verbal scores, assumed to be $N(\mu_Y, \sigma^2)$. If the following data are observed, find a 90% confidence interval for $\mu_X - \mu_Y$:

$x_1 = 644 \quad x_2 = 493 \quad x_3 = 532 \quad x_4 = 462 \quad x_5 = 565$

$y_1 = 623 \quad y_2 = 472 \quad y_3 = 492 \quad y_4 = 661 \quad y_5 = 540$

$y_6 = 502 \quad y_7 = 549 \quad y_8 = 518$

7.2-3. Independent random samples of the heights of adult males living in two countries yielded the following results: $n = 12$, $\bar{x} = 65.7$ inches, $s_x = 4$ inches and $m = 15$, $\bar{y} = 68.2$ inches, $s_y = 3$ inches. Find an approximate 98% confidence interval for the difference $\mu_X - \mu_Y$ of the means of the populations of heights. Assume that $\sigma_X^2 = \sigma_Y^2$.

7.2-4. [*Medicine and Science in Sports and Exercise* (January 1990).] Let X and Y equal, respectively, the blood volumes in milliliters for a male who is a paraplegic and participates in vigorous physical activities and for a male who is able-bodied and participates in everyday, ordinary activities. Assume that X is $N(\mu_X, \sigma_X^2)$ and Y is $N(\mu_Y, \sigma_Y^2)$. Following are $n = 7$ observations of X:

1612	1352	1456	1222	1560	1456	1924

Following are $m = 10$ observations of Y:

1082	1300	1092	1040	910
1248	1092	1040	1092	1288

Use the observations of X and Y to

(a) Give a point estimate for $\mu_X - \mu_Y$.

(b) Find a 95% confidence interval for $\mu_X - \mu_Y$. Since the variances σ_X^2 and σ_Y^2 might not be equal, use Welch's T.

7.2-5. A biologist who studies spiders was interested in comparing the lengths of female and male green lynx spiders. Assume that the length X of the male spider is approximately $N(\mu_X, \sigma_X^2)$ and the length Y of the female spider is approximately $N(\mu_Y, \sigma_Y^2)$. Following are $n = 30$ observations of X:

5.20	4.70	5.75	7.50	6.45	6.55
4.70	4.80	5.95	5.20	6.35	6.95
5.70	6.20	5.40	6.20	5.85	6.80
5.65	5.50	5.65	5.85	5.75	6.35
5.75	5.95	5.90	7.00	6.10	5.80

Following are $m = 30$ observations of Y:

8.25	9.95	5.90	7.05	8.45
9.80	10.80	6.60	7.55	8.10
6.10	9.30	8.75	7.00	7.80
9.00	6.30	8.35	8.70	8.00
9.50	8.30	7.05	8.30	7.95

The units of measurement for both sets of ob[illegible] tions are millimeters. Find an approximate one[illegible] 95% confidence interval that is an upper bou[illegible] $\mu_X - \mu_Y$.

7.2-6. A test was conducted to determine wheth[illegible] wedge on the end of a plug fitting designed to hold [illegible] onto the plug was doing its job. The data taken were [illegible] form of measurements of the force required to rem[illegible] seal from the plug with the wedge in place (say, X) [illegible] the force required without the plug (say, Y). Assume [illegible] the distributions of X and Y are $N(\mu_X, \sigma^2)$ and $N(\mu_Y$[illegible] respectively. Ten independent observations of X are

3.26 2.26 2.62 2.62 2.36 3.00 2.62 2.40 2.30 [illegible]

Ten independent observations of Y are

1.80 1.46 1.54 1.42 1.32 1.56 1.36 1.64 2.00 [illegible]

(a) Find a 95% confidence interval for $\mu_X - \mu_Y$.

(b) Construct box-and-whisker diagrams of these data [illegible] the same figure.

(c) Is the wedge necessary?

7.2-7. An automotive supplier is considering changing [illegible] electrical wire harness to save money. The idea is [illegible] replace a current 20-gauge wire with a 22-gauge wi[illegible] Since not all wires in the harness can be changed, the ne[illegible] wire must work with the current wire splice process. T[illegible] determine whether the new wire is compatible, random samples were selected and measured with a pull test. A pull test measures the force required to pull the spliced wires apart. The minimum pull force required by the customer is 20 pounds. Twenty observations of the forces needed for the current wire are

28.8	24.4	30.1	25.6	26.4	23.9	22.1	22.5	27.6	28.1
20.8	27.7	24.4	25.1	24.6	26.3	28.2	22.2	26.3	24.4

Twenty observations of the forces needed for the new wire are

14.1	12.2	14.0	14.6	8.5	12.6	13.7	14.8	14.1	13.2
12.1	11.4	10.1	14.2	13.6	13.1	11.9	14.8	11.1	13.5

(a) Does the current wire meet the customer's specifications?

(b) Find a 90% confidence interval for the difference of the means for these two sets of wire.

(c) Construct box-and-whisker diagrams of the two sets of data on the same figure.

(d) What is your recommendation for this company?

7.2-8. Let $\overline{X}$, $\overline{Y}$, S_X^2, and S_Y^2 be the respective sample means and unbiased estimates of the variances obtained from independent samples of sizes n and m from the normal distributions $N(\mu_X, \sigma_X^2)$ and $N(\mu_Y, \sigma_Y^2)$, where μ_X, μ_Y, σ_X^2, and σ_Y^2 are unknown. If $\sigma_X^2/\sigma_Y^2 = d$, a known constant,

(a) Argue that $\dfrac{(\overline{X}-\overline{Y})-(\mu_X-\mu_Y)}{\sqrt{d\sigma_Y^2/n+\sigma_Y^2/m}}$ is $N(0,1)$.

(b) Argue that $\dfrac{(n-1)S_X^2}{d\sigma_Y^2}+\dfrac{(m-1)S_Y^2}{\sigma_Y^2}$ is $\chi^2(n+m-2)$.

(c) Argue that the two random variables in (a) and (b) are independent.

(d) With these results, construct a random variable (not depending upon σ_Y^2) that has a t distribution and that can be used to construct a confidence interval for $\mu_X - \mu_Y$.

7.2-9. Students in a semester-long health-fitness program have their percentage of body fat measured at the beginning of the semester and at the end of the semester. The following measurements give these percentages for 10 men and for 10 women:

Males		Females	
Pre-program %	Post-program %	Pre-program %	Post-program %
11.10	9.97	22.90	22.89
19.50	15.80	31.60	33.47
14.00	13.02	27.70	25.75
8.30	9.28	21.70	19.80
12.40	11.51	19.36	18.00
7.89	7.40	25.03	22.33
12.10	10.70	26.90	25.26
8.30	10.40	25.75	24.90
12.31	11.40	23.63	21.80
10.00	11.95	25.06	24.28

(a) Find a 90% confidence interval for the mean of the difference in the percentages for the males.

(b) Find a 90% confidence interval for the mean of the difference in the percentages for the females.

(c) On the basis of these data, have these percentages decreased?

(d) If possible, check whether each set of differences comes from a normal distribution.

7.2-10. Twenty-four 9th- and 10th-grade high school girls were put on an ultraheavy rope-jumping program. The following data give the time difference for each girl ("before program time" minus "after program time") for the 40-yard dash:

0.28	0.01	0.13	0.33	−0.03	0.07	−0.18	−0.14
−0.33	0.01	0.22	0.29	−0.08	0.23	0.08	0.04
−0.30	−0.08	0.09	0.70	0.33	−0.34	0.50	0.06

(a) Give a point estimate of μ_D, the mean of the difference in race times.

(b) Find a one-sided 95% confidence interval that is a lower bound for μ_D.

(c) Does it look like the rope-jumping program was effective?

7.2-11. The Biomechanics Lab at Hope College tested healthy old women and healthy young women to discover whether or not lower extremity response time to a stimulus is a function of age. Let X and Y respectively equal the independent response times for these two groups when taking steps in the anterior direction. Find a one-sided 95% confidence interval that is a lower bound for $\mu_X - \mu_Y$ if $n = 60$ observations of X yielded $\overline{x} = 671$ and $s_X = 129$, while $m = 60$ observations of Y yielded $\overline{y} = 480$ and $s_Y = 93$.

7.2-12. Let X and Y equal the hardness of the hot and cold water, respectively, in a campus building. Hardness is measured in terms of the calcium ion concentration (in ppm). The following data were collected ($n = 12$ observations of X and $m = 10$ observations of Y):

x:	133.5	137.2	136.3	133.3	137.5	135.4
	138.4	137.1	136.5	139.4	137.9	136.8
y:	134.0	134.7	136.0	132.7	134.6	135.2
	135.9	135.6	135.8	134.2		

(a) Calculate the sample means and the sample variances of these data.

$y = 142$ out of a random sample of $n = 200$ letters were delivered the day after they were mailed.

(a) Give a point estimate of p.

(b) Use Equation 7.3-2 to find an approximate 90% confidence interval for p.

(c) Use Equation 7.3-4 to find an approximate 90% confidence interval for p.

(d) Use Equation 7.3-5 to find an approximate 90% confidence interval for p.

(e) Find a one-sided 90% confidence interval for p that provides a lower bound for p.

7.3-3. Let p equal the proportion of triathletes who suffered a training-related overuse injury during the past year. Out of 330 triathletes who responded to a survey, 167 indicated that they had suffered such an injury during the past year.

(a) Use these data to give a point estimate of p.

(b) Use these data to find an approximate 90% confidence interval for p.

(c) Do you think that the 330 triathletes who responded to the survey may be considered a random sample from the population of triathletes?

7.3-4. Let p equal the proportion of Americans who favor the death penalty. If a random sample of $n = 1234$ Americans yielded $y = 864$ who favored the death penalty, find an approximate 95% confidence interval for p.

7.3-5. In order to estimate the proportion, p, of a large class of college freshmen that had high school GPAs from 3.2 to 3.6, inclusive, a sample of $n = 50$ students was taken. It was found that $y = 9$ students fell into this interval.

(a) Give a point estimate of p.

(b) Use Equation 7.3-2 to find an approximate 95% confidence interval for p.

(c) Use Equation 7.3-4 to find an approximate 95% confidence interval for p.

(d) Use Equation 7.3-5 to find an approximate 95% confidence interval for p.

7.3-6. Let p equal the proportion of Americans who select jogging as one of their recreational activities. If 1497 out of a random sample of 5757 selected jogging, find an approximate 98% confidence interval for p.

7.3-7. In developing countries in Africa and the Americas, let p_1 and p_2 be the respective proportions of women with nutritional anemia. Find an approximate 90% confidence interval for $p_1 - p_2$, given that a random sample of $n_1 = 2100$ African women yielded $y_1 = 840$ with nutritional anemia and a random sample of $n_2 = 1900$ women from the Americas yielded $y_2 = 323$ women with nutritional anemia.

7.3-8. A proportion, p, that many public opinion polls estimate is the number of Americans who would say yes to the question, "If something were to happen to the president of the United States, do you think that the vice president would be qualified to take over as president?" In one such random sample of 1022 adults, 388 said yes.

(a) On the basis of the given data, find a point estimate of p.

(b) Find an approximate 90% confidence interval for p.

(c) Give updated answers to this question if new poll results are available.

7.3-9. Consider the following two groups of women: Group 1 consists of women who spend less than \$500 annually on clothes; Group 2 comprises women who spend over \$1000 annually on clothes. Let p_1 and p_2 equal the proportions of women in these two groups, respectively, who believe that clothes are too expensive. If 1009 out of a random sample of 1230 women from group 1 and 207 out of a random sample 340 from group 2 believe that clothes are too expensive,

(a) Give a point estimate of $p_1 - p_2$.

(b) Find an approximate 95% confidence interval for $p_1 - p_2$.

7.3-10. A candy manufacturer selects mints at random from the production line and weighs them. For one week, the day shift weighed $n_1 = 194$ mints and the night shift weighed $n_2 = 162$ mints. The numbers of these mints that weighed at most 21 grams was $y_1 = 28$ for the day shift and $y_2 = 11$ for the night shift. Let p_1 and p_2 denote the proportions of mints that weigh at most 21 grams for the day and night shifts, respectively.

(a) Give a point estimate of p_1.

(b) Give the endpoints for a 95% confidence interval for p_1.

(c) Give a point estimate of $p_1 - p_2$.

(d) Find a one-sided 95% confidence interval that gives a lower bound for $p_1 - p_2$.

7.3-11. For developing countries in Asia (excluding China) and Africa, let p_1 and p_2 be the respective proportions of preschool children with chronic malnutrition (stunting). If respective random samples of $n_1 = 1300$ and $n_2 = 1100$ yielded $y_1 = 520$ and $y_2 = 385$ children with chronic malnutrition, find an approximate 95% confidence interval for $p_1 - p_2$.