Dice = 2
Step = 4 Dice = 3
Step = 5 Dice = 3
Step = 4 Dice = 1
Step = 5 Dice = 5
6 Encountered Re-Rolling, Step = 4 Dice = 1
Step = 3 Dice = 2
Step = 4 Dice = 3
Step = 5 Dice = 3
Step = 4 Dice = 1
Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 2 Dice = 2
Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 4
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 5
Step = 3 Dice = 3
Step = 4 Dice = 5
Step = 5 Dice = 4
Step = 6 Dice = 3
Step = 7 Dice = 3
6 Encountered Re-Rolling, Step = 6 Dice = 2
Step = 5 Dice = 1
Step = 6 Dice = 3
Step = 7 Dice = 3
Step = 8 Dice = 3
Step = 9 Dice = 3
Step = 10 Dice = 5
Step = 9 Dice = 1
Step = 10 Dice = 3
Step = 9 Dice = 1
Step = 8 Dice = 1
Step = 7 Dice = 2
Step = 6 Dice = 2
Step = 5 Dice = 1
Step = 4 Dice = 1
6 Encountered Re-Rolling, Step = 5 Dice = 5
Step = 4 Dice = 1
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 3 Dice = 3
Step = 4 Dice = 4
Step = 5 Dice = 4
Step = 4 Dice = 2
Step = 5 Dice = 3
Step = 6 Dice = 4
Step = 7 Dice = 4
Step = 6 Dice = 2
Step = 5 Dice = 2
Step = 6 Dice = 4
Step = 7 Dice = 3
Step = 8 Dice = 5
Step = 7 Dice = 1

Step = 7 Dice = 1
Step = 6 Dice = 1
Step = 7 Dice = 3
Step = 6 Dice = 1
Step = 7 Dice = 5
Step = 6 Dice = 1
Step = 5 Dice = 1
Step = 4 Dice = 2
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 2 Dice = 3
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 0 Dice = 1
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 4
Step = 3 Dice = 5
Step = 2 Dice = 2
Step = 3 Dice = 3
6 Encountered Re-Rolling, Step = 4 Dice = 4
Step = 5 Dice = 4
Step = 6 Dice = 3
Step = 5 Dice = 2
Step = 6 Dice = 5
Steps Reached At the end of 997 Cycle = 6
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 3 Dice = 3
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 2 Dice = 3
Step = 3 Dice = 3
Step = 4 Dice = 3
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 3 Dice = 5
Step = 2 Dice = 2
Step = 1 Dice = 2
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 2 Dice = 4
Step = 3 Dice = 3
Step = 2 Dice = 2
Step = 3 Dice = 4
Step = 2 Dice = 2
Step = 3 Dice = 3
Step = 4 Dice = 3
Step = 5 Dice = 4
Step = 4 Dice = 2
Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 1 Dice = 2

Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 2 Dice = 3
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 2 Dice = 3
6 Encountered Re-Rolling, Step = 3 Dice = 5
Step = 2 Dice = 2
6 Encountered Re-Rolling, Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 3 Dice = 5
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 2 Dice = 4
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 3 Dice = 4
Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 1 Dice = 2
6 Encountered Re-Rolling, Step = 2 Dice = 5
6 Encountered Re-Rolling, Step = 3 Dice = 4
Step = 4 Dice = 4
Step = 3 Dice = 1
Step = 4 Dice = 4
Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 3
Step = 1 Dice = 2
Step = 2 Dice = 4
Step = 1 Dice = 2
Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 3
Step = 2 Dice = 4
Step = 3 Dice = 4
6 Encountered Re-Rolling, Step = 4 Dice = 3
Step = 3 Dice = 1

Step = 2 Dice = 2
Step = 1 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 0 Dice = 2
Step = 1 Dice = 4
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 0 Dice = 1
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 1 Dice = 4
Step = 2 Dice = 3
Step = 3 Dice = 5
6 Encountered Re-Rolling, Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 4
6 Encountered Re-Rolling, Step = 3 Dice = 4
Step = 4 Dice = 5
Step = 5 Dice = 3
Step = 4 Dice = 2
Step = 3 Dice = 1
6 Encountered Re-Rolling, Step = 2 Dice = 2
Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 4
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 2 Dice = 5
Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 2

6 Encountered Re-Rolling, Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 4
Step = 1 Dice = 1
Step = 2 Dice = 4
6 Encountered Re-Rolling, Step = 1 Dice = 2
Step = 2 Dice = 5
Step = 3 Dice = 3
Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 4 Dice = 3
6 Encountered Re-Rolling, Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 4 Dice = 3
Step = 3 Dice = 1
Step = 4 Dice = 3
Step = 5 Dice = 5
6 Encountered Re-Rolling, Step = 6 Dice = 5
Step = 5 Dice = 2
Step = 4 Dice = 2
Step = 3 Dice = 2
Step = 2 Dice = 2
6 Encountered Re-Rolling, Step = 3 Dice = 3
Step = 2 Dice = 1
Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 1 Dice = 2
6 Encountered Re-Rolling, Step = 2 Dice = 4
Step = 3 Dice = 3
Step = 4 Dice = 3
Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 2 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 1
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 3
Step = 1 Dice = 2
6 Encountered Re-Rolling, Step = 0 Dice = 1
Steps Reached At the end of 998 Cycle = 0
Step = 1 Dice = 5
Step = 2 Dice = 5
Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 3 Dice = 5
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2

Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 4
Step = 1 Dice = 2
Step = 2 Dice = 4
Step = 3 Dice = 3
Step = 4 Dice = 4
Step = 5 Dice = 5
Step = 6 Dice = 3
Step = 5 Dice = 2
Step = 6 Dice = 3
Step = 5 Dice = 1
Step = 6 Dice = 3
Step = 5 Dice = 1
Step = 4 Dice = 1
Step = 3 Dice = 1
Step = 2 Dice = 1
Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 3 Dice = 5
Step = 4 Dice = 5
6 Encountered Re-Rolling, Step = 5 Dice = 3
6 Encountered Re-Rolling, Step = 4 Dice = 1
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 3 Dice = 3
6 Encountered Re-Rolling, Step = 4 Dice = 3
Step = 3 Dice = 1
Step = 2 Dice = 2
Step = 3 Dice = 3
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 2 Dice = 4
Step = 1 Dice = 1
6 Encountered Re-Rolling, 6 Encountered Re-Rolling, Step = 2 Dice = 3
Step = 3 Dice = 4
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 0 Dice = 1
Step = 1 Dice = 4
Step = 2 Dice = 3
Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 3 Dice = 3
Step = 2 Dice = 2
Step = 3 Dice = 5
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 3 Dice = 3
Step = 2 Dice = 2
6 Encountered Re-Rolling, Step = 3 Dice = 5

6 Encountered Re-Rolling, Step = 5 Dice = 5
Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 0 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 5
Step = 3 Dice = 3
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 0 Dice = 1
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 5
Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 3
Step = 0 Dice = 1
Step = 1 Dice = 4
6 Encountered Re-Rolling, Step = 0 Dice = 1
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 4
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 3 Dice = 5
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 4 Dice = 3
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 2 Dice = 3
6 Encountered Re-Rolling, Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
6 Encountered Re-Rolling, Step = 1 Dice = 3
Step = 2 Dice = 4
Step = 3 Dice = 3
Step = 2 Dice = 1
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 3
Step = 2 Dice = 3
Step = 3 Dice = 4
Step = 4 Dice = 4
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 3 Dice = 3
Step = 4 Dice = 3
Step = 3 Dice = 1
6 Encountered Re-Rolling, Step = 4 Dice = 5
Step = 5 Dice = 5
Step = 4 Dice = 1
Step = 3 Dice = 2
Step = 2 Dice = 1
Step = 3 Dice = 3

6 Encountered Re-Rolling, Step = 4 Dice = 5
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 3 Dice = 3
Step = 2 Dice = 2
Step = 1 Dice = 1
Step = 2 Dice = 5
Step = 3 Dice = 4
Step = 2 Dice = 1
Step = 3 Dice = 5
Step = 4 Dice = 3
Step = 5 Dice = 5
Step = 4 Dice = 2
Step = 3 Dice = 1
Step = 4 Dice = 3
Step = 5 Dice = 4
Step = 4 Dice = 2
Step = 5 Dice = 3
Step = 6 Dice = 3
6 Encountered Re-Rolling, Step = 7 Dice = 3
Step = 6 Dice = 2
Step = 5 Dice = 1
Step = 4 Dice = 1
Step = 5 Dice = 5
Step = 4 Dice = 2
Step = 3 Dice = 2
Step = 2 Dice = 2
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 2 Dice = 3
Step = 1 Dice = 1
6 Encountered Re-Rolling, Step = 0 Dice = 2
Step = 1 Dice = 3
6 Encountered Re-Rolling, Step = 2 Dice = 3
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 1 Dice = 4
Step = 2 Dice = 3
Step = 1 Dice = 2
Step = 0 Dice = 2
Step = 0 Dice = 1
Step = 1 Dice = 5
Step = 2 Dice = 5
Step = 1 Dice = 2
Step = 2 Dice = 3
Step = 1 Dice = 1
Step = 2 Dice = 4
Step = 1 Dice = 1
Step = 2 Dice = 3
Step = 1 Dice = 2
6 Encountered Re-Rolling, Step = 2 Dice = 5
Step = 1 Dice = 1
Step = 0 Dice = 2
Step = 1 Dice = 5
Step = 2 Dice = 4
Step = 3 Dice = 4
Step = 4 Dice = 3
Step = 5 Dice = 5
Step = 6 Dice = 3
Step = 5 Dice = 2
Step = 6 Dice = 4
Step = 5 Dice = 2

```
Step = 5 Dice = 1  
Step = 6 Dice = 3  
Step = 7 Dice = 5  
Step = 8 Dice = 3  
Steps Reached At the end of 999 Cycle = 8  
We Moved above Sixty Step = 0 AND We are Less Than Sixty Steps = 1000  
Probability (1000) Trials and 250 Throws per trial = 0.0
```


After applying weights to every number of dice the probability of getting a sum of 60 is reduced to 0 in 1000 trial runs with 250 throws of dice in c

```
# Data-Generation For Linear Regression
def Data_Generation_For_Linear_Regression(no_of_rows, no_of_attributes):
    error = norm.rvs(0, 0.25, no_of_rows)
    # print(error)
    features = []
    for v in range(no_of_attributes):
        x = norm.rvs(0, 1, no_of_rows)
        x = x[:, np.newaxis]
        if v == 0:
            features = x
        else:
            features = np.c_[x, features]
    # print(features)

y = []
for value in features:
    summation = 0
    for w in range(0, len(value)):
        # print(value[w])
        # print('value[w] =', value[w])
        # print('weight =', weight[w])
        # print('sum =', summation + value[w] * weight[w])
        summation = summation + value[w] * weight[w]
```



```

        summation = summation + (1 / (w + 2)) * value[w]
    # print(summation)
    y.append(summation)
y = y + error - 1
cols = []
for i in range(no_of_attributes):
    cols.append(i)
data_set = pd.DataFrame(features, columns=cols)
data_set["y"] = y
print(data_set.head())
data_set.to_csv("Linear_Regression_Dataset.csv")

```

Data_Generation_For_Linear_Regression(1000, 2)

```

➡
      0      1      y
0 -0.152764  1.424079 -0.403523
1  1.423984 -2.212763 -1.060273
2 -0.590866  1.526053 -0.648980
3 -0.791985 -0.124292 -1.384540
4  1.368648  0.010023 -0.089877

```

```

def Data_Generation_For_Logistic_Regression(no_of_rows, no_of_attributes):
    features = []
    for v in range(no_of_attributes):
        x = norm.rvs(0, 1, no_of_rows)
        x = x[:, np.newaxis]
        if v == 0:
            features = x
        else:
            features = np.c_[x, features]
    # print(features)
    y = []
    for value in features:
        summation = 1
        z = 0
        for w in range(0, len(value)):
            # print(value[w])
            summation = summation + ((w + 2) * value[w])
            z = 1 / (1 + np.exp(-summation))
        y.append(1 if z >= 0.5 else 0)

    cols = []
    for i in range(no_of_attributes):
        cols.append(i)
    data_set = pd.DataFrame(features, columns=cols)
    data_set["y"] = y
    print(data_set.head())
    data_set.to_csv("Logistic_Regression_Dataset.csv")

```

Data_Generation_For_Logistic_Regression(1000, 2)

```

➡
      0      1      y
0 -1.068516  0.446754  1
1  0.190577  1.851807  1
2 -1.114792 -0.053733  0
3 -0.157581  2.810342  1
4 -1.142359 -0.532436  0

```

```
def Data_Generation_For_K_Means(no_of_values, features):
    x, y = datasets.make_blobs(no_of_values, features, random_state=0, centers=3)
    cols = []
    for i in range(features):
        cols.append(i)
    data_set = pd.DataFrame(x, columns=cols)
    print(data_set.head())
    data_set.to_csv("Data_Set_K_Means.csv")
```

```
Data_Generation_For_K_Means(1000, 2)
```

```

0      0      1
0 -0.807236  2.669463
1  1.926358  4.152430
2 -1.500166  3.101333
3 -1.109050  2.877864
4 -2.531227  1.919691
```

```
# Linear Regression Using Gradient Descent
```

```
def Linear_Regression_Using_Batch_Gradient_Descent(lr, weights, epochs, x, y):
    costs = []
    for _ in range(epochs):
        prediction = np.dot(x, weights)
        error = prediction - y
        cost = 1 / (len(x)) * np.dot(error.T, error)
        costs.append(cost)
        weights = weights - (lr * (1 / len(x)) * np.dot(x.T, error))
    return weights, costs
```

```
def MSE(y, predicted):
    error = y - predicted
    return 1 / (len(y)) * np.dot(error.T, error)
```

```
np.random.seed(123)
data = pd.read_csv("Linear_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
thetas = np.random.rand(len(X[0]) + 1)
```

```
# Appending 1 for intercept purpose
```

```
X = np.c_[np.ones(X.shape[0]), X]
Y = data.iloc[:, v - 1].values
```

```
# Splitting Data_Sets
```

```
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]
```

```
theta_, past_cost = Linear_Regression_Using_Batch_Gradient_Descent(0.021, thetas, 1000, X_train, Y_train)
print(past_cost)
print(theta_)
```

```
# Plot the cost function...
```

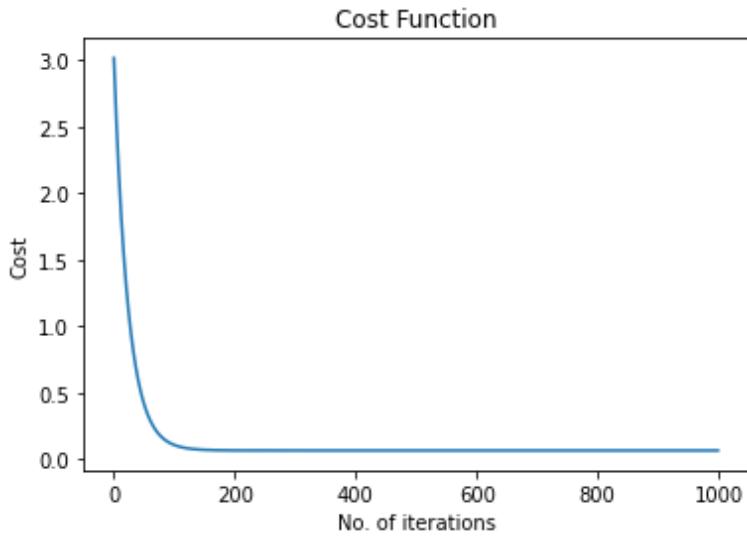
```
plt.title('Cost Function')
plt.xlabel('No. of iterations')
```

```
plt.ylabel('Cost')
plt.plot(past_cost)
plt.show()

predictions = []
c = theta_[0]
for i in X_test:
    s = 0
    for j in range(0, len(i) - 1):
        # print(j)
        s = s + (theta_[j + 1] * i[j + 1])
    s += c
    predictions.append(s)
print("Predictions")
print(predictions)
print("Original Values")
print(Y_test)
print("MSE : ", MSE(Y_test, predictions))
```



[3.018437488898325, 2.8946064840522654, 2.775972673639861, 2.6623177017662583, 2.553432396536307
[-0.99885003 0.5035994 0.32033775]



Predictions

[-0.6195958016574215, -0.9905642110713203, -0.8075575233318206, -1.437508490474022, -0.306388979

Original Values

[-4.03522609e-01 -1.06027346e+00 -6.48980387e-01 -1.38454012e+00
-8.98768793e-02 -9.94190105e-01 7.77865259e-03 -4.27983002e-01
-1.24089995e-01 -7.34424130e-02 -8.76282245e-01 -3.17863545e-01
-2.08344892e+00 -1.45084323e+00 -1.28002748e+00 -1.35898031e+00
-1.14135793e+00 -1.13154402e+00 -3.28585749e-01 -1.17014089e+00
-2.03816490e+00 1.27375913e-01 -1.40818139e+00 -1.23572006e+00
-1.52645705e+00 -9.45491306e-01 -1.80224557e+00 -1.37044996e+00
-1.25730769e+00 -7.05063366e-01 -1.25211037e+00 -1.80032054e+00
-2.09570390e+00 -2.15748810e+00 -1.58546913e+00 -5.38348445e-01
-1.14017494e+00 -1.30210507e+00 -7.14837982e-01 -8.15430782e-01
-2.03846749e-01 -6.70294458e-01 -1.01393280e-01 -5.63633994e-01
-1.59855763e+00 -1.44405917e+00 -9.61149886e-01 -4.35106865e-01
-1.78000332e+00 -1.16361257e+00 -1.53049862e+00 -7.07440920e-01
-4.09965825e-01 -7.43946338e-01 -6.33134499e-03 -1.46556966e+00
-7.57609454e-01 -2.81492907e+00 -8.07250605e-01 -1.89521966e+00
-1.10755332e+00 -3.13845944e-01 -1.28735952e+00 -1.37396532e+00
-7.90734305e-01 -8.80085538e-01 4.29119212e-01 -1.70398295e+00
-1.25822934e+00 -1.81450214e+00 -8.67313738e-01 -1.72566638e+00
-1.63398258e+00 -1.01460500e+00 -1.42887505e+00 -1.32493049e+00
-3.25668547e-01 -1.46753719e+00 -1.13271894e+00 -1.05336500e+00
-4.18867444e-01 -8.06232865e-01 -1.06281783e+00 -8.64551560e-01
-1.33992351e+00 -1.38437736e+00 -7.27748086e-02 -7.19542126e-01
-1.52979160e+00 -1.55151942e-01 -7.34049131e-01 -7.68506557e-01
-1.25815688e-01 7.33917594e-01 -2.28686097e+00 -8.68283340e-01
-8.29139901e-01 -1.05939653e+00 -1.18489803e+00 -9.48015775e-01
-1.50972509e+00 -7.17560475e-01 -6.30642074e-01 -1.77361675e+00
1.35623406e-01 -6.48317000e-01 -1.19637711e+00 -8.15022932e-01
-1.87363638e+00 -8.28030042e-01 2.00266470e-01 -1.64857283e+00
-1.76806736e-01 -9.88344793e-01 -1.27665429e+00 -9.66453106e-01
-1.28710932e+00 -7.55206561e-01 -1.31816549e+00 -1.22398814e+00
-4.23684121e-01 -6.26806763e-01 2.71995580e-04 -1.45629902e+00
-1.49033569e-01 -1.36887321e+00 -6.70549675e-01 -1.00937450e+00
-1.14659410e+00 8.54294310e-02 -3.56555370e-02 -1.30653744e+00
-1.98370954e+00 -1.40883815e+00 -1.23565669e+00 1.14748713e-01
-1.43664872e+00 -1.60430836e+00 -1.07732193e-01 -8.47319431e-01
-4.33880838e-01 -3.57844908e-01 -6.20349007e-01 -7.13265352e-01
-1.07858742e+00 -1.39097174e+00 -2.30034482e+00 -4.49649806e-01
-1.10066600e+00 5.24771437e-01 -9.24283859e-01 -2.68733804e-02
8.75548905e-02 -8.93376759e-01 -1.35163483e+00 -1.87551313e+00
-7.65251419e-01 -8.45807868e-01 -1.44412718e+00 -2.06879748e+00
2.10372114e-01 -1.71641897e+00 -6.27114764e-01 -1.57859163e+00
-1.73567432e+00 -1.20868788e+00 -3.09034151e-01 -8.85197720e-01
-7.30663183e-01 -7.34214512e-01 -5.37640548e-01 -1.61766603e+00
-7.35103158e-01 -8.78202964e-01 -1.30941141e+00 -1.34517012e+00
-9.87143529e-01 -2.57079122e-01 -2.37368909e+00 1.18501946e-01

```

-1.31626339e+00 -1.78368742e+00 -1.43288301e+00 -5.59770530e-01
-1.49557975e+00 -9.42465490e-01 -1.40665516e+00 -2.59930221e+00
-6.30104701e-01 -3.32148002e-01 -1.56180240e+00 -1.04174115e+00
-1.53360688e+00 -1.27199766e+00 4.03415696e-01 -2.15351989e-01
-1.17599870e+00 -2.76953352e+00 -5.59351784e-01 -2.38780077e+00
-9.40922703e-01 -1.32523292e+00 -3.96012354e-01 -1.23902806e+00
1.19866096e-01 -1.60085523e+00 -7.98085908e-01 -6.10743964e-01
-9.38009175e-01 -9.65804876e-02 -5.97726858e-01 -2.18669356e-01
-4.75017034e-01 -7.65852006e-01 -1.05442794e+00 -7.57129046e-01
-1.73292820e+00 -4.88648684e-01 3.50429806e-01 -1.05993187e+00
-1.43631755e+00 -8.46700323e-01 -8.07602949e-01 -1.58663736e+00
-2.92671368e-01 -7.04514264e-01 -1.68416790e+00 -7.76508373e-01
-1.85324025e+00 -9.64748222e-01 -2.33800178e+00 -5.91702344e-01
-1.24909901e+00 -8.62858884e-01 -8.98380194e-01 -8.52120308e-01
-1.75072055e+00 -6.08447804e-01 -1.15804117e+00 -9.86420737e-02
-6.83706415e-01 -9.27365764e-01 -5.67876811e-02 -1.72763710e-01
-1.46277837e+00 -2.54179218e-01 -1.16508006e-01 -1.28356790e+00
-1.86214996e+00 -7.59349291e-01 -1.65588934e+00 -7.24873346e-01
-4.05184222e-01 1.53850599e-02 -6.82881167e-01 -1.83201015e+00
-1.41207566e+00 -1.24556276e+00 -9.96946675e-01 -1.25233108e+00
-1.65627048e+00 -6.52098179e-01 -6.27113395e-01 -1.72374400e-01
-1.96163660e+00 -2.66316892e-02 1.07596519e-01 -8.37689592e-01
-2.20735297e-01 -1.09891426e+00 -1.73300507e+00 -1.57638679e+00
-1.52583158e+00 -1.64413263e+00 -4.52269275e-01 -9.86903932e-02
-8.02683681e-01 -8.56213297e-01 -1.22778762e+00 -1.65009674e+00
-1.36810640e+00 1.40649033e-01 -1.22382770e+00 -1.05642167e+00
-1.17589214e+00 -5.74392074e-01 -1.21622012e+00 -1.26232686e+00
-8.43206660e-01 -1.55543447e-01 -1.01339406e+00 -2.17807054e-01
-4.89120520e-01 -1.18782481e+00 -5.40421758e-01 -7.32778820e-01
-7.22299782e-01 -1.13914863e+00 -1.52217192e+00 -9.10179199e-01
-1.01996444e+00 -2.51707565e-01 -6.98232437e-01 -1.08268500e-02
-1.12650170e+00 -1.82777097e+00 -1.26612997e+00 -2.20700581e+00
-2.84177208e-01 -9.57656220e-01 -5.69442845e-02 -9.56563013e-01
-1.10856611e+00 -1.21548734e+00 -1.68402565e+00 2.26769754e-01
-2.19851906e+00 -7.34783927e-01 2.73473270e-01 -1.80503294e+00
-1.16536417e+00 -1.73398163e+00 -1.09629621e+00 -9.37602616e-01
-1.96790263e+00 -5.25922319e-01 -1.79456630e+00 -4.65570549e-01
-5.83922474e-01 -1.92467720e+00 -1.99756600e+00 -1.06446429e-01
-1.00300740e+00]

```

MSE : 0.05845457138998334

```
# Logistic Regression Using Gradient Descent
```

```
def Logistic_Regression_Using_Gradient_Descent(lr, weights, epochs, x, y):
```

```
    costs = []
```

```
    for _ in range(epochs):
```

```
        prediction = np.dot(x, weights)
```

```
        sigmoid = 1 / (1 + np.exp(-prediction))
```

```
        error = sigmoid - y
```

```
        cost = (-y) * np.log(sigmoid) - (1 - y) * np.log(1 - sigmoid)
```

```
        cost = sum(cost) / len(x)
```

```
        costs.append(cost)
```

```
        weights = weights - (lr * (1 / len(x)) * np.dot(x.T, error))
```

```
    return weights, costs
```

```
def accuracy_metric(actual, predicted):
```

```
    correct = 0
```

```
    for i in range(len(actual)):
```

```

        for i in range(len(actual)):
            if actual[i] == predicted[i]:
                correct += 1
        return correct / len(actual) * 100.0

np.random.seed(123)
data = pd.read_csv("Logistic_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
# thetas = np.random.rand(len(X[0]))
thetas = np.zeros(len(X[0]))
Y = data.iloc[:, v - 1].values

# Splitting Data_Sets
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]

theta_, past_cost = Logistic_Regression_Using_Gradient_Descent(0.25, thetas, 1000, X_train, Y_train)
print(past_cost)
print(theta_)

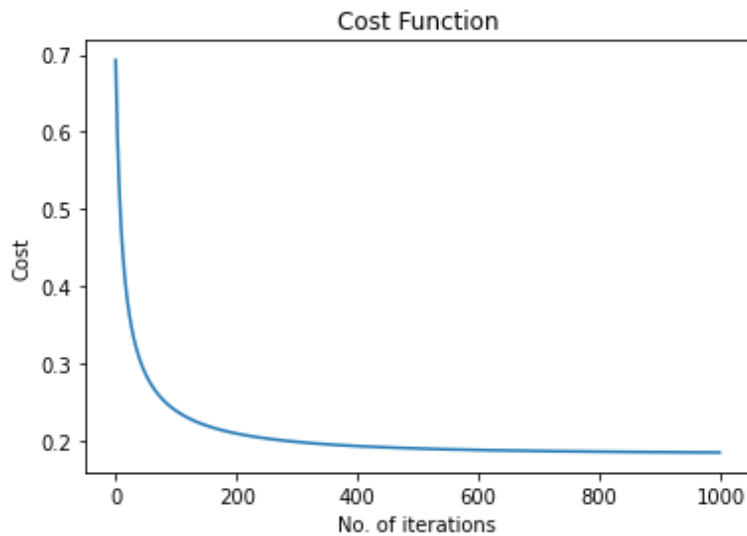
# Plot the cost function...
plt.title('Cost Function')
plt.xlabel('No. of iterations')
plt.ylabel('Cost')
plt.plot(past_cost)
plt.show()

predictions = []
for i in X_test:
    s = 0
    for j in range(0, len(i)):
        # print(j)
        s = s + (theta_[j] * i[j])
    z = round(1 / (1 + np.exp(-s)))
    predictions.append(z)
print("Predictions")
print(predictions)
print("Original Values")
print(Y_test)
print("Accuracy = ", accuracy_metric(Y_test, predictions))

```



[0.693147180559947, 0.6554030455649172, 0.6223683519018094, 0.5933866813815665, 0.56786585032240
[2.93907775 4.75255947]



Predictions

[0.0, 1.0, 0.0, 1.0, 0.0, 1.0, 0.0, 1.0, 1.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,

Original Values

```
[1 1 0 1 0 1 0 1 1 0 1 1 1 0 1 1 1 1 1 1 1 0 0 1 0 1 1 1 1 1 1 1 0 1 0 0
 0 1 0 0 0 1 0 0 1 1 1 0 1 0 1 1 0 0 0 1 0 1 1 0 1 0 0 1 0 0 1 0 0 1 1 0 1
 1 1 0 0 0 0 0 1 0 1 0 1 1 1 1 0 0 0 1 1 1 1 0 1 1 1 1 1 1 1 1 0 0 0 1 1 1
 1 1 1 0 1 1 1 1 1 1 1 0 1 1 0 0 1 1 0 1 1 0 1 0 1 0 0 1 1 1 1 1 1 0 0 1 1 0
 1 0 1 0 0 0 1 0 0 0 1 0 1 1 0 1 0 0 1 1 0 0 0 1 1 1 1 1 1 1 1 0 0 0 1 0 1 0
 1 1 0 0 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 0 1 1 1 0 1 0 0 0 1 0 1 0 0 1 0 1 0
 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1 0 0 1 1 0 1 1 0 1 1 0 0 0 1 0 1
 1 1 1 1 0 1 1 0 1 0 0 0 1 1 1 1 0 0 1 1 1 0 1 1 1 1 0 0 1 0 1 1 0 0 1 0 1
 1 1 0 1 0 1 0 1 1 0 1 0 0 0 0 1 1 0 1 0 1 0 1 0 0 1 1 1 1 1 0 0 1 0 0 1 1]
```

Accuracy = 87.68768768768768

K - Means Using Random Centroids From Scratch

```
def K_Means(x, no_of_clusters):
```

```
    centroids = np.array([]).reshape(len(x[0]), 0)
```

```
    # print(centroids)
```

```
    for i in range(no_of_clusters):
```

```
        random_val = random.randint(0, len(x) - 1)
```

```
        centroids = np.c_[centroids, x[random_val]]
```

```
    print(centroids)
```

```
    distance = euclidean_distance(centroids, no_of_clusters, len(x), x)
```

```
    plt.scatter(x[:, 0], x[:, 1], c='maroon')
```

```
    plt.show()
```

```
    color = ['red', 'blue', 'green', 'black', 'purple', 'orange', 'brown', 'pink', 'neon']
```

```
    if len(x[0]) == 2:
```

```
        for k in range(no_of_clusters):
```

```
            plt.scatter(x=distance[k][:, 0], y=distance[k][:, 1], c=color[k])
```

```
            plt.scatter(centroids[0, :], centroids[1, :], color='yellow')
```

```
            plt.show()
```

```
    for va in distance.keys():
```

```
        print("cluster {} ----> {}".format(va, distance[va]))
```

```
    return centroids, distance
```

```
def euclidean_distance(centroids, no_of_clusters, length, x):
```

```
    euclidean = np.array([]).reshape(length, 0)
```

```
    for i in range(no_of_clusters):
```

```
        distance = np.sum((x - centroids[:, i]) ** 2, axis=1)
```

```
        euclidean = np.c_[euclidean, distance]
```

```

# print(euclidean)
index = np.argmin(euclidean, axis=1)
# print(index)
distances = {}
for k in range(no_of_clusters):
    distances[k] = np.array([]).reshape(len(x[0]), 0)
for i in range(length):
    distances[index[i]] = np.c_[distances[index[i]], x[i]]
for k in range(no_of_clusters):
    distances[k] = distances[k].T
return distances

```

```

def weighted_sum_of_squares(x):
    weighted_sum_squares = []
    for va in range(1, 8):
        centroids, distance = K_Means(x, va)
        weighted_sum_square = 0
        for k in range(va):
            weighted_sum_square += np.sum((distance[k] - centroids[:, k]) ** 2)
        weighted_sum_squares.append(weighted_sum_square)

plt.plot(weighted_sum_squares)
plt.show()

```

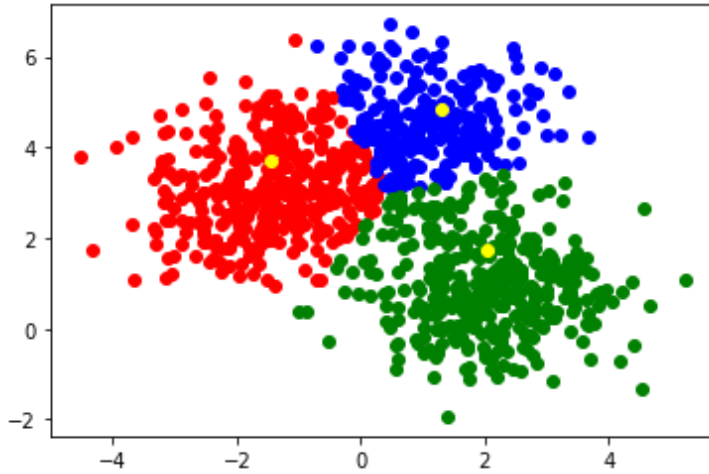
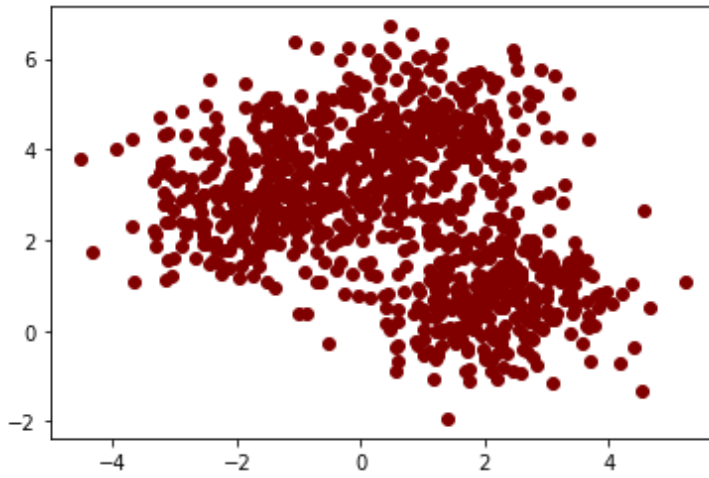
```

data = pd.read_csv("Data_Set_K_Means.csv")
val = len(data.columns)
X = data.iloc[:, 1: val].values
Y = data.iloc[:, val - 1].values
# print(len(X[0]))
K_Means(X, 3)
weighted_sum_of_squares(X)

```




```
[[ -1.45938716  1.2934307  2.04040982]
 [ 3.6954864  4.82382794  1.7190696  ]]
```



```
cluster 0 -----> [[ -8.07235843e-01  2.66946295e+00]
 [-1.50016563e+00  3.10133251e+00]
 [-1.10905031e+00  2.87786354e+00]
 [-2.53122673e+00  1.91969053e+00]
 [-7.66086119e-01  3.00054457e+00]
 [-2.66880543e+00  1.60691189e+00]
 [-1.22938966e+00  2.96190454e+00]
 [-1.50555730e-01  3.57310957e+00]
 [-2.25083272e+00  1.79825403e+00]
 [-2.39576656e+00  3.57427301e+00]
 [-3.07515834e+00  3.44985690e+00]
 [-5.64526936e-01  4.36704932e+00]
 [-3.03419095e-01  3.71835612e+00]
 [-4.47790830e-01  3.81046744e+00]
 [-1.22819035e+00  3.82852793e+00]
 [-2.04952343e+00  3.96085986e+00]
 [-1.88801715e+00  3.52684460e+00]
 [-2.16762974e+00  1.78357067e+00]
 [-2.62913420e+00  2.89333284e+00]
 [-9.75534023e-01  3.64389560e+00]
 [-6.57897670e-01  3.10206353e+00]
 [-1.25123746e+00  2.20949721e+00]
 [-2.50379940e+00  2.32830234e+00]
 [-1.06052444e+00  2.82348975e+00]
 [-2.53221589e+00  3.01928941e+00]
 [-1.06610969e+00  2.51689610e+00]
 [-1.37946961e+00  1.94041738e+00]
 [-7.79620505e-01  4.75472179e+00]
 [-1.33417502e+00  3.61432093e+00]
 [-5.05679270e-01  3.62657753e+00]
 [-1.44072717e+00  5.10878027e+00]
 [-2.89166224e+00  2.89601235e+00]
 [-2.66335168e-01  2.81748876e+00]
 [-3.13334370e+00  1.54482873e+00]
 [-2.25777760e+00  1.27617903e+00]
```

[-1.81085181e-01	3.99149508e+00]
[6.75068326e-02	3.87946971e+00]
[-2.41668433e-01	3.99882369e+00]
[-9.72776435e-01	2.24775636e+00]
[-1.45830479e+00	2.64560616e+00]
[-1.67567017e+00	3.01388647e+00]
[-3.16586831e-01	4.57083820e+00]
[-1.06959437e+00	3.88022401e+00]
[-1.66959173e+00	1.69024584e+00]
[-1.50827664e+00	3.97220724e+00]
[-1.28013799e+00	4.44383982e+00]
[-1.76620060e+00	2.67108870e+00]
[-1.26333398e+00	4.70528638e+00]
[-1.12601833e+00	2.90822502e+00]
[-4.72726104e-01	3.86871596e+00]
[-1.51671849e+00	5.11617860e+00]
[-1.51928651e+00	3.80474695e+00]
[-1.58719155e+00	3.19596331e+00]
[-7.92268372e-01	4.65926912e+00]
[-1.79811135e+00	1.60070747e+00]
[-1.56617200e+00	1.96894945e+00]
[-2.03783019e+00	3.69261058e+00]
[-5.35994840e-01	2.73117315e+00]
[-1.04928454e-01	3.37424562e+00]
[-1.42632280e+00	3.45704354e+00]
[3.18238226e-02	3.89373763e+00]
[-1.95736593e+00	4.06726164e+00]
[-2.02269951e+00	4.13445998e+00]
[-7.24852274e-01	1.07135028e+00]
[-1.28113261e-01	4.35595241e+00]
[-1.83285659e+00	2.47940780e+00]
[-7.10960614e-02	2.97337449e+00]
[-5.25572996e-01	3.51509477e+00]
[-1.60771563e+00	2.21402323e+00]
[-1.32791452e+00	4.90661418e+00]
[-2.12589179e-01	3.79697097e+00]
[-2.28926555e+00	1.47094193e+00]
[-1.41416607e+00	3.57514995e+00]
[-1.20778561e+00	3.22514704e+00]
[-1.78868233e-01	3.82558106e+00]
[-6.13702089e-01	5.12918659e+00]
[-1.39331683e+00	5.16783963e+00]
[-2.29967590e+00	3.79993886e+00]
[-4.52151687e+00	3.79881982e+00]
[-3.32435982e+00	1.854444932e+00]
[-3.17612099e+00	4.31644435e+00]
[-1.31166355e+00	1.91151674e+00]
[-1.85346499e+00	2.90967238e+00]
[-1.99439719e+00	2.05538896e+00]
[-7.21835741e-01	4.69106780e+00]
[-1.05441439e+00	6.36828019e+00]
[-2.77949735e+00	2.33156224e+00]
[-9.27534641e-01	2.66156537e+00]
[-1.69015896e+00	2.83142698e+00]
[-6.37627769e-01	4.09104705e+00]
[-1.99434502e+00	2.05772888e+00]
[-2.16985657e+00	3.06799749e+00]
[2.81227797e-01	3.35452074e+00]
[-1.71461311e-01	2.51973413e+00]
[-1.95560608e+00	2.28004170e+00]
[-2.26777072e+00	2.30959111e+00]
[-9.22767273e-01	1.28829866e+00]
[-8.83849468e-01	3.50610719e+00]
[-1.09613288e+00	2.76799067e+00]
[-2.33562155e+00	1.81375828e+00]
[-3.64808046e+00	1.07903566e+00]
[-1.38790374e+00	4.32412151e+00]

[1.58798574e+00	4.52412151e+00]
[-2.34217967e+00	4.71909625e+00]
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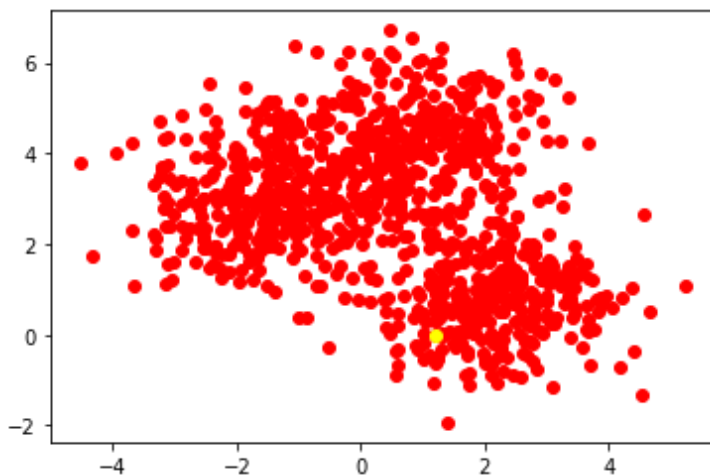
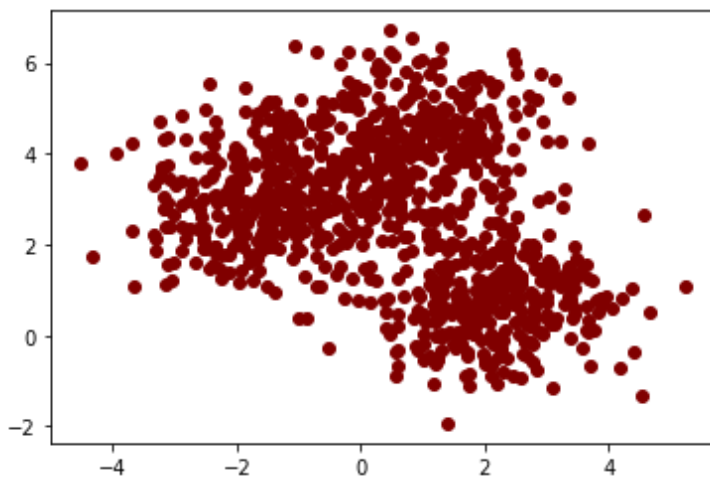
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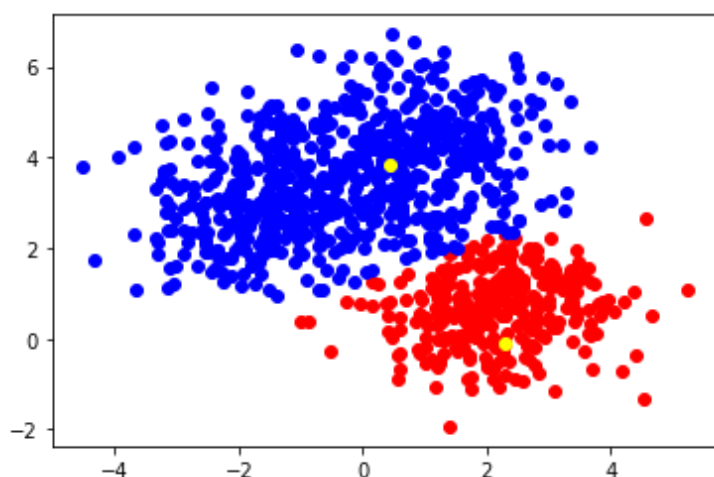
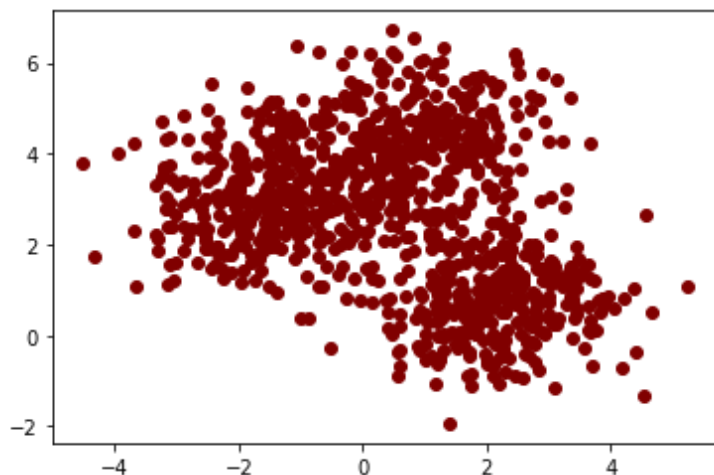
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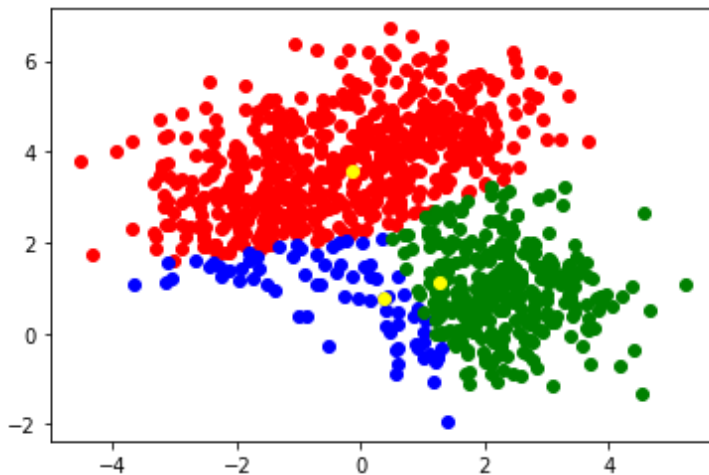
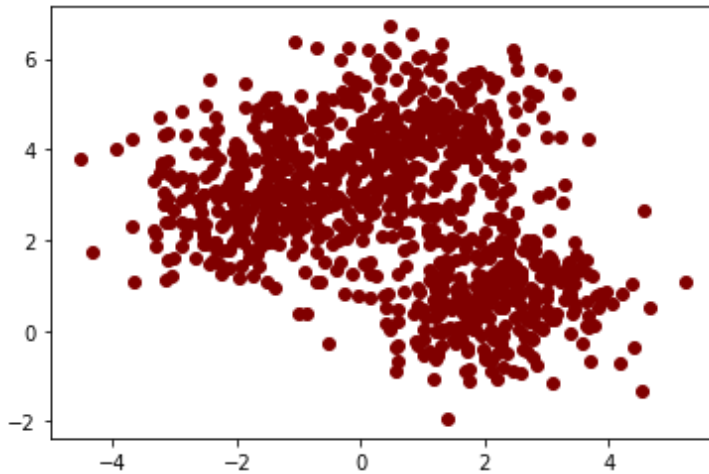
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...
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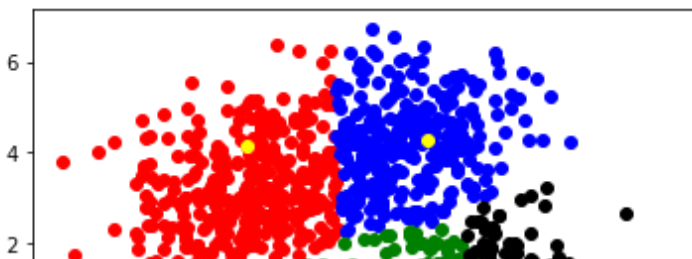
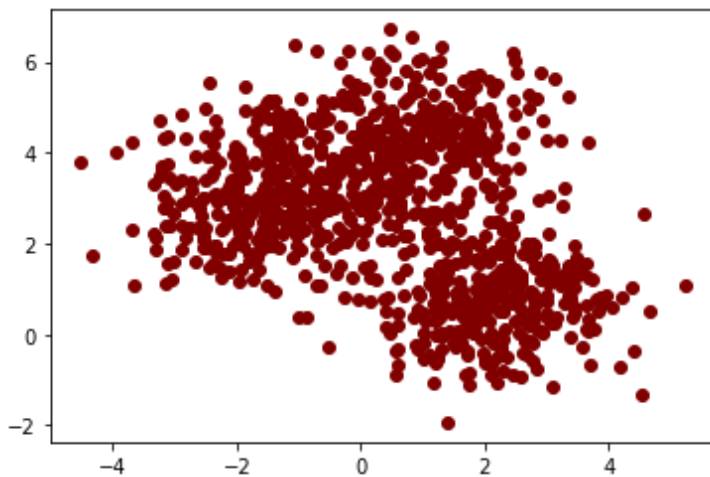
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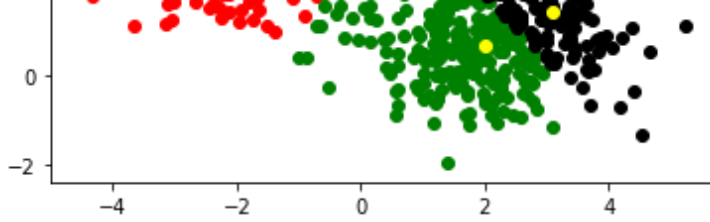
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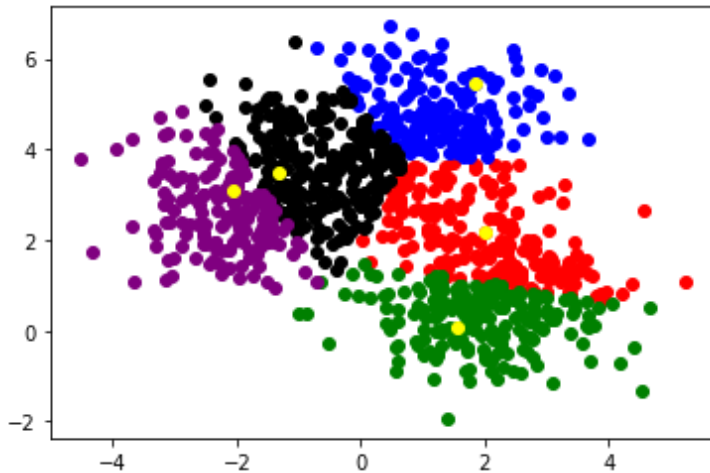
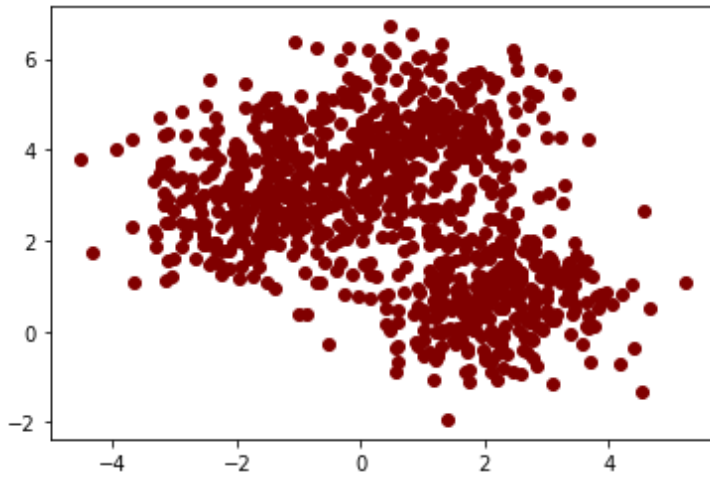
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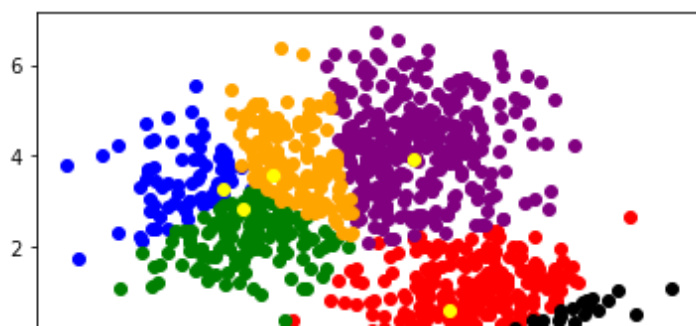
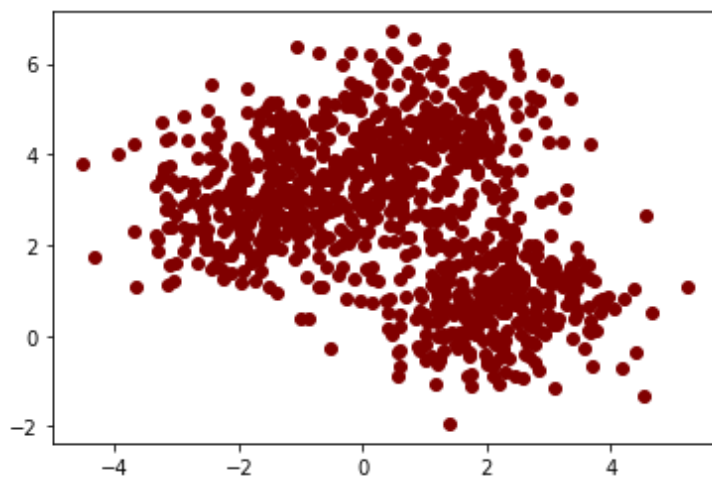
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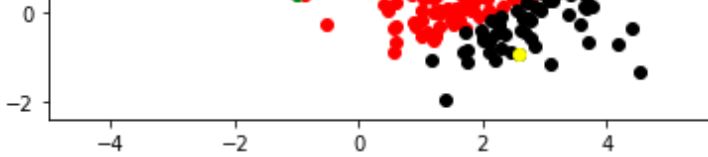
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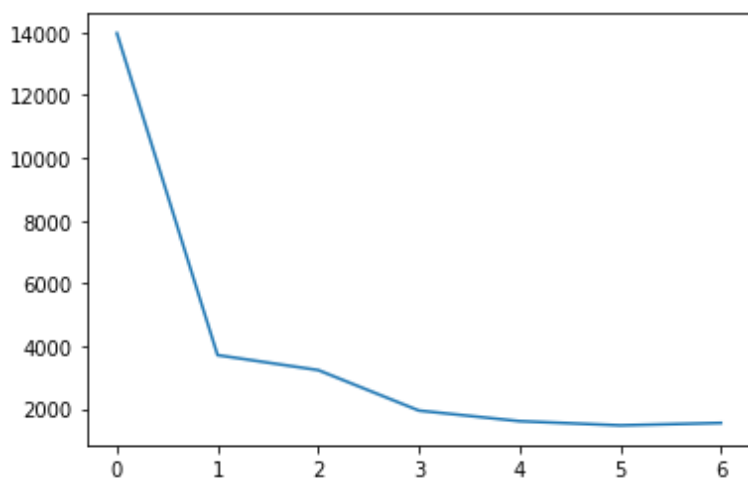
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```




```

# Linear Regression Using L1 and L2 Regularization
def L1_L2-Regularization_Linear_Regression(x, y, epochs, lr, weight):
    l1 = 0.4
    l2 = 1 - l1
    costs = []
    for _ in range(epochs):
        prediction = np.dot(x, weight)
        error = prediction - y
        cost = 1 / (len(x)) * np.dot(error.T, error)
        costs.append(cost)
        weight = weight - (lr * (x.T.dot(error) + l1 * np.sign(weight) + l2 * 2 * weight) * 1 / len(x)
        # print(weight)

```

```

        # print(weight)
    return costs, weight

def MSE(y, predicted):
    error = y - predicted
    return 1 / (len(y)) * np.dot(error.T, error)

np.random.seed(123)
data = pd.read_csv("Linear_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
thetas = np.random.randn(len(X[0]) + 1)
print(thetas)
# Appending 1 for intercept purpose
X = np.c_[np.ones(X.shape[0]), X]
Y = data.iloc[:, v - 1].values

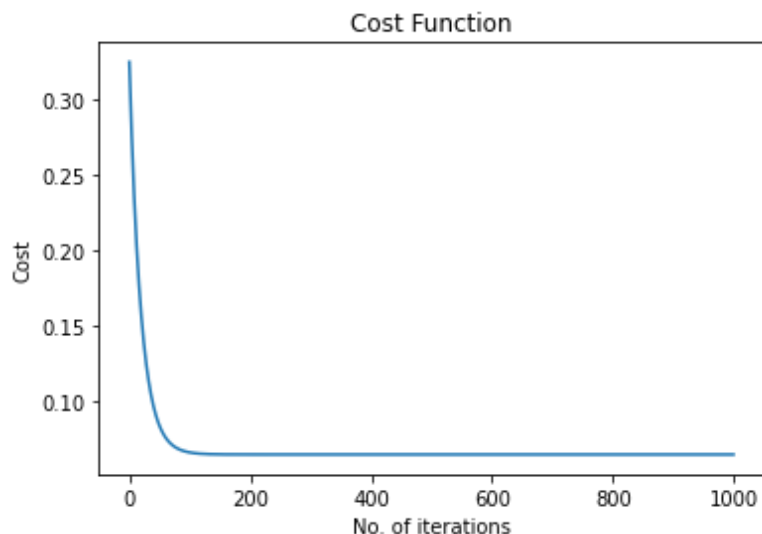
# Splitting Data_Sets
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]
cost_val, weights = L1_L2_Regularization_Linear_Regression(X_train, Y_train, 1000, 0.025, thetas)
plt.title('Cost Function')
plt.xlabel('No. of iterations')
plt.ylabel('Cost')
plt.plot(cost_val)
plt.show()

predictions = []
c = weights[0]
for i in X_test:
    s = 0
    for j in range(0, len(i) - 1):
        # print(j)
        s = s + (weights[j + 1] * i[j + 1])
    s += c
    predictions.append(s)
print("Predictions")
print(predictions)
print("Actual Value")
print(Y_test)
print("MSE : ", MSE(Y_test, predictions))

```



[-1.0856306 0.99734545 0.2829785]



Predictions

[-0.6186397164300892, -0.9876439303012914, -0.8061252790353846, -1.4339486906395493, -0.30589426

Actual Value

[-4.03522609e-01 -1.06027346e+00 -6.48980387e-01 -1.38454012e+00
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-1.24089995e-01 -7.34424130e-02 -8.76282245e-01 -3.17863545e-01
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MSE : 0.058408094910145064

```

```
def Logistic_Regression_Using_Gradient_Descent(lr, weights, epochs, x, y):
```

```
    l1 = 0.4
```

```
    l2 = 1 - l1
```

```
    costs = []
```

```
    for _ in range(epochs):
```

```
        prediction = np.dot(x, weights)
```

```
        sigmoid = 1 / (1 + np.exp(-prediction))
```

```
        error = sigmoid - y
```

```
        cost = (-y) * np.log(sigmoid) - (1 - y) * np.log(1 - sigmoid)
```

```
        cost = sum(cost) / len(x)
```

```
        costs.append(cost)
```

```
        weights = weights - (lr * (x.T.dot(error) + l1 * np.sign(weights) + l2 * 2 * weights) * 1 / len(x))
```

```
    return weights, costs
```

```
def accuracy_metric(actual, predicted):
```

```
    correct = 0
```

```
    for value in range(len(actual)):
```

```

        for value in range(len(actual)):
            if actual[value] == predicted[value]:
                correct += 1
    return correct / len(actual) * 100.0

np.random.seed(123)
data = pd.read_csv("Logistic_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
# thetas = np.random.rand(len(X[0]))
thetas = np.zeros(len(X[0]))
Y = data.iloc[:, v - 1].values

# Splitting Data_Sets
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]

theta_, past_cost = Logistic_Regression_Using_Gradient_Descent(0.025, thetas, 1000, X_train, Y_train)
print(past_cost)
print(theta_)

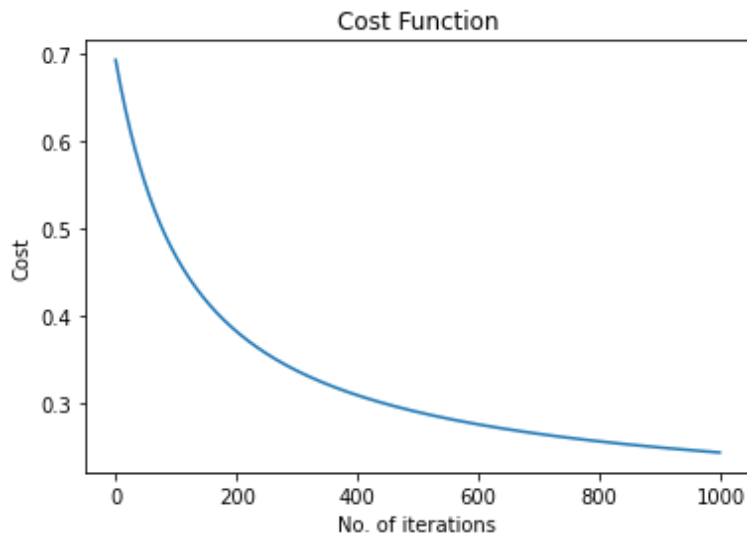
# Plot the cost function...
plt.title('Cost Function')
plt.xlabel('No. of iterations')
plt.ylabel('Cost')
plt.plot(past_cost)
plt.show()

predictions = []
for i in X_test:
    s = 0
    for j in range(0, len(i)):
        # print(j)
        s = s + (theta_[j] * i[j])
    z = round(1 / (1 + np.exp(-s)))
    predictions.append(z)
print(predictions)
print(Y_test)
print("Accuracy = ", accuracy_metric(Y_test, predictions))

```



[0.693147180559947, 0.6892591435903599, 0.6854295993539662, 0.6816496478305433, 0.67791862848938
[1.4299747 2.31898035]



[0.0, 1.0, 0.0, 1.0, 0.0, 1.0, 0.0, 1.0, 1.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0,
[1 1 0 1 0 1 0 1 1 0 1 1 1 0 1 1 1 1 1 1 0 0 1 0 1 1 1 1 1 1 1 0 1 0 0
0 1 0 0 0 1 0 0 1 1 1 0 1 0 1 1 0 0 0 1 0 1 1 0 0 1 0 0 1 0 0 1 0 0 1 1 0 1
1 1 0 0 0 0 0 1 0 1 0 1 1 1 1 0 0 0 0 1 1 1 1 0 1 1 1 1 1 1 1 1 0 0 0 1 1 1
1 1 1 0 1 1 1 1 1 1 1 0 1 1 0 0 0 1 1 0 1 1 0 1 0 1 0 0 1 1 1 1 1 0 0 1 1 0
1 0 1 0 0 0 1 0 0 0 1 0 1 1 0 1 0 0 0 1 1 0 0 0 1 1 1 1 1 1 1 1 0 0 0 1 0 1 0
1 1 0 0 1 1 1 1 0 1 1 1 1 1 1 1 0 1 1 1 0 1 1 1 0 0 0 0 1 0 1 0 0 1 0 1 0
1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 0 1 0 0 0 1 1 1 0 0 1 1 0 1 1 0 1 1 0 0 0 1 0 1
1 1 1 1 0 1 1 0 1 0 0 0 1 1 1 1 0 0 0 1 1 1 0 1 1 1 1 0 0 1 0 1 1 0 0 1 0 1
1 1 0 1 0 1 0 1 1 0 1 0 0 0 0 1 1 0 1 0 1 0 1 0 0 1 1 1 1 1 0 0 1 0 0 1 0 1]

Accuracy = 87.38738738738738

Object Oriented Approach

class Regression:

def __init__(self, epochs, lr, l1_ratio=None):

self.epochs = epochs

self.learning_rate = lr

self.costings = []

self.predictions = []

self.l1_ratio = l1_ratio

@staticmethod

def Mean_Squared_Error(actual, predicted):

error = actual - predicted

return 1 / (len(actual)) * np.dot(error.T, error)

@staticmethod

def accuracy_metric(actual, predicted):

correct = 0

for i in range(len(actual)):

if actual[i] == predicted[i]:

correct += 1

return correct / len(actual) * 100.0

def gradient_descent(self, x, y, weights, switch=0):

for _ in range(self.epochs):

prediction = np.dot(x, weights)

if switch == 0:

pass

else:

print("Log")

```

        prediction = Regression.sigmoid_activation(prediction)
        error = prediction - y
        if switch == 0:
            # print("Linear")
            cost = 1 / (len(x)) * np.dot(error.T, error)
        else:
            # print("Log-1")
            cost = Regression.log_loss(y, prediction)
        self.costings.append(cost)
        if self.l1_ratio is None:
            weights = weights - (self.learning_rate * (1 / len(x)) * np.dot(x.T, error))
        else:
            weights = weights - (self.learning_rate * (x.T.dot(error) + self.l1_ratio * np.sign(w
            # print(weights)
    return weights

```

```

@staticmethod

```

```

def log_loss(y, prediction):
    cost = (-y) * np.log(prediction) - \
           (1 - y) * np.log(1 - prediction)
    cost = sum(cost) / len(y)
    return cost

```

```

@staticmethod

```

```

def sigmoid_activation(prediction):
    return 1 / (1 + np.exp(-prediction))

```

```

def cost_plot(self):
    plt.title('Cost Function')
    plt.xlabel('No. of iterations')
    plt.ylabel('Cost')
    plt.plot(self.costings)
    plt.show()

```

```

def prediction(self, weights, x):
    print(len(x))
    for i in x:
        s = 0
        for j in range(0, len(i)):
            s = s + (weights[j] * i[j])
        self.predictions.append(s)
    return self.predictions

```

```

class Linear_Regression(Regression):

```

```

    def __init__(self, epochs, lr, x, y, l1_ratio=None):
        super().__init__(epochs=epochs, lr=lr, l1_ratio=l1_ratio)
        self.x = x
        self.y = y
        np.random.seed(1)
        self.weights = np.random.randn(len(x[0]) + 1)

```

```

    def fit(self):
        self.weights = super().gradient_descent(x=self.x, y=self.y, weights=self.weights)

```

```

    def predict(self, x_test):
        self.weights = list(self.weights)
        c = self.weights.pop(0)
        self.predictions = super().prediction(weights=self.weights, x=x_test)
        self.predictions += c

```

```
self.predictions += c
return self.predictions
```

```
class Logistic_Regression(Regression):
    def __init__(self, epochs, lr, x, y, l1_ratio=None):
        super().__init__(epochs=epochs, lr=lr, l1_ratio=l1_ratio)
        self.x = x
        self.y = y
        np.random.seed(1)
        self.weights = np.zeros(len(x[0]))

    def fit(self):
        self.weights = super().gradient_descent(x=self.x, y=self.y, weights=self.weights, switch=1)

    def predict(self, x_test):
        self.predictions = super().prediction(weights=self.weights, x=x_test)
        self.predictions = [round(Regression.sigmoid_activation(value)) for value in self.predictions]
        return self.predictions
```

```
# Linear Regression Using Gradient Descent
```

```
print("=" * 40)
print("Linear Regression Using Gradient Descent")
data = pd.read_csv("Linear_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
Y = data.iloc[:, v - 1].values
```

```
# Splitting Data_Sets
```

```
val = len(X) // 3
X_train = X[val:]
X_train = np.c_[np.ones(X_train.shape[0]), X_train]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]
```

```
model = Linear_Regression(1000, 0.021, X_train, Y_train)
model.fit()
model.cost_plot()
predictions = model.predict(X_test)
print("Predictions")
print(predictions)
print("Original Values")
print(Y_test)
print("Means Squared Error : ", Regression.Mean_Squared_Error(Y_test, predictions))
```

```
# Logistic Regression Using Gradient Descent
```

```
print("=" * 40)
print("Linear Regression Using Gradient Descent")
data = pd.read_csv("Logistic_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
Y = data.iloc[:, v - 1].values
```

```
# Splitting Data_Sets
```

```
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
```

```
Y_test = Y[: val]
```

```
model = Logistic_Regression(1000, 0.021, X_train, Y_train)
model.fit()
model.cost_plot()
predictions = model.predict(X_test)
print("Predictions")
print(predictions)
print("Original Values")
print(Y_test)
print("Accuracy Score : ", Regression.accuracy_metric(Y_test, predictions))
```

```
# Linear Regression With L1_L2_Regularization
print("=" * 40)
print("Linear Regression With L1 And L2 Regularization")
data = pd.read_csv("Linear_Regression_Dataset.csv")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
Y = data.iloc[:, v - 1].values
```

```
# Splitting Data_Sets
val = len(X) // 3
X_train = X[val:]
X_train = np.c_[np.ones(X_train.shape[0]), X_train]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]
```

```
model = Linear_Regression(1000, 0.021, X_train, Y_train, l1_ratio=0.5)
model.fit()
model.cost_plot()
predictions = model.predict(X_test)
print("Predictions")
print(predictions)
print("Original Values")
print(Y_test)
print("Means Squared Error : ", Regression.Mean_Squared_Error(Y_test, predictions))
```

```
# # Logistic Regression With L1_L2_Regularization
data = pd.read_csv("Logistic_Regression_Dataset.csv")
print("=" * 40)
print("Logistic Regression With L1 And L2 Regularization")
v = len(data.columns)
X = data.iloc[:, 1:v - 1].values
Y = data.iloc[:, v - 1].values
```

```
# Splitting Data_Sets
val = len(X) // 3
X_train = X[val:]
X_test = X[: val]
Y_train = Y[val:]
Y_test = Y[: val]
```

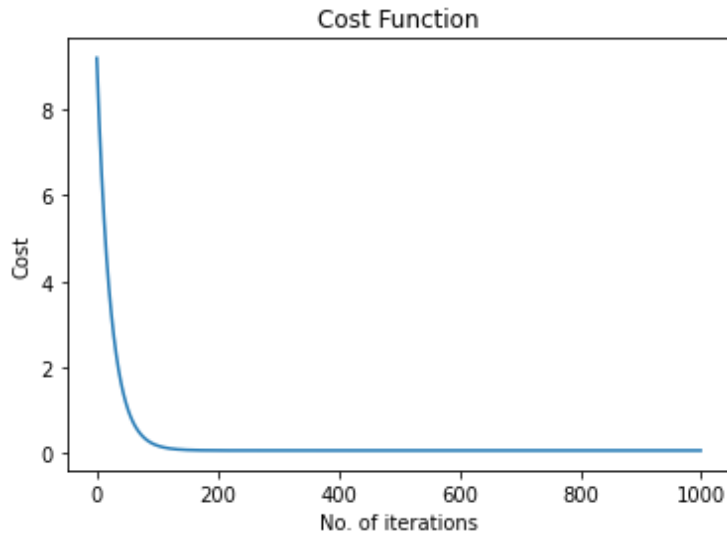
```
model = Logistic_Regression(1000, 0.021, X_train, Y_train, 0.5)
model.fit()
model.cost_plot()
predictions = model.predict(X_test)
print("Predictions")
print(predictions)
```

```
print(Y_test)
print("Original Values")
print(Y_test)
print("Accuracy Score : ", Regression.accuracy_metric(Y_test, predictions))
```



=====

Linear Regression Using Gradient Descent



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Predictions

```
[ -6.19595802e-01 -9.90564209e-01 -8.07557524e-01 -1.43750849e+00
-3.06388979e-01 -1.11259391e+00 -1.41010770e-01 -7.92671571e-01
-3.97137776e-01 3.54393704e-02 -8.26549763e-01 -8.40862380e-01
-1.71048002e+00 -1.40314975e+00 -1.20191573e+00 -1.01564169e+00
-1.01302401e+00 -1.28094905e+00 -5.54322605e-01 -8.07129989e-01
-1.38041443e+00 -2.07077895e-01 -1.38302472e+00 -1.27685620e+00
-1.24122090e+00 -1.24068477e+00 -1.76192044e+00 -1.24305490e+00
-1.16657026e+00 -7.90849659e-01 -1.59446546e+00 -1.46422155e+00
-2.01795979e+00 -1.89372602e+00 -1.39459063e+00 -7.62003062e-01
-1.39454282e+00 -1.34379039e+00 -1.04855271e+00 -9.21346026e-01
-4.36578087e-01 -4.56641789e-01 -5.25038165e-01 -1.00624229e+00
-1.74671035e+00 -1.37201321e+00 -6.35972417e-01 -5.04059690e-01
-1.79723284e+00 -8.69192825e-01 -1.44968090e+00 -5.48169550e-01
-6.11518058e-01 -6.99123851e-01 7.43802703e-02 -1.52201304e+00
-1.03348976e+00 -2.54811648e+00 -1.06495895e+00 -1.88732124e+00
-1.35843974e+00 -7.02746774e-01 -1.40058123e+00 -1.54336321e+00
-5.45177244e-01 -1.17258399e+00 1.76312955e-01 -1.57092946e+00
-1.31198669e+00 -1.81580141e+00 -9.32688356e-01 -1.81177109e+00
-1.42528448e+00 -9.88168158e-01 -1.05114742e+00 -1.15056641e+00
-5.33777091e-01 -1.24660643e+00 -1.22920224e+00 -8.76896027e-01
-4.14010372e-01 -8.21376472e-01 -8.93893147e-01 -9.46067055e-01
-1.35940789e+00 -1.41984815e+00 3.45783639e-01 -4.59996322e-01
-1.20805873e+00 -4.30126495e-01 -1.03402072e+00 -4.79216571e-01
-3.81032745e-01 2.73864079e-01 -1.80710140e+00 -9.79769546e-01
-5.00687686e-01 -1.06555707e+00 -1.30468066e+00 -8.66723183e-01
-1.69131825e+00 -1.05206907e+00 -5.48520371e-01 -1.76074141e+00
2.82205207e-01 -9.49496163e-01 -1.39301444e+00 -7.80317195e-01
-1.37436079e+00 -8.67618100e-01 9.55873136e-02 -2.00622835e+00
3.67154695e-02 -9.78011705e-01 -6.94406684e-01 -1.22832148e+00
-1.40284129e+00 -1.50759407e+00 -1.15950795e+00 -1.28992087e+00
-5.51531501e-01 -7.41515789e-01 1.62354480e-02 -1.57045283e+00
-2.49192548e-01 -1.21565474e+00 -8.11268313e-01 -1.43902256e+00
-1.51331109e+00 -1.77657209e-01 -2.43037618e-01 -1.10840414e+00
-1.69533249e+00 -1.03775893e+00 -1.36831155e+00 2.48851259e-01
-1.53230455e+00 -1.68961452e+00 -2.82400851e-01 -9.33954803e-01
-5.76530638e-01 -2.81822346e-01 -3.78416752e-01 -1.01186502e+00
-8.22911087e-01 -1.00502459e+00 -1.88573911e+00 -4.74315191e-01
-1.47278626e+00 1.87646640e-01 -1.15490451e+00 -9.22557401e-02
-1.35692322e-01 -1.09276780e+00 -1.34879393e+00 -2.14595364e+00
-6.68068996e-01 -9.88623887e-01 -1.43656233e+00 -2.23699747e+00
1.47437595e-01 -1.78906843e+00 -2.46385658e-01 -1.34413338e+00
-1.62343022e+00 -1.17408077e+00 -7.57734615e-01 -5.10455579e-01
-3.24991256e-01 -9.86617990e-01 -3.83144562e-01 -1.30649462e+00
-6.23653713e-01 -8.80848588e-01 -1.60042127e+00 -1.66132832e+00
-1.06562038e+00 -7.15782130e-01 -2.61706996e+00 -3.05004530e-01
-1.45321348e+00 -1.87559768e+00 -1.15215563e+00 -7.25912499e-01
```