Introduction_Homework

April 2, 2020

[2]:
```
from scipy.stats import norm
from matplotlib import pyplot as plt
import numpy as np
import math
```

0.1 Task 1. (Introduction)

Suppose that we have three coloured boxes r (red), b (blue), and g (green).

- Box r contains 3 apples, 4 oranges, and 3 limes,
- Box b contains 1 apple, 1 orange, and 0 limes, and
- Box g contains 3 apples, 3 oranges, and 4 limes.

If a box is chosen at random with probabilities p(r) = 0.2, p(b) = 0.2, p(g) = 0.6, and a piece of fruit is removed from the box (with equal probability of selecting any of the items in the box), then what is the probability of selecting an apple?

If we observe that the selected fruit is in fact an orange, what is the probability that it came from the green box?

$$Priorprobability \implies p(r) = 0.2, p(b) = 0.2, p(g) = 0.6 \tag{1}$$

$$p(f = a) = p(f = a|b = r)p(r)+p(f = a|b = b)p(b)+p(f = a|b = g)p(g) = 0.3x0.2+0.5x0.2+0.3x0.6 = 0.34 \tag{2}$$

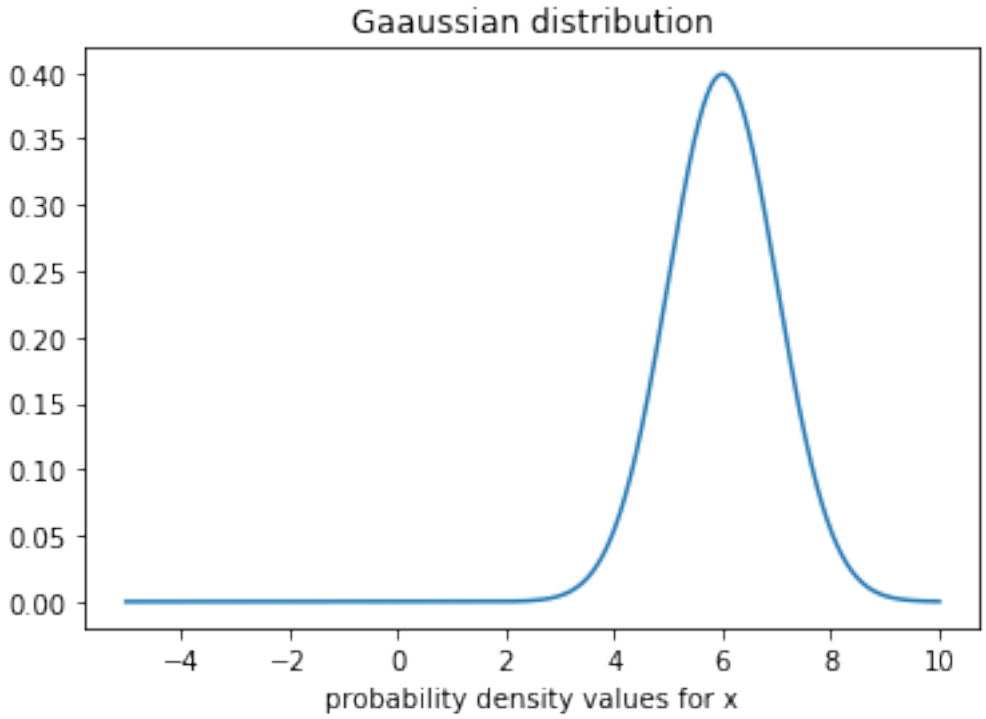
$$p(b = g|f = o) = \frac{p(f = o|b = g)xp(b = g)}{p(f = o)} = \frac{0.3x0.6}{0.4x0.2 + 0.5x0.2 + 0.3x0.6} = 0.5 \tag{3}$$

0.2 Task 2. (Introduction)

Consider a Gaussian distribution $p_x(x)$ over x with mean = 6 and standard deviation $\sigma = 1$. Plot this distribution.
Next, draw a sample of N = 50000 points from this distribution and plot a histogram of their values, which as expected agrees with the distribution $p_x(x)$.
Now consider a non-linear change of variables from x to y given by

$x = g(y) = ln(y) - ln(1-y) + 5$
The inverse of this function is given by
$y = g^{-1}(x) = \frac{1}{1+exp(-x+5)}$
which is a logistic sigmoid function. Plot this function in the same Figure.
Plot the curve $p_x(g(y))$ that is a transformation of $p_x(x)$ as a function of x $p_x(g(y))$

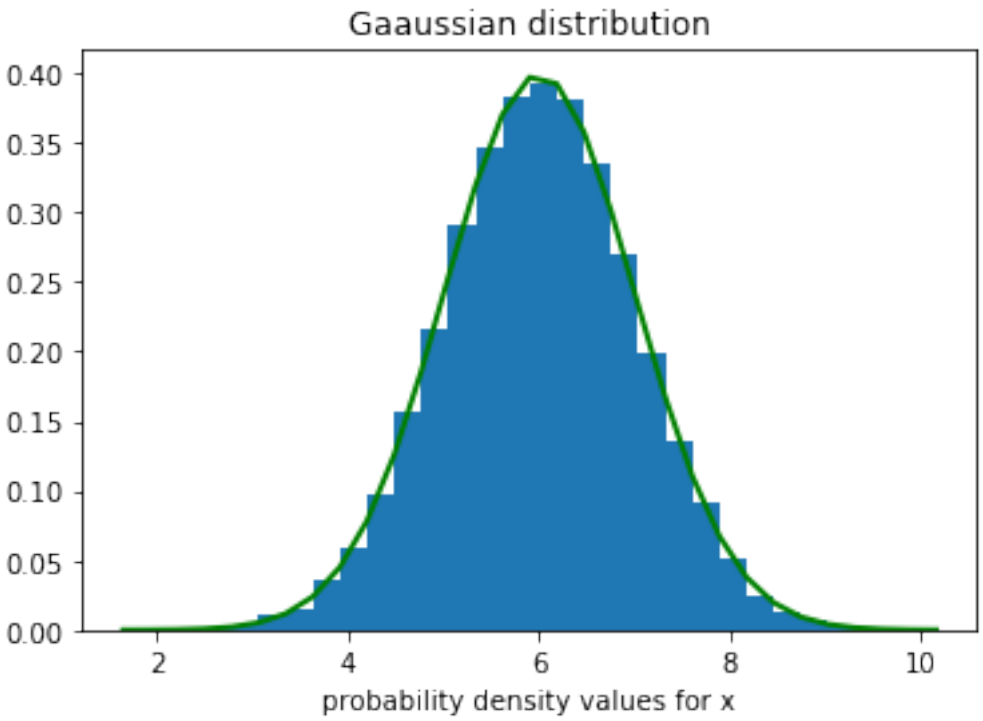
[4]:
```
mu = 6
sigma = 1

x = np.linspace(-5,10,100000)
plt.plot(x,norm(mu,sigma).pdf(x))
plt.title('Gaaussian distribution')
plt.xlabel("probability density values for x")
plt.show()
```



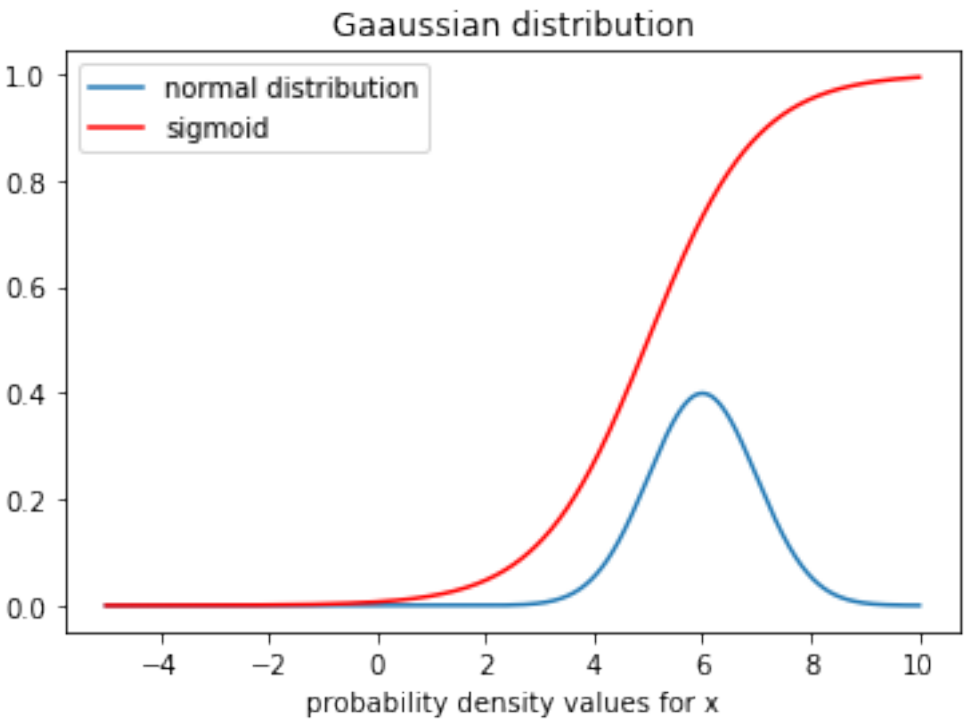
[63]:
```
s = np.random.normal(mu, sigma, 50000)
count, bins, ignored = plt.hist(s, 30, normed=True, label="p(x)")
plt.plot(bins, 1/(sigma * np.sqrt(2 * np.pi))*np.exp( - (bins - mu)**2 / (2 *␣
↪sigma**2) ),linewidth=2, color='g')
plt.title('Gaaussian distribution')
plt.xlabel("probability density values for x")
plt.show()
```

```
/home/manoj/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:2:
```

```
MatplotlibDeprecationWarning:
The 'normed' kwarg was deprecated in Matplotlib 2.1 and will be removed in 3.1.
Use 'density' instead.
```



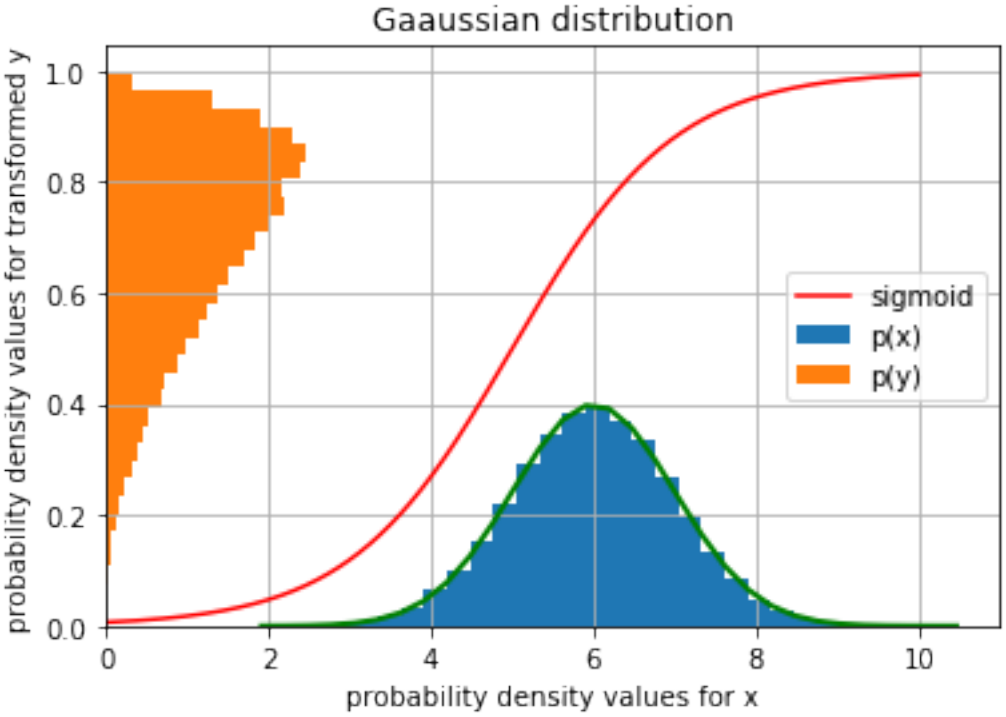
[6]:
```
x = np.linspace(-5,10,100000)
plt.plot(x,norm(mu,sigma).pdf(x), label = "normal distribution")
sigmoid = lambda x:1/(1+np.exp(-x+5))
plt.title('Gaaussian distribution')
plt.xlabel("probability density values for x")
plt.plot(x,sigmoid(x),'r', label="sigmoid")
plt.legend()
plt.show()
```



[62]:
```
x = np.linspace(0,10,50000)
s = np.random.normal(mu, sigma, 50000)
count, bins1, ignored = plt.hist(s, 30, normed=True, label="p(x)")
plt.plot(bins1, 1/(sigma * np.sqrt(2 * np.pi))*np.exp( - (bins1 - mu)**2 / (2 *␣
 ↪sigma**2) ),linewidth=2, color='g')
sigmoid = lambda x:1/(1+np.exp(-x+5))
new = sigmoid(s)
count2, bins2, ignored2 = plt.hist(new, 30, normed=True,␣
 ↪orientation='horizontal', label="p(y)")
plt.plot(x,sigmoid(x),'r', label="sigmoid")
plt.title('Gaaussian distribution')
plt.xlabel("probability density values for x")
plt.ylabel("probability density values for transformed y")
plt.legend()
plt.grid()
plt.show()
```

```
/home/manoj/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:3:
MatplotlibDeprecationWarning:
The 'normed' kwarg was deprecated in Matplotlib 2.1 and will be removed in 3.1.
Use 'density' instead.
  This is separate from the ipykernel package so we can avoid doing imports
until
/home/manoj/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:7:
```

```
MatplotlibDeprecationWarning:
The 'normed' kwarg was deprecated in Matplotlib 2.1 and will be removed in 3.1.
Use 'density' instead.
  import sys
```



[ ]: