STAT 580 HW2

Haozhe Zhang

February 16, 2017

Question 1

```c
#include <stdio.h>
#include <math.h>

#define P0 0.01 /* lower limit of the probability (p) */
#define P1 0.5 /* upper limit of the probability (p) */
#define PLEN 10 /* number of columns */
#define N 5 /* number of experiments (n) */

int factorial(int n){
    if(n==0) return(1);
    //if(n<0) return(EOF);
    if(n>1){
        return(n*factorial(n-1));
    }
    else{
        return(n);
    }
}

int main(){
    int x=0, i=0;
    double prob, density_value;

    printf("%s\t", "x\\p");

    for(i=0;i<PLEN;i++){
        prob = P0+i*(P1-P0)/(PLEN-1);
        printf("%5.4f  ", prob);
    }
    printf("%s","\n");

    for(x=0;x<N+1;x++){
        printf("%d  \t",x);
        for(i=0;i<PLEN;i++){
                prob = P0+i*(P1-P0)/(PLEN-1);
            density_value = factorial(N)/(factorial(x)*factorial(N-x))*pow(prob,x)*pow(1-prob,N-x);
            printf("%5.4f  ", density_value);
        }
        printf("%s","\n");
    }
    return 0;
```

Question 2

(a) Algorithm:

1. Generate a sample U from unif(0,1);
2. Compute X=10^U, where X is a random sample from f(x).

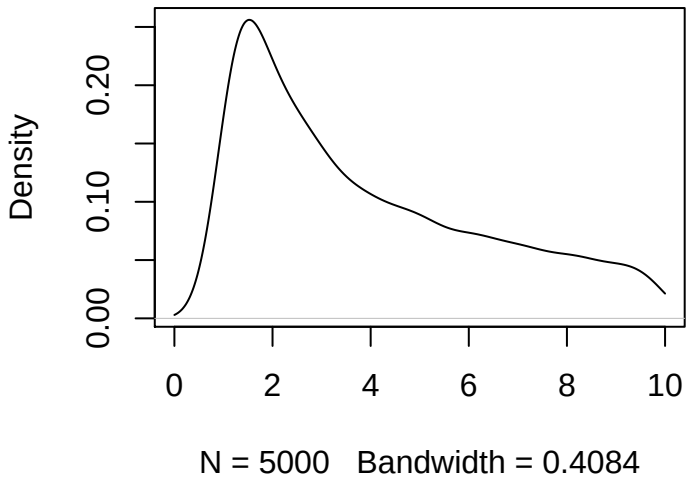
(b) C program

```c
#include <stdio.h>
#include <time.h>
#include <Rmath.h>

int main(void){
    set_seed(time(NULL), 19921129);
    printf("%f\n", pow(10,unif_rand()));
    return(0);
```

(c) R program

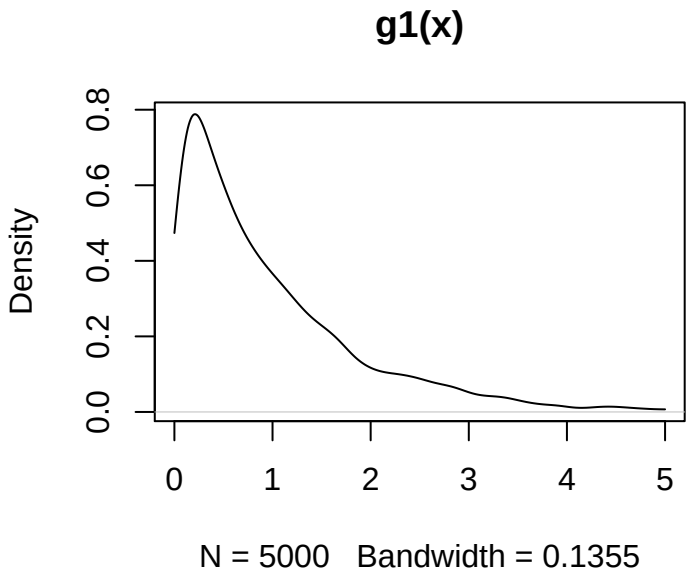
```r
N = 5000
plot(density(10^(runif(N, 0, 1)), from = 0, to = 10), main = "")
```



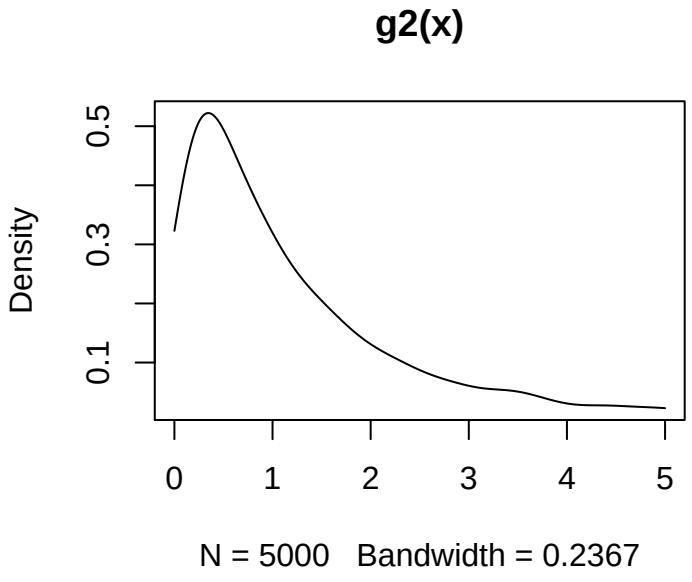
Question 3

(a) Generate 5000 samples from $g_1(x)$ and $g_2(x)$

```r
plot(density(rgamma(N, 1, 1), from = 0, to = 5), main = "g1(x)")
```

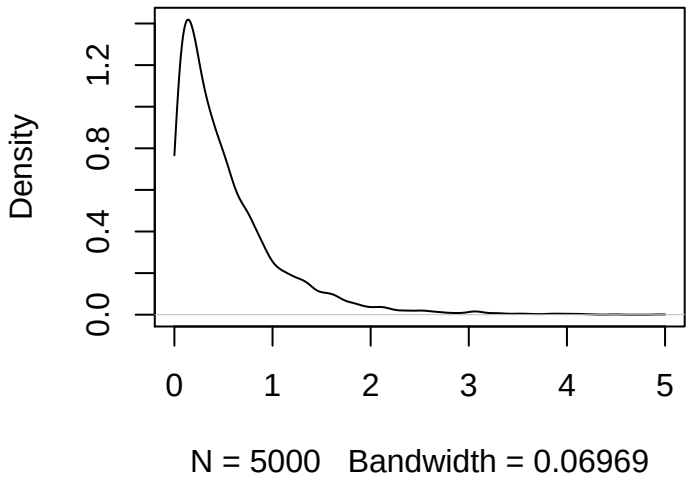



```
plot(density(abs(rcauchy(N, 0, 1)), from = 0, to = 5), main = "g2(x)")
```



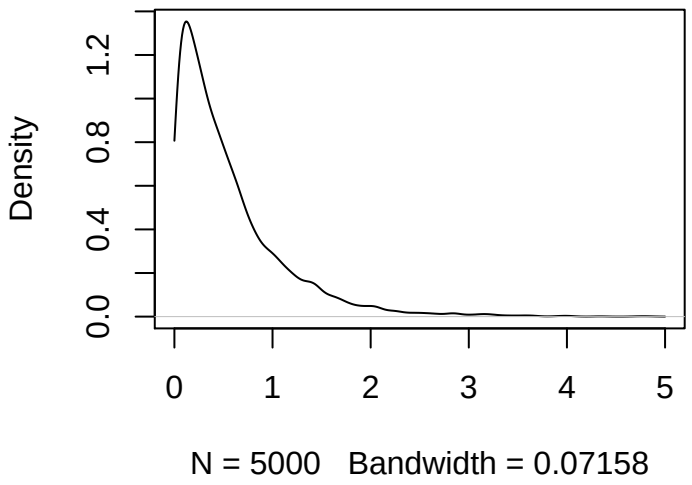
Generate samples from f(x) using rejection sampling with g_{1}(x)

```
f_g1_sample <- rep(NA, N)
n <- 1
while (n <= N) {
    gamma_sample <- rgamma(1, 1, 1)
    if (runif(1, 0, 1) <= 1/(1 + gamma_sample^2)) {
        f_g1_sample[n] <- gamma_sample
        n <- n + 1
    }
}
plot(density(f_g1_sample, from = 0, to = 5), main = "")
```



Generate samples from $f(x)$ using rejection sampling with $g_2(x)$

```
f_g2_sample <- rep(NA, N)
n <- 1
while (n <= N) {
    cauchy_sample <- abs(rcauchy(1, 0, 1))
    if (runif(1, 0, 1) <= exp(-cauchy_sample)) {
        f_g2_sample[n] <- cauchy_sample
        n <- n + 1
    }
}
plot(density(f_g2_sample, from = 0, to = 5), main = "")
```



(c)