

MIDDLE EAST TECHNICAL UNIVERSITY  
FACULTY OF ENGINEERING  
CE 204 UNCERTAINTY and DATA ANALYSIS  
Spring Semester 2014-15

Homework 3- Date Due: May 25th, 2015 Monday till 11.00am, no late submissions will be accepted.

**IMPORTANT NOTICE:**

- Please submit the homework to K4-Z8 room at Water Resources Lab. Building (K4).
- You are allowed to collaborate with other students (or ask questions to your assistants/ instructors) on homework provided that you stay away from plagiarizing (according to dictionaries “to plagiarize” means to steal and pass off ideas and/or words/ solutions of another as one’s own without citing the source). That is, collaboration is accepted if you write and give your own solutions. If you are caught on plagiarizing or cheating by handing in “too similar” homework, you will be graded by zero on this homework.
- You are to hand in answers to all questions but you will be graded on only one randomly chosen answer.

**Q1)** Mean travel time between city A and B by bus are obtained as 125, 129, 113, 118, 119, 122, 120, 125, 119, 127, 130, and 123.

a) Find sample mean and standard deviation of the travel time between city A and B (show all your work).

b) Find 95% confidence interval of average travel time.

c) Find 97.5% upper confidence limit for true standard deviation.

**Q2)** Let us dedicate this question to the **Soma Coal Miners Memory** who lost their lives in one of the worst coal mine disaster history on May 13th, 2014. Coal mine accidents in many countries are defined as disasters if the incident has 5 or more fatalities. Many of the risk analysis on coal mine accidents emphasize the causes as i) Lack of Control (administrative and technical investigations, observations etc.), ii) Basic Causes (lack of knowledge, inadequate maintenance, etc.), iii) Immediate Causes (failure to warn, substandard conditions, etc.). Also many mine experts study the relation between mine workers involvement in accidents and education/training status of workers stating that every year 40 to 200 hours of training is to be given to coal mine workers. The following simplified table gives the observations on 100 workers for studying the relation between education/training and accident involvement at a certain region.

| Accident Involvement (X)                                 | Number of Workers Involved in Accidents:<br>( X=1) | Number of Workers Not Involved in Accidents:<br>(X= 0) |
|--|--|--|
| Education Status (Y)                                     |  |  |
| Workers with No Formal Education and Training<br>( Y= 0) | 67   | 16   |
| Workers with Formal Education and Training<br>(Y=1)      | 7  | 10   |

- a) Find the joint probability mass function for the accident involvement (X) and education status (Y) (i.e.  $P_{XY}(x,y)$ ) and show it on the table below.

|   | Y | 0 | 1 |
|---|---|---|---|
| X | 0 |   |   |
|   | 1 |   |   |

- b) Determine covariance of X and Y.  
c) Are X and Y correlated? Why yes/ why no? Give your comments briefly.

**Q3)** Settlements (X, in cm) of 8 random foundation piles are recorded as

1.26 1.27 1.35 1.45 1.56 1.72 1.80 2.43

- a) Using 5 class intervals from 1.25 cm to 2.45 cm, draw the histogram for the pile settlements, X.  
b) Find the coefficient of variation and standard error of the pile settlements X, give your comments on the results.  
c) If the 8 pile settlements are assumed to come from a population with probability density function as  $f_X(x) = k e^{-x}$ ,  $1.25 \leq x \leq 2.45$   
 $f_X(x) = 0$ , elsewhere.  
Find the constant k so that  $f_X(x)$  is a proper density function.

**Q4)** In a study of the relationship between oxygen content (X) and the ultimate testing strength (Y) of welds, 29 pairwise observations were obtained from a sample of 29 welds and the following quantities were computed:

$$\bar{X}=1.52; \bar{Y}=75.50; S_{XX}=SS_X=1.34; S_{YY}=SS_Y=1304.23; S_{XY}=SS_{XY}=22.64; S_{Y/X}=5.84$$

(Here oxygen content is measured in parts per thousand and strength in MPa.)

- a) Based on this data obtain the least square estimates of the intercept ( $\theta_0$ ) and slope ( $\theta_1$ ) of the regression line. Write down the equation of the regression line.  
b) Obtain the **95% prediction intervals** for the strength of a particular weld whose oxygen content is **1.7** parts per thousand.  
c) Compute the values of the **coefficient of correlation** and **coefficient of determination** and explain what they show.