Fake Quiz 2 Calculus 3 9/26/2008

Each problem is worth 0 points. In the event of an actual quiz, you would have received warning.

1. Three alleles (alternative versions of a gene) A, B, and O determine the four blood types A (AA or AO), B (BB or BO), O (OO) and AB. The Hardy-Weinberg Law states that the proportion of individuals in a population who carry two different alleles is

$$P = 2pq + 2pr + 2rq$$

where p, q, and r are the proportions of A, B, and O in the population. Use the fact that

$$p + q + r = 1$$

to show that P is at most 2/3. [From Stuart 5th, #52 in §14.7]

2. Some items are sold at a discount to senior citizens or children. The reason is that these groups are more sensitive to price, so a discount has greater impact on their purchasing decisions. The seller faces an optimization problem: How large a discount to offer in order to maximize profits? Suppose a theater can sell q_c child tickets and q_a adult tickets at prices p_c and p_a, according to the demand functions:

$$q_c = rp_c^{-4} \qquad \text{and} \qquad q_a = sp_a^{-2},$$

and has operating costs proportional to the total number of tickets sold. What should be the relative price of children's and adults' tickets? [From Hughes-Hallett et al. 3rd, sic, #22 in §15.2]

3. The strength of a radio signal is basically inversely proportional to the cube root of distance from the transmitter. Suppose three transmitters of equal strength are located at the origin, the point (10,0), and the point (0, 5). If reception is proportional to the sum of the three signals received, where will reception be best? [Mea culpa]