

## Chapter 24 (on DVD) Analysis of Variance

### *Solutions to Class Examples*

1. See Class Example 1.
2. Solution to Class Example 2:

Source	Sum of Squares	DF	Mean Square	<i>F</i> Ratio	P-value
Pizza	97.75	9	10.861	1.2438	0.2833
Error	611.25	70	8.732		
Total	709.00	79			

Even though the *P*-value of 0.2833 would usually provide no evidence of a difference in the mean fat content of pizzas sold by these 10 national chains, the boxplots and summary statistics indicate that the spreads of the 10 groups are not plausibly the same. The conditions for the *F*-test are not met.

*Statistics Quiz – Chapter 24*

Name \_\_\_\_\_

Of the 23 first-year male students at State U. admitted from Jim Thorpe High School, 8 were offered baseball scholarships and 7 were offered football scholarships. The University admissions committee looked at the students' composite ACT scores (shown in the table), wondering if the University was lowering their standards for athletes. Assuming that this group of students is representative of all admitted students, what do you think?

Composite ACT Score		
Baseball	Non-athletes	Football
25	21	22
22	27	21
19	29	24
25	26	27
24	30	19
25	27	23
24	26	17
23	23	

1. Test an appropriate hypothesis and state your conclusion.

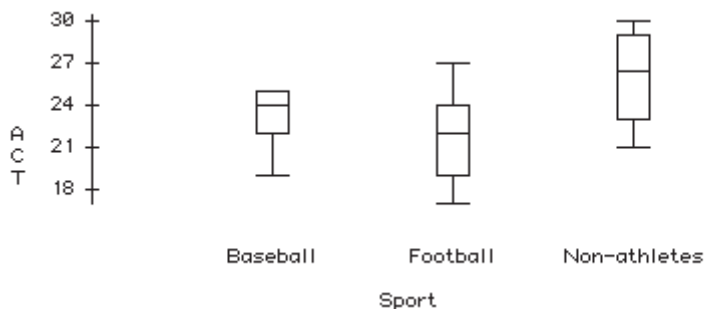
2. Are the two sports teams mean ACT scores different?

**Statistics Quiz – Chapter 24 – Key**

Depending on your class situation, you may want to include the plots and output here for this quiz. Otherwise, the student will need access to a software package.

1.  $H_0 : \mu_F = \mu_B = \mu_{NA}$  vs.  $H_A$ : not all the means are equal.

We assume these students are representative of all admissions. Scores for the groups are independent. Boxplots of the three groups show similar variance and no outliers.

**Analysis of Variance Table**

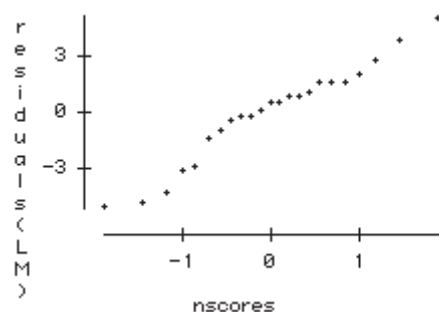
Source	Sums of Squares	df	Mean Squares	F-ratio	P-value
Team	71.00	2	35.50	4.56	0.023
Error	155.61	20	7.78		
Total	226.61	22			

**Means and Std Deviations**

Level	Number	Mean	Std Dev
Baseball	8	23.375	2.0658
Football	7	21.857	3.2877
Non Athlete	8	26.125	2.9489

The nearly Normal condition appears to be met from the Normal probability plot:

With a  $P$ -value this low we reject the null hypothesis (even with this small sample size!). There is evidence that average composite ACT scores for the three groups are not the same.



2. To get a 95% confidence interval for the difference between the baseball and football players, we replace the  $t^*$  critical value at  $\alpha = .05$  with a  $t^{**}$  value at  $\alpha = .05/3 = .01667$ . For 20 degrees of freedom,  $t^{**} = 2.162$ . The pooled standard deviation is  $s_p = 2.79$  points. The mean ACT of the baseball players is 23.375 and 21.857 for football players, so the Bonferroni confidence interval for the difference is:

$$23.375 - 21.857 \pm t^{**} \times s_p \sqrt{\frac{1}{n_B} + \frac{1}{n_F}} = 1.518 \pm 2.162 \times 2.79 \sqrt{\frac{1}{8} + \frac{1}{7}}$$

$$= (-2.26, 5.28) \text{ points.}$$

So we conclude that there is not sufficient evidence of a difference between the mean ACT of the two teams.