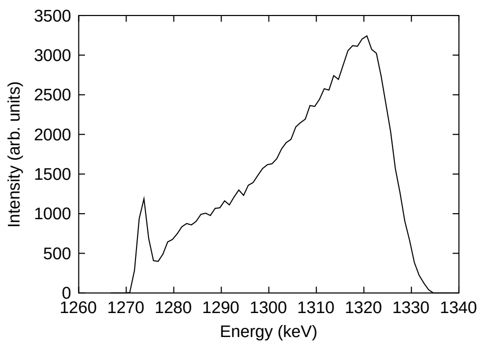

Figur 1: The DSA lineshape used in exc. 4.

Basics of Monte Carlo simulations 2005. Exercise 3

To be handed in Mon 28.2, exercise session Thu 3.3 10:15.

1. (6 p) Write a program which evaluates the volume of an N-dimensional hypersphere using Monte Carlo simulation, with the hit-and-miss approach. N should be a parameter in the code. The code should also calculate the statistical uncertainty. Hand in the code and results.

2. (6 p) Write a program which evaluates the volume of an N-dimensional hyperspheres using Monte Carlo simulation, with the sampling approach. N should be a parameter in the code. It should also calculate the statistical uncertainty. Hand in the code and results.

3. (12p) Consider the distribution `dsa_nonegative.dat` given on the course web page and Fig. 1. This is a γ-ray distribution from a Doppler-broadened nuclear lifetime state measured in the Accelerator laboratory [K. Arstila et al, Nucl. Instr. and Meth. in Phys. Res. B 101 (1995) 321-326] Assume you will repeat this measurement, but can generate only 300 counts of statistics in the repeated measurements. Using the procedure outlined in lecture notes section 6.1, generate enough synthetic data sets to determine the statistical uncertainty of the mean for such 300-count distributions. Note that the uncertainty may be unsymmetric. Also compare with the uncertainty of the mean calculated using Gaussian statistics for the individual distributions. Report the obtained synthetic data uncertainties and the Gaussian ones. If you are certain your answer is right, you do not need to return the code.

You may freely use your (or the lecturers) solution to exercise 2.3 as a starting point.