Homework 7: Samples, Distributions, Graphs

1. (6 points) The article **"Expectation Analysis of the Probability of Failure for Water Supply Pipes" (*J. of Pipeline Systems Engr. and Practice*, May 2012: 36–46)** proposed using the Poisson distribution to model the number of failures in pipelines of various types. Suppose that for cast-iron pipe of a particular length, the expected number of failures is 1 (very close to one of the cases considered in the article). Then X, the number of failures, has a Poisson distribution with $mean = 1$. Write r-code that computes the following probabilities.
   a. (3 points) $P(X \leq 5)$
   b. (3 points) $P(X = 2)$

2. (3 points) The defect length of a corrosion defect in a pressurized steel pipe is normally distributed with mean value 30 mm and standard deviation 7.8 mm [suggested in the article **"Reliability Evaluation of Corroding Pipelines Considering Multiple Failure Modes and Time- Dependent Internal Pressure" (*J. of Infrastructure Systems*, 2011: 216–224)**]. What is the 75th percentile of the defect length distribution— that is, the value that separates the smallest 75% of all lengths from the largest 25%? Provide the r-code that produces the result.

3. (5 points) A 4-digit PIN has no restriction on the digits (0 – 9), repetition is allowed. Use functions sample( ) and replicate( ) to generate 10 random PINs.

4. (10 points) A t-distribution is getting closer to $N(0,1)$ as the sample size increases. The following plot contains the densities of the standard normal distribution and two t-distributions with the degrees of freedom equal to 5 and 10 respectively. Using base package, produce the following plot.