Advanced Statistics - Lab 01

1) Write a program that as input takes
   - the multi-dimensional function $g(x_1, x_2, ..., x_d)$
   - integral limits a and b, where $a < b$,
   - and any other input that you wish

   and then as output provides
   - the approximate numerical integral of this function, given by
   $$I = \int_a^b \int_a^b ... \int_a^b g(x_1, x_2, ..., x_d) dx_1 dx_2 ... dx_d$$
   - an estimated value on the average error that your numerical integration program is making. Use $\sqrt{MSE}$ for the average error, where $MSE =$ mean squared error.

2) Test your numerical integration program on the following function
$$I = \int_a^b \int_a^b ... \int_a^b \left(\sum_{i=1}^{d} x_i \right)^2 dx_1 dx_2 ... dx_d,$$
   where $a = -\frac{1}{2}$ and $b = \frac{1}{2}$, having in mind that the exact integral I is
$$I = \frac{d}{12}$$
   and plot a figure of the average error that your integral is making as a function of some important parameter that your program is using. Again, use $\sqrt{MSE}$ for the average error.

Upload the results on Moodle in a single PDF file or as the script itself that contains explanations, the code, and figures.

Important note: By failing to do the following, you will loose points:

- You must provide clear explanation of what your program is doing.
- You must provide comments in your code in order for anyone to understand the code.
- You must not use in-bulid functions for obtaining the PDF, mean, variance, and probability.
- You must use different colors, lines, and markers in the plots, along with legends for each curve and suitable line-widths of the curves so that the figure is understandable.

- You muse clearly define what are the x and y axis in your figures.
- Finally, you must use caption that fully explains the figure.