Queens College
Department of Mathematics

Final Examination

Mathematics 110 **2.5 Hours** **Fall 2016**

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

1. The members of an Anthropology department are voting in order to decide what type of cake they should buy for their holiday party. Their preference rankings are offered below.

	Number of votes					
Cake	**11**	**13**	**12**	**9**	**6**	**14**
Chocolate	1√	3√	3	2√	4	4
Ice Cream	2√	1√	4	5	3√	3
Red Velvet	4	5	1√	3√	5	1√
Carrot	3	4√	5	4	1√	2
Coffee	5	2√	2√	1√	2√	5

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

2. a) If 1375 votes are cast in an election, what is the smallest number of votes a winning candidate can have in a seven-candidate race to be decided by plurality?

b) Carl, Fred, Isabel, Laura and Oscar are running for the position of vice-president of their club. From the first 48 votes Carl received 5 votes, Fred received 12, Isabel had 14, Laura had 8, and Oscar received 9. If there are 24 votes left, what is the minimum number of remaining votes Oscar needs to be assured a win?

3. There are 64 camp counselors at a large camp held for children in grades 3 through 7. The total number of students in each grade is listed below. The camp would like to apportion the counselors to the different grades based upon the number of students.

Grade	3	4	5	6	7
Number of students	82	166	191	129	132

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

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4. A cosmetic company financed a study to determine the average age of their consumers. A random sample yielded the following ages:

17	24	34	41	44	22	22	23	15	26	36
29	18	19	31	32	29	28	28	22	27	

a) Calculate the mode and the range for this sample.
b) Determine the five-number summary and construct a box-and-whisker plot.
c) Find the sample mean and sample standard deviation.

5. An experiment has outcomes 0, 1, 2, 3, 4, 5 and 6, with probabilities as shown below.

$p(x)$	.05	.1	.2	.3	.2	?	.1
x	0	1	2	3	4	5	6

a) Find the missing $p(x)$.
b) Determine the mean and standard deviation.
c) Construct the probability histogram. Carefully label the axes.

6. Suppose we place 5 red marbles that are labelled with the numbers 1 through 5 into a bag. Suppose we do the same with 5 blue marbles (labelled 1 to 5) and 5 green marbles (labelled 1 to 5), giving us a total of 15 marbles in the bag. We randomly choose one marble. Then, without replacing the first marble, we choose a second. What is the probability that
a) both marbles are blue?
b) the first marble is blue and the second red?

Now suppose we place those two marbles back into the bag and we randomly choose only one marble from the fifteen. What is the probability that the marble
c) has a #4 on it?
d) doesn't have a #4 on it?
e) is either green or a #4 marble?

7. Sam owns two caps, four jeans, two pairs of pants, three pairs of shoes and eight shirts.
a) If an outfit consists of shoes, a shirt and either a pair of jeans or pants, with a cap being optional, in how many ways can he construct an outfit?
b) How many outfits are available if a cap isn't optional?
c) How many outfits are available if a cap is optional but he must wear jeans?

8. Suppose 1500 students took a college entrance exam such that the scores had an approximately normal distribution with $\mu = 101$ and $\sigma = 12$.
a) Find the percent of scores below 80.
b) Find the percent of scores above 119.
c) About how many students scored between 86 and 107?