

## Module 1: Introduction to Graphical Model - Joint Probability Distribution

```
# Reading the Data using pandas
import pandas as pd
data = pd.read_csv('Purchase Behavior.csv')
data.head()
```

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0

Next steps: [Generate code with data](#) [View recommended plots](#) [New interactive sheet](#)

```
data.shape
```

```
(400, 5)
```

Start coding or [generate](#) with AI.

```
#Joint Probability
```

```
joint_prob_Gender = data.groupby(['Gender','Purchased']).size()/400
print("Joint Probability based on Gender \n", joint_prob_Gender, end="\n")
```

```
Joint Probability based on Gender
Gender  Purchased
Female  0          0.3175
        1          0.1925
Male    0          0.3250
        1          0.1650
dtype: float64
```

```
#Joint Probability
```

```
joint_prob_Age = data.groupby(['Age','Purchased']).size()/400
print("Joint Probability based on Age \n ", joint_prob_Age, end="\n")
```

```
Joint Probability based on Age
Age  Purchased
18   0          0.0125
19   0          0.0175
20   0          0.0175
21   0          0.0100
22   0          0.0125
...
57   1          0.0125
58   1          0.0150
59   0          0.0050
     1          0.0125
60   1          0.0175
Length: 70, dtype: float64
```

```
#Joint Probability
```

```
Joint_Prob_Age_Gender = data.groupby(['Age','Gender','Purchased']).size()/400
print("Joint Probability based on Age, Gender \n", Joint_Prob_Age_Gender, end="\n")
```

```
Joint Probability based on Age, Gender
Age  Gender  Purchased
18   Female  0          0.0075
     Male    0          0.0050
19   Female  0          0.0050
     Male    0          0.0125
20   Female  0          0.0100
...
59   Female  0          0.0050
```

```

1          0.0075
Male      1          0.0050
60 Female 1          0.0050
Male      1          0.0125
Length: 119, dtype: float64

```

Q1: What is the joint probability of a Male aged 35 purchasing a car?

```

prob_q1 = Joint_Prob_Age_Gender.get((35, 'Male', 1), 0)
print(f"Joint Probability (Male, Age 35, Purchased=1): {prob_q1}")

```

```

↔ Joint Probability (Male, Age 35, Purchased=1): 0.0025

```

Q2: What is the joint probability of a Female aged 40 NOT purchasing a car?

```

prob_q2 = Joint_Prob_Age_Gender.get((40, 'Female', 0), 0)
print(f"Joint Probability (Female, Age 40, Purchased=0): {prob_q2}")

```

```

↔ Joint Probability (Female, Age 40, Purchased=0): 0.0075

```

Q3: What is the total joint probability for Age 25, regardless of Gender or Purchase?

```

age_25_data = data[data['Age'] == 25]
prob_q3 = len(age_25_data) / 400
print(f"Total Joint Probability for Age 25: {prob_q3}")

```

```

↔ Total Joint Probability for Age 25: 0.015

```

Q4: What is the conditional probability of purchase given Male and Age 50?

```

subset_q4 = data[(data['Age'] == 50) & (data['Gender'] == 'Male')]
purchased_q4 = subset_q4[subset_q4['Purchased'] == 1]
prob_q4 = len(purchased_q4) / len(subset_q4) if len(subset_q4) > 0 else 0
print(f"Conditional Probability (Male, Age 50, Purchased=1 | Male, Age 50): {prob_q4}")

```

```

↔ Conditional Probability (Male, Age 50, Purchased=1 | Male, Age 50): 0

```

Q5: For all Females, what is the probability of purchasing a car?

```

female_data = data[data['Gender'] == 'Female']
purchased_female = female_data[female_data['Purchased'] == 1]
prob_q5 = len(purchased_female) / len(female_data) if len(female_data) > 0 else 0
print(f"Probability (Female, Purchased=1): {prob_q5}")

```

```

↔ Probability (Female, Purchased=1): 0.37745098039215685

```

6. Calculate the joint probability that a customer is 30 years old, male, and purchased a car.

7. Determine the joint probability for a female aged 40 who did not purchase a car.

8. What is the joint probability that a randomly selected individual aged 50, regardless of gender, has purchased a car?

9. If the joint probability of purchasing a car at age 28 for males is 0.06 and for females is 0.04, what is the total joint probability for age 28?

10. For age 45, if the joint probability of purchasing a car for males is 0.08 and not purchasing is 0.02, what is the conditional probability of purchasing given the person is a 45-year-old male?

## 6. Calculate the joint probability that a customer is 30 years old, male, and purchased a car

```

import pandas as pd
data = pd.read_csv('Purchase Behavior.csv')

```

```
# Total number of records
total_records = len(data)

# Filter for customers who are 30 years old, male, and purchased a car
condition1 = (data['Age'] == 30) & (data['Gender'] == 'Male') & (data['Purchased'] == 1)
joint_count_1 = len(data[condition1])

# Joint probability
joint_prob_1 = joint_count_1 / total_records
print(f"Joint Probability (30 years old, Male, Purchased): {joint_prob_1:.4f}")
```

↗ Joint Probability (30 years old, Male, Purchased): 0.0050

Start coding or generate with AI.

```
# 7. Determine the joint probability for a female aged 40 who did not purchase a car.
condition2 = (data['Age'] == 40) & (data['Gender'] == 'Female') & (data['Purchased'] == 0)
joint_count_2 = len(data[condition2])
joint_prob_2 = joint_count_2 / total_records
print(f"Joint Probability (40 years old, Female, Not Purchased): {joint_prob_2:.4f}")
```

↗ Joint Probability (40 years old, Female, Not Purchased): 0.0075

```
# 8. What is the joint probability that a randomly selected individual aged 50, regardless of g
condition3 = (data['Age'] == 50) & (data['Purchased'] == 1)
joint_count_3 = len(data[condition3])
joint_prob_3 = joint_count_3 / total_records
print(f"Joint Probability (50 years old, Purchased): {joint_prob_3:.4f}")
```

↗ Joint Probability (50 years old, Purchased): 0.0075

```
# 9. If the joint probability of purchasing a car at age 28 for males is 0.06 and for females i
joint_prob_male_28 = 0.06
joint_prob_female_28 = 0.04
total_joint_prob_28 = joint_prob_male_28 + joint_prob_female_28
print(f"Total Joint Probability for Age 28: {total_joint_prob_28:.2f}")
```

↗ Total Joint Probability for Age 28: 0.10

```
# 10. For age 45, if the joint probability of purchasing a car for males is 0.08 and not purcha
joint_prob_male_45_purchased = 0.08
joint_prob_male_45_not_purchased = 0.02
conditional_prob_purchasing_given_male_45 = joint_prob_male_45_purchased / (joint_prob_male_45_
print(f"Conditional Probability of purchasing given a 45-year-old male: {conditional_prob_purch
```

↗ Conditional Probability of purchasing given a 45-year-old male: 0.80