STAT1302 – Statistical Analysis II
Assignment #3 – Solutions
Winter 2018

Q1. Find the critical value of F for the following.

a) $df = (2, 6)$ and area in the right tail $= 0.025$. $F_{0.025} = 7.26$
b) $df = (3, 10)$ and area in the right tail $= 0.05$. $F_{0.05} = 3.71$
c) $df = (6, 12)$ and area in the right tail $= 0.01$. $F_{0.01} = 4.82$

Q2. The following table lists the numbers of violent crimes reported to police on randomly selected days for this year. The data are taken from three large cities of about the same size.

City A	City B	City C
5	2	8
9	4	12
12	1	10
3	13	3
9	7	9
7	6	14
13		
$T_1 = 58$	$T_2 = 33$	$T_3 = 56$

a) Calculate the between-samples and within-samples variances.

- $n = n_1 + n_2 + n_3 = 7 + 6 + 6 = 19$
- $k = 3$
- $\sum x = 147$
- $\sum x^2 = 1427$
- $SSB = \left(\frac{T_1^2}{n_1} + \frac{T_2^2}{n_2} + \frac{T_3^2}{n_3}\right) - \frac{(\sum x)^2}{n} = \left(\frac{58^2}{7} + \frac{33^2}{6} + \frac{56^2}{6}\right) - \frac{147^2}{19} = 1184.7381 - 1137.3158 = 47.4223$
- $SSW = \sum x^2 - \left(\frac{T_1^2}{n_1} + \frac{T_2^2}{n_2} + \frac{T_3^2}{n_3}\right) = 1427 - 1184.7381 = 242.2619$
- $MSB = \frac{SSB}{k-1} = \frac{47.4223}{3-1} = 23.7112$
- $MSW = \frac{SSW}{n-k} = \frac{242.2619}{19-3} = 15.1414$

b) Write the ANOVA table for this exercise.

ANOVA Table

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	Value of the Test Statistic
Between	2	47.4223	23.7112	$F = \frac{23.7112}{15.1414} = 1.57$
Within	16	242.2619	15.1414	
Total	18	289.6842		

c) Using a 5% significance level, test the null hypothesis that the mean number of violent crimes reported per day is the same for each of these three cities. State the underlying assumption(s).

1) Identify the parameters of interest.

Let μ_1, μ_2, and μ_3 be the mean number of violent crimes reported per day for City I, II and III, respectively.

2) State the null and alternative hypotheses; $H0$ and H_1.

$\begin{cases} H_0: \text{All mean number of violent crimes reported per day is the same for each of the three cities } (\mu_1 = \mu_2 = \mu_3). \\ H_1: \text{Not all three means are equal.} \end{cases}$

3) Select the distribution to use.

We assume that all the assumptions required to apply the one-way ANOVA procedure hold true. They are:

a. The populations from which the samples are drawn are approximately normally distributed.
b. The populations from which the samples are drawn have the same variance (or standard deviation).
c. The samples drawn from different populations are random and independent.

Use the F distribution with

Degrees of freedom for the numerator $= k - 1 = 3 - 1 = 2$

Degrees of freedom for the denominator $= n - k = 16$

4) Calculate the value of the test statistic and determine the rejection and non-rejection regions

$$F = \frac{MSB}{MSW} = 1.57$$

Reject H_0 if $F \geq F_\alpha = F_{0.05} = 3.63$.

5) Make a decision : $F = 1.57 < F_{0.05} = 3.63 \Longrightarrow$ We do not reject H_0

6) Conclusion: At a 5% level of significance, we conclude that the mean number of violent crimes reported per day is the same for each of the three cities.

Q3. While browsing through the magazine rack at a bookstore, a statistician decides to examine the relationship between the price of a magazine and the percentage of the magazine space that contains advertisements. The data collected for eight magazines are given in the following table.

Percentage containing ads	37	43	58	49	70	28	65	32
Price ($)	5.5	6.95	4.95	5.75	3.95	8.25	5.5	6.75

a) Construct a scatter diagram for these data. Does the scatter diagram exhibit a linear relationship between the percentage of a magazine's space containing ads and the price of the magazine?