PROMiDAT IBEROAMERICANO

Programa Iberoamericano de Formación en Minería de Datos

Aplicación del Análisis de Datos Simbólico a la Detección de Inusualidades

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Inusualidad o atipicidad

Objetos Simbólicos:

- “Real-life objects are too ***complex*** to be represented by points in a vectorial space” [Bock&Diday, 2000]

- “Symbolic objects overcome this limitation by representing ***concepts*** rather than individuals” [Bock&Diday, 2000]

- “Knowledge extraction from large data bases is our main aim as in Data Mining“ [Diday, 1998]

- En análisis simbólico de datos transforma la Minería de Datos una herramienta para “Big Data”.

Tabla clásica:

Example 4.1.2: A classical data matrix with mixed variables

The classical data matrix in Table 4.2 describes characteristics of $N = 6$ students in terms of $p = 4$ variables:

Person u	Height Y_1	Weight Y_2	Subject Y_3	Sex Y_4
Anna	1.70	65.9	*math*	1
Berta	1.62	61.4	*med*	1
Claudia	1.65	60.1	*phys*	1
Daniel	1.75	77.3	*math*	0
Eric	1.80	74.3	*med*	0
Fred	1.68	67.0	*econ*	0

Table 4.2: *A classical data matrix* $\underset{\sim}{X} = (x_{uj})$ *with mixed variables*

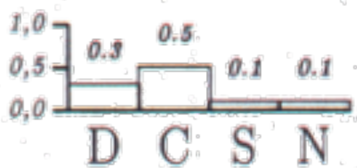
Symbolic Data Table:

$$\underline{X} = \left(\begin{array}{c|cccc|l} (80,100] & (\mathrm{D}\ 0.4; & \mathrm{C}\ 0.3; & \mathrm{S}\ 0.2; & \mathrm{N}\ 0.1) & \{\mathrm{CL},\ \mathrm{BNP}\} \\ (100,130] & (\mathrm{D}\ 0.1; & \mathrm{C}\ 0.3; & \mathrm{S}\ 0.4; & \mathrm{N}\ 0.2) & \{\mathrm{SPK},\ \mathrm{DB},\ \mathrm{BNP}\} \\ (8,10] & (\mathrm{D}\ 0.3; & \mathrm{C}\ 0.5; & \mathrm{S}\ 0.1; & \mathrm{N}\ 0.1) & \{\mathrm{SPK}\} \\ (10,13] & (\mathrm{D}\ 0.3; & \mathrm{C}\ 0.3; & \mathrm{S}\ 0.3; & \mathrm{N}\ 0.1) & \{\mathrm{CL},\ \mathrm{DB},\ \mathrm{BNP}\} \end{array} \right) \begin{array}{l} \leftarrow x_1' \\ \leftarrow x_2' \\ \leftarrow x_3' \\ \leftarrow x_4' \end{array}$$

where, e.g., the third row

$$x_3' = ((8,10],\ (\mathrm{D}\ 0.3;\ \mathrm{C}\ 0.5;\ \mathrm{S}\ 0.1;\ \mathrm{N}\ 0.1),\ \{\mathrm{SPK}\})$$

describes the town a_3 and could be equivalently displayed in a semi–graphical form such as

$x_3' = \Big((8,10],$  $, \{\mathrm{SPK}\}\Big)$ ← Symbolic Object

Creando tablas simbólicas:

Classical description of Schools

Schools	Town	Nb of pupils	Kind	Level
Jaurès	Paris	320	Public	1
Condorcet	Paris	450	Public	3
Chevreul	Lyon	200	Public	2
St Hélène	Lyon	380	Private	3
St Sernin	Toulouse	290	Public	1
St Hilaire	Toulouse	210	Private	2

Symbolic description of the towns by the schools variables

Town	Nb of pupils	Kind	Level
Paris	[320, 450]	(100%)Public	{1, 3}
Lyon	[200, 380]	(50%)Public , (50%)Private	{2, 3}
Toulouse	[210, 290]	(50%)Public , (50%)Private	{1, 2}

¿Cómo se construyen las tablas simbólicas?

Análisis Clásico

Datos

Millones…

Id-trx	*Causal*	*Sucursal*	*Monto*	*# Tarjeta*
3457	*36*	*Curridabat*	*2,500.00*	*1000*
1251	*28*	*San Pedro*	*1,750.00*	*1001*
3245	*39*	*Grecia*	*2,400.00*	*1000*
7635	*35*	*San Pedro*	*1,900.00*	*1001*
3245	*35*	*Alajuela*	*1,850.00*	*1001*
5367	*27*	*Alajuela*	*1,900.00*	*1002*
6486	*34*	*Heredia*	*1,600.00*	*1002*

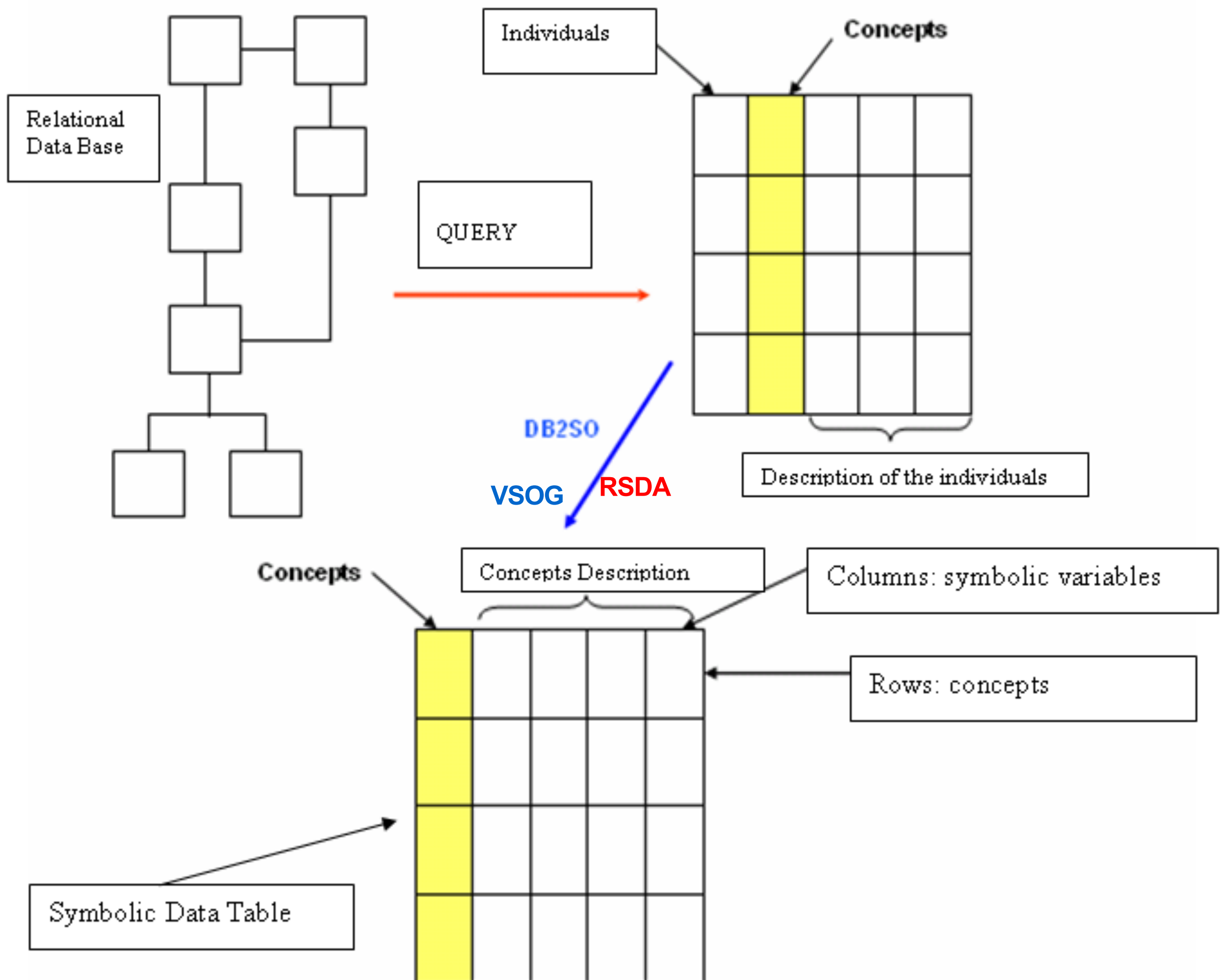
Análisis Multivariado Simbólico

Conceptos

Cientos…

# Tarjeta	*Causal*	*Sucursal*	*Monto*	**Salario**
1000	36(1/2),39(1/2)	*{Curr-50%,Gre-50%}*	[2.4,2.5]	255.4
1001	28(1/3),35(2/3)	*{SP-66%,Al-33%}*	[1.75,1.9]	122,2
1002	27(1/2),34(1/2)	*{Al-50%,Her-50%}*	[1.6,1.9]	534,5

From a Relational Database to a symbolic data table:



Symbolic Data Base:

Relational Data Base

100% knowledge

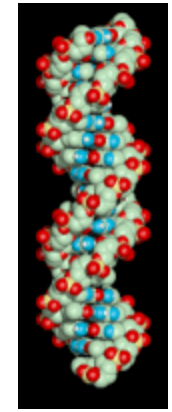
15 Gigabyte

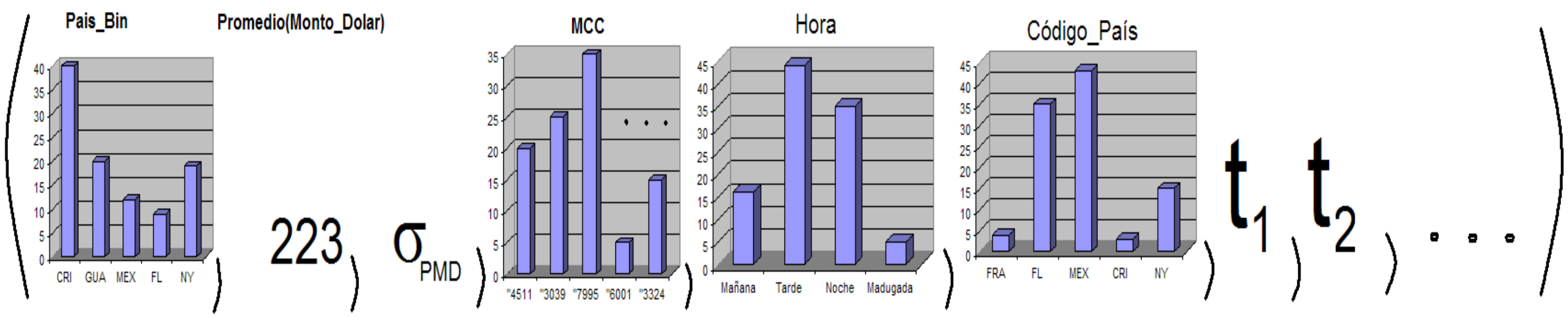
Symbolic Data Base

90 % knowledge

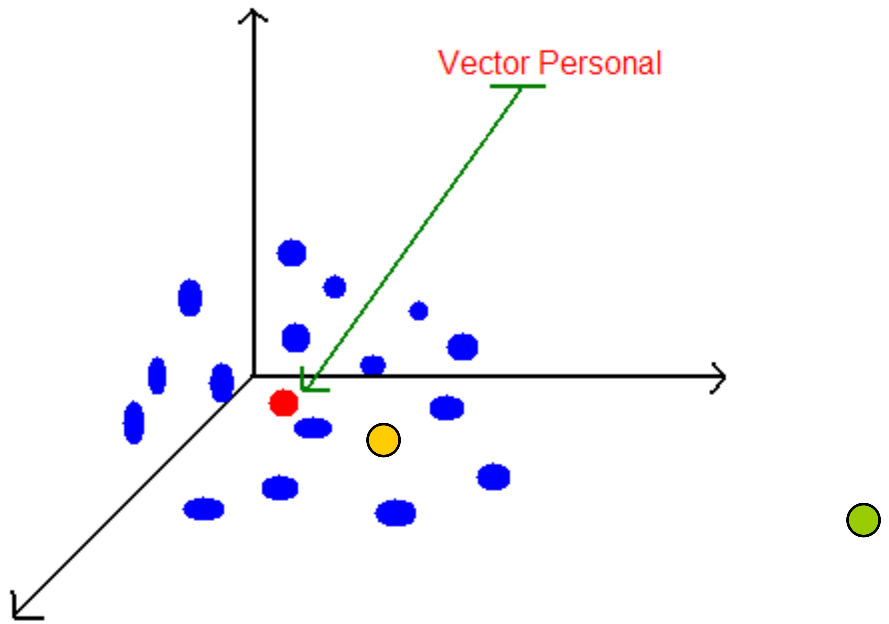
10.3 Megabyte

Perfil simbólico

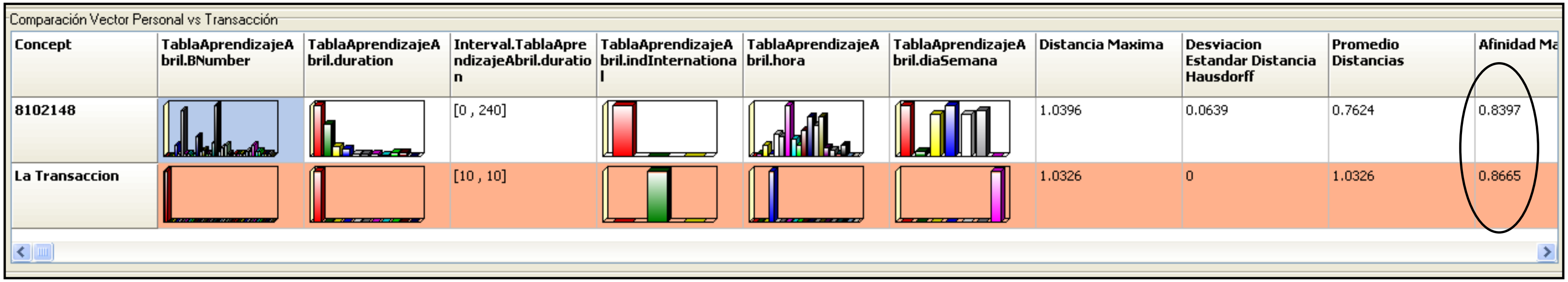




Espacio con el Perfil Simbólico y sus Transacciones



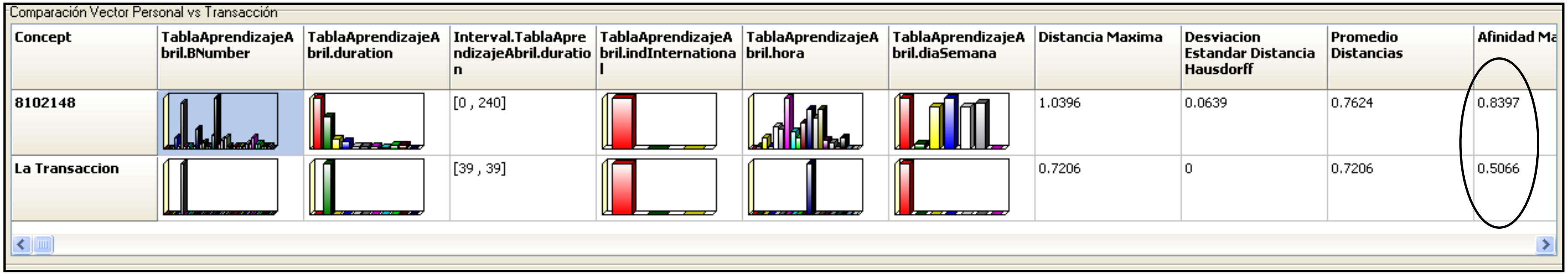
Transacción Inusual



Comparación Vector Personal vs Transacción

Concept	TablaAprendizajeAbril.BNumber	TablaAprendizajeAbril.duration	Interval.TablaAprendizajeAbril.duration	TablaAprendizajeAbril.indInternational	TablaAprendizajeAbril.hora	TablaAprendizajeAbril.diaSemana	Distancia Maxima	Desviacion Estandar Distancia Hausdorff	Promedio Distancias	Afinidad Ma
8102148			[0 , 240]				1.0396	0.0639	0.7624	0.8397
La Transaccion			[10 , 10]				1.0326	0	1.0326	0.8665

Transacción Usual



Comparación Vector Personal vs Transacción

Concept	TablaAprendizajeAbril.BNumber	TablaAprendizajeAbril.duration	Interval.TablaAprendizajeAbril.duration	TablaAprendizajeAbril.indInternational	TablaAprendizajeAbril.hora	TablaAprendizajeAbril.diaSemana	Distancia Maxima	Desviacion Estandar Distancia Hausdorff	Promedio Distancias	Afinidad Ma
8102148			[0 , 240]				1.0396	0.0639	0.7624	0.8397
La Transaccion			[39 , 39]				0.7206	0	0.7206	0.5066

Distancias entre Objetos Simbólicos

FIG. 4.3 – *Comparaison d'intervalles*

Distancias entre Objetos Simbólicos

Notation	Intervalle	Qualitatif
A_k	$[a_l, a_u]$	$a_1, \ldots$
B_k	$[b_l, b_u]$	$b_1, \ldots$
inters ou $\|A_k - -B_k\|$	longueur $(\mathrm{A}_k \cap \mathrm{B}_k)$	card $(\mathrm{A}_k \cap \mathrm{B}_k)$
l_s ou $\|A_k + +B_k\|$	$\|max(a_u, b_u) - min(a_l, b_l)\|$	$l_a + l_b - inters$
l_a ou $\|A_k\|$	$\|a_u - a_l\|$	card(A_k)
l_b ou $\|B_k\|$	$\|b_u - b_l\|$	card(B_k)
$\|U_k\|$	longueur du domaine	cardinal du domaine

Mesure proposée par Ichino [Ichino88]

En reprenant les notations du tableau 4.1 (page 146), la mesure s'écrit de la façon suivante :

$$\Phi(A_k, B_k) = |A_k + +B_k| - |A_k - -B_k| + \gamma(2|A_k - -B_k| - |A_k| - |B_k|)$$

Distancias entre Objetos Simbólicos

Distance de Hausdorff [Bandemer et Nather92]

Entre deux ensembles A et B, la distance s'écrit :

$$D_h(A,B) = \max\{\sup_{a\in A}\inf_{b\in B} d(a,b), \sup_{b\in B}\inf_{a\in A} d(a,b)\}$$

La mesure du Khi2 est la suivante:

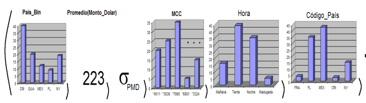
$$d(1,2) = \sum_{k=1}^{p}\left(\sum_{i=1}^{q}\frac{1}{f_{ik}^1+f_{ik}^2}\left(\frac{f_{ik}^1}{\sum_{i=1}^q f_{ik}^1} - \frac{f_{ik}^2}{\sum_{i=1}^q f_{ik}^2)}\right)^2\right)^{\frac{1}{2}}$$

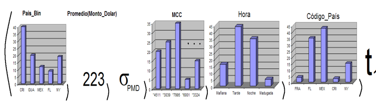
Índice de Afinidad

Now, if we weight the importance of a variable Y_j with a weight w_j (with $0 \leq w_j \leq 1$ and $\sum_{j=1}^{p} w_j = 1$), we define the (weighted) **affinity similarity coefficient** $\mathit{aff}(k,k') \equiv a(k,k')$ between the units (groups) $k, k' \in E$ by the weighted average:

$$a(k,k') \quad := \quad \sum_{j=1}^{p} w_j \cdot \mathit{aff}\,(\xi_{kj}, \xi_{k'j}) = \sum_{j=1}^{p} w_j \cdot \sum_{l=1}^{m_j} \sqrt{\frac{n_{kjl}}{n_{kj\cdot}} \cdot \frac{n_{k'jl}}{n_{k'j\cdot}}}. \qquad (8.68)$$

Perfil del Cliente

$VC\_1 = ($  $, t_1, t_2, \ldots) \longrightarrow d_1$

$VC\_2 = ($  $, t_1, t_2, \ldots) \longrightarrow d_2$

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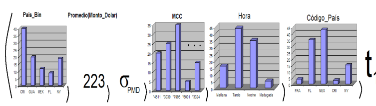
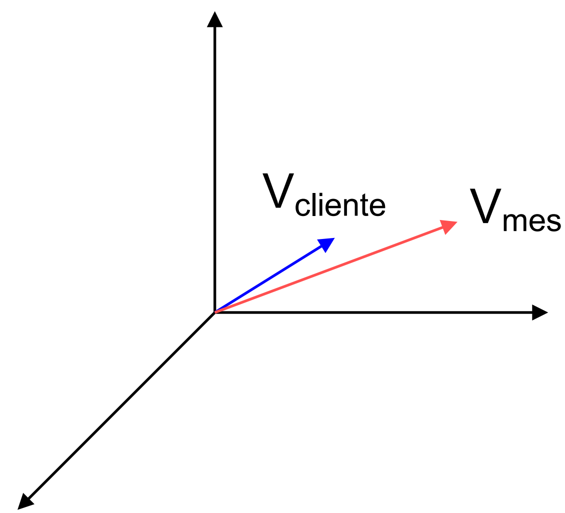
$VC\_n = ($  $, t_1, t_2, \ldots) \longrightarrow d_n$

$\longrightarrow V_{cliente} = (d_1, d_2, \ldots, d_n)$

Distancia Máxima = $\| V_{cliente} \|$



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Comparación Vector Personal vs Transacción

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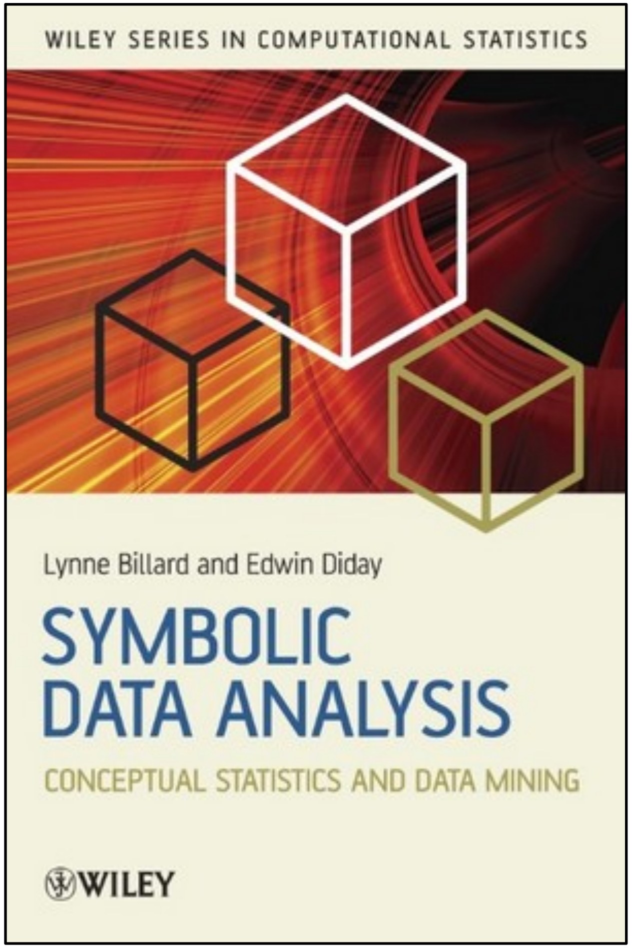
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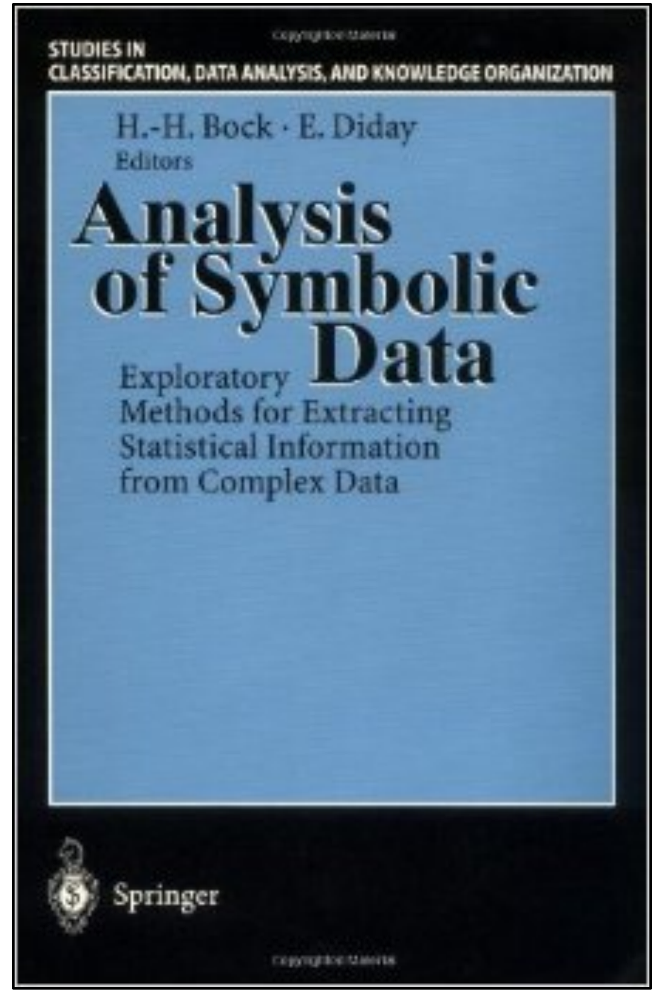
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Gracias…..