Queens College
Department of Mathematics

Final Examination

Mathematics 110 | 2.5 Hours | Fall 2018

Instructions: Answer all questions. Show all work in the exam booklet.

1) The employees of a company are voting in order to decide which day of the week to have their holiday party. Their preference rankings are offered below.

	Number of votes					
Day	**12**	**8**	**10**	**6**	**9**	**15**
Tuesday	4	4	3	4	2√	4
Wednesday	3	2√	4	3	4	1√
Thursday	2√	3√	1√	1√	3√	2√
Friday	1√	1√	2√	2√	1√	3

a) Which day would be selected using the plurality method?
b) Which day would be selected using plurality with a runoff between the top two days?
c) Which day would be selected using Borda's method?
d) Which day would be selected using the approval voting method?

2) a) If 2093 votes are cast in an election, what is the smallest number of votes a winning candidate can have in a six-candidate race to be decided by plurality?

b) There are 160 votes to be cast in a plurality election among four candidates – Jane, Rick, Sam, and Kyle. From the first 122 votes Jane receives 52 votes, Rick receives 39 votes, Sam receives 15 votes, and Kyle receives 16 votes. What is the minimal number of additional votes Jane needs to be assured of a win?

3) There are five divisions in a college in need of teaching assistants. The school would like to apportion the 75 available assistants to the divisions based on the number of faculty members.

Division	English	Mathematics	Art History	Physics	Anthropology
No. of Faculty	141	133	74	61	101

a) Apportion the assistants using Hamilton's Method.
b) Apportion the assistants using Lowndes' Method.
c) Apportion the assistants using Jefferson's Method.

4) A tech company is interested in the ages of their consumers. A random sample of ages is listed below.

38 32 38 26 29 35 28 19 18 16 17
41 15 23 43 39 44 33 24 14 37

a) Calculate the median, mode, and the range for this sample.
b) Find the sample mean and sample standard deviation.
c) Determine the five-number summary and construct a box-and-whisker plot.
d) Determine the quartile points Q_1, Q_2, and Q_3.

(continued on the back)

5) An experiment has outcomes 0, 1, 2, 3, and 4, with the probabilities as shown below.

$p(x)$	.12	.2	.08	?	.25
x	0	1	2	3	4

a) Find the missing $p(x)$

b) Determine the mean and standard deviation.

c) Construct the probability histogram.

6) A bag contains 10 black marbles (labelled with the numbers 1 through 10), 8 white marbles (labelled 1 to 8), 7 blue marbles (labelled 1 to 7), and 15 yellow marbles (labelled 1 to 15). Find the probability that

a) a #5 marble is picked from the bag.

b) a black marble or a #5 marble is picked from the bag.

c) a blue marble is picked and then, without replacement, another blue marble is picked.

d) a yellow marble is picked, replaced, and then another yellow marble is picked.

7) Suppose that a password can include capital letters (A-Z), lowercase letters (a-z), and digits (0-9). How many passwords can be created if

a) it must be of length 6 and repetition of letters and digits is allowed?

b) it must be of length 6 and repetition of letters and digits is not allowed?

c) it must be of length 6, repetition is allowed, but it must begin with a capital letter?

8) At one university, students were asked to listen for a particular sound so that their reaction times could be measured. The researcher found that, given the auditory stimulus, the students had reaction times that were approximately normally distributed with $\mu = 90$ milliseconds (ms) and $\sigma = 15$ ms.

a) Find the percentage of students with a reaction time longer than 123 ms.

b) Find the percentage of students with a reaction time between 95 and 110 ms.

c) If there are 20,000 students at the university, how many students have a reaction time less than 78 ms?

d) Below what reaction time is the fastest 4.75% of reaction times?