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

Mathematics 110 **Spring 2017**

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

1. The members of the math department are voting on their favorite doughnut and their preference rankings are listed below:

Doughnut	Group of 7	Group of 12	Group of 13	Group of 6	Group of 10	Group of 9	Group of 20
Chocolate	1√	2	1√	3	3√	4	2√
Crumb	2√	1√	2√	1√	1√	3√	4
Powdered	3	3	4	4	2√	2√	3√
Plain	4	4	3√	2√	4√	1√	1√

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

2. a) If 1,923 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 six-candidate race if no ties are allowed?

b) Suppose there are 90 votes to be cast in an election among five candidates – Sylvia, Deborah, Jeffrey, Sharon, and Michael. After the first 55 votes are counted, the tallies are as follows: Sylvia received 8 votes, Deborah received 13 votes, Jeffrey received 5 votes, Sharon received 13 votes, and Michael received 16 votes. What is the minimal number of votes Deborah needs to be assured of a win?

3. The city of Houston is planning on creating 200 tree sculptures to represent the most common tree species found in the city. The number of each tree species found in the city in 2002 is listed below.

Tree Species	Chinese Tallow	Loblolly Pine	Cedar Elm	Water Oak	Hawthorn
Number(thousands)	152,498	123,974	45,546	35,608	31,771

Apportion the 200 sculptures based on the number of each tree species found in the city using
a) Hamilton's method
b) Lowndes' method
c) Hill-Huntington's method

(continued on the back)

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

76	80	65	99	79	98	68	93	95	100	79	70
72	92	89	85	94	96	47	59	61	83	55	85

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

5. Out of eight applicants for a scholarship, only three applicants are to be selected as winners.
a) How many groups of three applicant winners are possible?
b) If the winners are to be distinguished as first place, second place, and third place, how many groups of ordered winners are possible?

6. An experiment has outcomes 4, 5, 6, 7, and 8 with probabilities as shown

$\boldsymbol{p(x)}$	.3	.4	.12	?	.11
$\boldsymbol{x}$	4	5	6	7	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) a face card is picked (K, Q, or J).
b) an ace is picked and then without replacement, a face card is picked.
c) an even card is picked, replaced, and then a heart is picked.

8. The IQ's of employees at a company have an approximately normal distribution with $\mu = 100$ and $\sigma = 15$.
a) Find the percentage of employees with an IQ less than 80.
b) Find the percentage of employees with an IQ between 90 and 115.
c) Below what IQ is 88.30% of the employees at the company?
d) If there are 500 employees at the company, how many employees have an IQ above 120?