STAT 580 Homework 1

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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 <= 1)
        return 1;
    else
        return (n * factorial(n - 1));
}

double binopmf(int n, int x, double p)
{
    return (factorial(n) / (factorial(n - x) * factorial(x))) * pow(p, x
        ) * pow(1 - p, n - x);
}

int main()
{
    printf("x\\p\t");
    double step = (P1 - P0) / (double) (PLEN - 1);
    for (int i = 1; i <= PLEN - 1; i++)
    {
        printf("%.4f\t", P0 + (i - 1)*step);
    }
    printf("%.4f\n", P0 + (PLEN - 1)*step);

    for (int x = 0; x <= N; x++)
    {
        printf("%d\t", x);
        for (int i = 1; i <= PLEN - 1; i++)
        {
            printf("%.4f\t", binopmf(N, x, P0 + (i - 1)*step));
        }
        printf("%.4f\n", binopmf(N, x, P0 + (PLEN - 1)*step));
    }
    return 0;
}
```

2. (a) $\int_1^{10} f(x) = 1 \Rightarrow c\int_1^{10} \frac{1}{x}\mathrm{d}x = c(\log 10 - 0) = 1 \Rightarrow \frac{1}{\log 10}$. Hence

$$F(x) = \int_1^x f(x)\mathrm{d}x = \int_1^x \frac{1}{\log 10}\frac{1}{x}\mathrm{d}x = \frac{\log x}{\log 10} = \log_{10}(x),\ 1 < x < 10$$

Hence the inverse function

$$F^{-1}(u) = 10^u,\ 0 < u < 1$$

Thus the algorithm would be

Algorithm 1 Sampling X with cdf $F(x) = \log_{10}(x)$

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1. Generate $U \sim Unif(0, 1)$;
2. Set $X = 10^U$;
