APPENDIX

Figure 1. Mathematical model Susceptible (S) -> Infectious (I) (with rate inf). Infectious (I) -> Detected/Death (D) (with rate 1/durat)

EARLY DETECTION

Set of dependent variables stocks counts farm/pigs/wild boars in each of the groups, and agents (farm/pigs/wild boars) can change states according to schema:

Here epidemiological variable (Jarynowski, 2011) basic reproduction rate: $R_0 = inf \cdot durat$, where:

inf – infectivity

durat – detection time/elimination time

$\frac{\delta I}{\delta t} = dif \cdot \triangle I + inf \cdot I \cdot S - I/durat$

The early detection method in zeros approximation can be done by fitting the incidence curve to the qasi-exponential growth with constant increments (Diekmann, et al. 2013), resulting estimation of the infectivity coefficient (attact rate) per month) [Fig. **??**].

We try few approx formulas in differntial form $\frac{\Delta Incid(t)}{\Delta t} \sim Incid(t) \cdot inf$. Due nonstationarity and seasonality, we calculate infectivity for different time regim, with notation n is initial month and N ending month of estimation

In first apprach we take average (super upper limit) we calculate mean difference between consecutive increments $\hat{inf} =<< \frac{Incid(i+t+j)}{Indic(i+j)} >_{i \subset (n+j,.,N-t)} - < \frac{Incid(i+t+j-1)}{Indic(i+j-1)} >_{i \subset (n+j-1,.,N-t)} >_{j \subset (1,.,N-1)}$,

We fit linieral regresion coefintion (upper limit) in relationship Y(t) ~ inf*t, with $Y(t) =< \frac{Incid(i+t)}{Indic(i)} >_{i \subset (n,.,N-t)}$,

We estimate exponential fit to incidence function: $Incid(t) \sim exp(inf \cdot t)$

In last appraach fit linieral regresion coefintion in relationship Y(t) ~ inf*t, with $Y(t) =< ln(\frac{Incid(i+t)}{Indic(i)}) >_{i \subset (n,.,N-t)}$,

According to simplified relation in SID (Susceptible, Infectious, Detected) model $R_0 = inf * durat$ we observe that detection and elimination time is critical to satisfy epidemic condition (R0=1).

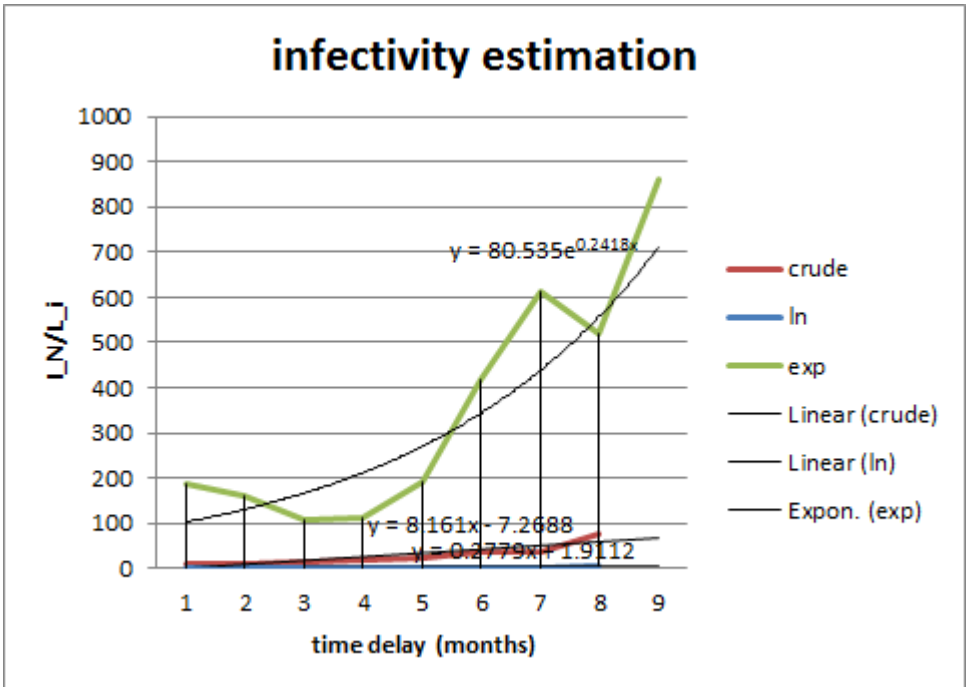

Figure 2. Infectivity estimation from July 2017 till March 2018 – nonstationary outbreak (faster increase due and WB hunting surveillance, spatial expansion ~0.75 County per month/3.2% monthly)

1) Regime February 2014 to July 2016. Pre (sub) epidemic regime, spatial expansion ~0.28 County per month. Infectivity rate is estemated between 0 up to 0.005 with reasonable upper limit around on 0 level per month

2) Regime July 2016 to June 2017 – stationary 'epidemic' regime with increase due to spatial expansion ~0.8/4.4% monthly County per month. Infectivity rate is estemated between 0.2 up to 1.25 with reasonable guess around 0.25 per month

3) Regime June 2017 till March 2018 –super epidemic regime with nonstationary outbreak (faster increase due and WB hunting surveillance, spatial expansion ~0.75 County per month/3.2% monthly). Infectivity rate is estemated between 0.25 up to 5 with reasonable guess around 0.27 per month

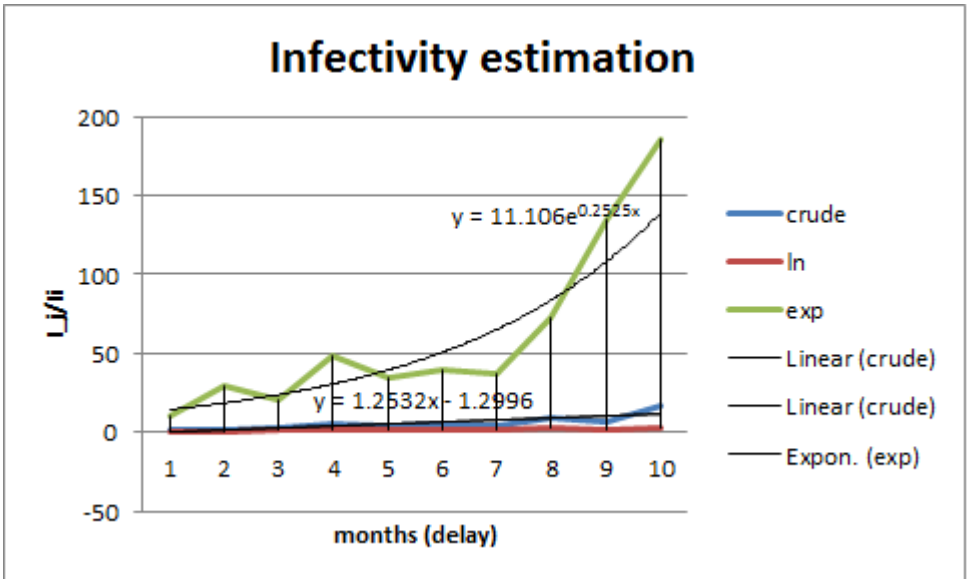

Figure 3. Infectivity estimation from July 2016 till June 2017 – stationary outbreak 'epidemic' increase due to spatial expansion ~0.8/4.4% monthly County per month