Elements of Statistics (Math 106) - Quiz 1
Fall 2009 - Brad Hartlaub

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Directions: Please answer all of the questions below. The point values for each problem are indicated in parentheses. Partial credit will be awarded if you show your work.

1. A test was conducted to determine the effectiveness of using an anti-inflammatory cream on delayed-onset muscle soreness. A random sample of 10 patients is treated with the cream on one arm and with a placebo on the other (control) arm. After 4 days, a measure of muscle soreness is then taken for each patient on each arm. The results are listed in the Minitab worksheet p:\data\math\stats\muscle.mtw. Retrieve this worksheet and answer the questions below.

a. List two measures of center for the measurements on the control arm. (10)

mean = 25.6, median = 24, trimmed mean = 24.87

b. List two measures of spread for the measurements on the treated arm. (10)

$s = 14.84$, IQR = 32 − 2 = 30, Range = 39 − 2 = 37

c. Compare the muscle soreness values for treated and control arms using appropriate descriptive statistics and at least one graphical display. Do you think the cream reduces muscle soreness? Explain. (15) (Use side-by-side boxplots)

Although there is considerably more variation in the muscle soreness measurements for the treated arms ($s_T = 14.84$ vs $s_C = 12.82$), both the mean and median are lower ($\bar{x}_T = 17.4$ vs $\bar{x}_C = 25.6$; $\tilde{x}_T = 16$ vs $\tilde{x}_C = 24$) There is some evidence that the cream reduces muscle soreness

2. As part of a student project, James Pollard took a sample of 24 nutrition bars and found the caloric content of each. The data is in the Minitab worksheet p:\data\math\stats\nutritionbars.mtw.

a. Comment on the shape of the distribution of caloric content. (10)

The distribution is skewed to the right with a single peak at 250.

b. What percentile is a value of 219? (5)

219 is the 6th value in the ordered list $\frac{6}{24} \times 100 = 25^{th}$ percentile.

c. Compute and interpret the standardized z-score for 225. (10)

Calc > Standardize

$$\frac{225 - \text{mean}}{s} = \frac{225 - 261.2}{92.8} = -.3901 \quad (-.39035 \text{ using MTB})$$

225 is .3901 standard deviations below the mean caloric content for these nutrition bars.

3. The Per Capita Gross Domestic Product (GDP) and the Per Capita Health Care Spending (HCS) for 22 countries is provided in p:\data\math\stats\health.mtw.

a. Is there any association between HCS and GDP for these countries? (5)

Yes, there is a strong positive association between HCS and GDP for these countries

b. Find and interpret the value of Pearson's correlation coefficient for HCS and GDP. (5)

$r = .899$ => strong linear association between HCS and GDP

c. What is the equation of the least squares regression line for predicting HCS using GDP? (5)

$\widehat{HCS} = -325 + .104\ GDP$

or $\widehat{HCS} = -324.9 + .10429\ GDP$

d. The country of Auschtabeckwinstille has a GDP of $12000, but no data is available for the value of its HCS. What would you predict as the value of Auschtabeckwinstille's HCS? Show how you arrived at this value. (5)

Same GDP as Australia => Predicted value = 926.54

e. Do you think the linear model provides an adequate fit? Explain. (10)

* Must comment on r^2 and residual plot.

$r^2 = 80.8\%$ => 80.8% of the variability in HCS is explained by using a linear model with GDP as the predictor variability. Good fit.

Most of the residuals are in an unstructured band between -200 and 200. However, there is one unusually large residual. Also, the three GDP's close to 15,000 all have negative residuals. A model with some curvature should be considered, but the linear model does a good job.