ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ — ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

Statistics for Business **Fall Semester 2026–2027**

Assignment 2

(Release Date: 08/09/2026)

Answer the following questions and hand in your answers by **Monday, September 14, 2026**. These should **handwritten**, scanned and sent electronically (via E-mail at pkonstantinou.aueb@gmail.com). Please make sure that your files are in PDF format and that they do not exceed 8MB in size, otherwise the server might block them!

Sampling Distributions

1. The annual expenditure of firms on a particular service is normally distributed with population mean $\mu = 120$ and population standard deviation $\sigma = 18$. A random sample of $n = 36$ firms is selected.

   (a) Find $E(\bar{X})$.

   (b) Find $Var(\bar{X})$ and $SE(\bar{X})$.

   (c) Find $\Pr(115 < \bar{X} < 125)$.

2. The distribution of daily sales at a store is strongly right-skewed, with population mean $\mu = 80$ and population standard deviation $\sigma = 24$. A random sample of $n = 144$ days is selected.

   (a) State the approximate sampling distribution of $\bar{X}$.

   (b) Find $\Pr(\bar{X} < 84)$.

3. A population has mean $\mu = 100$ and standard deviation $\sigma = 20$. Consider samples of sizes $n = 25$, $n = 100$, and $n = 400$.

   (a) Compute $SE(\bar{X})$ for each sample size.

   (b) Using the normal approximation, compute

   $$\Pr(|\bar{X} - \mu| < 4)$$

   for each sample size.

   (c) What happens to the sampling distribution as n increases?

Confidence Intervals

4. A normal population has known standard deviation $\sigma = 16$. A random sample of $n = 64$ observations gives
$$\bar{X} = 75.$$
Construct a 95% confidence interval for μ.

5. A sample of $n = 225$ observations has provided us with
$$\bar{X} = 120, \qquad s = 30.$$
Construct:
   (a) a 90% confidence interval for μ;
   (b) a 95% confidence interval for μ;
   (c) a 99% confidence interval for μ.
   (d) Discuss the width of the confidence intervals.

6. A random sample of $n = 16$ observations from a normal population has given us
$$\bar{X} = 40, \qquad s = 8.$$
Construct a 95% confidence interval for μ.

7. Two independent samples of size n_1 and n_2 give
$$n_1 = 100, \quad \bar{X}_1 = 50, \quad s_1 = 10,$$
$$n_2 = 144, \quad \bar{X}_2 = 46, \quad s_2 = 12.$$
Construct a 95% confidence interval for
$$\mu_1 - \mu_2.$$

8. Two independent normal populations are assumed to have equal but unknown variances. Taking two samples, one from each population, are observed the following:
$$n_1 = 15, \quad \bar{X}_1 = 25.4, \quad s_1 = 4.2,$$
$$n_2 = 12, \quad \bar{X}_2 = 22.1, \quad s_2 = 3.8.$$
Assuming that the populations are normal with equal variances, construct a 95% confidence interval for $\mu_1 - \mu_2$.

9. A firm measures employee processing time before and after a training program. Define the paired difference as

$$d_i = \text{After}_i - \text{Before}_i.$$

For a sample of $n = 8$ employees, the sample mean and standard deviation of the differences are

$$n = 8, \qquad \bar{d} = -3.5, \qquad s_d = 4.0.$$

Construct a 95% confidence interval for the population mean difference μ_d.

Hypothesis Tests

10. A company claims that the mean output per worker is no more than 100 units. A researcher believes that the mean is higher. Assume the population standard deviation is known to be $\sigma = 12$. A random sample of $n = 36$ workers gives

$$\bar{X} = 104.$$

Test at the 5% significance level:

$$H_0 : \mu \leq 100, \qquad H_1 : \mu > 100.$$

11. The mean number of subscriptions per household is claimed to be 3. Assume the population standard deviation is known to be $\sigma = 0.6$. A sample of $n = 100$ households gives

$$\bar{X} = 2.88.$$

Test

$$H_0 : \mu = 3, \qquad H_1 : \mu \neq 3$$

at the 5% level.

12. Suppose a process is designed to produce a mean output of 500 units. The population standard deviation is known to be $\sigma = 50$. A sample of 100 observations gives

$$\bar{X} = 512.$$

   (a) Test $H_0 : \mu = 500$ against $H_1 : \mu \neq 500$.
   (b) Compute the p-value.
   (c) State the conclusion at the 5% and 1% significance levels.

13. A researcher wishes to test whether mean annual earnings equal 60,000. A sample of $n = 400$ individuals gives

$$\bar{X} = 61{,}800, \qquad s = 18{,}000.$$

Test

$$H_0 : \mu = 60{,}000, \qquad H_1 : \mu \neq 60{,}000$$

at the 5% significance level.

14. A normal population has unknown variance. A random sample of $n = 16$ gives

$$\bar{X} = 42, \qquad s = 8.$$

Test

$$H_0 : \mu = 38, \qquad H_1 : \mu \neq 38$$

at the 5% significance level.

15. Two independent random samples give the following results:

$$n_1 = 100, \quad \bar{X}_1 = 82, \quad s_1 = 10,$$
$$n_2 = 120, \quad \bar{X}_2 = 78, \quad s_2 = 12.$$

Test

$$H_0 : \mu_1 - \mu_2 = 0, \qquad H_1 : \mu_1 - \mu_2 \neq 0$$

at the 5% level.

16. Two independent normal populations are assumed to have equal but unknown variances. The following samples are observed:

$$n_1 = 15, \quad \bar{X}_1 = 25.4, \quad s_1 = 4.2,$$
$$n_2 = 12, \quad \bar{X}_2 = 22.1, \quad s_2 = 3.8.$$

Test

$$H_0 : \mu_1 - \mu_2 = 0, \qquad H_1 : \mu_1 - \mu_2 \neq 0$$

at the 5% level.

17. A firm measures employee processing time before and after a training program. Define the paired difference as

$$d_i = \text{After}_i - \text{Before}_i.$$

For $n = 8$ employees, the sample mean and standard deviation of the differences are

$$\bar{d} = -3.5, \qquad s_d = 4.0.$$

Test whether the training changed mean processing time:

$$H_0 : \mu_d = 0, \qquad H_1 : \mu_d \neq 0$$

at the 5% significance level.