PROBLEM SETS

All answers must be explained

PROBLEM SET #1
Due: Tuesday 18 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on (a) the introduction to logic and (b) combinatorics.

Problem 2 (1 point). (a) How many integers between 100 and 999 have three distinct digits, and (b) how many of those integers are odd?

Problem 3 (1 point). Vanessa is a cabaret singer who always opens her act by telling four jokes. Her current engagement is scheduled to run for four months. If she gives one performance a night and never wants to repeat the same set of jokes on any two nights, what is the minimum number of jokes she must have in her repertoire?

Problem 4 (1 point). A pinochle deck has 48 cards, two of each of six denominations (9, J, Q, K, 10, A) and the usual four suits. In a hand of 12 cards, what is the probability of getting a *"bare" roundhouse*, namely a king and queen of each suit and no other kings or queens?

PROBLEM SET #2
Due: Wednesday 19 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on the unconditional probability calculus.

Problem 2 (1 point). In a soon-to-be released Halloween martial arts movie, a pumpkin has a starring role. Because of the rather violent nature of the film, the producers have also hired a stunt pumpkin. Suppose that the featured pumpkin appears in 40% of all the film's scenes, the stunt pumpkin in 30%, and the two appear together in 5% of the scenes. What is the probability that in a given scene (a) only the stunt pumpkin appears, (b) neither pumpkin appears?

Problem 3 (1 point). A committee of 3 is chosen at random from a group of 5 men and 5 women. What is the probability that (a) the committee consists of only men or only women, (b) at least one man and at least one woman are on the committee, (c) at least one man is on the committee?

Problem 4 (1 point). Each of m urns contains 3 red and 4 white chips. From each urn, r chips are drawn with replacement. What is the probability that at least one of the mr drawn chips is red?

PROBLEM SET #3
Due: Thursday 20 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on the conditional probability calculus.

Problem 2 (1 point). Suppose that two fair dice are tossed. What is the probability that the sum equals 10 given that it exceeds 8?

Problem 3 (1 point). Josh takes a 20-question multiple-choice exam where each question has five answers. Some of the answers he knows, while others he gets right just by making lucky guesses. Suppose that the conditional probability of his knowing the answer to a randomly selected question given that he got it right is 0.92. How many of the 20 questions was he prepared for?

Problem 4 (1 point). A company has bought three software packages to solve an accounting problem. They are called Fog, Golem, and Hotshot. Fog crashes 10% of the time, Golem 20% of the time, and Hotshot 30% of the time. Of 10 employees, six are assigned Fog, three are assigned Golem, and one is assigned Hotshot. Sophia was assigned a program at random. Given that it crashed on the first trial, what is the probability that she was assigned Hotshot?

PROBLEM SET #4
Due: Monday 24 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on discrete random variables.

Problem 2 (1 point). Suppose a coin having probability 0.7 of coming up heads is tossed three times. Let X denote the number of heads that appear in the three tosses. Determine the probability mass function of X.

Problem 3 (1 point). A person attempts to predict the face of a fair coin in each of several successive trials. If she is only guessing, what is the probability that she will predict correctly (a) in 4 out of 4 successive trials, (b) in at most 2 out of 10 trials, (c) in 8 or more out of 10 trials?

Problem 4 (1 point). On the basis of past performance, the probability that the favorite will win the Bellevue Handicaps is 0.46, while there is a probability of only 0.1 that a certain dark horse will win. If the favorite pays even money, and the odds offered are 8-to-1 against the dark horse, a $100 bet on which horse has higher expected value?

PROBLEM SET #5
Due: Tuesday 25 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on continuous random variables.

Problem 2 (1 point). The Stanford-Binet IQ test is scaled to give a mean score of 100 with a standard deviation of 16. Suppose that children having IQs of less than 80 or greater than 145 are deemed to need special attention. Given a population of 2000 children, what is the expected number of children who will need special attention?

Problem 3 (1 point). The diameter of the connecting rod in the steering mechanism of a foreign sports car must be between 1.480 and 1.500 cm, inclusive, to be usable. The distribution of connecting rod diameters produced by the manufacturing process is normal with a mean of 1.495 cm and a standard derivation of 0.005 cm. What percentage of rods are unusable?

Problem 4 (1 point). It is estimated that 80% of all 18-year-all women have weights ranging from 103.5 to 144.5 lb. Assuming the weight distribution can be adequately approximated by a normal curve and that 103.5 and 144.5 are equal distances from the average weight μ, calculate σ.

PROBLEM SET #6
Due: Wednesday 26 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on (a) the material of the previous quizzes and (b) the interpretations of probability.

Problem 2 (1 point). In a population of n +1 people, a man, the " progenitor", sends out letters to two distinct persons, the "first iteration". These repeat the performance and, generally, for each letter received the recipient sends out two letters to two people chosen at random without regard to past development. Find the probability that up to and including iteration number 1, 2, …, r the progenitor will not have received any letter.

Problem 3 (1 point). The probability of a twenty-year-old man living to age seventy is 0.74, and the probability of a twenty-year old woman living to the same age is 0.82. If a recently married couple, both age twenty, give 8-to-1 odds on their staying married for fifty years given that they are both alive until then, what is the probability that (a) at least one will live to age seventy, (b) they will celebrate their golden wedding anniversary?

Problem 4 (1point). The number of miles a driver gets on a set of tires is normally distributed with a mean of 30,000 miles and a standard deviation of 5,000 miles. Is the manufacturer of these tires justified in claiming that 90% of all drivers will get at least 25,000 miles?

PROBLEM SET #7
Due: Thursday 27 June at 1:10pm in class

Problem 1 (1 point). In-class quiz on estimating proportions.

Problem 2 (1 point). In a sample of 60 randomly selected students, only 22 favored the amount being budgeted for next year's intramural and interscholastic sports. Construct the 99% confidence interval for the proportion of all students who support the proposed budget amount.

Problem 3 (1 point). A random sample of 400 human subjects produced 280 subjects who were classified as right-eye-dominant on the basis of a sighting task. Estimate the fraction of the entire population who are right-eye-dominant; use a 95 percent confidence interval.

Problem 4 (1 point). A bank believes that approximately 2/5 of its checking-account customers have used at least one other service provided by the bank within the last six months. How large a sample is needed to estimate the proportion to within (i.e., ±) 5% at the 98% level of confidence?

PROBLEM SET #8
Due: Monday 1 July at 1:10pm in class

Problem 1 (1 point). In-class quiz on estimating and comparing means.

Problem 2 (1 point). While doing an article on the high cost of college education, a reporter took a random sample of the cost of textbooks for a semester. Her sample data can be summarized by $n = 41$, $\Sigma x = 550.22$, and $\Sigma(x - \bar{x})^2 = 1617.984$. (a) Find the sample mean. (b) Find the sample standard derivation. (c) Find the 90% confidence interval to estimate the mean textbook cost for the semester based on this sample.

Problem 3 (1 point). A group of ten recently diagnosed diabetics was tested to determine whether an educational program was effective in increasing their knowledge of diabetes. They were given a test, before and after the educational program, concerning self-care aspects of diabetes. The scores on the test were as follows.

Before:	75	62	67	70	55	59	60	64	72	59
After:	77	65	68	72	62	61	60	67	75	68

Determine whether the scores improved as a result of the program. Use $\alpha = 0.05$.

Problem 4 (1 point). To compare the merits of two short-range rockets, 8 of the first kind and 10 of the second kind are fired at a target. The first kind has a sample mean target error of 36 ft and a sample standard deviation of 15 ft, while the second kind has a sample mean target error of 52 ft and a sample standard deviation of 18 ft. Does this indicate that the second kind of rocket is less accurate than the first? Use $\alpha = 0.01$ and assume normal distribution for target error.

PROBLEM SET #9
Due: Tuesday 2 July at 1:10pm in class

Problem 1 (1 point). In-class quiz on goodness of fit.

Problem 2 (1 point). A manufacturer of floor polish conducted a consumer-preference experiment to determine which of five different floor polishes was the most appealing in appearance. A sample of 100 consumers viewed five patches of flooring that had each received one the five polishes. Each consumer indicated the patch he or she preferred. The lighting and background were approximately the same for all patches. The results were as follows:

Polish:	A	B	C	D	E
Frequency:	27	17	15	22	19

(a) State the hypothesis for "no preference" in statistical terminology. (b) What test statistic will be used in testing this null hypothesis? (c) Complete the hypothesis test using $\alpha = 0.10$.

Problem 3 (1 point). A certain type of flower seed will produce magenta, chartreuse, and ochre flowers in the ratio 6 : 3 : 1 (one flower per seed). A total of 100 seeds are planted and all germinate, yielding 52 magenta, 36 chartreuse, and 12 ochre. (a) If the null hypothesis (6 : 3 : 1) is true, what is the expected number of magenta flowers? (b) How many degrees of freedom are associated with chi-square? (c) Complete the hypothesis test using $\alpha = 0.01$.

Problem 4 (1 point). High blood pressure is known to be one of the major contributors to coronary heart disease. A study was done to see whether or not there is a significant relationship between the blood pressures of children and those of their fathers. If such a relationship did exist, it might be possible to use one group to screen for high-risk individuals in the other group. The subjects were 92 eleventh graders, 47 males and 45 females, and their fathers. Blood pressures for both the children and the fathers were categorized as belonging to either the lower, middle, or upper third of their respective distributions.

		Child's blood pressure		
		Lower third	Middle third	Upper third
Father's	Lower third	14	11	8
blood	Middle third	11	11	9
pressure	Upper third	6	10	12

Test whether or not the blood pressure of children can be considered to be independent of the blood pressure of their fathers. Let $\alpha = 0.05$.

PROBLEM SET #10
Due: Wednesday 3 July at 1:10pm in class

Problem 1 (1 point). In-class quiz on Bayesian statistical inference.

Problem 2 (1 point). The full-time student body of a college is composed of 50% males and 50% females. Does a random sample of students (30 male, 20 female) from an introductory chemistry course show sufficient evidence to reject the hypothesis that the proportions of male and female students who take this course are the same as those of the whole student body? Use $\alpha = 0.001$.

Problem 3 (1 point). Twenty laboratory mice were randomly divided into two groups of ten. Each group was fed according to a prescribed diet. At the end of three weeks, the weight gained by each animal was recorded. Do the data in the following table justify the conclusion that the mean weight gained on diet B was different from the mean weight gained on diet A, at the $\alpha =$ 0.05 level of significance?

Diet A:	5	14	7	9	11	7	13	14	12	8
Diet B:	5	21	16	23	4	16	13	19	9	21

Problem 4 (1 point). A program for generating random numbers on a computer is to be tested. The program is instructed to generate 100 single-digit integers between 0 and 9. The frequencies of the observed integers were as follows:

Integer:	0	1	2	3	4	5	6	7	8	9
Frequency:	11	8	7	7	10	10	8	11	14	14

At the 0.05 level of significance, is there sufficient reason to believe that the integers are not being generated uniformly?

PROBLEM SET #11
Due: Tuesday 9 July at 1:10pm in class

Problem 1 (1point). In-class quiz on decision theory.

Problem 2 (1 point). Some gamblers think that they have a nifty way of winning money. Slick Jim likes to go to the horse races. He enjoys the scene. He does not want to get rich, but at least he wants to cover the price of admission, which in his town is $10. So he bets enough on the first race to win $10. He is betting on a favorite, so he has to put up $7. If he loses, he bets enough to win $17. Next race he bets on a long shot, and he puts up $3. If he loses that race, he bets enough to win $20. And so on. If he loses on every race this Saturday, he is out of pocket, say, $164. So next Saturday he has to bet enough to win $164 + $10. What is wrong with this strategy?

Problem 3 (1 point). Someone at a fund-raiser gives you a ticket that he has purchased. Five hundred tickets were sold. You can turn the ticket in for a $10 cash payout or you can enter it in a raffle for a prize of $1,000. (a) If money is the only consideration, what is the expected value of each of the choices? (b) What kind of decision is involved? (c) What are your utilities in this case? (d) Which decision rule would you use, and which decision would you make?

Problem 4 (1 point). As an enthusiastic opera fan, you are considering the purchase of a season ticket to the opera. If you buy a $100 season ticket, you can see five operas for the price of four single tickets ($25). Your work schedule is erratic, however, and you figure the probability that you can attend at most three is about 2/3; the probability that you can attend at least three is about 1/3. Should you buy a season ticket? In your answer, describe the relevant states of the world and the probability and utility associated with each.

PROBLEM SET #12
Due: Wednesday 10 July at 1:10pm in class

Problem 1 (1 point). In-class quiz on causal reasoning.

For each causal argument in the following passages, (a) formulate the (implicit) conclusion as a causal claim, (b) explain what sense of causality is used in the conclusion, (c) explain which one of Mill's methods is being used, and (d) critically evaluate the argument.

Problem 2 (1 point). Researchers from the National Cancer Institute announced that they have found a number of genetic markers shared by gay brothers, indicating that homosexuality has genetic roots. The investigators, reporting in *Science*, 16 July 1993, have found that out of 40 pairs of gay brothers examined in their study, 33 pairs shared certain DNA sequences on their X chromosome, the chromosome men inherit only from their mothers. The implicit reasoning of this report is that, if brothers who have specific DNA sequences in common are both gay, these sequences can be considered genetic markers for homosexuality.

Problem 3 (1 point). Repeated reports, before and after Kinsey, showed college-educated women to have a much lower-than-average divorce rate. More specifically, a massive and famous sociological study by Ernest W. Burgess and Leonard S. Cottrell indicated that women's chances of happiness in marriage increased as their career preparation increased…. Among 526 couples, less than 10 percent showed "low" marital adjustment where the wife had been employed seven or more years, had completed college or professional training, and had not married before twenty-two. Where wives had been educated *beyond college*, less than 5 percent of marriages scored "low" in happiness. (Betty Friedan, *The Feminine Mystique*.)

Problem 4 (1 point). Some theories arise from anecdotal evidence that is difficult to confirm. In *The Left-Hander Syndrome* (1992), Stanley Coren sought to evaluate the common belief that left-handed persons die sooner than right-handers. But death certificates or other public records very rarely mention the hand preferred by the deceased. What could serve as a reliable data source with which that hypothesis could be tested? Coren searched baseball records, noting which hand baseball pitchers threw with, and then recording their ages at death. Right-handed pitchers, he found, lived on average nine months longer than lefties. Then, in a follow-up study, he and a colleague telephoned the relatives of people named on death certificates in two California counties, to ask which hand the deceased favored. Right-handed people (that study found) lived an average of nine years longer than lefties.

PROBLEM SET #13
Due: Thursday 11 July at 1:10pm in class

Problem 1 (1 point). In-class quiz on analogical reasoning.

For each analogical argument in the following passages, (a) explain which of the six types of analogical arguments in Handout 14 it exemplifies, and (b) critically evaluate the argument by using the three-step procedure in Handout 14.

Problem 2 (1 point). The body is the substance of the soul; the soul is the functioning of the body. ... The relationship of the soul to its substance is like that of sharpness to a knife, while the relationship of the body to its functioning is like that a knife to sharpness. What is called sharpness is not the same as the knife, and what is called the knife is not the same as sharpness. Nevertheless, there can be no knife if the sharpness is discarded, nor sharpness, if the knife is discarded. I have never heard of sharpness surviving if the knife is destroyed, so how can it be admitted that the soul can remain if the body is annihilated? (Fan Chen, *Essay on the Extinction of the Soul*.)

Problem 3 (1 point). Just as the bottom of a bucket containing water is pressed more heavily by the weight of the water when it is full than when it is half empty, and the more heavily the deeper the water is, similarly the high places of the earth, such as the summits of mountains, are less heavily pressed than the lowlands are by the weight of the mass of the air. This is because there is more air above the lowlands than above the mountain tops; for all the air along a mountain side presses upon the lowlands but not upon the summit, being above the one but below the other. (Blaise Pascal, *Treatise on the Weight of the Mass of the Air*.)

Problem 4 (1 point). At the Mad Tea Party in Wonderland, Alice makes a logical mistake. The March Hare reproves her sharply, saying: "You should say what you mean." The conversation then continues:

> "I do", Alice hastily replied; "at least—at least I mean what I say—that's the same thing, you know."
> "Not the same thing a bit!" said the Hatter.
> "Why, you might just as well say that 'I see what I eat' the same thing as 'I eat what I see'!"
> "You might just as well say," added the March Hare, "that 'I like what I get' is the same thing as 'I get what I like'!".
> "You might just as well say," added the Dormouse, which seemed to be talking in its sleep, "that 'I breathe when I sleep' is the same thing as 'I sleep when I breathe'!".
> "It *is* the same thing with you," said the Hatter, and here the conversation dropped.

(Lewis Carroll, *Alice's Adventures in Wonderland.*)