**Statistical inference**

1. We have a sample drawn from a chi-squared distribution: x=rchisq(n=1000, df=5). Please use mle to estimate df.
2. Try different optimization methods to see how are their precisions.

**The following assignments will be graded.**

1. You are given a vector of length 1000:

> xp

[1] 5 4 5 6 6 4 1 8 1 4 4 8 6 6 5 5 7 4 9 6 4 5 7 5 2 5 5 4 5 5 3 7

[33] 0 3 0 6 5 3 4 1 8 6 2 8 3 6 6 4 4 2 5 6 5 6 2 2 8 4 4 3 10 5 1 4

[65] 5 3 7 4 6 7 7 4 8 8 6 7 5 7 1 9 5 4 8 4 5 3 4 4 4 3 5 4 7 5 9 5

[97] 6 9 2 5 2 1 1 5 3 5 6 7 4 6 5 10 5 9 5 3 6 7 9 6 2 8 6 4 4 5 6 7

[129] 2 3 6 5 3 3 8 3 3 6 6 6 3 2 6 7 7 5 8 6 5 3 7 3 6 3 4 5 8 5 2 4

[161] 6 4 6 4 3 6 6 7 4 5 3 3 6 4 4 7 5 6 6 5 7 2 4 3 3 10 6 8 5 9 5 7

[193] 4 4 7 9 8 9 5 3 6 4 4 4 5 6 6 4 5 9 7 12 5 3 7 3 9 1 5 6 1 6 4 6

[225] 7 4 6 2 1 3 4 9 8 5 5 3 7 8 5 6 6 10 7 5 3 3 6 3 9 7 2 5 7 5 3 8

[257] 5 5 5 8 7 4 3 4 7 3 5 3 3 4 3 3 5 4 3 3 6 5 3 6 6 6 3 3 5 5 4 6

[289] 7 6 4 5 3 4 2 4 6 6 5 5 3 5 9 5 2 6 5 8 6 3 4 3 12 11 6 3 6 4 5 6

[321] 7 4 5 6 3 8 4 4 3 6 5 5 7 7 4 6 5 4 2 6 7 2 10 4 4 6 10 3 4 5 5 5

[353] 3 5 6 3 2 7 6 5 4 4 5 6 1 1 6 6 4 7 5 10 7 6 1 5 4 3 7 7 7 8 5 6

[385] 4 3 3 5 3 2 3 5 9 3 6 5 4 6 7 5 3 6 3 7 5 3 4 7 4 8 3 3 10 6 4 5

[417] 10 7 5 5 5 2 4 3 6 12 7 5 4 6 6 3 0 3 2 6 7 3 3 2 6 8 6 7 5 3 6 0

[449] 6 6 4 7 3 5 0 5 2 7 3 5 4 6 5 3 9 6 4 1 6 10 2 6 1 2 6 5 1 8 3 2

[481] 3 5 5 6 4 9 0 5 8 7 4 9 4 3 5 5 7 1 5 4 10 3 4 4 3 2 5 4 4 4 4 6

[513] 5 3 4 1 3 3 8 11 3 8 7 4 6 9 4 4 5 6 8 3 4 6 4 6 11 4 5 4 6 5 5 4

[545] 10 2 1 7 7 2 8 4 4 5 5 4 5 6 7 3 7 4 5 7 6 4 5 7 2 2 6 7 3 9 0 2

[577] 6 10 5 2 6 4 8 5 10 3 6 7 6 3 6 2 3 1 3 3 2 4 4 8 9 3 8 5 6 6 3 8

[609] 2 4 1 6 6 6 4 7 6 4 4 0 2 3 6 2 4 3 4 6 8 6 4 4 7 8 8 6 3 4 8 5

[641] 2 2 4 4 4 5 0 3 2 4 6 4 4 5 2 6 6 4 5 5 5 8 6 8 6 4 4 4 2 2 4 4

[673] 6 3 3 2 7 9 14 2 6 4 6 5 3 7 7 4 5 5 6 6 7 2 2 3 6 4 8 5 7 4 4 7

[705] 7 9 9 6 7 6 7 7 6 6 8 5 6 5 6 6 4 5 4 6 3 4 4 4 5 2 5 5 7 2 8 2

[737] 5 4 5 2 5 2 3 4 6 1 10 8 6 4 4 5 3 4 8 8 5 7 10 1 3 5 0 1 11 3 5 5

[769] 4 11 6 2 6 2 4 3 7 2 6 4 4 3 6 11 4 6 3 9 3 5 6 2 8 4 4 4 5 5 6 3

[801] 3 1 3 4 8 4 3 6 5 5 6 4 5 5 2 2 4 7 3 2 1 4 3 5 7 8 3 9 8 3 3 4

[833] 5 8 5 6 11 4 6 3 4 5 6 2 1 5 6 3 3 3 2 8 2 2 7 8 2 3 6 4 0 9 5 7

[865] 8 4 9 4 4 3 7 4 3 6 4 6 3 2 9 6 6 6 6 7 4 8 3 3 5 3 5 7 7 2 8 6

[897] 2 2 3 12 6 9 3 6 9 5 4 3 3 5 2 6 6 2 2 7 5 2 3 8 5 3 4 8 2 1 3 7

[929] 7 6 2 3 5 5 3 4 7 6 3 9 6 4 6 7 3 1 6 4 6 8 3 1 4 4 7 4 2 8 6 1

[961] 10 5 8 6 3 8 4 6 7 6 5 6 4 5 8 5 4 5 8 5 7 3 6 4 7 8 7 3 2 2 5 4

[993] 4 3 5 7 5 5 6 6

* We know that this sample follows a distribution called “Poisson distribution”. Please try to figure out what parameters a Poisson distribution should have, how to use R to analyze it, and use mle to estimate the related parameters.

1. Design an mle procedure to solve a linear regression

* Y~ β0 + β1X1 + β2X2 + ε
* Figure out how precise is your outcome with respect to the following properties:
  + Sample size (the length of Y);
  + The variance of ε (σ).