

1. Record Nr.	UNINA9910632484403321
Titolo	Mathematics research for the beginning student . Volume 1. : accessible projects for students before calculus // edited by Eli E. Goldwyn, Sandy Ganzell and Aaron Wootton
Pubbl/distr/stampa	Cham, Switzerland : , : Springer, , [2022] ©2022
ISBN	3-031-08560-4
Descrizione fisica	1 online resource (323 pages)
Collana	Foundations for Undergraduate Research in Mathematics
Disciplina	510
Soggetti	Mathematics - Research Investigació matemàtica Llibres electrònics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Preface -- Contents -- Games on Graphs: Cop and Robber, Hungry Spiders, and Broadcast Domination -- 1 Introduction -- 2 The Game of Cops and Robbers -- 3 Hungry Spiders -- 4 (t,r) Broadcast Domination -- 5 Further Investigation -- 6 A Short Primer on Graph Theory -- References -- Mathematics for Sustainable Humanity: Population, Climate, Energy, Economy, Policy, and Social Justice -- 1 Introduction -- 2 Quantifying Change -- 2.1 Absolute and Relative Change and Rate of Change -- 2.2 Linear and Exponential Change -- 2.3 Measuring and Estimating -- 3 Population Growth and Ecological Footprint -- 4 Climate Change -- 5 Energy Production, Consumption, and Efficiency -- 6 Economic Growth (and Collapse) -- 7 Policy and Social Justice -- References -- Mosaics and Virtual Knots -- 1 Math and Knots -- 2 Gauss Codes -- 3 Virtual Knots -- 4 Mosaics -- 5 Virtual Mosaics -- 6 Further Reading -- References -- Graph Labelings: A Prime Area to Explore -- 1 Introduction -- 1.1 Families and Classes of Graphs -- 1.2 Graph Operations -- 1.3 Introduction to Graph Labeling -- 2 Coprime and Prime Labelings -- 2.1 Minimal Coprime Labeling -- 3 Consecutive Cyclic Prime Labelings -- 4 Neighborhood-Prime Labelings -- 4.1 Building on Cycles -- 4.2 Building on Trees -- 4.2.1 Further Projects on Neighborhood-Prime Labelings -- 5 Conclusion --

References -- Acrobatics in a Parametric Arena -- 1 Analogies to Motivate Parametric Thinking -- 2 Overview -- 3 Parametric Basics -- 3.1 Parametric Function 1 -- 3.2 Parametric Function 2 -- 3.3 Parametric Function 3 -- 4 Function Concepts -- 4.1 Functions and Nonfunctions, Based on the Context -- 4.2 Connecting Component Functions and the Parametric Function -- 5 Try Some Parametric Acrobatics Yourself -- 5.1 General Desmos Graphing Instructions -- 5.2 Exercises with some Desmos Instructions -- 5.3 Experimentation. 6 True Acrobatics: Parametric Modeling of a Flower Stick -- 6.1 Flower Sticks and Digitized Motion -- 6.2 Modeling the Left End of the Flower Stick -- 6.3 More on the Flower Stick -- 6.4 Your Work -- 7 Financial Acrobatics: Modeling US Wireless Subscribers -- 7.1 About the Data -- 7.2 Views of the Data -- 7.3 Data Projections -- 7.4 Linear Fits to 2004-2014 Data -- 7.5 Proportional Growth -- 8 GeoGebra to Practice 3D Parametric Equation -- 9 Your Project -- References -- Further Reading -- Software -- But Who Should Have Won? Simulating Outcomes of Judging Protocols and Ranking Systems -- 1 Introduction -- 2 Fundamentals of Probability -- 2.1 A Little Set Theory -- 2.2 Computing Probability -- 2.3 Conditional Probability -- 2.4 Random Variables and Probability Functions -- 2.4.1 Discrete Random Variables -- 2.4.2 Continuous Random Variables -- 3 Introduction to Simulation -- 3.1 Random Number Generation -- 3.1.1 Sampling from Discrete Distributions -- 3.1.2 Sampling from Continuous Distributions -- 3.2 "If/Else" Statements -- 3.3 "While" and "For" Loops -- 3.3.1 "While" Loops -- 3.3.2 "For Loops" -- 3.4 Writing More Complex Simulation Code -- 4 Suggested Research Projects -- 4.1 Scenario 1: Objective Ranking -- 4.2 Scenario 2: Subjective Ranking -- 4.3 Scenario 3: Comparing Voting Methods -- References -- Modeling of Biological Systems: From Algebra to Calculus and Computer Simulations -- 1 Introduction -- 1.1 A Description of Mathematical Modeling -- 1.2 Building a Model with Bias -- 1.3 A Note About Computer-Based Simulations -- 1.4 Active Learning -- 2 Grey Squirrels in Six Fronts Park: Modeling a Changing Population -- 2.1 The Problem -- 2.1.1 Step 1: Goals, Questions, and Assumptions -- 2.1.2 Step 2: Build a Model -- 2.1.3 Step 3. Apply the Model -- 2.1.4 Step 4. Assess and Revise Your Model -- 2.2 Conclusion and Exercises. 3 Non-contact Cardiovascular Measurements -- 3.1 Context -- 3.2 The Challenge -- 3.3 The Initial Experiment -- 3.4 Weigh a Bed? -- 3.5 Let Us Get Our Hands Dirty! -- 3.6 Interesting Observations -- 3.7 Conclusions -- 4 Difference Equations in Population Ecology -- 4.1 Introduction -- 4.2 Population Growth with Difference Equations -- 4.3 Coding Difference Equations -- 4.4 Difference Equations for Predator-Prey Problems -- 5 Modeling the Spread of Infectious Diseases with Differential Equations -- 5.1 Modeling the Demise of Candy -- 5.2 Population Growth Models in Continuous Time -- 5.2.1 A Basic Model of Infectious Disease Spread -- 5.3 Discussion -- 6 Conclusions -- References -- Population Dynamics of Infectious Diseases -- 1 Mathematical Models in Epidemiology -- 2 An Individual-Based Epidemic Model -- 2.1 Model Description and Physical Simulation -- 2.2 Computer Simulation -- 2.3 Section 2 Exercises -- 2.4 Section 2 Challenge Problem -- 2.5 Section 2 Projects -- 3 Continuous-Time Dynamical Systems -- 3.1 The Derivative -- 3.2 Dynamical Systems -- 3.3 Section 3 Exercises -- 4 Dynamical System Models -- 4.1 Classification of Dynamical System Models -- 5 Building the SEIR Epidemic Model -- 5.1 Quantifying the Processes -- 5.1.1 Transition Processes -- 5.1.2 The Transmission Process -- 5.2 The Final Model -- 5.3 Section 5 Exercises -- 6 Modeling -- 6.1 Identifying Parameter Values -- 6.2 The Basic Reproduction Number -- 6.3 Section 6

Exercises -- 6.4 Section 6 Challenge Problem -- 7 Model Analysis --
7.1 Early Phase Exponential Growth -- 7.2 The End State -- 7.3 Section
7 Exercises -- 7.4 Section 7 Challenge Problems -- 7.5 Section 7
Project -- 8 Simulations -- 8.1 Numerical Simulation of Continuous
Dynamical Systems -- 8.2 Implementation of Numerical Simulations --
8.3 Section 8 Exercises -- 8.4 Section 8 Projects -- Appendix:
Programs -- hpsr.m.
HPSR_onesim.m -- HPSR_avg.m -- seir.m -- SEIR_onesim.m --
SEIR_comparison.m -- SEIR_paramstudy.m -- References -- Playing
with Knots -- 1 Knots: Knotted and Unknotted -- 1.1 What Is a Knot?
(The Basics) -- 1.2 Knot Equivalence and Reidemeister Moves -- 1.3
Some Useful Knots and Links -- 1.4 Unknotting Operations and
Numbers -- 1.5 Knot Invariants -- 2 The Knotting-Unknotting Game --
3 The Region Unknotting Game -- 4 The Linking-Unlinking Game -- 5
The KnotLink Game -- 6 The Link Smoothing Game -- 7 Conclusion --
References.
