MAP inference

> In the fifth homework you will perform an application of the MAP inference we saw in class. For instance, you will design a Bayesian net-based based classifier, train and test it, and compare it according a benchmark.
>
> If further questions arise, please use the slack channel, or write me to esjimenezro@iteso.mx.
>
> **References:**
>
> - Solving A Simple Classification Problem with Python — Fruits Lovers' Edition

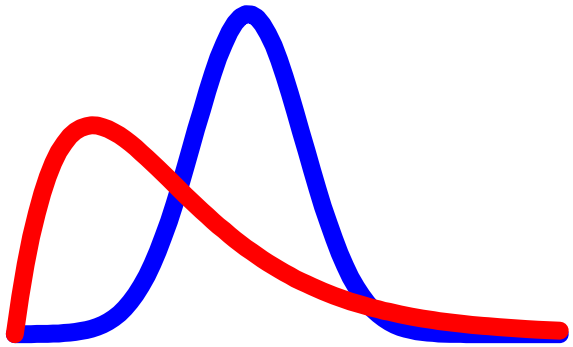


Imagen recuperada de: https://upload.wikimedia.org/wikipedia/commons/e/ed/Bayes_icon.svg.

Data

The fruits dataset was created by Dr. Iain Murray from University of Edinburgh. He bought a few dozen oranges, lemons and apples of different varieties, and recorded their measurements in a table. And then the professors at University of Michigan formatted the fruits data slightly and it can be downloaded from here.

1. EDA

Perform some exploratory data analysis over the fruits dataset to get familiarized with the data.

In [114…
```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from pandas.plotting import scatter_matrix
import matplotlib.pyplot as plt
from matplotlib import cm
import seaborn as sns
import pandas as pd
import numpy as np

%matplotlib inline
```

In [8]:
```
df = pd.read_csv('C:\\Users\\Omar\\Documents\\Modelos Graficos Probabilisticos
```

In [ ]:
```
df.info()
```

In [3]:
```
df.describe()
```

Out[3]:

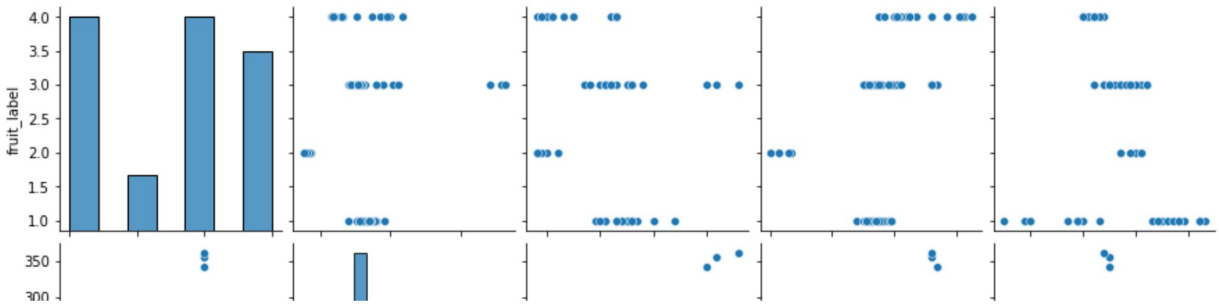
	fruit_label	mass	width	height	color_score
count	59.000000	59.000000	59.000000	59.000000	59.000000
mean	2.542373	163.118644	7.105085	7.693220	0.762881
std	1.208048	55.018832	0.816938	1.361017	0.076857
min	1.000000	76.000000	5.800000	4.000000	0.550000
25%	1.000000	140.000000	6.600000	7.200000	0.720000
50%	3.000000	158.000000	7.200000	7.600000	0.750000
75%	4.000000	177.000000	7.500000	8.200000	0.810000
max	4.000000	362.000000	9.600000	10.500000	0.930000

In [101…
```
#training-test split
X = df[['mass','width','height','color_score']]
# into y we put our target
y = df['fruit_label']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, shuf
```

In [117…
```
sns.pairplot(df)
```

Out[117… `<seaborn.axisgrid.PairGrid at 0x21d8d46e448>`



2. Design a logistic regression classifier

2.1. Split the dataset into train and test. Be sure to suffle the data because it comes ordered.

2.2. Train a logistic regression classifier, using as explainer variables the **mass**, the **width**, the **height**, and the **color_score** for the target variable **fruit_label**

2.3. Obtain the accuracy of your classifier over the test dataset.

In [111…
```
clf = LogisticRegression(random_state=0).fit(X_train, y_train)
clf.score(X_test, y_test)
```

```
c:\users\omar\appdata\local\programs\python\python37\lib\site-packages\sklear
n\linear_model\_logistic.py:764: ConvergenceWarning: lbfgs failed to converge
(status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regress
ion
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
```

Out[111… 0.75

3. Design naïve Bayes classifier

3.1. Use the same train and test sets from the above point.

3.2. Design and train a naïve Bayes classifier, using as explainer variables the **mass**, the **width**, the **height**, and the **color_score** for the target variable **fruit_label**

3.3. Obtain the accuracy of your classifier over the test dataset.

In [77]:
```
from pgmpy.models import BayesianModel
```

In [92]:
```
model = BayesianModel([('fruit_label','mass'),
                       ('fruit_label','width'),
                       ('fruit_label','height'),
                       ('fruit_label','color_score')])
```

In [103…
```
train = pd.DataFrame(X_train).join(y_train).copy()
train.reset_index(drop=True, inplace=True)
train.mass = pd.cut(train.mass, bins=3, labels=np.arange(3), right=False)
train.width = pd.cut(train.width, bins=3, labels=np.arange(3), right=False)
train.height = pd.cut(train.height, bins=3, labels=np.arange(3), right=False)
train.color_score = pd.cut(train.color_score, bins=3, labels=np.arange(3), ri
```

In [104…
```
model.fit(train)
```

```
WARNING:root:Replacing existing CPD for color_score
WARNING:root:Replacing existing CPD for fruit_label
WARNING:root:Replacing existing CPD for height
WARNING:root:Replacing existing CPD for mass
WARNING:root:Replacing existing CPD for width
```

In [105…
```
model.check_model()
```

Out[105… True

In [106…
```
test = pd.DataFrame(X_test).copy()
test.mass = pd.cut(test.mass, bins=3, labels=np.arange(3), right=False)
test.width = pd.cut(test.width, bins=3, labels=np.arange(3), right=False)
test.height = pd.cut(test.height, bins=3, labels=np.arange(3), right=False)
test.color_score = pd.cut(test.color_score, bins=3, labels=np.arange(3), right
```

In [107…
```
y_pred = model.predict(test)
```

```
100%|
| 9/9 [00:00<00:00, 1800.90it/s]
```

In [108…
```
(y_pred.values.T == y_test.values.T).sum() / len(y_test)
```

Out[108… 0.9166666666666666

Which classifier performs better on the test set?

Bayesian model perform the best for this data set in particular.

Created with Jupyter by Esteban Jiménez Rodríguez.