

Homework Assignment 2
(Due Friday, September 9, 2022 at 5PM)

Total Points: 76

Please email your answer (compiled pdf file from R markdown) and R code to Yen-Yi Ho (hoyen@stat.sc.edu). Please use the R markdown Homework template (Stat704_HWtemplate.Rmd) to write your homework solutions.

1. Create a $n \times m$ matrix of random numbers. Then determine how long it take to calculate the mean of each column using [Hint: use **proc.time** to track time]
 - (a) a **for** loop (4 points)
 - (b) **apply** (6 points)
2. Suppose that, for a randomly drawn subject from a particular population, the proportion of their skin that is covered in freckles follows a density that is constant on $[0; 1]$. (This is called the uniform density.) That is, $f(x) = k$ for $0 \leq x \leq 1$.
 - (a) Draw this density. What must k be? (3 points)
 - (b) Suppose a random variable, X , follows a uniform distribution. What is the probability that X is between .1 and .7? Interpret this probability in the context of the problem. (5 points)
 - (c) Verify the previous calculation in R. What's the probability that $a < X < b$ for generic values $0 < a < b < 1$? (4 points)
 - (d) What is the cumulative distribution function associated with this density? (3 points)
 - (e) What is the median of this density? Interpret the median in the context of the problem. (3 points)
 - (f) What is the 95th percentile? Interpret this percentile in the context of the problem. (3 points)
 - (g) Do you believe that the proportion of freckles on subjects in a given population could feasibly follow this distribution? (Why or why not.) (5 points)
3.
 - (a) Simulate a string of 10,000 characters drawn uniformly and independently from the set $\{A, C, G, T\}$ [Hint: **sample**] (7 points)
 - (b) Create a frequency table of the string [Hint: **table**] (3 points)
 - (c) Write a function to create a contingency table of adjacent k -tuples. For example, with $k=3$ and with the string "CAGACAAAAC", you would want to produce the following table: [**Only use for loops and paste(, collapse=""), Do not use embed, substr or do.call**] (20 points)

AAA	AAC	ACA	AGA	CAA	CAG	GAC
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4. $x! = 1 \times 2 \times 3 \dots \times x$; $0! = 1$. x is an integer ≥ 0 . Write your own function to perform the calculation. (10 points) [Do not use the function **prod** and **factorial** in R]