Supplementary exercise :

Generation of a random value picked from a given probability distribution

Example used here is the Compton Scattering angular distribution

Problem spec:

The Compton scattered photon is produced at an angle ϕ with respect to the "straight on" direction. The probability of it being scattered at such an angle ϕ is given by:

$$P(\phi) \propto \left[\frac{1}{1+\alpha(1-\cos\phi)}\right]^2 \times \left[1+\cos^2\phi + \frac{\alpha^2(1-\cos\phi)^2}{1+\alpha(1-\cos\phi)}\right]$$

where is α = incident photon energy/electron mass

The maximum value of this expression is at ϕ = 0

You are required to write a random generator class (similar to the one written before) which delivers a random value of ϕ with this probability distribution. It should return a value in the range 0-180 degrees.

You might start by reminding yourselves of the example which you wrote earlier in C which generates a random number with uniform or Gaussian distributions.

1. Remind yourself of the algorithm to pick a random number from a given distribution, I.e.

- **pick a random number, x, in the required range.**
- **pick another number, P_{test}, in the range $0 \rightarrow$ Max(P)**
- **if P_{test} < P(x) then keep the x value generated**
- **otherwise repeat the loop until the test is satisfied**

2. Write a class which has the following public methods:

```
float uniform( )    // uniform distribution
float gauss( )      // gaussian distribution
float scatter( )    // compton scattering angular distribution
```

3. It should also have a constructor which takes the incident photon energy and electron mass as arguments.

[You are going to need these in the Monte Carlo generator we write in the second part of the course]