Chapter 11 Solutions

Section 11.1

1. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$
   H_1: At least one mean differs from the others.
   T.S.: $F = \dfrac{n \cdot s_{\bar{x}}^2}{s_p^2} = \dfrac{7 \cdot 4.5221}{60.25} = 0.525390239.$
   $df1 = k - 1 = 4 - 1 = 3$
   $df2 = k \cdot (n - 1) = 4 \cdot (7 - 1) = 24$
   $\alpha = 0.05$
   C.V.: $F = 3.0088$
   p-value = 0.6690 (Using computer software).

   We fail to reject the null hypothesis. *There is insufficient evidence to warrant rejection of the claim that these populations of bacteria colonies have equal means. This is emphasized by the large p-value of 0.6690, which is calculated using computer software.*

Sample Data			**Intermediate Calculations**		
Means	**Variances**	**Sample sizes**	$n_i \bar{x}_i$	$n_i(\bar{x}_i - \bar{\bar{x}})^2$	$(n_i - 1)s_i^2$
60.857143	60.142857	7	426	47.58035714	360.857143
65.857143	64.142857	7	461	40.08035714	384.857143
64.285714	88.571429	7	450	4.723214286	531.428571
62.857143	28.142857	7	440	2.580357143	168.857143

N	**Grand Mean** $\bar{\bar{x}}$
28	63.46428571
k	**SS(treatment)**
4	94.96428571
Test Stat.	**MS(treatment)**
0.525390239	31.6547619
C.V.	**SS(error)**
3.0088	1446
p-value	**MS(error)**
0.66902581	60.25

3. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7$

H_1: At least one mean differs from the others.

T.S.: $F = \dfrac{n \cdot s_{\bar{x}}^2}{s_p^2} = \dfrac{10 \cdot 0.497962}{0.874483} = 5.6944$

$df1 = k - 1 = 7 - 1 = 6$

$df2 = k \cdot (n - 1) = 7 \cdot (10 - 1) = 63$

$\alpha = 0.01$

C.V.: $F = 3.1864$ (This is based on $df2$ =50 degrees of freedom – the correct C.V. is below).

p-value = 0.0000891 (Using computer software).

We reject the null hypothesis. *The data do not support the claim that mean length of eggs in these different populations have equal means. This conclusion is strongly supported by the p-value of 0.0000891, which was computed using computer software.*

Sample Data			**Intermediate Calculations**		
Means	**Variances**	**Sample sizes**	$n_i \bar{x}_i$	$n_i (\bar{x}_i - \bar{\bar{x}})^2$	$(n_i - 1) s_i^2$
22.29	0.8849984	10	222.9	0.503040816	7.96498588
22.91	0.9550451	10	229.1	1.565897959	8.59540575
23.1	1.2534397	10	231	3.430612245	11.2809574
22.81	0.595259	10	228.1	0.874469388	5.35733143
22.14	0.641526	10	221.4	1.400897959	5.77373363
23.17	0.9900056	10	231.7	4.299612245	8.9100505
21.18	0.8011103	10	211.8	17.80318367	7.20999307

N 70	**Grand Mean** $\bar{\bar{x}}$ 22.51428571
k 7	**SS(treatment)** 29.87771429
Test Stat. 5.694354788	**MS(treatment)** 4.979619048
C.V. 3.102766752	**SS(error)** 55.09245765
p-value 8.90588E-05	**MS(error)** 0.874483455

5. H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

H_1: At least one mean differs from the others.

T.S.: $F = \dfrac{n \cdot s_{\bar{x}}^2}{s_p^2} = \dfrac{7 \cdot 1.237159}{1.187778} = 7.2910$

$df1 = k - 1 = 5 - 1 = 4$

$df2 = k \cdot (n - 1) = 5 \cdot (7 - 1) = 30$

$\alpha = 0.01$

C.V.: $F = 4.0179$

p-value = 0.000316 (Using computer software).

We reject the null hypothesis. *The data do not support the claim that mean temperature responses to the different treatments have equal means. This conclusion is strongly supported by the p-value of 0.000316, which was computed using computer software.*

Sample Data			**Intermediate Calculations**		
Means	**Variances**	**Sample sizes**	$n_i \bar{x}_i$	$n_i (\bar{x}_i - \bar{\bar{x}})^2$	$(n_i - 1) s_i^2$
98.3	1.21	7	688.1	21.03342229	7.26
96.2	1.22333333	7	673.4	0.940622286	7.34
96.83285714	0.99555714	7	677.83	0.496356571	5.973342857
95.3	1.22333333	7	667.1	11.22942229	7.34
96.2	1.28666667	7	673.4	0.940622286	7.72

N	**k**
35	5
SS(treatment)	**MS(treatment)**
34.64044571	8.660111429
SS(error)	**MS(error)**
35.63334286	1.187778095
Test Stat.	**C.V.**
7.291017963	4.017876837
p-value	**Grand Mean:** $\bar{\bar{x}}$
0.000316169	96.56657143