STAT 3023/3923/4023

Semester 2	Statistical Inference	2021

Computer Lab Week 2

1. (a) Using `rbinom`, generate 1000 Binomial$(200, 0.3)$ random variables and store them in `X`. Plot a histogram of `X` using `hist`, and overlay it with a normal density curve with appropriate mean and standard deviation using `curve` and `dnorm`.

   (b) Find $P(45 \leq X \leq 55)$ using either `pbinom` or `dbinom`.

   (c) Using `pnorm`, compute the same probability with the normal approximation and normal approximation with continuity correction. Comment on how close the approximations are.

2. (a) Generate 1000 Binomial$(200, 0.03)$ random variables (`rbinom`) and 1000 Poisson(6) random variables (`rpois`), store them in `X` and `Y` respectively. Set up a plotting environment with 1 row and 2 columns (`par(mfrow=c(1,2))`), and generate histograms of `X` and `Y`. Comment on the similarity of the two distributions.

   (b) Find $P(X \leq 5)$ with `pbinom` and $P(Y \leq 5)$ with `ppois`. Compare the two results.

   (c) Approximate $P(X \leq 5)$ with the normal approximation (`pnorm`). How close is it this time?

3. Recall that for n iid random variables $X_1, \ldots, X_n$, the standardised sum is given by

$$S = \frac{\sum_{i=1}^{n}(X_i - E(X_i))}{\sqrt{n\text{Var}(X_1)}}.$$

   (a) Generate 1000 realisations of the sum of n ($n = 5$) Unif(0,1) random variables (using `runif`), compute the standardised the sums and store them in `S1`. Repeat for $n = 100$ and store the results in `S2`.

   (b) Plot histograms of `S1` and `S2`, overlay them with the density curve of standard normal, and place these two plots side by side using `par(mfrow=c(1,2))`. Comment on how close the normal approximation is for the two values of n.

   (c) Repeat (a) and (b) for the sum of lognormal(0,1) distributions (use `rlnorm(n, meanlog = 0, sdlog = 1)`). In this case, $E(X_i) = \exp(1/2)$, $\text{Var}(X_i) = (\exp(1) - 1)\exp(1)$.