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

Homework 1- Date Due: March 23th, 2015 Monday till 16.00

There were typos in the homework & below is the updated version. If you have already solved the homework it is ok, otherwise below version clarifies the questions.

IMPORTANT NOTICE:

- ***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.***
- ***For late submission of homework, there will be 5 points of deduction for every late day and no homework will be accepted after a week from the due date.***
- ***You are to hand in answers to all questions but you will all be graded on only one randomly chosen answer.***

1. An engineering Company E is submitting bids for two projects A and B; the probabilities of winning are estimated to be, respectively 0.5 and 0.3. Also, if the company wins one bid, his chance of winning the other bid is reduced to one-half of the original probability.
a) What is the probability of Company E winning at least one of its bids?
b) If company E wins at least of one of its bids, what is the probability that it will be for project A and not Project B?
c) If company E is awarded only one project, what is the probability that it will be Project A?

Furthermore, on the basis of past performance, it is estimated that the probability of Company E completing Project A within a target time is 0.75, whereas, if another company is awarded the project, the probability of on-time completion of project A is only 0.5.

d) What is the probability that project A will be completed on time?
e) If the project A is completed on time, what is the probability that it was done by Company E?

2. Mammograms are frequently used to screen women for breast cancer, while this procedure exposes patients to radiation. Because of this exposure, mammograms has long been a topic for heated arguments particularly because the false-positive (the test result says positive while the patient does not have cancer) ratios are high. In general the more mammograms a woman has, the more likely she is to have a false positive result. When a false-positive is obtained, then patients are recommended for more follow-up tests and screening. Hence the justification of the radiation taken during breast cancer screening should be investigated very carefully.
When a woman truly has cancer, the chances that mammogram will result in a positive result is 95% while 5% of the time false-positive results are obtained (positive mammogram results obtained from truly cancer-free patients). Based on a recent study has analyzed 170,000 women between the ages of 40 and 59 and found 4,500 women to have invasive breast cancer (i.e. these are not mammogram results, but instead true! cancer results). Based on these data,
a) If a patient receives a positive mammogram result, what are the chances that she truly has cancer?
b) If a patient receives two positive mammogram results (independent tests), what are the chances that she truly has cancer? (Hint: consider the cases that the patient has true cancer during either tests as cancer; or consider the patient is cancer free only if she does not have true cancer during either tests).
c) If a patient receives three positive mammogram results (independent tests), what are the chances that she truly has cancer? (same hint applies above).

3. Water for a city is supplied from two sources; namely, Source A and Source B. During the summer season, the probability that the supply from Source A will be below normal is 0.30; the corresponding probability for Source B is 0.15. However, if Source A is below normal, the probability that Source B will also be below normal during the same summer season is increased to 0.30.
The probability of water shortage in the city will obviously depend on the supplies from the two sources. The probability that there will be water shortage given Source B is providing water at normal rates but Source A is below normal is 0.20; the probability that there will be water shortage given Source A is providing water at normal rates but Source B is below normal is 0.25; the probability that there will be water shortage given none of the sources are below normal is 0 (both are supplying water at normal rates); the probability that there will be water shortage given both sources are providing water at rates below normal is 0.80.

During a summer season, determine the following:
a) The probability that there will be below normal supply of water from either or both sources.
b) The probability that only one of the two sources will be below normal supply.
c) The probability of water shortage in the city during the summer season.
d) If the water shortage should occur in the city, what is the probability that it was caused by below normal supplies from both sources?
e) If there is no water shortage in the city during the summer, what is the probability there was normal supply from Source A?

4. Based on past measurements made between 1900 and 2013, spring discharge of Dream River is normally distributed with mean 675 m^3/sec and standard deviation 200 m^3/sec. Heavy majority the water sources of Dream River is used for irrigation, power generation or released to downstream countries, while the dams built over this Dream River will be filled only if the spring discharge is above 1075 m^3/sec.
a) Assuming you are responsible for the forecasts of water levels at local dams built on Dream River, what are the chances that these dams will be filled in 2014 (discharge > 1075)?
b) What are the chances that the spring discharge of Dream River will be between 425 m^3/sec and 925 m^3/sec?
c) What should be threshold for the spring discharge (instead of 1075), if it is desired that the dams will be filled on average only one-in-three years (Probability = 0.33).
d) What are the differences between Normal distribution and Standard Normal Distribution?