Workshop Notation: Extending the Relational Event Model

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1 Introduction to Relational (Hyper) Event Models

Symbol	Description
$V = \{1, 2, \dots, p\}$	Set of entities in the system
e = (s, r, t)	Relational event
$s \subset V$	Sender of event e
$S \subseteq V$	Senders of hyperevent $/$ Actors of a meeting e
$r \subset V$	Receiver of event e
$R \subseteq V$	Receivers of hyperevent e
$t \in \mathbb{R}^+$	Time of event
$E = \{e_1, \dots, e_i, \dots, e_n\}$	Event sequence
n	Number of events in the event sequence
i	Index of a generic event in the event sequence
$\{N_{sr}(t)\}_{s\subset V,r\subset V,t\in\mathbb{R}^+}$	Longitudinal network / multivariate counting process
$N_{sr}(t)$	Counting process evaluated for dyad (s, r) at time t
$\Lambda_{sr}(t)$	Cumulative intensity function
$M_{sr}(t)$	Martingale residual
$\lambda_{sr}(t)$	Hazard / instantaneous rate / intensity function
$W_{sr}(t)$	Risk Indicator Function
$\lambda_0(t)$	Baseline Function
$f_{sr}(t)$	(Log-Hazard) Contribution Function
$\Delta T_{sr}(t)$	Waiting Time for dyad (s, r) ;

2 Relational (Hyper) Event Statistics

$ \begin{array}{c} \boldsymbol{x}_{sr}(t) \\ \boldsymbol{z}_{sr}(t) \\ \boldsymbol{z}_{sr}(t) \\ \boldsymbol{n}_{ame} = \boldsymbol{statistics}(s,r,t) \\ \boldsymbol{n}_{ame} = \boldsymbol{n}_{ame} = \boldsymbol{n}_{ame} \\ \boldsymbol{n}_{ame} = \boldsymbol{n}_$	Symbol	Description
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computed as mean of attribute values of individuals; Average absolute difference among attribute values of pairs of individuals, for all possible pairs in the hyperevent; computed as mean of attribute values of individuals;	$\widehat{\operatorname{closure}}(S,t)$	Average N. of two-paths via a third node for any pair of nodes in S
diff. $z(S,t)$ Average absolute difference among attribute values of pairs of individuals, for all possible pairs in the hyperevent; computed as mean of attribute values of individuals;	$\operatorname{avg.z}(S,t)$	Average attribute value for hyperevent,
of pairs of individuals, for all possible pairs in the hyperevent; computed as mean of attribute values of individuals;		computed as mean of attribute values of individuals;
computed as mean of attribute values of individuals;	$\operatorname{diff.z}(S,t)$	Average absolute difference among attribute values
		of pairs of individuals, for all possible pairs in the hyperevent;
$\mathbb{E}_{M}(\cdot)$ Expectation according to model M ;		computed as mean of attribute values of individuals;
	$\mathbb{E}_M(\cdot)$	Expectation according to model M ;

3 Relational (Hyper) Event Model: Inference

Symbol	Description
$\overline{\mathbb{W}=\{\mathcal{W}_t\}_{t\in\mathbb{R}^+}}$	Filtration arising from events and exogenous information
$\Delta N_{sr}(t_i)$	Difference between counts of events between t_{i-1} and t_i
$\ell(oldsymbol{eta})$	Log-Likelihood Function
$\mathcal{L}^P(oldsymbol{eta})$	Partial Likelihood Function
$\ell^P(oldsymbol{eta})$	Partial Log-Likelihood Function
\mathcal{SR}_t	Sampled Risk set evaluated at time t
m	number of sampled non-events
$\mathbb{F} = \{\mathcal{F}_t\}_{t \in \mathbb{R}^+}$	Filtration integrated with sampling information
$\pi_t(\mathcal{SR} (s,r))$	Probability of sampling the risk set given the observed dyad
y_i	Response of (Conditional) Logistic Regression for observation i
π_i	Success Probability of (Conditional) Logistic Regression for observation i
$\lambda_{sr,\mathcal{SR}}(t)$	Intensity of the sampling counting process
$\mathcal{L}^{S}(oldsymbol{eta})$	Sampled Partial Likelihood Function
$\ell^S(oldsymbol{eta})$	Sampled Partial Log-Likelihood Function
$\Delta oldsymbol{x}_i$	Difference between the covariate evaluated for the event and the non-event

4 Mixed Effect Additive Relational Event Models

Symbol	Description
$\beta(t)$	Time-varying effect vector
$f(oldsymbol{x}_{sr}(t))$	Non-linear effect of $x_{sr}(t)$
γ	Random effect vector
$b(\cdot)$	Basis function
j	Index of a generic basis $b_j(\cdot)$
q	Spline dimension
$oldsymbol{ heta}$	Basis coefficient vector
$oldsymbol{x}_{sr}^{(1)}$	Vector of covariates with linear fixed effect
$oldsymbol{x}_{sr}^{(2)}$	Vector of covariates with time-varying effect
	Specifically, Bike example: distance from public transport
$oldsymbol{x}_{sr}^{(3)}$	Vector of covariates with non-linear effect
	Specifically, Bike example: distance between bike stations
$oldsymbol{z}_{sr}$	Vector of covariates with random effect
	Bike example: start station indicator
σ^2	variance of a single random effect

5 Goodness of Fit

Symbol	Description
$G[\hat{m{eta}},t]$	Observed cumulative martingale residual process
\hat{J}	Variance-covariance matrix of process G
$\mathcal{I}[\hat{oldsymbol{eta}}]$	Observed information matrix
S	penalty matrix
T	test statistic

6 Advanced Relational Hyper Event Models

Symbol	Description
$\overline{V_1}$	Sender set in a two-mode relational graph;
V_2	Receiver set in a two-mode relational graph;
V_t	Set of potential nodes at time t
$V_{*,t}$	Set of nodes of type $*$ at time t
$V_{2,t}(s)$	Set of receiver at time t available for sender s ;
$\overline{\lambda}_{s B }(t)$	baseline intensity in directed RHEM;
$\overline{\lambda}_{s, R }(t) \ \mathcal{L}^P(oldsymbol{eta},t)$	Partial likelihood
$\lambda_{sR}^{(dyadic)}(t) / \lambda_{sR}^{(rhem)}(t)$	intensity process
repetition (s, R, t)	weighted sum of previous $s \to R$ events before t
hy. $\deg^{(in)}(R',t)$	N. (or weighted count) of previous events
	with receiver set $\subset R'$
$r.sub.rep^{(k)}(s, R, t)$	Average N. (or weighted count) of previous joint events
	with receivers set $\subset R$
hy.deg(s, R', t)	N. (or weighted count) of previous events from s to receiver set $\subset R'$
$s.r.sub.rep^{(k)}(s, R, t)$	Average N. (or weighted count) of previous joint events
	with receivers set $\subset R$
interact.receivers $^{(k)}(s,R,t)$	Interaction among receivers
reciprocation(s, R, t)	N. (or weighted count) of previous events from $r \in R$ to s over $ R $
$\deg^{(out)}(s',t)$	N. (or weighted count) of previous events from s' (to whoever)
gen.recip(s, R, t)	N. (or weighted count) of previous events from $r \in R$ (to whoever) over $ R $
trans.closure(s, R, t)	N. (or weighted count) of previous triangles $s \to a$ and $a \to r \in R$
	for possible a (over $ R $)
$\operatorname{cyclic.closure}(s, R, t)$	N. (or weighted count) of previous 2-path $a \to s$ and $r \in R \to a$
	for possible a (over $ R $)
shared.sender(s, R, t)	N. (or weighted count) of previous 2-path $a \to s$ and $a \to r \in R$
	for possible a (over $ R $)
shared.receiver (s, R, t)	N. (or weighted count) of previous 2-path $s \to a$ and $r \in R \to a$
	for possible a (over $ R $)
$e_i = (S_i, t_i, x_i, y_i)/e_i =$	Relational event with outcome y_i and covariates x_i ;
(S_i, t_i, y_i)	
hy.deg(S', t, E) /	Same as hy. $deg(S', t)$
hy.deg(S', t, G[E, t])	(k)(a, b)
$\operatorname{sub.rep}^{(k)}(S,t,E)$	Same as sub.rep $^{(k)}(S,t)$
performance (S',t)	Total prior success;
prior.success $^{(k)}(S,t)$	Prior share success of order k ;
$e_i = ([S_i, l_i], t_i)$	Labeled (l_i) relational hyperevent;
$e_i = (r(t_i), S_i, R_i, t_i)$	Publication of paper $r(t_i)$ at time r_i by authors S_i citing papers R_i ;
r(t)	paper published at time t;
$\operatorname{cocite}(R',t)$	N. (or weighted count) of previous publication events
$(k)(D_{i})$	with common references R' ;
cocite $rep^{(k)}(s, R, t)$	Average N. (or weighted count) of publication joint events
	including set of references of size k subset of R ;
cite paper and its $refs(R, t)$	
cite coauthor (S, R, t)	
$\operatorname{coauth}(s, s', t)$	
$\operatorname{author}(s', r, t)$	
auth cite repet (S, R, t)	
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