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1. (50 points) **Batman Incorporated:** Recently, Batman has been having trouble solving all of Gotham's super-crime all by himself. In an average month, the Bat signal is turned on 7 times and from there the process of gathering clues, beating up flunkies, escaping from elaborate traps, and capturing the villain behind everything takes  $1/4$  of a month. To handle the case load, Batman is thinking of bringing in some associates (Robin, Batgirl, Huntress, etc.), but first he must know how many heroes will be needed to cover the case load. Assume the Bat Signals follow a Poisson distribution.
- (a) (15 points) Batman has been collecting data on Bat Signal Usage over the past decade. Use R to simulate this data and plot a histogram of the results.
  - (b) (10 points) How many Bat Signals can Batman cover in a month? In an average month, how many heroes would it take to stop all the super-crime? (Round up to the nearest whole hero).
  - (c) (5 points) What's the *theoretical* standard deviation for the number of Bat Signals appearing in a month? What does the simulated data show?
  - (d) (10 points) If Batman brings on one teammate, what percentage of the time will this be sufficient to thwart all super-crime?
  - (e) (10 points) Suppose Batman wants to bring in enough heroes to cover the case load in 95 percent of the time, how many heroes will he need on his team?

2. (50 points) **The Statistics Of Deadly Quarrels:** The following question uses the `Quarrels` data set in the package `HistData`.
- (a) (15 points) Describe the `Quarrels` data set. Create a histogram for the number of months a conflict took place over with a binwidth equivalent to one year.
  
  
  
  
  
  
  
  
  
  
  - (b) (5 points) What's the average number of months for a conflict? What's the standard deviation?
  
  
  
  
  
  
  
  
  
  
  - (c) (5 points) Take a sample of 30 data points and use this to estimate the mean and standard deviation of the full data set.
  
  
  
  
  
  
  
  
  
  
  - (d) (10 points) What's the 90 percent confidence interval for the actual mean based on your first sample? Does the actual mean fall in this interval? (Show all work.)
  
  
  
  
  
  
  
  
  
  
  - (e) (15 points) Repeat the sampling 100,000 times. Make a histogram of the Sample Means and find the standard deviation of the Sample Means.