

CS215 Assignment2 Problem 1

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1 Ellipse

1.1 Random points on circle in Polar form

First step involves uniformly generating random points on the unit circle in polar form (R, θ) .

To generate r we need to find $\mathbf{P}(R = r)$, which is $\int_0^{2\pi} (\frac{1}{\pi}) r d\theta = 2r$.

This can be generated by randomly generating a number between 0 and 1 and taking its square root.

And θ is generated randomly between 0 and 2π .

1.2 Convert to X-Y coordinates

This is a standard step:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

1.3 Scale down along Y-axis

Now scale the y coordinate down by a factor of 2.

This gives uniform probability as the already uniform probability is scaled by $\frac{1}{2}$.

Moreover scaling down y coordinate of unit circle by 2 gives an ellipse with required parameters.

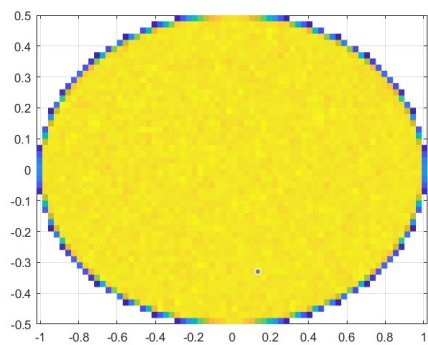


Figure 1: Ellipse

2 Triangle

1. Get random points in unit square.
2. Reflect to get random points in triangle with vertices $(0,0), (0,1), (1,0)$.
3. Apply linear transformation on this to map it to the required triangle.
4. As the probability is scaled by determinant of the linear transformation it remains constant.

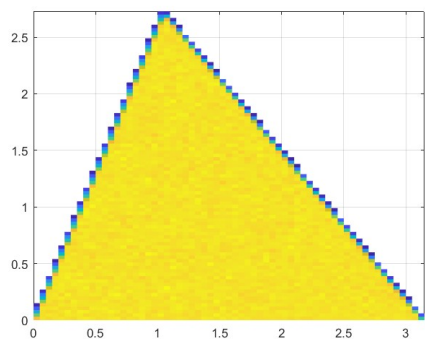


Figure 2: Triangle