2.25 The following are the burning times (in minutes) of chemical flares of two different formulations. The design engineers are interested in both the means and variance of the burning times.

Type 1		Type 2	
65	82	64	56
81	67	71	69
57	59	83	74
66	75	59	82
82	70	65	79

(a) Test the hypotheses that the two variances are equal. Use $\alpha = 0.05$.

$$H_0 : \sigma_1^2 = \sigma_2^2 \qquad S_1 = 9.264$$
$$H_1 : \sigma_1^2 \neq \sigma_2^2 \qquad S_2 = 9.367$$
$$F_0 = \frac{S_1^2}{S_2^2} = \frac{85.82}{87.73} = 0.98$$
$$F_{0.025,9,9} = 4.03 \qquad F_{0.975,9,9} = \frac{1}{F_{0.025,9,9}} = \frac{1}{4.03} = 0.248 \quad \text{Do not reject.}$$

(b) Using the results of (a), test the hypotheses that the mean burning times are equal. Use $\alpha = 0.05$. What is the P-value for this test?

$$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} = \frac{1561.95}{18} = 86.775$$
$$S_p = 9.32$$
$$t_0 = \frac{\bar{y}_1 - \bar{y}_2}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{70.4 - 70.2}{9.32\sqrt{\frac{1}{10} + \frac{1}{10}}} = 0.048$$
$$t_{0.025,18} = 2.101 \quad \text{Do not reject.}$$

From the computer output, t=0.05; do not reject. Also from the computer output P=0.96

2.29 The diameter of a ball bearing was measured by 12 inspectors, each using two different kinds of calipers. The results were:

Inspector	Caliper 1	Caliper 2	Difference	Difference^2
1	0.265	0.264	.001	.000001
2	0.265	0.265	.000	0
3	0.266	0.264	.002	.000004
4	0.267	0.266	.001	.000001
5	0.267	0.267	.000	0
6	0.265	0.268	-.003	.000009
7	0.267	0.264	.003	.000009
8	0.267	0.265	.002	.000004
9	0.265	0.265	.000	0
10	0.268	0.267	.001	.000001
11	0.268	0.268	.000	0
12	0.265	0.269	-.004	.000016
			$\sum = 0.003$	$\sum = 0.000045$

(a) Is there a significant difference between the means of the population of measurements represented by the two samples? Use $\alpha = 0.05$.

$$H_0: \mu_1 = \mu_2 \quad H_1: \mu_1 \neq \mu_2 \quad \text{or equivalently} \quad H_0: \mu_d = 0 \quad H_1: \mu_d \neq 0$$

$t = 0.4318$, df $= 11$, $t_{\alpha/2} = 2.201 > t$. Fail to reject null hypothesis. There is no significant difference.

(b) Find the *P*-value for the test in part (a). *P*=0.674

(c) Construct a 95 percent confidence interval on the difference in the mean diameter measurements for the two types of calipers.

$$\bar{d} - t_{\alpha/2,n-1}\frac{S_d}{\sqrt{n}} \leq \mu_D (= \mu_1 - \mu_2) \leq \bar{d} + t_{\alpha/2,n-1}\frac{S_d}{\sqrt{n}}$$

$$0.00025 - 2.201\frac{0.002}{\sqrt{12}} \leq \mu_d \leq 0.00025 + 2.201\frac{0.002}{\sqrt{12}}$$

$$-0.00102 \leq \mu_d \leq 0.00152$$