```
import numpy as np # import built-in librairies (super
    ↪ useful)

import matplotlib.pyplot as plt

# make graphics show up in Jupyter notebook

%matplotlib inline

import os

import pylab



def data_generator(mean, std, n_measurements = 500,
    ↪ n_samples = 20): # function name and arguments

    """

    Generates an array of measurements from a standard
        ↪ distribution.



    Parameters

    ----------

    mean : float

            Desired mean value of the measurements.



    std : float
```

```
        Desired standard deviation of the measurements.

    n_measurements : int, optional

                 Number of separate measurements.
                   ↪ Default is 500 measurements.

    n_samples : int, optional

             Number of samples taken per measurement.
               ↪ Default is 20 samples.

             per measurement.

    Returns

    -------

    data : ndarray, shape (n_measuremets, n_samples)

          Array representing the experimental data. Each
            ↪ measurement

          (composed of many samples) is a row of this
            ↪ array:

                 -----------------------------------

          meas1    | sample0 | sample1 | sample2 | ...
```

```
            meas2     | sample0 | sample1 | sample2 | ...

            meas3     | sample0 | sample1 | sample2 | ...

             ...


    """

    # The following array has n_measurements rows, and
       ↪ n_samples columns

    return np.random.normal(loc = mean, scale = std, size
       ↪ = (n_measurements, n_samples))
```

```
print(data)
```

Yes, it does make sense to transpose this.

```
data = np.transpose(data)
```

So now we handle the nan and put each row into its own python list, run it through numpy again, and put the means into another list.

```
data_l = []

row = 0

for i in data:

    data_c = []

    for j in i:

        if not np.isnan(j):
```

```
            data_c.append(j)
    data_l.append(data_c)
    row += 1

#print(np.array(data_l))

means = []
stds = []
for i in data_l:
    means.append(float(np.mean(np.array(i))))
    stds.append(float(np.std(np.array(i),ddof=1)))

print(means, "\n", stds)
```

These values do agree with manual calculations! We will choose the 2nd distance, 40cm to generate our data.

```
sim_data = data_generator(means[1], stds[1])
```

We will now plot this as a histogram:

```
flattened = (sim_data.flatten())
plt.hist(flattened, bins=10);
```

That doesn't look very Gaussian! Let's change the amount of bins, and see something much more pleasant:

```
counts, bins, _ = plt.hist(flattened, bins=100); # save
    ↪ the outputs, into variables, of pyplot.hist,
    ↪ ignoring the "patches" return object.
```

There we go! Let's investigate the mean and standard deviation of that.

```
print(f"The mean is {np.mean(flattened)}, and the standard
    ↪  deviation is: {np.std(flattened, ddof=1)}.")
```

```
# Save the counts (heights of the bars) to a file

np.savetxt("histogram_counts.txt", counts)



# Save the bin edges (edges of the bins) to another file
    ↪ if needed

np.savetxt("histogram_bins.txt", bins)
```

We will now be plotting a histogram of all of the means from each trial. So we will first make a list of means.

```
sd_means = []

for i in sim_data:

    sd_means.append(np.mean(i))
```

```
sdm_count, sdm_bins, _ = plt.hist(sd_means, bins=25);

np.savetxt("sdm_count.txt", bins)

np.savetxt("sdm_bins.txt", bins)
```

The means and standard deviations are as follows:

```
mean_means = np.mean(sd_means)

mean_stds = np.std(sd_means, ddof=1)

print(f"The mean of the means is: {mean_means}, and the
    ↪ standard deviation is: {mean_stds}")
```

Okay, quick detour, let's find the area under our histogram so that we can normalize our Gaussian.

```
def area_of_bins(counts, bins):

    area = 0

    width = bins[1] - bins[0]

    for i in counts:

        area += width * i

    # the width is constant if you specify bins= as an
        ↪ integer, within plt.hist(), as said in
        ↪ documentation

    return float(area)



#area_of_bins(sdm_count, sdm_bins);
```

Great! With that out of the way, let me start getting my values for my Gaussian. Let's make a function:

```
def gaussian(x, mu, sigma):

    return (1)/(sigma * np.sqrt(2*np.pi)) * np.exp(     -1
       ↪ * ( ((x-mu)**2)/( 2 * (sigma**2) ) )   )
```

```
outputs = []

for i in np.linspace(2, 3, num=500):

    outputs.append(gaussian(i, mean_means, mean_stds))
```

```

```