MGF 1107 PROBLEM SET 10

1. Suppose state A has a population of 100,000 and receives 5 representatives while state B has a population of 90,000 and receives 3 representatives. To determine which state is favored in this apportionment, we can calculate the number of citizens per representative. Calculate this number for each state and use it to determine which state is favored (i.e. better represented).

The numbers you calculated in #1 are called each state's *district population* (or *district size*). If you have trouble remembering whether the state with the larger or smaller district population is better off, think of the extreme case where state A has a district population of 3 citizens/seat and state B has a district population of 3000 citizens/seat. Obviously, this apportionment favors state A since each congressman could get to know each constituent personally.

2. A second way to measure which state is treated better by an apportionment is to calculate the average number of representatives per citizen. Calculate this number for the following two states, based on 2010 census data

State	**Population**	**Representatives**
Florida	18,900,773	27
Illinois	12,864,380	18

The numbers you calculated in #2, the reciprocals of district population, are called each state's *representative share*. Because decimals like 0.000001399 seats/person are difficult for us to quantify, representative shares are usually expressed in a different unit, microseats/person, which is obtained by moving the decimal point 6 places to the right or, equivalently, multiplying by 1,000,000.

3. In 2010, California had a population of 37,341,989 and was apportioned 53 seats in Congress. a) Find California's representative share, expressed in microseats/person, rounded to 2 decimal places.

b) In 2010, which of the states Florida, Illinois, and California was most favored by the apportionment? Which was least favored?

If you have trouble remembering whether the state with the larger or smaller representative share is better off, again think of the extreme case where state A has a representative share of 3 microseats/person and state B has a representative share of 3000 microseats/person. Obviously, this apportionment favors state B since each state B receives 1000 times more seats for each citizen.

4. In a perfect apportionment, every state would have the same district population and the same representative share. However, since there is no perfect apportionment method, we would like an apportionment that makes the district populations and representative shares as close to equal as possible. For the following problems, we will again use 2010 census data.

State	2010 population	Hill-Huntington apportionment	Webster apportionment
North Carolina	9,565,781	13	14
Rhode Island	1,055,247	2	1

a) Calculate each state's district population using the Hill-Huntington apportionment. Round to one decimal place.

b) Calculate each state's district population using the Webster apportionment. Round to one decimal place.

c) Which method produces district populations closer to equal?

We define the *absolute difference* between two numbers to equal the bigger number minus the smaller number. It has been proved that the Hill-Huntington method is always better than Webster's method *if* the criterion is minimizing the absolute difference in district populations. Actually, another apportionment method, Dean's method, always produces a smaller absolute difference in district populations.

d) Calculate each state's representative share using the Hill-Huntington apportionment. Answer in microseats/person rounded to one decimal place.

e) Calculate each state's representative share using the Webster apportionment. Answer in microseats/person rounded to one decimal place.

f) Using absolute difference in representative shares, which apportionment method produced a better apportionment?

Another way of measuring how close two numbers are to being equal is to compute their *relative difference*:

$$\boxed{\text{relative difference} = \frac{bigger\ \ number - smaller\ \ number}{smaller\ \ number} \times 100\%}$$

g) Using relative difference in representative shares, which apportionment method produced a better apportionment?

It has been proven that the Hill-Huntington method always yields the apportionment that minimizes the relative differences in representative shares (or district populations).