MA 69204 Statistical Software Lab

Assignment No. 2

(a) Generation of a Random Sample from a Bernoulli (p) Distribution

Generate $U \sim U\,[0,1]$. If $U \leq p$, return $X = 1$, else return $X = 0$.

(b) Generation of a Random Sample from a Discrete Uniform Distribution

The density function is: $p(x) = \dfrac{1}{\mathrm{j} - \mathrm{i} + 1}, \;\; x = i, i+1, \ldots, j.$

Algorithm: Generate $U \sim U\,[0,1]$. Return $X = i + [(j - i + 1)\,U]$.

(c) Generation of a Random Sample from a Binomial (n, p) Distribution

Generate $Y_1, Y_2, \ldots, Y_n$ as Bernoulli (p) random variables. Return $X = Y_1 + Y_2 + \ldots + Y_n$.

(d) Generation of a Random Sample from a Geometric (p) Distribution

Generate $U \sim U\,[0,1]$. Return $X = [\ln U / \ln(1 - p)]$.

(e) Generation of a Random Sample from a Negative Binomial (r, p) Distribution

Generate $Y_1, Y_2, \ldots, Y_r$ as Geometric (p) random variables.

Return $X = Y_1 + Y_2 + \ldots + Y_r$.

(f) Generation of a Random Sample from a Poisson (λ) Distribution

1. Let $a = e^{-\lambda}, b = 1, i = 0$.
2. Generate $U_{i+1} \sim U[0,1]$ and replace b by $b\,U_{i+1}$. If $b < a$, return $X = i$, otherwise go to Step 3.
3. Replace i by $i + 1$ and go back to Step 2.

Generate 1000 random variates using each algorithm and apply Chi-square goodness of fit test in each case. Also generate 1000 random variates from each of the above mentioned distributions using general direct inverse transform method given below and apply goodness of fit test on these samples too. Give your comments on relative performance of both methods.

General Direct Inverse Transform Method

1. Generate $U \sim U\,[0, 1]$.
2. Return $X = I$, satisfying $\sum_{j=0}^{i-1} p(j) \leq U < \sum_{j=0}^{i} p(j)$