

## Book Assignment: Z-Intervals & T-Intervals

### PAGE 370 (Z-Intervals)

15a, 17a, 19, 22

### PAGE 383 (T-Intervals)

13b, 14b, 15b, 16b

NOTE: You will use the answers given in Part “a” as your calculator input for Part “b”.

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## Z-INTERVAL PROBLEMS (P. 370)

### Problem 15

NOTE: Even though 15 is a small sample, it is reasonable to use a **z-interval** because we know the standard deviation for the population.

*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.

(a) Find an 80% confidence interval for the average weights of Allen’s hummingbirds in the study region. What is the margin of error?

Go to STAT → TESTS → Z-Interval

```
EDIT CALC TESTS
1: Z-Test...
2: T-Test...
3: 2-SampZTest...
4: 2-SampTTest...
5: 1-PropZTest...
6: 2-PropZTest...
7: ZInterval...
```

IMPORTANT: If “Data” is highlighted on your calculator, you will need to use the right arrow to highlight “Stats”, and then press ENTER. (Once you’ve switched to Stats, it should remain the default.)

```
TInterval
Inpt: Stats
List: L1
Freq: 1
C-Level: .95
Calculate
```

Once "Stats" is highlighted, enter the information you are given:

```
ZInterval
Inpt:Data Stats
σ: .33
x̄: 3.15
n: 15
C-Level: .8
Calculate
```

The answer screen looks like this:

```
ZInterval
(3.0408, 3.2592)
x̄=3.15
n=15
```

The main answer is what's in the parentheses: (3.0408 , 3.2592), which means hummingbirds should have an average weight between 3.0 and 3.3 grams.

The problem also asks to find the margin of error. Take upper bound of interval -  $\bar{x}$ .

```
3.2592-3.15
.1092
```

## 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.

(a) Find a 99% confidence interval for the population mean blood plasma volume in male firefighters. What is the margin of error?

```
ZInterval
Inpt:Data Stats
σ: 7.5
x̄: 37.5
n: 45
C-Level: .99
Calculate
```

```
ZInterval
(34.62, 40.38)
x̄=37.5
n=45
```

```
40.38-37.5
2.88
```

## Problem 19

**FBI Report: Larceny** Thirty small communities in Connecticut (population near 10,000 each) gave an average of  $\bar{x} = 138.5$  reported cases of larceny per year. Assume that  $\sigma$  is known to be 42.6 cases per year (Reference: *Crime in the United States*, Federal Bureau of Investigation).

- (a) Find a 90% confidence interval for the population mean annual number of reported larceny cases in such communities. What is the margin of error?

NOTE that “n” in these problems is 30, not 10,000, because there are 30 communities.

```
ZInterval
Inpt:Data Stats
σ:42.6
 $\bar{x}$ :138.5
n:30
C-Level:.9
Calculate
```

```
ZInterval
(125.71,151.29)
 $\bar{x}$ =138.5
n=30
```

```
151.29-138.5
12.79
```

On “b” and “c”, all you do is change C-Level.

- (b) Find a 95% confidence interval for the population mean annual number of reported larceny cases in such communities. What is the margin of error?

```
ZInterval
Inpt:Data Stats
σ:42.6
 $\bar{x}$ :138.5
n:30
C-Level:.95
```

```
ZInterval
(123.26,153.74)
 $\bar{x}$ =138.5
n=30
```

```
153.74-138.5
15.24
```

- (c) Find a 99% confidence interval for the population mean annual number of reported larceny cases in such communities. What is the margin of error?

```
ZInterval
Inpt:Data Stats
σ:42.6
 $\bar{x}$ :138.5
n:30
C-Level:.99
Calculate
```

```
ZInterval
(118.47,158.53)
 $\bar{x}$ =138.5
n=30
```

```
158.53-138.5
20.03
```

- (d) Compare the margins of error for parts (a) through (c). As the confidence levels increase, do the margins of error increase?
- (e) **Critical Thinking:** Compare the lengths of the confidence intervals for parts (a) through (c). As the confidence levels increase, do the confidence intervals increase in length?

- d. YES, the margin of error increases.
- e. YES, the length of the confidence interval (which is just twice the margin of error) increases. (The point of the question is to remind you that if you want to be more confident—be right more often—you have to widen the interval to include more possibilities.)

## Problem 22

**Ecology: Sand Dunes** At wind speeds above 1000 centimeters per second (cm/sec), significant sand-moving events begin to occur. Wind speeds below 1000 cm/sec deposit sand and wind speeds above 1000 cm/sec move sand to new locations. The cyclic nature of wind and moving sand determines the shape and location of large dunes (Reference: *Hydraulic, Geologic, and Biologic Research at Great Sand Dunes National Monument and Vicinity, Colorado*, Proceedings of the National Park Service Research Symposium). At a test site, the prevailing direction of the wind did not change noticeably. However, the velocity did change. Sixty wind speed readings gave an average velocity of  $\bar{x} = 1075$  cm/sec. Based on long-term experience,  $\sigma$  can be assumed to be 265 cm/sec.

- (a) Find a 95% confidence interval for the population mean wind speed at this site.
- (b) **Interpretation:** Does the confidence interval indicate that the population mean wind speed is such that the sand is always moving at this site? Explain.

a.

```
ZInterval
Inpt:Data stats
σ:265
x̄:1075
n:60
C-Level: .95
Calculate
```

```
ZInterval
(1007.9,1142.1)
x̄=1075
n=60
```

They don't ask for a margin of error this time, so there's no need to find it.

- b. Our interval says the average wind speed is somewhere between 1007.9 and 1142.1 cm/sec. The problem says "sand-moving events" occur when the wind speed is 1000 cm/sec or higher. Since even the LOW end of the interval is well above 1000, it's pretty safe to say that the sand is always moving. So the answer to part "b" is YES.

## T-INTERVAL PROBLEMS (P. 383)

### Problem 13

**Archaeology: Tree Rings** At Burnt Mesa Pueblo, the method of tree ring dating gave the following years A.D. for an archaeological excavation site (*Bandelier Archaeological Excavation Project: Summer 1990 Excavations at Burnt Mesa Pueblo*, edited by Kohler, Washington State University):

1189    1271    1267    1272    1268    1316    1275    1317    1275

- Use a calculator with mean and standard deviation keys to verify that the sample mean year is  $\bar{x} \approx 1272$ , with sample standard deviation  $s \approx 37$  years.
- Find a 90% confidence interval for the mean of all tree ring dates from this archaeological site.

Go to STAT → TESTS → T-Interval

```
EDIT CALC TESTS
2↑T-Test...
3:2-SampZTest...
4:2-SampTTest...
5:1-PropZTest...
6:2-PropZTest...
7:ZInterval...
8↓TInterval...
```

Use the answers they give you on “a” as you calculator input for Part “b”.

(By the way, if you had to do part “a”—which you DON’T, you’d just enter the list and calculate 1-variable statistics.)

NOTE: To find “n”, just count up how many years they give you. It’s 9.

```
TInterval
Inpt:Data
x̄:1272
Sx:37
n:9
C-Level:.9
```

Calculate. Your answer is the parentheses.

```
TInterval
(1249.1,1294.9)
x̄=1272
Sx=37
n=9
```

So the trees date to between 1249 and 1295 A.D.

### Problem 14

**Camping: Cost of a Sleeping Bag** How much does a sleeping bag cost? Let's say you want a sleeping bag that should keep you warm in temperatures from 20°F to 45°F. A random sample of prices (\$) for sleeping bags in this temperature range was taken from *Backpacker Magazine: Gear Guide* (Vol. 25, Issue 157, No. 2). Brand names include American Camper, Cabela's, Camp 7, Caribou, Cascade, and Coleman.

80	90	100	120	75	37	30	23	100	110
105	95	105	60	110	120	95	90	60	70

- Use a calculator with mean and sample standard deviation keys to verify that  $\bar{x} \approx \$83.75$  and  $s \approx \$28.97$ .
- Using the given data as representative of the population of prices of all summer sleeping bags, find a 90% confidence interval for the mean price  $\mu$  of all summer sleeping bags.

```
TInterval
Inpt:Data STATS
x̄=83.75
Sx=28.97
n=20
C-Level:.9
Calculate
```

```
TInterval
(72.549,94.951)
x̄=83.75
Sx=28.97
n=20
```

**So the average cost of all sleeping bags should be between \$72.55 and \$94.95**

### Problem 15

**Wildlife: Mountain Lions** How much do wild mountain lions weigh? *The 77th Annual Report of the New Mexico Department of Game and Fish*, edited by Bill Montoya, gave the following information. Adult wild mountain lions (18 months or older) captured and released for the first time in the San Andres Mountains gave the following weights (pounds):

68	104	128	122	60	64
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- Use a calculator with mean and sample standard deviation keys to verify that  $\bar{x} = 91.0$  pounds and  $s \approx 30.7$  pounds.
- Find a 75% confidence interval for the population average weight  $\mu$  of all adult mountain lions in the specified region.

```
TInterval
Inpt:Data STATS
x̄:91
Sx:30.7
n:6
C-Level: .75
Calculate
```

```
TInterval
(74.695,107.31)
x̄=91
Sx=30.7
n=6
```

### Problem 16

**Franchise: Candy Store** Do you want to own your own candy store? Wow! With some interest in running your own business and a decent credit rating, you can probably get a bank loan on startup costs for franchises such as Candy Express, The Fudge Company, Karmel Corn, and Rocky Mountain Chocolate Factory. Startup costs (in thousands of dollars) for a random sample of candy stores are given below (Source: *Entrepreneur Magazine*, Vol. 23, No. 10).

95      173      129      95      75      94      116      100      85

a. Use a calculator with mean and sample standard deviation keys to verify that  $\bar{x} \approx 106.9$  thousand dollars and  $s \approx 29.4$  thousand dollars.

b. Find a 90% confidence interval for the population average startup costs  $\mu$  for candy store franchises.

```
TInterval
Inpt:Data STATS
x̄:106.9
Sx:29.4
n:9
C-Level: .9
```

```
TInterval
(88.676,125.12)
x̄=106.9
Sx=29.4
n=9
```

**NOTE:** The numbers in the problem are in THOUSANDS of dollars. So this means the actual average cost must be between \$88,676 and \$125,120. (An actual cost analyst would probably round the numbers and say something like “between \$90,000 and \$125,000”.)