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MA 110 Test 3 Answers

Questions on this test count the number of points indicated [n], for a total of 95 points. Show work for partial credit. (You get 5 points for printing your code number.)

1. [15] The legislature of Appalachie has 200 seats to be apportioned among its four states Alab, Geog, Tenn, and Weva, in proportion to their populations. The table below shows the populations of the states. Complete the table by filling in all **unshaded** blanks to produce an apportionment by each of Jefferson's, Adams' and Webster's methods. (There is a scratch sheet on the last page.)

State	Alab	Geog	Tenn	Weva	Total	Points
Population	21,120	152,580	54,150	12,150	240,000	1
Standard Divisor	1,200					
Standard Quotas	17.600	127.150	45.125	10.125	200.00	2
Modified Divisor	1,190	1183	1192			
Modified Quota	17.748	128.218	45.504	10.210		
Jefferson App't	17	128	45	10	200	4
Modified Divisor	1,213	1211	1214			
Modified Quota	17.411	125.787	44.641	10.016		
Adams App't	18	126	45	11	200	4
Modified Divisor	1,200	1197	1206			
Modified Quota	17.6000	127.1500	45.1250	10.1250		
Webster App't	18	127	45	10	200	4

Note range of workable modified divisors above. See companion spreadsheet for testing divisors.

2. [5] Did a violation of the quota occur in any of the apportionments in question 1? If so, state which apportionment(s), which state(s), and in each case if it was a violation of the upper quota or the lower quota.
   Yes. In Adams' with state Geog, there is a violation of the lower quota.

3. [5] On a certain day in June, 330 people bought a ticket on the fast train from Birmingham to Atlanta and 500 people bought a ticket from Atlanta to Charleston. Suppose 720 people altogether bought tickets. How many people bought two tickets: one Birmingham to Atlanta and another Atlanta to Charleston?
   BA + AC – overlap = total
   330 + 500 – x = 720
   x = 110
   So, 110 people bought both tickets.

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4. [5] Seven fair coins are tossed at one time and the sequence of heads (H) and tails (T) that comes up is observed. What does a typical element of the sample space look like? What is the size of the sample space?
   A typical element is a sequence of 7 H or T, for example, HHTTHHT.
   Since each coin can come up 2 ways, the multiplication principle leads us to the size of the sample space is $2^7 = 128$.

5. [15] An Egyptian license plate consists of two digits, followed by three letters, followed by two more digits.
   a. How many such license plates are possible if the first digit cannot be 0?
      9 x 10 x 26 x 26 x 26 x 10 x 10 = 158,184,000

   b. If, in addition, no letter or digit can be repeated, how many such license plates are possible?
      9 x 9 x 26 x 25 x 24 x 8 x 7 = 70,761,600

   c. How many of the plates in part a have exactly three digits the same?
      first 2 same + second 2 same = total (no overlap)
      (9 x 1 x 26 x 26 x 26 x 1 x 9 x 2) + (9 x 9 x 2 x 26 x 26 x 26 x 1 x 1) =
      = (2,847,312) + (2,847,312) = 5,694,624

6. [15] A committee of four members is to be formed from a school Spanish club containing 16 members, of whom 7 are boys and 9 are girls.
   a. If the order in which members are picked is not important, how many such committees are possible?
      (16 x 15 x 14 x 13)/(4 x 3 x 2 x 1) = 1,820

   b. If the first chosen is chair, but the other three can be picked in any order, then how many such committees are possible?
      16 x [(15 x 14 x 13)/(3 x 2 x 1)] = 7,280

   c. If the committee must have equal numbers of boys and girls, but the order in which they are picked is not important, then how many such committees are possible?
      [(7 x 6)/2] x [(9 x 8)/2] = 756

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7. [15] Henry owns four books titled A, B, C, and D.

   a. In how many different ways can he arrange the four books in a row on his bookshelf?
   4 x 3 x 2 x 1 = 24

   b. In how many different many ways can he put them on a circular rotating tray?
   (4 x 3 x 2 x 1)/4 = 6

   c. In how many different many ways can he choose two books to keep and two to give away?
   Order is not important.
   Keep: (4 x 3)/2 = 6. Give away is then determined. So, answer is 6.

8. [10] Three fair coins are tossed at one time. The sequence of heads (H) and tails (T) that comes up is observed.
   The sample space is
   {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}
   with sample size = 8. All outcomes are equally likely.

   a. What is the probability that at least two tails are observed?
   Event at least 2 T = {HTT, THT, TTH, TTT}
   with size = 4
   prob(at least 2 T) = event size/sample size = 4/8 = 1/2
   [Accept 4/8.]

   b. What is the probability that at most two tails are observed?
   Event at most 2 tails = {HHH, HHT, HTH, THH, HTT, THT, TTH}
   with size = 7
   prob(at most 2 T) = 7/8

9. [10] A jar contains one blue marble, three red marbles, and four white marbles. A marble is drawn from the jar at random.
   Sample space is {B, R, W}. Outcomes are not equally likely.

   a. What is the probability that the marble drawn is white?
   Since 4 out of 8 marbles are white, prob(W) = 4/8 = 1/2
   [Accept 4/8.]

   b. What is the probability that the marble drawn is red?
   Since 3 out of 8 marbles are red, prob(R) = 3/8