**Week 3**

**Probability learning activity 1: Law of large numbers**

1. Using R calculate *mean(X)* where *X* is a sequence of *N* (*N = 100, 1000, 10000)* random numbers uniformly distributed between -1 and 1. Note *X* can be generated via the R function *runif.*
2. Make a log-log plot of the absolute value of the mean for different *N*
3. On top of the same plot draw a function *1 / sqrt(N).* Interpret the obtained plots

**Probability learning activity 2: calculating the area of a circle of a unit radius via the Monte Carlo integration**

1. Using the function *runif* in Rgenerate a sequence of *N* random numbers uniformly distributed between -1 and 1. Save this sequence under the name *X*
2. Generate another such sequence with the name *Y*
3. Create a new sequence *F* of length *N* such that *F[i] = 1* if *X[i]2 + Y[i]2 < 1* otherwise *F[i] = 0*, where *X[i], Y[i],* and *F[i]* denote the ith element of the sequence *X, Y,* and *F,* respectively. Note that *F[i] = 1* only if a point *(X[i], Y[i])* lies inside the circle of a unit radius.
4. Calculate *4 \** *mean(F)* for *N = 100, 1000, 10000*
5. Which value does this ratio approach as *N* gets larger?
6. Make a log-log plot of the absolute value of the difference between *4 \** *mean(F)* and π for different values of N
7. On top of the same plot draw a function *1 / sqrt(N).* Interpret the obtained plots

Reading Lists:

https://en.wikipedia.org/wiki/Law\_of\_large\_numbers

https://en.wikipedia.org/wiki/Monte\_Carlo\_integration