

## Applied Statistics Comprehensive Examination

Methods I & II

April 19, 2008

1. (25 Points) Sickle-cell disease is a potentially lethal genetic disease in African-Americans. It is estimated that 30% of African-Americans in a certain Gulf Coast region have the disease or carry the trait for it. This figure seems too large to a physician in the region, so he takes a random sample of 15 of his African-American patients and examines blood smears.
  - (a) (5 Points) State the null and the alternative hypotheses.
  - (b) (10 Points) What rejection region should be used if the test is to have a Type I error rate as close to 0.05 as possible?
  - (c) (10 Points) If the true rate of African Americans who have sickle-cell disease or carry the trait for it is 10%, find the probability of a Type II error.
  
2. (30 Points) Two brands of water filters are to be compared in terms of the mean reduction in impurities measured in parts per million (ppm). 21 waters samples were tested with each filter and the reduction in the impurity level was measured, resulting in the following data:

$$\begin{array}{l} \text{Filter 1: } n_1 = 21 \quad \bar{x}_1 = 8.0 \quad s_1^2 = 4.5 \\ \text{Filter 2: } n_2 = 21 \quad \bar{x}_2 = 6.5 \quad s_2^2 = 2.0 \end{array}$$

- (a) (15 Points) Test at the 0.10 level to determine if there is a difference in the population variances. Be sure to state the assumptions for the test.
- (b) (10 Points) Construct a 95% confidence interval for the difference in mean reduction in impurities between the two filters. Be sure to state the assumptions for the confidence interval.
- (c) (5 Points) On the basis of the confidence interval in part b, can you conclude that a difference in mean reduction in impurities exists between the two filters? Explain.

3. (20 Points) In the late Gene Siskel and Roger Ebert's TV show *Sneak Preview*, the two Chicago movie critics reviewed the week's new movie releases and then rated them thumbs up (positive) or thumbs down (negative). The following table categorizes 111 such movie reviews.

Siskel	Ebert		Totals
	Thumbs Down	Thumbs Up	
Thumbs Down	24	13	37
Thumbs Up	10	64	74
Totals	34	77	111

- (a) (15 Points) Do the data provide sufficient evidence to conclude that an association exists between the ratings of Siskel and Ebert? Explain.
- (b) (5 Points) Is this a Goodness of Fit Test, a Test of Homogeneity or a Test of Independence? Explain.

4. (25 Points) The following table reports the weights (in hundreds of pounds) and time to travel one-quarter mile (in seconds) from rest for ten cars classified in the ‘upscale’ category of *Consumer Reports’ 1999 New Car Buying Guide*:

Weight	Time	Weight	Time
34.6	16.4	31.9	16.8
37.8	17.5	32.6	16.6
38.0	17.0	33.4	16.3
36.5	17.0	33.2	16.7
34.7	17.4	33.0	15.9

The time to travel one-quarter mile is the response variable and the weight of the car is the explanatory variable. Use the following summary quantities to answer the questions below:

$$\begin{aligned} \sum x &= 345.7 & \sum y &= 167.6 & \sum x^2 &= 11993.5 \\ \sum y^2 &= 2811.16 & \sum xy &= 5799.9 & \sum (x - \bar{x})^2 &= 42.66 \\ \sum (y - \bar{y})^2 &= 2.184 & \sum (x - \bar{x})(y - \bar{y}) &= 5.928 \\ \text{Least Squares Line: } \hat{y} &= 11.96 + 0.14x & \text{SSE} &= 1.36 \end{aligned}$$

- (a) (10 Points) Fill out the following ANOVA table:

Source	df	SS	MS	F
Regression				
Error				
Total				

- (b) (10 Points) Test to determine if a significant linear relationship exists between the weight of the car and the time to travel one-quarter mile.
- (c) (5 Points) Calculate and interpret the coefficient of determination.