CO65: Monte Carlo Integration

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1 AIM and Method

The aim is to create two functions which can be used to calculate Monte Carlo Integrations. One (get_accepted_points) takes in a matrix of a defined number of randomly generated vectors between two defined values and a function that returns either true or false for a vector of numbers. It returns a matrix containing each point which returned true for the function. The second function takes the points that the previous output and sums the value of a defined function for each point. These two functions are used to calculate the area of a hypersphere, calculate the mass, centre of mass and moment of inertia of a Taurus and calculate an integral over a surface.

2 Results

10-Dimensional Hypersphere	
N	Area
100000	2.3654
100000	2.4269
100000	2.6726
10000000	2.5729
10000000	2.5509
10000000	2.5970

Surface Integral	
N	Integral
1000000	-0.0475
1000000	-0.0478
1000000	-0.0468
1000000	-0.0473

Taurus							
N	mass	Centre of mass (x,y,z)			Moment of inertia (xx, yy, zz)		
1000000	22.099 ±0.021	2.4074 ±0.0025	0.1652 ±0.0025	0.000645 ±0.000693	81.05 ±0.12	145.01 ±0.17	214.90 ±0.22
1000000	22.097 ±0.021	2.4093 ±0.0025	0.1665 ±0.0025	-0.000134 ±0.000694	81.16 ±0.12	145.24 ±0.17	215.21 ±0.22

3 Conclusions

The recommended value of N in the lab script did not provide the most accurate value for the area, with a large error. However increasing this to 1000000 provided a more coherent set of results, suggesting the value lies between 2.55 and 2.60. The literature value of 2.550 lies within this range. For the Taurus a value of N being 10000000 gave very small errors, as did using 1000000 for the surface integral. If N were to be increased and the computer left to calculate, the errors would be reduced and a value of each of these would be found accurately to more significant figures.