IC252 Eval 3
Level 2: Paper A

16 April 2019

1. Two missile systems, System A and System B, are being evaluated. Each system undergoes a large number of field trials, the results of which are recorded in the files `sysA.csv` and `sysB.csv`. The columns are: time of the test, location code, range of the missile, and whether the missile hit the target (denoted by H) or missed (denoted by M).

   (a) What is the probability that System A performed K firings before hitting the target (i.e. the target was hit on the $K+1$ th firing)? Accept K from the user.

   (b) Repeat for System B. Accept K from the user.

2. In the next evaluation, two newer missile systems, that fire a group of missiles together, are being field tested. System AG fires a group of 10 missiles, and System BG fires 12. The results of the trials are in the files `sysAG.csv` and `sysBG.csv`. Each time a missile misses its target, its adds to the systems operating loss. The cost of each individual missile is Y. Accept Y from the user.

   (a) Estimate the operating loss for System AG.

   (b) Repeat for System BG.

The function `str.count()` may be useful.

Solution

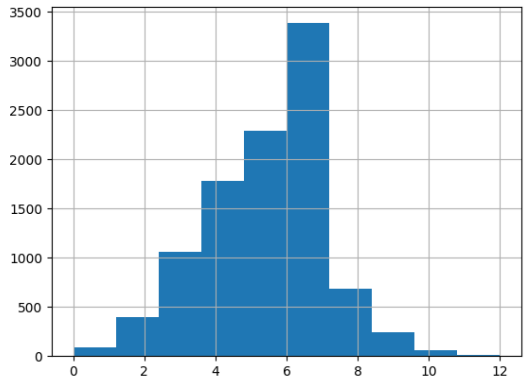
1. The system performed K firings before hitting the target means that the first K firings missed the target, and the $K+1$ th firing hit the target. Let the probability of hitting the target be p. This p can be estimated from the data file. The probability that the system performed K firings before hitting the target on the $K+1$ firing is therefore

   $$(1-p)^K p$$

   p can be estimated by counting the number of hits from the last column of the data file.

2. The number of hits (successes), achieved by the system that fires a group of n missiles can be modeled as a binomial random variable X with parameters (n, p). The X in each outcome can be determined by counting the number of hits (last column of the datafile.) The expected number of hits in n trials $= E(X)$. This can be estimated by plotting the histogram of the data X.

The peak of the histogram (or the mode of the data corresponding to X) will indicate the expected number of hits in n trials. For example, the histogram from one of the datasets is given below.



The operating loss of the system is based on the expected number of misses, which is $n - E(X)$. Therefore, the operating loss is $Y(n - E(X))$, where Y is the cost of each missile.