

Quantifying the impacts of social infrastructure on human networks

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Literatures:

People who visited a place at the same time repeatedly are likely to be socially related.







Assumption: POI (points of interest) afford social actives. And social events raise new relations.

Research Question: How do POI vary supports for different social events ?



Outdoors &



Reclassify 62 types (pre-classified by Maptitude) of POI to 13 categories



Co-location Analysis

Spatial statistics-based approaches •

Spatial autoregressive model + spatial regression, Ripley's

Business

Finance Food

edical Appearance

Parking

Party

Entertainment

Car Education

K function, Gravity model, etc.

- Data mining approaches ٠
- Association rule mining
- $X \rightarrow Y(p, cp)$, Both X and Y can be set of items



Association Pattern between POI and events





Expected result from our assumption:

$$\{poi_1, poi_2, \dots, poi_n\} \rightarrow \{s_n\} for s_n \in S$$

Prevalence measure:

 $Support\{X \to Y\} = \frac{Records \ containing \ both \ X \ and \ Y}{Total \ number \ of \ Records}$ Conditional measure: $Confidence\{X \to Y\} = \frac{Records \ containing \ both \ X \ and \ Y}{Records \ containing \ X}$ Interestness measure: $Support(X,Y) \qquad Cof(X \to Y)$

$$Lift{X \to Y} = \frac{Support(X,Y)}{Support(X) * Support(Y)} = \frac{Lof(X \to Y)}{Sup(Y)}$$

The popular Lift measure in literature suggests 29 significant association rules among the POI and event types.







Parallel coordinates plot for 35 rules

Graph-based parallel coordinate for 35 rules Width arrow: support (0.01-0.05) Color: confidence (0.1-0.22) lift: 1.07-3.8

POI		Social events	support	confidence	lift	count
{Business}	=>	{Tech}	0.0131	0.2259	3.8030	110
{Finance, Party, Shopping}	=>	{Arts}	0.0105	0.1082	3.4051	88
{Appearance, Finance,						
Party}	=>	{Arts}	0.0114	0.1005	3.1625	95
{Education, Finance}	=>	{Learning}	0.0176	0.1061	2.3922	147
{Finance, Party, Shopping}	=>	{Dance}	0.0127	0.1304	2.3718	106
{Education, Finance,						
Shopping}	=>	{Dance}	0.0118	0.1200	2.1830	99
{Parking}	=>	{Health&Wellness}	0.0136	0.2036	2.1700	114
{Medical}	=>	{Health&Wellness}	0.0188	0.1990	2.1212	157
<pre>{Food, Shopping}</pre>	=>	{Dance}	0.0214	0.1108	2.0162	179
{Entertainment}	=>	{Dance}	0.0345	0.1105	2.0104	289
{Hotel}	=>	{Health&Wellness}	0.0200	0.1813	1.9329	167
{Appearance, Finance}	=>	{Dance}	0.0182	0.1059	1.9269	152
{Hotel}	=>	{Career&Business}	0.0201	0.1824	1.8962	168
{Education, Party}	=>	{Dance}	0.0177	0.1027	1.8684	148
{Car}	=>	{Dance}	0.0151	0.1021	1.8575	126
{Appearance, Party,						
Shopping}	=>	{Social}	0.0136	0.1019	1.8216	114
{Appearance, Party,						
Shopping}	=>	{Dance}	0.0134	0.1001	1.8208	112
{Education, Finance,		<i>—</i>				
Party}	=>	{lech}	0.0110	0.1059	1.7825	92
{Car}	=>	{Health&Wellness}	0.0246	0.1669	1.7795	206
{Party}	=>	{Health&Wellness}	0.0441	0.1538	1.6396	369
{Food}	=>	{Sci-Fi&Games}	0.0314	0.1227	1.4755	263
{Appearance}	=>	{Career&Business}	0.0460	0.1247	1.2960	385
{Education, Shopping}	=>	{Sci-Fi&Games}	0.0250	0.1065	1.2801	209
{Car}	=>	{Beliefs}	0.0163	0.1102	1.2651	136
{Education}	=>	{Health&Wellness}	0.0507	0.1186	1.2646	424
{Car}	=>	{Sci-Fi&Games}	0.0151	0.1021	1.2276	126
{Entertainment}	=>	{Health&Wellness}	0.0359	0.1147	1.2229	300
{Finance}	=>	{Career&Business}	0.0376	0.1174	1.2200	315
{Party}	=>	{Career&Business}	0.0333	0.1163	1.2089	279
{Food}	=>	{Career&Business}	0.0290	0.1134	1.1787	243
{Food}	=>	{Health&Wellness}	0.0280	0.1092	1.1640	234
{Entertainment}	=>	{Career&Business}	0.0344	0.1101	1.1448	288
{Finance}	=>	{Health&Wellness}	0.0338	0.1054	1.1240	283
{Appearance}	=>	{Health&Wellness}	0.0379	0.1027	1.0943	317
{Shopping}	=>	{Career&Business}	0.0431	0.1035	1.0762	361

Oversampling

- Overlook the association with minorities (social events) since number of POI >> number of events
 Double Counting
- Exaggerate the conditional probability of the certain types of events and POIs

Possible solution

Non-transaction-based association rule mining.



Future Work: Colocation and temporal analysis



Safegraph Building footprints Geometry data in June 2020. Aggregate POI footprints to buildings In June-2020 data, 55,846 buildings had POIs POIs in August 2020 appeared in 51,893 buildings Meetup events were within 730 buildings.



Temporal trend of social events 25,000 social events data for over 2 years (2020-now) Address the impact from pandemic to local social networks



Thank you! Questions?



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