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Week 8 Assignment

Question 1

- A one 6-sided die is rolled once, what is the probability of getting a 3 given you know the number is odd?
  - There are three odd values on a 6-sided die. Thus $P(3|odd) = \frac{1}{3}$
- What is the probability that the total of two dice will be greater than 8, given that the first die is a 5?
  - $P(D_1 + D_2 > 8|D_1 = 5) = \frac{P((D_1+D_2>8)\cap P(D_1=5|D_1+D_2>8))}{P(D_1=5)} = \frac{(\frac{10}{36})\cdot(\frac{5}{10})}{\frac{1}{6}} = \frac{5}{6} = .833$

Question 2

A CSU Professor surveyed 100 high school students on which course they would most like to study at CSU after leaving high school. This two-way table displays data for the sample of students who responded to the survey.

Course	Male	Female	Total
CompSc	26	12	38
Physics	12	32	44
Biology	10	8	18
TOTAL	48	52	100

- A student is chosen at random. Find the probability that the student chose to study CompSc.
  - $P(CompSc) = \frac{38}{100} = .38$
- Find the probability of that the student is a male.
  - $P(Male) = \frac{48}{100} = .48$
- Find the probability of that the student is a female.
  - $P(Female) = \frac{52}{100} = .52$
- Find the probability that the student is a male given that he chose to study CompSc.
  - $P(Male|CompSc) = \frac{P(Male\cap CompSc)}{P(CompSc)} = \frac{\frac{26}{100}}{\frac{38}{100}} = \frac{26}{38} = .684$

- Find the probability that the student is a female given that she chose to study CompSc.
  - $P(Female|CompSc) = \frac{P(Female \cap CompSc)}{P(CompSc)} = \frac{\frac{12}{100}}{\frac{38}{100}} = \frac{12}{38} = .333$
- Find the probability that the student chose to study CompSc, given that the student was male.
  - $P(CompSc|Female) = \frac{P(CompSC \cap Female)}{P(Female)} = \frac{\frac{12}{100}}{\frac{52}{100}} = \frac{12}{52} = .231$
- Find the probability that the student chose to study CompSc, given the student was female.
  - $P(CompSc|Male) = \frac{P(CompSC \cap Male)}{P(Male)} = \frac{\frac{26}{100}}{\frac{48}{100}} = \frac{26}{48} = .542$

Question 3

Question 3a

A student has 80% chance of getting to class on time if his alarm rings but only a 30% if it does not ring. The alarm rings 90% of the time.

- What is the probability of the student getting to class on time?
  - $P(class\ on\ time) = (.8 \cdot .9) + (.3 \cdot .1) = .72 + .03 = .75 = 75\%$
- The student is late for class today. What is the probability that his alarm did not work this morning?
  - $P(no\ alarm|late) = \frac{P(no\ alarm \cap late)}{P(late)} = \frac{P(late|no\ alarm) \cdot P(no\ ring)}{P(late)} = \frac{.7 \cdot .1}{.25} = \frac{.07}{.25} = .28 = 28\%$

Question 3b

A football team wins half of its games. When the star plays the team wins 70% of its games, but the star only plays 60% of the games.

- In what proportion of games does the team win and the star play?
  - $P(win \cap star) = P(win|star) \cdot P(star) = .7 \cdot .6 = .42$
  - Out of every 100 games, there will be 42 where the team wins and the star plays.
- If the team wins, what is the probability that the star played?
  - $P(star|win) = \frac{P(win \cap star)}{P(win)} = \frac{.42}{.5} = .84$
- Would you say that the event "the team wins" is independent of the event "the star plays"? Why?
  - I would say that the team wins is not independent of the star plays. This is due to the fact that $P(win \cap star) \neq P(win) \cdot P(star)$.

Question 4

- The Code

```
import pandas
import numpy as np
from sklearn.naive_bayes import GaussianNB
from sklearn import datasets
from sklearn import metrics

names=['sepal_length','sepal_width','petal_length','petal_width','flower']
url = 'https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data'
Iris = pandas.read_csv(url, names=names)
pd.set_option('display.max_rows',150)
Iris.columns = names
print(Iris.to_string(index=False))

cols_to_use = [0,1,2,3]
dataset.data=pandas.read_csv(url, names=['sepal_length','sepal_width','petal_length','petal_width','flower'],
                        usecols= cols_to_use)
dataset.target = [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
                  0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,
                  1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,
                  1,1,1,1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,
                  2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2]

model=GaussianNB()
model.fit(dataset.data, dataset.target)
expected=dataset.target
predicted = model.predict(dataset.data)
print(metrics.classification_report(expected, predicted))
print(metrics.confusion_matrix(expected,predicted))
```

- The Probabilities

```
                precision    recall  f1-score   support

             0       1.00      1.00      1.00        50
             1       0.94      0.94      0.94        50
             2       0.94      0.94      0.94        50

avg / total          0.96      0.96      0.96       150

[[50  0  0]
 [ 0 47  3]
 [ 0  3 47]]
```

- Printing the Data

sepal_length	sepal_width	petal_length	petal_width	flower
5.1	3.5	1.4	0.2	Iris-setosa
4.9	3.0	1.4	0.2	Iris-setosa
4.7	3.2	1.3	0.2	Iris-setosa
4.6	3.1	1.5	0.2	Iris-setosa
5.0	3.6	1.4	0.2	Iris-setosa
5.4	3.9	1.7	0.4	Iris-setosa
4.6	3.4	1.4	0.3	Iris-setosa
5.0	3.4	1.5	0.2	Iris-setosa
4.4	2.9	1.4	0.2	Iris-setosa
4.9	3.1	1.5	0.1	Iris-setosa
5.4	3.7	1.5	0.2	Iris-setosa
4.8	3.4	1.6	0.2	Iris-setosa
4.8	3.0	1.4	0.1	Iris-setosa
4.3	3.0	1.1	0.1	Iris-setosa
5.8	4.0	1.2	0.2	Iris-setosa
5.7	4.4	1.5	0.4	Iris-setosa
5.4	3.9	1.3	0.4	Iris-setosa
5.1	3.5	1.4	0.3	Iris-setosa
5.7	3.8	1.7	0.3	Iris-setosa
5.1	3.8	1.5	0.3	Iris-setosa
5.4	3.4	1.7	0.2	Iris-setosa
5.1	3.7	1.5	0.4	Iris-setosa
4.6	3.6	1.0	0.2	Iris-setosa
5.1	3.3	1.7	0.5	Iris-setosa
4.8	3.4	1.9	0.2	Iris-setosa
5.0	3.0	1.6	0.2	Iris-setosa
5.0	3.4	1.6	0.4	Iris-setosa
5.2	3.5	1.5	0.2	Iris-setosa
5.2	3.4	1.4	0.2	Iris-setosa
4.7	3.2	1.6	0.2	Iris-setosa
4.8	3.1	1.6	0.2	Iris-setosa
5.4	3.4	1.5	0.4	Iris-setosa
5.2	4.1	1.5	0.1	Iris-setosa
5.5	4.2	1.4	0.2	Iris-setosa
4.9	3.1	1.5	0.1	Iris-setosa
5.0	3.2	1.2	0.2	Iris-setosa
5.5	3.5	1.3	0.2	Iris-setosa
4.9	3.1	1.5	0.1	Iris-setosa
4.4	3.0	1.3	0.2	Iris-setosa
5.1	3.4	1.5	0.2	Iris-setosa
5.0	3.5	1.3	0.3	Iris-setosa
4.5	2.3	1.3	0.3	Iris-setosa
4.4	3.2	1.3	0.2	Iris-setosa
5.0	3.5	1.6	0.6	Iris-setosa
5.1	3.8	1.9	0.4	Iris-setosa
4.8	3.0	1.4	0.3	Iris-setosa
5.1	3.8	1.6	0.2	Iris-setosa
4.6	3.2	1.4	0.2	Iris-setosa
5.3	3.7	1.5	0.2	Iris-setosa
5.0	3.3	1.4	0.2	Iris-setosa
7.0	3.2	4.7	1.4	Iris-versicolor
6.4	3.2	4.5	1.5	Iris-versicolor
6.9	3.1	4.9	1.5	Iris-versicolor
5.5	2.3	4.0	1.3	Iris-versicolor
6.5	2.8	4.6	1.5	Iris-versicolor
5.7	2.8	4.5	1.3	Iris-versicolor
6.3	3.3	4.7	1.6	Iris-versicolor
4.9	2.4	3.3	1.0	Iris-versicolor
6.6	2.9	4.6	1.3	Iris-versicolor
5.2	2.7	3.9	1.4	Iris-versicolor
5.0	2.0	3.5	1.0	Iris-versicolor
5.9	3.0	4.2	1.5	Iris-versicolor
6.0	2.2	4.0	1.0	Iris-versicolor
6.1	2.9	4.7	1.4	Iris-versicolor
5.6	2.9	3.6	1.3	Iris-versicolor
6.7	3.1	4.4	1.4	Iris-versicolor
5.6	3.0	4.5	1.5	Iris-versicolor
5.8	2.7	4.1	1.0	Iris-versicolor
6.2	2.2	4.5	1.5	Iris-versicolor
5.6	2.5	3.9	1.1	Iris-versicolor
5.9	3.2	4.8	1.8	Iris-versicolor
6.1	2.8	4.0	1.3	Iris-versicolor
6.3	2.5	4.9	1.5	Iris-versicolor
6.1	2.8	4.7	1.2	Iris-versicolor
6.4	2.9	4.3	1.3	Iris-versicolor
6.6	3.0	4.4	1.4	Iris-versicolor
6.8	2.8	4.8	1.4	Iris-versicolor
6.7	3.0	5.0	1.7	Iris-versicolor
6.0	2.9	4.5	1.5	Iris-versicolor
5.7	2.6	3.5	1.0	Iris-versicolor
5.5	2.4	3.8	1.1	Iris-versicolor
5.5	2.4	3.7	1.0	Iris-versicolor
5.8	2.7	3.9	1.2	Iris-versicolor
6.0	2.7	5.1	1.6	Iris-versicolor
5.4	3.0	4.5	1.5	Iris-versicolor
6.0	3.4	4.5	1.6	Iris-versicolor
6.7	3.1	4.7	1.5	Iris-versicolor
6.3	2.3	4.4	1.3	Iris-versicolor
5.6	3.0	4.1	1.3	Iris-versicolor
5.5	2.5	4.0	1.3	Iris-versicolor
5.5	2.6	4.4	1.2	Iris-versicolor
6.1	3.0	4.6	1.4	Iris-versicolor
5.8	2.6	4.0	1.2	Iris-versicolor
5.0	2.3	3.3	1.0	Iris-versicolor
5.6	2.7	4.2	1.3	Iris-versicolor
5.7	3.0	4.2	1.2	Iris-versicolor
5.7	2.9	4.2	1.3	Iris-versicolor
6.2	2.9	4.3	1.3	Iris-versicolor
5.1	2.5	3.0	1.1	Iris-versicolor
5.7	2.8	4.1	1.3	Iris-versicolor
6.3	3.3	6.0	2.5	Iris-virginica
5.8	2.7	5.1	1.9	Iris-virginica
7.1	3.0	5.9	2.1	Iris-virginica
6.3	2.9	5.6	1.8	Iris-virginica
6.5	3.0	5.8	2.2	Iris-virginica
7.6	3.0	6.6	2.1	Iris-virginica
4.9	2.5	4.5	1.7	Iris-virginica
7.3	2.9	6.3	1.8	Iris-virginica
6.7	2.5	5.8	1.8	Iris-virginica
7.2	3.6	6.1	2.5	Iris-virginica
6.5	3.2	5.1	2.0	Iris-virginica
6.4	2.7	5.3	1.9	Iris-virginica
6.8	3.0	5.5	2.1	Iris-virginica
5.7	2.5	5.0	2.0	Iris-virginica
5.8	2.8	5.1	2.4	Iris-virginica
6.4	3.2	5.3	2.3	Iris-virginica
6.5	3.0	5.5	1.8	Iris-virginica
7.7	3.8	6.7	2.2	Iris-virginica
7.7	2.6	6.9	2.3	Iris-virginica
6.0	2.2	5.0	1.5	Iris-virginica
6.9	3.2	5.7	2.3	Iris-virginica
5.6	2.8	4.9	2.0	Iris-virginica
7.7	2.8	6.7	2.0	Iris-virginica
6.3	2.7	4.9	1.8	Iris-virginica
6.7	3.3	5.7	2.1	Iris-virginica
7.2	3.2	6.0	1.8	Iris-virginica
6.2	2.8	4.8	1.8	Iris-virginica
6.1	3.0	4.9	1.8	Iris-virginica
6.4	2.8	5.6	2.1	Iris-virginica
7.2	3.0	5.8	1.6	Iris-virginica
7.4	2.8	6.1	1.9	Iris-virginica
7.9	3.8	6.4	2.0	Iris-virginica
6.4	2.8	5.6	2.2	Iris-virginica
6.3	2.8	5.1	1.5	Iris-virginica
6.1	2.6	5.6	1.4	Iris-virginica
7.7	3.0	6.1	2.3	Iris-virginica
6.3	3.4	5.6	2.4	Iris-virginica
6.4	3.1	5.5	1.8	Iris-virginica
6.0	3.0	4.8	1.8	Iris-virginica
6.9	3.1	5.4	2.1	Iris-virginica
6.7	3.1	5.6	2.4	Iris-virginica
6.9	3.1	5.1	2.3	Iris-virginica
5.8	2.7	5.1	1.9	Iris-virginica
6.8	3.2	5.9	2.3	Iris-virginica
6.7	3.3	5.7	2.5	Iris-virginica
6.7	3.0	5.2	2.3	Iris-virginica
6.3	2.5	5.0	1.9	Iris-virginica
6.5	3.0	5.2	2.0	Iris-virginica
6.2	3.4	5.4	2.3	Iris-virginica
5.9	3.0	5.1	1.8	Iris-virginica