An introduction to Monte Carlo integration

0.1 Level 1

This exercise should be revision: Use the block below to generate 20 pairs of uniform random variables X_i and Y_i that each lie between 0 and 1. Then plot each of these pairs of random variables at (X_i, Y_i). All the points you show should have $0 < X_i < 1$ and $0 < Y_i < 1$.

0.2 Level 2

Now use the blocks below to generate 25 points on the graph shown on the right. These points should be at $(0.1 + i * 0.2, 0.1 + j * 0.2)$ with $i \in \{0, 1, 2, 3, 4\}$ and $j \in \{0, 1, 2, 3, 4\}$. Click here if you want to watch the explanatory video.

0.3 Level 3

Use the blocks below to generate 25 points on the graph shown on the right. These points should again be at $(0.1 + i * 0.2, 0.1 + j * 0.2)$ with $i \in \{0, 1, 2, 3, 4\}$ and $j \in \{0, 1, 2, 3, 4\}$. Now though I only want you to display the points if they lie within a circle of radius one that is centered on the origin. Click here if you want to watch the explanatory video.

0.4 Level 4

Let's now reintroduce the random variables. Select a random point (X, Y) by generating two uniform random variables between 0 and 1, X and Y, and determine whether the point you selected is within a circle of radius one that is centred on the origin. Set the bernoulli random variable Z equal to one if (X, Y) is within the circle and zero otherwise. Use the blocks below to generate a sample of Z values and draw a graph showing how the sample mean, $\mu_n = \frac{1}{n}\sum_{i=1}^{n} Z_i$ for the random variable Z changes as the number of indepedent random variables in the sample (the number of Z_i values) increases. In other words, plot a graph with points at (n, μ_n) for n values between 0 and 20. Click here if you want to watch the explanatory video.

0.5 Level 5

Compute a set of 10 samples of the integral that you computed during the last exercise. Calculate each estimate of the sample mean by generating 5 Z values. Use the plotting to display the mean of your 10 samples of the integral together with an error bar indicating the 90Click here if you want to watch the explanatory video.

0.6 Level 6

Compute the integral that you computed during the last exercise by sampling only once. Calculate the 80Click here if you want to watch the explanatory video.