10.49 a. $s_{\bar{d}} = s_d / \sqrt{n} = 6.3 / \sqrt{12} = 1.81865335$

$df = n - 1 = 12 - 1 = 11$

The 99% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = 17.5 \pm 3.106(1.81865335) = 17.5 \pm 5.65 = 11.85$ to 23.15

b. $s_{\bar{d}} = s_d / \sqrt{n} = 14.7 / \sqrt{27} = 2.82901632$

$df = n - 1 = 27 - 1 = 26$

The 95% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = 55.9 \pm 2.056(2.82901632) = 55.9 \pm 5.82 = 50.08$ to 61.72

c. $s_{\bar{d}} = s_d / \sqrt{n} = 8.3 / \sqrt{16} = 2.075$

$df = n - 1 = 16 - 1 = 15$

The 90% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = 29.3 \pm 1.753(2.075) = 29.3 \pm 3.64 = 25.66$ to 32.94

10.50 a. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d \neq 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 9 - 1 = 8$

For $\alpha = .05$, the critical values of t are -1.860 and 1.860.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 2.5 / \sqrt{9} = .83333333$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (6.7 - 0)/.83333333 = 8.040$

Step 5: Reject H_0 since $8.040 > 1.860$.

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d > 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 22 - 1 = 21$

For $\alpha = .05$, the critical value of t is 1.721.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 6.4 / \sqrt{22} = 1.36448458$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (14.8 - 0)/1.36448458 = 10.847$

Step 5: Reject H_0 since $10.847 > 1.721$.

c. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d < 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 17 - 1 = 16$

For $\alpha = .01$, the critical value of t is -2.583.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 4.8 / \sqrt{17} = 1.16417100$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (-9.3 - 0)/1.16417100 = -7.989$

Step 5: Reject H_0 since $-7.989 < -2.583$.

10.51 a. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d \neq 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 26 - 1 = 25$

For $\alpha = .05$, the critical values of t are -2.060 and 2.060.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 3.9 / \sqrt{26} = .76485293$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (9.6 - 0)/.76485293 = 12.551$

Step 5: Reject H_0 since $12.551 > 2.060$.

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d > 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 15 - 1 = 14$

For $\alpha = .01$, the critical value of t is 2.624.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 4.7 / \sqrt{15} = 1.21353478$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (8.8 - 0)/1.21353478 = 7.252$

Step 5: Reject H_0 since $7.252 > 2.624$.

c. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d < 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: $df = n - 1 = 20 - 1 = 19$

For $\alpha = .10$, the critical value of t is -1.328.

Step 4: $s_{\bar{d}} = s_d / \sqrt{n} = 2.3 / \sqrt{20} = .51429563$

$t = (\bar{d} - \mu_d) / s_{\bar{d}} = (-7.4 - 0)/.51429563 = -14.389$

Step 5: Reject H_0 since $-14.389 < -1.328$.

10.52

Before	After	d	d^2
8	10	−2	4
5	8	−3	9
4	5	−1	1
9	11	−2	4
6	6	0	0
9	7	2	4
5	9	−4	16
		$\Sigma d = -10$	$\Sigma d^2 = 38$

$\bar{d} = \Sigma d / n = -10/7 = -1.43$

$$s_d = \sqrt{\frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}} = \sqrt{\frac{38 - \frac{(-10)^2}{7}}{7-1}} = 1.98805959$$

$s_{\bar{d}} = s_d / \sqrt{n} = 1.98805959 / \sqrt{7} = .75141590$

$df = n - 1 = 7 - 1 = 6$

a. The 95% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = -1.43 \pm 2.447(.75141590) = -1.43 \pm 1.84 = -3.27$ to $.41$

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d < 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: For $\alpha = .01$ with $df = 6$, the critical value of t is -3.143.

Step 4: $t = (\bar{d} - \mu_d) / s_{\bar{d}} = (-1.43 - 0)/.75141590 = -1.903$

Step 5: Do not reject H_0 since $-1.903 > -3.143$.

Conclude that attending the course does not increase the mean score of employees.

10.53

Before	After	d	d^2
103	100	3	9
97	95	2	4
111	104	7	49
95	101	−6	36
102	96	6	36
96	91	5	25
108	101	7	49
		$\Sigma d = 24$	$\Sigma d^2 = 208$

$\bar{d} = \Sigma d / n = 24/7 = 3.43$ minutes

$$s_d = \sqrt{\frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}} = \sqrt{\frac{208 - \frac{(24)^2}{7}}{7-1}} = 4.57737708 \text{ minutes}$$

$s_{\bar{d}} = s_d / \sqrt{n} = 4.57737708 / \sqrt{7} = 1.73008592$ minutes

$df = n - 1 = 7 - 1 = 6$

a. The 99% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = 3.43 \pm 3.707(1.73008592) = 3.43 \pm 6.41 = -2.98$ to 9.84 minutes

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d > 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: For $\alpha = .025$ with $df = 6$, the critical value of t is 2.447.

Step 4: $t = (\bar{d} - \mu_d) / s_{\bar{d}} = (3.43 - 0)/1.73008592 = 1.983$

Step 5: Do not reject H_0 since $1.983 < 2.447$.

Conclude that taking the dietary supplement does not result in faster mean times in the time trials.

10.54

Before	After	d	d^2
81	97	−16	256
75	72	3	9
89	93	−4	16
91	110	−19	361
65	78	−13	169
70	69	1	1
90	115	−25	625
64	72	−8	64
		$\Sigma d = -81$	$\Sigma d^2 = 1501$

$\bar{d} = \Sigma d / n = -81/8 = -10.13$

$$s_d = \sqrt{\frac{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}{n-1}} = \sqrt{\frac{1501 - \frac{(-81)^2}{8}}{8-1}} = 9.86244681$$

$s_{\bar{d}} = s_d / \sqrt{n} = 9.86244681 / \sqrt{8} = 3.48690151$

$df = n - 1 = 8 - 1 = 7$

a. The 90% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = -10.13 \pm 1.895(3.48690151) = -10.13 \pm 6.61 = -16.74$ to -3.52

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d < 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: For $\alpha = .05$ with $df = 7$, the critical value of t is −1.895.

Step 4: $t = (\bar{d} - \mu_d) / s_{\bar{d}} = (-10.13 - 0)/3.48690151 = -2.905$

Step 5: Reject H_0 since $-2.905 < -1.895$.

Conclude that attending this course increasing the mean writing speed of secretaries.

10.55

Before	After	d	d^2
180	183	–3	9
195	187	8	64
177	161	16	256
221	204	17	289
208	197	11	121
199	189	10	100
		$\sum d = 59$	$\sum d^2 = 839$

$\bar{d} = \sum d / n = 59/6 = 9.83$ pounds

$$s_d = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}} = \sqrt{\frac{839 - \frac{(59)^2}{6}}{6-1}} = 7.19490561 \text{ pounds}$$

$s_{\bar{d}} = s_d / \sqrt{n} = 7.19490561/\sqrt{6} = 2.93730791$ pounds

$df = n - 1 = 6 - 1 = 5$

a. The 95% confidence interval for μ_d is

$\bar{d} \pm t s_{\bar{d}} = 9.83 \pm 2.571(2.93730791) = 9.83 \pm 7.55 = 2.28$ to 17.38 pounds

b. Step 1: H_0: $\mu_d = 0$, H_1: $\mu_d > 0$

Step 2: Since the samples are dependent, σ_d is unknown, the sample is small, and the population of paired differences is normally distributed, use the t distribution.

Step 3: For $\alpha = .01$ with $df = 5$, the critical value of t is 3.365.

Step 4: $t = (\bar{d} - \mu_d)/s_{\bar{d}} = (9.83 - 0)/2.93730791 = 3.347$

Step 5: Do not reject H_0 since $3.347 < 3.365$.

Conclude that the mean weight loss for all persons due to this special exercise program is not greater than zero.

10.56

Before	After	d	d^2
24.6	26.3	–1.7	2.89
28.3	31.7	–3.4	11.56
18.9	18.2	.7	.49
23.7	25.3	–1.6	2.56
15.4	18.3	–2.9	8.41
29.5	30.9	–1.4	1.96
		$\sum d = -10.3$	$\sum d^2 = 27.87$

$\bar{d} = \sum d / n = -10.3/6 = -1.72$ mpg