QUEENS COLLEGE
DEPARTMENT OF MATHEMATICS
FINAL EXAMINATION
$2\frac{1}{2}$ HOURS

Mathematics 110 **Spring 2018**

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

1. The members of the Math Team are voting on their favorite Team Shirt Color and their preference rankings are listed below:

Color	Group of 12	Group of 6	Group of 15	Group of 2	Group of 6	Group of 9
Black	1√	1√	3	2	3	2√
Red	2	3	1√	1√	2√	3
Gold	3	2√	2√	3	1√	1√

a) Which color would be selected using the plurality method?
b) Which color would be selected using the plurality with runoff?
c) Which color would be selected using Borda's method?
d) Which color would win the approval vote?
e) Which color is the Condorcet winner, if any?

2. a) If 2,354 votes are cast in an election that is to be decided by plurality, what is the smallest number of votes a candidate can win with in a five-candidate race if no ties are allowed?

b) Suppose there are 180 votes to be cast in an election among four candidates – Alice, Byron, Candace, and Dylan. After the first 150 votes are counted, the tallies are as follows: Alice received 42 votes, Byron received 23 votes, Candace received 38 votes, and Dylan received 47 votes. What is the minimal number of additional votes Candace needs to be assured of a win?

3. A generous donor has given The City University of NY 150 Smart Boards. The university has decided to give them to each of these colleges based on its enrollment.

College	Queens College	City College	Hunter College	York College
Apx. Enrollment	19,520	16,161	23,018	8,513

Apportion the 150 Smart Boards based on the number of enrollment in each college using:
a) Hamilton's method
b) Lowndes' method
c) Webster's method

(continued on the back)

4. A random sample of the grades on an exam are listed:

49	88	69	59	99	71	88	61	52	99
74	67	99	89	89	75	66	92	69	85

a) Construct a frequency table and histogram with the first exam interval 40-49.
b) Find the sample mean and the sample standard deviation.
c) Find the five-number summary and construct a box-and-whisker plot.

5. Out of nine applicants for an internship, only two applicants are to be selected.
a) How many distinct ways can two interns be chosen?
b) If the first intern will work in the CEO's office and the second will be working in the mailroom, how many ways can the interns be chosen?

6. An experiment has outcomes 2, 3, 5, 6, and 8 with probabilities as shown

$\boldsymbol{p(x)}$	.15	.13	.25	?	.37
$\boldsymbol{x}$	2	3	5	6	8

a) Find the missing $p(x)$.
b) Calculate the mean and standard deviation.
c) Calculate the probability of having an outcome greater than 5.
d) Construct the probability histogram.

7. In a standard 52-card deck (2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A with four suits (clubs, diamonds, hearts, and spades)), find the probability that
a) one card is picked and it is a face card (K, Q, or J).
b) an ace is picked and then without replacement, a face card is picked.
c) an ace is picked, replaced and then a face card is picked.
d) an even card is picked and then, without replacement, another even card is picked.
e) an even card is picked, replaced, and then another even card is picked.

8. The salaries of employees at a company have an approximately normal distribution with $\mu = \$75{,}000$ and $\sigma = \$20{,}000$.
a) Find the percentage of employees with salaries less than \$80,000.
b) Find the percentage of employees with an salaries between \$50,000 and \$70,000.
c) Below what salary are 88.30% of the employees at the company?
d) If there are 1000 employees at the company, how many employees have a salary above \$120,000?