REPORT FOR LAB 12

Solution 1: We were asked to generate numbers from gamma distribution.
I chose **standard gamma distribution** with **alpha=2** and hence my gamma distribution pdf is proportional to

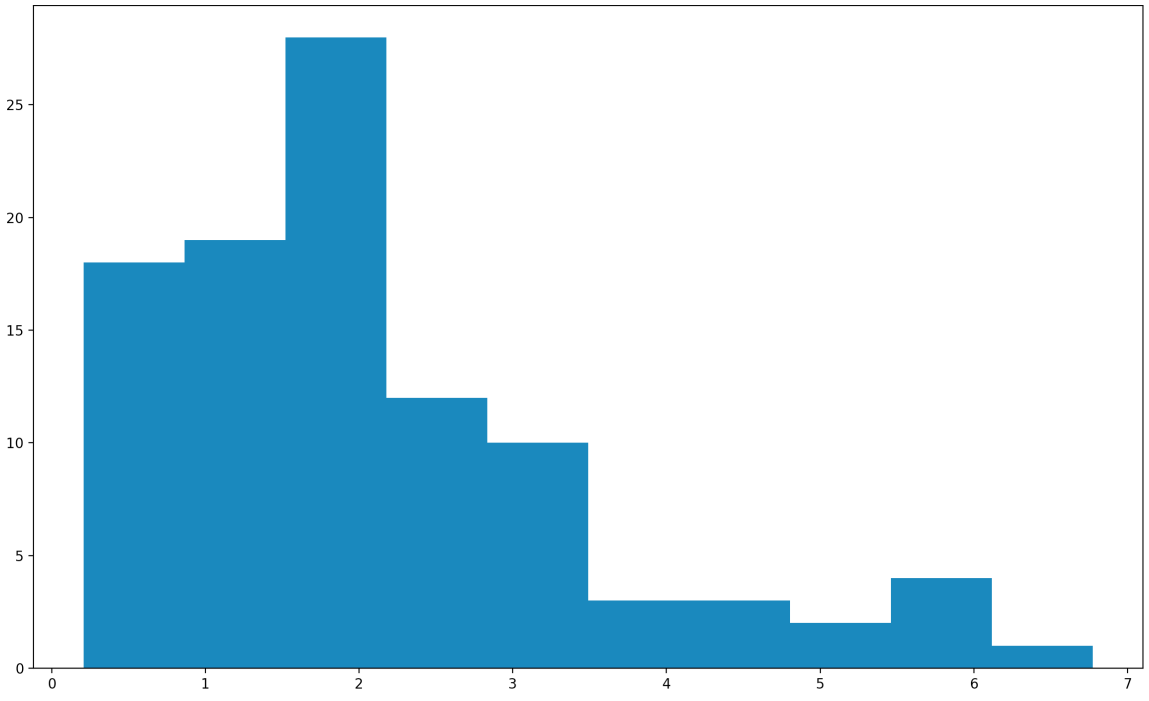
$$f(x) = xe^{-x}$$

For proposal density I used,

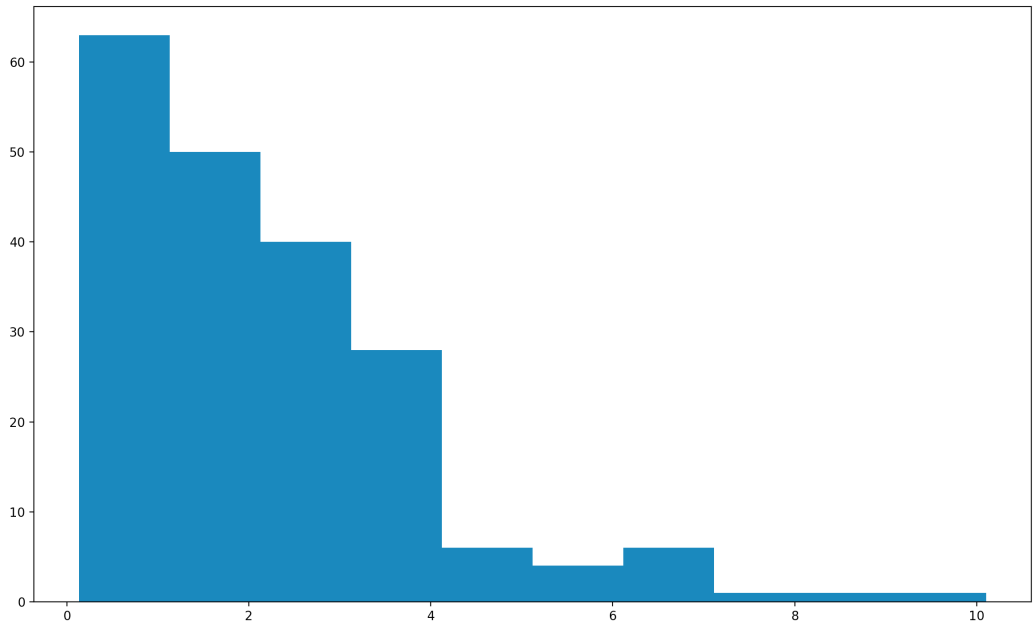
$$q(x2\,|\,x1) = \frac{1}{\sqrt{2\Pi}} e^{\frac{-(x2-x1)^2}{2}}$$

Below are attached histograms:

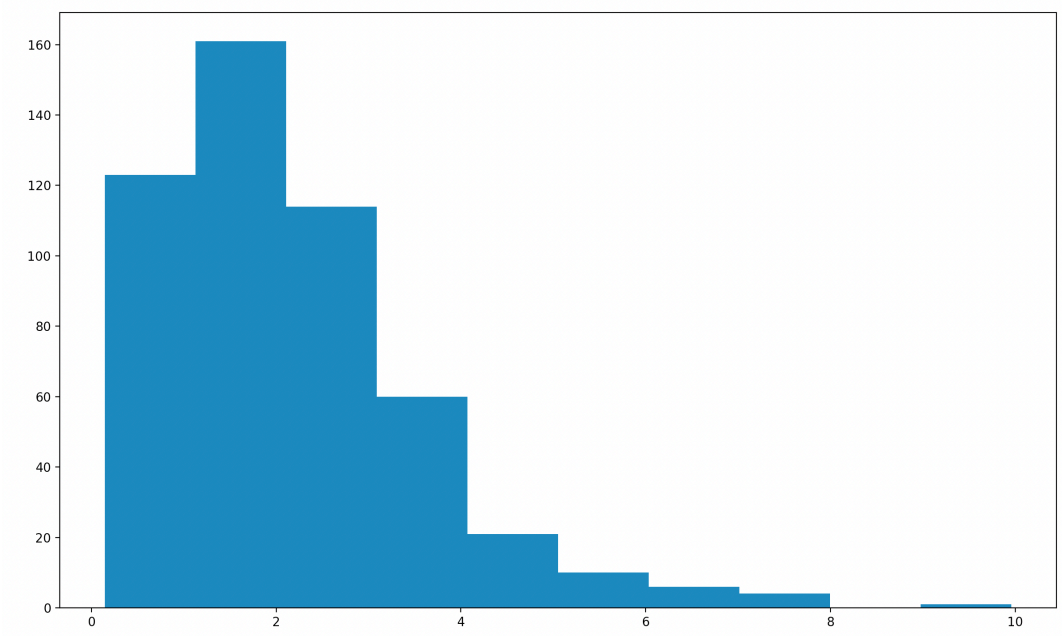
N=100



N=200



N=500



```
vaibhav@Vaibhavs-Air lab12 % /usr/local/bin/python3 "/Users/vaibhav/Desktop/5th sem/monte carlo lab/lab12/ques1.py"

Mean for obtained seqeunce for n 100 is 2.063695836459838
Mean for obtained seqeunce for n 200 is 2.2276166947680354
Mean for obtained seqeunce for n 500 is 2.1390896906506764
vaibhav@Vaibhavs-Air lab12 %
```

The histograms above approach to the graph of a gamma distribution and mean obtained is approximately 2 which is

$$\int_0^\infty xe^{-x}dx = 2$$

Solution 2:

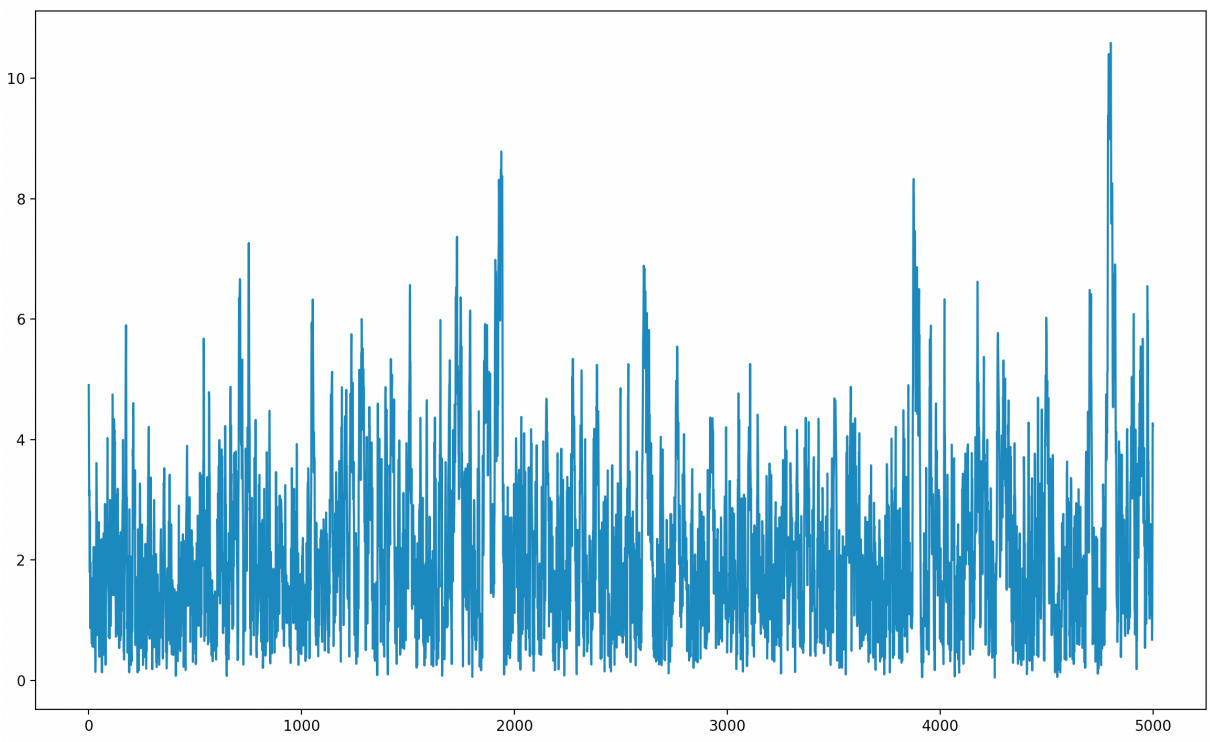
I used three proposal densities for this task

1) Symmetric
2)Independent
3)Random Walk

I will be explaining each and displaying obtained results in order mentioned above.

Symmetric

Here the proposal density used was same as in previous question.

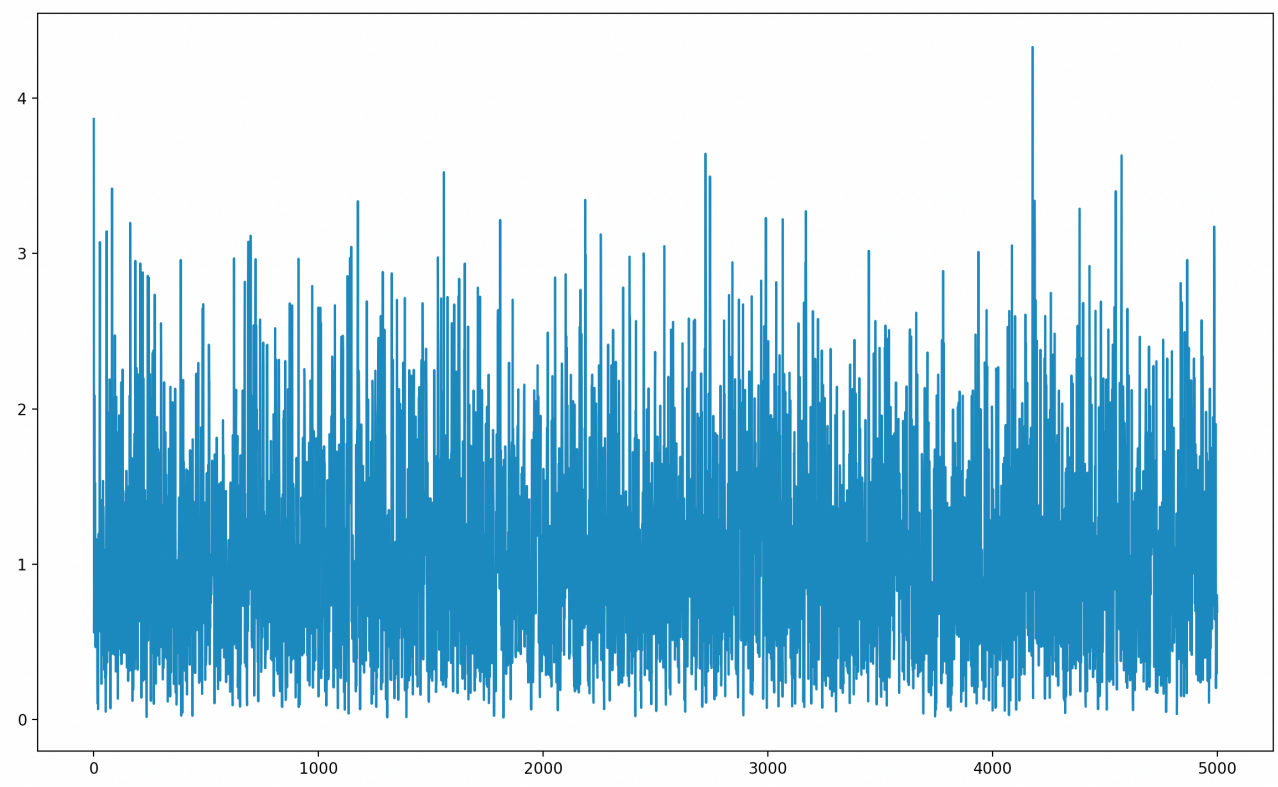


```
vaibhav@Vaibhavs-Air lab12 % /usr/local/bin/python3 "/Users/vaibhav/Desktop/5th sem/monte carlo lab/lab12/ques2.py"
Autocorelation with lag 0 for symmetric mcmc is 1.0
Autocorelation with lag 50 for symmetric mcmc is -0.024842373777158217
Autocorelation with lag 100 for symmetric mcmc is 0.05702641132613467
Autocorelation with lag 150 for symmetric mcmc is 0.047286399092554034
```

Independent

q(x2|x1) = q(x2). I used standard normal distribution as proposal density

$$q(x2) = \frac{1}{\sqrt{2\Pi}} e^{\frac{-(x2)^2}{2}}$$



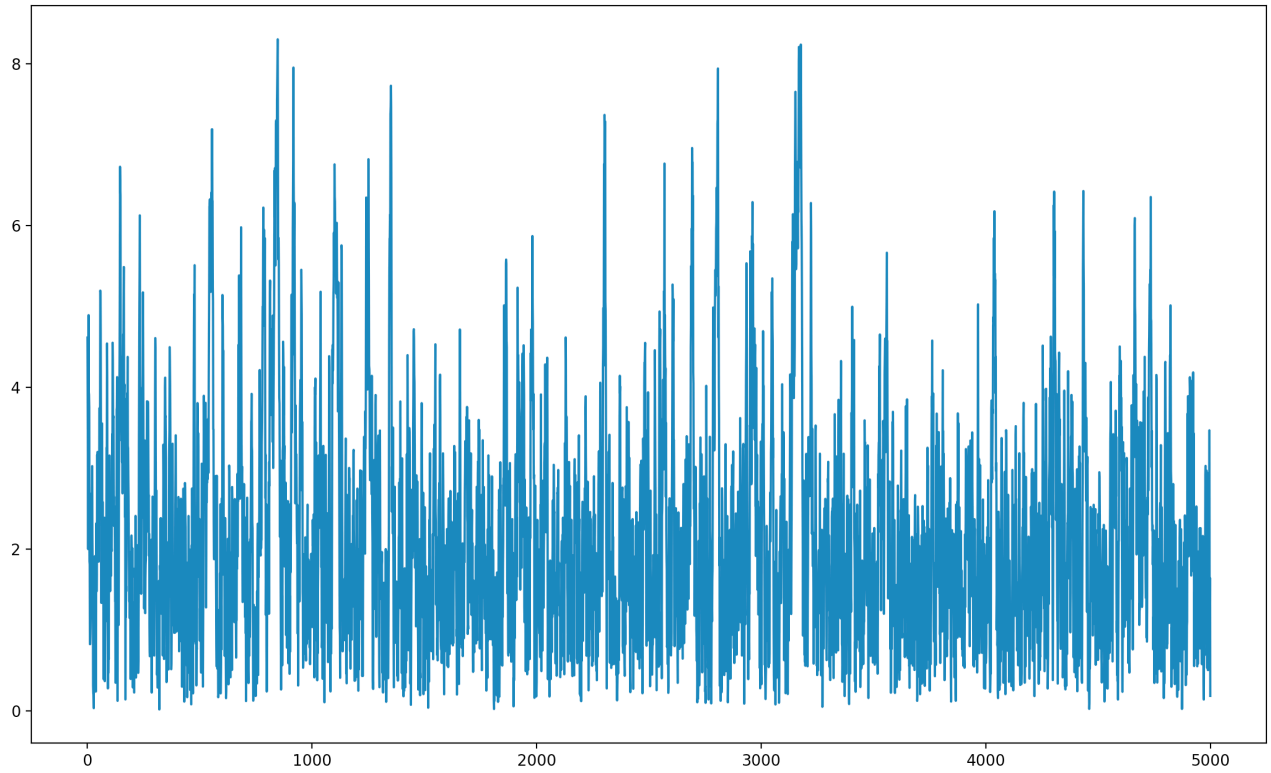

```
vaibhav@Vaibhavs-Air lab12 % /usr/local/bin/python3 "/Users/vaibhav/Desktop/5th sem/monte carlo lab/lab12/ques2.py"
Autocorelation with lag 0 for independent mcmc is 1.0
Autocorelation with lag 50 for independent mcmc is 0.0026764577833940156
Autocorelation with lag 100 for independent mcmc is 0.003657646997473742
Autocorelation with lag 150 for independent mcmc is 0.013517223659477686
```

Random Walk

Here, q(x,y)=(y-x). I generated y=x+gt where gt belonged to standard normal distribution.

Hence,

q(y|x)=q(gt) and q(x|y)=q(-gt) and since q is standard normal distribution, q(gt)=q(-gt)




```
vaibhav@Vaibhavs-Air lab12 % /usr/local/bin/python3 "/Users/vaibhav/Desktop/5th sem/monte carlo lab/lab12/ques2.py"
Autocorelation with lag 0 for random walk mcmc is 1.0
Autocorelation with lag 50 for random walk mcmc is 0.04086911984139496
Autocorelation with lag 100 for random walk mcmc is 0.05376977873601212
Autocorelation with lag 150 for random walk mcmc is -0.05814556646029071
```