

**Queens College
Department of Mathematics**

**Final Examination
2 $\frac{1}{2}$ Hours**

Mathematics 110

Spring 2022

Instructions: Answer all questions. Show all work in the exam booklet. Box your final answers.

- 1) A science club is voting in order to decide which sport to play at their picnic. The preference rankings are offered below.

Number of Votes						
Sport	9	5	8	3	4	13
Basketball	1√	1√	2√	3	2√	3
Soccer	2√	3	1√	1√	3	2
Volleyball	3	2	3	2	1√	1√

- a) Which sport would be selected using the plurality method?
b) Which sport would be selected using plurality with a runoff between the top two sports?
c) Which sport would be selected using Borda's method?
d) Which sport would be selected using the approval voting method?
- 2) There are 150 votes to be cast in a plurality election among four candidates – Ethan, Felix, Gabby, and Isabella. After the first 110 votes are counted, the tallies are as follows:
- | | |
|----------|----|
| Ethan | 36 |
| Felix | 28 |
| Gabby | 15 |
| Isabella | 31 |
- a) What is the minimal number of additional votes Ethan needs to be assured of a win?
b) What is the minimal number of additional votes Gabby needs to be assured of a win?
- 3) The enrollment in 4 introductory science courses is expected to be as follows. A junior college would like to offer 20 classes among the courses based on the expected enrollment.

Course	Biology	Chemistry	Physics	Astronomy
Enrollment	258	316	200	151

- a) Apportion the classes using Hamilton's Method.
b) Apportion the classes using Lowndes' Method.
c) Apportion the classes using Jefferson's Method.
- 4) A beauty salon is interested in the ages of their customers. A random sample of ages is listed below.
- | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|
| 64 | 40 | 67 | 51 | 41 | 81 | 74 | 56 | 61 | 35 |
| 33 | 64 | 52 | 45 | 72 | 23 | 62 | 62 | 62 | |
- a) Construct a frequency table and histogram, beginning with the age interval 20-29.
b) Calculate the median, mode, and the range for this sample.
c) Find the sample mean and sample standard deviation.
d) Determine the five-number summary and construct a box-and-whisker plot.

(continued on the back)

- 5) An experiment has outcomes 2, 3, 4, 5, and 6, with the probabilities as shown below.

$p(x)$.05	.35	.2	?	.25
x	2	3	4	5	6

- a) Find the missing $p(x)$.
- b) Determine the mean and standard deviation.
- c) Calculate the probability of having an outcome greater than 3.
- 6) Suppose an automobile license plate must use two capital letters (A-Z) followed by four digits (0-9). How many different license plates are possible
- a. if repetition of letters and digits is allowed?
- b. if neither repetition of letters nor repetition of digits is allowed?
- c. if repetition of letters and digits is allowed, but the plate must end with the digit 7?
- 7) In a standard 52-card deck, there are four suits (hearts, diamonds, clubs, spades), each with thirteen cards (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, and A). Find the probability that
- a. one card is selected which is a Q or a club.
- b. a Q is selected, replaced, and then a club is selected.
- c. a diamond is selected and then, without replacement, a club is selected.
- d. a face card (J, Q, K) is selected, replaced, and then another face card is selected.
- e. a face card (J, Q, K) is selected and then, without replacement, another face card is selected.
- 8) A company gave their employees a survey to determine the average number of hours they sleep on a weekly basis. Assume the distribution is approximately normal with $\mu = 50$ hours and $\sigma = 6$ hours.
- a. Find the percentage of employees who sleep above 43 hours.
- b. Find the percentage of employees who sleep between 51 and 59 hours.
- c. Find the percentage of employees who sleep between 45 and 55 hours.
- d. If there are 12,000 employees at the company, how many sleep less than 39 hours?
- e. Above what number of hours do 32% of employees sleep?