

## Homework 5

Due November 17

1. (40 points) The data below reports the observed 90th percentile of systolic blood pressure for boys in single years of age from age 1 to age 18 based on prior studies.

Age(x)	SBP(y)	Age(x)	SBP(y)
1	105	10	117
2	106	11	119
3	107	12	121
4	108	13	124
5	109	14	126
6	111	15	129
7	112	16	131
8	114	17	134
9	115	18	136

We choose a more efficient way to display the data and choose linear regression to accomplish this task.

- (a) Fit a regression line relating age to SBP. Note that

$$\sum_{i=1}^{18} x_i = 171, \quad \sum_{i=1}^{18} x_i^2 = 2109, \quad \sum_{i=1}^{18} y_i = 2124, \quad \sum_{i=1}^{18} y_i^2 = 252,338, \quad \sum_{i=1}^{18} x_i y_i = 21,076.$$

- (b) Provide a 95% CI for the parameters of the regression line.  
 (c) Discuss the goodness of fit for this linear regression line.  
 (d) What is the predicted blood pressure for an average 13-year-old boy as estimated from the regression line? What is the residual component? What is the regression component? Answer the same questions for an average 18-year-old boy.
2. (20 points) The following multilinear logistic model is considered:

$$\ln\left(\frac{p}{1-p}\right) = -1.637 + 2.242x_1 + 0.102x_2$$

where  $p$  is the probability to develop an infectious disease,  $x_1$  is a binary variable which is 0 for white women and 1 for black women,  $x_2$  records the number of sexual partners. Give an interpretation of the regression coefficients. What is the predicted probability of a white woman that had three sexual partners to develop the infectious disease? Answer the same question for a black woman.

3. (50 points) **You may work in group for this problem to reduce the volume of computations.**

The following data was collected in two ways: by using a diet record (DR) which asked individuals to write down the exact amount of food eaten over a period of one week and by using a food frequency questionnaire (FFQ) which asks the individual to write the number of servings per day typically eaten in the past year. The data set below records (in order) : Saturated fat (DR), Saturated fat (FFQ), Total fat (DR), Total fat (FFQ), Alcohol consumption (DR), Alcohol consumption (FFQ).

33.20	21.20	81.15	53.80	8.26	1.68
17.73	10.60	53.28	36.60	0.83	0.00
38.73	23.80	83.48	47.20	20.13	15.10
21.57	22.70	49.65	55.30	11.16	7.49
21.35	30.40	55.18	71.00	7.18	12.84
28.04	15.10	73.83	41.10	1.76	0.00
23.17	17.80	68.29	49.10	22.66	25.06
19.73	19.10	58.30	48.90	0.00	0.00
36.31	23.40	92.58	55.40	0.00	0.00
20.87	16.00	68.44	44.20	0.00	0.00
26.40	19.40	69.16	46.60	4.75	1.06
28.26	27.40	79.42	59.70	4.57	1.81
19.81	15.80	69.59	50.50	15.12	11.14
23.48	19.90	65.86	55.60	5.37	2.57
25.62	17.40	74.22	51.70	0.00	0.00
23.59	9.50	63.44	23.40	1.89	0.76
14.60	20.90	38.14	46.90	0.78	5.70
20.71	27.70	49.77	70.10	8.09	10.56
28.63	15.30	80.73	35.30	37.90	35.34
18.12	20.70	53.56	55.70	2.22	0.76

Use the t-test for Spearman rank correlation to study the following relationships:

- (a) between alcohol intake as reported on the diet record to alcohol intake as reported on the frequency-food questionnaire;
  - (b) between total fat intake as reported on the diet record to total fat intake as reported on the frequency-food questionnaire;
  - (c) between saturated fat intake as reported on the diet record to saturated fat intake as reported on the frequency-food questionnaire.
4. (40 points) Write a short essay (1-2 pages) about the importance of mathematical modeling. Try to express **your** views on the following issues:
- is it more important to keep the mathematical rigor when trying to solve a problem or to provide a solution even though some steps were not rigorously motivated?
  - what role do you believe applied mathematicians should play in today's society? Do they need to know any background about the problem they are working on, or should they just focus on providing logical and correct solutions? Why?
  - what role do you think computers will play in the next 50 years? Will mathematicians be slowly replaced by the very fast machines of the future?

- do you remember a time when you had to use mathematics for a real-life problem (something more complex than computing the tip at a restaurant)?
- do you feel competent to take care of your personal finances or would you hire a financial advisor? Do you know how to compute the interest for a savings account or for a loan?
- do you believe that the college provides you with too much or too little mathematical training for your future job?
- give an example of a mathematical model and explain how you would attempt to solve it.