IT3030 midterm exam #2 May 18, 2015 ID: ______________ Name: __________

1. (25%) In a particular city, the average number of suicides (自殺) reported each month is 2.75. Assume that the number of suicides follows a Poisson distribution.

(a) (5%) What is the probability that <u>no suicides</u> will be reported during a given month?

(b) (5%) What is the probability that <u>four or more</u> suicides will be reported?

(c) (5%) What is the probability that <u>six or more</u> suicides be reported?

(d) (10%) Graph a probability distribution ranging from 0 to 10 suicides (a bar chart).

[Hint: Recall that, for an incident (like suicide mentioned in this problem) occurring at a probability of p, the average number of people involved among a population of n people would be np, which is the same as the parameter λ used in a Poisson distribution with the formula shown below. Useful MATLAB functions include poisspdf, poisscdf and poissinv.]

$$P(X=x)=\frac{e^{-\lambda}\lambda^{x}}{x!}$$

Answer:

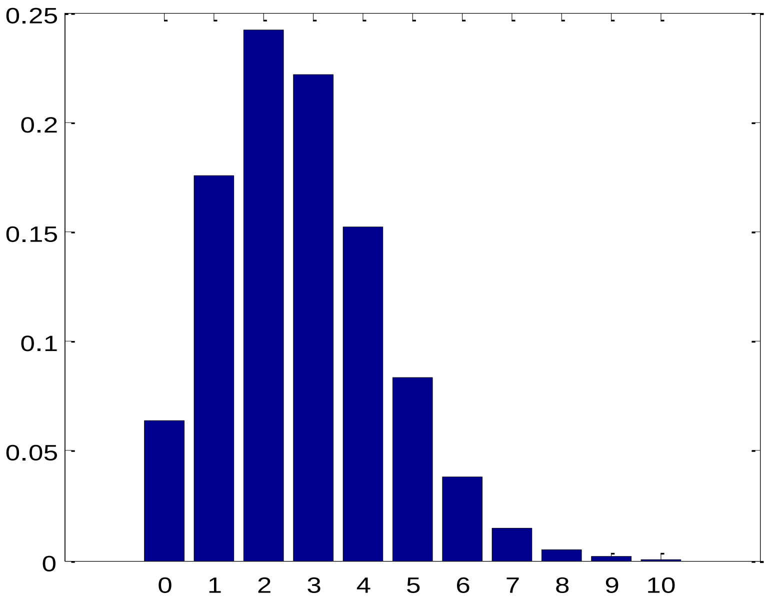
P(X=x) = [exp(-lambda)*(lambda)^x] / x! = poisspdf(x, lambda)

(a) poisspdf(0, 2.75) = 0.0639.

(b) 1 - poisscdf(3, 2.75) = 0.2970

(c) 1 - poisscdf(5, 2.75) = 0.0608

(d) >> x=0:10; >> y=poisspdf(x,2.75); >> bar(x,y)



2. (35%) For the population of adult males in the United States, the distribution of weights is approximately normal with μ = 172.2 pounds and standard deviation σ = 29.8 pounds.
(a) (10%) Considering the sampling distribution of the means of samples of n = 25 that are randomly drawn from this population. What is the mean value and standard deviation for this sampling distribution?
(b) (5%) What is the upper bound for 90% of the mean weights of samples size 25?
(c) (5%) What is the lower bound for 80% of the mean weights?
(d) (15%) Build the 95% confidence interval of weight for this population with sampling size of 10, 25 and 50, respectively.
[Hint: The sampling distribution of the means is a normal distribution with a standard deviation of σ/sqrt(n). Useful MATLAB functions include normpdf, normcdf and norminv.]

Answer:
(a) The mean value will be the same as the mean weight for the population, which is 172.2. The standard deviation would be 29.8 / sqrt(n) = 5.96
(b) norminv(0.95, 172.2, 5.96) = 182.0033
(c) norminv(0.1, 172.2, 5.96) = 164.5620
(d) For n = 25, the lower bound is norminv(0.025, 172.2, 5.96) = 160.5186. The upper bound is norminv(0.975, 172.2, 5.96) = 183.8814.
For n = 10, the lower bound is norminv(0.025, 172.2, 29.8/sqrt(10)) = 153.7301. The upper bound is norminv(0.975, 172.2, 29.8/sqrt(10)) = 190.6699.
For n = 50, the lower bound is norminv(0.025, 172.2, 29.8/sqrt(50)) = 163.9400. The upper bound is norminv(0.975, 172.2, 29.8/sqrt(50)) = 180.4600.

3. (40%) Maximum breadth (寬度) of twelve male Egyptian skulls (埃及人的頭骨) from 4000 B.C. (公元前) were listed as 131, 119, 138, 125, 129, 126, 131, 132, 126, 128, 128 and 131 millimeters. Also known are the maximum skull breadth for 12 Egyptians from 150 A.D (公元後) as 136, 130, 126, 126, 139, 141, 137, 138, 133, 131, 134 and 129 millimeters.

(a) (10%) Compute the mean value and standard deviation of maximum skull breadth for these 12 Egyptians from 4000 B.C.

(b) (10%) Construct a 95% confidence interval for the mean value based on statistics from part (a).

(c) (5%) Compute the mean value of maximum skull breadth for these 12 Egyptians from 150 A.D. and determine whether the head sizes appear to have changed from 4000 B.C. to 150 A.D. Explain your result.

(d) (5%) Build a null hypothesis that the 150 A.D. skulls are of the same average size as the 4000 B.C. skulls. Given the sample mean and standard deviation of skull size of the 12 samples from 4000 B.C., determine the t-value for the 150 A.D. mean skull size you computed in part (c).

(e) (5%) Given the level of significance of 0.05 for the hypothesis test, compute the p-value and determine whether you should reject the null hypothesis or not.

(f) (5%) What would be the minimum of 150 A.D. mean skull size for not rejecting the null hypothesis?

[Hint: Useful MATLAB functions include mean, std, tpdf, tcdf, tinv.]

Answer:

(a) x=[131, 119, 138, 125, 129, 126, 131, 132, 126, 128, 128, 131];

>> mu = mean(x) = 128.6667

>> S = std(x) = 4.6384

(b) Since n = 12, the degree of freedom is 11.

Lower bound of the 95% CI based on t-distribution is mu + tinv(0.025, 11)*S/sqrt(12) = 125.7195.

The upper bound is mu + tinv(0.975, 11)*S/sqrt(12) = 131.6138.

(c) y = [136, 130, 126, 126, 139, 141, 137, 138, 133, 131, 134, 129]

mean(y) = 133.3333. Note that this mean value of 150 A.D. Egyptians is outside of the upper bound of 95% CI of 4000 B.C. Egyptians. This suggests that 150 A.D. skulls are not having a comparable size as the 4000 B.C. skulls. In fact, the head size grows.

(d) >> t=(133.3333-mu)/(S/sqrt(12)) = 3.4852

(e) >> 1-tcdf(t,11) = 0.0026. Remember we are testing whether the two sizes are the same. In other words, this is a 2-tailed test, which would give a p-value twice the amount of 0.0026, which is 0.0052. Still this is smaller than 0.05, suggesting a rejection of the null hypothesis. That is, the head size differs significantly.

(f) mu + tinv(0.975, 11)*S/sqrt(12) = 131.6138.