

## CS 262 – Introduction to Computational Social Science

Shiza Khalidi (sk03870) Eraj Rizwan (er03984)

### Modelling Domestic Violence

#### Purpose

The purpose of the ABM is to simulate the relationship between a husband and wife, and use this simulation to explain the various factors that lead to domestic violence, particularly abuse of the wife by the husband.

Another purpose of the model is to educate the general public. Intimate partner violence is one of the most predominant social issues. Especially in places like Karachi, people from all sorts of socio-economic backgrounds are affected by it. We would like this model to become a basis for providing public awareness about the factors that lead to intimate partner violence, and how small actions can create a severe impact on a couple's relationship in the long run.

#### Agents and Entities

This model has heterogeneous agents. They differ based on their gender; male (husband) or female (wife). They are characterized by multiple attributes, some of which are specific to them while other are generalized. The general parameters of these turtles include *age*, *color*, *spouse*, *gender*, *posx*, *posy*, *education\_level*, *economic\_background*, *history* and *have-children*.

- *Posx* and *posy* are set based on the grid-cell. These are static parameters.
- *Education\_level* and *economic\_background* are set as either 'low', 'medium' or 'high' based on a number of other characteristics. These are static parameters.

- *History* is the history of witnessing abuse. This is a static parameter.
- *Have-children* is a Boolean value that signifies if the couple has children or not. This is a static parameter.

The attributes specific to the 'male' gendered husband include *substance-use* and *anger*.

- *Substance\_use* is a Boolean value that signifies if the husband uses drugs or drinks alcohol frequently. This is a static parameter.
- *Anger* is a very important characteristic that depends on all other parameters of the husband. It will eventually indicate if the husband has a tendency to be abusive or not. This is a static parameter.

The attributes specific to 'female' gendered wives are *endurance* and *reaction-to-abuse*.

- *Endurance*, a dynamic parameter, is determined by all other parameters of wives, and it indicates how much patience a woman will have towards abuse. It depletes with passing ticks, and eventually some couples are led to a divorce, which is denoted by the *reaction-to-abuse* parameter, another dynamic parameter.

### State and Global variables

Global parameters include *wife\_agents* that the user will use to set the number of couples to be rendered on the grid, *satisfaction* that signifies if a women is happy or not (compared to her *endurance*), *SocietyType* is the variable of the chooser that give the choice to select a rural, Scandinavian or a mixed society for the simulation, and the *abuse-threshold* that the user can

set to compare with the *anger* of the male agents and determine if he is abusive or not. All of these are static parameters.

The Environment is a social environment, there is no geographical space. Each tick represents four months period, the agents are aging and their respective dynamic attributes are also updating with time.

### Process overview and scheduling

With each step, the following actions take place; (1) Aging (with respect to a four months period), (2) comparison of the tendency of being abusive, (3) Wife agent's *endurance* reduced based on the result of comparison, and (4) if the *endurance* falls below a certain threshold (satisfaction), the couple gets divorced.

### Design concepts:

This model implements many important features of Agent-based modelling. Some of them include sensing, interaction and stochasticity.

### Sensing

The agents are aware of their attributes, e.g. age, gender, *education\_level*, *economic\_background* etc. The husband agents can sense their *anger* level, which if exceeds the *abuse-threshold*, causes them to inflict violence on their wife. The *anger* levels are represented by the *color* of the husband agent. A darker *color* represents a high *anger* level and thus a higher tendency to abuse their wife.

The wife agents are aware of the abuse that is inflicted upon them by their husbands, which influences their behaviour i.e. their *endurance* level decreases.

## Interaction

Interaction was very important for this model and its outcome. There is a direct interaction between the husband and wife in the social space, i.e. the abuse of the husband against the wife. This abuse is represented by the *color* of the wife agent. As more violence is inflicted upon her, her *endurance* level decreases and her *color* becomes a darker shade of red.

However, it should be noted that the husband-wife couples do not interact with other husband-wife couples directly.

If the wife agent's *endurance* becomes lower than a certain threshold, depending on her *economic\_background* and *education\_level*, then either she breaks the tie of marriage from her husband and the couple gets divorced, or she is forced to spend the rest of her life with her husband due to various socio-economic factors. A divorced couple is represented by the *color* blue, whereas if a wife-agent is forcefully living with her husband, then she is represented by the *color* black.

## Stochasticity / Randomness

Stochasticity is used in assigning certain attributes to the agents. Each couple's position in the social space is randomly assigned. However, the husband and wife agents in each couple are positioned together with the male on the right (from the user's view). The possibility of a couple to have children is completely random.

Wife *education\_level* depends on the kind of society that she lives in. However, within each society there is a probability being generated which will determine the wife agent's *education\_level*. For example, in the mixed rural urban setting (Karachi), overall 80% of the females should have education of 'low' or 'medium' levels and 20% of 'high' level. This is to create resemblance in the model with the actual society.

*Education\_level* of the female in turn affects other attributes like her own *economic\_background*, *age* as well as the husband's *education\_level* and *economic\_background* are some examples. However, all of these attributes have some randomness in them, as we wanted to create some variability in the models as real societies are, but also match the agents' overall behaviour with the expected distributions. Therefore, with each simulation, the model varies slightly but the patterns that we observe remain similar with every run.

### Setup and initialization

The grid consists of 61x35 patches/cells, and the world does not wrap around horizontally or vertically, as our turtles are static and so there was no need.

As the model is initialized, a number of agents, specified by *wife-agents* (from 1 to 100), are created along with the patch *color* being set to green, and the *satisfaction* gets defined according to the *SocietyType* chosen by the user.

The parameters of wife are then set; their position is set randomly, but the grid-cell space is considered as their male counterparts would be positioned closed to them. Based on the *SocietyType*, if it is a rural setting, *education\_level* of majority of the wives have 'low' *education\_level*, and a few have it as 'medium', if it is a Scandinavian society, majority has 'high'

education level, with a few having 'low' or 'medium', and if it is a mixed society, majority is of 'medium' or 'low' *education\_level* while 20% are of 'high' *education\_level*. On the basis of this *education\_level*, their *economic\_background*, age, and *endurance* are set. *History* is set on a probabilistic basis.

The husbands are created after their wives (hatch function). Their parameters are set in a similar way, most based on probability. The *education\_level* and *economic\_background* depends on their wife's *education\_level*, while *age* is determined by the age-difference, which is inspired by the stories we considered for this project. *Sunstance\_use* and *history* are randomly allotted. All these parameters contribute towards some value of *anger* for the husband agent. The *anger* values are added based on some specific range for different cases.

### Input data

The model does not use input data to represent time-varying processes. All agents are created and attributes are assigned to them at the time of setup and initialization.

### Outputs

Several graphs and monitors have been created so that the user can have a good understanding of what the model is depicting.

As the simulation runs, the *colors* of the wife agents change. A darker shade of red represents that the wife's *endurance* level is decreasing, i.e. her ability to bear the abuse is lessening. If her *endurance* comes to a certain point, she can either file for a divorce, represented by the *color* blue. Or she has to remain with her abusive husband for the rest of her life, as represented by the *color* black.

The average wife *endurance* of a society can be seen in a monitor as well as in the average female *endurance* plot. As expected, in each run, with time the average *endurance* decreases.

Another monitor shows the number of divorces that take place in the model. The husband and wife monitors show the number of husbands and wives, and should be equal. The sum of the number of wives and the number of divorces should equal the total couples selected at the start.

Tension within marriages of the entire society can be observed through the histogram, where *endurance* of wife agents and *anger* level of husband agents can be seen together. As expected, with each run, the number of wives with lower *endurance* increases. This histogram not only helps to visualize the tension of marriages in a society after the simulation has been run, but at setup, the user can see how these attributes vary for different types of societies.

Lastly, the ABM also shows number of happy and unhappy or divorced couples, which is determined by the wife's *endurance* and her husband's *anger* level.

### [Sub-models/processes/functions](#)

The following processes take place at every go function:

1. **Aging:** Since each tick represents 4 months, hence at each tick, every agent's *age* increase by one-third.
2. **Check violence:** at every tick, the husband agent's *anger* level will be compared with the *abuse-threshold* selected by the user. If the *anger* level exceeds or is equal to the *abuse-threshold*, then that husband will inflict violence on his wife.

If the husband is abusive, the wife's *endurance* starts to exhaust as it gets reduced by some specific value. The proportion by which the *endurance* decreases depends on the attributes of the wife; her *economic\_background*, *education\_level*, *history* of witnessing abuse and whether she has children or not.

If the *endurance* drops below a specific point, *react-to-violence* function sets the *reaction-to-abuse* parameter as 'divorced' and updates other parameters accordingly.

3. **Death:** If an agent's *age* becomes greater than 80, then that agent and their spouse will also die. Since, in our model, there is no option of remarriage or multiple marriages, hence once an agent dies, their spouse will no longer remain relevant to model domestic violence.
4. **Updating labels of *endurance* and *anger* of wife and husband agents:** With each tick the label on husband and wife agents of their *anger* level and *endurance* level will be updated to match the current values after the *check-violence* function has run.