DMS First draft

Pranay
Surya

June 8, 2016

1 Data required

We need the $AREA$ where a $CLIENT$ visits during each $TIMESLOT$ of current $TIMESTEP$.
We will use this data to find the probabilities for the $CLIENT$ to be in an $AREA$ a given $TIMESLOT$ in the next $TIMESTEP$.
We might also need a confirmed observation about the state of the $CLIENT$.
We can use this to learn the location factors of an area in particular timeslots.

2 EQUATIONS

Equation for updating fever count

$$f_p(t) = \delta f_p(t-1) + \sum_{i=1}^{k} \epsilon_i(t-1) f_i(t-1) \tag{1}$$

Where:

- $f_p(t)$: fever count of person p with after the timestep t
- k: Number of encounters of the person during timestep t
- x_i : fever count of i^{th} encounter
- ϵ_i : location factor of the i^{th} encounter

Equation for calculating fever in an area

$$F_{mn}(t) = \sum_{i=1}^{N} P^i_{mn}(t-1) * f_i(t-1) \tag{2}$$

Where:

- $F_{mn}(t)$: Fever count of an area n at timeslot m after timestep t

- $P^i_{mn}(t)$: Probability that a person i will visit area n during timeslot m after time step t
- $f_i(t)$: fever count of a client i after timestep t
- N : total number of clients

Equation for predicting the fever count of person after next timeslot

$$f_p(t+1) = \delta f_p(t) + \sum_{n=1}^{24} \sum_{m=1}^{M} \epsilon_{mn}(t) * P^i_{mn}(t) * F_{mn}(t) \tag{3}$$

Where:

- $F_{mn}(t)$: Fever count of an area n at timeslot m after timestep t
- $P^i_{mn}(t)$: Probability that a person i will visit area n during timeslot m after time step t
- $f_p(t)$: fever count of a client p after timestep t
- M : total number of arears being monitored
- $\epsilon_{mn}(t)$: Location factor for area n during the timeslot m after timestep t

3 Can this be possible?

By using the data whether a $CLIENT$s state is $FEVER/NOFEVER$, can we learn the probabilities of spreading of fever in the $AREA$s on the particular $TIMESLOT$s. For Example, we know that a $CLIENT$ took leave from office and is staying at home.He gets affected by fever. This can make us learn about the $AREA$ "client's home" and the location factor ϵ for his house.

4 Modeling as a markov chain

4.1 Modeling

State: fever count of each $CLIENT$ say $f_1 f_2 f_3 ... f_N$
Transition: a transition is an interaction. An interaction is of form $[p_1, p_2, A, TS]$. This represents the meeting of person p_1 with person p_2 in an $AREA$ A during $TIMESLOT$, TS.
Transition probability: Equation for transition probability is yet to find. But this depends upon the following factors.

- probablity that a person p_1 goes to an $AREA$ A at a $TIMESLOT$ TS after the previous timestep. $P^{p_1}_{TS,A}(t)$

- probablity that a person p_2 goes to an $AREA$ A at a $TIMESLOT\ TS$ $.P^{p_2}_{TS,A}(t)$
- depends on the location factor for the $AREA$ A in the $TIMESLOT\ TS$
- depends on the fever counts of the clients in the previous $TIMESTEP$. $f_i(t-1)$

4.2 Difficulty

Since the states of the markov chain are continuous as the fever count is a continuous variable. We are searching for ways to model the continuous distribution. If we consider a discrete distribution, say with four states for each $CLIENT$ instead of the fever count. The problem is that we get a very high number of states. 4^N if we consider three states. We still are figuring out how to get the transition probability in terms of current state $f_1f_2f_3...f_N$ and the next state $f_1^{'}f_2^{'}f_3^{'}...f_N^{'}$