

ANALYSIS OF THREE INTERACTION MATRICES

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## Analysis of Three Interaction Matrices

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The first matrix represents the cross-citations between nineteen business and economic journals. The positions of these journals relative to each other, as obtained from a multidimensional scaling algorithm, are as illustrated in Figure one. These are extracted from a paper by Hamelman and Smith, who also provided the cross-citation table. The procedure suggested in IIASA RR-75-19, Spatial Interaction Patterns, was applied to this 19 by 19 array, and the result is shown in Figure Two. The asymmetry of the array is 29.5 percent. The influence field appears to be from the substantive economics journals to the statistical and methodological journals. An interpretation would be that discussions occurring in the subject matter fields are used as a basis, or a justification, for methodological investigation.

The second matrix consists of intersectoral job changes in Belgium. As suggested in IIASA Research Report-75-19, dissimilarities between sectors was calculated from the following formula

$$d_{ij} = \sqrt{2P_i P_j / M_{ij}}$$

where  $P_i$  and  $P_j$  are the sizes of the sectors (number of

Multidimensional Scaling of 19 Business and Economic Journals

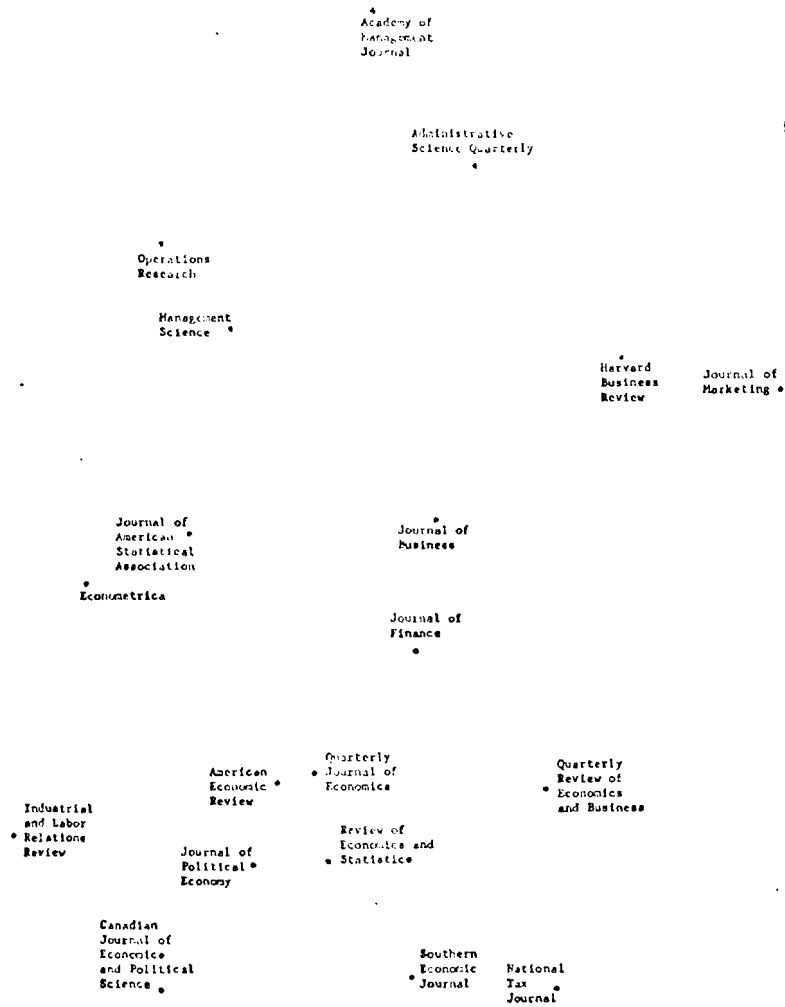


FIGURE I: Spatial Positioning of Journals



FIGURE II: Vector field of Journal Interactions

employees) and  $M_{ij}$  is the number of people who changed employment from sector  $i$  to sector  $j$ . A trilateration algorithm estimates  $x, y$  coordinates from the separations, as listed in Table one. After thus locating the sectors relative to each other, the 21 by 21 interaction table (provided by Dr. Vanoverbeke) was used to estimate the gradient of the potential between sectors, as described in RR-75-19. The result is shown in Figure Four. The asymmetry of the original array is only 8.6 percent so that differential effects do not appear strongly. The large vector at sector twelve (Energy) is misleading since the volume of exchange here is very small. Otherwise the figure is difficult to interpret. There seems to be some movement away from textiles and tobacco, and movement towards services.

The third array, Table II, provided by Prof. John Nystuen, indicates the amount of interaction between retail establishments, as indicated by customer movements from one establishment to another. Table III gives the trilateration solution obtained from  $d_{ij} = (P_i P_j / M_{ij})^{\frac{1}{2}}$ . Figure V indicates the interaction field obtained from the array of Table II. The cluster of businesses in the center of Figure V includes Supermarket, Drug Store, Department store, Bank, Bakery, Restaurant, and variety store. The next ring includes Grocery, Utility Company, Hardware and Paint, Miscellaneous Retail, Appliances, Clothing and Shoes, Furniture, and Theater. The outer ring includes all of the remaining establishments.

I	SECTOR	P <sub>i</sub>	X <sub>i</sub>	Y <sub>i</sub>
1	Landbouw (Agriculture)	11,930	180	-418
2	Extractie (Extractive)	48,810	700	-610
3	Voeding (Food)	82,170	-70	288
4	Tabak (Tobacco)	7,010	-635	224
5	Scheikunde (Chemicals)	54,640	63	455
6	Hout en Kurk (Wood and Cork)	45,870	326	332
7	Papier (Paper)	22,180	-171	-26
8	Boek en foto (Book and Photography)	28,440	-648	-77
9	Huiden en Leder (Hide and Leather)	8,250	-108	-212
10	Textiel (Textile)	113,020	-535	691
11	Kleding (Clothing)	78,780	-1,000	-377
12	Energie (Energy)	11,540	-643	-921
13	Niet Metaal (Non-metal)	56,690	302	-137
14	Staal nijverheid (Steel)	103,460	686	-236
15	Metaalverwerkende nijverheid (Metal working)	268,700	170	59
16	Diverse be-enverwerkende nijverheid (Industry)	30,070	127	367
17	Bouw (Construction)	224,590	448	-30
18	Transport (Transportation)	61,190	690	194
19	Handel en financiële instellingen (Commerce)	116,060	-19	43
20	Horeca (Hotels, eating establishments)			
21	Overheiden n.e.v. diensten (Service)	69,440	-909	-523
		103,300	-150	159

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TABLE I: Belgium Handarbeiders



FIGURE III: BELGIUM HANDARBEIDERS  
Spatial Positioning of Sectors





FIGURE IV: Belgium Handarbeiders  
Vector field of interaction

NUMBER OF STOPS AT OTHER RETAIL ESTABLISHMENTS  
IN EVERY ONE HUNDRED TRIPS TO EACH BUSINESS TYPE

Entries indicate the number of stops in 100 trips to the business types listed by row made to business types listed by columns.

Actual Number of Trips	Business Type	Number of Single Purpose Trips in 100 Trips per Business Type	Business Types																									
			Department Store	Clothing and Shoes	Variety and Shoes	Banks	Appliances	Miscellaneous Retail	Hardware and Paint	Utility Company Office	Doctor	Dentist	Hotel	Insurance	Restaurant	Tavern	Theatre	Beauty Shop	Laundry and Dry Cleaning	Auto Repair	Car Station	Ice Cream Store	Meat & Vegetable Markets	Bakery	Supermarket	Grocery	Furniture	
151	Department Store	7	50	22	28	11	*	*	*	*	*	*	*	*	13	*	*	*	*	*	*	*	*	*	*	*	*	*
52	Clothing and Shoes	4	94	25	15	17	*	*	*	*	*	*	*	21	*	*	*	*	*	*	*	12	*	*	*	*	*	*
66	Variety	3	91	15	17	*	*	*	*	*	*	*	*	15	*	*	*	*	*	*	*	17	*	*	*	*	*	*
60	Banks	4	40	17	10	*	*	*	*	*	*	*	*	38	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12	Appliances	2	42	25	17	*	*	*	*	*	*	*	*	17	*	*	*	*	*	*	*	*	*	*	*	*	*	*
37	Miscellaneous Retail	6	43	25	22	*	*	*	*	*	*	*	*	14	11	*	*	*	*	*	*	24	*	*	*	*	*	*
25	Hardware and Paint	7	43	12	*	*	*	*	*	*	*	*	*	14	*	*	*	*	*	*	*	33	*	*	*	*	*	*
29	Utility Company Office	8	66	17	14	*	*	*	*	*	*	*	*	21	*	*	*	*	*	*	*	16	*	*	*	*	*	*
49	Doctor	7	33	39	*	*	*	*	*	*	*	*	*	11	*	*	*	*	*	*	*	24	*	*	*	*	*	*
13	Dentist	6	38	*	*	*	*	*	*	*	*	*	*	1	*	*	*	*	*	*	*	15	*	*	*	*	*	*
12	Hotel	11	41	*	*	*	*	*	*	*	*	*	*	33	33	*	*	*	*	*	*	15	*	*	*	*	*	*
18	Insurance, Real Estate, Lawyers	11	50	11	*	*	*	*	*	*	*	*	*	22	17	*	*	*	*	*	*	11	*	*	*	*	*	*
145	Restaurant	11	17	*	*	*	*	*	*	*	*	*	*	1	*	*	*	*	*	*	*	11	*	*	*	*	*	*
14	Tavern	11	14	21	*	*	*	*	*	*	*	*	*	50	*	*	*	*	*	*	*	21	*	*	*	*	*	*
108	Theatre	11	9	*	*	*	*	*	*	*	*	*	*	19	*	*	*	*	*	*	*	9	*	*	*	*	*	*
16	Beauty Shop	31	19	19	*	*	*	*	*	*	*	*	*	31	*	*	*	*	*	*	*	23	15	*	*	*	*	*
13	Laundry and Dry Cleaning	0	23	*	*	*	*	*	*	*	*	*	*	38	15	*	*	*	*	*	*	23	15	*	*	*	*	*
18	Bakery	28	22	*	*	*	*	*	*	*	*	*	*	22	11	*	*	*	*	*	*	17	*	*	*	*	*	*
14	Auto Accessory	64	*	*	*	*	*	*	*	*	*	*	*	11	*	*	*	*	*	*	*	*	*	*	*	*	*	*
60	Gas Station	18	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
30	Auto Repair	23	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
32	Ice Cream Store	41	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	10	*	*	*	*	*	*
160	Drug Store	33	25	*	*	*	*	*	*	*	*	*	*	9	*	*	*	*	*	*	*	*	*	*	*	*	*	*
24	Meat & Vegetable Markets	25	*	*	*	*	*	*	*	*	*	*	*	13	*	*	*	*	*	*	*	*	*	*	*	*	*	*
33	Bakery	15	9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	17	*	*	*	*	*	*
144	Supermarket	34	26	*	*	*	*	*	*	*	*	*	*	*	10	*	*	*	*	*	*	12	*	*	*	*	*	*
264	Grocery	60	*	*	*	*	*	*	*	*	*	*	*	*	10	*	*	*	*	*	*	11	*	*	*	*	*	*
18	Furniture	17	50	11	17	*	*	*	*	*	*	*	*	28	*	*	*	*	*	*	*	18	*	*	*	*	*	*

(\*) indicates eight (8) or fewer stops were made at the business type listed in the column in every 100 trips to the business type listed in the row. Blank cells indicate the business types were never associated in the same trip.

TABLE II:

SOLUTION COORDINATES (X,Y)

0.09	0.43
-6.03	13.08
-1.48	4.65
-6.91	1.06
-26.34	9.04
-21.45	-2.08
-23.96	-0.67
-14.30	-6.23
25.69	-10.14
53.90	22.67
19.73	72.68
4.76	32.18
-5.51	6.50
-31.53	-36.01
-13.53	19.06
-22.74	50.82
-50.19	-17.35
-33.34	-28.95
70.77	-41.99
4.34	-15.74
0.88	-16.41
17.68	-40.03
-3.55	2.29
38.02	-13.45
-2.47	-1.71
1.90	4.81
4.73	-8.48
20.75	2.82

TABLE III:



FIGURE V: Retail Establishments  
Vector Field of Interactions

This grouping seems to resemble that of a modern shopping center. The array exhibits strong assymetry (48%) and the influence field seems directed towards the central cluster, with some exceptions.

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Figure 2.

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