# HS 167 Exam 2—April 17, 2007

Name: _____

**Instructions:** (1) Answer questions in your blue book. *Remember to number each response.* (2) Write your name on your blue book and on this test. (3) You are allowed to use your calculator and formulas sheets with tables. (4) Time limit: 1¼ hours. (5) Each question is worth one point unless otherwise noted. Best of luck! (*Chance favors the prepared mind*. Oliver Wendell Holmes)

## Introduction to confidence intervals

1) Multiple choice [M/C]: In lab you found that the population you sampled was not Normal, but that the distribution of means from SRSs from the population tended to distribute themselves Normally. This was an effect the:

   (a) Law of large numbers (b) Square root law

   (c) Central limit theorem (d) None of the above

2) [M/C]: The average of the sampling distribution of a mean is equal to:

   (a) $\mu$ (b) $\bar{x}$ (c) $\sigma/\sqrt{n}$ (d) none of the above

3) [M/C]: The standard deviation of a sampling distribution of a mean is equal to:

   (a) $\sigma$ (b) $s$ (c) $\sigma/\sqrt{n}$ (d) none of the above

4) [M/C]: Which is the most precise reflection of a population mean?

   (a) An individual observation drawn at random from the population

   (b) A sample mean based on an SRS of $n = 10$

   (c) A sample mean based on an SRS of $n = 30$

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**The next five questions address a sample from a population that has a Normal distribution with $\mu = 100$ and $\sigma = 15$.**

5) What is the standard error of a mean based on 25 observations? (numerical answer)

6) What is the margin of error for a 95% confidence interval for $\mu$ when based on $n = 25$? (numerical answer)

7) A sample based on $n = 25$ reveals $\bar{x} = 97$. What is the *lower* confidence limit for the 95% confidence interval for $\mu$ based on this sample? (numerical answer)

8) What is the upper confidence limit for the 95% confidence interval? (numerical answer)

9) Did your confidence interval capture $\mu$? (Yes or no.)

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10) In the long run, what percentage of 95% confidence intervals for μ will fail to capture μ?

11) What percentage of 95% confidence intervals for μ will fail to capture $\bar{x}$ ?

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**The next four questions address a sample of *n* = 30 in which $\bar{x}$ = 40 and *s* = 12.**

12) What is the standard error of the mean for these data?

13) How many *df* does the *t* value have for these data? What is the value of *t* for 95% confidence? [2 pts]

14) What is the *lower* limit of the 95% confidence interval for μ?

15) What is the *upper* limit of the 95% confidence interval for μ?

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## Introduction to hypothesis tests

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**This first series of questions address this hypothetical situation:**

16) A sample of 9 individuals from a population with a Normal distribution, μ = 100 and σ = 15 will have a standard error of 5. Based on this information, what percentage of sample means will be greater than 110?

17) You want to test $H_0$: μ = 100 from this population. What is the two-sided alternative hypothesis?

18) Your sample of *n* = 9 shows $\bar{x}$ = 108. Calculate the test statistic for this problem.

19) Determine the one-sided *P* value for the problem.

20) Determine the two-sided *P* value for the problem.

21) Interpret the two-sided *P* value. Is the evidence it provides against $H_0$ significant?

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22) You have decided to reject a null hypothesis that is in fact true. Therefore, you have made
(a) a type I error (b) a type II error (c) the correct decision

23) You have decided to retain a null hypothesis that is in fact true. Therefore, you have made
(a) a type I error (b) a type II error (c) the correct decision

24) A *P* value of 0.07 provides evidence against the null hypothesis that is:
a) not significant
b) marginally significant
c) significant
d) highly significant

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**We want to test whether a population gains weight. A sample of 25 individuals from this population finds an average weight gain 0.75 pounds with standard deviation 1.3 pounds.**

25) Write the *null* hypothesis for this problem.

26) Calculate the standard error of the mean.

27) Calculate the test statistic to address the null hypothesis.

28) How many degrees of freedom are associated with the test statistic?

29) What is the two-sided *P* value for this problem?

30) Interpret your test results.

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## Paired samples

31) What are *paired samples*? (One sentence narrative response.)

32) [M/C] This is the probability of *avoiding* a type II error:

a) alpha b) confidence c) beta d) power

33) $\Phi(-0.23) = ?$

34) [M/C] Increasing the size of sample will do this to the power of a study.

(a) increase it (b) decrease it (c) have no effect

35) Decreasing the difference worth detecting in a study will do this to the power of a study.

(a) increase it (b) decrease it (c) have no effect

36) [M/C] The box labeled "36" in this table represents a:

(a) type I error (b) type II error (c) correct decision

| | $H_0$ true | $H_1$ true |
|---|---|---|
| Retain $H_0$ | | "36" |
| Reject $H_0$ | | |

37) Does a confidence for a mean difference based on paired samples try to locate $\bar{x}_d$ or $\mu_d$?

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The remaining questions address these nine paired difference data points ("DELTAs"):

7 8 −4 −2 3 4 4 6 3

38) Plot these data points (in your blue book) as a stemplot with a stem that looks something like this:

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|−0|
|−0|
| 0|
| 0|
 ×10
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39) Does the sample distribution show any clear departures from Normality? (Yes or no).

40) What is the value of *t* when calculating a 95% confidence interval for μ?

Here's output for this problem from SPSS:

**One-Sample Statistics**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| VAR00001 | 9 | 3.2222 | 3.96162 | 1.32054 |

**One-Sample Test**

| | Test Value = 0 | | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | |
| | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| VAR00001 | 2.440 | 8 | .041 | 3.22222 | .1771 | 6.2674 |

41) What is the null hypothesis addressed by the above *t* statistic?

42) Draw a *t* density curve in your blue book. Place the $t_{stat}$ on your curve and shade the area under the curve corresponding to the two-sided *P* value.

43) The evidence against the null hypothesis for this problem is

a) insignificant

b) marginally significant

c) significant

d) highly significant

44) Report the confidence interval for $\mu_d$ with 2 decimal place accuracy.