

Instructions: The exam consists of five questions. The total points for each questions is listed with the questions. The maximum number of possible points is 25. All the paper you should need is provided in the exam.

Here is a list of conditions that apply.

1. Show all work.
2. Probability tables are provided - you have every table needed to complete the exam.

You have until 1:45 to complete the exam.

1. (6 points) The US Census and the Bureau of Labor Statistics conduct an annual survey entitled the Consumer Expenditure Survey. The survey collects information on the proportion of income spent on various goods and services. The following table was generated from the 1993 Survey. The unit of analysis is single people. The table is based on two variables from the survey. Variable #1 is the percent of income spent on food, this includes food prepared at home as well as prepared food purchased outside the home. Variable #2 is net income, that is, income after taxes.

The table shows the percentage of persons by income and food purchase. There are two row values. Row 1 are individuals who spent less than 10% of their annual income on food (**FL**). Row 2 are individuals who spent 10% or more of their income on food (**FH**). Column 1 are those individuals who earned less than the median income for this group (\$18,300) (**IL**). Column 2 are those individuals who earned the median income or greater (**IH**). For example, looking at the value in row 1, column 2, 43.04% of the survey respondents earned \$18,300 or more and spent less than 10% of their income on food.

% of Income spent on Food	Income		Total
	less than \$18,300 IL	\$18,300 or more IH	
less than 10% FL	0.2500	0.4304	0.6804
10% or more FH	0.2500	0.0696	0.3196
Total	0.5000	0.5000	

If one person is selected from the sample ...

- (a) What is $P(\text{FH})$?
- (b) What is $P(\text{IH} \cap \text{FH})$?
- (c) What is $P(\text{IL} \cup \text{FH})$?
- (d) What is $P(\text{FH}|\text{IL})$?
- (e) Are income and the proportion of income spent on food independent? Support your assessment with the probability condition for independence.

2. (5 points) From a binomial experiment.

$$n=23$$

$$p=0.25$$

(a) Calculate $P(x = 7)$

(b) Calculate $P(7 \leq x \leq 9)$

3. (5 points) Car insurance is a way to protect drivers from the cost of a major accident. Suppose a driver pays \$750 for car insurance. From the actuarial tables, the probability of having an accident within the year that results in a loss of \$60,000 is p . What is the value of p such that the insurance company breaks even.

4. (4 points) The number x of critically injured people arriving to an emergency room from 11pm to 5am Friday night/Saturday morning has a Poisson probability distribution with a mean equal to six persons.
- (a) What is the probability that ten critically injured people will arrive in this time period.
 - (b) The administration is interested in decreasing the number of emergency doctors per night shift from 3 to 2. The distribution of patients is symmetrical. Using the Empirical Rule, identify the lower and upper bounds for the values that contain 95 % of the measurements. Can the administration reduce the number of doctors and ensure that the maximum patient to doctor ratio remains under 4?

5. (5 points) Although faculty salaries at colleges and universities in the US continue to rise, they do not always keep pace with the cost of living. During the 1996-1997 academic year, female assistant professors earned an average of \$40,000 per year. Suppose the salaries were normally distributed with a standard deviation of \$6,000.
- (a) What proportion of female assistant professors will have salaries less than \$30,000?
 - (b) What proportion of female assistant professors will have salaries between \$50,000 and \$55,000 ?
 - (c) What proportion of female assistant professors are found with $\pm 10\%$ of the mean value?