Risk analysis lab 2014. 12. 01. (Monte Carlo methods I.)

1. For a given $g(\boldsymbol{y})$ function, calculate

   - $AL = E(g(\boldsymbol{y})) = \sum_{\boldsymbol{y} \in \{0,1\}^N} g(\boldsymbol{y}) p(\boldsymbol{y})$;

   - $P = P(g(\boldsymbol{y}) > C) = \sum_{\boldsymbol{y} \in \{0,1\}^N ; g(\boldsymbol{y}) > C} p(\boldsymbol{y})$,

   where $\boldsymbol{y}$ is a binary vector, and the g is given as a „black-box" function (please find the binary file `g.p`). Try it with different lengths (N), use p=0.95 and C=0.5.

   $$p(\boldsymbol{y}) = \prod_{i=1}^{N} p^{y_i} (1-p)^{(1-y_i)}$$

   ```
   function [AL, P] = calcAnalytic(g, p, C, N)
   e.g. [AL, P] = calcAnalytic(@g, 0.95, 0.5, 10);
   ```

2. Generate a random vector in the N dimensional binary space according to the following distribution: $P(\boldsymbol{y}) = \prod_{i=1}^{N} p^{y_i} (1-p)^{(1-y_i)}$ ($\boldsymbol{y} \in \{0,1\}^N$, $P(y_i = 1) = p, P(y_i = 0) = 1 - p$).

   ```
   function y = generateY(p, N)
   ```

   Calculate the previous quantities (AL and P) with Monte Carlo sampling. Generate K samples ($Y^{(K)} = \{\boldsymbol{y_k}, g(\boldsymbol{y_k}), k = 1, \ldots, K\}$) for K = 10, K = 100 and K = 1000, then

   - $AL = \frac{1}{K} \sum_{\boldsymbol{y} \in Y} g(\boldsymbol{y})$;

   - $P = \frac{1}{K} \sum_{\boldsymbol{y} \in Y ; g(\boldsymbol{y}) > C} 1$.

   ```
   function [AL, P] = calcMC(g, p, C, N, K)
   ```

   Compare the mean squared error of the estimation and the running time for different values of K and N (`lab8.m`).