



Summer Project 2023

Pritish Karmakar

21MS179

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1 Gaussian curve and its fourier transform

1.1 Standard normal

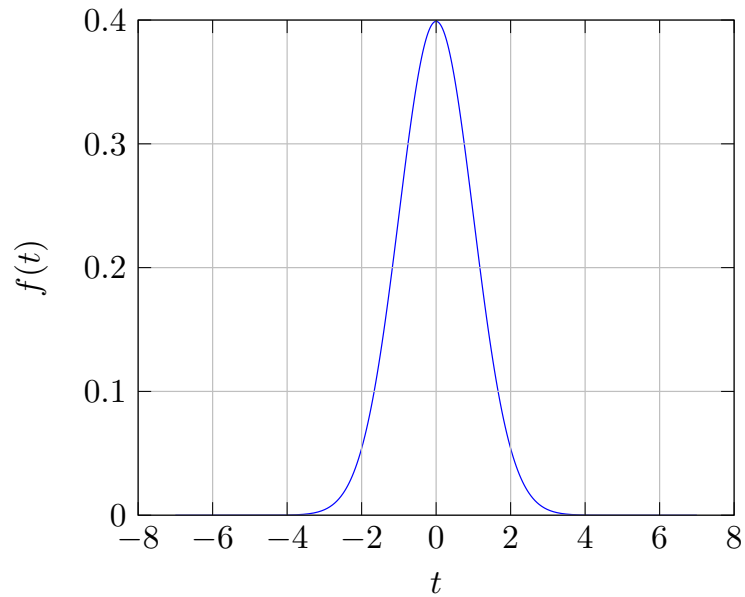


Figure 1: Standard Normal curve

```
..... Code Block .....  
  
import matplotlib.pyplot as plt  
import numpy as np  
plt.style.use("classic")  
  
def f(t):  
    return np.exp(-(t)**2/2)/(np.sqrt(2*np.pi))  
  
xv = np.linspace(-7,7,1000)  
yv = f(xv)  
  
plt.plot(xv, yv, lw=1)  
plt.xlabel("$t$")  
plt.ylabel("$f(t)$")  
plt.grid(True)  
  
.....
```

1.2 Fourier transform of Standard normal

If $f(t) = \int_{-\infty}^{\infty} g(\omega)e^{i\omega t}d\omega$, then fourier transform of that is $g(\omega) = \frac{1}{2\pi} \int_{-\infty}^{\infty} f(t)e^{-i\omega t}dt$. Here,
 $f(x) = \frac{1}{\sqrt{2\pi}}e^{-x^2/2}$

$$\begin{aligned}
g(\omega) &= \frac{1}{2\pi} \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt \\
&= \frac{1}{2\pi} \int_{-\infty}^{\infty} f(t) \cos(\omega t) dt - i \frac{1}{2\pi} \int_{-\infty}^{\infty} f(t) \sin(\omega t) dt
\end{aligned}$$

..... **Code Block**

```

import numpy as np
import matplotlib.pyplot as plt
from scipy.integrate import quad

def f(t):
    return np.exp(-(t)**2/2)/(np.sqrt(2*np.pi))

def ft(y):
    int_re = lambda t: f(t)*np.sin(y*t)
    int_im = lambda t: f(t)*np.cos(y*t)
    g_re = quad(int_re,-np.inf,np.inf)[0]/(2*np.pi)
    g_im = quad(int_im,-np.inf,np.inf)[0]/(2*np.pi)
    return g_re - 1j*g_im
g = np.frompyfunc(ft, 1, 1)

xv = np.linspace(-7,7,1000)
yv = np.abs(g(xv))
plt.plot(xv, yv, lw=1)
plt.xlabel("$\omega$")
plt.ylabel("$abs(g(\omega))$")
plt.grid(True)

```

.....

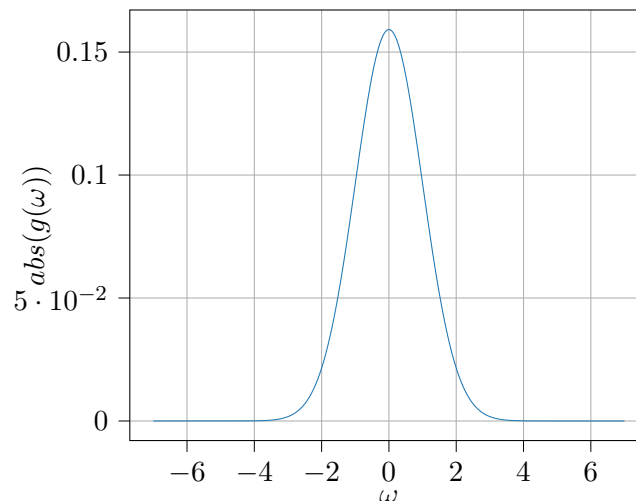


Figure 2: Fourier transform of Standard Normal