Exercises

Q1. Run hypothesis test to see if a soda machine was correctly dispensing 12 ounces of soda. The amount dispensed is assumed to be normally distributed. The machine is not working properly if the bottles are overfilled or underfilled. You observe the machine filling 30 bottles and collected the following data (in ounces):

11.6, 12.62, 11.4, 10.69, 11.59, 11.49, 11.11, 10.66, 10.9, 11.47, 11.56, 12.74, 11.87, 11.63, 10.84, 11.55, 12.42, 12.18, 12.39, 12.30, 11.26, 11.82, 11.71, 12.94, 12.35, 11.21, 11.36, 11.57, 11.66, 11.42.

Is there any evidence to indicate that the machine is not filling the bottles properly? Use α=0.05.

Q2. The following data are the oxygen uptakes (milliliters) during incubation of a random sample of 15 cell suspensions:

14.0, 14.1, 14.5, 13.2, 11.2, 14.0, 14.1, 12.2, 11.1, 13.7, 13.2, 16.0, 12.8, 14.4, 12.9

Do these data provide sufficient evidence at the .05 level of significance that the population mean is not 12 ml? What assumptions are necessary?

Q3. There has been some concern that young children are spending too much time watching TV. In a study of TV viewing these observations are obtained on the random variable X, the number of cartoon shows watched per child from 7:00 AM to 1:00 PM on a day.

2, 2, 1, 3, 3, 5, 7, 5, 3, 8, 1, 4, 0, 4, 2, 0, 4, 2, 7, 3, 6, 1, 3, 5, 6, 4, 4, 4.

1. Is X normally distributed?

2. Would you believe a claim that the true mean value is at least seven cartoon shows per child? Use $\alpha=0.05$.
3. Construct a 90% confidence interval on the average number of cartoon shows watched by children in the population from which this sample was drawn.

Q4. Recorded here are the germination times (number of days) for seven seeds of a new strain of snap bean.

12, 16, 15, 20, 17, 11, 18

Determine a 95% C.I for the true mean germination time for this strain.

Q5. As part of a study of the development of the thymus gland, researchers weighed the glands of five chick embryos after 14 days of incubation. The thymus weights (mg) were as follows:

29.6, 21.5, 28.0, 34.6, 44.9

For these data,

1. Find the point estimate of the population mean.
2. Find the point estimate of the population variance.
3. Calculate the standard error of the mean.
4. Construct a 90% confidence interval for the population mean.

Q6. Researchers wished to know if they could conclude that two populations of infants differ with respect to mean age at which they walked alone. The following data (ages in months) were collected:

Sample from population A: 9.5, 10.5, 9.0, 9.75, 10.0, 13.0, 10.0, 13.5, 10.0, 9.5, 10.0, 9.75

Sample from population B: 12.5, 9.5, 13.5, 13.75, 12.0, 13.75, 12.5, 9.5, 12.0, 13.5, 12.0, 12.0

What should the researchers conclude? Let $\alpha = 0.05$.

Q7. Researchers were interested in the short-term effect that caffeine has on heart rate. They enlisted a group of volunteers and measured each person's resting heart rate. Then they had each subject drink 6 ounces of coffee. Nine of the subjects were given coffee containing caffeine and 11 were given decaffeinated coffee. After 10 minutes each person's heart rate was measured again. The data in the table show the change in heart rate; a positive number means that heart rate went up and a negative number means that heart rate went down.

	CAFFEINE	DECAF
	28	26
	11	1
	−3	0
	14	−4
	−2	−4
	−4	14
	18	16
	2	8
	2	0
		18
		−10
n	9	11
$\bar{y}$	7.3	5.9
s	11.1	11.2
SE	3.7	3.4

1. Use these data to construct a 90% confidence interval for the difference in mean affect that caffeinated coffee has on heart rate, in comparison to decaffeinated coffee.
2. Using the interval computed in part (a) to justify your answer, is it reasonable to believe that caffeine may not affect heart rates?

Q8. The following table shows the number of bacteria colonies present in each of several petri dishes, after E. coli bacteria were added to the dishes and they were incubated for 24 hours. The "soap" dishes contained a solution prepared from ordinary soap; the "control" dishes contained a solution of sterile water.

	CONTROL	SOAP
	30	76
	36	27
	66	16
	21	30
	63	26
	38	46
	35	6
	45	
n	8	7
$\bar{y}$	41.8	32.4
s	15.6	22.8
SE	5.5	8.6

Use a t-test to investigate whether soap affects the number of bacteria colonies that form. Use $\alpha = 0.10$

Q9. In an experiment to compare two diets for fattening beef steers, nine pairs of animals were chosen from the herd; members of each pair were matched as closely as possible with respect to hereditary factors. The members of each pair were randomly allocated, one to each diet. The following table shows the weight gains (lb) of the animals over a 140-day test period on diet 1 (Y1) and on diet 2 (Y2).

PAIR	DIET 1	DIET 2	DIFFERENCE
1	596	498	98
2	422	460	−38
3	524	468	56
4	454	458	−4
5	538	530	8
6	552	482	70
7	478	528	−50
8	564	598	−34
9	556	456	100
Mean	520.4	497.6	22.9
SD	57.1	47.3	59.3

1. Calculate the standard error of the mean difference.
2. Test for a difference between the diets using a paired t test at $\alpha = 0.05$.
3. Construct a 90% confidence interval for the mean difference.
4. Interpret the confidence interval from part (c) in the context of this setting.