Please download Vensim PLE system dynamics software (for free)

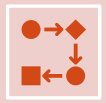
Please go to **pollev.com**
Enter the code **sdspolls877**

Please answer the following questions:
Which country are you joining us from?
What is your knowledge of system dynamics?

ROMEO AND JULIET
A FIRST MODEL AND AN INTRODUCTION TO THE SD MODELLING PROCESS

NICI ZIMMERMANN
Associate Professor in System Dynamics
University College London

THIS SEMINAR WILL ENABLE YOU TO



Build your very first quantitative SD model

Apply Vensim software for very, very basic quantitative modelling

Familiarise yourself with the SD modelling process

Hopefully understand my enthusiasm for SD and the Romeo and Juliet model

WORK THAT THIS SEMINAR IS BASED ON

Mike Radzicki

Radzicki MJ. 1993. Dyadic processes, tempestuous relationships, and system dynamics. System Dynamics Review 9(1): 79–94.

John Morecroft

Morecroft, J. 2010. Romeo and Juliet in Brazil: Use of Metaphorical Models for Feedback Systems Thinking. In: Richmond, J., Richmond, K., Egner, J. & Stuntz, L. (ed.): Tracing Connections: Voices of Systems Thinkers. Hanover, NH: isee systems Publications.

Mike Radzicki and John Morecroft have kindly agreed that I can use the Romeo and Juliet example here.

THE PROCESS OF SYSTEMS THINKING

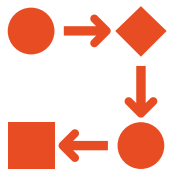
Problem definition: Formulating a problem from a dynamic perspective

Key variables: Recognising central factors and key variables

Behaviour over time: Recognising and estimating the behaviour of key variables over time

Feedback diagrams: Identifying cause and effect, drawing feedback diagrams

THE PROCESS OF SIMULATION



Stock and flow diagrams: Identification of stocks and flows in the system

Model equations: For stocks: integrations, for flows: identification of policies

Simulation: Generating model behaviour over time

Analysis and implementation: Compare real and simulated behaviour, test structure, identify and test policy alternatives, implement changes in the real system

ROMEO AND JULIET

Have you ever thought about romantic relationships in terms of their feedback mechanisms?

Can system dynamics modelling help us understand the problem of 'waxing and waning of love between Romeo and Juliet'? (Morecroft (2010): p. 99)

We will build a system dynamics model of Romeo and Juliet's 'waxing and waning' love for each other. Let's build and analyse it together!

(Morecroft (2010): p. 99)

An 1870 oil painting by Ford Madox Brown

ROMEO AND JULIET

Dyadic processes, tempestuous relationships, and system dynamics

Search within citing articles

[PDF] Dynamical models of happiness

JC Sprott - Nonlinear Dynamics, Psychology, and Life Sciences, 2005 - Citeseer

A sequence of models for the time evolution of one's happiness in response to external events is described. These models with added nonlinearities can produce stable oscillations and chaos even without external events. Potential implications for psychotherapy and a ...

☆ 99 Cited by 132 Related articles All 9 versions »

[PDF] Dynamical models of love

JC Sprott - Nonlinear dynamics, psychology, and life sciences, 2004 - tmuk.pw

Following a suggestion of Strogatz, this paper examines a sequence of dynamical models involving coupled ordinary differential equations describing the time-variation of the love or hate displayed by individuals in a romantic relationship. The models start with a linear ...

☆ 99 Cited by 128 Related articles All 19 versions »

Laura and Petrarch: An intriguing case of cyclical love dyı

S Rinaldi - SIAM Journal on Applied Mathematics, 1998 - SIAM

Three ordinary differential equations are proposed to model the dynam Petrarch, a celebrated Italian poet of the 14th century, and Laura, a beai lady. The equations are nonlinear but can be studied through the singu

☆ 99 Cited by 109 Related articles All 18 versions

Love dynamics: The case of linear couples

S Rinaldi - Applied Mathematics and Computation, 1998 - Elsevier

This paper proposes a minimal model composed of two ordinary differential equations to describe the dynamics of love between two individuals. The equations take into account three mechanisms of love growth and decay: the pleasure of being loved (return), the ...

☆ 99 Cited by 91 Related articles All 13 versions

Supporting cognitive feedback using system dynamics: a demand model of the global system of mobile telecommunication

T Bui, C Loebbecke - Decision Support Systems, 1996 - Elsevier

Cognitive feedback has been known to be useful in providing decision makers with insights for enhancement of the modeling process. This paper proposes a design methodology to embed functionalities that integrate cognitive feedback in a computer-based decision ...

☆ 99 Cited by 51 Related articles All 7 versions

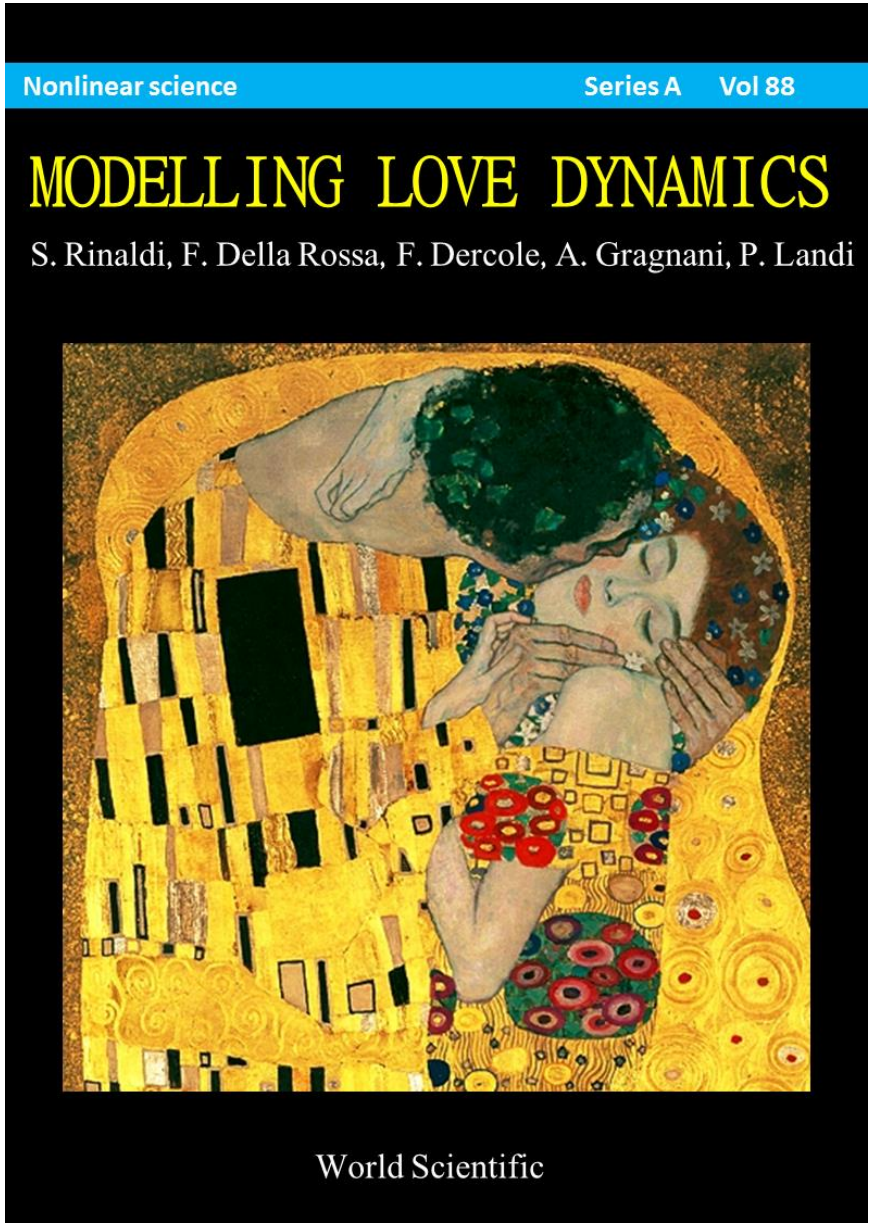
Cyclic dynamics in romantic relationships

A Gragnani, S Rinaldi, G Feichtinger - International Journal of ..., 1997 - World Scientific

Minimal models composed of two ordinary differential equations are considered in this paper to mimic the dynamics of the feelings between two persons. In accordance with attachment theory, individuals are divided into secure and non-secure individuals, and ...

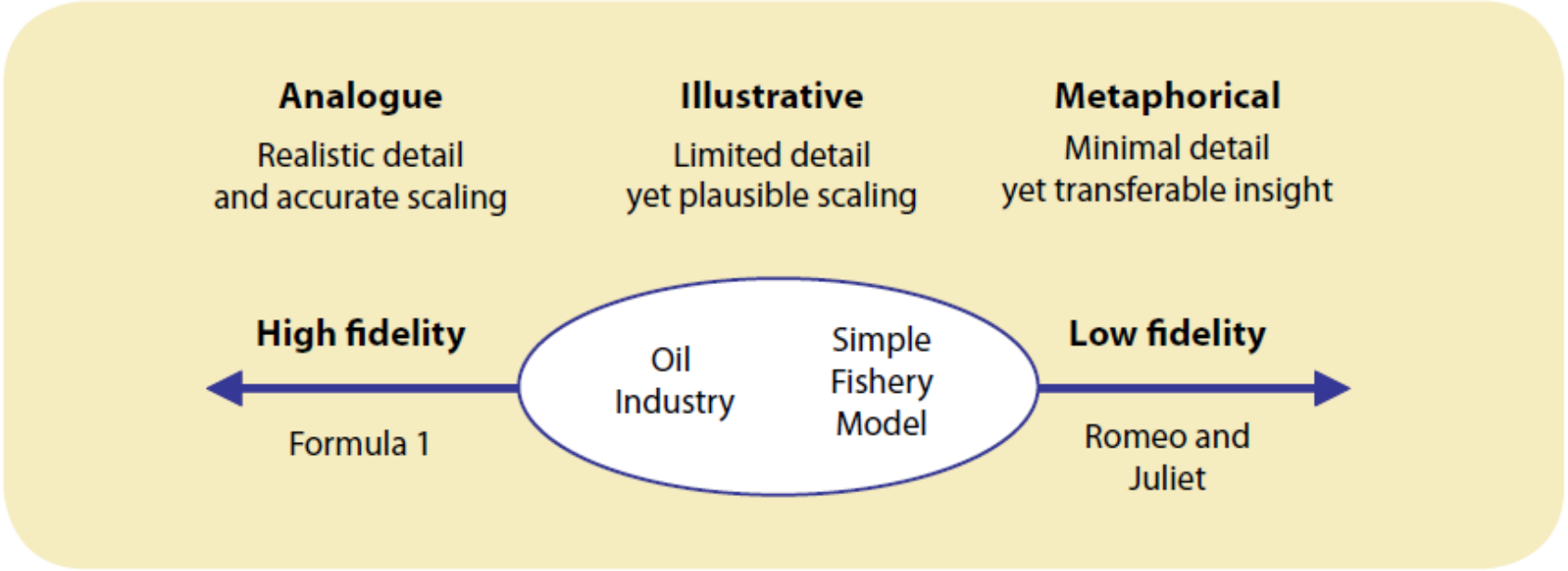
☆ 99 Cited by 45 Related articles All 4 versions

Many tanks to Mike Radzicki for the book picture.



ROMEO AND JULIET

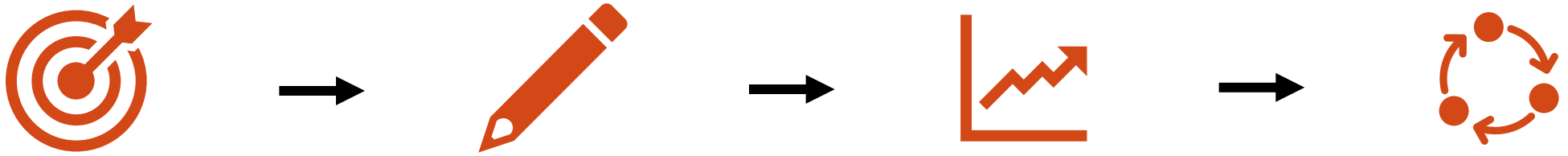
This will not be a high-fidelity model, but a highly insightful model and hopefully a fun exploration.



(Morecroft (2010): p. 99) Figure 6.2. Modeling and realism—a spectrum of model fidelity

LET'S BUILD AND ANALYSE THE MODEL TOGETHER!

THE PROCESS OF SYSTEMS THINKING



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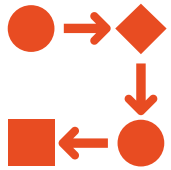
THE PROCESS OF SIMULATION



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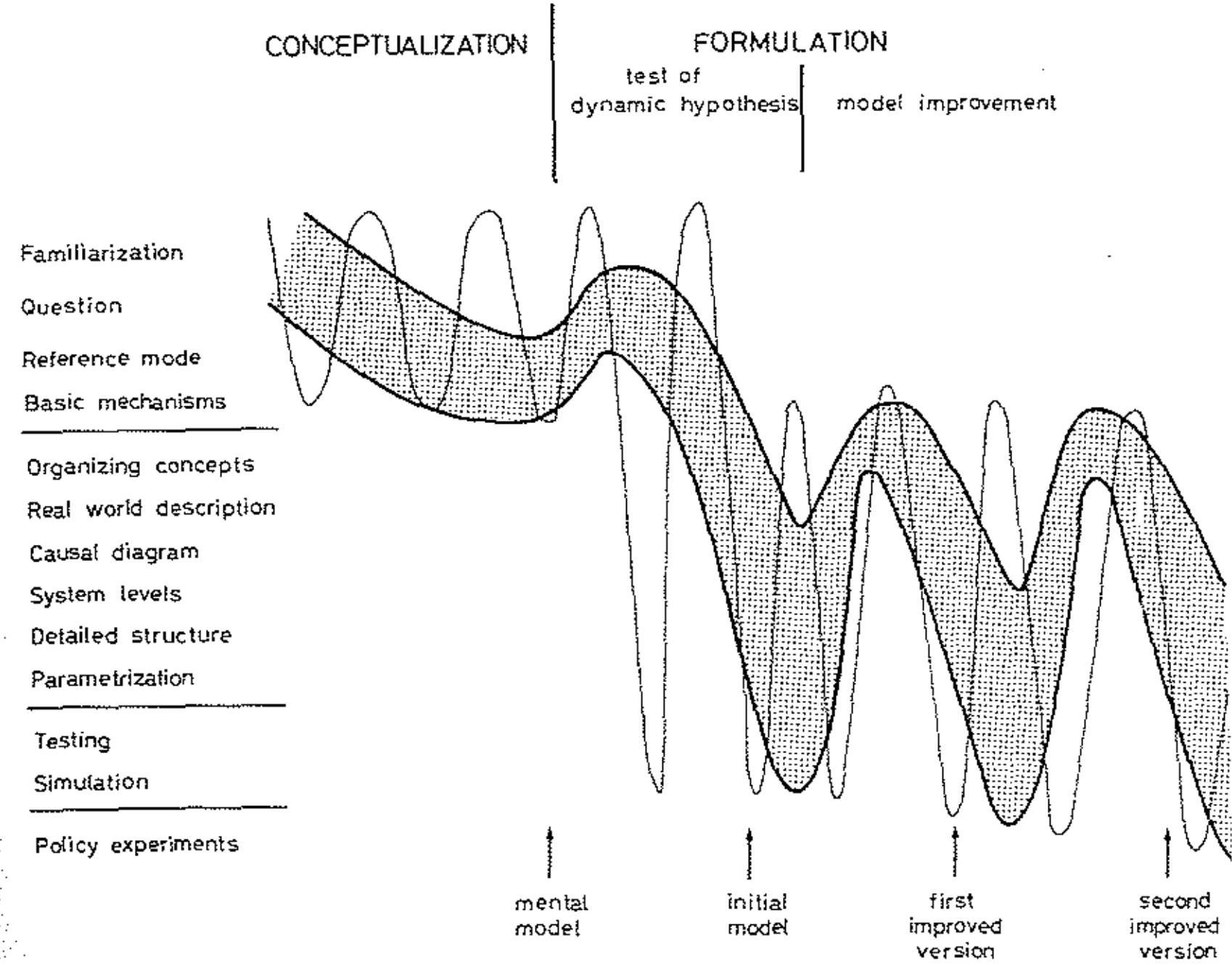
BUT REMEMBER



Randers, J. 1980. Elements of the System Dynamics Method, p. 135.

GOOD SD MODELLING

Accumulations	Delays	Nonlinearities	Feedback	Perceptions	Information
Physical, social and mental accumula-tions in the system	Material and information delays (e.g. transport delay and noticing delay)	Nonlinear effects (not covered today)	Balancing and reinforcing feedback	Biases and delays in perception	Also in a model, people act only on information available to them

Structure	Decisions and actions

POLICIES

Tweaking	Strengthening Weakening	Cutting	Adding	Adding
Tweaking constants	Strengthening/ weakening feedback loops	Cutting feedback loops	Adding feedback loops	Adding larger parts of structure that add new and influence old feedback loops

Plus, addressing delays

PLACES TO INTERVENE IN A SYSTEM (SIMPLIFIED)

Paradigms,
ways of thinking

Goals and
system rules

Feedback
structure, delays

3

Numbers,
constants

Adapted from: Meadows, Donella (1999): Leverage Points: Places to Intervene in a System. Available at: https://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

FURTHER READING

Romeo and Juliet modelling and teaching

Morecroft J. 2010. Romeo and Juliet in Brazil: Use of Metaphorical Models for Feedback Systems Thinking In J. Richmond, K. Richmond, J. Engner, & L. Strunz (Eds.), Tracing Connections: Voices of Systems Thinkers. isee systems Publications: Hanover, NH: 93–119.

Radzicki MJ. 1993. Dyadic processes, tempestuous relationships, and system dynamics. System Dynamics Review 9(1): 79–94.

Rinaldi, S., Della Rossa, F., Dercole, F., Gragnani, A., Landi, P. 2015. Modelling love dynamics. Singapore, World Scientific.

Work by Sergio Rinaldi more generally.

Papers citing Radzicki 1993 (see slide 7).

System dynamics process

Core

Randers J. 1980. Elements of the System Dynamics Method, MIT Press: Cambridge, MA, ch. 6: Guidelines for Model Conceptualization, 117–139.

Martinez-Moyano IJ, & Richardson GP. 2013. Best practices in system dynamics modeling. System Dynamics Review 29(2): 102–123. Also check the online supplement.

Sterman J. 2000. Business Dynamics: Systems Thinking and Modeling for a Complex World. Boston, MA: Irwin/McGraw-Hill, ch. 3: The Modeling Process, 83–105.

SD principles

Dana Meadows' lecture on the philosophy of system dynamics

George Richardson's talk introducing system dynamics principles

Model conceptualisation based on textual data

Kim H, & Andersen DF. 2012. Building confidence in causal maps generated from purposive text data: mapping transcripts of the Federal Reserve. System Dynamics Review 28(4): 311–328.

Eker S, & Zimmermann N. 2016. Using Textual Data in System Dynamics Model Conceptualization. Systems 4(3): 28–41.

Hands-on learning materials

Diaries during/after lockdown self-paced SD learning materials

QUESTIONS?

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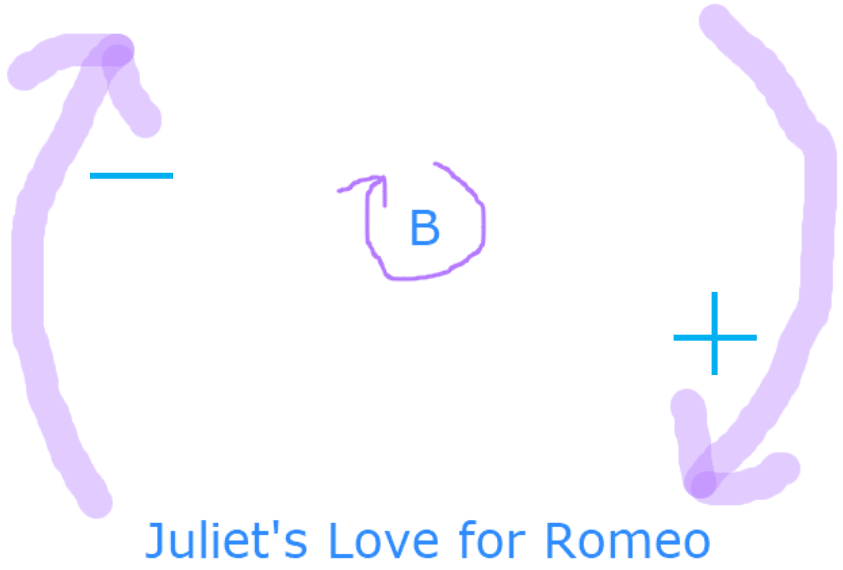
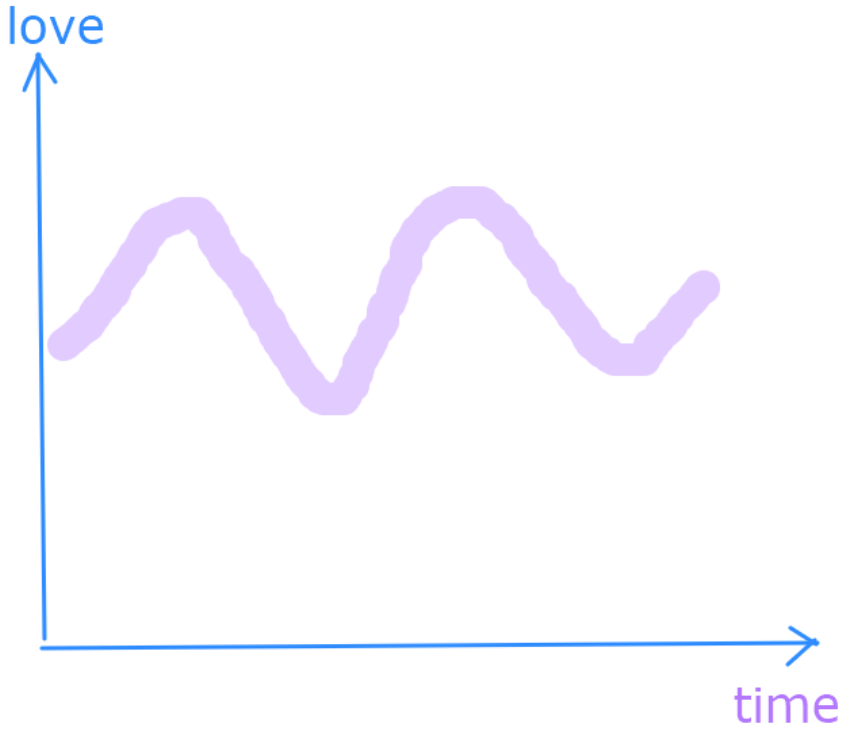
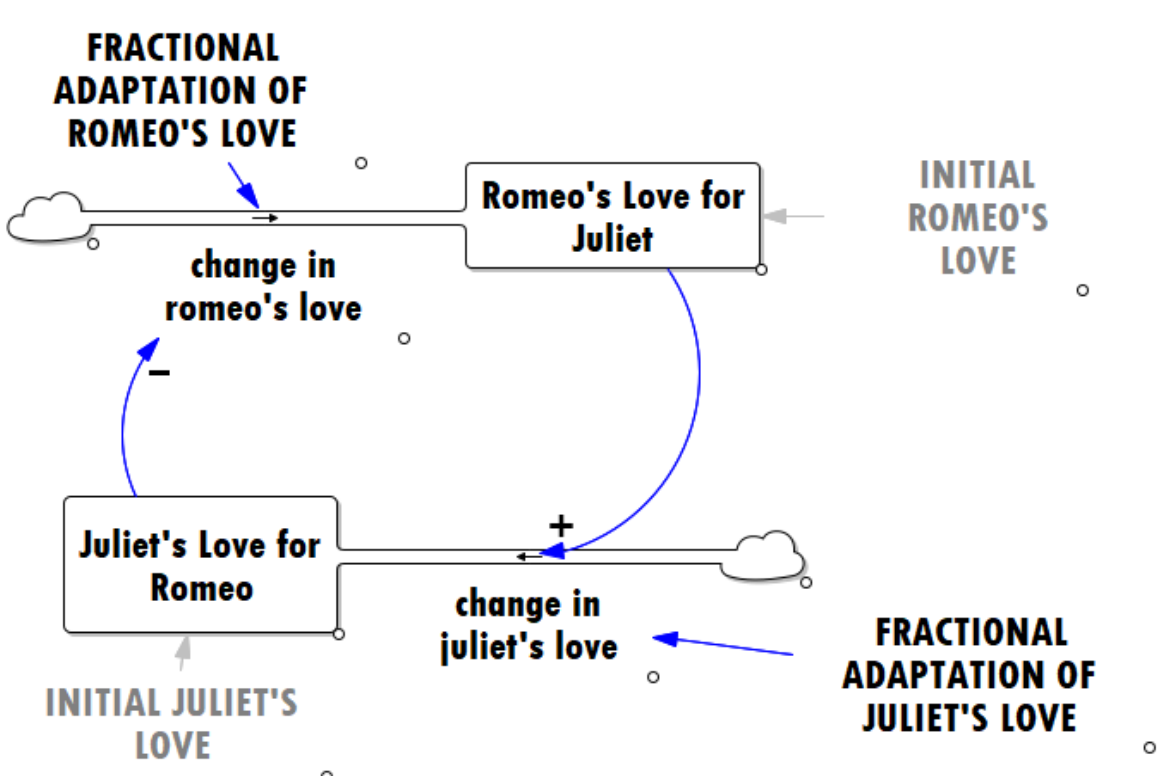
n.zimmermann@ucl.ac.uk
Twitter: @NiciZim

CAUSAL LOOP DIAGRAM AND BEHAVIOUR OVER TIME GRAPH





STOCK AND FLOW DIAGRAM OF THE SIMULATION MODEL



You can ask and vote for questions at pollev.com using the code sdspolls877

The User Guide, Modeling Guide and Reference Guide can be found under --> Help --> Vensim Manual

This model was created by Nici Zimmermann during the Seminar "Romeo and Juliet: Introduction to the Modeling Process" and it originates from Radzicki 1993 System Dynamics Review.