CmpE 343
Fall 2008
Term Project
(Due Friday, January 16^{th} 9:00)

- 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: (*60 points*) Implement a random variate generator for Bernoulli distribution with parameter $p = 0.28$ in C/C++. [Hint: `(double)rand()` / `RAND_MAX` $\sim U(0,1)$]

(a) (*20 points*) Submit carefully indented and commented source code.

(b) (*10 points*) Generate a sample of size 60 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) (*20 points*) Test the following hypotheses for the sample you generate in part (b) with $\alpha = 0.05$.

1. $H_0 : p = 0.32$ vs $H_1 : p < 0.32$
2. $H_0 : p = 0.32$ vs $H_1 : p \neq 0.32$
3. $H_0 : p = 0.32$ vs $H_1 : p > 0.32$

Question2: (*90 points*) Implement a random variate generator for Normal distribution with parameters $\mu = 125$ and $\sigma^2 = 640$ in C/C++. $\left[\text{Hint: } \sum_{i=1}^{12} U(0,1) - 6 \sim Z\right]$

(a) (*20 points*) Submit carefully indented and commented source code.

(b) (*10 points*) Generate a sample of size 90 and estimate (μ, σ^2) from the sample.

(c) (*10 points*) Construct a 95% confidence interval for μ from the sample you generate in part (b). You can safely assume that the population is normally distributed and its variance is 640.

(d) (*10 points*) Construct a 95% confidence interval for μ from the sample you generate in part (b). You can safely assume that the population is normally distributed and its variance is unknown.

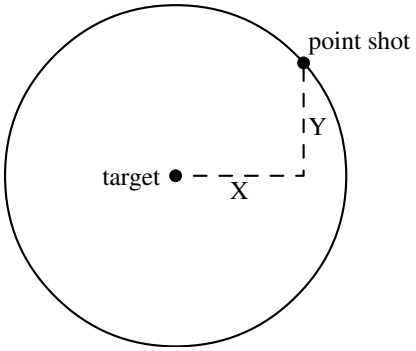
(e) (*20 points*) Test the following hypotheses for the sample you generate in part (b) with $\alpha = 0.05$. You can safely assume that the population is normally distributed and its variance is 640.

1. $H_0 : \mu = 120$ vs $H_1 : \mu < 120$
2. $H_0 : \mu = 120$ vs $H_1 : \mu \neq 120$
3. $H_0 : \mu = 120$ vs $H_1 : \mu > 120$

(f) (*20 points*) Test the following hypotheses for the sample you generate in part (b) with $\alpha = 0.05$. You can safely assume that the population is normally distributed but its variance is unknown.

1. $H_0 : \mu = 130$ vs $H_1 : \mu < 130$
2. $H_0 : \mu = 130$ vs $H_1 : \mu \neq 130$
3. $H_0 : \mu = 130$ vs $H_1 : \mu > 130$

Question3: (*50 points*) Suppose that *Harry Potter* casts a magic spell at a target and his spell deviates from the target X centimeters horizontally and Y centimeters vertically, as shown in the figure. X and Y are independent random variables from a standard normal distribution.



The square of the radius of the circle which is centered at the target and passes through the point shot is distributed with a χ^2 distribution with $\upsilon = 2$ degrees of freedom. Implement a random variate generator for R^2 in C/C++.

(a) (*20 points*) Submit carefully indented and commented source code.

(b) (*10 points*) Generate a sample of size 1000 and estimate R^2 from the sample.

(c) (*20 points*) Plot the histogram for R^2 from the sample you generate in part (b) and compare its shape with shape of the χ^2 distribution with $\upsilon = 2$ degrees of freedom. You can use Excel or Matlab for plotting.

Question4: (*50 points*) Implement linear regression method in C/C++ for the $x - y$ data in the given file. In the text file, the first column contains the x values, and the second column contains the y values.

Data is available at *http://www.cmpe.boun.edu.tr/courses/cmpe343/fall2008/projectq4.txt*

(a) (*20 points*) Submit carefully indented and commented source code.

(b) (*10 points*) Report sum square error on the given data and the model parameters, β_0 and β_1.

(c) (*20 points*) Plot the fitted line together with the data points. You can use Excel or Matlab for plotting.