

Sample Size Questions

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15d, 16d, 17d, 18b

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23, 24, 25, 26

NOTE: On this page, part “a” you assume the spread is 50-50, and in Part “b” they give you the known percentages.

ESTIMATING SAMPLE SIZE FOR AVERAGES (P. 370)

The formula for these problems is $n = \left(\frac{z_c \cdot s}{E}\right)^2$

You will also use the inset in your z-table:

Areas of a Standard Normal Distribution *continued*

(b) Confidence Interval
Critical Values z_c

Level of Confidence c	Critical Value z_c
0.70, or 70%	1.04
0.75, or 75%	1.15
0.80, or 80%	1.28
0.85, or 85%	1.44
0.90, or 90%	1.645
0.95, or 95%	1.96
0.98, or 98%	2.33
0.99, or 99%	2.58

Problem 15

Zoology: Hummingbirds Allen's hummingbird (*Selasphorus sasin*) has been studied by zoologist Bill Alther (Reference: *Hummingbirds*, K. Long and W. Alther). A small group of 15 Allen's hummingbirds has been under study in Arizona. The average weight for these birds is $\bar{x} = 3.15$ grams. Based on previous studies, we can assume that the weights of Allen's hummingbirds have a normal distribution, with $\sigma = 0.33$ gram.

- (d) **Sample Size** Find the sample size necessary for an 80% confidence level with a maximal error of estimate $E = 0.08$ for the mean weights of the hummingbirds.

For 80% confidence, $Z_c = 1.28$

$$\left(\frac{1.28 * .33}{.08}\right)^2 = 27.8784$$

... Round answer UP, so 28

Problem 16

Diagnostic Tests: Uric Acid Overproduction of uric acid in the body can be an indication of cell breakdown. This may be an advance indication of illness such as gout, leukemia, or lymphoma (Reference: *Manual of Laboratory and Diagnostic Tests*, F. Fischbach). Over a period of months, an adult male patient has taken eight blood tests for uric acid. The mean concentration was $\bar{x} = 5.35$ mg/dl. The distribution of uric acid in healthy adult males can be assumed to be normal, with $\sigma = 1.85$ mg/dl.

- (d) **Sample Size** Find the sample size necessary for a 95% confidence level with maximal error of estimate $E = 1.10$ for the mean concentration of uric acid in this patient's blood.

For 90% confidence, $Z_c = 1.96$

$$\left(\frac{1.96 * 1.85}{1.1}\right)^2 = 10.86601322$$

... 11

Problem 17

Diagnostic Tests: Plasma Volume Total plasma volume is important in determining the required plasma component in blood replacement therapy for a person undergoing surgery. Plasma volume is influenced by the overall health and physical activity of an individual. (Reference: See Problem 12.) Suppose that a random sample of 45 male firefighters are tested and that they have a plasma volume sample mean of $\bar{x} = 37.5$ ml/kg (milliliters plasma per kilogram body weight). Assume that $\sigma = 7.50$ ml/kg for the distribution of blood plasma.

- (d) **Sample Size** Find the sample size necessary for a 99% confidence level with maximal error of estimate $E = 2.50$ for the mean plasma volume in male firefighters.

For 99% confidence, $Z_c = 2.58$

$$\left(\frac{2.58 \cdot 7.5}{2.5}\right)^2 = 59.9076$$

... 60

Problem 18

Agriculture: Watermelon What price do farmers get for their watermelon crops? In the third week of July, a random sample of 40 farming regions gave a sample mean of $\bar{x} = \$6.88$ per 100 pounds of watermelon. Assume that σ is known to be \$1.92 per 100 pounds (Reference: *Agricultural Statistics*, U.S. Department of Agriculture).

- (b) **Sample Size** Find the sample size necessary for a 90% confidence level with maximal error of estimate $E = 0.3$ for the mean price per 100 pounds of watermelon.

For 90% confidence, $Z_c = 1.645$

$$\left(\frac{1.645 \cdot 1.92}{.3}\right)^2 = 110.838784$$

... 111

ESTIMATING SAMPLE SIZE FOR PERCENTAGES (P. 398)

The formula for these problems is $\hat{p} \cdot \hat{q} \left(\frac{z_x}{E}\right)^2$

Problem 23

Medical: Blood Type A random sample of medical files is used to estimate the proportion p of all people who have blood type B.

- (a) If you have no preliminary estimate for p , how many medical files should you include in a random sample in order to be 85% sure that the point estimate \hat{p} will be within a distance of 0.05 from p ?
- (b) Answer part (a) if you use the preliminary estimate that about 8 out of 90 people have blood type B. (Reference: *Manual of Laboratory and Diagnostic Tests*, F. Fischbach.)

For 85% confidence, $Z_c = 1.44$

```
.5*.5(1.44/.05)2
207.36
```

a. 208

```
8/90
.0888888889
1-Ans
.9111111111
.09*.91(1.44/.05
)2
67.931136
```

b. 68

NOTE: You first have to find \hat{p} and \hat{q} . Then work out the formula. You may get a slightly different answer due to rounding, but it still rounds up to 68.

Problem 24

Business: Phone Contact How hard is it to reach a businessperson by phone? Let p be the proportion of calls to businesspeople for which the caller reaches the person being called on the *first* try.

- If you have no preliminary estimate for p , how many business phone calls should you include in a random sample to be 80% sure that the point estimate \hat{p} will be within a distance of 0.03 from p ?
- The *Book of Odds*, by Shook and Shook (Signet), reports that businesspeople can be reached by a single phone call approximately 17% of the time. Using this (national) estimate for p , answer part (a).

```
.5*.5(1.28/.03)2
      455.1111111
.17*.83(1.28/.03
)2
      256.8647111
```

Part "a" is 456, and Part "b" is 257

Problem 25

Campus Life: Coeds What percentage of your campus student body is female? Let p be the proportion of women students on your campus.

- If no preliminary study is made to estimate p , how large a sample is needed to be 99% sure that a point estimate \hat{p} will be within a distance of 0.05 from p ?
- The *Statistical Abstract of the United States*, 112th Edition, indicates that approximately 54% of college students are females. Answer part (a) using this estimate for p .

```
.5*.5(2.58/.05)2
      665.64
.54*.46(2.58/.05
)2
      661.379904
```

Part "a" is 666, and Part "b" is 662.

Problem 26

Small Business: Bankruptcy The National Council of Small Businesses is interested in the proportion of small businesses that declared Chapter 11 bankruptcy last year. Since there are so many small businesses, the National Council intends to estimate the proportion from a random sample. Let p be the proportion of small businesses that declared Chapter 11 bankruptcy last year.

- (a) If no preliminary sample is taken to estimate p , how large a sample is necessary to be 95% sure that a point estimate \hat{p} will be within a distance of 0.10 from p ?
- (b) In a preliminary random sample of 38 small businesses, it was found that six had declared Chapter 11 bankruptcy. How many *more* small businesses should be included in the sample to be 95% sure that a point estimate \hat{p} will be within a distance of 0.10 from p ?

$$.5 * .5 (1.96 / .1)^2$$
$$96.04$$

a.

97

$$6/38$$
$$.1578947368$$
$$1 - \text{Ans}$$
$$.8421052632$$
$$.16 * .84 (1.96 / .1)^2$$
$$51.631104$$

b.

You need 52 total

NOTE: Since the question asks “how many more”, you should technically take $52 - 38$, so the answer the book wants is 14. (You don’t need to worry about a question like that, but you will have to find the total number needed.)