Assignment 3: Random Numbers

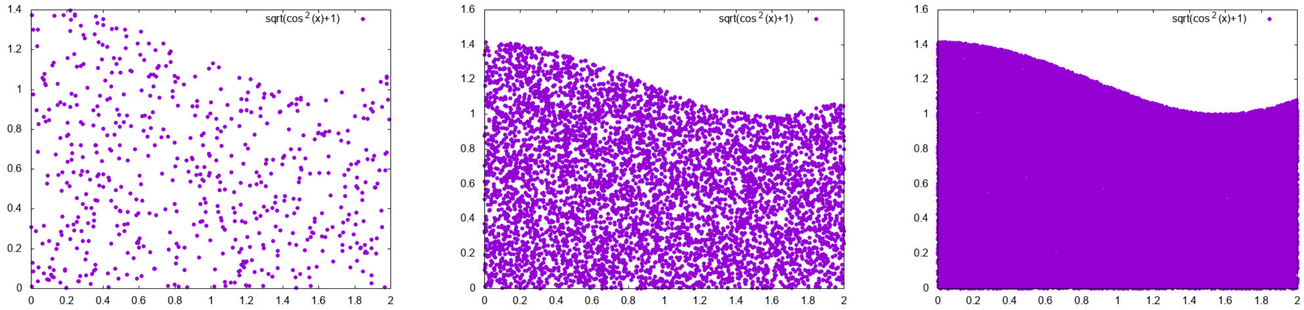
TASK 1 (Random Number Generation using LCG) (7 marks)

For this task, choose any variation of LCG method (given in lectures). Write a code that is able to generate 10,000 random numbers between 1 and 100 (or 0 and 99) from a uniform distribution using your choice of LCG method. By finding the error of your random number generator, report the best values of multiplier, increment, and modulus variables.

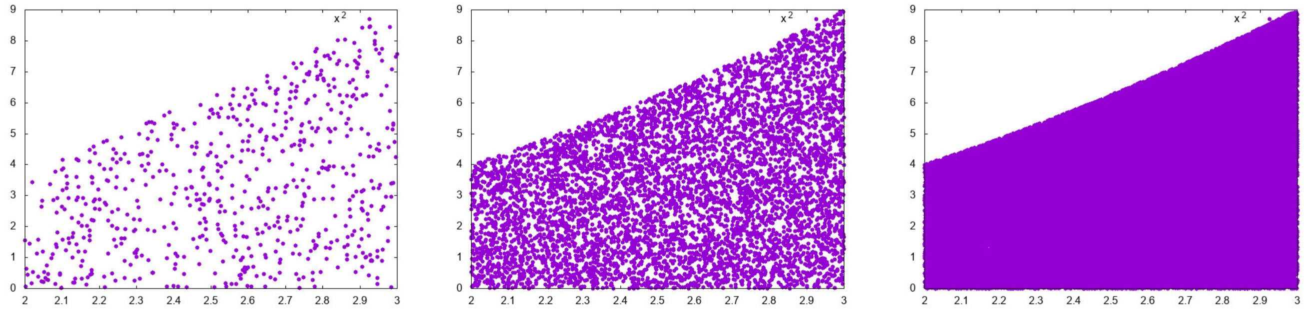
TASK 2 (Area using Monte Carlo Sampling): (8 marks)

Use the Monte Carlo Technique to determine the following:

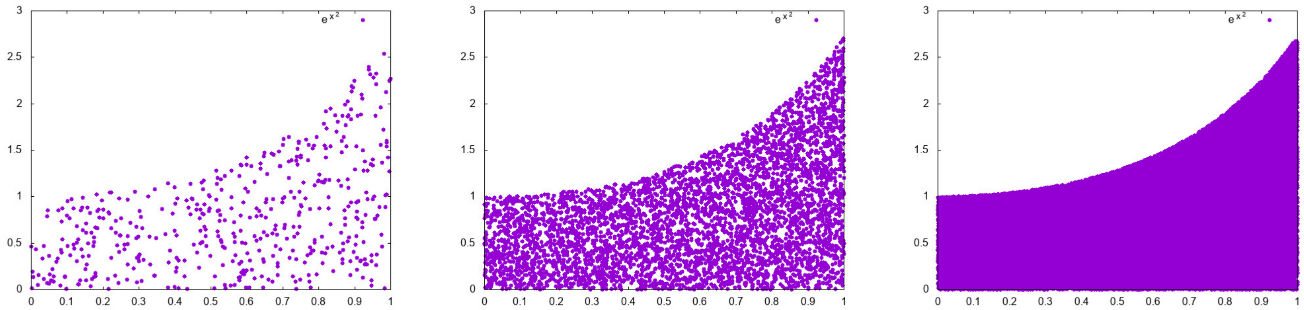
a) Area under the curve of the function $f(x)=\sqrt{(\cos^2(x)+1)}$ at convergence point between $0 \le x \le 2$. Answer should be close to 2.35169



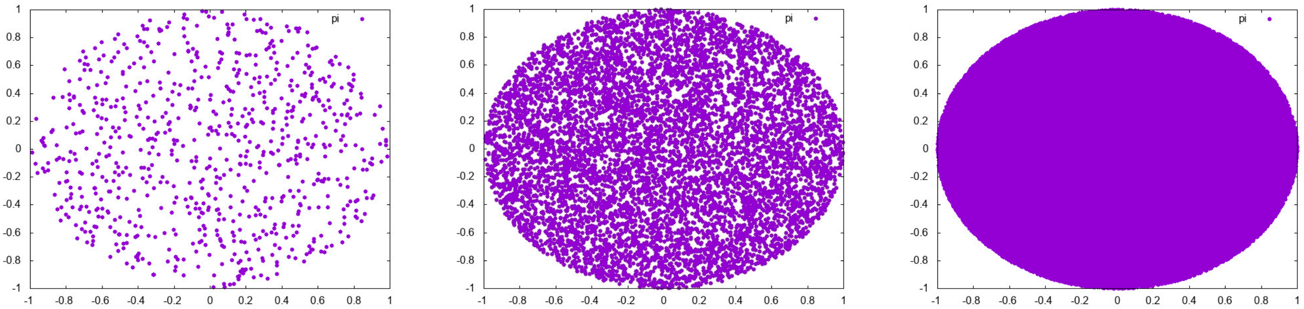
b) Area under the curve of the function $f(x)=x^2$ at convergence point between $2 \le x \le 3$. Answer should be close to 6.3333



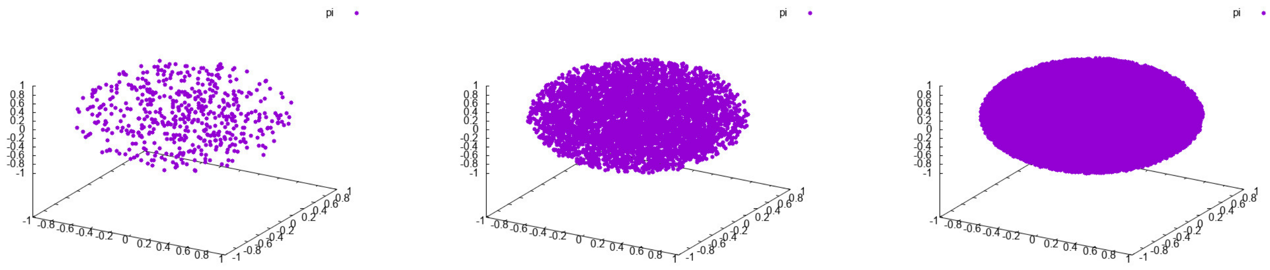
c) Area under the curve of the function $f(x)=e^{x^2}$ at convergence point between $0 \le x \le 1$. Answer should be close to 1.46265



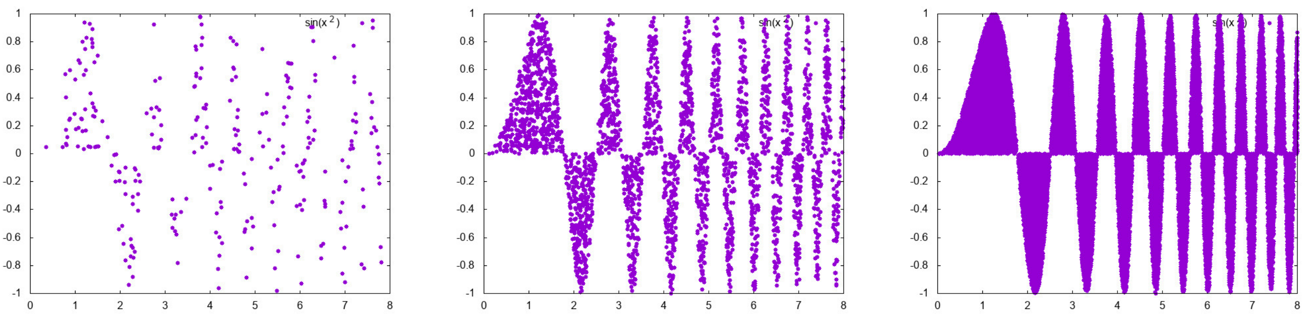
d) In this question, you will estimate the value of π. You have to remember that the area of a circle is given as $A=\pi r^2$ (where r is the radius) and the equation of a circle (of radius r) with center at the origin is $x^2+y^2=r^2$. Thus for a radius of 1, the equation would be $x^2+y^2 \le 1$. Use the montecarlo method to generate two random numbers $-1 \le x \le +1$ and $-1 \le y \le +1$. If the generated numbers satisfy $x^2+y^2 \le 1$, it means they are inside the circle. Find the area of the circle and from it, extract the value of π. Note that in this case, you have moved from a 1D to 2D problem.



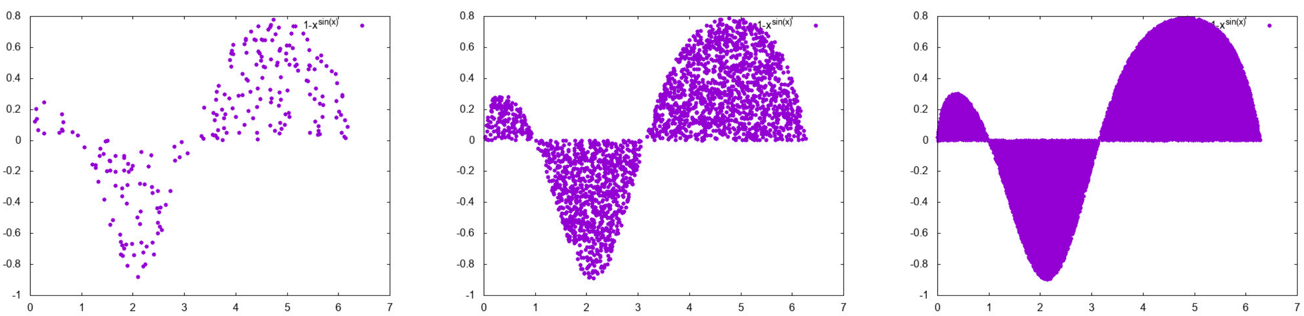
e) In this question, you will again estimate the value of π, but this time, using volume of a sphere. The volume of a sphere is given as $V=(4/3)\pi r^3$ (where r is the radius) and the equation of a sphere (of radius r) with center at the origin is $x^2+y^2+z^2=r^2$. Thus for a radius of 1, the equation would be $x^2+y^2+z^2\leq 1$. Use the montecarlo method to generate three random numbers $-1\leq x\leq +1$, $-1\leq y\leq +1$, and $-1\leq z\leq +1$. If the generated numbers satisfy $x^2+y^2+z^2\leq 1$, it means they are inside the sphere. Find the volume of the sphere and from it, extract the value of π. Note that in this case, you have moved from a 2D to 3D problem.



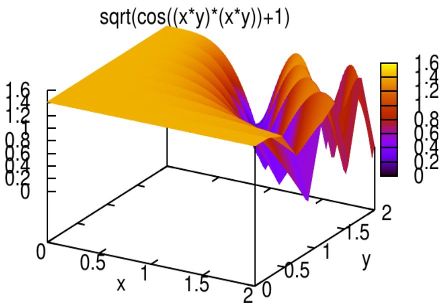
f) Get the area under the curve of $\int_0^8 \sin(x^2)\,dx$. This question is tricky in that you have to think carefully how the y random variable is generated. Please note that when a function is negative (below the x-axis), it's integral would be negative, while if the function is positive (above the x-axis), it's integral would be positive. Answer should be close to 0.601722.

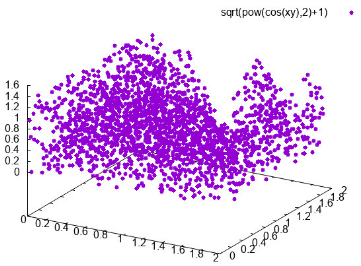


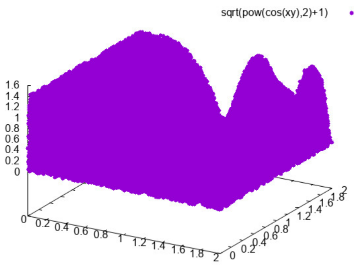
g) Repeat (f) for $\int_0^{2\pi}(1-x^{\sin(x)})\,dx$ by applying same principles. Answer should be close to 0.864811



h) Determine the volume under the surface of $\int_0^2\int_0^2\sqrt{(\cos(x^2 y^2)+1)}\,dx\,dy$. Answer should be close to 4.65045







Notes

Do the questions yourself. Questions like these can appear in the exam.

Deliverable:

Send me a tar file containing each of the material required. Your file names **MUST** be named as follows:

rollnumber-task-x

As an example,

p13-1234-task-1.c
p13-1234-task-2a.c
p13-1234-task-2b.c

etc. etc.