Burstiness in phone calls

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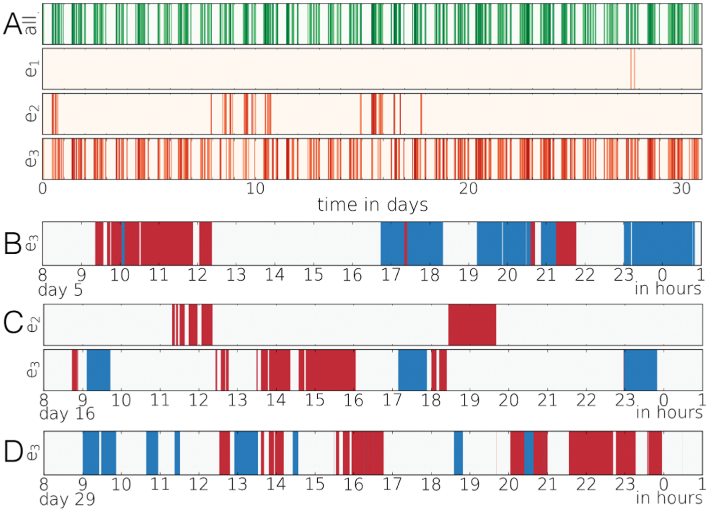
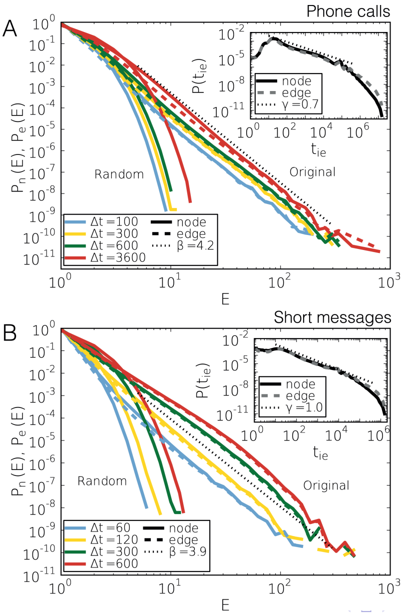
An person call three friends



Content

- Inter-event time:$P(t_{ie}) \sim t_{ie}^{-\gamma}$
- A train of bursty events consists of consecutive events with inter-event time $t_{ie} < \Delta t$
- Independent $P(t_{ie})$, P(E) decay exponentially while for correlated signals, P(E) behaves power-law
- Number E of events:$P(E) \sim E^{-\beta}$

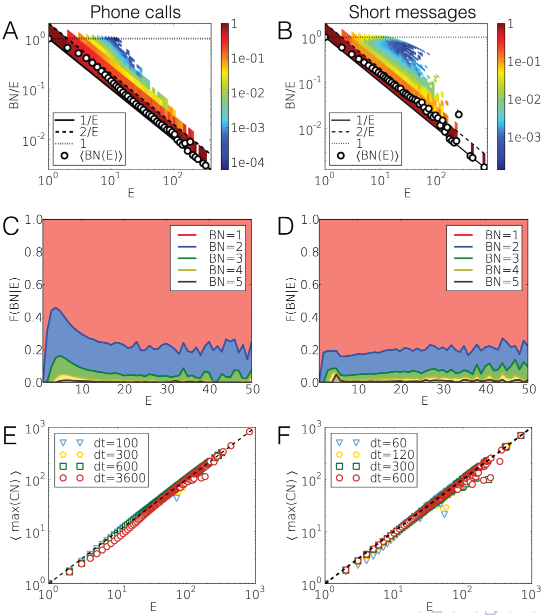
Data distribution



Number of neighbors per call

- BN: number of neighbors an individual called during a train.
- The ratio of BN/E: 1/E if only talk to one person, 1 if talk to completely different people.

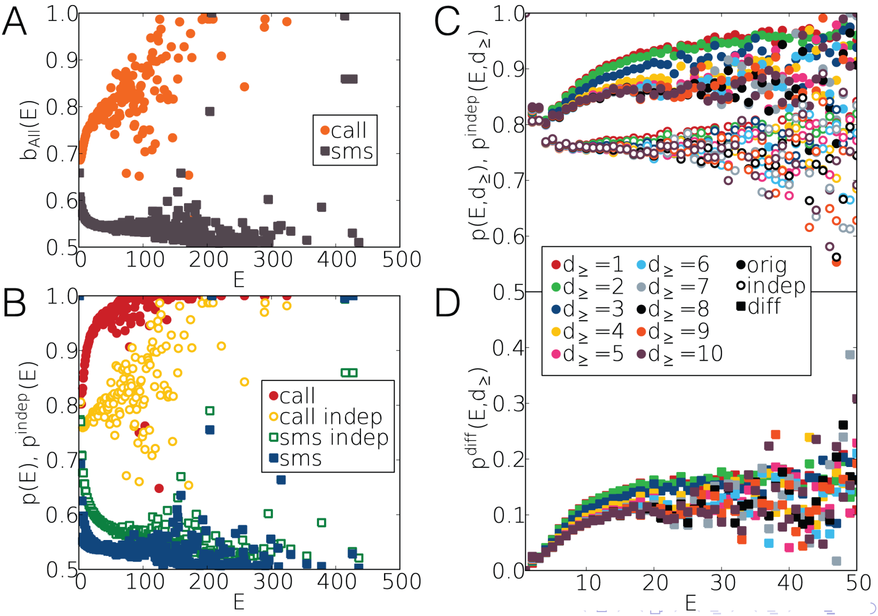
Number of neighbors per call



Mutual bursty behaviour

- Balance for a particular edge: $b_e = \frac{max(N_A,N_A)}{N_A+N_B}$, N_A means numbers of calls A calls B. $1/2$ perfect balance.
- $b_{all}E$ means balance index over all possible edges in train with E events.
- Balance for an edge in m-th train with size E: $p_e(E_m) = \frac{max(n_A,n_A)}{n_A+n_B}$, p(E) is the average
- Benchmark: $p_e^{indep}(E_m = E) = f(E, b_e)$, a train composed only independent events from a set with balance b_e.

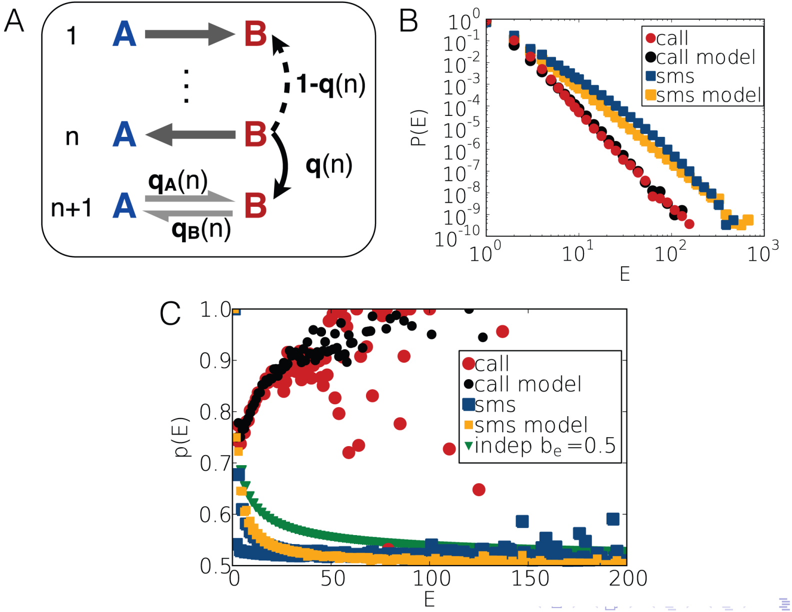
Mutal bursty



Model

- The probability of having one more event in a size n train: $q(n) = (\frac{n}{n+1})^v$, $v = \beta + 1$
- Calls Mutuality: $q_\sigma(n|\sigma_1) = \frac{n}{n+1}$ and $q_\sigma(n|\neg\sigma_1) = 1 - \frac{n}{n+1}$. $q_\sigma(n|\sigma_1)$ is the probability of nth event being initiated by the same person who initiates the train.
- SMS Mutuality: $q_\sigma(n|\neg\sigma_{n-1}) = \frac{n}{n+1}$ and $q_\sigma(n|\sigma_{n-1}) = 1 - \frac{n}{n+1}$.

simulation



A
1 A B
n A B
n+1 A B
1-q(n)
q(n)
qA(n)
qB(n)
B
call
call model
sms
sms model
P(E)
E
C
call
call model
sms
sms model
indep be =0.5
p(E)
E