

TUFTS UNIVERSITY  
Medical School

Prof. M. Bianconi; CMBA0264-01; Statistics with Applications; Summer 2009; July 21, 2009

**MID-TERM EXAMINATION – Partial Answer Key**

1. (i). A late 80's study showed that 75% of all journalists used computers and 85% used type writers, and 60% used both. What is the probability that a journalist will use at least one of those? Explain in one line the result.

**Point of problem is to know the addition rule of probabilities:**

$$P(C)=0.75$$

$$P(TW)= 0.85$$

$$P(C \text{ Inters } TW)=0.60$$

$$P(C \text{ Union } TW) = P(C) + P(TW) - P(C \text{ Inters } TW) = 1$$

**All journalists use either a computer, or a typewriter or both.**

(ii)  $X$  units of 'shmoos' is a random variable that follows a normal distribution with mean 1,200 units and variance 10,000.

What is the probability that a random draw from this population will fall in between 1,100 and 1,300 'shmoos?'

$$P(1100 - 1200 / \sqrt{10,000} < Z < 1300 - 1200 / \sqrt{10,000}) = P(-1 < Z < 1)$$

$$= Fz(1) - (1 - Fz(1)) = 2Fz(1) - 1 = 0.6828 \text{ (table or mental accounting)}$$

2. Assume that you designed a clever test to measure the effectiveness of written communication, and know that on a scale of 0-100 the standard deviation is 11.3. You apply the test to a random sample of 352 professionals and the sample mean score of the test is 60.

(i) Find a 90% confidence interval for the population mean score of the test.

$$n=352,$$

$$\bar{x}=60;$$

$$sig=11.3;$$

$$1-\alpha=0.9; \alpha=0.1; \alpha/2=0.05$$

$$P(\bar{x} - z \alpha/2 sig/ \sqrt{n} < \mu < \bar{x} + z \alpha/2 sig/ \sqrt{n}) = 1 - \alpha$$

$z_{\alpha/2} = 1.645$  (from table or mental accounting)

interval is  $\bar{x} \pm 0.9907$  == ~ 59---61

(ii) Explain how you might evaluate the results of the test, in one line only.

**Since the CI is so tight, the sample mean is a fine threshold, anything above sample mean would be a good score.**

5. Briefly explain the three main properties of a point estimator.

**Let a population parameter be  $\theta$ , and the point estimator be  $\hat{\theta}$ :**

**Unbiasedness:  $E[\hat{\theta}] = \theta$ ; on average the estimator is equal to the population parameter.**

**Consistency: As the sample size gets larger, the estimator converges to the true population parameter.**

**Efficiency: In the class of unbiased estimators, the more efficient has the lower variance.**

6. A random sample of 590 consumers was asked to respond on a scale from one (strongly disagree) to five (strongly agree) to the assertion that “a limit should be placed on the amount of punitive damages awarded for product liability.” The sample mean response was 3.0 and the sample standard deviation was 1.4.

(i) Test, at the 5% significance level, the null hypothesis that the population mean is at least 3.75 against the alternative of less than 3.75.

$$Z^* = 3 - 3.75/1.4/\sqrt{590} = -13.0125 < z(0.05) = -1.645$$

**Reject null at 5% level.**

(ii) According to your result in (a) and the sample results, what is your assessment of the support or not for this assertion in the population?

**The null is rejected that the majority agree with the assertion. No statistical evidence consumers support the measure.**

Selected Z-Values

$\alpha$	0.01	0.02	0.05	0.10
$Z_{\alpha/2}$	2.58	2.33	1.96	1.645
Confidence Level	99%	98%	95%	90%
Significance Level	1%	2%	5%	10%