

## Homework #1

Due Friday, February 7, 2014 at 11:30 am

1. All of your calculations in this problem should be done by hand – A calculator is fine, but don't use one of the programs on the web.
  - (a) Consider the weighted voting system [8: 5, 3, 1, 1, 1]. Calculate the Penrose measure of power and the Banzhaf power index for each voter.
  - (b) Now consider the system [8:4,4, 1,1,1] where the first voter has transferred one 'vote' to the second voter. Perform the same calculations in this case.
  - (c) Compare the Penrose measure and Banzhaf index for each voter in the two different systems. Discuss any interesting observations you see. Explain why these occur.
  
2. Consider the weighted voting system  $[q : w_1, w_2, \dots, w_n]$ . For a particular voter  $i$ , let  $y_i$  denote the number of divisions with positive outcome where  $i$  votes 'yes', and let  $\eta_i$  denote the number of divisions where  $i$  is decisive and votes 'yes'. Show that

$$n_i = 2^{n-1} - (y_i - \eta_i)$$

3. In 1995, the Council of Ministers in the European Union used the Qualified Majority Voting scheme described in Table 2 of Felsenthal & Machover.

Analyze the impact on the individual nations and the system overall of decreasing the quota required for passage from 62 to 54.

You should consider not only the change in power as applied to the individual nations, but also the structural impact as measured by the sensitivity index  $S$  and resistance coefficient  $R$ . Be thorough in your analysis.

*Big Hint:* Since this is a weighted system, it is fairly straightforward (although a bit tedious) to calculate all of the power indices. You will almost certainly want to use the power calculators that are linked from the course webpage, such as [ipgenf](#) at the University of Warwick or [Powerslave Mark I](#) at the University of Turku.

4. Repeat # 3 analyzing the impact of increasing the quota from 62 to 70.