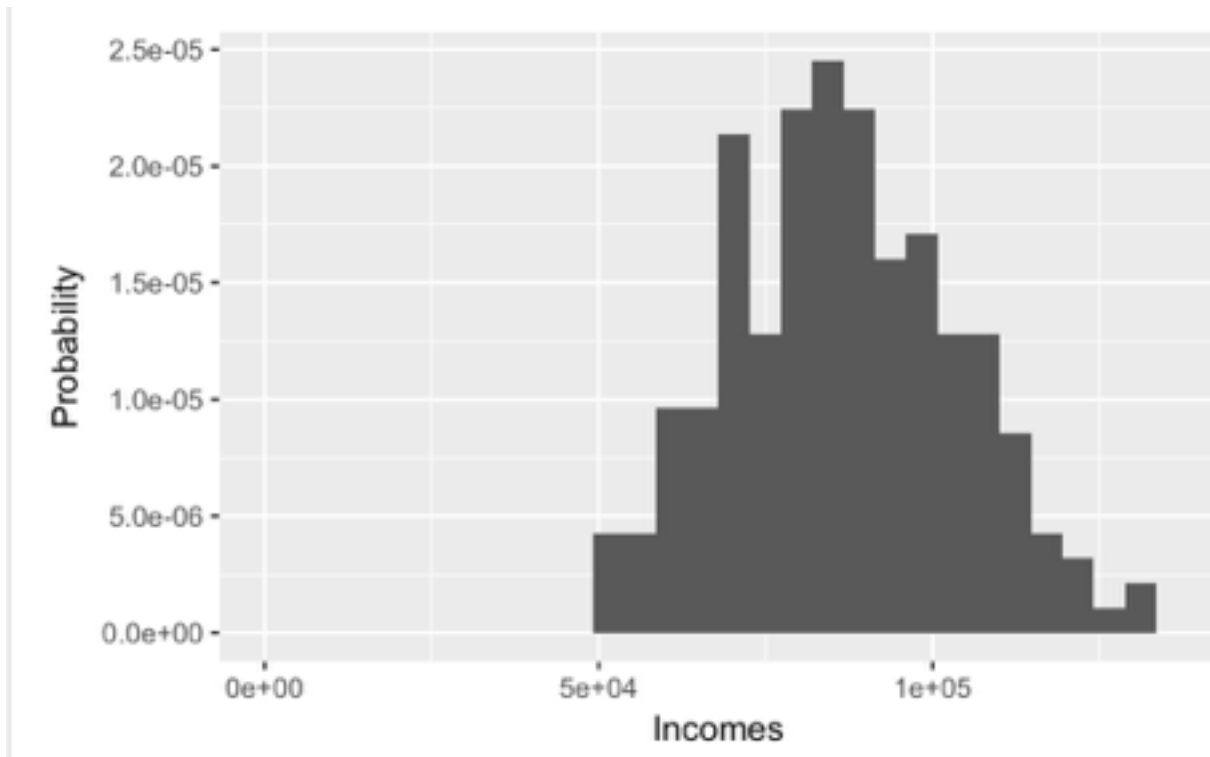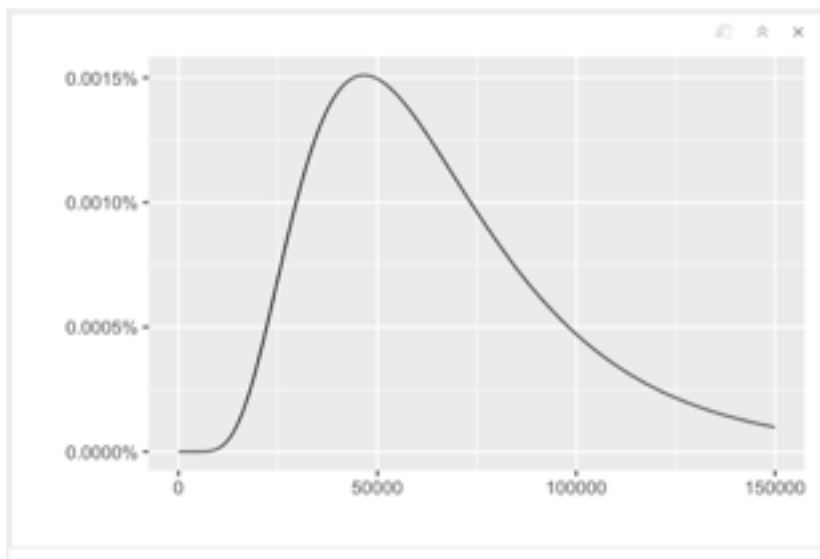Homework 2 - Perspectives on Computational Modeling - Winter'18

1. a) Histogram:

b) Lognormal pdf:

Value of log likelihood function: -2385.7

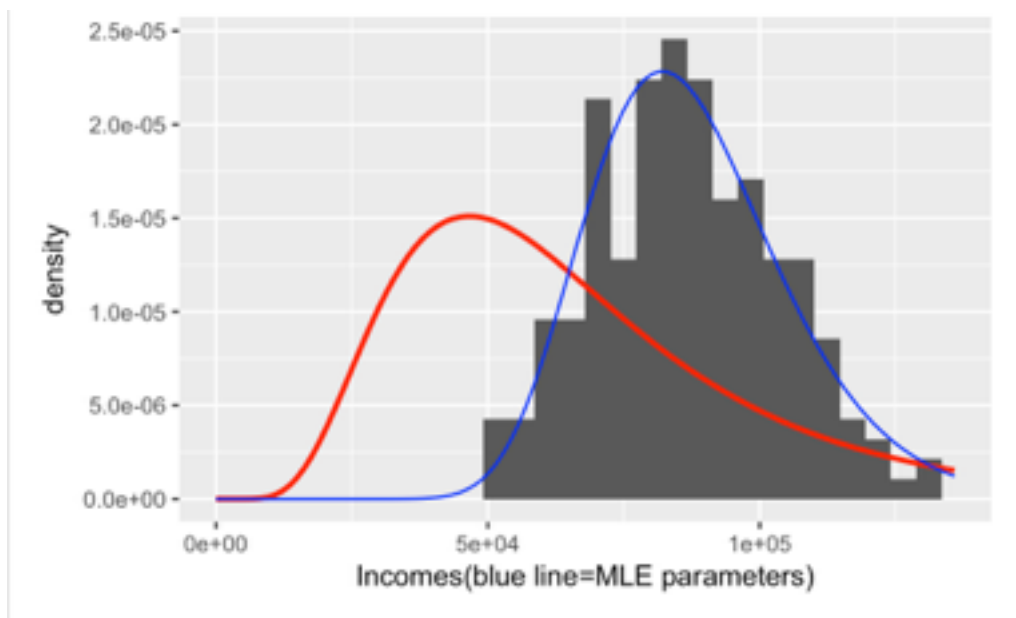1. c)

Parameters obtained:
Mu=11.3590229
Sigma = 0.2081824

The variance/covariance matrix is:

```
> print(covariance_matrix)
              [,1]           [,2]
[1,] -2.166996e-04 1.032825e-10
[2,] -1.032825e-10 1.083353e-04
```

The value of the log likelihood function for the most optimal parameters is -2241.719.

Histogram with overlayed pdfs:

d) Results of the likelihood ratio test:

```
        Likelihood-ratio Test

data:  -2241.9076275-2385.856997
Likelihood-ratio = 287.9, chi-square critical value = 3.8415,
alpha = 0.0500, Degrees of Freedom = 1.0000, p-value <
2.2e-16
alternative hypothesis: greater
```

1d) Continued:

P(Income>$100,000)=0.2298388
P(Income<$75,000)=0.2602752

Question 2

a)

```
The array of MLE optimized parameters is [ 0.25164459  0.01293349  0.40050085 -0.00999171  0.00301755]
The log likelihood function is 876.865066401
```

Variance/Covariance Matrix:

```
[[  1.08658284e+02    1.59951411e+00    9.72932170e+00    7.51358476e-01
    -6.09381308e-01]
 [  1.59951411e+00    4.12712689e-02    2.36763352e-02   -5.54015639e-04
     3.22451359e-03]
 [  9.72932170e+00    2.36763352e-02    2.46726580e+00   -1.65044640e-01
     1.09911715e-01]
 [  7.51358476e-01   -5.54015639e-04   -1.65044640e-01    1.14774285e-02
     7.56101138e-03]
 [ -6.09381308e-01    3.22451359e-03    1.09911715e-01    7.56101138e-03
     5.34367470e-03]]
```

b)

```
In [90]: b0=1
         sd=0.01
         b1=0
         b2=0
         b3=0
         null = log_like_q2(dataQ2, b0, b1, b2, b3, sd)
         mle_calc = log_like_q2(dataQ2, 0.25201543, 0.01295189, 0.40030231, -0.01000917, 0.051814)
         ratio = 2 * (mle_calc - null)
         p = 1.0 - sts.chi2.cdf(ratio, 2)
         print('The P-Value is = ', p, ',therefore we can reject the null hypothesis.')

         The P-Value is =  0.0 ,therefore we can reject the null hypothesis.
```