**Q3**

Below is a table listing the average computed value of π, as well as the standard deviation in the calculation:

|  |  |  |
| --- | --- | --- |
| Num Points | avg | std dev |
| 10 | 3.12 | 0.334664 |
| 100 | 3.168 | 0.196774 |
| 1000 | 3.144 | 0.076368 |
| 10000 | 3.13448 | 0.017569 |

One sees a trend moving (in general) closer to the exact value of π=3.1416…with increasing number of points N . One also sees that the estimated uncertainty (standard deviation in this case) in the calculation is decreasing with N, which is to be expected. Below is a plot of that uncertainty as a function of the number of points:

A best fit line to this data suggests that the uncertainty (standard deviation in this case) is decreasing (approximately) as 1/, where N is the number of points used. This is to be expected from a random sampling. Using this information, we can estimate how many points would be required for an uncertainty of 10E-20: Error = 1/, or for Error ≈ 10E-20, N ≈ 10E38! This is an enormous number of points, and demonstrates how inefficient a random sampling is in integrating simple functions, such as the area of a circle.