CHAPMAN University

Department of Computational and Data Sciences (CADS)
CS501 Introductory Computation for Scientists
Fall 2019
Class Project#2
Leibniz Series + Normal Distribution Plots

Date Given: Oct 16, 2019 Due Date: Nov 12, 2019

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Download R software from CRAN (www.r-project.org) and install it on your computer.
Download RStudio software (www.rstudio.com) and install it on your computer.

There are 4 problems in this Class Project#2. Solve these problems using R software. Make sure that the graphics generated by your R-code matches with the given graphics.

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1. Gottfried Wilhelm (von) Leibniz (sometimes spelled Leibnitz) (1646 – 1716) was a prominent German mathematician and philosopher. His most notable accomplishment was conceiving the ideas of differential and integral calculus, independently of Isaac Newton's contemporaneous developments.

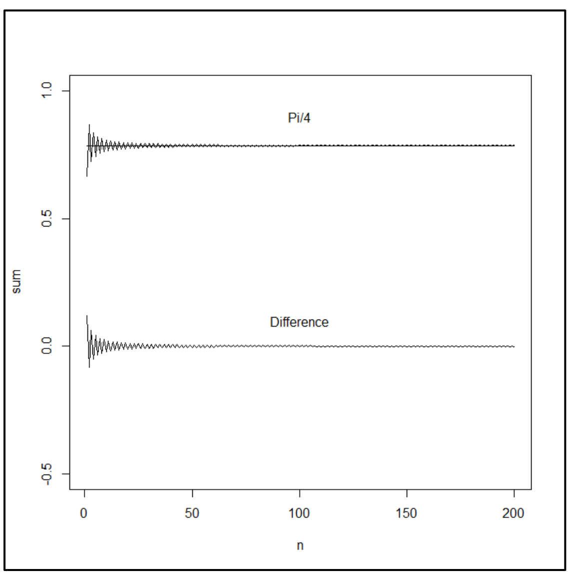
   The following Leibniz series converges to the value $\frac{\pi}{4}$ as n → ∞.

   $$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots = \frac{\pi}{4}$$

   Leibniz series can be generalized as follows.

   $$S(n) = \sum_{k=0}^{n} (-1)^k \frac{1}{2k+1}$$

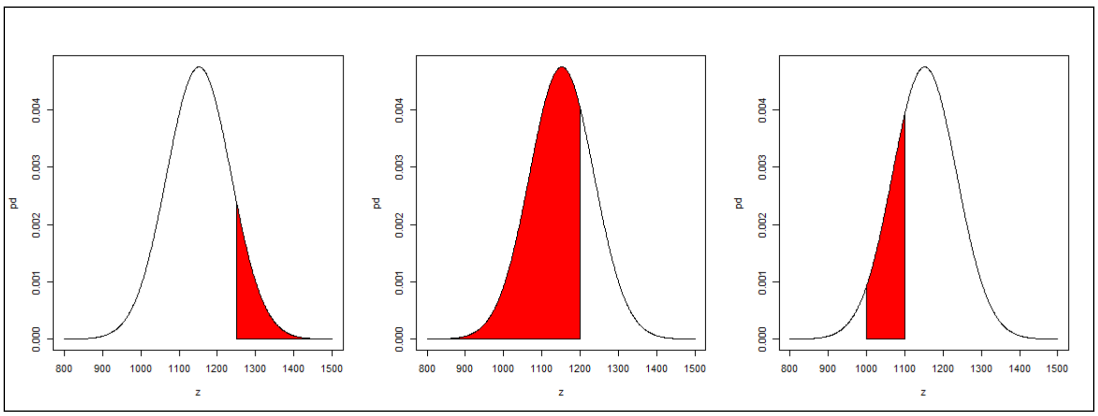
   Plot the Leibniz series and the difference between π/4 and sum S(n) versus n for 0 ≤ n ≤ 200. You are supposed to get the following plot.



2. The Virginia Cooperative Extension reports that the mean weight of yearling Angus steers is 1,152 pounds. Suppose that weights of all such animals can be described by a Normal model with a standard deviation of 84 pounds.

   Plot the normal distribution curve (μ = 1,152 and σ = 84). Fill the distribution curve with your choice of color:
   a. Where weight is over 1,250 pounds
   b. Where weight is under 1,200 pounds
   c. Where weight is between 1,000 and 1,100 pounds

   You are supposed to get the following plot.



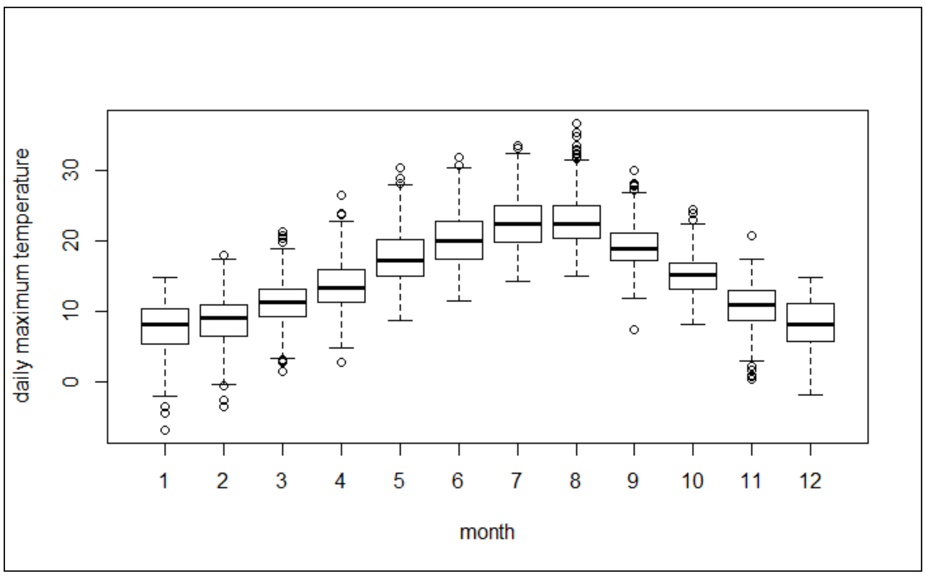
3. Read the ‘temperature.csv’ file (this is the same file that we used in Homework#9). This file contains the following data.
   - High and low temperature (degree centigrade)
   - Rainfall (centimeters)
   - Month (from 1 to 12)
   - Year (for 20 years - from 1987 – 2005)

   The first 6 lines of this file are as follows.

temperature	lower	rain	month	yr
10.8	6.5	12.2	1	1987
10.5	4.5	1.3	1	1987
7.5	-1	0.1	1	1987
6.5	-3.3	1.1	1	1987
10	5	3.5	1	1987

   This file contains 6,940 lines of data.

   Create a boxplot of ‘high temperature’ using ‘month’ as a factor variable.



4. In a Binomial experiment with 'n' trials, the probability of success is 'p' in each trial. The probability of exactly 'x' successes in 'n' trials is given by the following expression.

$$P(x : successes) = \left({}_nC_x p^x (1-p)^{(n-x)}\right)$$

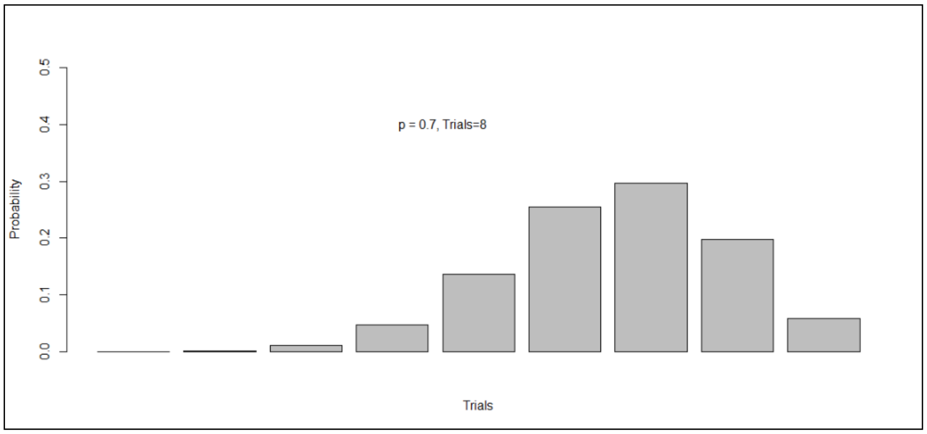
Suppose the probability of success (p) = 0.7 (probability of failure is (1 – 0.7) = 0.3). Therefore, in 8 trials (n = 8), the probability of exactly 5 successes (x = 5) is:

$$= {}_8C_5 (0.7)^5 (0.3)^{(8-5)} = 0.25412$$

Similarly, the following probabilities can be computed:

0 success	1 success	2 success	3 success	4 success	5 success	6 success	7 success	8 success	SUM of Probabilities
0.00006	0.00122	0.01	0.04667	0.13613	0.25412	0.29647	0.1977	0.05764	1.00

The bar plot of the above table is as follows.



Vary the probability of success from 0.1 to 0.9 and generate the following 9 bar plots in R that represent the probability of 'x' successes in '8' trials.