1. (25%) A random sample of 100 recorded deaths in a city showed an average life span of 71.8 years and a standard deviation of 8.9 years.
   (a) Estimate a 90% confidence interval for the mean life span of the city.
   (b) Test the hypothesis that the mean life span is greater than 70 years at the significance level of 0.05.

   (Hint: the critical value $z_{0.05}$=1.645 and $t_{0.05}$=1.661 with the 99 degrees of freedom)

2. (25%) Given $N$ data points $(x_i, y_i)$, $i = 1 \sim N$, we want to determine a circle that best describes the observed data. Formulate the least-squares circle fit to find the center and radius of the circle using a multiple linear regression model.

3. Consider a probability space consisting of the sample space $\Omega = \{(k, m): k, m \in Z^+\}$, i.e., all pairs of positive integers, where the set of events is the power set of $\Omega$, and the probability measure is defined by assigning probabilities to points in the sample space such that:

$$P\big((k, m)\big) = p^2(1-p)^{k+m-2}, \text{ for } 0 < p < 1$$

(a) Find P({(k,m):k≧m}).(10%)
(b) Find the probability P({(k,m): k+m=r}) as a function of r for r=2,3,... (10%)
(c) Find the probability P({(k,m): k is an odd number}) (10%)

4. A number x is selected at random in the interval [-1, 1]. Let the event A={x<0}, B={|x-0.5|<1}, and C={x>0.75}.

(a) Find the probabilities of B, A∩B, and A∩C (10%)
(b) Find the probabilities of A∪B, A∪C, and A∪B∪C (10%)