

# Statistics 1040, Section 004, Midterm 1 (200 Points)

October 3, 2003

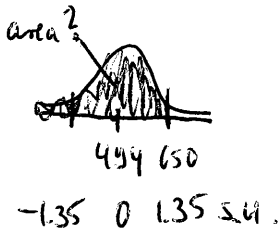
Your Name: \_\_\_\_\_

## Question 1: Normal Distribution (50 Points)

The Graduate Record Examination (GRE) is a test taken by college students who intend to pursue a graduate degree in the United States. A longterm average for the verbal ability portion of this exam of all college seniors and graduates who take this exam is 494, with a standard deviation of 115. Assuming that the histogram of all GRE scores follows the normal curve, answer the following questions. **Show your work.**

1. (25 Points) If you received a score of 650 on the GRE exam, what percentile of the distribution would you be in?

Answer: 91 <sup>(9)</sup>th percentile



$$\frac{650 - 494}{115} = \frac{156}{115} = 1.35 \text{ s.d.} \quad (8)$$

area between -1.35 and 1.35: 82.30% (8)

area above 1.35:  $\frac{100\% - 82.30\%}{2} = \frac{17.7\%}{2} = 8.85\%$

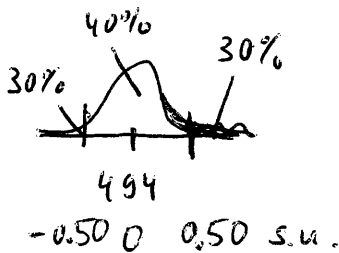
area below 1.35:  $100\% - 8.85\% = 91.15\% \approx 91\%$

[or:  $50\% + \frac{82.30\%}{2} = 50\% + 41.15\% = 91.15\% \approx 91\%$ ]

(5) if correct graph only  
(in 1. & 2.)

2. (25 Points) A graduate school program in English will admit only students with GRE verbal ability scores in the top 30%. What is the lowest GRE score you must have to be accepted in this graduate program?

Answer: 552 [or 557] (9)



area between -0.50 and 0.50: 38.29% (8)

[or -0.55 and 0.55: 41.77%]

original score:  $0.5 \cdot 115 + 494 = 551.5 \approx 552$

[  $0.55 \cdot 115 + 494 = 557.25 \approx 557$  ]

part 1.) from: FPP, Chapter 8, page 134-135, Review Exercise 1

**Question 2: Correlation and Regression (60 Points)**

A study of the IQs of husbands and wives obtained the following results:

for husbands, average IQ = 100, SD = 15

for wives, average IQ = 100, SD = 15

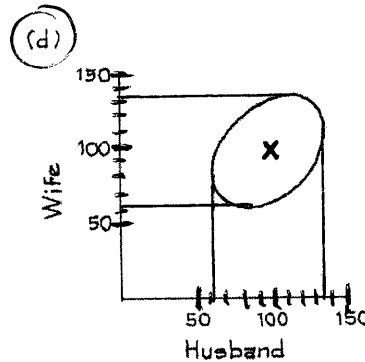
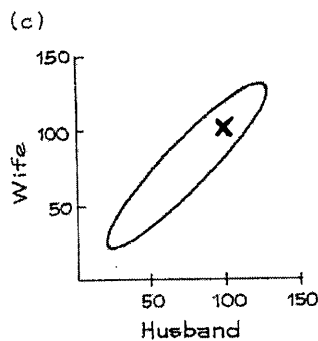
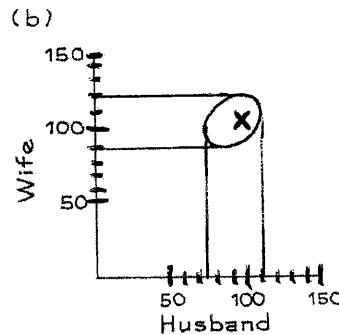
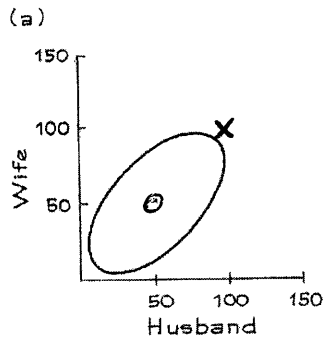
$$r = 0.6$$

1. (15 Points) One of the following is a (summarized) scatter diagram for the data. Which one?

Circle your answer and explain briefly why you reject the others.

(a) (b) (c) **(d)**  
**g**

- S if (b) instead of (d)



Answers adapted from Workbook.

Reject others because:

- ② (a) has the wrong means (it has  $\bar{x}_{avg} = \bar{y}_{avg} = 50$ , should be  $\bar{x}_{avg} = \bar{y}_{avg} = 100$ )
- ② (b) has the wrong SD's (it has  $SD_x = SD_y \approx 8$ , should be  $SD_x = SD_y = 15$ )
- ② (c) has too much correlation (it has  $r \approx 0.9$ , should be  $r = 0.6$ )

2. (15 Points) Predict the IQ of the wife whose husband has an IQ of 130.

$$S.u.x = \frac{x - \text{avg}_x}{SD_x} = \frac{130 - 100}{15} = 2.0$$

(5)

husband: x  
wife: y

$$S.u.y = r \cdot S.u.x = 0.6 \cdot 2.0 = 1.2$$

(5)

$$y = S.u.y \cdot SD_y + \text{avg}_y = 1.2 \cdot 15 + 100 = \underline{\underline{118}}$$

(5)

3. (15 Points) Predict the IQ of the husband whose wife has an IQ of 118.

$$S.u.x = \frac{118 - 100}{15} = 1.2$$

(5)

wife: x

$$S.u.y = 0.6 \cdot 1.2 = 0.72$$

(5)

husband: y

$$y = 0.72 \cdot 15 + 100 = 110.8 \approx \underline{\underline{111}}$$

(5)

4. (15 Points) Apparently, intelligent men tend to marry women who are less intelligent than themselves. On the other hand, women tend to marry men who are even less intelligent! How is this possible?

Nothing unexpected happened - this is just the regression effect.

The statement above is incorrect and an example for the regression fallacy.

-12 if statement is confirmed

-5 for missing keyword (each)

From: Stat 1040, Fall 2001, Final Test, December 13, 2001, Question 1,  
Question 3: Controlled Experiment/Observational Study (60 Points)

A recent study in Europe looked at a large group of women of childbearing age. The researchers asked each woman how much alcohol they had consumed over the past 12 months. The researchers found that women who drank moderate amounts of alcohol were somewhat less likely to have infertility problems than women who did not drink alcohol at all (November, 2001). The study said it "controlled for age, income, and religion".

1. (15 Points) Based on the information above, was this a controlled experiment or an observational study? Explain briefly.

Answers from  
Course Web Page:

no intervention was used - nobody was told to drink / not to drink

⑤ correct explanation  
① some explanation

2. (15 Points) Why did they "control for" age, income, and religion?

these factors may be confounding factors

-5 for missing keyword  
(but otherwise correct  
explanation)

3. (15 Points) Is this convincing evidence that infertility would decrease if women with infertility problems started to drink moderate amounts of alcohol? (Note: we are only asking about infertility. There may be other problems introduced by such behavior, but ignore them for answering this question).

no! - we only know that there is association between drinking and fertility; drinking does not cause fertility

[ association is not causation! ]

4. (15 Points) Suggest a possible confounding factor (other than age, income, or religion) and **clearly explain** why you think it might be a confounding factor.

general health (condition):

someone who has some other medical problem may not drink and also be less fertile

⑩ for correct confounding factor

⑤ for correct explanation

① for some explanation

From: FPP, Chapter 5, page 95, Review Exercise 8

Question 4: Average and Standard Deviation (30 Points)

True or false, and explain briefly (if false, explain what happens instead):

- (5 Points) If you add 7 to each entry on a list, that adds 7 to the average.

True / False?

True  
5 -

- (5 Points) If you add 7 to each entry on a list, that adds 7 to the SD.

True / False?

False  
4

Workbook: Adding a constant to the data does not change the spread. ①

- (5 Points) If you double each entry on a list, that doubles the average.

True / False?

True  
5 -

- (5 Points) If you double each entry on a list, that doubles the SD.

True / False?

True  
5 -

- (5 Points) If you change the sign of each entry on a list, that changes the sign of the average. True / False?

True  
5 -

- (5 Points) If you change the sign of each entry on a list, that changes the sign of the SD. True / False?

False  
4

Workbook: The deviations from the average will also have their signs changed, but negative signs go away in the squaring. Besides, SD is never negative. ①