Notes for : "How Should We Measure Polarization in Congress?"

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Abstract

Suppose we have an index of left-right ideology for all members of Congress, and they are in two parties, Democrat and Republican. What do we mean by saying Congress is more polarized than ten years ago?

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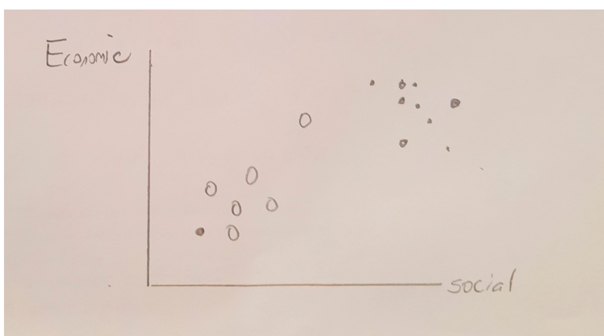
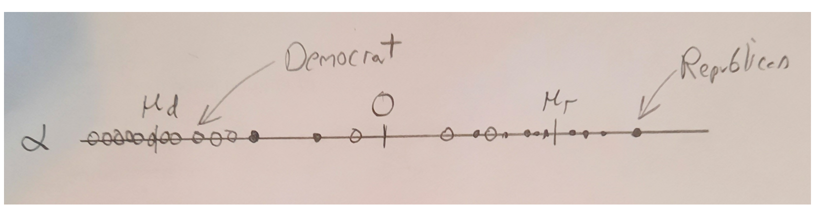
1. Introduction

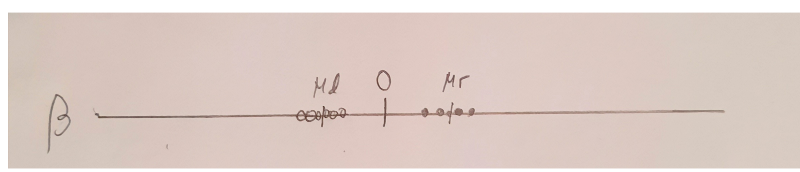
When we think of parties and polarization, there are two distinct ways Congress might become more polarized:

1. The average opinions diverge more: The average Democratic ideological position becomes further from the average Republican one. Call this “Party Polarization”? This is easily measured by the difference in means, $|\mu_r - \mu_d|$.

2. The clusters become more dispersed and more overlapping: more Democrats are close to more Republicans and vice versa. Call this “Cluster Polarization”? This is measurable, sort of, by the sum of the standard deviations, $\sigma_r + \sigma_d$, but that is not satisfactory, because that would be positive even if each party has identical members.







How about this?

$$P^2 \equiv \frac{1}{2} \cdot \frac{\sqrt{\Sigma_{i=1}^{D}(d_i - \mu_r)^2/D}}{\sqrt{\Sigma_{i=1}^{D}(d_i - \mu_d)^2/D}} + \frac{1}{2} \cdot \frac{\sqrt{\Sigma_{i=1}^{R}(r_i - \mu_d)^2/R}}{\sqrt{\Sigma_{i=1}^{R}(r_i - \mu_r)^2/R}} - 1 \tag{1}$$

We ought to also do something to squish the top end, so the measure goes from 0 to 1 instead of 0 to infinity. So maybe the following is better:

$$P^3 \equiv 1 - \frac{1}{\frac{1}{2} \cdot \frac{\sqrt{\Sigma_{i=1}^{D}(d_i - \mu_r)^2/D}}{\sqrt{\Sigma_{i=1}^{D}(d_i - \mu_d)^2/D}} + \frac{1}{2} \cdot \frac{\sqrt{\Sigma_{i=1}^{R}(r_i - \mu_d)^2/R}}{\sqrt{\Sigma_{i=1}^{R}(r_i - \mu_r)^2/R}}} \tag{2}$$

This might be easier to read if we define

$$\sigma_d \equiv \sqrt{\frac{\Sigma_{i=1}^{D}(d_i - \mu_d)^2}{D}}, \quad \sigma_{d-r} \equiv \sqrt{\frac{\Sigma_{i=1}^{D}(d_i - \mu_r)^2}{D}}, \tag{3}$$

with the equivalents for σ_d and σ_{r-d} (which does NOT equal σ_{d-r}). Then we have

$$P^3 = 1 - \frac{.5}{\frac{\sigma_{d-r}}{\sigma_d} + \frac{\sigma_{r-d}}{\sigma_r}} \tag{4}$$

P^2 and P^3 have some desirable properties.

1. Two parties with identical means have zero polarization.

2. Polarization rises with the distance between party means.

3. Polarization goes to the maximum level (∞ or 1) as the distance between party means goes to ∞.

4. Moving a party member closer to the party mean increases polarization (IS THIS TRUE?)

What other properties are desirable?

One problem with these measures is that they are undefined if $\sigma_d = 0$.

I think we can get these properties from many different functions— indeed, maybe from any strictly monotonic transformation of P^2, including P^1. We could, for example, even keep the same nice normalizations if we define σ_{d-r} using absolute deviations instead of squared deviations, as

$$\sigma'_d \equiv \frac{\sum_{i=1}^{D} |d_i - \mu_r|}{D} \tag{5}$$

Is there any reason to prefer P^3 except for the fact that it "feels" better to someone trained in statistics who is used to the nice maximum likelihood properties of squared deviations?

Prof. Chris Connell of Indiana Math suggests that something might be done with correlations instead of with variances, but he didn't have anything particular in mind. Here, however, we don't match up observations as when correlations are ordinarily used— we aren't comparing the Republican candidate in a particular election with the Democrat, for example. Note, too, that we are not talking about samples, but populations— we are just interested in a particular Congress, and we observe every single member, not just a sample. That's why I have μ and σ^2, not $\bar{x}$ and s^2, and use D instead of $D-1$ (though the D's cancel out anyway).

Congressmen:	d_1	d_2	d_3	d_4	r_1	r_2	r_3	μ_d	μ_r	σ_d	σ_r	P^2	P^3
Congress 1: Unpolarized	-2	-1	1	2	-3	0	3	0	0	2.5	6	0.0	.00
Congress 2: Polarized both ways	-4	-3	-3	-2	2	3	4	-3	3	0.7	0.7	7.0	.97
Congress 3: Parties differ	-6	-6	0	4	0	2	7	-2	3	4.2	2.9	0.8??	.86
Congress 4: Congressmen concentrated	-1	-1	0	0	1	1	2	-0.5	.5	.5	0.7	2.9	.94

"1. The difference between the location of the median Democrat and the median Republican. This measure gets at one aspect of inter-party heterogeneity.

2. The ratio of the standard deviation of ideal points in the Democratic party to that of the full House, which indicates variation in intra-party homogeneity.

3. The proportion of overlap between the two parties' distribution of ideal points subtracted from one. Overlap is measured by the minimum number of ideal points that would have to be changed to yield a complete separation of the two parties, with all Democrats' ideal points being to the left of all Republicans' ideal points.

4. The R2 resulting from regressing the Member's ideal point location on party affiliation."