#### JSS MAHAVIDYAPEETHA

## JSS SCIENCE AND TECHNOLOGY UNIVERSITY

#### SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING

**MYSURU - 570006** 



#### "NUTRITION ANALYSIS USING PROBABLITY THEORY"

## Problem solving approach in

#### **ENGINEERING MATHEMATICS IV**

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#### Under the Guidance of

Dr. T D Roopamala Head of the Department, Department of Mathematics.

#### **Name of Candidates**

- 1. Srikanta Vaibhav N
- 2. AmaraSimha G Hebbar
- 3. Nagabharana K Jamadagni

Dept. of ISE, JSSSTU

## **Problem Statement**

The owner of the cafe and restaurant wants to analyse his customer's orders based on nutrition. The cafe and restaurant have 50 items of 100g each in its menu.

If a customer orders *n* items from the menu and if X denotes the number of

- 1. Calorie rich items ( $\geq 300$ cal)
- 2. Protein rich items ( $\geq 8\%$ )
- 3. Fat rich items ( $\geq 15\%$ ), and
- 4. Carbs–rich items ( $\geq 30\%$ )

in the customer's orders.

Find the probability distribution of X (for individual nutrients), Mean, Variance and Standard Deviation of the distribution and plot the cumulative graph.

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## **ABSTRACT**

**Probability theory** is concerned with the analysis of random phenomena. Today it has applications far beyond games of chance. It has contributed to the solution of problems in biology, physics, chemistry, other natural sciences, and in social sciences as well.

Here, we analyze food items of a restaurant on the grounds of its nutrition scale (using probability distribution function), and determining the average number of a type of items that the owner of the restaurant can expect from his customers.

The outcome cannot be determined unless a customer places an order, but it may be any one of several possible outcomes. The actual outcome is considered to be determined by chance

## **INTRODUCTION**

Good nutrition is an important part of leading a healthy lifestyle. Combined with physical activity, a good diet can help you to reach and maintain a healthy weight, reducing the risk of chronic diseases, and promoting your overall health.

In today's busy world, people are eating and drinking about one-third of their calories away from home. Although consumers can find calories and other nutrition information on the Nutrition Facts label on packaged foods and beverages they buy in stores, this type of labeling is generally not available in restaurants or visible on food from vending machines.

Calorie labeling on restaurant menus and vending machines can help you make healthy and informed decisions about meals and snacks.

Many restaurants fear the thought that they would lose customers if the customers knew how unhealthy their food was, and they are also socially responsible when they provide food its customers.

Customers are more likely to visit restaurants that provide both healthy foods and nutrition information. Therefore, it is necessary for restaurants to keep track of their orders, and analyze them based on nutrition

# **Data Set:**

Sl No.	Food Product(100g)	Calories	Protein(%)	Fat(%)	Carbs(%)
1	Cheese Sandwich	298	10	13.6	34.3
2	Fried Rice	110	2.2	3.6	17.4
3	Plain Dosa	189	5.2	4.8	31.5
4	Wheat Chapati	244	8.7	1.2	49.6
5	Rava Upma	131	3.4	4.8	18.7
6	Wheat Poori	288	8	10.6	43.6
7	Palak Paneer	118	4	9.5	4.1
8	Rasam	43	2.4	1.1	6.2
9	White Rice	115	2.5	0.3	25.6
10	Rice Idli	139	4.9	0.3	29
11	Uddina Vada	348	10.5	22.4	26
12	Vegetable Pulao	97	2.3	2.5	16.4
13	Akki Rotti	208	2.7	8.1	30.4
14	Curd Rice	118	3.7	3.1	18.7
15	Maggi Noodles	423	9.2	15.8	61.1
16	Wheat Bread	270	5	29	66
17	Brown Bread	244	8.8	1.4	49
18	Coco Cola(100ml)	42	0	0	10.6
19	Fanta(100ml)	51	0	0	13
20	Sprite(100ml)	48	0	0	12
21	Maaza Drink(100ml)	55	0	0	13.3
22	Cow's Milk(100ml)	69	3.3	4.2	4.5
23	Powdered Milk(100ml)	434	17.4	18.2	50.3
24	Curd	60	3.1	4	3
25	Tea with Sugar & Milk	41	1.7	1.8	4.6

26	Coffee with Sugar	54	1.5	2.9	5.1
27	Peanut Butter	594	21.9	50	25
28	Paneer	265	18.3	20.8	1.2
29	Butter	729	0	81	0
30	Ice Cream	262	2	19.2	21.7
31	Cake	392	6	21.8	44.2
32	Chocolate Pastry	377	7.3	18.4	45.8
33	French Fries	314	3.8	16.1	38.4
34	Samosa	268	3.9	15.3	28.5
35	Vegetable Pizza	127	5.9	2.4	20.8
36	Lays Maxx Potato Chips	520	8	31	52
37	Kurkure	564	6.3	35.7	54.3
38	Banana Chips	519	2.3	33.6	58.4
39	Pani Puri	231	3.3	12.2	26.9
40	Masala Puri	129	5.2	2.8	23.2
41	Bhel Puri	119	2.5	2.7	21.4
42	Kachori	375	8	21.8	36.8
43	Pav Bhaji	151	3.3	2.4	29.3
44	Vegetable Puff	255	3.9	16.7	22.5
45	Aloo Bun	287	6.2	8.9	45.4
46	Mysore Pak	366	3	22.4	39
47	Jelebi	236	4.5	8.9	34.2
48	Gulab Jamun	375	4.2	23.9	36.8
49	Champakali	127	3.3	3.3	21.7
50	Carrot Halwa	241	4.9	11.3	30.3

## **Solution:**

Let the customer order 3 items from the menu i.e., n = 3.

Sample space  $S = \{ (a,b,c) \mid a,b,c \in Food \text{ products in Menu. } \}$ 

Total number of possible outcomes = 
$$|S|$$
  
=  ${}^{50}C_3$   
= 19600

#### Let X be the number of calorie-rich items in the customer's order.

P(X=0) = Probability of not ordering any calorie rich food item from the Menu.

$$= \frac{{}^{14}\text{C}_{0} \times {}^{36}\text{C}_{3}}{{}^{50}\text{C}_{3}} = \frac{7140}{19600} = \frac{51}{140} = 0.3643$$

P(X=1) = Probability of ordering 1 calorie rich food item from the Menu.

$$= \frac{{}^{14}\text{C}_{1} \times {}^{36}\text{C}_{2}}{{}^{50}\text{C}_{3}} = \frac{8820}{19600} = \frac{9}{20} = \textbf{0.4500}$$

P(X=2) = Probability of ordering 2 calorie rich food items from the Menu.

$$= \frac{{}^{14}\text{C}_2}{{}^{50}\text{C}_3} \times {}^{36}\text{C}_{\underline{1}} = \frac{3276}{19600} = \frac{117}{700} = 0.1671$$

P(X=3) = Probability of ordering 3 calorie rich food items from the Menu.

$$= \frac{{}^{14}\text{C}_3 \times {}^{36}\text{C}_0}{{}^{50}\text{C}_3} = \frac{364}{19600} = \frac{13}{700} = 0.0185$$

#### **Probability Distribution Table:**

X	0	1	2	3
P(x)	0.3643	0.4500	0.1671	0.0185

Mean 
$$\mu = \sum x_i P(x_i)$$
  
=  $0 \times 0.3643 + 1 \times 0.4500 + 2 \times 0.1671 + 3 \times 0.0185$ 

$$\therefore \quad \mu = 0.8400$$

is the expected average of the number of items with high calories in the customer's order.

Variance 
$$\sigma^2 = E[(x - \mu)^2]$$
  

$$= \sum_{i=1}^n (x - \mu)^2 P(x_i)$$

$$= \sum_{i=1}^n (x - 0.8400)^2 P(x_i)$$

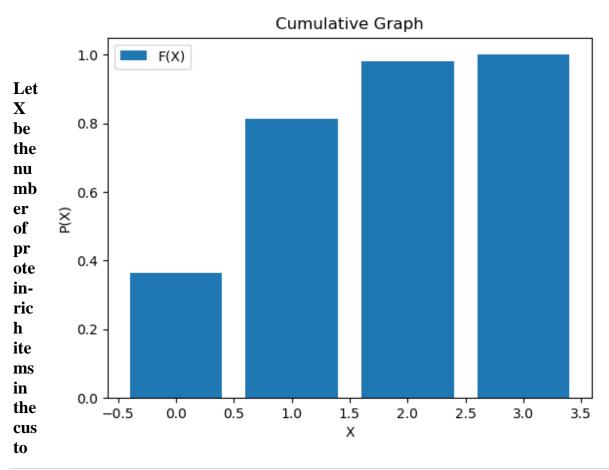
$$= (0 - 0.84)^2 \times 0.3643 + (1 - 0.84)^2 \times 0.4500 + (2 - 0.84)^2 \times 0.1671 + (3 - 0.84)^2 \times 0.0185$$

$$\therefore \quad \sigma^2 = \mathbf{0.5801}$$

**Standard Deviation**  $\sigma = \sqrt{Variance}$ 

$$= \sqrt{\sigma^2}$$
$$= \sqrt{0.5801}$$

## **Cumulative Graph:**



#### mer's order.

P(X=0) = Probability of not ordering any protein rich food item from the Menu.

$$= \frac{{}^{11}\text{C}_0 \times {}^{39}\text{C}_3}{{}^{50}\text{C}_3} = \frac{9139}{19600} = \mathbf{0.4663}$$

P(X=1) = Probability of ordering 1 protein rich food item from the Menu.

$$= \frac{{}^{11}\text{C}_{1} \times {}^{39}\text{C}_{2}}{{}^{50}\text{C}_{3}} = \frac{8151}{19600} = \textbf{0.4159}$$

P(X=2) = Probability of ordering 2 protein rich food items from the Menu.

$$= \frac{{}^{11}\text{C}_2 \times {}^{39}\text{C}_1}{{}^{50}\text{C}_3} = \frac{2145}{19600} = \frac{429}{3920} = 0.1094$$

P(X=3) = Probability of ordering 3 protein rich food items from the Menu.

$$= \frac{{}^{11}\text{C}_{3} \times {}^{39}\text{C}_{0}}{{}^{50}\text{C}_{3}} = \frac{165}{19600} = \frac{33}{3920} = 0.0084$$

#### **Probability Distribution Table:**

X	0	1	2	3
P(x)	0.4663	0.4159	0.1094	0.0084

Mean 
$$\mu = \sum x_i P(x_i)$$
  
=  $0 \times 0.4663 + 1 \times 0.4159 + 2 \times 0.1094 + 3 \times 0.0084$ 

$$\therefore \mu = 0.6600$$

is the expected average of the number of items with high protein in the customer's order.

Variance 
$$\sigma^2 = \mathbb{E} [(x - \mu)^2]$$
  

$$= \sum_{i=1}^n (x - \mu)^2 P(x_i)$$

$$= \sum_{i=1}^n (x - 0.6600)^2 P(x_i)$$

$$= (0 - 0.6600)^2 \times 0.4663 + (0 - 0.6600)^2 \times 0.4159 + (0 - 0.6600)^2 \times 0.1094 + (0 - 0.6600)^2 \times 0.0084$$

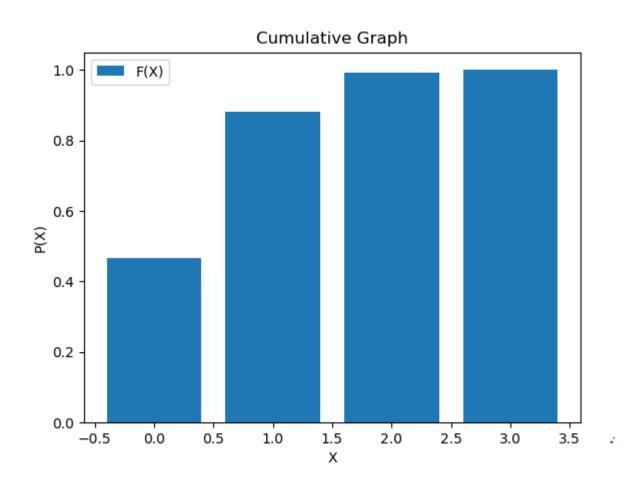
$$\therefore \quad \sigma^2 = 0.4938$$

**Standard Deviation**  $\sigma = \sqrt{Variance}$ 

$$= \sqrt{\sigma^2}$$
$$= \sqrt{0.3863}$$

$$\therefore \quad \sigma = 0.7027$$

## **Cumulative Graph:**



#### Let X be the number of Fat-rich items in the customer's order.

P(X=0) = Probability of not ordering any fat rich food item from the menu.

$$= \frac{{}^{19}\text{C}_{0} \times {}^{31}\text{C}_{3}}{{}^{50}\text{C}_{3}} = \frac{4495}{19600} = \frac{899}{3920} = \mathbf{0.2293}$$

P(X=1) = Probability of ordering 1 fat rich food item from the menu.

$$= \frac{{}^{19}\text{C}_{1} \times {}^{31}\text{C}_{2}}{{}^{50}\text{C}_{3}} = \frac{8835}{19600} = \frac{1767}{3920} = \textbf{0.4508}$$

P(X=2) = Probability of ordering 2 fat rich food items from the menu.

$$= \frac{{}^{19}\text{C}_2}{{}^{50}\text{C}_3} \times {}^{31}\text{C}_1 = \underline{5301} = \mathbf{0.2705}$$

P(X=3) = Probability of ordering 3 fat rich food items from the menu.

$$= \frac{{}^{19}\text{C}_3}{{}^{50}\text{C}_3} \times {}^{31}\text{C}_0 = \frac{969}{19600} = \textbf{0.0494}$$

#### **Probability Distribution Table:**

X	0	1	2	3
P(x)	0.2293	0.4508	0.2705	0.0494

Mean 
$$\mu = \sum x_i P(x_i)$$
  
=  $0 \times 0.2293 + 1 \times 0.4508 + 2 \times 0.2705 + 3 \times 0.0494$ 

$$\therefore \mu = 1.1400$$

is the expected average of the number of the items with high in the customer's order.

Variance 
$$\sigma^2 = E[(x - \mu)^2]$$
  

$$= \sum_{i=1}^n (x - \mu)^2 P(x_i)$$

$$= \sum_{i=1}^n (x - 1.1400)^2 P(x_i)$$

$$= (0 - 1.1400^2 \times 0.2293 + (0 - 1.1400)^2 \times 0.4508 + (0 - 1.1400)^2 \times 0.2705 + (0 - 1.1400)^2 \times 0.0494$$

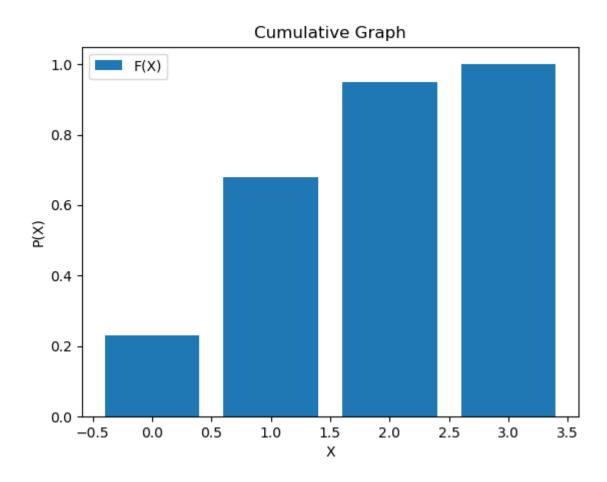
$$\therefore \quad \sigma^2 = 0.6780$$

**Standard Deviation**  $\sigma = \sqrt{\text{Variance}}$ 

$$= \sqrt{\mathbf{O}^2}$$
$$= \sqrt{0.780}$$

$$\sigma = 0.8234$$

## **Cumulative Graph:**



#### Let X be the number of Carbs-rich items in the customer's order.

P(X=0) = Probability of not ordering any carbs rich food item from the menu.

$$= \frac{{}^{21}\text{C}_{0} \times {}^{29}\text{C}_{3}}{{}^{50}\text{C}_{3}} = \frac{3654}{19600} = \frac{261}{1400} = 0.1864$$

P(X=1) = Probability of ordering 1 carbs rich food item from the menu.

$$= \frac{{}^{21}\text{C}_{1} \times {}^{29}\text{C}_{2}}{{}^{50}\text{C}_{3}} = \frac{8526}{19600} = \frac{87}{200} = \textbf{0.4350}$$

P(X=2) = Probability of ordering 2 carbs rich food items from the menu.

$$=\frac{{}^{20}\text{C}_{\underline{2}}\times{}^{30}\text{C}_{\underline{1}}}{{}^{50}\text{C}_{3}} \qquad = \quad \underline{\frac{6090}{19600}} \quad = \quad \underline{\frac{87}{280}} = \quad \textbf{0.3107}$$

P(X=3) = Probability of ordering 3 Carbs rich food items from the Menu.

$$= \frac{{}^{20}\text{C}_3 \times {}^{30}\text{C}_0}{{}^{50}\text{C}_3} = \frac{1330}{19600} = \frac{19}{280} = \mathbf{0.0679}$$

#### **Probability Distribution Table:**

X	0	1	2	3
P(x)	0.1864	0.4350	0.3107	0.0679

Mean 
$$\mu = \sum x_i P(x_i)$$
  
=  $0 \times 0.1864 + 1 \times 0.4350 + 2 \times 0.3107 + 3 \times 0.0679$ 

$$\therefore \mu = 1.2600$$

is the expected average of the number of items with high carbohydrates in the customer's order.

Variance 
$$\sigma^2 = E[(x - \mu)^2]$$
  

$$= \sum_{i=1}^n (x - \mu)^2 P(x_i)$$

$$= \sum_{i=1}^n (x - 1.2600)^2 P(x_i)$$

$$= (0 - 1.2600)^2 \times 0.1864 + (0 - 1.2600)^2 \times 0.4350 + (0 - 1.2600)^2 \times 0.3107 + (0 - 1.2600)^2 \times 0.0679$$

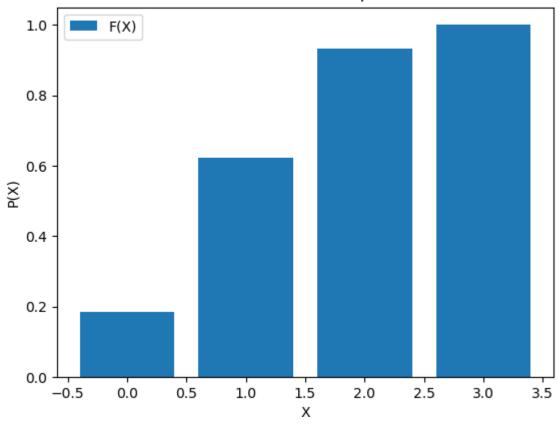
$$\therefore \quad \sigma^2 = 0.7010$$

## **Standard Deviation** $\sigma = \sqrt{\text{Variance}}$

$$= \sqrt{\sigma^2}$$
$$= \sqrt{0.7010}$$

## **Cumulative Graph:**





## **Source Code (in Python):**

```
import math
import matplotlib.pyplot as plt
def dispProbMenu(file):
      print("MENU (in detail)".center(94,"-")+"\n"+file.read()+"-"*94)
      print("The restaurant has 50 items (100g each) in its menu.")
      n=int(input("How many items did the customer order?"))
      ch=int(input("\nProbability Distribution of\n1: Calorie-rich(>300cal) items\n2:
Protein-rich(>8%) items\n3: Fat-rich(>15%) items\n4: Carbs-rich(>30%)
items\nSelect the probability distribution you require: "))
      while ch not in [1,2,3,4]: ch=int(input("Invalid selection!\nRe-enter valid
choice: "))
      file.close()
      return [n,ch]
def findDistribution(file,n,ch):
      items=[]; val=[]; richItems=[]; richVal=[]; px=[]; threshold=[300,8,15,30];
firstLine=True
      while 1:
            line=file.readline()
            if firstLine:
                   firstLine=False; continue
            if not line: break
            words=list(filter(lambda x: x!=",line.split("\t")))
            items.append(words[1])
            val.append(words[ch+1])
            if float(words[ch+1])>=threshold[ch-1]:
                   richItems.append(words[1])
                   richVal.append(words[ch+1])
      items.pop(0); val.pop(0)
      s=C(50,n) #|sample space|
      nrich=len(richVal)
      for i in range(0,n+1):
            px.append(C(nrich,i)*C(50-nrich,n-i)/s)
      print("\nFood items with high "+(["Calories","Proteins","Fat","Carbs"][ch-
1])+":")
      for i in range(0,nrich):
            print(str(i+1)+".",richItems[i],"("+richVal[i],end=")
            if ch==1: print("cal)")
            else: print("%)")
      print("\n Let X be the number of "+(["Calorie","Protein","Fat","Carbs"][ch-
1])+"-rich items in the customer's order.\n"+"Probabilty Distribution Table:")
      print("-"*(9*n+19),"\n|"+"X".center(8)+"|",end=")
```

```
for i in range(0,n+1): print(str(i).center(8)+"|",end=")
      print("\n"+"-"*(9*n+19),"\n"+"P(X)".center(8)+"|",end=")
      for i in px: print("{0:0.4f}".format(i).center(8)+"|",end=")
      print("\n"+"-"*(9*n+19))
      file.close()
      return px
def findSD(n,px,ch):
      mean, var, sd=0,0,0
      for x in range(0,n+1): mean=mean+x*px[x]
      for x in range(0,n+1): var=var+pow(x-mean,2)*px[x]
      sd=math.sqrt(var)
      print("Mean = {:0.4f}), is the expected average of the number of items with
high ".format(mean)+(["Calorie", "Protein", "Fat", "Carbs"][ch-1])+" in the customer's
order.\n"+"Variance = \{:0.4f\}\\nStandard Deviation = \{:0.4f\}\".format(var,sd))
def C(n,r):
      f = math.factorial
      return f(n) / (f(r)*f(n-r))
def plot(n,px):
      f=[];
      for i in range(n+1):
             sum=0
             for j in range(i+1):
                   sum+=px[j]
             f.append(sum)
      plt.bar([i for i in range(n+1)],f,label="F(X)")
      plt.legend()
      plt.xlabel('X')
      plt.ylabel('P(X)')
      plt.title('Cumulative Graph')
      plt.show()
# Driver Code
l=dispProbMenu(open("data.txt"))
px=findDistribution(open("data.txt"),l[0],l[1])
findSD(1[0],px,1[1])
plot(1[0],px)
```

# Output:

Product(100g) Product(100g) Product(100g) Prosa Chapati Joma Poori Paneer  Rice Idli Pada Ible Pulao Potti Pace Noodles Bread Bread Bread Iola(100ml)	298 110 189 244 131 288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	Protein(%) 10.0 2.2 5.2 8.7 3.4 8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 0.0 3.3 17.4 3.1	Fat(%) 13.6 3.6 4.8 1.2 4.8 10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0 4.2 18.2	34.3 17.4 31.5 49.6 18.7 43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Rice Dosa Chapati Jpma Poori Paneer Rice Edli Vada Able Pulao Rotti Rice Noodles Bread Bread Bread (100ml) (100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml)  Ted Milk(100ml)	110 189 244 131 288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	2.2 5.2 8.7 3.4 8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	3.6 4.8 1.2 4.8 10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0 4.2	17.4 31.5 49.6 18.7 43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Dosa Chapati Jpma Poori Paneer Rice Edli Vada Able Pulao Rotti Rice Noodles Bread Bread Bread Cola(100ml) C100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml) Sed Milk(100ml)	189 244 131 288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	5.2 8.7 3.4 8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	4.8 1.2 4.8 10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0 4.2	31.5 49.6 18.7 43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Chapati Jpma Poori Paneer Rice Idli Vada Ible Pulao Rotti Rice Noodles Bread Bread Bread I00ml) I00ml) C100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml) The Sugar & Milk Reside Milk Resid	244 131 288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	8.7 3.4 8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	1.2 4.8 10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0	49.6 18.7 43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Jpma Poori Paneer Rice Idli Vada Jobe Pulao Rotti Rice Noodles Bread Bread Jola(100ml) Poink(100ml) Milk(100ml) Fed Milk(100ml) The Sugar & Milk Rice With Sugar	131 288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	3.4 8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	4.8 10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0 4.2	18.7 43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Poori Paneer Rice Edli Vada Bole Pulao Rotti Rice Noodles Bread Bread Cola(100ml) P(100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml) Standar & Milk With Sugar	288 118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	8.0 4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	10.6 9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0 4.2	43.6 4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Paneer Rice Idli Vada Ible Pulao Rotti Rice Noodles Bread Bread Cola(100ml) P(100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml) Standard & Milk Rich Sugar & Milk Rich Sugar	118 43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	4.0 2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	9.5 1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0	4.1 6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Rice Edli Vada Soluti Vice Noodles Bread Bread Cola(100ml) (100ml) Drink(100ml) Milk(100ml) Ed Milk(100ml)	43 115 139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	2.4 2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	1.1 0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0	6.2 25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
dli Vada ble Pulao cotti cice Noodles Bread Cola(100ml) (100ml) Drink(100ml) Milk(100ml) ced Milk(100ml)	115 139 348 97 208 118 423 270 244 42 51 48 55 69 434	2.5 4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	0.3 0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0	25.6 29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
dli Vada ble Pulao cotti cice Noodles Bread Cola(100ml) (100ml) Drink(100ml) Milk(100ml) ced Milk(100ml)	139 348 97 208 118 423 270 244 42 51 48 55 69 434 60	4.9 10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	0.3 22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0	29.0 26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Vada sble Pulao sotti sice Noodles Bread Sola(100ml) (100ml) P(100ml) Drink(100ml) ed Milk(100ml) th Sugar & Milk	348 97 208 118 423 270 244 42 51 48 55 69 434 60	10.5 2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	22.4 2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0	26.0 16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
bble Pulao notti nice Noodles Bread Bread cola(100ml) (100ml) P(100ml) Drink(100ml) Milk(100ml) ed Milk(100ml)	97 208 118 423 270 244 42 51 48 55 69 434 60	2.3 2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0	2.5 8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0	16.4 30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
totti tice Noodles Bread Bread Cola(100ml) (100ml) C(100ml) Drink(100ml) Milk(100ml) Ted Milk(100ml)  th Sugar & Milk with Sugar	208 118 423 270 244 42 51 48 55 69 434 60	2.7 3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	8.1 3.1 15.8 29.0 1.4 0.0 0.0 0.0	30.4 18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Rice Noodles Bread Bread Cola(100ml) (100ml) P(100ml) Drink(100ml) Milk(100ml) Fed Milk(100ml)	118 423 270 244 42 51 48 55 69 434 60	3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0	18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Noodles Bread Bread cola(100ml) 100ml) c(100ml) Drink(100ml) Milk(100ml) ced Milk(100ml)	423 270 244 42 51 48 55 69 434	3.7 9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	3.1 15.8 29.0 1.4 0.0 0.0 0.0 0.0	18.7 61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Noodles Bread Bread cola(100ml) 100ml) c(100ml) Drink(100ml) Milk(100ml) ced Milk(100ml)	423 270 244 42 51 48 55 69 434	9.2 5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	15.8 29.0 1.4 0.0 0.0 0.0 0.0	61.1 66.0 49.0 10.6 13.0 12.0 13.3 4.5
Bread Bread Cola(100ml) 100ml) (100ml) Drink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk	270 244 42 51 48 55 69 434	5.0 8.8 0.0 0.0 0.0 0.0 3.3 17.4	29.0 1.4 0.0 0.0 0.0 0.0 4.2	66.0 49.0 10.6 13.0 12.0 13.3 4.5
Bread cola(100ml) 100ml) (100ml) Drink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	244 42 51 48 55 69 434	8.8 0.0 0.0 0.0 0.0 3.3 17.4	1.4 0.0 0.0 0.0 0.0 4.2	49.0 10.6 13.0 12.0 13.3 4.5
cola(100ml) 100ml) (100ml) Prink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	42 51 48 55 69 434	0.0 0.0 0.0 0.0 3.3 17.4	0.0 0.0 0.0 0.0 4.2	10.6 13.0 12.0 13.3 4.5
100ml) (100ml) Drink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	51 48 55 69 434 60	0.0 0.0 0.0 3.3 17.4	0.0 0.0 0.0 4.2	13.0 12.0 13.3 4.5
e(100ml) Drink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	48 55 69 434 60	0.0 0.0 3.3 17.4	0.0 0.0 4.2	12.0 13.3 4.5
Drink(100ml) Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	55 69 434 60	0.0 3.3 17.4	0.0 4.2	13.3 4.5
Milk(100ml) ed Milk(100ml) th Sugar & Milk with Sugar	69 434 60	3.3 17.4	4.2	4.5
ed Milk(100ml) th Sugar & Milk with Sugar	434 60	17.4		
th Sugar & Milk with Sugar	60		10.2	50.3
with Sugar		3.1	4.0	3.0
with Sugar				
		1.7	1.8	4.6
	54	1.5	2.9	5.1
	594	21.9	50.0	25.0
	265	18.3	20.8	1.2
	729	0.0	81.0	0.0
eam	262	2.0	19.2	21.7
	392	6.0	21.8	44.2
•				45.8
				38.4
				28.5
				20.8
				52.0
				54.3
				58.4
				26.9
				23.2
				21.4
				36.8
				29.3
				22.5
				45.4
				39.0
_				34.2
				36.8
				21.7
Halwa	241	4.9	11.3	30.3
	e Chips uri Puri uri i aji ble Puff un Pak	Fries 314	Fries 314 3.8 268 3.9 ble Pizza 127 5.9 axx Potato Chips 520 8.0 e 564 6.3 Chips 519 2.3 uri 231 3.3 Puri 129 5.2 uri 119 2.5 i 375 8.0 aji 151 3.3 ble Puff 255 3.9 un 287 6.2 Pak 366 3.0 236 4.5 Jamun 375 4.2 kali 127 3.3	Fries 314 3.8 16.1 268 3.9 15.3 ble Pizza 127 5.9 2.4 axx Potato Chips 520 8.0 31.0 e 564 6.3 35.7 Chips 519 2.3 33.6 uri 231 3.3 12.2 Puri 129 5.2 2.8 uri 119 2.5 2.7 ii 375 8.0 21.8 aji 151 3.3 2.4 ble Puff 255 3.9 16.7 un 287 6.2 8.9 Pak 366 3.0 22.4 236 4.5 8.9 Jamun 375 4.2 23.9 kali 127 3.3 3.3

1: Catorie-rich(>300Cat) tiems
2: Protein-rich(>8%) items
3: Fat-rich(>15%) items
4: Carbs-rich(>30%) items
Select the probability distribution you require: 2

#### NUTRITION ANALYSIS USING PROBABILITY THEORY

```
Food items with high Proteins:

1. Cheese Sandwich (10.0%)

2. Wheat Chapati (8.7%)

3. Wheat Poori (8.0%)

4. Uddina Vada (10.5%)

5. Maggi Noodles (9.2%)

6. Brown Bread (8.8%)

7. Powdered Milk(100ml) (17.4%)

8. Peanut Butter (21.9%)

9. Paneer (18.3%)

10. Lays Maxx Potato Chips (8.0%)

11. Kachori (8.0%)

Let X be the number of Protein-rich items in the customer's order.

Probabilty Distribution Table:

| X | 0 | 1 | 2 | 3 |

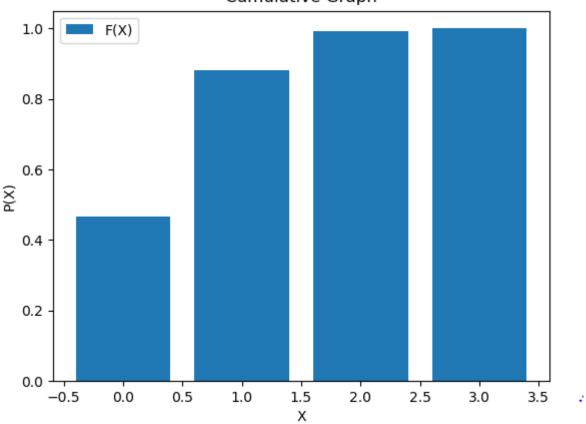
| P(X) | 0.4663 | 0.4159 | 0.1094 | 0.0084 |

Mean = 0.6600, is the expected average of the number of items with high Protein in the customer's order.

Variance = 0.4938

Standard Deviation = 0.7027
```

#### **Cumulative Graph**



2

		· <u>M</u> EN	U (in detail)		
l no.			Protein(%)	Fat(%)	Carbohydrates(%)
1	Cheese Sandwich	298	10.0	13.6	34.3
2	Fried Rice	110	2.2	3.6	17.4
3	Plain Dosa	189	5.2	4.8	31.5
4	Wheat Chapati	244	8.7	1.2	49.6
5	Rava Upma	131	3.4	4.8	18.7
6	Wheat Poori	288	8.0	10.6	43.6
7	Palak Paneer	118	4.0	9.5	4.1
8	Rasam	43	2.4	1.1	6.2
9	White Rice	115	2.5	0.3	25.6
0	Rice Idli	139	4.9	0.3	29.0
1	Uddina Vada	348	10.5	22.4	26.0
2	Vegetable Pulao	97	2.3	2.5	16.4
3	Akki Rotti	208	2.7	8.1	30.4
4	Curd Rice	118	3.7	3.1	18.7
5	Maggi Noodles	423	9.2	15.8	61.1
б	Wheat Bread	270	5.0	29.0	66.0
7	Brown Bread	244	8.8	1.4	49.0
8	Coco Cola(100ml)	42	0.0	0.0	10.6
9	Fanta(100ml)	51	0.0	0.0	13.0
0	Sprite(100mĺ)	48	0.0	0.0	12.0
1	Maaza Drink(100ml)	55	0.0	0.0	13.3
2	Cow's Milk(100ml)	69	3.3	4.2	4.5
3	Powdered Milk(100ml)	434	17.4	18.2	50.3
4	Curd	60	3.1	4.0	3.0
5	Tea with Sugar & Milk		1.7	1.8	4.6
6	Coffee with Sugar	54	1.5	2.9	5.1
7	Peanut Butter	594	21.9	50.0	25.0
8	Paneer	265	18.3	20.8	1.2
9	Butter	729	0.0	81.0	0.0
0	Ice Cream	262	2.0	19.2	21.7
1	Cake	392	6.0	21.8	44.2
2	Chocolate Pastry	377	7.3	18.4	45.8
3	French Fries	314	3.8	16.1	38.4
4	Samosa	268	3.9	15.3	28.5
5	Vegetable Pizza	127	5.9	2.4	20.8
6	Lays Maxx Potato Chips		8.0	31.0	52.0
7	Kurkure	564	6.3	35.7	54.3
8	Banana Chips	519	2.3	33.6	58.4
9	Pani Puri	231	3.3	12.2	26.9
9	Masala Puri	129	5.2	2.8	23.2
1	Bhel Puri	119	2.5	2.7	21.4
2	Kachori	375	8.0	21.8	36.8
3	Pav Bhaji	151	3.3	2.4	29.3
4	Vegetable Puff	255	3.9	16.7	22.5
5	Aloo Bun	287	6.2	8.9	45.4
6	Mysore Pak	366	3.0	22.4	39.0
7	Jelebi	236	4.5	8.9	34.2
8	Gulab Jamun	375	4.2	23.9	36.8
9	Champakali	127	3.3	3.3	21.7
0	Carrot Halwa	241	4.9	11.3	30.3

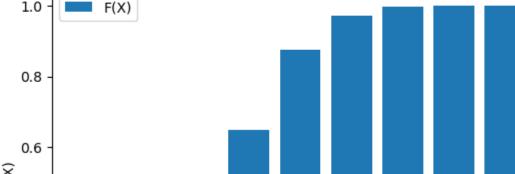
The restaurant has 50 items (100g each) in its menu. How many items did the customer order? 8

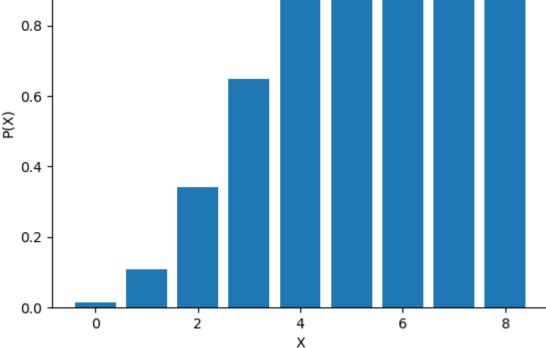
Probability Distribution of 1: Calorie-rich(>300cal) items 2: Protein-rich(>8%) items 3: Fat-rich(>15%) items 4: Carbs-rich(>30%) items Select the probability distribution you require: 3

#### NUTRITION ANALYSIS USING PROBABILITY THEORY

```
Food items with high Fat:
1. Uddina Vada (22.4%)
2. Maggi Noodles (15.8%)
3. Wheat Bread (29.0%)
4. Powdered Milk(100ml) (18.2%)
5. Peanut Butter (50.0%)
6. Paneer (20.8%)
7. Butter (81.0%)
8. Ice Cream (19.2%)
9. Cake (21.8%)
10. Chocolate Pastry (18.4%)
11. French Fries (16.1%)
12. Samosa (15.3%)
13. Lays Maxx Potato Chips (31.0%)
14. Kurkure (35.7%)
15. Banana Chips (33.6%)
16. Kachori (21.8%)
17. Vegetable Puff (16.7%)
18. Mysore Pak (22.4%)
19. Gulab Jamun (23.9%)
Let X be the number of Fat-rich items in the customer's order.
Probabilty Distribution Table:
   P(X) | 0.0147 | 0.0931 | 0.2345 | 0.3067 | 0.2272 | 0.0974 | 0.0235 | 0.0029 | 0.0001 |
Mean = 3.0400, is the expected average of the number of items with high Fat in the customer's order.
Variance = 1.6155
Standard Deviation = 1.2710
```

Cumulative Graph





## **Applications of probability theory:**

Probability theory today has applications far beyond games of chance. It has contributed to the solution of problems in Biology, Physics, Chemistry, other natural sciences and in the Social Sciences as well. It is also used to make important business decisions such as where to locate a supermarket and to analyze the needs of customers.

The telephone network, call centers, and airline companies with their randomly fluctuating loads could not have been economically designed without probability theory.

The Defense Forces also use probability theory to estimate whether a missile will hit its target or not. Various sampling techniques which are used in the quality control of mass produced items, are based on the theory of probability.

## **CONCLUSION**

The use of probability theory in this analysis helps the owner of the restaurant to expect an average number of a type of items that his customer is likely to order.

Providing healthy food and nutrition information can improve a restaurant's image. Often, managers must choose between profitability and social responsibility when making decisions. However, providing nutrition information and healthy food items yields benefits from both perspectives.

Based on results of this study, the owner of a restaurant may make an easy decision to increase more healthy items on their menu while simultaneously increasing the image of their business.

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