**Quiz #4 (open book, open note) Name: JERRY JACOB**

**Business Analytics, Fall 2016**

1. (4 points) A particular car engine has 4 cylinders. Each cylinder consists of a piston that must fit into a sleeve. Due to inevitable variations in manufacturing processes, the diameters of pistons and sleeves vary somewhat. The diameter of a sleeve, denoted S, is normally distributed with a mean of 0.5010 inches and a standard deviation of 0.0002 inches. The diameter of a piston, denoted P, is normally distributed with a mean of 0.5 inches and a standard deviation of 0.0002 inches. The critical dimension is the clearance between the piston and the sleeve, defined as

Clearance = C = S - P.

The design specification for clearance is that C must lie between 0.0007 and 0.0013 inches (in other words, 0.001 + 0.0003 inches). In quiz 3 you showed that the proportion of cylinders assembled that meet these design specifications if pistons and sleeves are matched at random is 0.711 (71.1%).

Assuming that cylinders are randomly chosen to be assembled into engines, what is the probability that all 4 cylinders chosen for a particular engine will be within design spec? (Hint: Let N = the # of the 4 cylinders that meet design specs. What kind of distribution does N follow and what are its parameters?)

N follows binomial distribution with parameters n=4 and p=0.711

Mean = p = 0.711

Standard Deviation = sqrt(n\*p\*(1-p)) = 0.821916

1. (4 points) Recall problem 8 from problem Set #4:

Consider workers 1 and 2 as described in parts b and c of the problem.

What is the probability that worker 1 is idle for 5 or more seconds due to being blocked?

**Let T denote the time of the first worker and S denote the time of the second worker. Worker 2 finishes 5 seconds earlier if and only if S > T which is equivalent to S – T > 5.**

**Let W = S - T. W is a weighted sum of random variables where the weight on S is +1 and the weight on T is -1. W is, therefore, normally distributed with**

**Mean = 70 - 60 = 10**

**Variance = 16 + 56 = 72**

**Standard deviation = sqrt(72) = 8.49 (approximately)**

**P(W>5) = 1 - P(W<=5)**

**= 1 - NORMDIST(5, 10, 8.49, 1)**

**= 1 - 0.277955**

**= 0.722045**

What is the probability that worker 2 is idle for 5 or more seconds due to being starved?

**P(W<=5) = NORMDIST(5, 10, 8.49, 1)**

**= 0.277955**

3. (2 points) Recall problem 6 from problem set #5: Skateboards are assembled in a particular manufacturing plant on an assembly line by three workers. Worker 1 performs the first three assembly steps. We have collected the following 10 observations of the time (in seconds) it takes worker 1 to perform his three assembly steps. Assume that a sample size of 10 is large enough for the Central Limit Theorem to apply.

|  |
| --- |
| 12.26 |
| 12.25 |
| 15.59 |
| 11.09 |
| 19.17 |
| 10.99 |
| 12.10 |
| 15.24 |
| 13.50 |
| 15.17 |

Construct a 95% confidence interval about the mean of the sampling distribution.

**Mean of the sample: 13.736  
Std. Deviation of the sample: 2.427856  
Std. Error: 0.767755  
NORMSINV(.975) = 1.959964  
Confidence Interval = Mean +- (1.959964\*0.767755)  
= [13.736 - 1.504772, 13.736 + 1.504772]  
= [12.23123, 15.24077]**