CmpE 343
Fall 2009
Term Project
(Due Monday, January 4^{th} 12:00)

- All work you turn in must be ***your own***. Cheaters will be punished severely.
- Please always remember that every student deserves a chance to get a fair grade!
- Late submissions will not be graded.

Question1: (*50 points*)

(a) (*20 points*) Implement a random variate generator for Bernoulli distribution with parameter p as a C/C++ function. Submit carefully indented and commented source code.

[Hint: `(double)rand() / RAND_MAX` $\sim U(0,1)$]

(b) (*10 points*) Generate a sample of size 60 with parameter $p = 0.83$, report the sample, and estimate p from the sample.

(c) (*10 points*) Construct a 95% confidence interval for p from the sample you generate in part (b).

(d) (*10 points*) Test the following hypotheses for the sample you generate in part (b) with $\alpha = 0.05$.

1. H_0: $p = 0.78$ vs $H_1 : p < 0.78$
2. H_0: $p = 0.78$ vs $H_1 : p \neq 0.78$
3. H_0: $p = 0.78$ vs $H_1 : p > 0.78$

Question2: (*30 points*)

(a) (*15 points*) Implement a random variate generator for binomial distribution with parameters n and p as a C/C++ function. Submit carefully indented and commented source code.

(b) (*15 points*) Implement a random variate generator for geometric distribution with parameter p as a C/C++ function. Submit carefully indented and commented source code.

Question3: (*70 points*)

(a) (*20 points*) Implement a random variate generator for Normal distribution with parameters μ and σ^2 as a C/C++ function. Submit carefully indented and commented source code.

$$\left[\text{Hint: } \sum_{i=1}^{12} U(0,1) - 6 \sim Z\right]$$

(b) (*10 points*) Generate samples of size 50, 100, 500, and 1000 with parameters $\mu = 166$ and $\sigma^2 = 484$, report the samples of size 50 and 100, and estimate (μ, σ^2) from each sample.

(c) (*10 points*) Construct a 99% confidence interval for μ from the samples you generate in part (b). You can safely assume that the population is normally distributed and its variance is 484.

(d) (*10 points*) Construct a 90% confidence interval for μ from the samples you generate in part (b). You can safely assume that the population is normally distributed and its variance is unknown.

(e) (*10 points*) Test the following hypotheses for the samples you generate in part (b) with $\alpha = 0.01$. You can safely assume that the population is normally distributed and its variance is 484.

1. $H_0 : \mu = 160$ vs $H_1 : \mu < 160$
2. $H_0 : \mu = 160$ vs $H_1 : \mu \neq 160$

3. $H_0 : \mu = 160$ vs $H_1 : \mu > 160$

(f) (*10 points*) Test the following hypotheses for the samples you generate in part (b) with $\alpha = 0.10$. You can safely assume that the population is normally distributed but its variance is unknown.

1. $H_0 : \mu = 180$ vs $H_1 : \mu < 180$
2. $H_0 : \mu = 180$ vs $H_1 : \mu \neq 180$
3. $H_0 : \mu = 180$ vs $H_1 : \mu > 180$

Question4: (*50 points*)

(a) (*30 points*) Implement linear regression method ($\hat{y} = \beta_0 + \beta_1 x$) as a C/C++ function for given x and y double arrays of size n. Submit carefully indented and commented source code.

(b) (*10 points*) Report sum square error, coefficient of determination (R^2), and the model parameters (β_0, β_1) for the text file which is available at:

http://www.cmpe.boun.edu.tr/courses/cmpe343/fall2009/projectq4.txt

where the first column contains the x values and the second column contains the y values.

(c) (*10 points*) Plot the fitted line together with the data points. You can use Excel or Matlab for plotting.