[30] Homework 3. *Programming Assignment*

The goal of this assignment is to find good approximations of

$$H_n^{(2)} = \sum_{k=1}^{n} \frac{1}{k^2}$$

and

$$n! = 1 \cdot 2 \cdot 3 \cdots n$$

for large n ($n \to \infty$).

[15] **Evaluation of (Zeta Function)** $H_n^{(2)}$:

Tabulate and plot $H_n^{(2)}$ for a range of n (e.g., $1 \le n \le 1000$) using your favorite programming language (Maple or Mathematica are fine). Based on this numerical computation find a *good* approximation of $H_n^{(2)}$ for large n up to a *constant* term. That is, find a simple function $f(n)$ (e.g., $f(n) = \log n$) such that $H_n^{(2)} \approx f(n) + \mathit{constant}$ (and this approximation you should check on your plots and/or tables). For example, your computations may indicate that $H_n^{(2)} \approx n\sqrt{n} + 3.2n + 4$ (this is **not** the correct answer!).

[15] **Stirling's Approximation**:

Tabulate and plot

$$\sum_{k=1}^{n} \log k$$

for a range of n (e.g., $1 \le n \le 1000$). Based on this numerical computation find a *good* approximation of

$$\log n! = \sum_{k=1}^{n} \log k$$

for large n up to a $\log n$ term, if possible. That is, your answer may look like this

$$\log n! \approx^{?} n^2 \log n + n + 3 \log n.$$

Include your program in the homework write-up.