

Instructions: Work problems on a separate sheet of paper and attach work to this page. You should show all work to receive full credit for problems. Questions with compact answers can be recorded directly on this page. Graphs and longer answers that won't fit here, indicate which page of the work the answer can be found on and be sure to clearly indicate it on the attached pages. You may use Excel to complete the problems, but then submit Excel files online.

1. Choose an acre of land in Canada at random. The probability that it is forest is 0.45, and that it is pasture is 0.03. a) What is the probability that the acre chosen is not forested? b) What is the probability that it is either forest or pasture? c) What is the probability that a randomly chosen acre in Canada is something other than forest or pasture?
2. In each of the following situations, state whether or not the given assignment of probabilities to individual outcomes is legitimate, that is, it satisfies the rules of probability. If not, give specific reasons for your answer.
 - a) When a coin is spun, $P(H)=0.55$, $P(T)=0.45$.
 - b) When two coins are tossed, $P(HH)=0.4$, $P(HT)=0.4$, $P(TH)=0.4$, $P(TT)=0.4$.
 - c) Plain M&Ms have not always had the colors they do now. In the past there were no red or blue candies. Tan had probability 0.1 and the other 4 colours had $P(\text{Brown})=0.2$, $P(\text{Yellow})=0.2$, $P(\text{Green})=0.1$, $P(\text{Orange})=0.1$.
3. Pew Research reports on the proportion of the world population belonging to each type of religion around the world here: <http://www.pewforum.org/2014/04/04/global-religious-diversity/>. If you were to draw a sample of 10 people at random from around the world, how many of them are likely to have no formal religion? How many are likely to be Muslim? How many will belong to a non-monotheist religion (the major monotheist religions include Islam, Christianity and Judaism). Explain how we could simulate such a random sample by selecting digits to represent the major categories reported in the article, and use a random number generator to simulate such a selection.
4. Elaine is enrolled in a self-paced course that allows three attempts to pass an examination on the material. She does not study and has probability $2/10$ of passing on any one attempt by luck. What is Elaine's probability of passing in three attempts? Assume the attempts are independent. Explain how you would use random digits to simulate her attempt. Elaine will stop taking the exam once she passes. Simulate 50 repetitions. What is your estimate of Elaine passing the exam? Do you think that Elaine's probability of passing the exam is the same on each trial is realistic? Why?
5. The psychologist Amos Tversky did many studies of our perception of chance behaviour. a) Tversky asked subjects to choose between two public health programs that affect 600 people. The first has probability of $1/2$ of saving all 600 people, and probability $1/2$ that all 600 will die. The other is guaranteed to save exactly 400 of the 600 people. Find the expected number of people saved by the first program. b) Tversky then offered a different choice. One program has probability $1/2$ of saving all 600 people and $1/2$ of losing all 600, while the other will definitely lose exactly 200 people. What is the difference between this situation and the situation in part (a)? Given option (a), most people chose the second program. Given option (b), most people chose the first program. Why do you think the choices differ in these two cases?

6. A 'psychic' runs the following ad in a magazine: 'Expecting a baby? Renowned psychic will tell you the sex of the unborn child from any photograph of the mother. Cost: \$20. Money-back guarantee.' This may be a profitable con-game. Suppose that the psychic simply replies with 'boy' all the time. In the worst case, everyone who has a girl will demand their money back. Suppose that the probability of having a boy is 0.51 and the probability of having a girl is 0.49. What is the 'psychic's' expected profit on each pregnant woman that sends her money?

7. Use the data in the Excel file 154data5.xlsx Sheet 1 to answer the questions that follow.
 - a. Create a two-way (pivot) table of Age and Opinion.
 - b. If a random person is selected from the data, what is the probability that the person is Middle Aged?
 - c. What is the probability the person is of the Strongly Agree opinion?
 - d. What is the probability the person is both Middle Aged and Strongly Agree?
 - e. What is the probability the person is either Strongly Agree or Middle Aged?
 - f. What is the probability the person is neither Strongly Agree or Middle Aged?
 - g. What is the probability the person Strongly Agrees given that they are Middle Aged?
 - h. What is the probability the person is Middle Aged, given that they Strongly Agree?

8. Use the data in Excel file 154data5.xlsx Sheet 2 to answer the questions that follow.
 - a. Create a two-way (pivot) table of Job Status and Number of Children.
 - b. If a random person is selected from the data, what is the probability that the person is working full time?
 - c. What is the probability the person has no children?
 - d. What is the probability the person is both working full-time and has no children?
 - e. What is the probability the person is either working full-time or has no children?
 - f. What is the probability the person is neither working full-time or has no children?
 - g. What is the probability the person is working full-time given that they have no children?
 - h. What is the probability the person have no children given that they work full-time?