

**Problem 1:** For each of the following short answer questions, no steps are required. Give your answer in factorial, binomial coefficient, and/or exponential expressions when appropriate. Do not simplify. One mark per answer.

- a. Find the number of ways to permute all letters in STATISTICS.
  
  
  
  
  
  
  
  
  
  
- b. What is the size of the sample space when you throw three different dice simultaneously?
  
  
  
  
  
  
  
  
  
  
- c. Out of a class of 23 students, 19 are male. How many ways can you choose a council consisting of 3 men and 1 woman?
  
  
  
  
  
  
  
  
  
  
- d. Select one card randomly from a deck of 52 poker cards. What is the probability that the card is not a diamond?
  
  
  
  
  
  
  
  
  
  
- e. In Lotto 6/49, you pick 6 distinct numbers from 1 to 49. Then a random selection of 6 distinct numbers is made by the lottery corporation. What is the chance that none of your numbers are selected?

Score: \_\_\_\_/5

**Problem 2:** Two marks per answer. Use exponential expressions, binomial coefficient, appropriately named pdf/cdf's and/or factorials as your step. Answer to 4 decimal place accuracy.

- a. Science division stationary room contains 100 special erasable pens of which 11 are defective. A sample of 20 pens is selected at random from this stock. Find the probability that three of the pens are defective.
  
  
  
  
  
  
  
  
  
  
- b. Roll a die until you get a 3. Find the probability that you need a total of 10 rolls.
  
  
  
  
  
  
  
  
  
  
- c. Pita Bread Factory knows that among all bagels produced by the factory, 5% of them have flaws and must be sold as *seconds*. Among a dozen randomly selected bagels, find the probability that at least two are *seconds*.
  
  
  
  
  
  
  
  
  
  
- d. Continuing with the Pita Bread Factory set up in the previous part, find the probability that 15 bagels must be chosen to obtain a dozen good bagels.

Score: \_\_\_\_/8

**Problem 3:** The table provided gives the number of times of late attendance to lecture by the 23 students in our class.

times late	students
0	15
1	4
2	1
3	2
4	1

- a. Find the modal number of late attendance to lecture.
- b. Find the mean of late attendance to lecture. Answer to 2 decimal place accuracy.
- c. Find the population standard deviation of late attendance. Answer to 2 decimal place accuracy.
- d. Why did I ask for the population standard deviation rather than the sample standard deviation in Part c?
- e. If a student receives 2 points for his punctuality for each of the four lectures and 0 for being late, find the standard deviation of the total punctuality records for the 23 students in class. Answer to 2 decimal place accuracy.
- f. If 3 students are randomly selected without replacement from the 23 in the class, what is the probability that none of the 3 will have been late for lecture? Answer to 3 decimal place accuracy.

Score: /7

**Problem 4:** For a certain probability experiment, the following is simultaneously satisfied:

- Events  $A$  and  $B$  are independent.
- Events  $A$  and  $C$  are mutually exclusive.
- $P(A) = 0.2$ ,  $P(B) = 0.3$ ,  $P(A \cup C) = 0.8$ ,  $P(B \cup C) = 0.7$ .

a. Draw the complete Venn diagram for this probability experiment, showing all details.

b. Determine each of the following:

$$(1) P(A | \bar{B}) = \boxed{\phantom{0.0}}$$

$$(2) P(\bar{B} | (A \cup B)) = \boxed{\phantom{0.000}} \text{ Answer to 3 decimal place accuracy.}$$

Score: /7

**Problem 5:** In the USA, over 4500 new cancer cases are diagnosed every day, and over half a million Americans will die from cancer this year. Suppose that oncologists know that 2% of the cases have modified genes that increase the malignancy of a tumour cell, and would benefit from early diagnosis and surgery. However, if a person carries such an aggressive cancer cell, the test will correctly diagnose it as such 95% of the time. If a person does not carry this type of aggressive cancer cell, the test will correctly diagnose it as such 98% of the time. If a person with cancer is diagnosed as not having the aggressive cancer cell, what is the probability that the person actually has the aggressive type? Answer to 5 decimal place accuracy.

Score: /6

**Problem 6:** The number of students signing at the instructor's desk at the MLC can be modelled by a Poisson process with a rate parameter of 7 per hour. Answer to 5 decimal place accuracy.

- a. What is the probability that exactly 4 arrive in a particular hour?

Score: /1

- b. What is the probability that at least 3 arrive during a particular 20-minute period?

Score: /2

**Problem 7:** Suppose that the mass of a newborn baby in Canada is normally distributed with mean 3.00 kg and variance  $0.50 \text{ kg}^2$ . Answer to 2 decimal place accuracy.

- a. What is the percentage of newborn Canadian babies with a mass of over 4.00 kg?

Score: /2

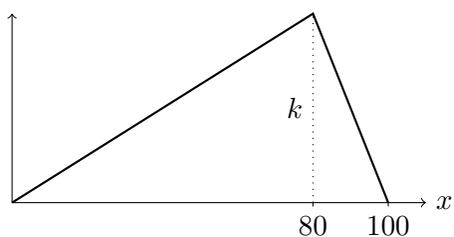
- b. Complete the statement: 80% of the newborns in Canada have mass more than

Score: /2

- c. In a random sample of 6 of the newborns, what is the likelihood that at most 3 have a mass of less than 2.50 kg?

Score: /3

**Problem 8:** Let  $X$  be the actual volume, in litres, occupied by Lily's Táobǎo purchase placed into a 100 L suitcase. The pdf of  $X$  is given by  $f$  shown below for  $x \in [0, 100]$ .



- a. Find  $k$ , and express  $f$  as a piece-wise defined function. No decimals.

Score: /2

- b. Compute and sketch the cdf of  $X$ . No decimals in your cdf.

Score: /3

- c. Find the probability that the suitcase is at most half full.

Score: /1

- d. Use your calculator to find the 75th percentile of the distribution. Answer to 2 decimal place accuracy.

Score: /1