Title: Math of The Walking Dead


School: Ettore Majorana, Mirano (Venezia)

Teachers: Mario Puppi, Carlo Andreatta

Researchers: Alberto Zanardo, Riccardo Colpi (Department of Mathematics of Padova University)

Short presentation of the research topic.

*The Walking Dead* is a TV serial which tells the story of a Zombie Apocalypse. Zombie stories are classic themes in science fiction, often consistent with infectious disease biology. In the episodes of serial *The Walking Dead* or films such as *World War Z* and *Resident Evil*, infection is caused by virus. In the novel *Deck Z* contagion is caused by bacteria, and prions are the cause in the film *Zombieland*. *Zombism* is a deadly disease that kills every infected human and turns the host into a deadly vector of the disease. Our challenge is

- develop a model of the interaction between humans and zombies
- study the model using computer simulations to identify values of parameters consistent with observations based on TV series *The Walking Dead*
- use the model to make prediction about survival of humanity and know how large number of the population will survive to a zombie attack.

We’ll make a model of *zombism* using assumptions adopted for traditional diseases that affect a population. Every day a human will be in one of three states:

- the state of susceptible or uninfected humans,
- the infected state of zombies,
- the removed state of a human died for natural causes or a zombie killed by an uninfected human

Two transitions are possible: a human can become infected by a zombie, and a zombie can be destroyed by a human. Two parameters govern the two transitions:

- a parameter gives the rate at which a zombie will infect humans
- another parameter gives the rate that a human kills the zombies.

We write the equations which describe explicitly the evolution of humans and zombies in time, and we study the model using two methods:

- running computer simulations we observe parameters involving infection rates and death rates to see how are affected the population of zombies and humans over time
- searching for the invariants quantities of the evolution and using them to construct useful approximation of the evolution.