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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 Inter-
action 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

Academy of
Management
Journal

Administrative
Science Quarterly

Operations
Research

Management
Science

Harvard   Journal of
Business   Marketing
Review

Journal of   Journal of
American   Business
Statistical
Association

Econometrica

Journal of
Finance

                Quarterly
American   Journal of   Quarterly
Economic   Economics   Review of
Review   Economics
Industrial   and Business
and Labor
Relations   Review of
Review   Journal of Economics and
              Political   Statistics
              Economy

Canadian
Journal of
Economics   Southern
and Political   Economic   National
Science   Journal   Tax
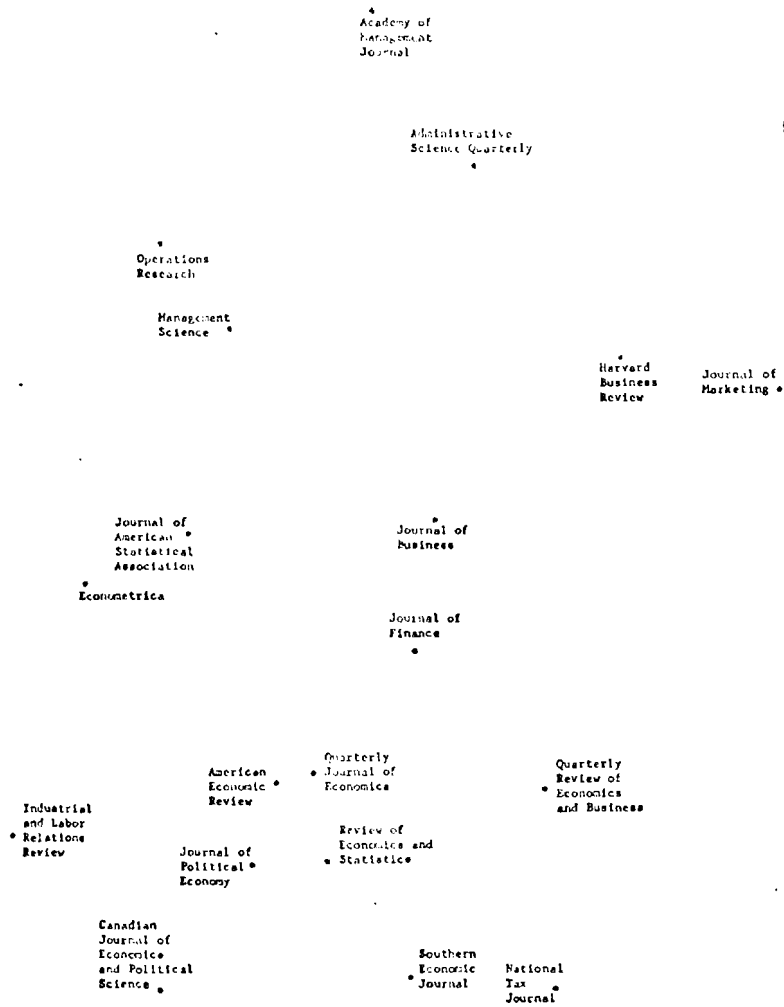   Journal

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_i	X_i	Y_i
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 enfinanciële instellingen	(Commerce)	116,060	-19	43
20	Horeca	(Hotels, eating establishments)	69,440	-909	-523
21	Overheiden n.e.v. diensten	(Service)	103,300	-150	159

TABLE I: Belgium Handarbeiders

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. 12

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	Department Store	Clothing and Shoes	Variety	Banks	Appliances	Miscellaneous Retail	Hardware and Paint	Utility Company Office	Doctor	Dentist	Hotel	Insurance, Real Estate, Lawyers	Restaurant	Tavern	Theatre	Beauty Shop	Laundry and Dry Cleaning	Barber	Auto Accessory	Gas Station	Auto Repair	Ice Cream Store	Drug Store	Meat & Vegetable Markets	Bakery	Supermarket	Grocery	Furniture
151	Department Store	1	7	50	22	28	11	*	*	*	9	*	*	*	*	13	*	*	*	*	*	*	*	*	*	19	*	*	19	*	*
52	Clothing and Shoes	2	4	94	25	15	17	*	*	*	*	*	*	*	21	*		*	12		*				*	12		*	*	*	
66	Variety	3	5	91	15	17	*	*	17	*	*	*	*	*	15		*	*			*		*	*	17		*	15	9	*
60	Banks	4	8	40	17	10	*	*		*	10	*		*	38		*	*	*	*		*		*	*	*	*	*	*	*	
12	Appliances	5	17	42	25	*	17		17	*	*	*			17		*		*		*				*	33			*		*
37	Miscellaneous Retail	6	11	43	*	22		*	11	*	*			*	14	11		*				*			*	*	24	*	*	14	*
25	Hardware and Paint	7	28	43	12	*		*	*		*	12			*			*		*	*		*			16		*	*	*	
29	Utility Company Office	8	11	66	*	17	14	*	*	*	21			11	*	*				*	*		*	*		24		*	*	11	17
49	Doctor	9	33	39	*	*	*	*		*		*			*				*		*	*	*	*	*	*	15	*	*	*	*	*
13	Dentist	10	38	*		*					1				*											15		*			
12	Hotel	11	41	*	17								*	33	33											*					
18	Insurance, Real Estate, Lawyers	12	11	50		11	*		*		17		22	*	17										11		*	11	17	*
145	Restaurant	13	11	17	*	*	13	*	*	*	*	1		*	*	*	*	12	*	*		*		*	11		*	*	*	*
14	Tavern	14	29			14	21		*		*				50	*			*			*	*		21	*			*	
108	Theatre	15	61	9	*	*	*	*	*	*				*	19		*	*			*			*	9	*	*	*	*	
16	Beauty Shop	16	31	19	*	19	*								31									*			19	*		
13	Laundry and Dry Cleaning	17	0	23			*	*	15	*					38	15								23	15	*				
18	Barber	18	28	22	*		*			11					22	11			*				17	11		*		*	17
14	Auto Accessory	19	64	*																									14	
60	Gas Station	20	18	*	*	*	*			*	*	*			*	*	*				*	*	*	*			*	*	*	*
30	Auto Repair	21	23	10	*			*	*		*						*				*	10			*	*	*		10
32	Ice Cream Store	22	41	*	*	*			*		*				*					*				*	*		*	16	
160	Drug Store	23	36	25	*	*	*	*	9	*	*	*	*	*	10	*	*	*	*	*	*	*	*	*	*	*	10	*	*
24	Meat & Vegetable Markets	24	25	*			*		*		13				*									17		**	21	17	*
33	Bakery	25	15	9	*	*	*	*	*		*	*		*	*		*		*		*	*	12	*	21	9	
144	Supermarket	26	34	26	*	*	*	*	*	*	*	*		*	10	*	*	*		*		*	11	*	*	*	*	*
264	Grocery	27	60	*	*	*	*		*	*	*			*	*		*	*		*	*	*		*	*	*	*	*	*
18	Furniture	28	17	50	*	11	17	*		28	*	*		28				*		*	18		*		*	17	22

(*) 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.

SOLUTION COORDINATES (X,Y)

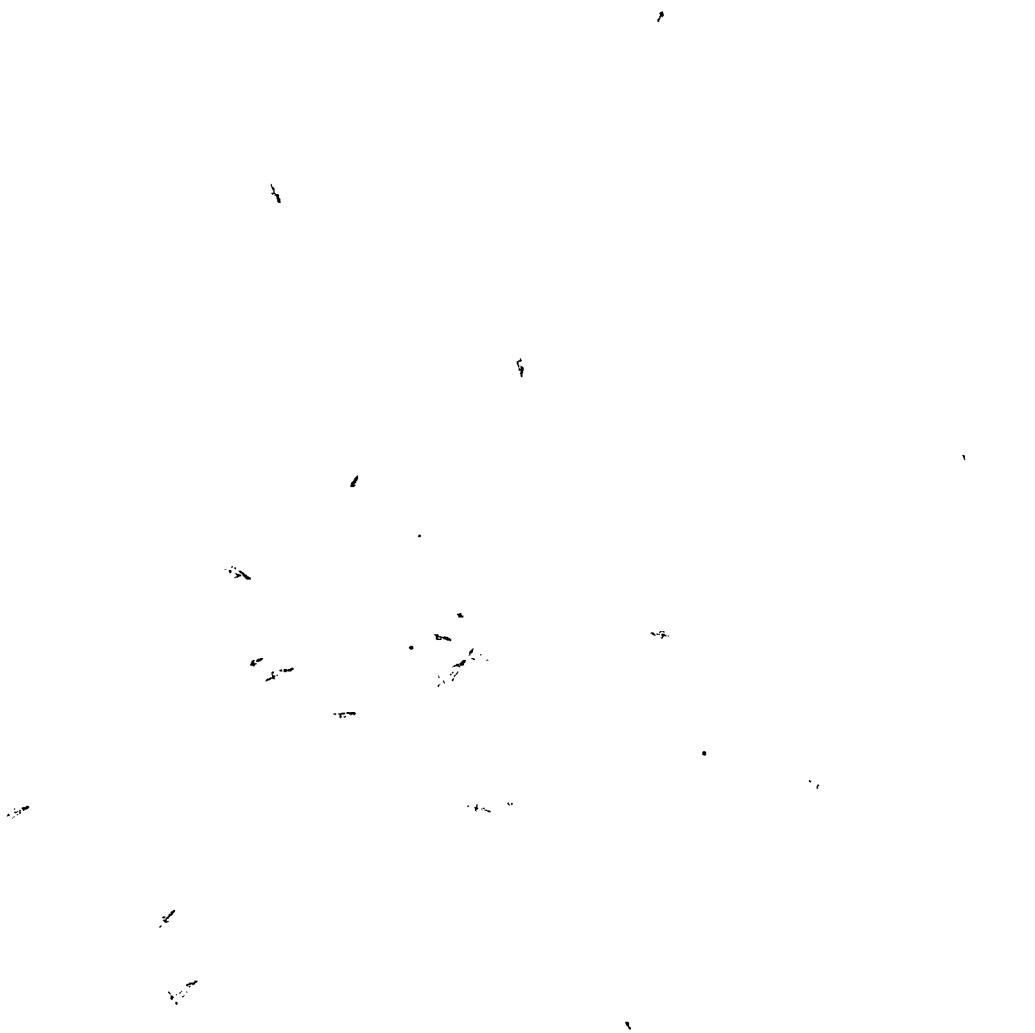|	
0.09	0.45
-6.03	13.08
-1.48	4.65
-6.91	1.06
-26.34	9.04
-21.45	-2.08
-23.96	-0.67
-14.30	-6.23
25.69	-10.14
53.98	22.67
19.73	70.68
4.76	32.18
-5.51	6.50
-31.53	-36.61
-13.53	19.06
-22.74	59.82
-54.19	-17.55
-33.34	-28.95
70.77	-41.99
4.34	-15.74
0.88	-16.41
17.68	-40.03
-3.55	2.29
38.02	-13.45
-2.47	-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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