Part 1

ST2195 COURSEWORK PROJECT

Table of Contents

UOL SRN: 220455073

(a) Construct a histogram and a kernel density plot in the same figure.

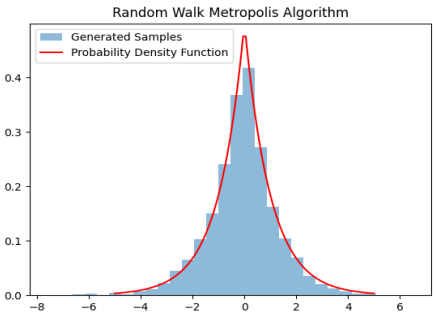

Figure 1 from Python

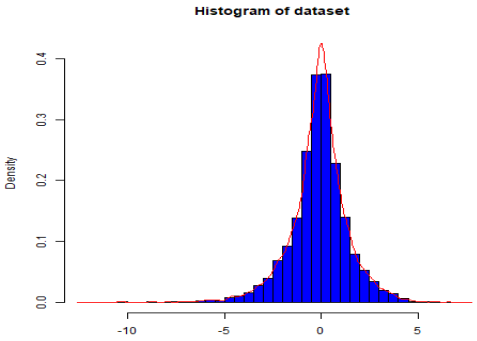

Figure 2 from R

The blue histogram plot represents generated samples from the algorithm and the red line plot is the kernel density plot. The y and x axis are density and x-values respectively. Figures 1 and 2 show that the algorithm is accurate in drawing random number for a distribution with probability density. The kernel density plot will be the result of a smooth histogram.

```
The Monte Carlo estimate of the mean: -0.0658646010119792
The Monte Carlo estimate of the standard deviation: 1.3423652424923291
```

Figure 3 from Python

```
[1] "The Monte Carlo estimate of the mean:
-0.128646889041125"
[1] "The Monte Carlo estimate of the standard deviation:
1.58631186644342"
```

Figure 4 from R

Since random number generators are used in the algorithm, the results of the sample mean, and standard deviation are slightly different in figures 3 and 4.

(b) Calculate $\hat{R}$. Provide a plot of the values of $\hat{R}$ over a grid of s values.

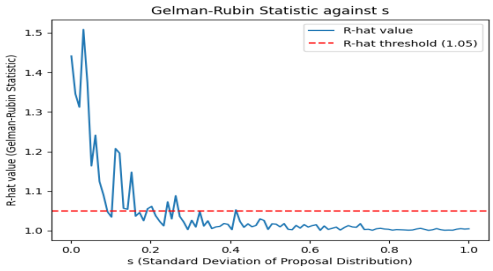

Figure 5 from Python

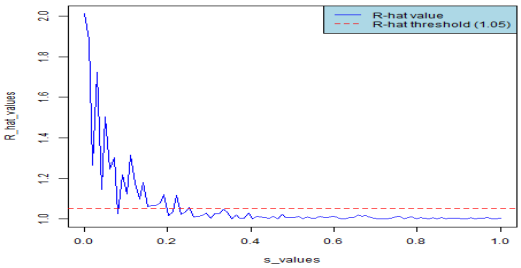

Figure 6 from R

By using the operations in part (a) to generate random numbers for chains and apply the rest of the procedure given in (b), I can attain the following $\hat{R}$ values for Python and R programming in figures 7 and 8 with N = 2000, s = 0.001 and J = 4.

```
Calculated R hat value: 1.8704430630141096
```

Figure 7 from Python

```
[1] "Calculated R hat value:1.41550938880599"
```

Figure 8 from R

Figures 5 and 6 show plots of $\hat{R}$ values (y-axis) corresponding to s values (x-axis) in the interval between 0.001 and 1. The blue line plot represents the $\hat{R}$ value. The red dotted line plot at $\hat{R}$=1.05 is the general threshold. Given that both plots have a general downward sloping trend, the $\hat{R}$ value only starts getting below 1.05 from s = 0.2 onwards, which is more desirable and indicates convergence closer to 1.