Statistics 1040, Sections 007 & 009, Midterm 1 (200 Points)

Friday, October 5, 2007

Your Name: _____

Question 1: Correlation / Regression I (**25 Points**)

from: FPP, Chapter 11, Review Exercise 6 (Solutions: → Worklook)

1. (13 Points) In a study of high–school students, a positive correlation was found between hours spent per week doing homeworks, and scores on standardized achievement tests. The investigators concluded that doing homework helps prepare students for these tests. Does the conclusion *follow from the data*? Answer **yes** or **no**, and **explain briefly**. (8)

"The conclusion seems right, but does not follow from the data. It could be, for example, that better students spend more time doing homework anyway". (Association is not causation!) (5)

from: FPP, Chapter 11, Review Exercise 7 (Solutions: → Worklook)

2. (12 Points) The freshmen at a large university are required to take a battery of aptitude tests. Students who score high on the mathematics test also tend to score high on the physics test. On both tests, the average score is 60; the SDs are the same too. The scatter diagram is football–shaped. Of the students *who scored about 75 on the mathematics test*:

   (i) just about half scored over 75 on the physics test.
   (ii) more than half scored over 75 on the physics test.
   (iii) less than half scored over 75 on the physics test. (8)

   Choose one option and explain.

"Regression effect": with 75 points, students belong to the top group on the mathematics test - therefore, it is natural that they will fall back on average on the physics test (4)

from: Stat 1040, Spring 2006, Final Test, Question 1 (Solutions: → Web Page)

Question 2: Controlled Experiment / Observational Study (**40 Points**)

The following is part of an article from Newsweek, April 24, 2006. This question concerns the Women's Health Study, described in the second paragraph.

Take an Aspirin and ...

BY JULIE BURING, SC.D., AND NANCY FERRARI

Aspirin is a wonder drug, plain and simple. At high doses, it quells inflammation; at medium doses, it provides effective pain relief; at low doses, it reduces the blood's ability to clot by inhibiting the action of tiny blood cells called platelets. It makes sense, then, that aspirin might help prevent clot-related cardiovascular events such as heart attack and stroke, even in healthy people. In 1988, the Physicians' Health Study showed exactly that. In healthy men, 325mg of aspirin taken every other day for five years reduced the risk of a first heart attack by 44 percent. That was great news. For men.

It wasn't until March 2005 that the Women's Health Study addressed aspirin's benefits for women. Healthy women — who were at least 45 years old at the start of the study — who participated in the study took either 100mg of aspirin or a placebo every other day for 10 years. Surprisingly, the women taking aspirin experienced no reduction in heart-attack risk. However, aspirin takers were 17 percent less likely to have a stroke. ...

1. (10 Points) Is the study controlled? How do you know?

   yes, it is controlled - women were given an aspirin (in the treatment group) or a placebo (in the control group) (7) (3)

2. (10 Points) Is the study blind? How do you know?

   yes, it is blind - as a placebo was given, women could not judge whether they were given the real aspirin treatment or not (7) (3)

3. (10 Points) What is a placebo? Why is it used?

   a placebo looks like the real treatment (i.e., aspirin here), but it has no active ingredients; (5) it is used to prevent that people respond to the idea (5) of treatment, rather than the treatment itself

4. (10 Points) The article does not say how the women were assigned to the aspirin and placebo groups. What is the best way to do this, and why?

   participants should be assigned randomly (5) to the two groups; this will reduce the effect of all possible confounding factors such as age, gender, etc. (5)

based on: Stat 1040, Spring 2006, Final Test, Question 4 [New Numbers!]

Question 3: Normal Curve (**45 Points**)

For 167 college students the average handspan size is 20.9 inches, with an SD of 1.9 inches. Fill the blanks in the statements below and **show all the work needed to obtain the answers.**

−2 for each calculation error
+2 for correct graph (and nothing else)

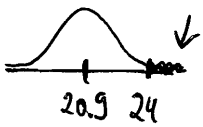
1. (15 Points) Using the normal curve, approximately what percentage of the students have a handspan of more than 20 inches?
   The answer is: 67.37 % [69.15%]

s.u.: $\frac{20-20.9}{1.9} = -0.473 \approx -0.45$ [or -0.50] (5)

−0.45 0 s.u.

area between -0.45 and 0.45: 34.73% (5)
[area between -0.50 and 0.50: 38.29%]
area above -0.45: $50\% + \frac{34.73\%}{2} = 67.37\%$ (5)
[area above -0.50: $50\% + \frac{38.29\%}{2} = 69.15\%$]

2. (15 Points) And what percentage of the students have a handspan of more than 24 inches?
   The answer is: 4.95 % [5.48%]

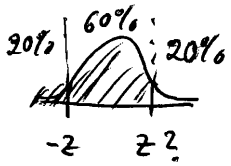


s.u.: $\frac{24-20.9}{1.9} = 1.632 \approx 1.65$ [or 1.60] (5)

0 1.65 s.u.

area between -1.65 and 1.65: 90.11% (5)
[area between -1.60 and 1.60: 89.04%]
area above 1.65: $\frac{100\% - 90.11\%}{2} = 4.95\%$ (5)
[area above 1.60: $\frac{100\% - 89.04\%}{2} = 5.48\%$]

3. (15 Points) If 80 percent of the students have a smaller handspan than the teacher, what is the teacher's handspan?
   The answer is: 22.52 inches



(5)

area between -0.85 and 0.85: 60.47% (closest to 60%) (5)

original units: $0.85 \cdot 1.9 + 20.9 = 22.52$ inches

from: Stat 1040, Spring 2006, Final Test, Question 5 (Solutions → Web Page)

Question 4: Correlation / Regression II (50 Points)

For the 167 college students in Question 3, the relationship between height and handspan size is summarized as follows:

x	height:	average = 68.0 inches	SD = 4.0 inches
y	handspan size:	average = 20.9 inches	SD = 1.9 inches
		r = 0.75	

(point of average; about 95% of data within 68 ± 2·4.0 = 60 to 76; about 95% of data within 20.9 ± 2·1.9 = 17.1 to 24.7)

Fill the blanks in the statements below and **show all the work needed to obtain the answers.**

1. (10 Points) Six scatter diagrams are printed on the next page. Which of the scatter diagrams is the correct one for these data? **Circle the correct letter below (No explanation is needed for this part!):**

   A (B) C D E F

   (10)

   [see figure for explanation - but not needed]

2. (15 Points) Using the summary statistics above, what is the regression estimate for handspan for a student who is 60 inches tall?
   The answer is: 18.05 inches

   (−2 for each calculation error)

   $$S.u._x = \frac{60-68}{4} = -2 \quad (5)$$

   $$S.u._y = -2 \cdot 0.75 = -1.5 \quad (5)$$

   $$Y = -1.5 \cdot 1.9 + 20.9 = 18.05 \text{ inches} \quad (5)$$

3. (15 Points) Find the r.m.s. error for your answer in the previous part.
   The answer is: 1.26 inches (15)

   (−5 for each mistake (e.g., not square or incorrect SD))

   $$\text{r.m.s error} = \sqrt{1-0.75^2} \cdot 1.9 = 1.26 \text{ inches}$$

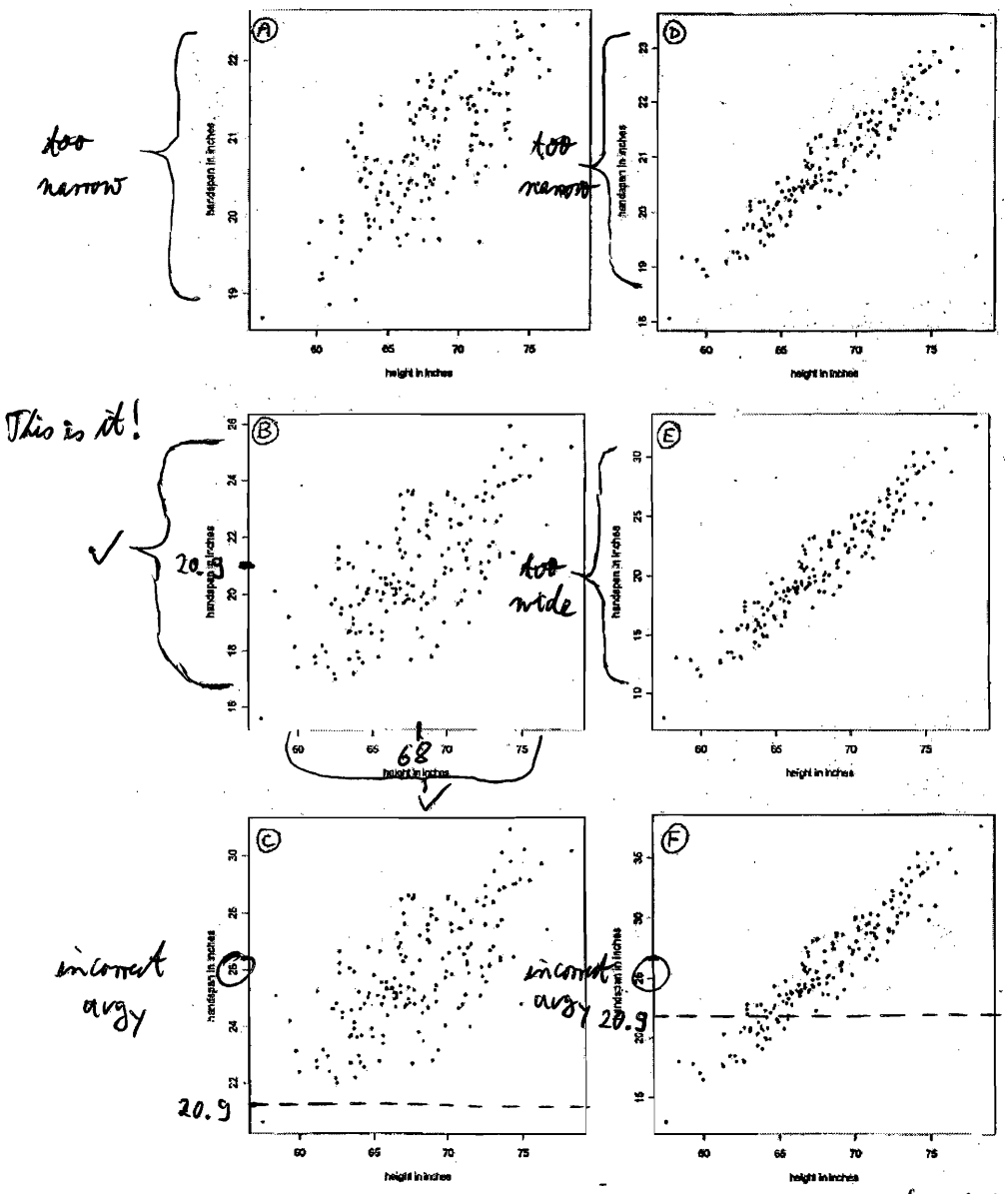
4. (10 Points) What would the correlation coefficient be if we changed all the handspan measurements to centimeters? (There are 2.54 centimeters in an inch).
   The answer is: $r = 0.75$ (it won't change!)

   (10)

Formulas:

$$\text{r.m.s. error} = \sqrt{1-r^2} \times \text{SD}_y$$

Exclude impossible plots:



from: Stat 1040, Spring 2006, Quiz 2, Question 2 (Solutions: → Web Page
& FPP, Chapter 3, Exercise Set C, Exercise 3, p. 41 & → Textbook, p. A-46)

Question 5: Histograms / Change of Scale (40 Points)

An investigator draws a histogram for some height data, using the metric system. She is working in centimeters (cm). The vertical axis shows density, and the top of the vertical axis is 10 percent per cm. Now she wants to convert to millimeters (mm). There are 10 millimeters to the centimeter. On the horizontal axis, she has to change 175 cm to 1,750 (10) mm, and 200 cm to 2,000 (10) mm. On the vertical axis, she has to change 10 percent per cm to 1 (10) percent per mm, and 5 percent per cm to 0.5 (10) percent per mm.

Just fill in the correct answers — no explanation is needed.

Textbook: "The idea on density: If you spread 10 percent evenly over 1 cm = 10 mm, there is 1 percent in each mm, that is, 1 percent per mm."