Contents

Preface v

1. Can we model love stories? 1

   1.1 Graphical representation of love stories 2
   1.2 The models 5
   1.3 ODE models 7
   1.4 Individual characteristics: Oblivion, reaction to appeal, and reaction to love 9
   1.5 From individuals to couples 13
   1.6 Summary of results 14

Simple models **17**

2. Linear models and their properties 19

   2.1 Historical premise 20
   2.2 Five properties of the model 24
   2.3 Consequences at community level 28

3. Couples composed of secure and unbiased individuals 33

   3.1 The model 34
   3.2 Alternative stable states 35
   3.3 Bifurcation analysis 37
   3.4 Temporary bluffing in love affairs 40

4. Roxane and Cyrano 43

4.1 The story of Roxane and Cyrano 44
4.2 The model of Roxane and Cyrano 46
4.3 Model validation 50
4.4 Conclusions 53

5. The discovery of hidden components of the appeal 55

5.1 Catastrophic bifurcations 55
5.2 Beauty and The Beast 57
5.3 Elizabeth and Darcy 60
5.4 Conclusions 64

6. Couples composed of insecure and unbiased individuals 65

6.1 The model 66
6.2 The case of identical individuals 68
6.3 The general case 71
6.4 Conclusions 74

7. Scarlett and Rhett 75

7.1 The love story between Scarlett and Rhett 76
7.2 The model 80
7.3 Validation of the model 82
7.4 Conclusions 84

8. Romantic cycles 87

8.1 Introduction 88
8.2 No bias implies no cycles 88
8.3 No insecurity implies no cycles 89
8.4 A first example of romantic cycle 91
8.5 A second example of romantic cycle 96

9. Kathe and Jules 99

9.1 The story 100
9.2 The Kathe-Jules model 101
9.3 Analysis and results 104

10. Kathe and Jim 111

10.1 The Kathe-Jim model 112
10.2 Analysis and results 114

Complex models **119**

11. Environmental stress and romantic chaos 121

11.1 Do couples replicate environmental stresses? 122
11.2 Canonical responses to stress 125
11.3 Romantic chaos 129
11.4 An example of romantic chaos 131

12. Extra emotional dimensions 141

12.1 Introduction 141
12.2 The model 143
12.3 Analysis and results 144
12.4 Slow-fast dynamics 147

13. Laura and Francesco 149

13.1 Petrarch's romantic cycle 150
13.2 A model of Laura and Francesco 153
13.3 Calibration of the model 155
13.4 The L-F cycle and its validation 157
13.5 Reliability of the results and discussion 159
13.6 The great conjecture 161

14. Triangular love stories and unpredictability 163

14.1 Triangular relationships 164
14.2 A catalog of triangles 166
14.3 Jealousy, conflict, and unpredictability 169
14.4 Conclusions and discussion 174

15. Kathe, Jules, and Jim 177

15.1 The story 178
15.2 The free-love hypothesis 179
15.3 The Kathe-Jules-Jim model 182
15.4 Analysis and results 184
15.5 The genius of Truffaut 188

Appendix A Appendix 191

A.1 A simple illustrative example 191
A.2 Dynamical systems and state portraits 196

A.3 Structural stability 205
A.4 Bifurcations as collisions 207
A.5 Local bifurcations 210
A.6 Global bifurcations 218
A.7 Catastrophes, hysteresis, and cusp 221
A.8 Routes to chaos 223
A.9 Numerical methods and software packages 225

Bibliography 231

Index 239