Conflict, Chaos, and the Art of Institutional Design – Online Supplement

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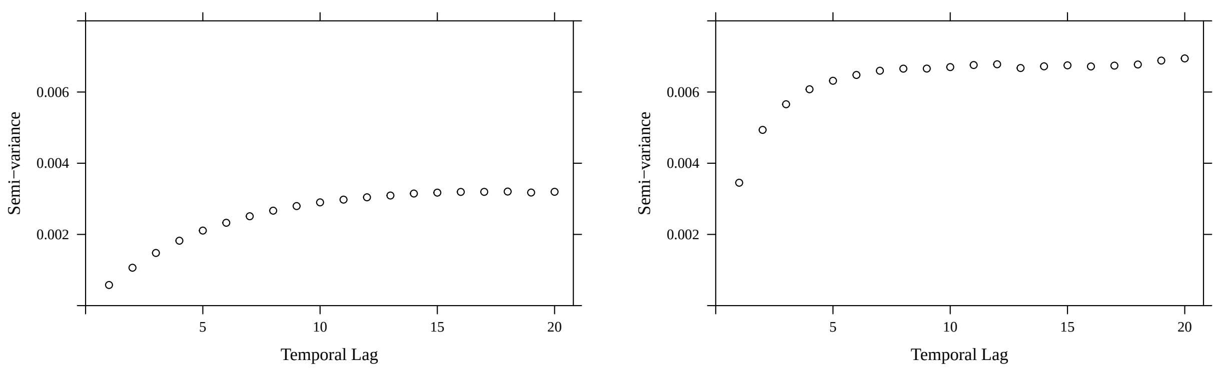
Supplemental Figures

Figure 1: Variogram for the NK landscape

(a) Variogram for $K = 0$ (b) Variogram for $K = 5$

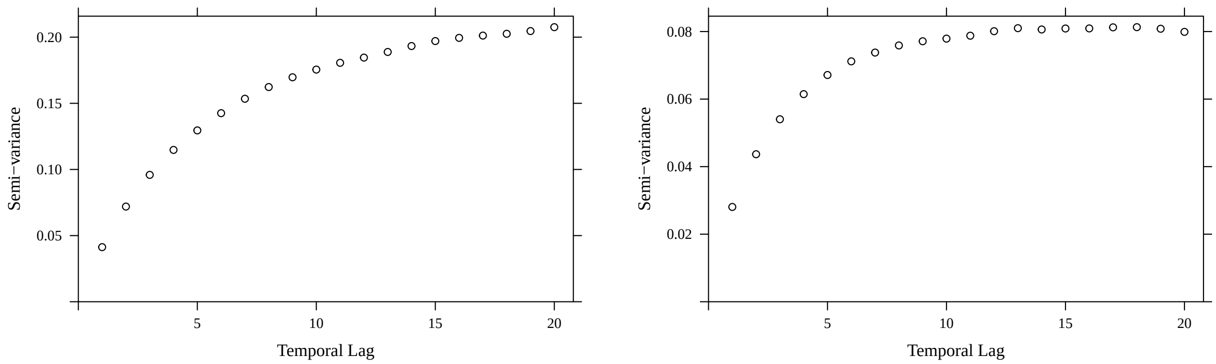


Note: The figure depicts variograms for an NK landscape where $N = 12$ and $K = 0$ (on the left) or $K = 5$ (on the right).

Figure 2: Variogram for Political Location

(a) Variogram for x-coordinate Value

(b) Variogram for Distance from Origin

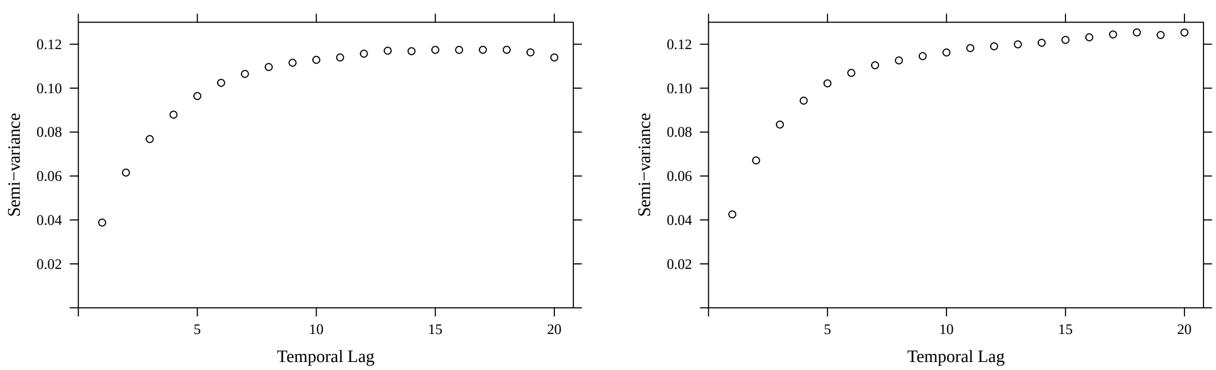


Note: The figure depicts variograms for the mapping from strategies to the x-coordinate in the political space after transforming $g(\mathbf{x})$ to Cartesian coordinates (on the left) and distance from the origin (on the right).

Figure 3: Variogram for Executive Utility f_0

(a) $K = 0$

(b) $K = 5$



Note: The figure depicts variograms for the mapping from strategies to utility for the executive for $N = 12$ and $K = 0$ (on the left) and $N = 12$ and $K = 5$ (on the right).

Conversion from $\bar{g}(\mathbf{x})$ to $g(\mathbf{x})$

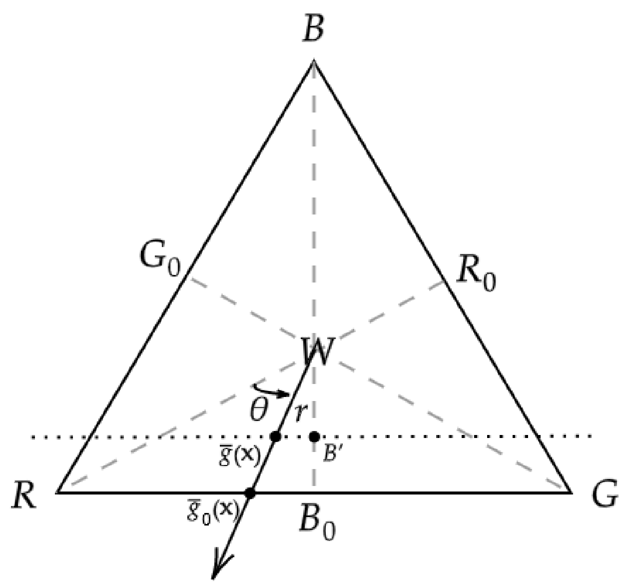
The following is an abbreviated version of the geometric proof in (Gonzalez and Woods, 1992, pp. 229-233). Figure 4 reproduces the 2-simplex from ??. W represents a neutral outcome, i.e., $\bar{g}(\mathbf{x}) = (\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$. $R = \{1, 0, 0\}$ and $R_0 = \{0, \frac{1}{2}, \frac{1}{2}\}$ with B, G, B_0, and G_0 analogously defined.

Assume, without loss of generality $\bar{g}(\mathbf{x})$ falls in the triangle RGR_0. θ is computed using the cosine formula:

$$\theta = cos^{-1}\left[\frac{(\bar{g}(\mathbf{x}) - W) \cdot (R - W)}{\|\bar{g}(\mathbf{x}) - W\| \, \|R - W\|}\right]$$

To compute r, assume without loss of generality that $\bar{g}(\mathbf{x})$ falls in the triangle RWG. Begin by relabeling the coordinate system on the 2-simplex from barycentric to Cartesian coordinates, with W at the origin, R at $(-\frac{1}{2}, -\frac{1}{3})$, G at $(\frac{1}{2}, -\frac{1}{3})$, B at $(0, \frac{2}{3})$, and the other points analogously defined. Note that the triangle $W, B_0, \bar{g}_0(\mathbf{x})$ is similar to the triangle $W, B', \bar{g}(\mathbf{x})$ with $B' = (0, \bar{B} - \frac{1}{3})$. Noting first that $|WB_0| = \frac{1}{3}$ and $|B_0B'| = \bar{B}$, $\frac{|W\bar{g}(\mathbf{x})|}{|W\bar{g}_0(\mathbf{x})|} = \frac{|WB'|}{|WB_0|} = 1 - 3\bar{B}$. By the same logic, for $\bar{g}(\mathbf{x})$ in the triangle RWB, $r = 1 - 3\bar{G}$ and for $\bar{g}(\mathbf{x})$ in the triangle BWG, $r = 1 - 3\bar{R}$.

Figure 4



Example of Ruggedness when $K = 0$

Let $K = 0$ and assume that all decisions equal to 1 have quality values of 1 ($c_i(1) = 1, \forall i$), and all decisions equal to 0 have quality values of 0 ($c_i(0) = 0, \forall i$). The strategy that maximizes f_0 is $\mathbf{x}^* = 111111111111$, because $f_0(\mathbf{x}^*) = v(\mathbf{x}^*) - \delta_f(\mathbf{x}^*)^2 = 1 - 0 = 1$. Assume the organization faces a status quo $\mathbf{x}_0 = 000100010001$ and, for the purposes of simplicity:

$$\begin{array}{rcllll}
(R_i^0, G_i^0, B_i^0) & = & (0, & 0, & 0), & \forall i \\
(R_1^1, G_1^1, B_1^1) & = & (8, & 0, & 0) & \\
(R_2^1, G_2^1, B_2^1) & = & (4, & 0, & 0) & \\
(R_3^1, G_3^1, B_3^1) & = & (2, & 0, & 0) & \\
(R_4^1, G_4^1, B_4^1) & = & (1, & 0, & 0) & \\
(R_5^1, G_5^1, B_5^1) & = & (0, & 8, & 0) & \\
(R_6^1, G_6^1, B_6^1) & = & (0, & 4, & 0) & \\
(R_7^1, G_7^1, B_7^1) & = & (0, & 2, & 0) & \\
(R_8^1, G_8^1, B_8^1) & = & (0, & 1, & 0) & \\
(R_9^1, G_9^1, B_9^1) & = & (0, & 0, & 8) & \\
(R_{10}^1, G_{10}^1, B_{10}^1) & = & (0, & 0, & 4) & \\
(R_{11}^1, G_{11}^1, B_{11}^1) & = & (0, & 0, & 2) & \\
(R_{12}^1, G_{12}^1, B_{12}^1) & = & (0, & 0, & 1) &
\end{array}$$

Thus, $f_0 = \frac{1}{4}$, because $\mathbf{x}_0$ maps to the origin and $v(\mathbf{x}_0) = \sum_i v(x_i)/12 = \frac{1}{4}$. Changing an decision from 0 to 1 will increase the quality value of the strategy by $\frac{1}{12}$ and changing an decision from 1 to 0 will decrease the quality value by $\frac{1}{12}$. If the organization selects an alternative that replaces a 1 with a 0, then the radial coordinate r will increase from 0 to 1 and, as a result, the new strategy will have a political outcome that is distance 1 from the origin. Thus, this alternative will be worse for the executive according to both the common-interest and politically-contested criteria. If instead the organization adopts an alternative that replaces a 0 with a 1, the quality value would increase. But, the new outcome would fall at least $\frac{2}{5}$ away from the origin in political space.[1] Thus, the utility for z_0 from the alternative would be less than the utility from the status quo. This example thus shows how the interdependence between the NK landscape and the dimensions of political space leads the organization to retain $\mathbf{x}_0$ even though it is not the global maximum.

[1] The smallest change in the political space would result from changing x_3, x_7, or x_1 to a 1. The new radial coordinate r would be $1 - \frac{3}{5} = \frac{2}{5}$.

Figure 5: Supplementary Analyses

Does moderate-conflict committee outperform dictatorship in short-term?	If so, until what period?	Does moderate-conflict committee outperform dicatorship in long-term?	If so, beginning in what period?	If so, by how much does f_0 with moderate-conflict committee exceed f_0 with dictatorship at $t = 100$?	Is performance non-monotonic in the extent of conflict at $t = 100$?
Base Case: $N = 12$, $K = 5$, $d \in \{1/8,\ 1/4,\ 1/2\}$, $p = 2/3$					
Yes	4	Yes	20	0.04	Yes
Quorum Requirement: 2 decision makers must be present to adopt an alternative					
No		Yes	30	< 0.01	No
Voting Rule: Decisions are made by majority rule					
No		Yes	33	0.03	Yes
Committee Size: Two decision maker committee					
No		Yes	31	0.03	Yes
Committee Size: Four decision maker committee					
Yes	4	Yes	20	0.04	Yes
Agenda-setting: Restricted to most-preferred local alternatives					
No		No			
Risk preferences: Linear spatial loss function					
Yes	2	No			
Risk preferences: Cubic spatial loss function					
Yes	5	Yes	15	0.04	Yes

References

Gonzalez, Rafael C. and Richard E. Woods, *Digital Image Processing*, Reading, Mass: Addison-Wesley, 1992.