

[SIMIODE Resource Guide or Table of Contents](#)

Guide to Modeling Scenarios and Technique Narratives Organized as Traditional Table of Contents for Differential Equations Text

This is a growing list of resources and as developed, refereed, edited, and finalized, new materials will be published.

- **Technique Narratives** are focused on solution strategies for differential equations, but with a motivational connection to a real-world situation.
- **Modeling Scenarios** are modeling driven activities motivated by rich detail and engagement in real world opportunities, often with data and model validation activities.

This Guide or Table of Contents is organized to follow the topics found in a traditional differential equations course, hence, the numbering system approximately reflects chapter sequencing in a standard differential equations text.

These materials are hyper-linked to [SIMIODE Publications](#) and they are available to all as Open Education Resources (OER) for adaptation and use in coursework with a request to acknowledge the source.

The link for each Publication takes the reader to a resource page which may have more than just the document.

Please use the Comments tab at each Publication to make suggestions, point to corrections needed, relate experiences in your use of the resource, upload further resources we will add to the resource, discuss technical materials, and share your thoughts on the material. These comments will go to the author and the SIMIODE editorial leadership.

Table of Contents for SIMIODE Modeling Scenarios and Technique Narratives

- **Modeling One — First Order Differential Equations**
[Technique Narratives](#)
[Modeling Scenarios](#)
- **Modeling Two — Numerical Methods**
[Technique Narratives](#)
- **Modeling Three — Second Order Homogeneous Differential Equation Models**
[Modeling Scenarios](#)
- **Modeling Four — Second Order NonHomogeneous Differential Equation Models**
[Modeling Scenarios](#)
- **Modeling Five — Linear Systems of Differential Equation Models**
[Technique Narratives](#)
[Modeling Scenarios](#)
- **Modeling Six — NonLinear Systems of Differential Equation Models**
[Modeling Scenarios](#)
- **Modeling Seven — Changing the Venue for Solution Success - Laplace Transforms**
[Technique Narratives](#)
[Modeling Scenarios](#)
- **Modeling Eight — Representing Natural Phenomena with Sines and Cosines**
[Modeling Scenarios](#)
- **Modeling Nine — Modeling with Differential Equations in Higher Dimensions**
[Modeling Scenarios](#)
- **Modeling Ten — Modeling with Difference Equations**
[Modeling Scenarios](#)

List of All Technique Narratives and Modeling Scenarios by Chapter

Modeling One — First Order Differential Equations

Technique Narratives – [Back to Main Table of Contents](#)

[1-001-SeparationOfVariable](#)

Technique narrative on solution method of separation of variables

[1-002-Integrating Factor](#)

Technique narrative on solution method of integrating factor

[1-003-IntroNumericalMethods](#)

Introduction to numerical methods for solving first order differential equations

[1-005-NavigatingNumericalMethods](#)

Using a lost at sea situation to learn numerical methods

[1-009-Bifurcation](#)

Early introduction to bifurcation with experimentation

[1-010-AtmosphericCO2Bifurcation](#)

Study of bifurcation of atmospheric carbon dioxide

[1-015-DimensionlessVariables](#)

Scaling for differential equations and dimensionless variables is discussed

[1-030-RandomPerturbation](#)

Tutorial on random perturbations for a linear first order equation

[1-060-RegularPerturbations](#)

Introduction to approximations referred to as regular perturbation

[1-061-SingularPerturbation](#)

Introduces the basics of singular perturbation methods

Modeling Scenarios – [Back to Main Table of Contents](#)

[1-001-MMDeathImmigration](#)

Modeling Death and Immigration with M&M 's and Simulation

[1-001A-M&MDeathImmigration-Variation](#)

Variation on modeling death and immigration with M&M's

[1-001B-MM-DeathImmigrationMystery](#)

Each student sets own immigration rate and others need to solve this mystery

[1-001C-PopulationDecayThenSome](#)

Variation on death and immigration with hotel modeling and MatLab

[1-001D-HotelPopulationDecay](#)

Modeling the comings and goings of hotel patrons using various models

[1-001E-M&MDeath](#)

Modeling death with M&M Simulation for Calculus I Students

[1-001s- BirthDeathImmigration](#)

Probability generating function approach to simulation

[1-002-Tossing](#)

Modeling a simulation of a large number of dice tossings

[1-003-CollegeSavings](#)

Saving for Child's College Education

[1-004-Microorganism Immigration](#)

Modeling Immigration in a Petri Dish

[1-005-OilSlick](#)

Modeling the Spread of Oil Slick with Incomplete Data

[1-005A-ChemDataCollection](#)

Analysis of incomplete reaction data

[1-005b-ChemDataCollection](#)

Analysis of incomplete reaction data

[1-005C-OilSlick](#)

Modeling Spread of Oil Slick with Incomplete Data for Calculus I Class

[1-006-FinancingSavingsAndLoan](#)

Bank Investment Analysis and Bank Loan Analysis

[1-007-AntTunnelBuilding](#)

How long does it take an ant to build a tunnel of length x in soil?

[1-009-ICUSpread](#)

Modeling the spread of ICU's in US Hospitals from 1958-1974

[1-010-AtmosphericCO2Bifurcation](#)

Modeling atmospheric carbon dioxide

[1-011-Kinetics](#)

Chemical Kinetics Models - Zeroth, First, and Second Order Reactions

[1-011A-Kinetics](#)

Same as 1-11-Kinetics but with more guidance and less narrative

[1-012-SublimationCarbonDioxide](#)

Sublimation of Carbon Dioxide

[1-013-SleuthingWithDifferentialEquations](#)

Situations associated with stopping cars, projectile steel ball, and time of death

[1-014-DrainingContainers](#)

For fixed volume column which radius of cylinder of water drains fastest

[1-015-Torricelli](#)

Modeling falling column of water

[1-016-DogDrugs](#)

Modeling drugs for anesthesiology

[1-017-DiseaseSpread](#)

Modeling spread of disease using logistic equation

[1-018-LogisticPopModeling](#)

Limited Growth Population Modeling

[1-019-RocksInTheirHeads](#)

Data Collection Experiment Comparing of Rock Masses

[1-020-IceMelt](#)

Which melts first a sphere or cube of ice of the same volume

[1-021-FeralCatControl](#)

Model for three feral cat control policies

[1-022-SpreadOfTechnology](#)

Model the spread of a number of technological advances

[1-023-RumorSpread](#)

Rate of Spread of False and True articles on the Internet

[1-024-MalariaControl](#)

Modeling and numerical methods for first order malaria growth

[1-025-MixingItUp](#)

Modeling more and more complex salt mixing situations

[1-026-Evaporation](#)

Modeling the evaporation of an alcohol and water mixture in various containers

[1-027-StochasticProcesses](#)

Modeling randomness with stochastic processes

[1-028-SouthernSweetIcedTea](#)

Data is offered to model making sweet iced team using luminescence

[1-029-ConeToCubeFlow](#)

Modeling water flowing from cone to cube and out

[1-030-EyeModel](#)

Modeling dissipation of intraocular gas bubbles used in eye surgery

[1-031-CoolIt](#)

Changing temperature of container of water in a changing environment

[1-032-WordPropagation](#)

Modeling the rate at which words propagate through English language text

[1-033-SouthernBarbeque](#)

Phases of barbecuing brisket are modeled using real data

[1-034-FishMixing](#)

Student designed fishing strategies for mix of fish in lake

[1-035- DotseroVolcanoEruption](#)

Using Carbon-14 dating to determine the age of a Colorado volcano

[1-036-NeutralBuoyancy](#)

Finding depth in water at which an object settles to neutral buoyancy

[1-037-CommonColdSpread](#)

Students conduct simulation of spread of common cold and model

[1-038-Ebola](#)

Modeling Ebola epidemic with first order differential equation models

[1-039-StochasticPopModels](#)

Creating population models using simple probabilistic assumptions

[1-040-OutcomeSavings](#)

Determining monthly deposit rate for long term savings goal

[1-041-AirToTop](#)

Variable ascent rate and air management in SCUBA diving

[1-042-Kool-Aid](#)

Modeling the amount of drink powder in a second tank of flow system

[1-043-CoolingUpAndDown](#)

Air conditioning cooling modeling

[1-044-CollegeBound](#)

Planning for full college education costs for the daughter of a friend

[1-045-TimeOfDeath](#)

Determining time of death given observations and environmental conditions

[1-046-GoingViral](#)

Simulation of spread of disease with logistic modeling

[1-047-Condensation](#)

Simulate the random motion of 200 particles in a 50 by 50 square

[1-047A-CondensationOptimization](#)

Optimize a condensation process which is modeled by a simulation

[1-050-BargingAhead](#)

Optimizing a barge trip upriver

[1-051-OneTankSaltModel](#)

Build one compartment salt mixing model

[1-052-SaltWaterTanks](#)

Studying tank in which water inflow containing salt increases

[1-053-SlimeSpread](#)

Modeling the spread of a slime puddle from video collected data

[1-054-GrowthInFarmland](#)

Modeling the growth of farmland with incomplete data

[1-055-WaterFallingInCone](#)

Modeling the falling of water in a right circular cone

[1-057-FiguringFluidFlow](#)

Evaluating three models of fluid flow from a tank using data

[1-058-WaterClocks](#)

A container is designed so water will fall out at constant rate of change in height

[1-059-ContainerShapeFallingWater](#)

Modeling column of falling water in different shaped containers

[1-060-SalesMarketing](#)

Building a model of sales of consumer products from a classic marketing study

[1-061-PotatoCooling](#)

Modeling the cooling of a baked potato

[1-062-BacterialGrowth](#)

Several models offered for exponential growth in increased complexity

[1-064-TorricelliBox](#)

Modeling falling column of water with a box at the base of the column

[1-061-PotatoCooling](#)

Cooling of a baked potato and compare it to student-collected data

[1-063-ThreeHoleColumnOfWater](#)

A column of water with three holes or spigots water exits

[1-0064-ToprricelliBox](#)

Emptying column of water with box on the bottom

[1-065-AlgalBlooms](#)

Investigation of massive algal blooms on Lake Chapala MEXICO

[1-066-USCensusModeling](#)

Modeling the US Census data with several different models

[1-067-ModelingWithSigmoidCurve](#)

Modeling using logistic and Gompertz S-shape curves is offered

[1-068-WaterBottleCooling](#)

How fluid in a water bottle changes its temperature to approach ambient

[1-070-FisheryHarvest](#)

Modeling harvesting of Atlantic cod fishery

[1-071-NewtonWatsonTimeOfDeath](#)

Sherlock Holmes determines time of death

[1-073-WaterExitBottle](#)

Estimating a parameter in Torricelli's model of water exiting a container

[1-074-BottleWaterFlow](#)

Comparing two models of water flowing out of a container through exit hole

[1-076-ClimateBifurcation](#)

Modeling the Earth's climate using known parameters

[1-077-RLMSimSeriesCircuit](#)

Modeling an RL series circuit with differential equations and Multisim software

[1-078-MonodGrowthModel](#)

Modeling bacteria growth in limited environment

[1-079-HomeHeating](#)

Modeling how to heat your home while you are away

[1-080-DrugAdministration](#)

Building a simple model for drug administration

[1-081-TumorGrowth](#)

Two different models for growth of cancer tumor

[1-082-MirrorMirror](#)

Foucault Knife Edge Test, an optical test used in lens making is modeled

[1-083-FallingMeteorites](#)

A falling meteorite is modeled with a number of factors considered

[1-084-GoingViral](#)

Randomized spread of viral disease and full model build and fit

[1-085-DrugBolus](#)

Modeling intravenous bolus of drug in the body

[1-086-MedicinalPill](#)

Modeling administration of medicinal pills

[1-087-ThanosPopulationDynamics](#)

Villain Thanos attempts to restore balance to the world

[1-088-RoomTemperature](#)

Analyzing room temperature in a temperature changing environment

[1-089-SpreadOfDisease](#)

Spread of disease and applications to Sleeping Beauty fairy tale

[1-090-EmptySphericalTank](#)

Comparing two ways to empty spherical tank of water

[1-091-InvestigatingSlopefields](#)

Building population models for various situations and using slope fields

[1-092-DashItAll](#)

World record sprinter's maximum effort race is modeled

[1-093-SucroseReaction](#)

Determining model for sucrose hydrolysis using lab data

[1-094-SteepingTea](#)

Modeling temperature change and dissolution of sugar in brewing fruit tea

[1-095-RatingChessPlayers](#)

Using Elo's Method for rating chess players and difference equations

[1-096-OpAmpDifferentiator](#)

Modeling an Op Amp Differentiator circuit using Multisim

[1-097-SwimmingPool](#)

Dynamics of chlorine concentration during regular swimming pool maintenance cycles

[1-098-NeuronDetection](#)

Coincidence detection in the integrate-and-fire neuron modeling

[1-100-EngineeringDemographics](#)

Several models are offered for demographics of women in engineering

[1-101-ClassM&MDeathImmigration](#)

Generating data and using individual model to estimate parameters

[1-102-CancerGrowth](#)

Several models are offered along with data for cancer growth models

[1-102C-CancerGrowth](#)

Using Calculus skills models are offered along with data for cancer growth

[1-104-InfectionRisk](#)

Comparing exponential and logistic models for solving epidemic issues

[1-104A-InfectionRisk](#)

Modeling, solving, and data analysis for epidemics

[1-105-AnimalFalling](#)

Comparing terminal velocity for variety of animal's falling

[1-107- ClothDry](#)

Modeling the rate at which drying takes place in a cloth wet with water

[1-108-PoissonProcess](#)

Probability functions for Poisson process waiting time are built

[1-109-EmployeeAttrition](#)

Maintaining workforce of employees after attrition

[1-110-TidePoolSnails](#)

Modeling temperatures of sand tide pool and snail shells

[1-111-SpreadOfInformation](#)

A simulation with coins and data on the spread of information

[1-114-EarthClimate](#)

Investigate the Earth's climate using an energy balance model

[1-115-ModelingWithFirstOrderODEs](#)

Several short illustrations and two exercises for modeling

[1-116-TropicalStormWindspeeds](#)

Modeling the decay of tropical cyclone winds

[1-118-SolowEconomicGrowth](#)

Analysis of the Solow-Swan model of economic growth theory

[1-119-DairyFarming](#)

Modeling population growth of a dairy farm

[1-120-CircularRollerCoaster](#)

Modeling a circular roller coaster to determine velocity to stay on track

[1-122-SpreadPEV](#)

Using recent sales data model the spread of plug-in electric vehicles

[1-124-World Population](#)

Modeling world population with varying growth rates

[1-125-DiceyPopulations](#)

Using dodecahedral dice population to model death and immigration

[1-126-MarriageMath](#)

Modeling the process of entry into marriage by an individual

[1-127-FishHarvesting](#)

Modeling a fish harvesting operation over a 25 year time period

[1-128-RocketFlight](#)

Modeling a rocket trajectory as it consumes fuel

[1-130-AspirinAbsorption](#)

Pharmacokinetic modeling of absorption of aspirin in body

[1-131-CaffeineElimination](#)

Pharmacokinetic modeling of elimination of caffeine from the body

[1-132-DigoxinElimination](#)

Pharmacokinetic modeling of elimination of digoxin from the body

[1-134-LanguageDynamics](#)

Modeling change in the fraction of a population speaking one language over another

[1-135-FishHarvesting](#)

Studying bifurcation through a fish harvesting model

[1-136-MarriageAge](#)

Model of fraction of people who are first time married by a certain age

[1-137-SheepGraze](#)

Developing a model for sheep grazing

[1-138-InnerEarDrugDelivery](#)

Developing a model for administering drugs to the inner ear

[1-139-PlantsVsHerbivores](#)

Developing a model for herbivores grazing

[1-140-LeakyBucket](#)

Modeling the height of water in a tank with a leak and water pouring in

[1-141-M&MGameRevisit](#)

We use a simulation and observe long term behavior to estimate a parameter

[1-142-WaterBottles](#)

Application of Newton's law of cooling to the study of insulated water bottles

[1-143-PopulationModelVariations-MATLAB](#)

Using populations and modeling while enhancing MATLAB skills

[1-144-HeatCool](#)

Liquid container in liquid tank – heating and cooling

[1-145-FastPitch](#)

Modeling the velocity of Major League Baseball fastball

[1-150-CancerTherapy](#)

Uses population growth models to compare treatments for cancer

[1-155-CruiseControl](#)

Modeling the cruise control in an automobile

[1-160-HeartDeathRate](#)

Modeling Two — Simulation of the heart death rate

[1-165-FlushToilet](#)

Spread of flush toilet technology

[1-170-CensusModeling](#)

Exploring modeling assumptions with census data

[1-190-IntroClass](#)

Broad first day cover of many themes beginning with first order equations

Modeling Two — Numerical Methods

Technique Narratives – [Back to Main Table of Contents](#)

[2-001-NumericalMethodsComparisons](#)

Developing and caring for several numerical methods for first order equations

[2-005-Linearize It All](#)

Analytic solutions and linear approximation solutions compared to data

Modeling Three — Second Order Homogeneous Differential Equation Models

Modeling Scenarios – [Back to Main Table of Contents](#)

[3-001-SpringMassDataAnalysis](#)

Data on a spring mass system with resistance is given for modeling for analysis

[3-002-ModelsMotivatingSecondOrder](#)

From real data several ways to model spring mass system emerge

[3-004-VanderPol](#)

Study of van der Pol's equation with applications and spreadsheet simulation

[3-006-Buoyancy](#)

Data on a bobbing container motivates model and parameter estimation

[3-008-HangTime](#)

Hang Time Modeling

[3-009-BallDropInWater](#)

Analysis of a falling ball in liquid to reach terminal velocity

[3-010-EnergyInSpringSystems](#)

Exploring damping and forcing terms to discover energy in system

[3-011-EulerBallThrowing](#)

Using Euler's Method in maximizing distance for throwing a ball

[3-013-WhiffleBallFall](#)

Using data on whiffle ball fall model resistance and predict the fall position

[3-015-StyrofoamBallFall](#)

Modeling a falling Styrofoam ball's motion

[3-016-FallingCoffeeFilters](#)

Using data on stack of coffee filters to build model

[3-017-StackedCoffeeFilters](#)

Using data on stacked coffee filter falling from the literature build models

[3-019-ShuttleCock Fall](#)

Modeling a falling shuttlecock

[3-020-ChordPathTime](#)

Time mass to slide along chord from high point to any point on a circle

[3-026-SpringInverseProblem](#)

Estimating an unknown parameter in an oscillating spring mass system

[3-027-BobbingDropping](#)

Modeling wood block bobbing in water and falling object

[3-029-FerrisWheelCatch](#)

We model the throw of an object to a person on a moving Ferris wheel

[3-030-SecondOrderIntro](#)

Intro to second order differential equations with applications

[3-031-SpringCost](#)

Producing a spring meeting industrial specifications at lowest cost

[3-033-TimeUpTimeDown](#)

Determining if vertical projectile takes same time to go up as to come down.

[3-034-CarSuspensions](#)

Study of spring-mass-dashpot which is part of car suspension system

[3-035-StadiumDesign](#)

Design a stadium which is fair to home run hitters in all directions

[3-040-FirstPassageTime](#)

We model and determine the first passage time for underdamped oscillator

[3-041-UpDown](#)

Relate times when projectile passes the same point – up and then down

[3-042-CatapultLaunch](#)

Maximizing the ranges of a projectile by backing up an incline

[3-043-BallisticsModeling-SpongeDart](#)

Building and comparing models for Sponge Dart ballistics

[3-044-DeepWell](#)

Given total time of pebble fall to sound coming back tell how deep a well

[3-045-RampBounce](#)

Bounce a ball on a tilted ramp for optimal horizontal distance traversed

[3-051-ProjectileMotions](#)

Several instances of projection motion from the ground and from a cliff

[3-052-OptimalProjectileFiring](#)

Examine optimal downrange issues for projectiles fired in different circumstances

[3-054-Relay](#)

Place infielder in optimal position for minimum time relay through form outfield

[3-055-FloatingBox](#)

Modeling floating bobbing box

[3-060-DataToDifferentialEquation](#)

Estimating damping coefficient and spring constant from data

[3-061-ChemEng](#)

Calculating concentration profile of cyclohexane

[3-063-FallingBuildingIce](#)

Modeling the fall of a piece of ice off a building

[3-064-GearTrain](#)

Modeling gear trains built with various gear combinations

[3-065-UpDown](#)

Modeling vertical projectile motion with resistance to address some issues

[3-067-RLC-SeriesCircuit](#)

Comparing analytic solution and numerical simulation for RLC series AC circuit

[3-069-HeatInBar](#)

Modeling the temperature distribution along a uniform slender bar

[3-070-FallingInWater](#)

Drop a canister in column of water, collect data from video, model motion

[3-071-WirelessTelegraphy](#)

A study of LC circuits, beats, and wireless telegraphy

[3-072-EarthQuake-Part I](#)

Bad Vibrations: Modeling a Building During an Earthquake - Part I: No Damping

[3-073-EarthQuake-Part II](#)

Bad Vibrations: Modeling a Building During an Earthquake - Part II: With Damping

[3-075-RLC-Circuits](#)

An introduction to RLC circuits is offered including definitions and modeling

[3-076-CircuitBuilding](#)

Building a circuit analytically in simulation, and physically

[3-080-PendulumModeling](#)

Several different pendulum configurations are modeled and compared

[3-085-SimplePendulum](#)

Modeling pendulum motion and verification of period with data

[3-087-ThanosPopulationDynamicsInteractingSpecies](#)

Thanos of "The Avengers" acts on world population modeled/strong>

[3-090-OneMassSpring](#)

Data on a single mass spring system permits modeling of oscillator

[3-090-ChebyshevPolynomialSolution](#)

Small study of Chebyshev Equation for which there are polynomial solutions

[3-091-SpringModeling](#)

Data analysis from videos for modeling spring mass motion

[3-092-WirelessPower](#)

Analyzing an efficient wireless power transmission system

[3-095-ShotInWater](#)

The resistance experienced by a bullet moving through water

[3-099-PullBack](#)

Modelling the velocity of a Pull-Back Toy

[3-100-RipCordToys](#)

Examining the motion of a rip-cord toy with data

[3-101-SpringMassFirstTry-NoResistance](#)

Modeling a simple spring mass with no damping conjecturing solutions

[3-102-SpringMassDamped](#)

Modeling a simple spring mass with damping conjecturing solutions

[3-103-PullBackCars](#)

Modeling the motion of spring loaded pullback cars

[3-105-FrequencyResponse](#)

Understanding maximum frequency response to second order model

[3-110-MilitarySpringMassApplication](#)

Modeling the shock absorber system for an Army vehicle

[3-130-MatterOfSomeGravity](#)

Estimating acceleration due to gravity from pendulum modeling

[3-140-TwoSpringOneMassFixedEnds](#)

Modeling two spring, single mass with fixed ends

[3-150-ItsABlastFurnace](#)

Steady-state heat equation to model temperature distribution in industrial furnace

Modeling Four — Second Order NonHomogeneous Differential Equation Models

Modeling Scenario – [Back to Main Table of Contents](#)

[4-020-AnIEDBlast](#)

Modeling the effects of an Improvised Explosive Device

[4-023-MysteryCircuit](#)

Students assigned various input voltages to a circuit to see what the circuit is

[4-035-ParEstSteadyState](#)

Input Output Analysis analyzing steady state to estimate parameters

[4-036-AltitudeDependentGravity](#)

Studying projectile motion with altitude dependent gravity

[4-039-FallingDarts](#)

Analyzing data on darts going up and going down

[4-050-ResonanceBeats](#)

We study the notions of resonance and beats for undamped system

[4-055-ShatterWineGlass](#)

Shattering wine glasses and other resonance phenomena are studied

[4-060-CircuitTuner](#)

Building the differential equation for a radio tuner

[4-065-GasInjection](#)

Numerical methods for solving singular (ordinary or partial) differential equations with small coefficients for the highest derivative terms

Modeling Five — Linear Systems of Differential Equation Models

Technique Narratives – [Back to Main Table of Contents](#)

[5-005-StiffDifferentialEquations](#)

An introduction to stiff differential equations and attendant numerical solutions

[5-010-MatrixExponential](#)

Using the matrix exponential to solve linear systems of ODEs

[5-012-LinearSystemConjecture](#)

Consequences of conjecturing solutions to linear systems of ODEs

[5-030-LinNonHomoSystemSol](#)

Strategies for solving system of nonhomogeneous differential equations

Modeling Scenarios – [Back to Main Table of Contents](#)

[5-001-LSDAndProblemSolving](#)

Modeling LSD in the body and correlating amounts with test performance

[5-002-RelationshipDynamics](#)

Using phase plane portraits to analyze Romeo and Juliet's relationship

[5-005-Dialysis](#)

Modeling Dialysis Machine

[5-007-ChemOpt](#)

Optimization for a Chemical Reaction

[5-010-DNA Degradation](#)

Modeling plasmid DNA degradation in rat plasma

[5-012-LipoproteinModeling](#)

Medical study data to build and affirm model for low-density-lipoprotein

[5-014-TwoSpringMass](#)

Build Free Body Diagram and model for two spring configuration

[5-015- RunnerSynchronize](#)

Developing phase model to study oscillatory phenomena

[5-022- ColdPill](#)

Modeling flow of drug from gastrointestinal tract to bloodstream for peak

[5-023-FakingGause](#)

Seeking parameters in toy data set protozoan population model

[5-024-PhGreatLakes](#)

Application of salt tank modeling approach to phosphorous in the US Great Lakes

[5-025-SaltCompartments](#)

Amount of salt in two water tanks is modeled in several ways

[5-026-Eviction](#)

A model for eviction in the United States is built

[5-030-AirshedSulphur](#)

Analyzing a model of the production of sulphur compounds in a Montana airshed

[5-036-HalfCarVibration](#)

Analyzing half-car approach to a vehicle's response when subject to a speed bump

[5-040-TunedMassDampers-Part I](#)

Applying a second mass to keep structure from experiencing resonance

[5-040-TunedMassDampers-Part II](#)

Applying second mass to keep structure from large displacement

[5-076-LanchesterLaws](#)

Using Lanchester's Laws to model strength of two armies' strengths

[5-077-MandMAttritionWarfare](#)

Using candies in simulations of attrition warfare

[5-080-SpaceFlightRecolonize](#)

Modeling the recolonization of the human race on a distant planet

[5-090-SolidParticleErosion](#)

Tutorial and modeling problems associated with pitting of ductile surface

Modeling Six — NonLinear Systems of Differential Equation Models

Modeling Scenarios – [Back to Main Table of Contents](#)

[6-001-Epidemic](#)

English Boarding School NonLethal Influenza

[6-002-EulerCromerPendulum](#)

Using the study of nonlinear pendulum to implement numerical methods

[6-003-SchoolFluEpidemic](#)

Using SIR model peak flu and total recovery times are determined

[6-004-VillageEpidemic](#)

Build a model of a mid seventeenth century English village epidemic

[6-005-InsectColonyCurvivalOpt](#)

Insect Colony Optimal Control

[6-006-ZombieGameHvZ](#)

Modeling this campus Zombie Game HvZ

[6-007- FunctionsAndDerivativesInSIRModels](#)

Relating functions and derivatives in SIR Models

[6-008-PursuitModels](#)

Linearization and Support from Homogeneous System Analysis

[6-009-FakeNews](#)

Model spread of fake news and ways to deter distributing misinformation

[6-010-SocialCampaigns](#)

Creating a model to capture the essence of social media campaigns

[6-011-HumansVsZombies](#)

Modeling variations of Humans vs Zombies battles

[6-012-RiverCrossing](#)

Building a model to help cross a river with current to land at specific spot

[6-015- CombatingEbolaEpidemic](#)

Making policy recommendations from models of spread of Ebola

[6-016-PandemicModeling](#)

Modeling COVID-19 Pandemic with SIR Model and Geogebra

[6-017-OncolyticViruses](#)

Explore oncolytic virotherapy using systems of differential equations

[6-018-ExploringSIRModel](#)

Modeling rumor and disease spread

[6-019-EnablingEpidemicExploration](#)

Several strategies for estimating parameters in models of epidemics

[6-020-AlgaePopulationSelf-Replenishment](#)

Investigate the massive algal blooms that struck Lake Chapala, Mexico

[6-021-AcornsRodentsSnakes](#)

Building a three trophic level model of acorns, rodents, and snakes

[6-022-CannibalismPredatorPrey](#)

Analysis of predator-prey system with cannibalism feature added.

[6-023-DroneHeadingHome](#)

Moving against a headwind create model of drone flight to fixed delivery point

[6-024-DronePackageDelivery](#)

Describe the flight path of a drone delivering a package using numerical methods

[6-025-WhalesAndKrill](#)

Use Excel to observe qualitative behavior a predator-prey model

[6-026-IsleRoyaleModeling](#)

Population ecology to connect vector calculus and differential equations

[6-028-SaltCompartments](#)

Amount of salt in two water tanks is modeled when tank volumes are changing

[6-029-TumorGrowth](#)

An introduction to systems and tumor growth modeling

[6-030-SaltAndTorricelli](#)

Modeling complex salt levels in a falling column of water

[6-035-Shampoo](#)

Modeling the amount of shampoo in a bottle during a shower

[6-040-StruggleForExistence](#)

Using historical data to model multiple species growth

[6-045-CholeraTransmission](#)

Modeling of the Haitian cholera epidemic

[6-065-InternetPlatformUsers](#)

Modeling the dynamics of Internet platform user's volume

[6-067-LotkaVolterra](#)

Studying Lotka Volterra equations in integrated environment for R

[6-068-VisualizingPredator-PreyCycles](#)

Nullcline analyses of predator-prey cycles

[6-070-BeerBubbles](#)

Modeling the rise and size of beer bubbles in a sitting glass of beer

[6-075-LorenzSystemSimulation](#)

Modeling the chaos of the Lorenz System with a physical simulation

Modeling Seven — Changing the Venue for Solution Success - Laplace Transforms

Technique Narratives – [Back to Main Table of Contents](#)

[7-005-OverviewLaplaceTransform](#)

Introduction and application of Laplace Transforms

[7-006-LaplaceTransformBirth](#)

Laplace Transform as the continuous analogue of a power series

[7-011-CoupledSystemLaplace](#)

Using a baby warmer coupled system Laplace transforms are presented

Modeling Scenarios – [Back to Main Table of Contents](#)

[7-008-MachineReplacement](#)

Laplace Transforms - Convolution Applications - Replacement Theory

[7-010-MultipleDoses](#)

Modeling several multiple dose approaches for drugs is considered

[7-020-ThermometerInVaryingTempStream](#)

Study thermometer while sitting in a stream whose temperature oscillates

[7-040-TankInterruptMixing](#)

Several approaches model flow of consecutive streams of salt into a container

Modeling Eight — Representing Natural Phenomena with Sines and Cosines

Modeling Scenarios – [Back to Main Table of Contents](#)

[8-002-TrigSumRepresentation](#)

Representing functions as sums of trigonometric functions

Modeling Nine — Modeling with Differential Equations in Higher Dimensions

Modeling Scenarios – [Back to Main Table of Contents](#)

[9-001-SkinBurnModelNumericalMethods](#)

Numerical methods for Heat Equation are introduced in context of skin burn issues

[9-002-GroundWaterFlow](#)

Modeling groundwater flow and developing effective PDE models with data collection

[9-005-InvasiveSpeciesModel](#)

Gentle progression from ODE to PDE modeling through invasive species model

[9-010-TravelingWaves](#)

Modeling a traveling wave in porous medium

[9-012-PDEGuitarTuning](#)

Tuning a Stringed Instrument with the Wave Equation

[9-014-TurkeyCook](#)

Investigate several models for the cooking time for a turkey

[9-015-UnearthingTruth](#)

Using electrical resistivity tomography to unearth tunnels

[9-020-HeatDiffusion](#)

Build equipment, conduct experiment, model data - has it all

[9-030-WaterHammer](#)

Modeling an initial-boundary value problem for the time evolution of a water hammer

[9-125-BeamModeling](#)

Modeling the deflection of a cantilever beam under two different distributed loads

[9-152-HorizontalBeam](#)

Modeling a suspended beam and collecting data to justify the model

Modeling Ten — Modeling with Difference Equations

Modeling Scenarios – [Back to Main Table of Contents](#)

[10-001-TilingHallway](#)

Using tiling of hallways to motivate difference equation modeling

[10-100-InsectOutbreaks](#)

Modeling climate change effects on insect outbreaks