

Assignment # 6

For each problem, assume that the error distributions are normal, with equal unknown variance σ^2 .

1

Ecology: Rocky Mountain National Park The following is based on information taken from *Winter Wind Studies in Rocky Mountain National Park*, by D. E. Glidden (Rocky Mountain Nature Association). At five weather stations on Trail Ridge Road in Rocky Mountain National Park, the peak wind gusts (miles per hour) in January and April are recorded below.

Weather Station	1	2	3	4	5
January	139	122	126	64	78
April	104	113	100	88	61

Does this information indicate that the peak wind gusts are higher in January than in April? Use $\alpha = 0.01$.

2

Wildlife: Wolves In environmental studies, sex ratios are of great importance. Wolf society, packs, and ecology have been studied extensively at different locations in the U.S. and foreign countries. Sex ratios for 8 study sites in Northern Europe are shown below (based on *The Wolf* by L. D. Mech, University of Minnesota Press).

Gender Study of Large Wolf Packs

Location of Wolf Pack	% Males (Winter)	% Males (Summer)
Finland	72	53
Finland	47	51
Finland	89	72
Lapland	55	48
Lapland	64	55
Russia	50	50
Russia	41	50
Russia	55	45

It is hypothesized that in winter "loner" males (not present in summer packs) join the pack to increase survival rate. Use a 5% level of significance to test the claim the average percentage of males in a wolf pack is higher in winter.

- ③. *Physiology: Oxygen* Aviation and high-altitude physiology is a specialty in the study of medicine. Let x = partial pressure of oxygen in the alveoli (air cells in the lungs) when breathing naturally available air. Let y = partial pressure when breathing pure oxygen. The (x, y) data pairs correspond to elevations from 10,000 feet up to 30,000 feet in 5,000-foot intervals for a random sample of volunteers. Although the medical data were collected using airplanes, it will apply equally well to Mt. Everest climbers (summit 29,028 feet).

x	6.7	5.1	4.2	3.3	2.1 (units: mm Hg/10)
y	43.6	32.9	26.2	16.2	13.9 (units: mm Hg/10)

(based on information taken from *Medical Physiology* by A. C. Guyton, M.D.)

- (a) Please verify that $SS_x = 12.25$; $SS_y = 598.29$; $SS_{xy} = 84.22$; $r \approx 0.984$; $b \approx 6.876$; $S_e \approx 2.532$.
- (b) Use a 1% level of significance to test the claim that the slope of the population least-squares line is positive. Include an estimate for the P value.
- (c) Compute a 95% confidence interval for β . For each unit change in oxygen pressure breathing only available air, what do you expect to be the corresponding change if you were breathing pure oxygen?

- ④. *New Car: Negotiating Price* Suppose you are interested in buying a new Toyota Corolla. You are standing on the sales lot looking at a model with different options. The list price is on the vehicle. As a salesperson approaches, you wonder what the dealer invoice price is for this model with its options. The following data are based on information taken from *Consumer Guide* (vol. 677). Let x be the list price (in thousands of dollars) for a random selection of Toyota Corollas of different models and options. Let y be the dealer invoice (in thousands of dollars) for the given vehicle.

x	12.6	13.0	12.8	13.6	13.4	14.2
y	11.6	12.0	11.5	12.2	12.0	12.8

- (a) Please verify that $SS_x = 1.733$; $SS_y = 1.088$; $SS_{xy} = 1.313$; $r \approx 0.956$; $b \approx 0.758$; $S_e \approx 0.1527$.
- (b) Use a 1% level of significance to test the claim that $\beta > 0$. Include an estimate for the P value.
- (c) Compute a 90% confidence interval for β , and interpret the meaning of the result in the context of this problem.

of the next two

In each problem, assume that the distributions are normal and have approximately the same population standard deviations. In each problem, do the following:

- State the null and alternate hypotheses.
- Find SS_{TOT} , SS_{BET} , and SS_W and check that $SS_{TOT} = SS_{BET} + SS_W$.
- Find $d.f._{BET}$ and $d.f._W$.
- Find MS_{BET} and MS_W .
- Find the F ratio.
- Find the critical value $F_{0.01}$ or $F_{0.05}$ as the problem requires.
- Decide if the null hypothesis is to be rejected or not rejected for the given level of significance α .
- Make a summary table for your ANOVA test.

3

5. **Archaeology: Ceramics** Wind Mountain is an archaeological study area located in southwest New Mexico. Potsherds are broken pieces of prehistoric Native American clay vessels. One type of painted ceramic vessel is called *Mimbres classic black on white*. At three different sites the number of such sherds was counted in local dwelling excavations. (Source: Based on information from *Mimbres Mogollon Archaeology*, by A. I. Woosley and A. J. McIntyre, University of New Mexico Press.)

Site I	Site II	Site III
61	25	12
34	18	36
25	54	69
12	67	27
79		18
55		14
20		

Shall we reject or not reject the claim that there is no difference in population mean Mimbres classic black on white sherd counts for the three sites? Use a 1% level of significance.

6. **Ecology: Pollution** The quantity of dissolved oxygen is a measure of water pollution in lakes, rivers, and streams. Water samples were taken at four different locations in a river in an effort to determine if water pollution varied from location to location. Location I was 500 m above an industrial plant water discharge and near the shore. Location II was 200 m above the discharge point and in midstream. Location III was 50 m downstream from the discharge point and near the shore. Location IV was 200 m downstream from the discharge point and in midstream. The following table shows the results. Lower dissolved oxygen readings mean more pollution. Because of the difficulty in getting midstream samples, ecology students collecting the data had fewer of these samples. Use an $\alpha = 0.05$ level of significance. Do we reject the claim that the quantity of dissolved oxygen does not vary from one location to another or not?

Location I	Location II	Location III	Location IV
7.3	6.6	4.2	4.4
6.9	7.1	5.9	5.1
7.5	7.7	4.9	6.2
6.8	8.0	5.1	
6.2		4.5	