# Ayudantía01_Simulation

September 4, 2020

**Análisis de Datos 2020 – Ayudantía 01**

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[1]:
```
import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

from scipy.special import binom
```

[2]:
```
def sampleY(n):
    """ Función que muestrea una variable no-uniforme
        en [0,1] para que al hacer la transformación
        T(x) = x se vuelva uniforme.
    """
    t = np.random.rand(n)
    z = np.sqrt(t)
    return z
```

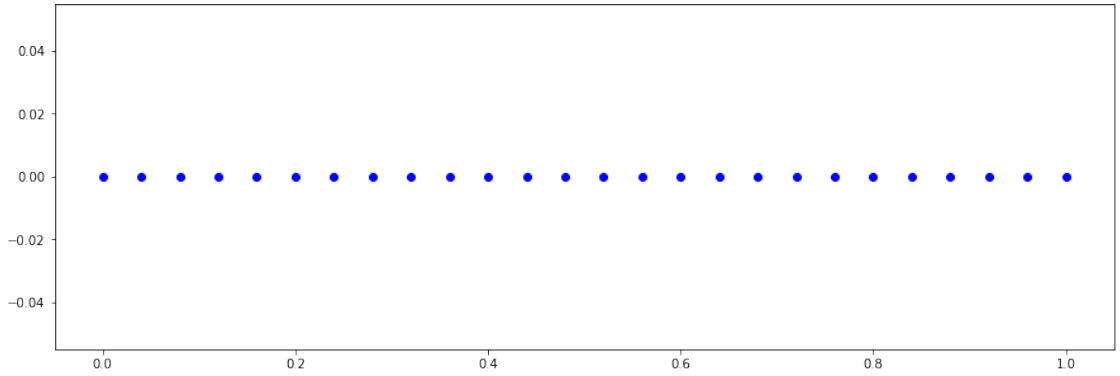
## 0.1 Ditribución uniforme en la esfera

[3]:
```
np.random.seed(9263)
```

[4]:
```
n = 25
x = np.linspace(0, 1, n+1)
print(x)
```

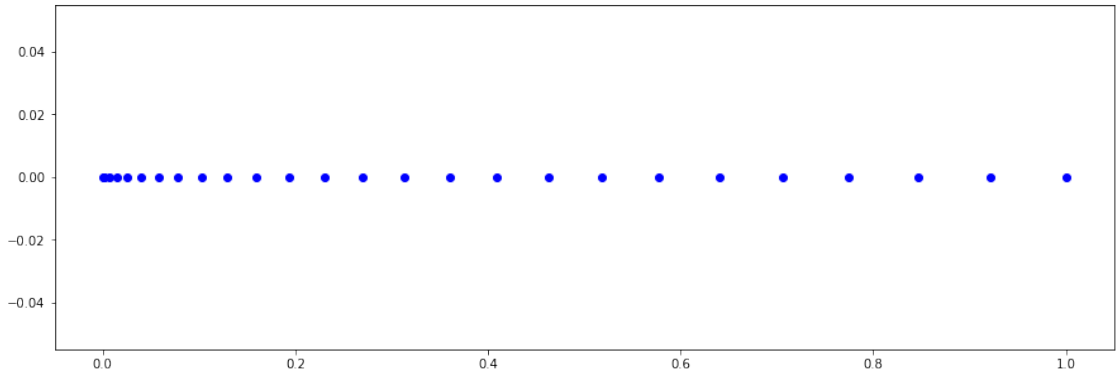
```
[0.   0.04 0.08 0.12 0.16 0.2  0.24 0.28 0.32 0.36 0.4  0.44 0.48 0.52
 0.56 0.6  0.64 0.68 0.72 0.76 0.8  0.84 0.88 0.92 0.96 1.  ]
```

[5]:
```
plt.figure(figsize=(15,5))
plt.plot(x, np.zeros(n+1), 'bo')
plt.show()
```




[6]:
```
y = x**2
```

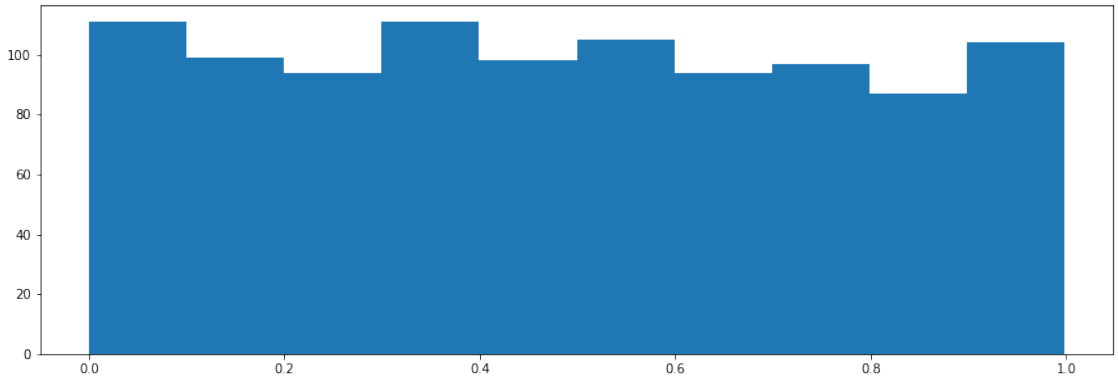
[7]:
```
plt.figure(figsize=(15,5))
plt.plot(y, np.zeros(n+1), 'bo')
plt.show()
```




[ ]:
```
```

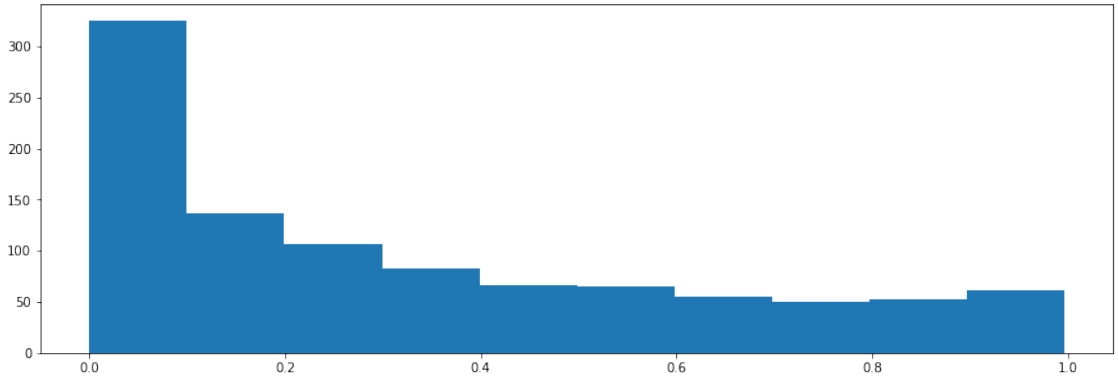
[8]:
```
n = 100
x = np.random.rand(1000)
```

[9]:
```
plt.figure(figsize=(15,5))
plt.hist(x, 10)
plt.show()
```




[10]:
```
y = x**2
```

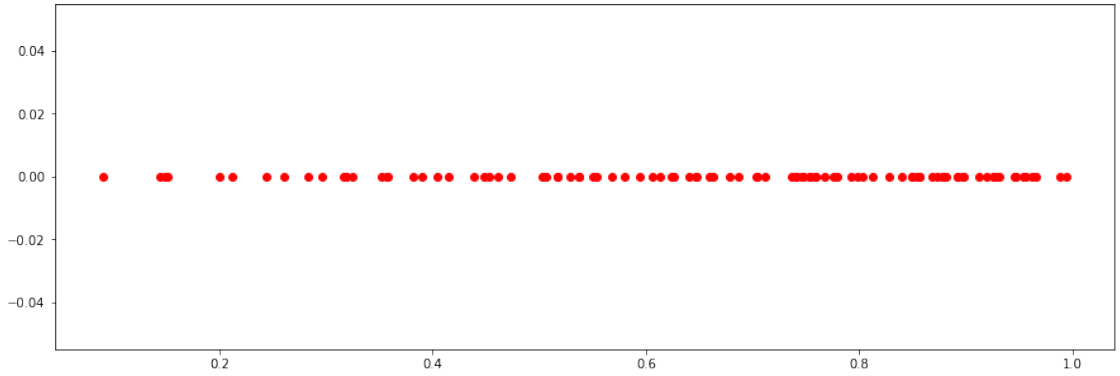
[11]:
```
plt.figure(figsize=(15,5))
plt.hist(y, 10)
plt.show()
```




[ ]:
```
```

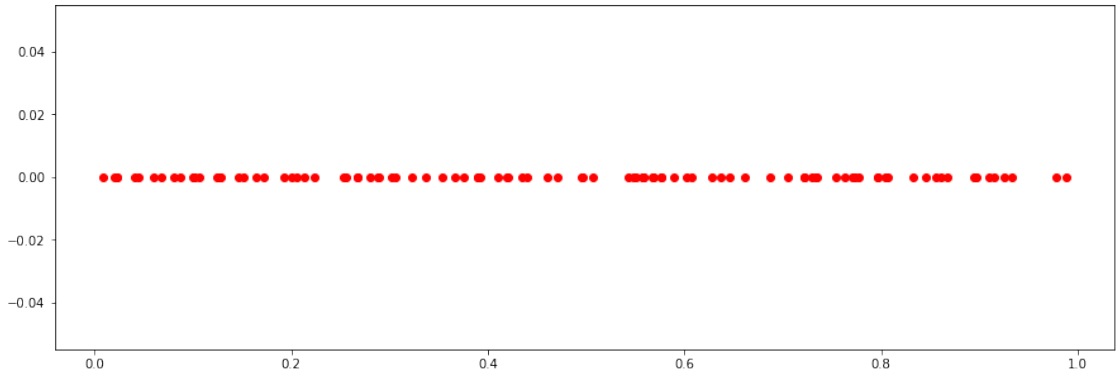
[12]:
```
n = 100
x = sampleY(n)
```

[13]:
```
plt.figure(figsize=(15,5))
plt.plot(x, np.zeros(n), 'ro')
plt.show()
```




[14]:
```
y = x**2
```

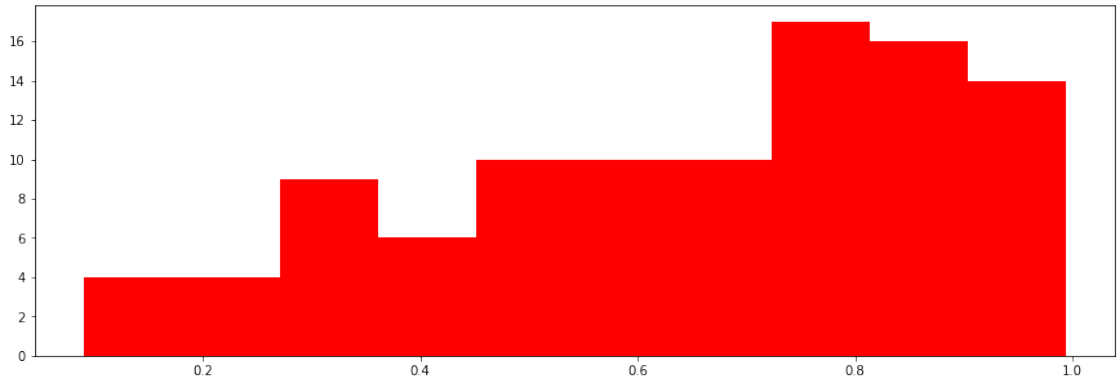
[15]:
```
plt.figure(figsize=(15,5))
plt.plot(y, np.zeros(n), 'ro')
plt.show()
```




[ ]:

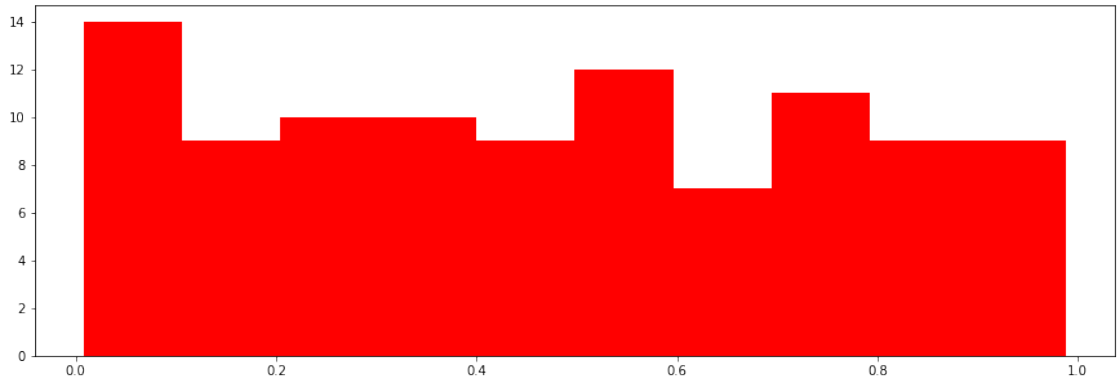
[ ]:

[16]:
```
plt.figure(figsize=(15,5))
plt.hist(x, 10, color='red')
plt.show()
```




[17]:
```
y = x**2
```

[18]:
```
plt.figure(figsize=(15,5))
plt.hist(y, 10, color='red')
plt.show()
```

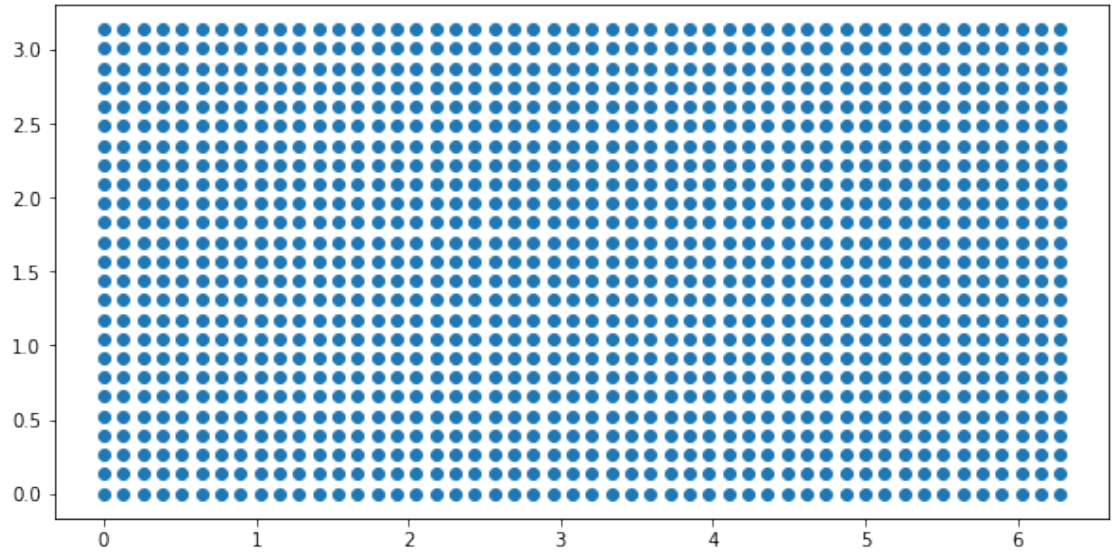



[ ]:
```

```

## 0.2 ¿Qué ocurre en la esfera?

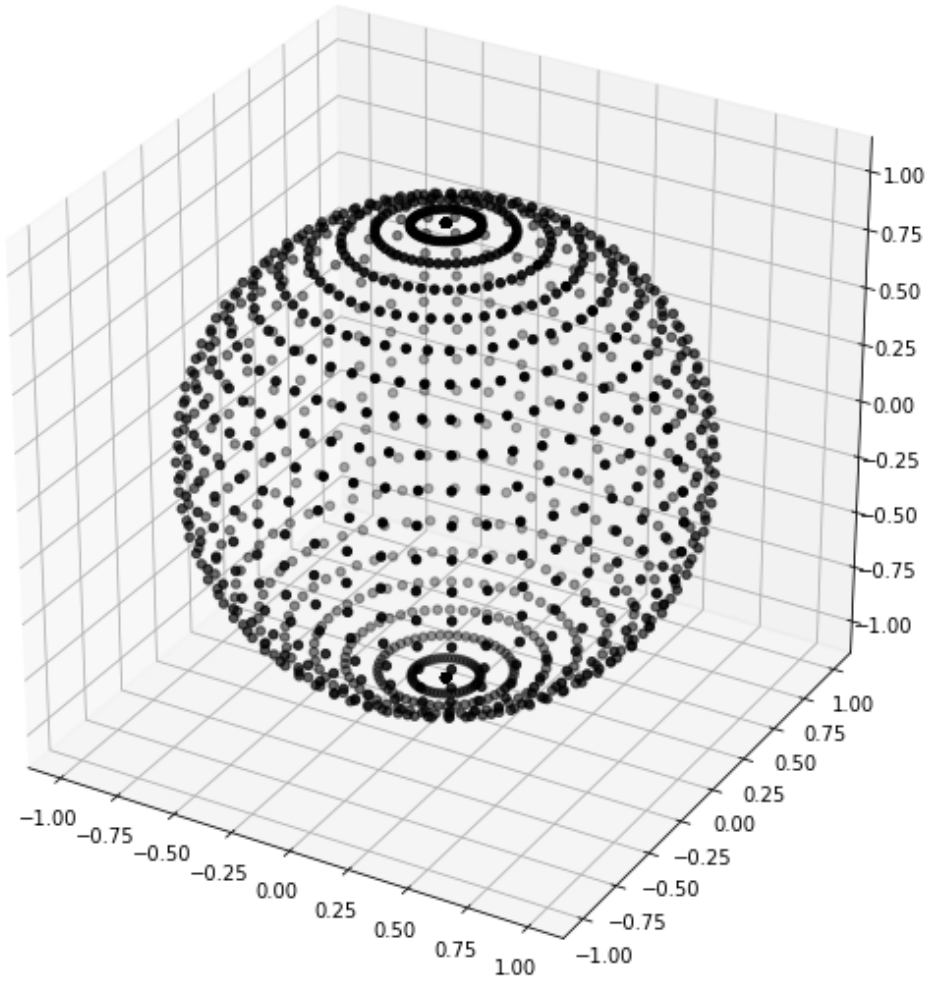
[19]:
```
# "uniform" grid on 2D rectalgle
n = 50
u = np.linspace(0, 2*np.pi, n)
v = np.linspace(0, np.pi, n//2)

x, y = np.meshgrid(u, v)
```

[20]:
```
plt.figure(figsize=(10,5))
plt.scatter(x, y)
plt.show()
```




[21]:
```
r = 1

# spherical parametrization
x = np.outer(r*np.cos(u), r*np.sin(v))
y = np.outer(r*np.sin(u), r*np.sin(v))
z = np.outer(r*np.ones(np.size(u)), r*np.cos(v))
```

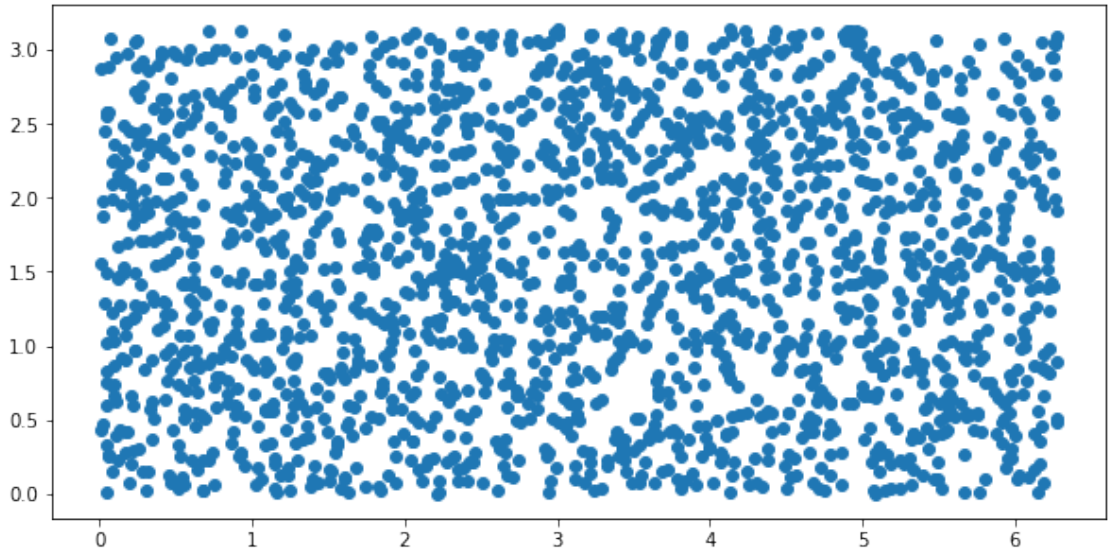
[22]:
```
stride = 2
r = 1

fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(111, projection='3d')
#ax.plot_surface(x,y,z, linewidth=0.1, cstride=stride, rstride=stride,␣
 ↪color='lightblue')
ax.scatter3D(x, y, z, 'o', color='black')
plt.show()
```



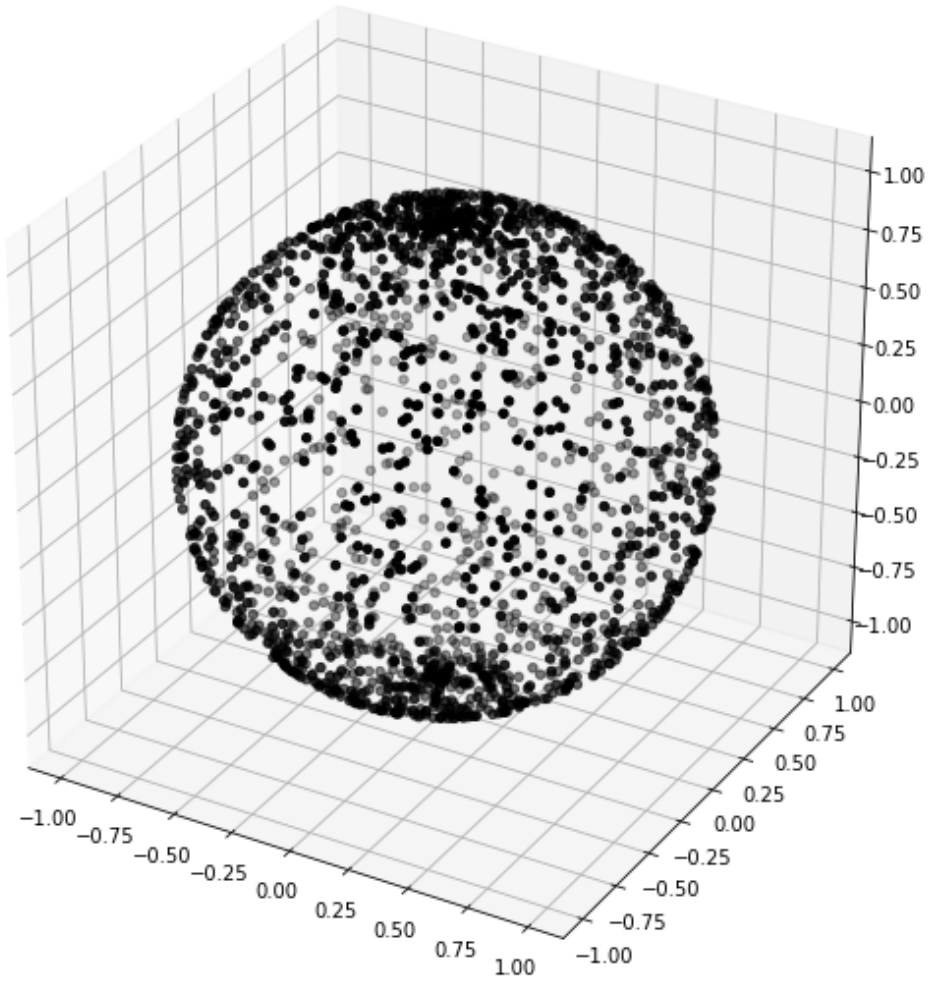

### 0.3 Incorrect sampling

[23]:
```
# uniform sampling on 2D rectalgle
m = 2000
u = 2.*np.pi*np.random.rand(m)
v = np.pi*np.random.rand(m)

# spherical parametrization
xp = r*np.cos(u)*np.sin(v)
yp = r*np.sin(u)*np.sin(v)
zp = r*np.cos(v)
```

[24]:
```
plt.figure(figsize=(10,5))
plt.scatter(u, v)
plt.show()
```



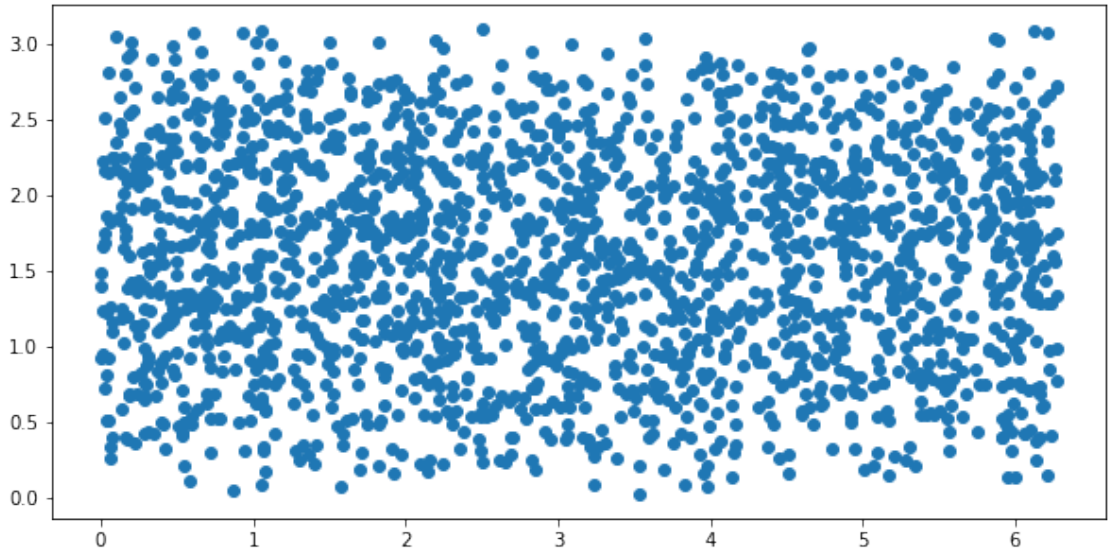

[25]:
```
stride = 2
r = 1

fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(111, projection='3d')
#ax.plot_surface(x,y,z, linewidth=0.1, cstride=stride, rstride=stride,␣
 ↪color='lightblue')
ax.scatter3D(xp,yp,zp, 'o', color='black')
plt.show()
```



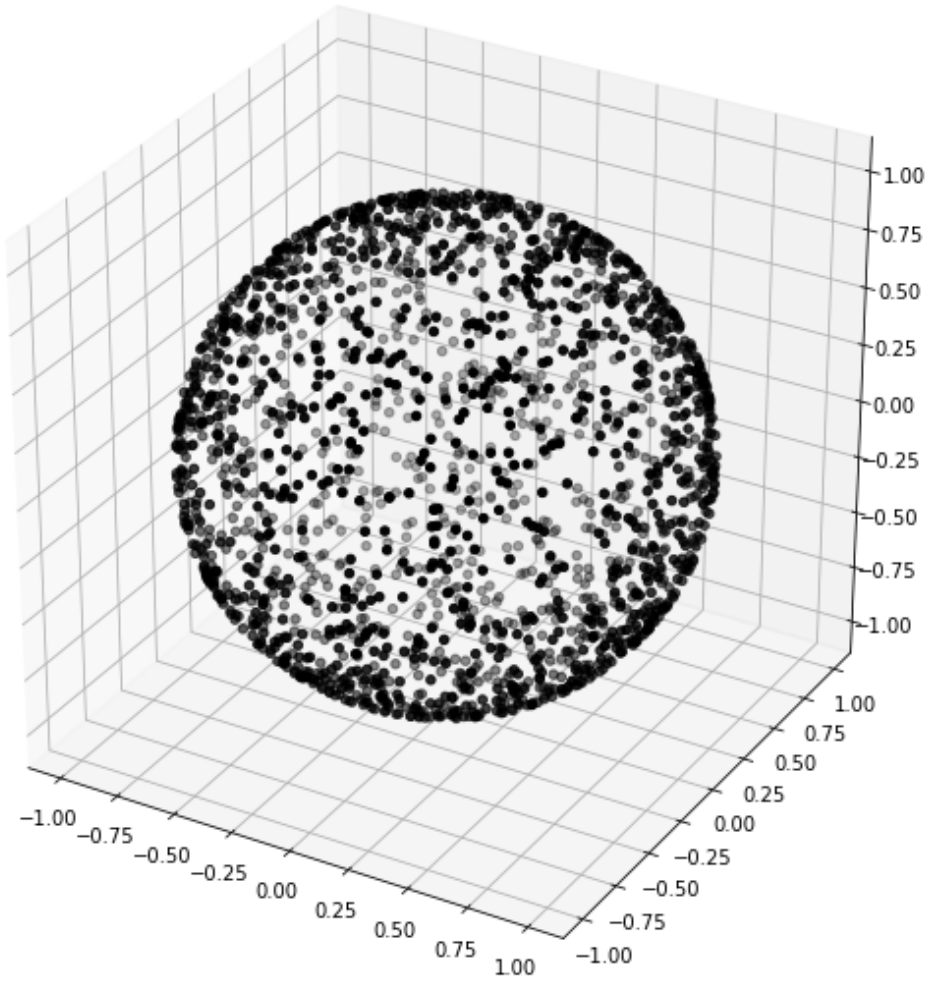

### 0.4 Correct sampling

[26]:
```
# using the inverse Jacobian for sampling on 2D rectalgle
u = 2.*np.pi*np.random.rand(m)
v = np.arccos(1. - 2.*np.random.rand(m))

# spherical parametrization
xp = r*np.cos(u)*np.sin(v)
yp = r*np.sin(u)*np.sin(v)
zp = r*np.cos(v)
```

[27]:
```
plt.figure(figsize=(10,5))
plt.scatter(u, v)
plt.show()
```




[28]:
```
stride = 2
r = 1

fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(111, projection='3d')
#ax.plot_surface(x,y,z, linewidth=0.1, cstride=stride, rstride=stride,␣
 ↪color='lightblue')
ax.scatter3D(xp,yp,zp, 'o', color='black')
plt.show()
```


1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00

[ ]:

## 0.5 Teorema de la Transformada Integral

### 0.5.1 $X$ Variable aleatoria continua, $g$ función biyectiva, $F_X$ la función de distribución de $X$, $f_X$ la densidad de $X$.

### 0.5.2 Aplicamos la transformación $Y = g(X)$.

### 0.5.3 $F_Y(y) =??$

### 0.5.4 $f_Y(y) =??$

[ ]: