The SILAS model: Demographics

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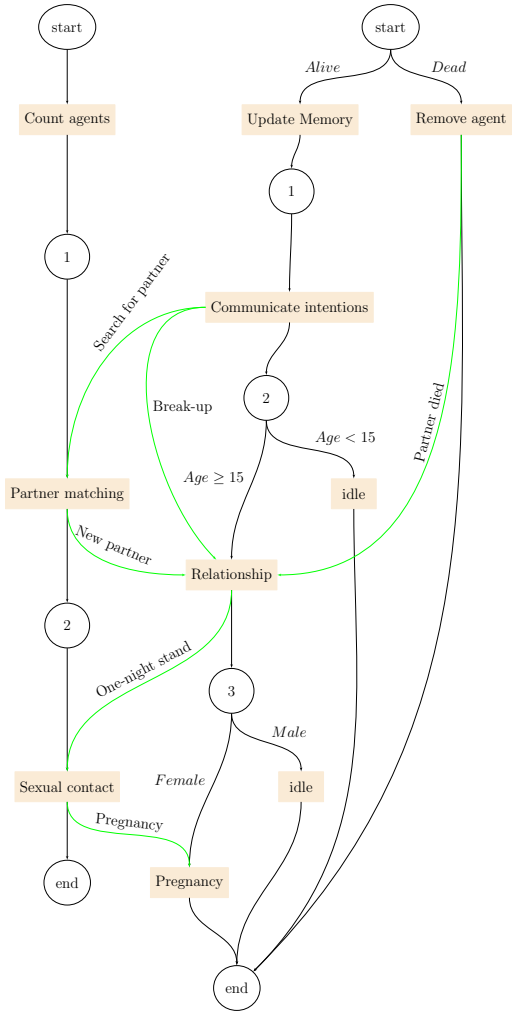
Infectious Disease Modeling

- State of the art in modeling infectious diseases are dynamic transmission models
- Mixing or contact patterns are incorporated via contact matrices, giving the mean number of contacts between all age-groups
- Extensive calibration may be necessary for models to produce observed prevalences or incidences
- Thinking of the spread of HIV at the beginnig of the pandemic in the US, the mean contact rate would not have represented the number of contacts of patient 0 (a flight attendant)

The SILAS model: Overview



The SILAS model: Demographic module

- Age- and sex-specific mortality rates
- Births are result of sexual contacts (see social module) under consideration of age-specific probabilities of:
  - Fertile phases of women
  - Conception during the fertile phase
  - Induced and spontaneous abortions
  - STI-protecting and non-STI-protecting contraception
- No migration

The SILAS model: Social/relationship module

- Age- and sex-specific rates of relationships
- Age-, sex- and sexual orientation-specific probabilities of forming and ending relationships
  (2-parameter Weibull distributions)
- Assumed probability of unfaithful behavior
- Age-, sex- and sexual orientation-specific probabilities for daily sexual contact of singles and couples
  (4-parameter beta-distributions)
- Age-, sex- and sexual orientation-specific probabilities for mode of contraception of singles and couples
  (multinomial-logit models)

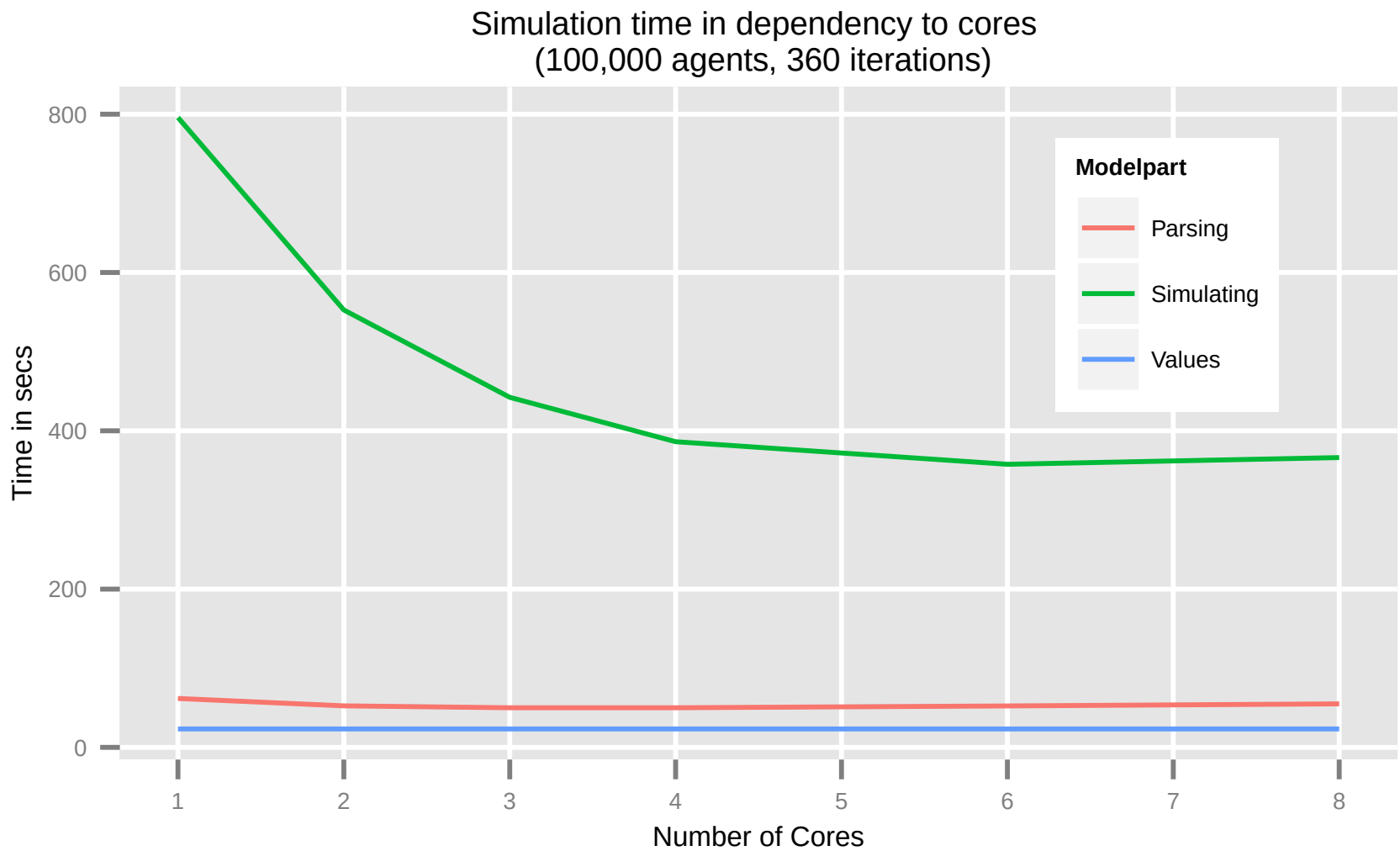
The SILAS model: Data sources

- PAIRFAM panel dataset: 6 waves of three age cohorts
- DESTATIS: Parameters of total German population
- Literature on parameters of fertility

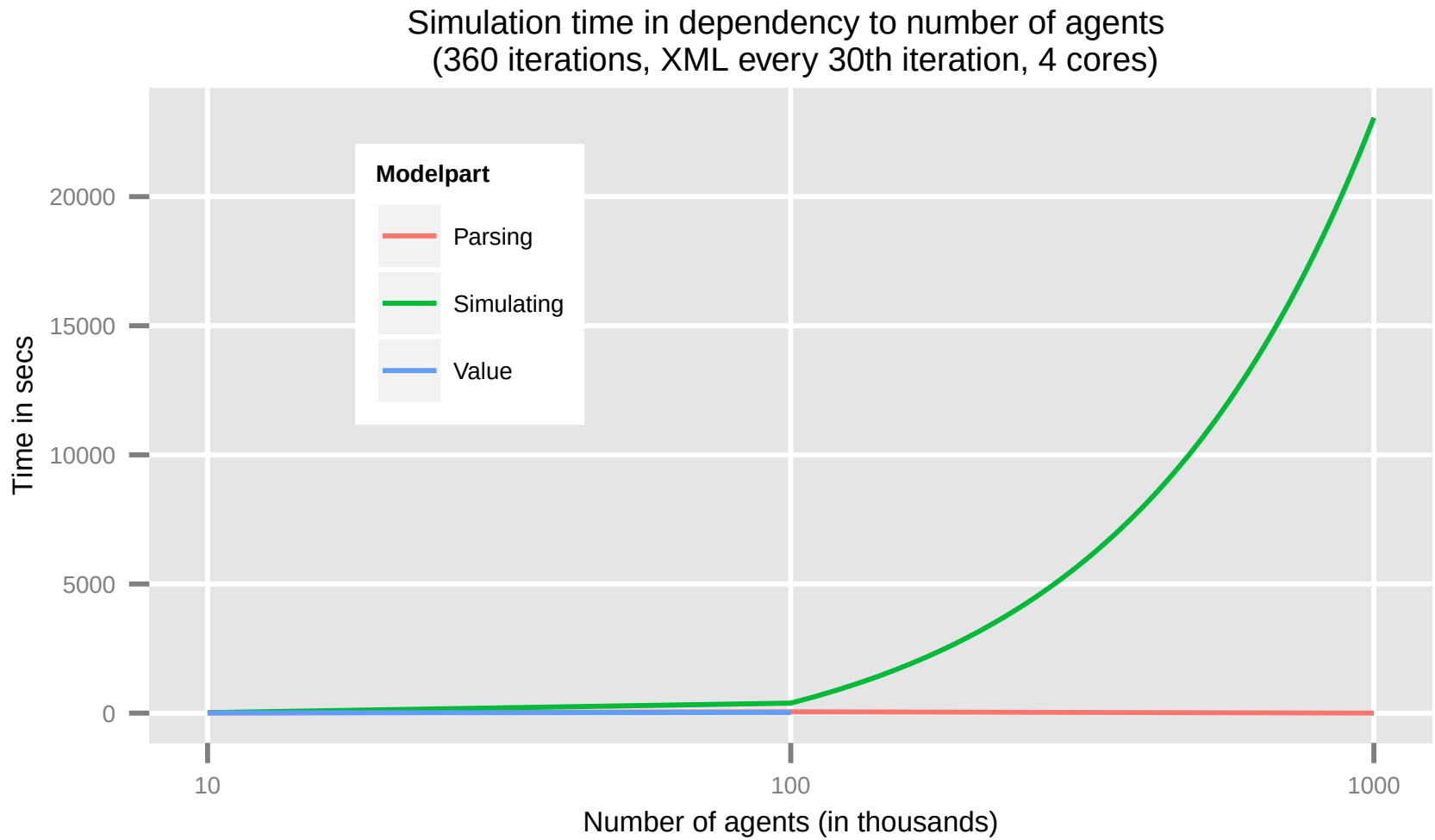
The SILAS model: Technicalities

- FLAME-framework on Ubuntu, Intel Xeon 3.3 GHz x 8 (4 physical) cores, 16GB RAM, HDD, openmpi
- Python based GUI for creation of starting population with following functions:
  - Class-based AgentMaker creating agents value sets including creating paired agents using the Law of Total Probability
  - xmlMaker for wrapping values sets in XML-tags
  - Multi-core parser for transformation of XML-files in CSV

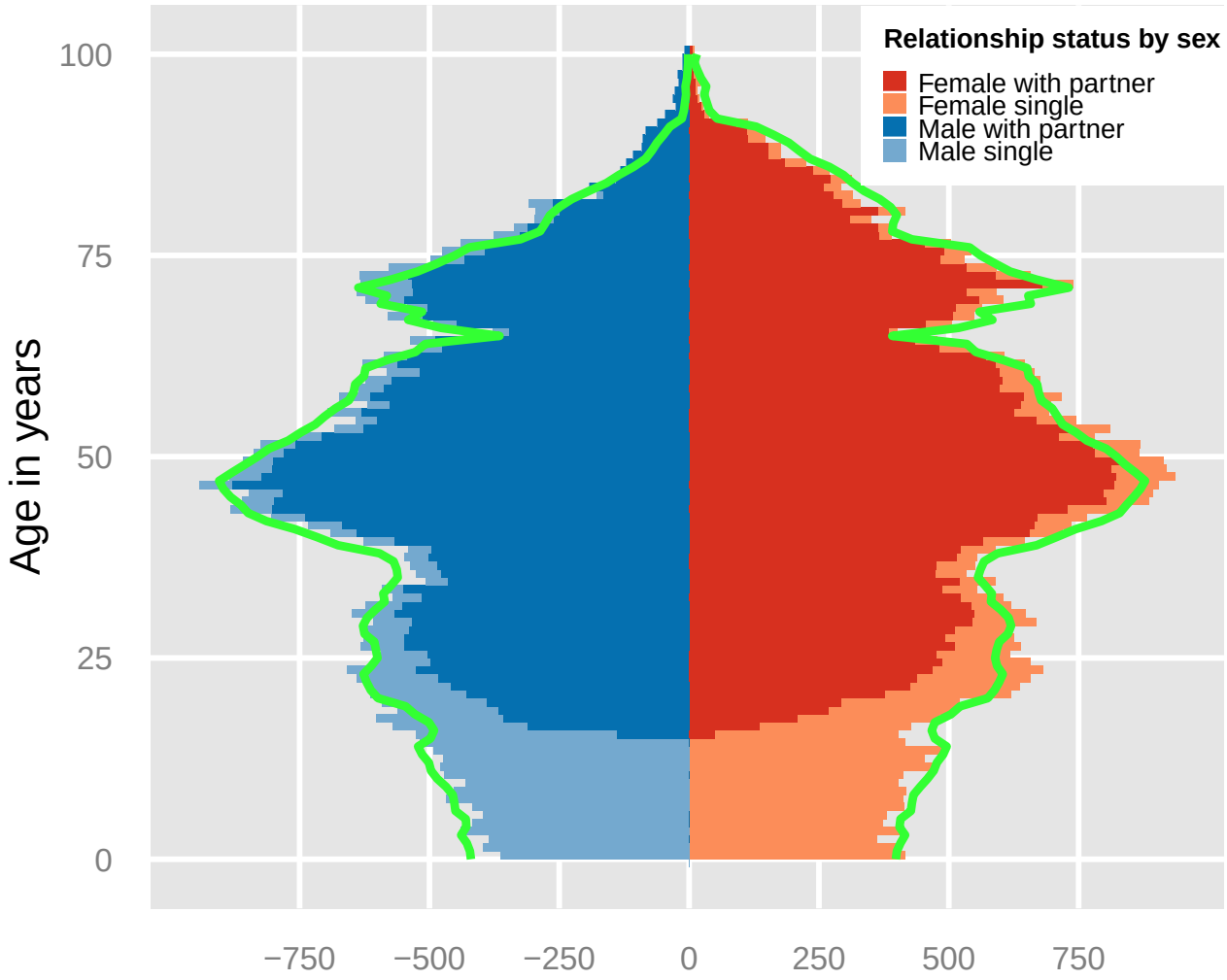
Performance No. of cores



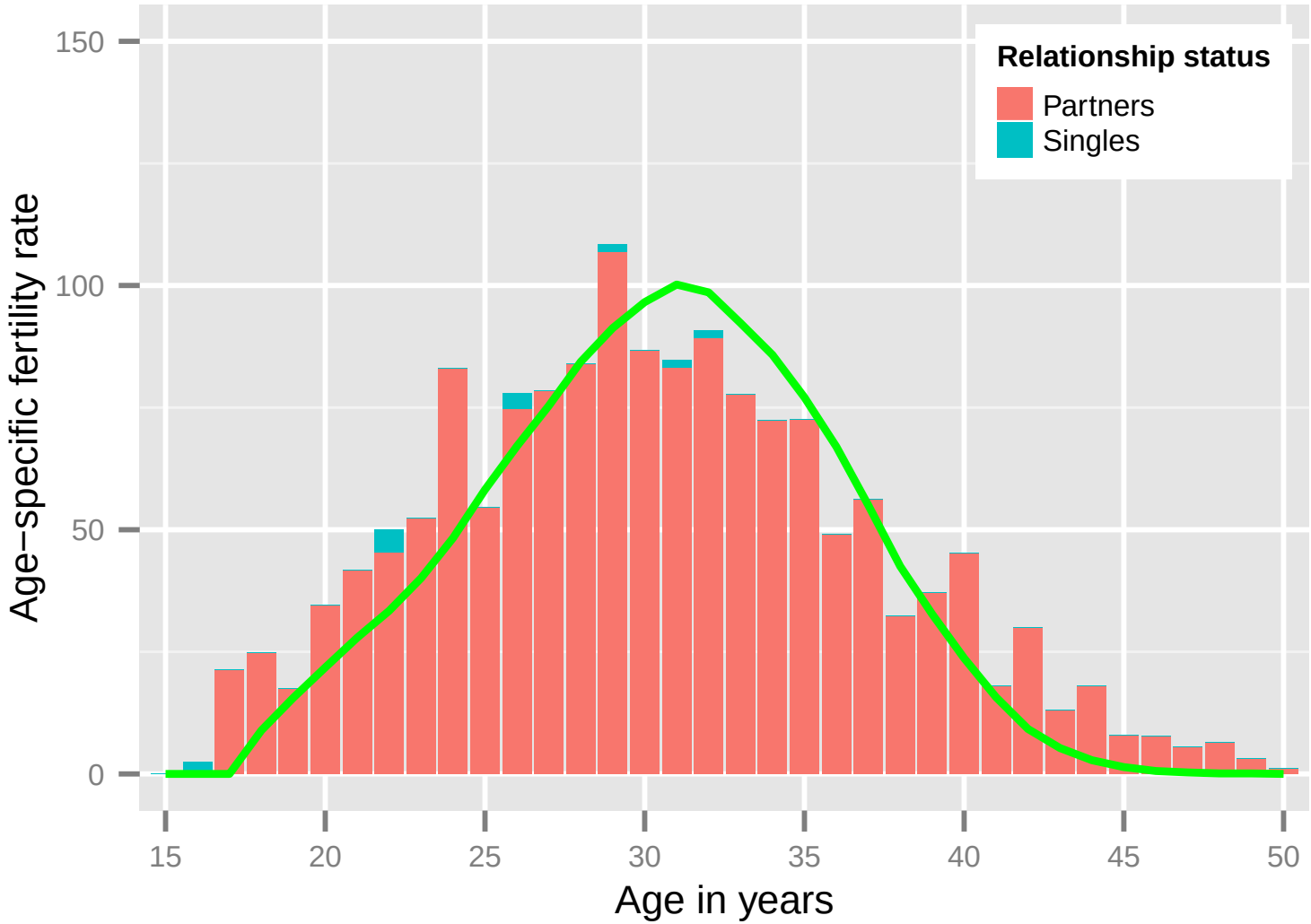
Performance No. of agents



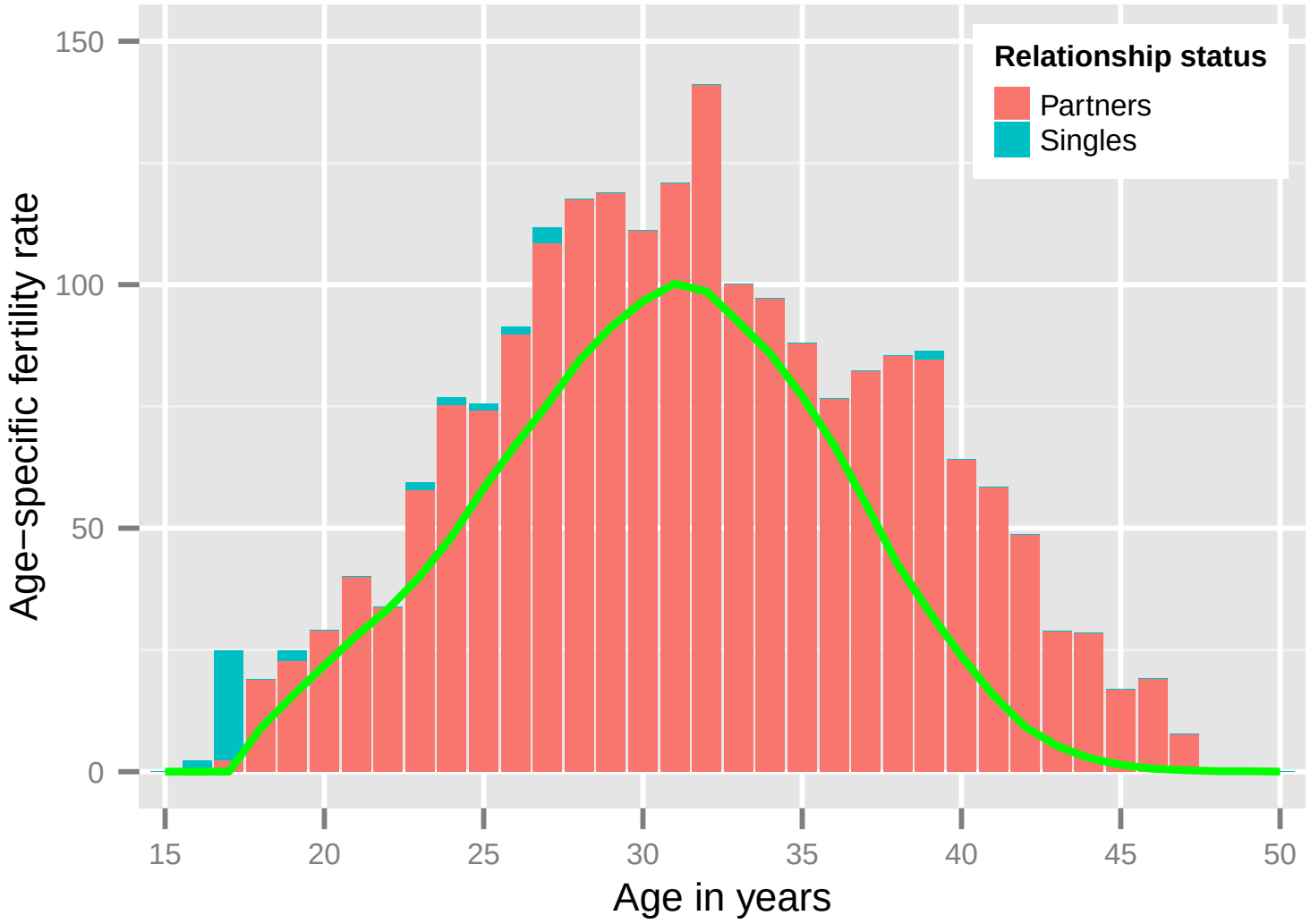
Demographics: Age structure 0-population



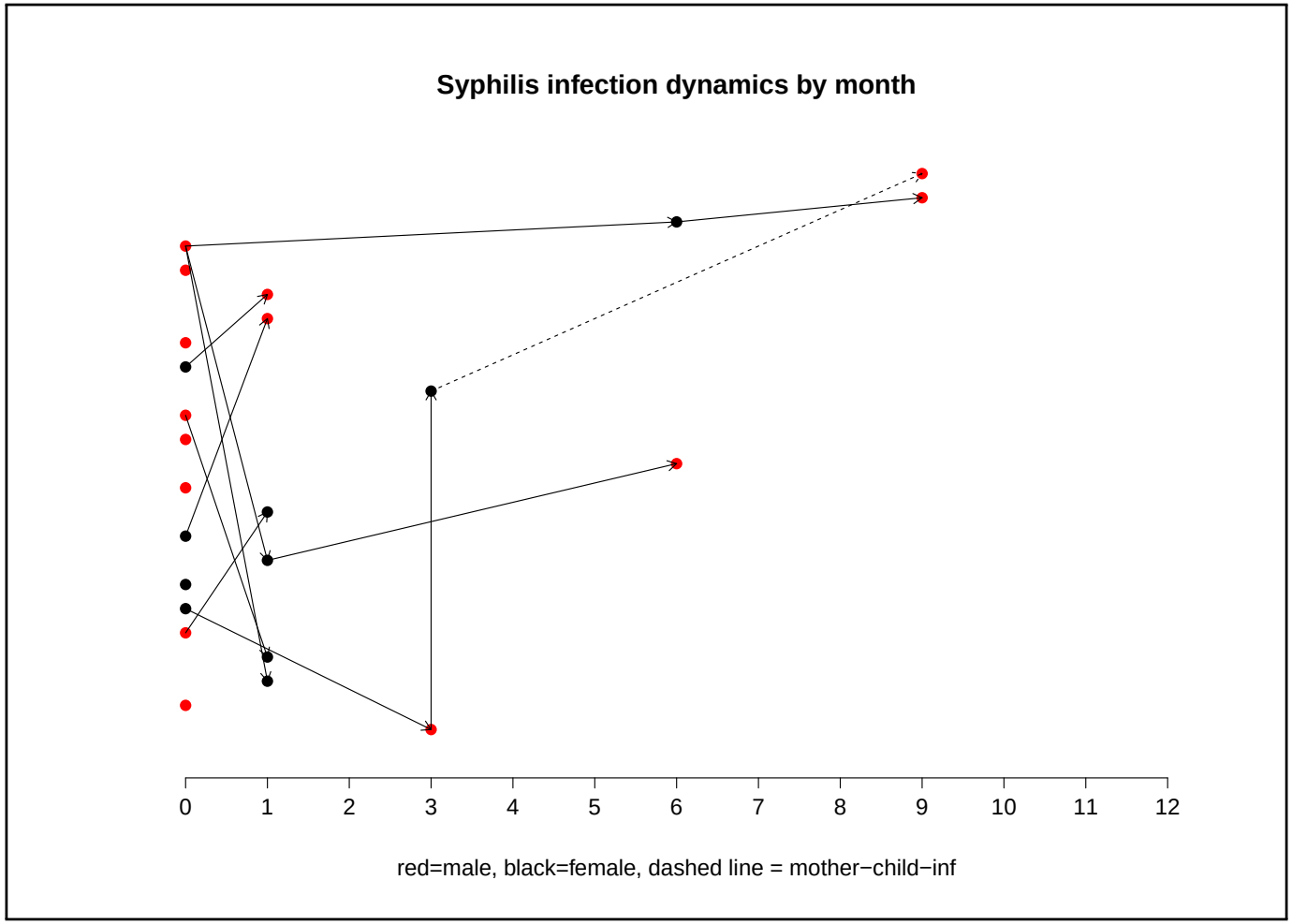
Demographics: Fertility of first year



Demographics: Fertility of second year



Epidemiological results



Pros and Cons of ABM

Pros:

- Inclusion of major factors in heterogeneity (age, sex, education, etc.)
- Inclusion of extreme cases
- Easier implementation of quantitative, regression-based research
- Few assumptions, single behavior rules easy to communicate

Cons:

- Computationally intensive
- Reporting becomes harder, the more behavior rules are implemented
- No standard software, no standard reporting scheme

Planned extensions

Extensions to SILAS:

- Regional distribution of agents (16 federal states)
- Other STIs (HIV, Hep B, HPV) in addition to syphilis
- Migrate to cluster (e.g. AWS) to scale model size

Other ABM-projects:

- Competition in the market of statutory sickness funds (GKV)

Thank you very much for your attention!

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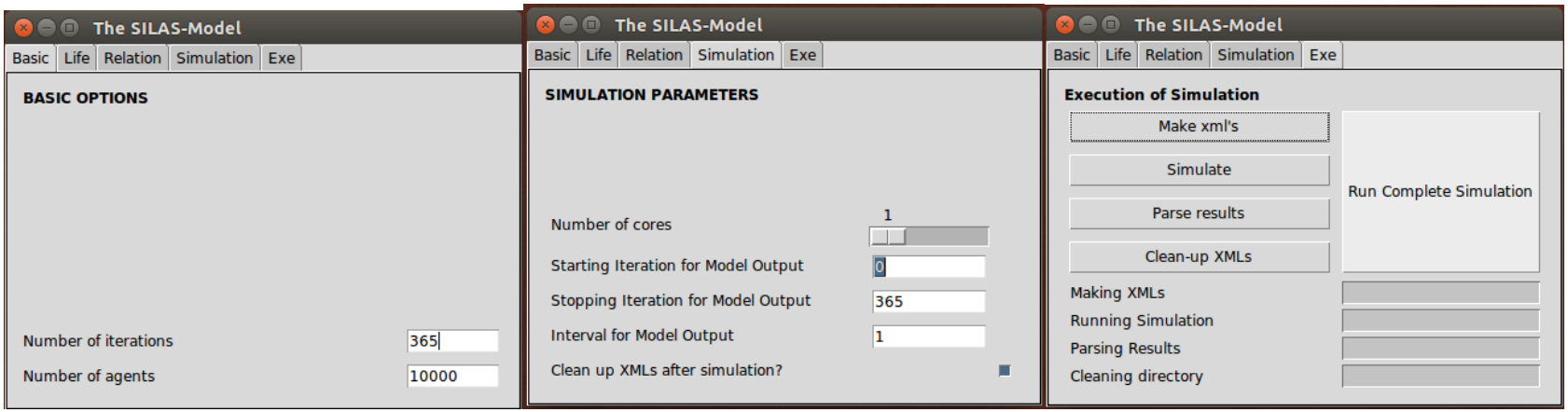
Please visit silas-model.com for more information.

Back-up: GUI


The SILAS-Model
Basic Life Relation Simulation Exe
BASIC OPTIONS
Number of iterations 365
Number of agents 10000
The SILAS-Model
Basic Life Relation Simulation Exe
SIMULATION PARAMETERS
Number of cores 1
Starting Iteration for Model Output 0
Stopping Iteration for Model Output 365
Interval for Model Output 1
Clean up XMLs after simulation?
The SILAS-Model
Basic Life Relation Simulation Exe
Execution of Simulation
Make xml's
Simulate
Parse results
Clean-up XMLs
Run Complete Simulation
Making XMLs
Running Simulation
Parsing Results
Cleaning directory

Back-up: GLM-example

	Single-time to first relationship	Single-time to next relationship
μ		
Intercept	2.956 (.003)***	−.192 (.062)**
Male	.075 (.005)***	.315 (.023)***
Homosexual		−.162 (.165)
Interaction (male:homosexual)		−.178 (.268)
Interaction (age:duration) last relationship		.005 (.001)***
ps(Age at end of last relationship)		.025 (.003)***
ps(Duration of last relationship)		−.161 (.023)***
σ		
Intercept	1.468 (.008)***	.088 (.031)**
Male	−.049 (.012)***	−.019 (.015)
Homosexual		−.057 (.094)
Interaction (male:homosexual)		.011 (.156)
ps(Age at end of last relationship)		−.016 (.002)***
ps(Duration of last relationship)		−.017 (.003)***
Num. obs.	11655	16609
Nagelkerke R^2	.997	.934
Generalized AIC	67392.305	38706.857

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$