

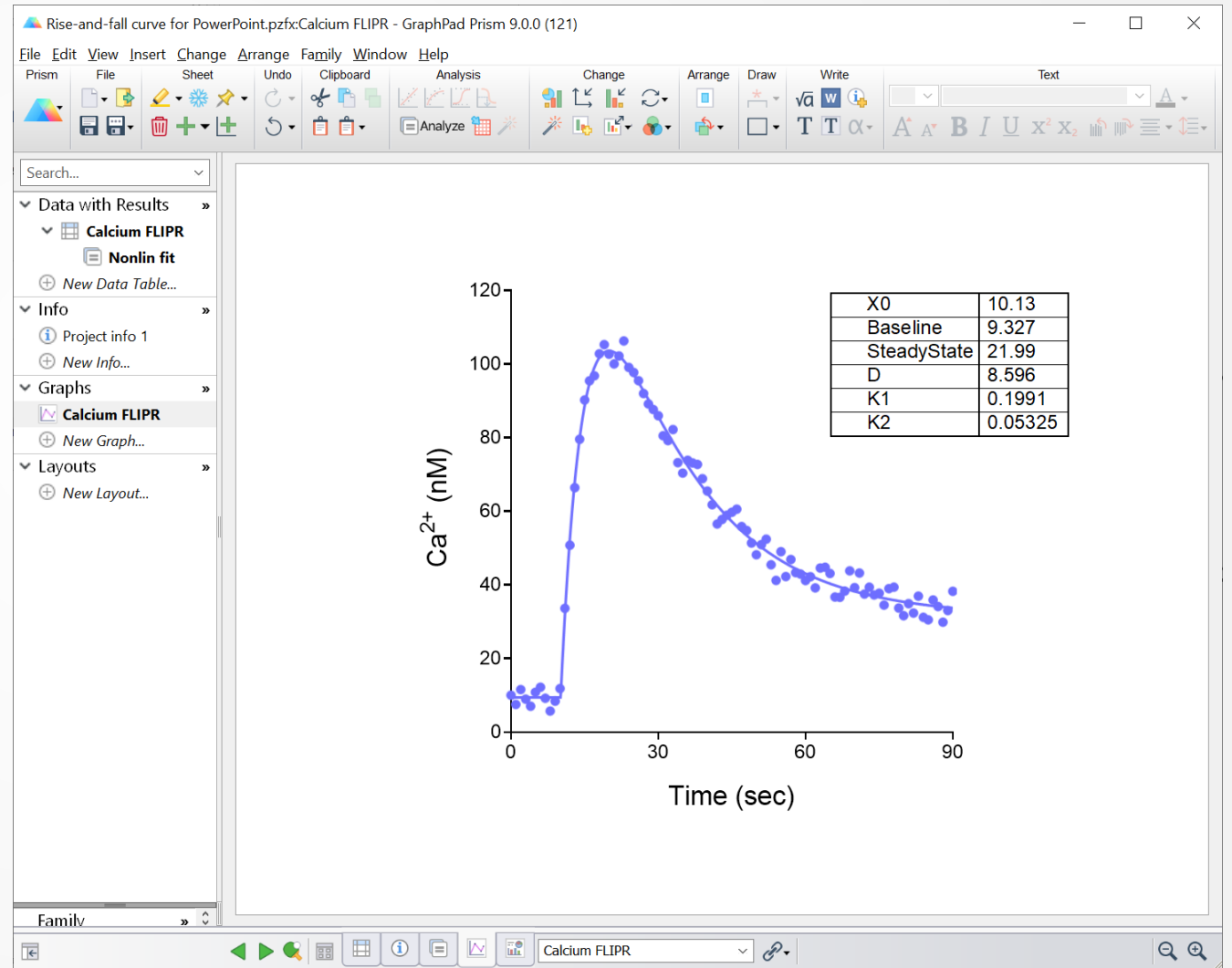
## **New time course equations for GraphPad Prism**

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sam.hoare@pharmmechanics.com

October 30 2020

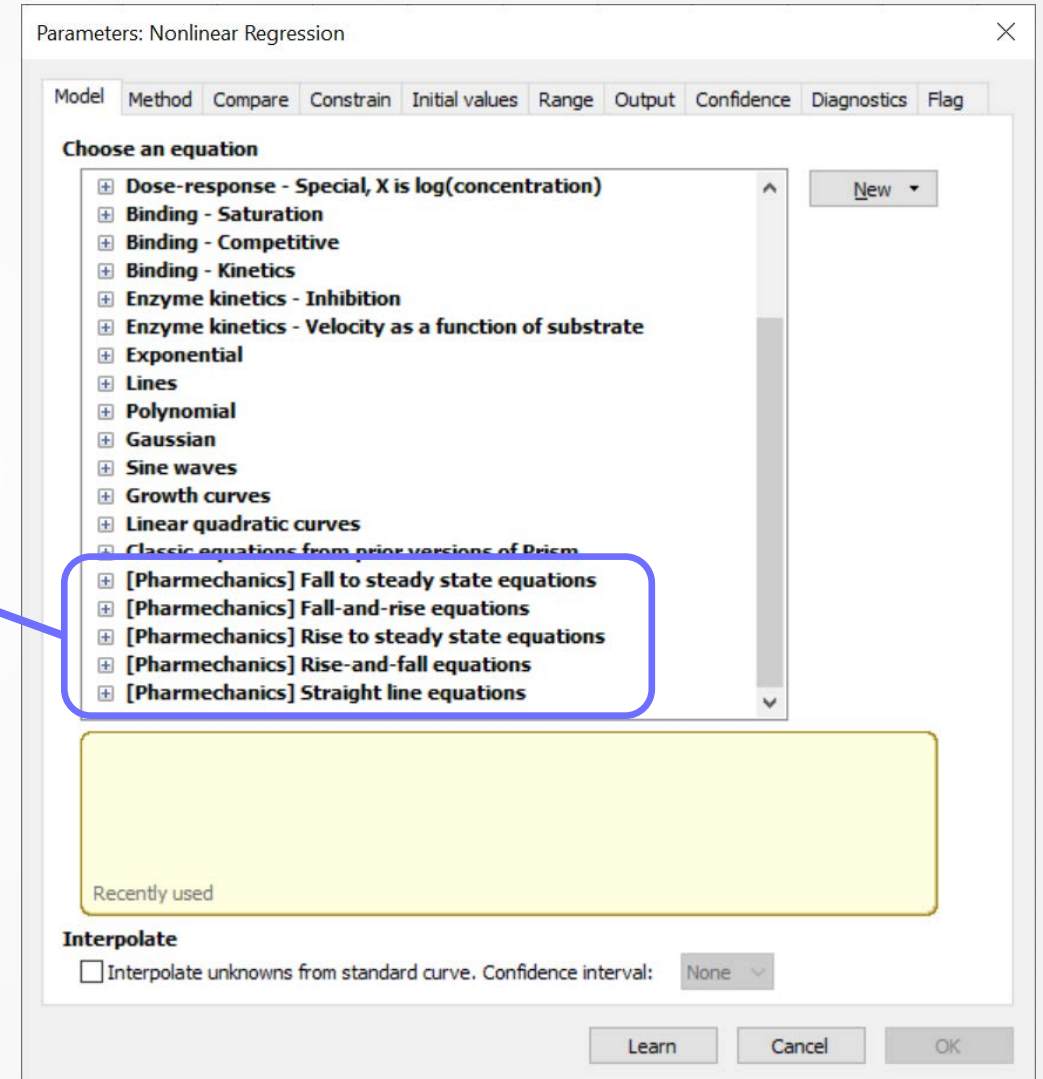
# Outline

- Time course data are often described by unfamiliar equations such as the rise-and-fall equation.
- These equations have been loaded into [GraphPad Prism](#) in custom templates designed by Pharmeconomics.
- We are grateful to Harvey Motulsky at GraphPad Software for guidance.

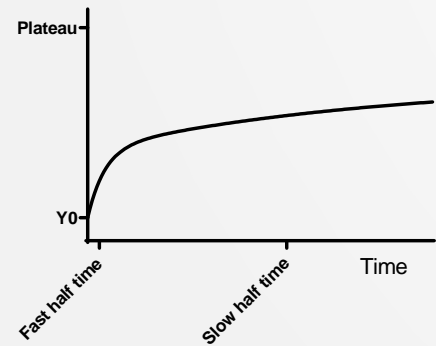
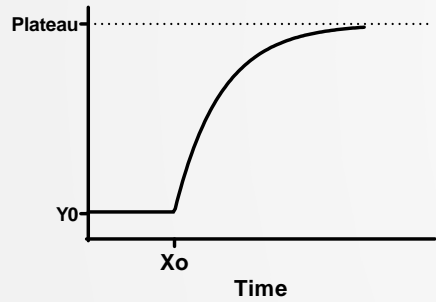
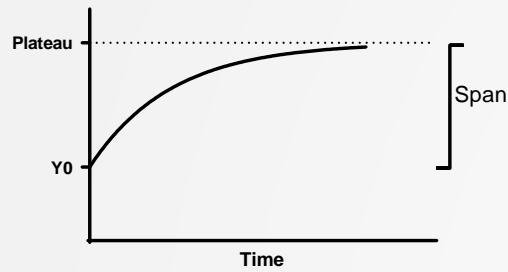


# Overview

- Download the relevant Prism template from [here](#).
- The equations can be loaded in batch or individually into your equation library as described [here](#) and on [Slide 16](#).
- Questions? Email [sam.hoare@pharmechanics.com](mailto:sam.hoare@pharmechanics.com)
- The equations are supported by [Pharmechanics](#), not by GraphPad.



# Familiar time course equations built into Prism



Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

Choose an equation

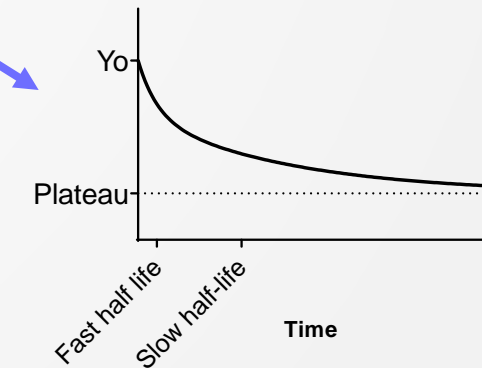
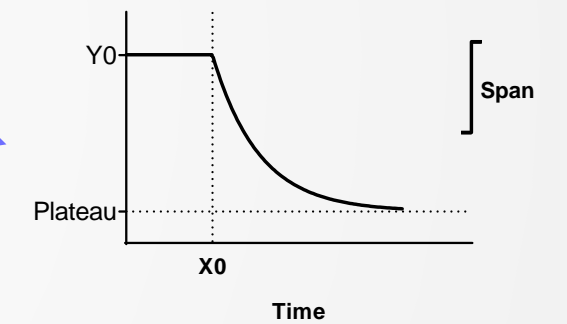
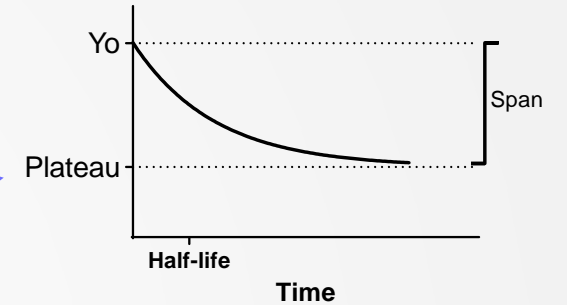
- Binding - Kinetics
- Enzyme kinetics - Inhibition
- Enzyme kinetics - Velocity as a function of substrate
- Exponential
  - One phase decay
  - Plateau followed by one phase decay
  - Two phase decay
  - Three phase decay
  - One-phase association
  - Plateau followed by one phase association
  - Two phase association
  - Exponential growth equation
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves
- Linear quadratic curves
- Classic equations from prior versions of Prism

If you have subtracted off the nonspecific signal, constrain Plateau to a constant value of 0.0

One phase decay  
Analytical derivatives [? Learn about this equation](#)

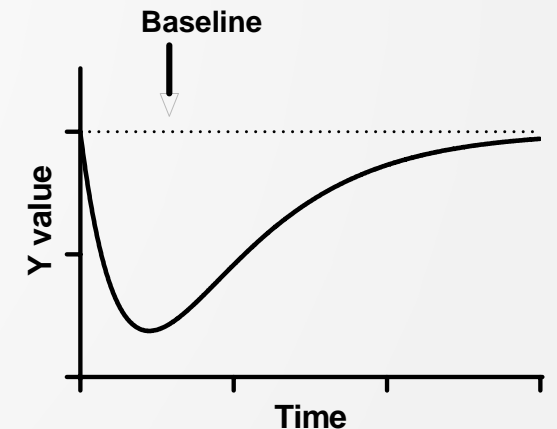
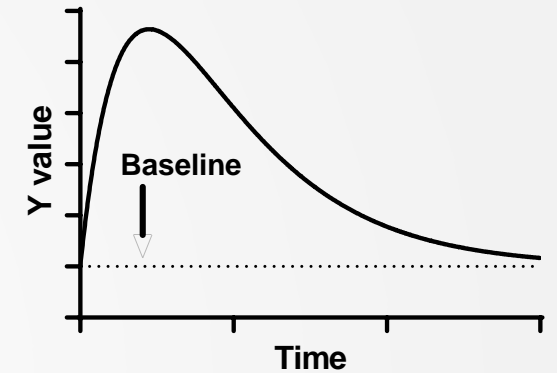
Interpolate  
 Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

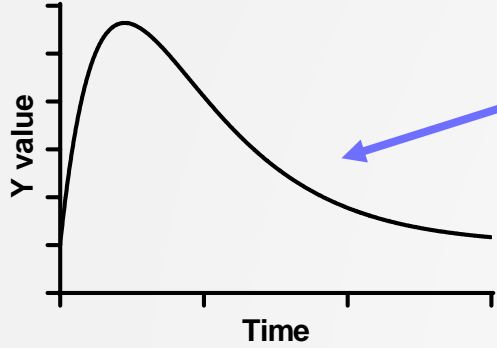


# New time course equations from Pharmeconomics

- New equations for rise-and-fall curves have been introduced by Pharmeconomics.
- Upward and downward versions available.
- In addition, the familiar time course equations (straight line, association & dissociation curves) have been rewritten to be in the same format as these new equations.



# Five files of equations

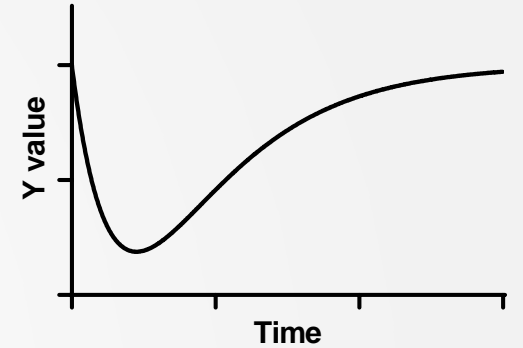


## 1. Rise-and-fall equations

Y increases over time, peaks, then falls back down.

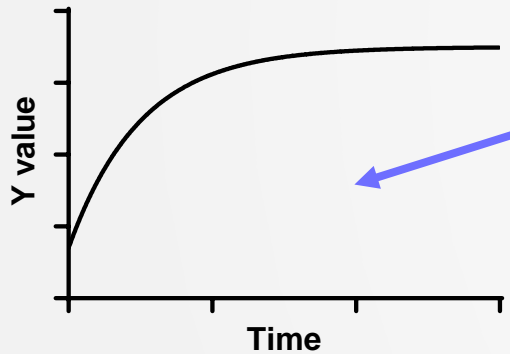
## 2. Fall-and-rise equations

Y decreases over time, troughs, then rises back up.



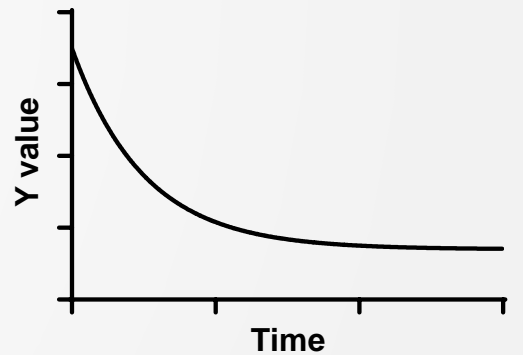
## 3. Rise to steady state equations

Y rises to a steady state plateau. Reformat of “One phase association” equation in Prism.



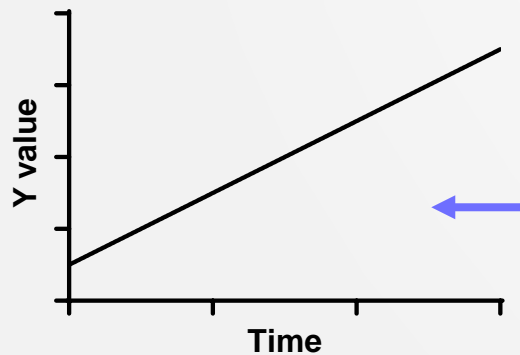
## 4. Fall to steady state equations

Y falls to a steady state plateau. Reformat of “One phase decay” equation in Prism.



## 5. Straight line equations

Y rises or falls linearly over time. Reformat of “Straight line” equation in Prism.



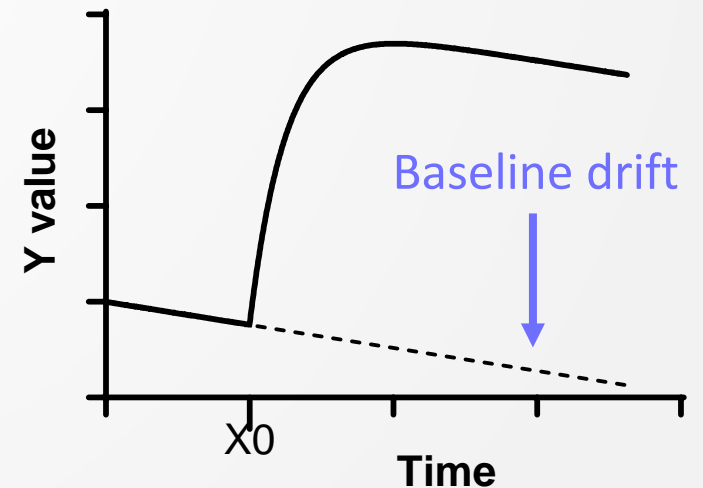
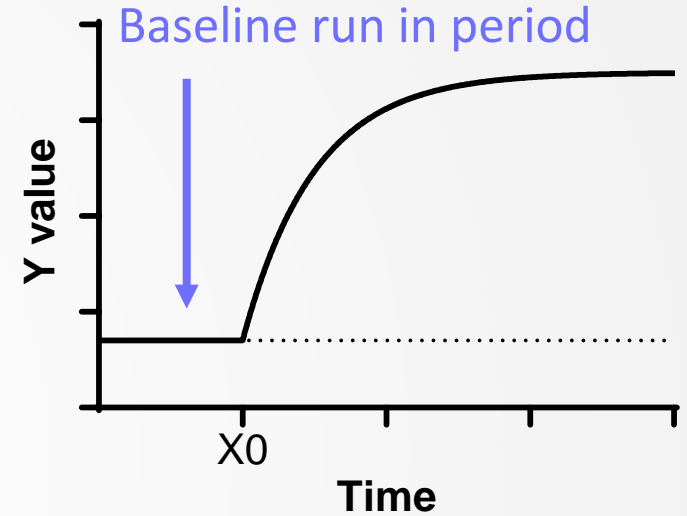
# Baseline considerations

In some experiments, baseline signaling is recorded before compound is added.

Equations are available that incorporate this baseline run in period.

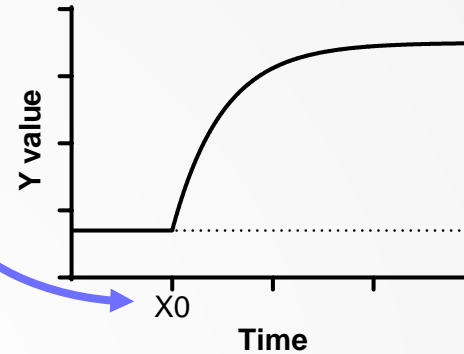
Occasionally, the baseline drifts over time.

Equations are available that incorporate this baseline drift

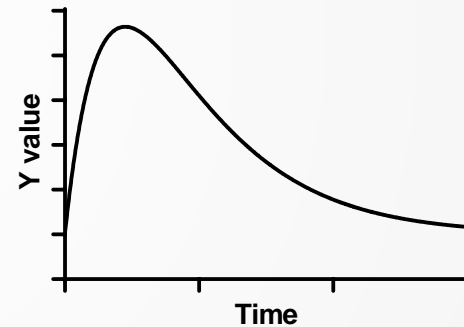


# Analysis tips

When there is a baseline run in period, the initial value of the parameter  $X_0$  often needs to be entered manually for the fit to work. See [here](#).



For the bell or U-shaped curves,  $K_1$  is the faster of the two rates and  $K_2$  is the slower. Usually, but not always,  $K_1$  is the rate of the first phase and  $K_2$  the rate of the second.



The equations are written out in the “Time course equation list” document [here](#) and can be viewed from the “Details” tab in the “Nonlinear regression” dialogue in Prism.

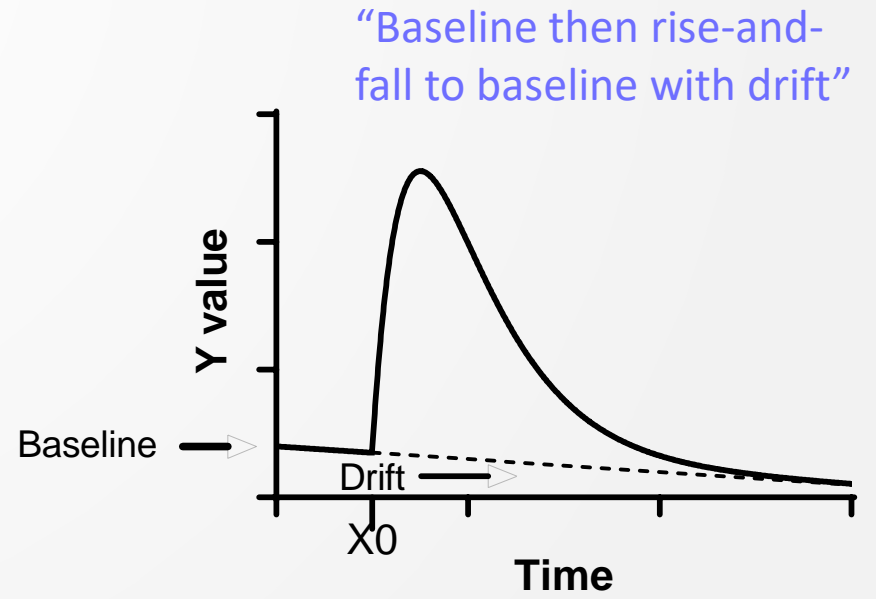
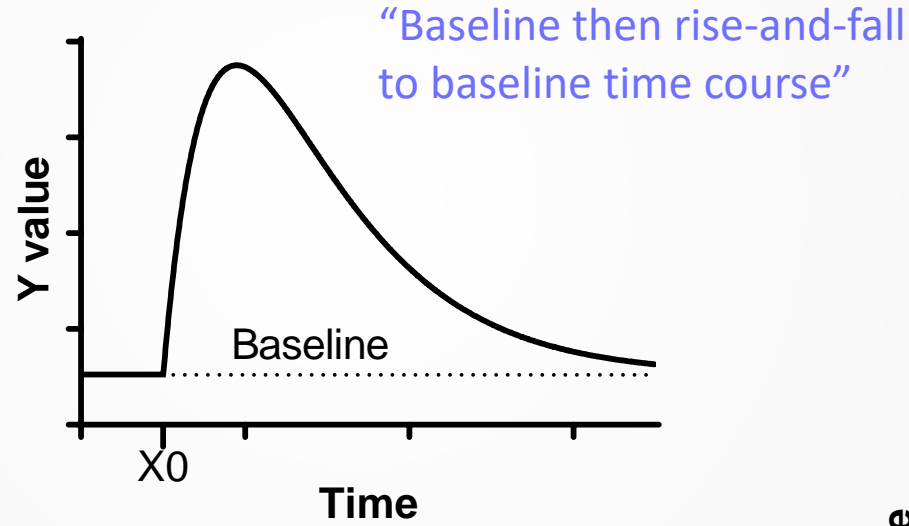
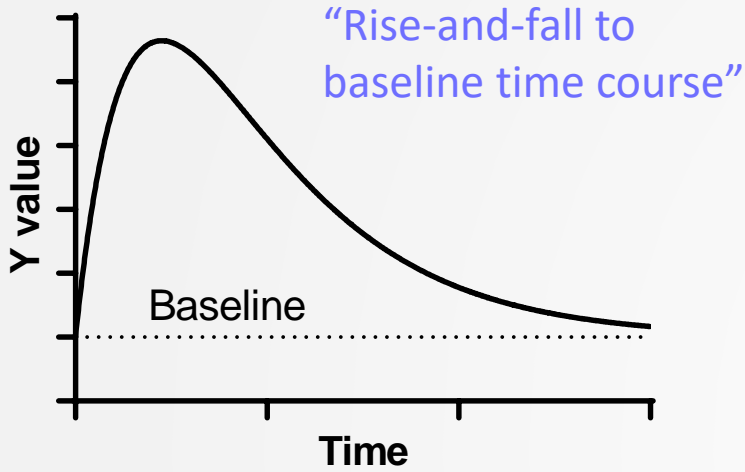


Time course  
equation list



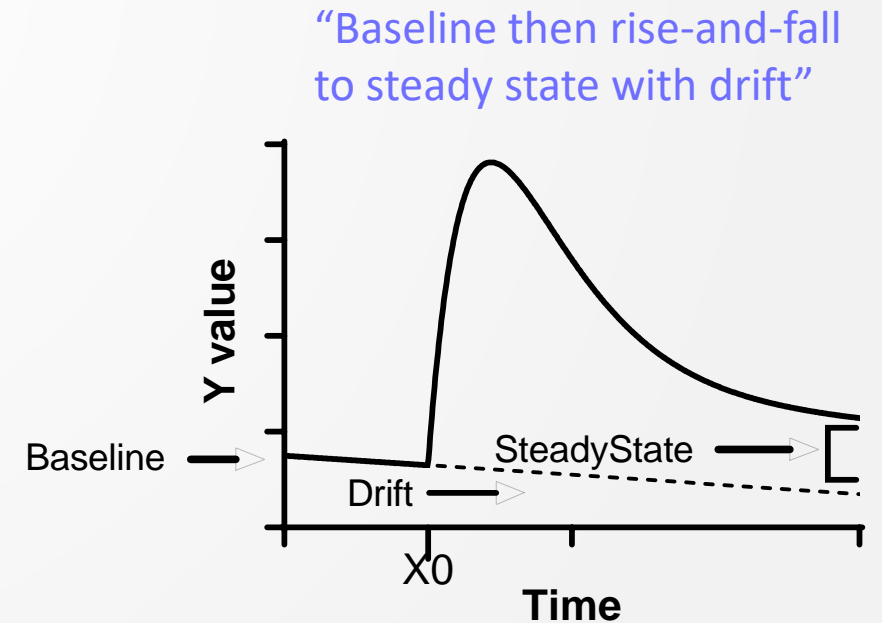
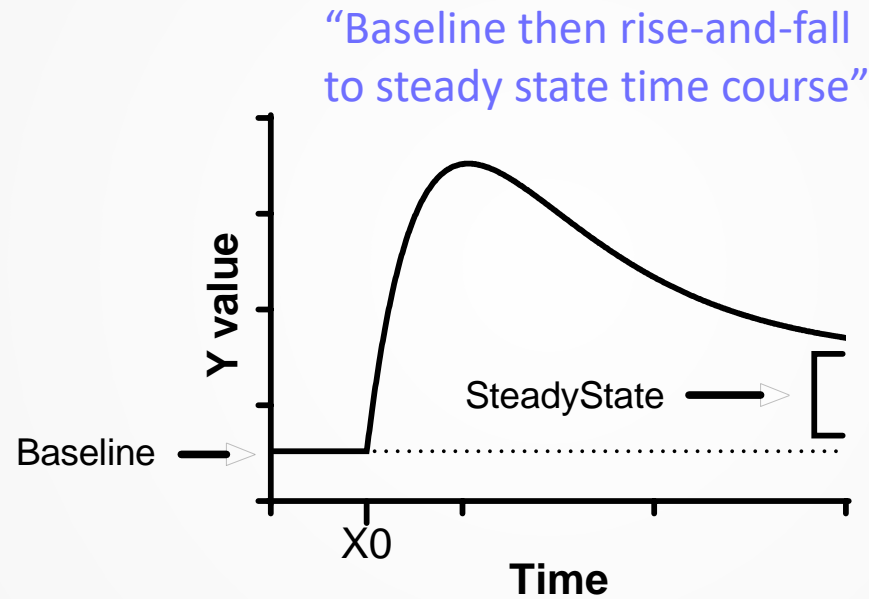
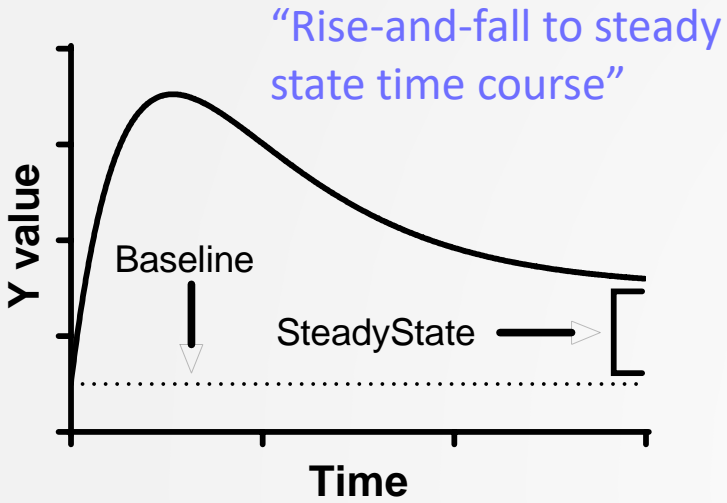
# Rise-and-fall equations

In "Rise-and-fall equations" file



# Rise-and-fall equations

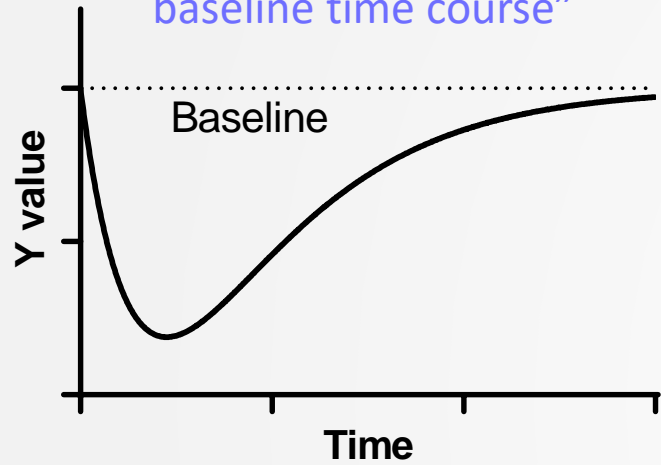
In "Rise-and-fall equations" file



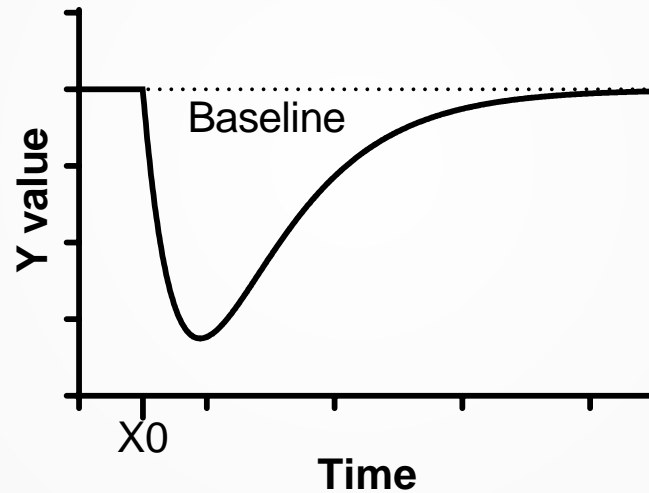
# Fall-and-rise equations

In "Fall-and-rise equations" file

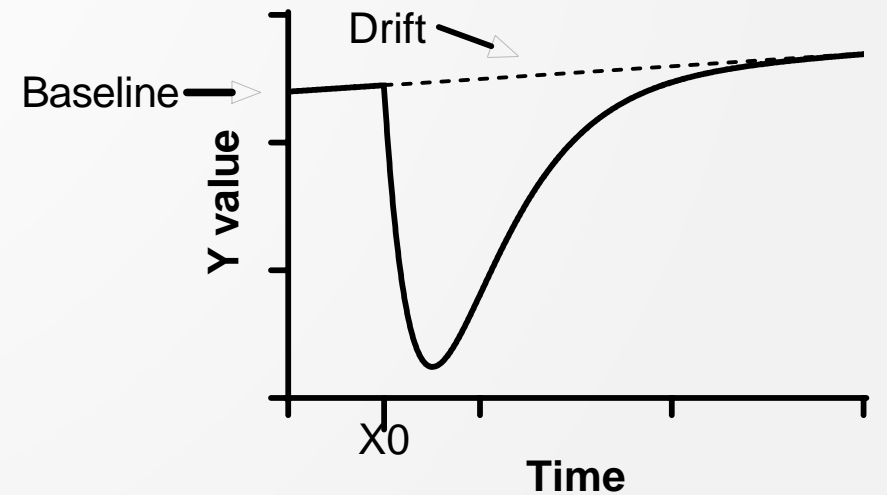
"Fall-and-rise to baseline time course"



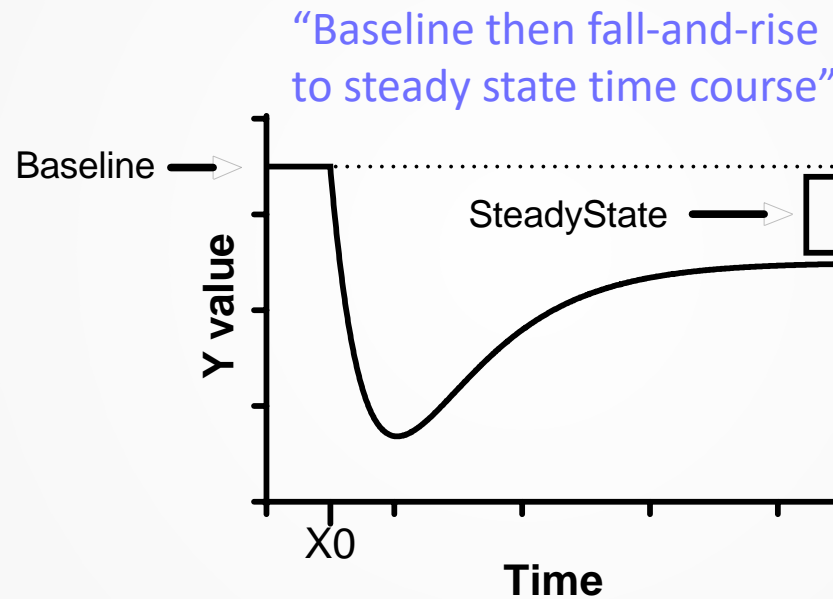
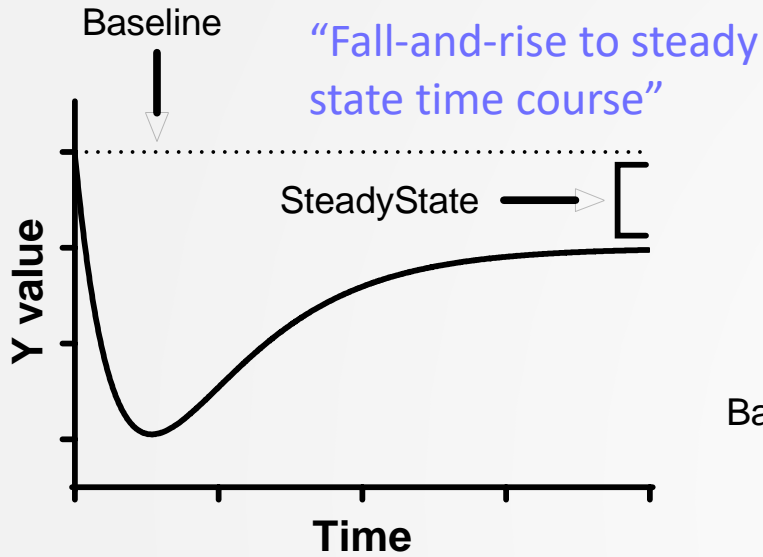
"Baseline then fall-and-rise to baseline time course"



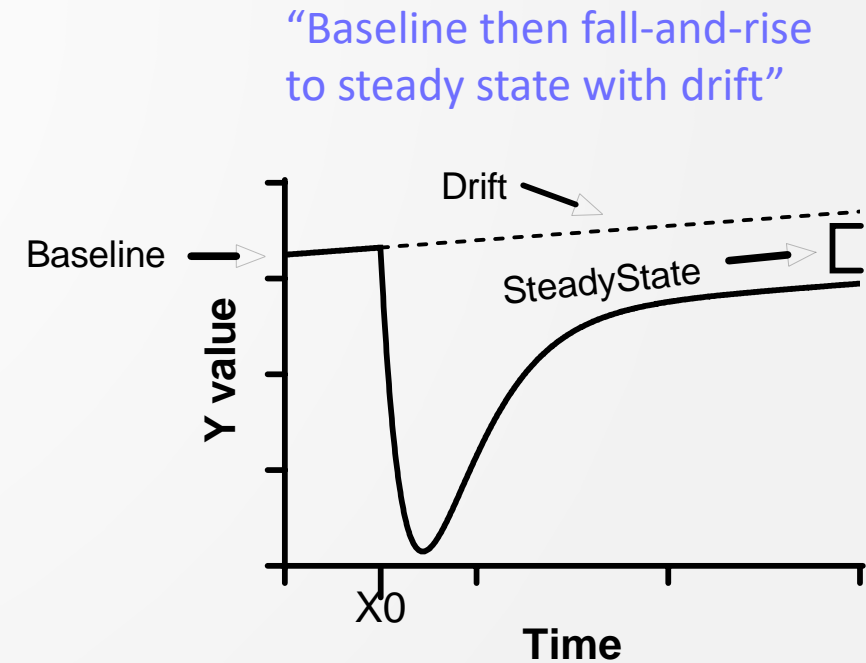
"Baseline then fall-and-rise to baseline with drift"



# Fall-and-rise equations

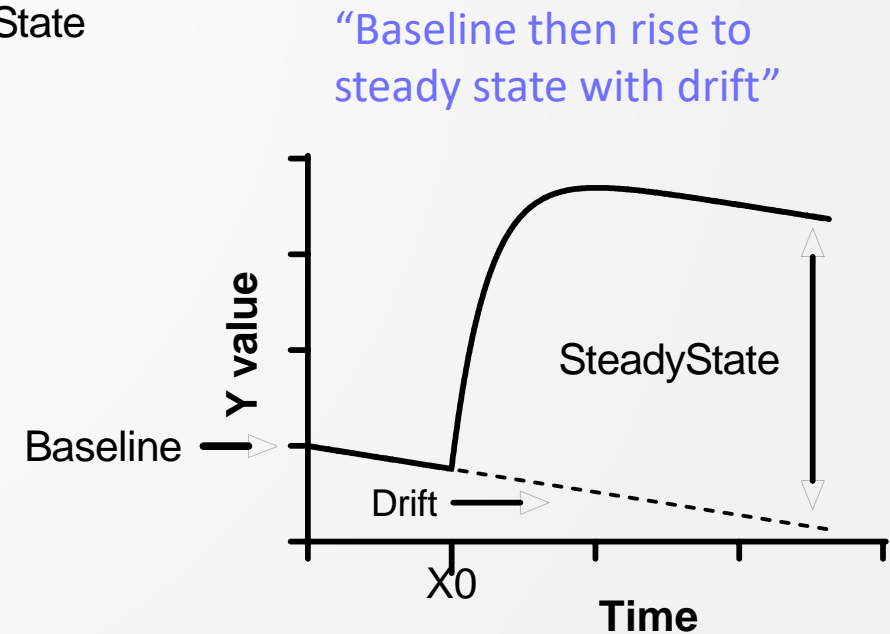
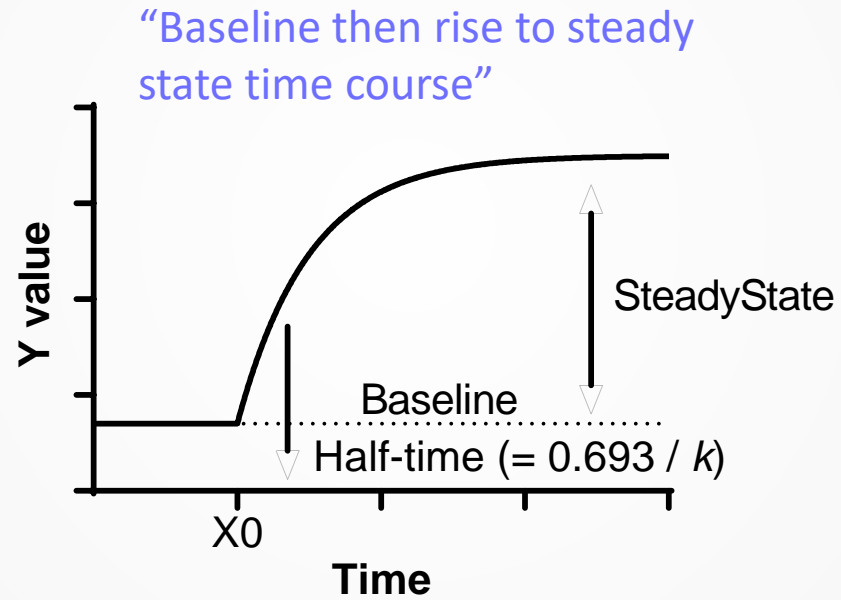
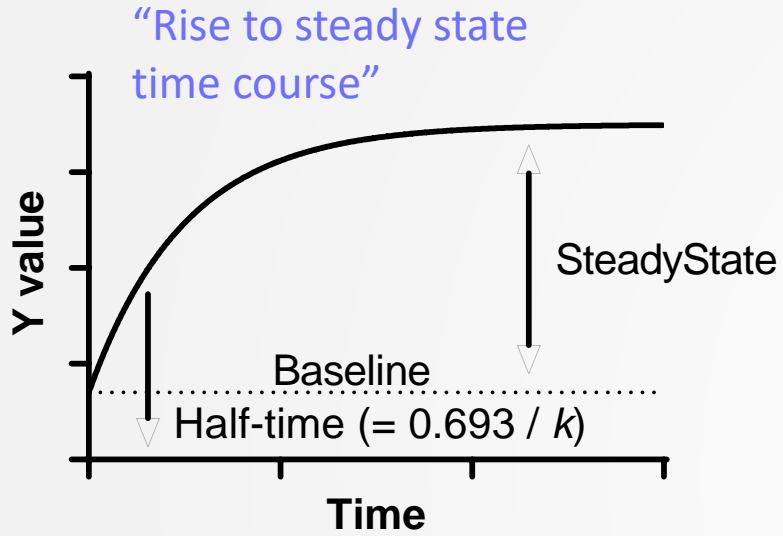


In “Fall-and-rise equations” file



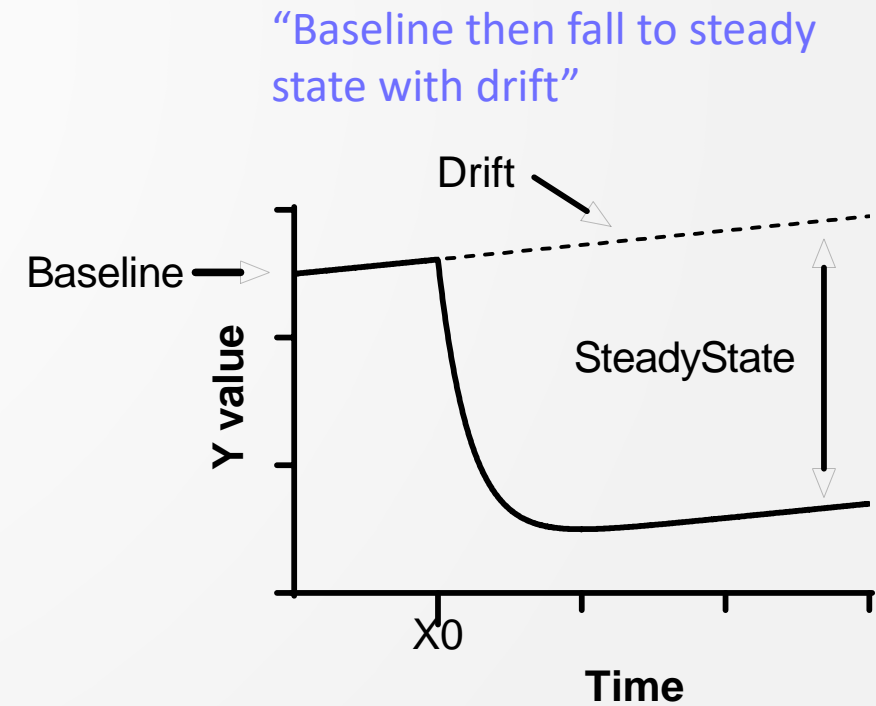
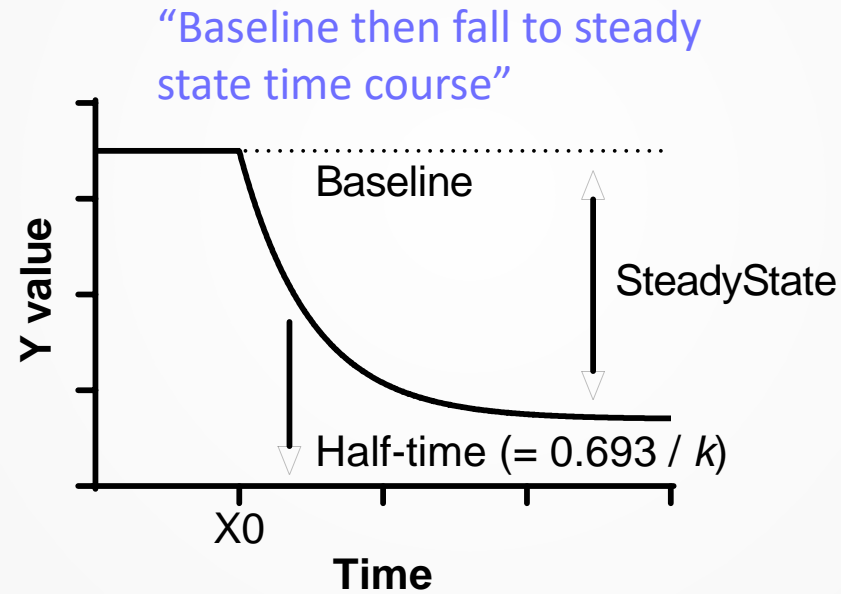
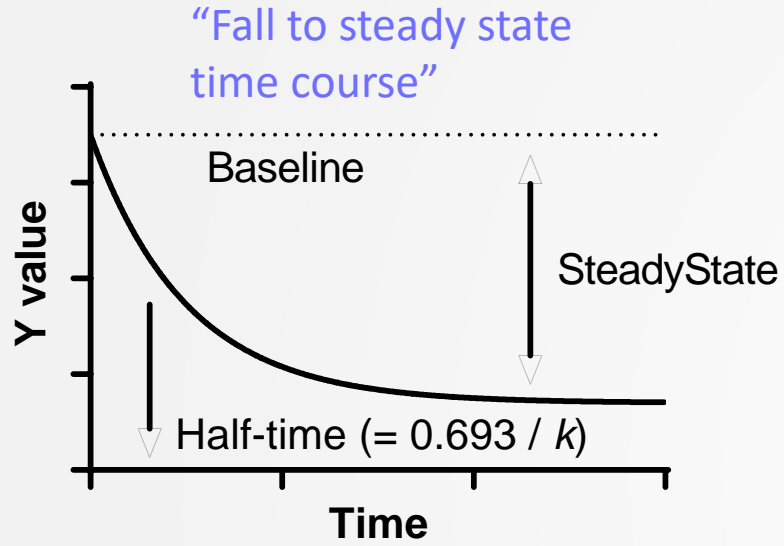
# Rise to steady state equations

In "Rise to steady state equations" file



# Fall to steady state equations

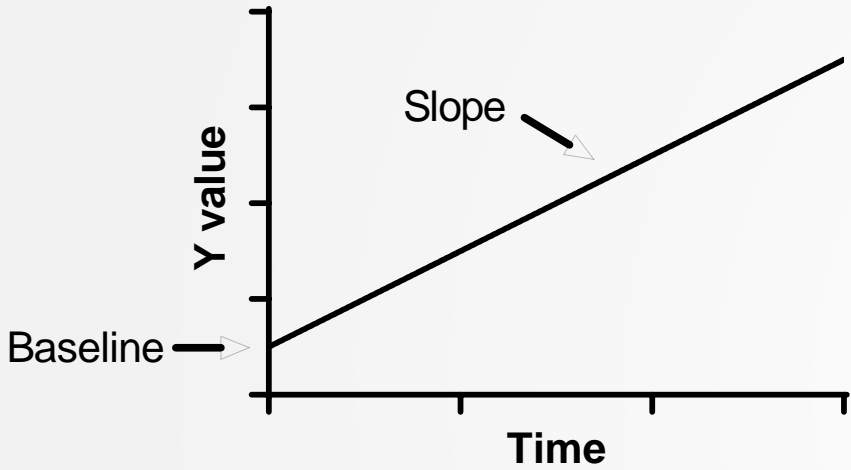
In "Fall to steady state equations" file



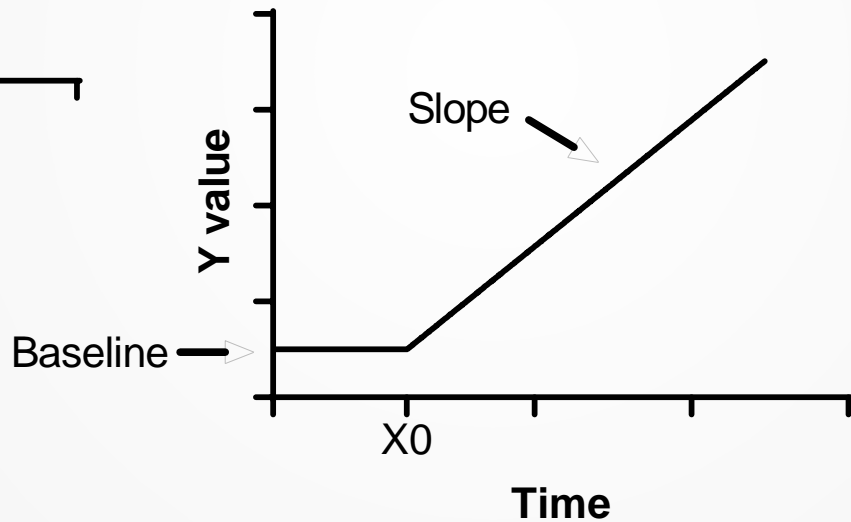
# Straight line equations

In "Straight line equations" file

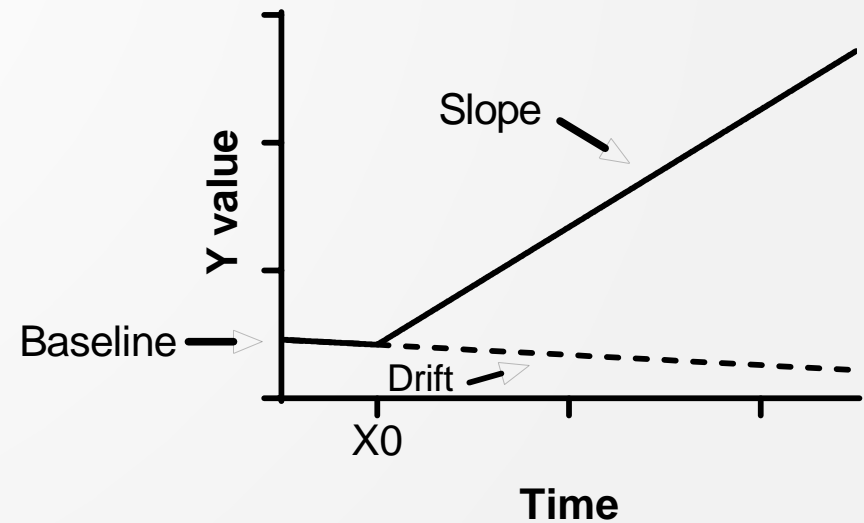
"Straight line time course"



"Baseline then straight line time course"



"Baseline then straight line with drift"



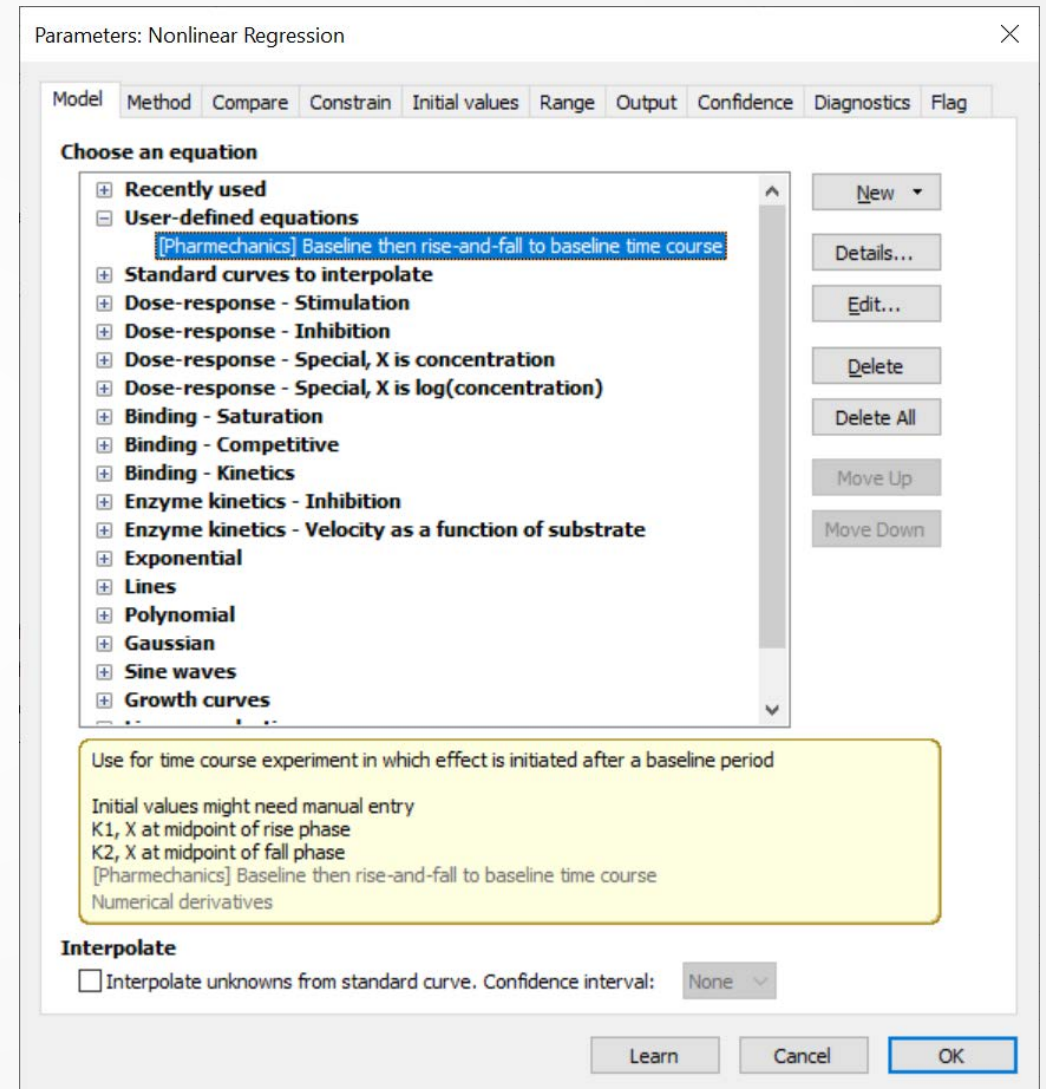
# Loading equations into Prism from a file



GraphPad Prism contains an equation editor for the input of user-defined equations.

There are sharing methods that simplify the loading of equations written by other users.

This avoids the need to write in the equation and all the fit settings.



First, download the files containing the equations to your computer. Here we are going to do all of the collections but you can select only the collection you need.

The files are located on an open-access Google Drive at:

<https://drive.google.com/drive/folders/1F5Qlyi30a3VNu9ZzCTKuTCDEmH6B4rdX?usp=sharing>

Google Drive interface showing a folder named "Pharmechanics equations in Prism". The file list is as follows:

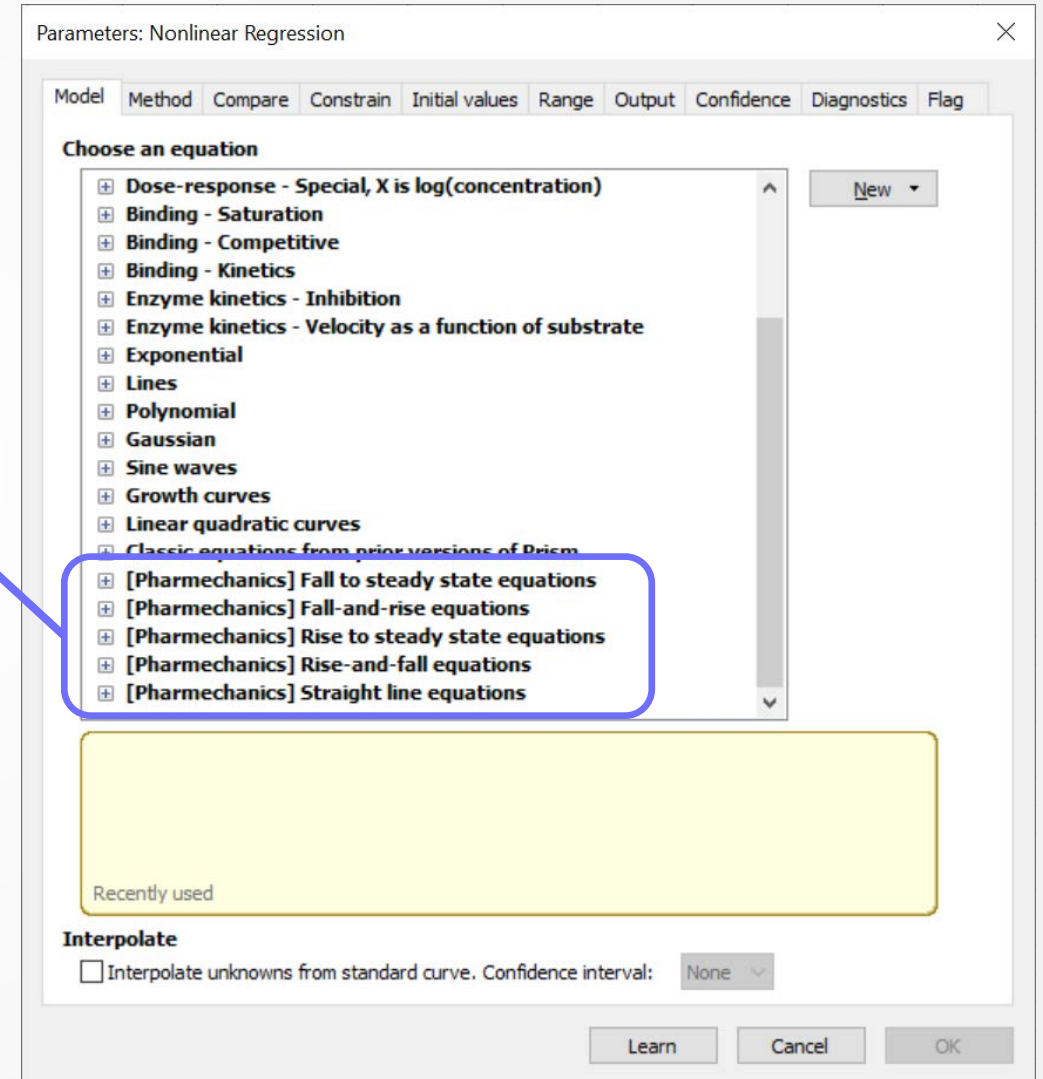
Name	Owner	Last modified	File size
[Pharmechanics] Fall to steady state equations.pzf	me	8:52 AM	1,011 KB
[Pharmechanics] Fall-and-rise equations.pzf	me	8:52 AM	2 MB
[Pharmechanics] Rise to steady state equations.pzf	me		
[Pharmechanics] Rise-and-fall equations.pzf	me		
[Pharmechanics] Straight line equations.pzf	me	8:51 AM	539 KB
Custom time course equations background info.pdf	me	Jan 22, 2021	3 MB
Custom time course equations background info.pp...	me	Jan 22, 2021	5 MB
Guide for loading equations into Prism from a file....	me	Jan 22, 2021	1 MB
Time course equation list.docx	me	Nov 4, 2020	241 KB
Time course equation list.pdf	me	Nov 4, 2020	193 KB

Windows File Explorer showing the "Downloads" folder. The file list is as follows:

Name	Date modified	Type	Size
[Pharmechanics] Fall to steady state equations	12/24/2020 11:19 AM	GraphPad Prism 9 Pr...	1,010 KB
[Pharmechanics] Fall-and-rise equations	12/24/2020 11:35 AM	GraphPad Prism 9 Pr...	1,854 KB
[Pharmechanics] Rise to steady state equations	12/24/2020 11:22 AM	GraphPad Prism 9 Pr...	1,021 KB
[Pharmechanics] Rise-and-fall equations	12/24/2020 11:36 AM	GraphPad Prism 9 Pr...	1,851 KB
[Pharmechanics] Straight line equations	12/24/2020 11:20 AM	GraphPad Prism 9 Pr...	36 KB

# Loading equations in batch

This will load a collection of equations into subfolders in the analysis dialogue.



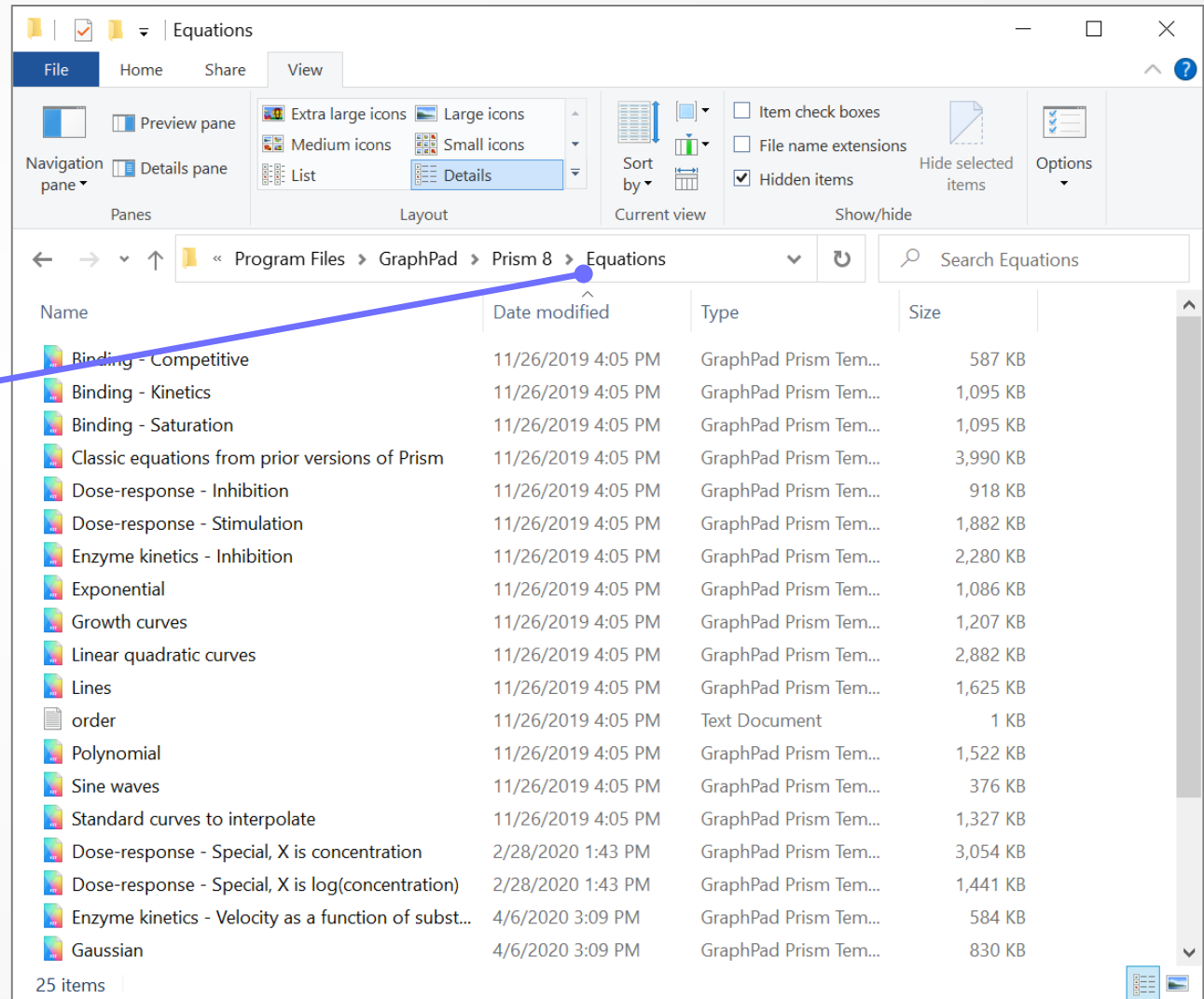
# Loading equations in batch

**First, if Prism is open, close it.**

Navigate to the Prism program files location on your computer.

Open the “Equations” folder.

Be very careful not to delete any of the files here – this is the equation library Prism uses.



# Loading equations in batch

Now copy the equations files into the “Equations” folder.

File Explorer window showing the Downloads folder. The 'Other (5)' group is expanded, showing five files:

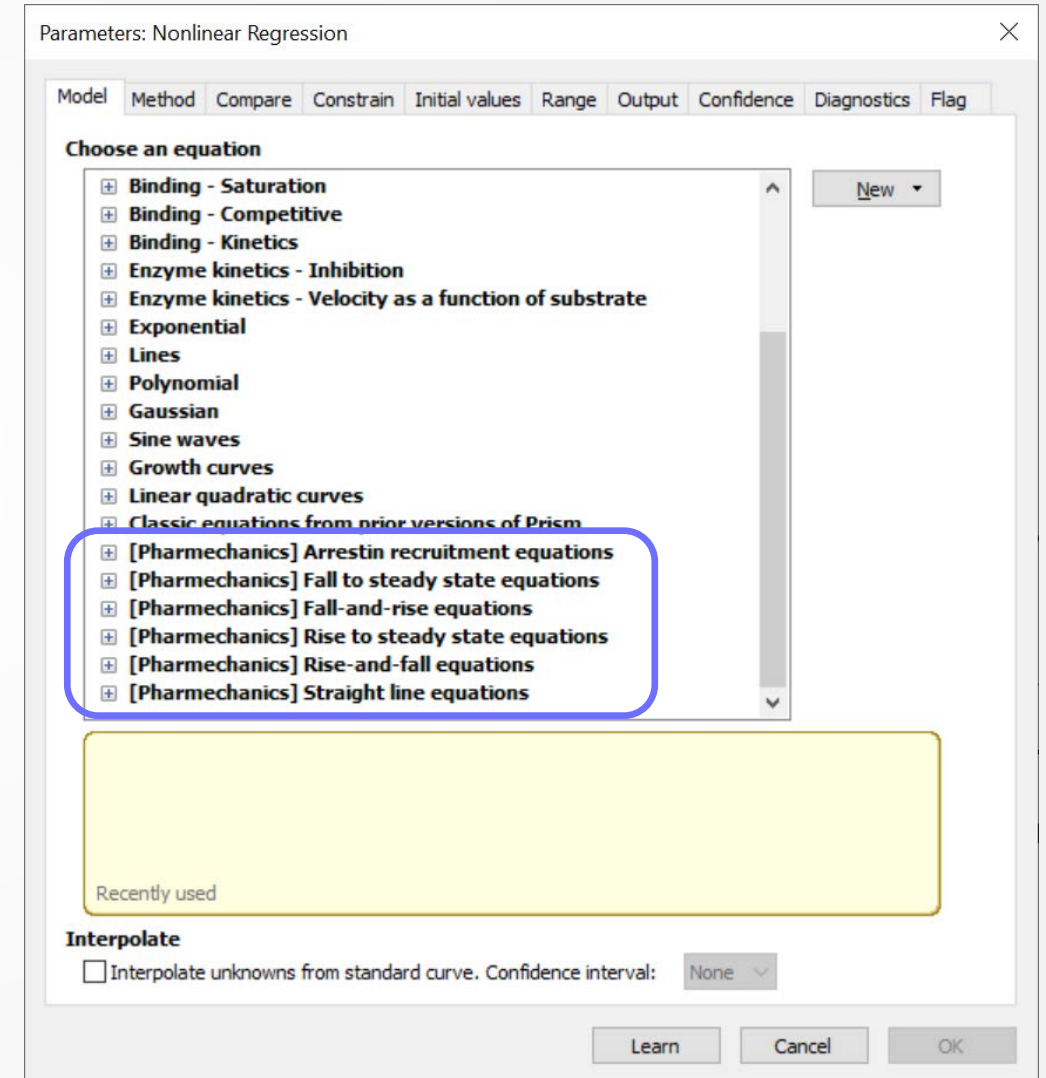
Name	Date modified	Type	Size
[Pharmechanics] Fall to steady state equations	12/24/2020 11:19 AM	GraphPad Prism 9 Pr...	1,010 KB
[Pharmechanics] Fall-and-rise equations	12/24/2020 11:22 AM	GraphPad Prism 9 Pr...	1,854 KB
[Pharmechanics] Rise to steady state equations	12/24/2020 11:22 AM	GraphPad Prism 9 Pr...	1,021 KB
[Pharmechanics] Rise-and-fall equations	12/24/2020 11:36 AM	GraphPad Prism 9 Pr...	1,851 KB
[Pharmechanics] Straight line equations	12/24/2020 11:20 AM	GraphPad Prism 9 Pr...	36 KB

File Explorer window showing the Equations folder. The folder contains 24 items:

Name	Date modified	Type	Size
[Pharmechanics] Rise to steady state equations	1/28/2021 8:52 AM	GraphPad Prism 9 Pr...	969 KB
[Pharmechanics] Fall-and-rise equations	1/28/2021 8:52 AM	GraphPad Prism 9 Pr...	1,855 KB
[Pharmechanics] Fall to steady state equations	1/28/2021 8:52 AM	GraphPad Prism 9 Pr...	1,012 KB
[Pharmechanics] Straight line equations	1/28/2021 8:51 AM	GraphPad Prism 9 Pr...	540 KB
[Pharmechanics] Rise-and-fall equations	1/28/2021 8:50 AM	GraphPad Prism 9 Pr...	1,862 KB
Enzyme kinetics - Velocity as a function of subst...	4/6/2020 3:09 PM	GraphPad Prism Tem...	584 KB
Gaussian	4/6/2020 3:09 PM	GraphPad Prism Tem...	830 KB
Dose-response - Special, X is concentration	2/28/2020 1:43 PM	GraphPad Prism Tem...	3,054 KB
Dose-response - Special, X is log(concentration)	2/28/2020 1:43 PM	GraphPad Prism Tem...	1,441 KB
Binding - Competitive	11/26/2019 4:05 PM	GraphPad Prism Tem...	587 KB
Binding - Kinetics	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,095 KB
Binding - Saturation	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,095 KB
Classic equations from prior versions of Prism	11/26/2019 4:05 PM	GraphPad Prism Tem...	3,990 KB
Dose-response - Inhibition	11/26/2019 4:05 PM	GraphPad Prism Tem...	918 KB
Dose-response - Stimulation	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,882 KB
Enzyme kinetics - Inhibition	11/26/2019 4:05 PM	GraphPad Prism Tem...	2,280 KB
Exponential	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,086 KB
Growth curves	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,207 KB
Linear quadratic curves	11/26/2019 4:05 PM	GraphPad Prism Tem...	2,882 KB
Lines	11/26/2019 4:05 PM	GraphPad Prism Tem...	1,625 KB

# Loading equations in batch

Open Prism, navigate to the “Nonlinear Regression” dialogue and in the “Model” tab the equation folders will appear at the bottom of the list.



# Loading equations in batch

Click the check box to see the equations in the folder.

The screenshot shows the 'Parameters: Nonlinear Regression' dialog box. The 'Method' tab is active, and the 'Choose an equation' section is expanded. A blue arrow points from the text 'Click the check box to see the equations in the folder.' to the check box next to '[Pharmechanics] Rise-and-fall equations'. Below this, a yellow box displays the expanded list of equations for that category. At the bottom, there is an 'Interpolate' section with a checkbox and a dropdown menu.

Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

Choose an equation

- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves
- Linear quadratic curves
- Classic equations from prior versions of Prism
- [Pharmechanics] Fall to steady state equations
- [Pharmechanics] Fall-and-rise equations
- [Pharmechanics] Rise to steady state equations
- [Pharmechanics] Rise-and-fall equations
  - [Pharmechanics] Rise-and-fall to baseline time course
  - [Pharmechanics] Rise-and-fall to steady state time course
  - [Pharmechanics] Baseline then rise-and-fall to baseline time course
  - [Pharmechanics] Baseline then rise-and-fall to steady state time course
  - [Pharmechanics] Baseline then rise-and-fall to baseline with drift
  - [Pharmechanics] Baseline then rise-and-fall to steady state with drift
- [Pharmechanics] Straight line equations

[Pharmechanics] Rise-and-fall equations

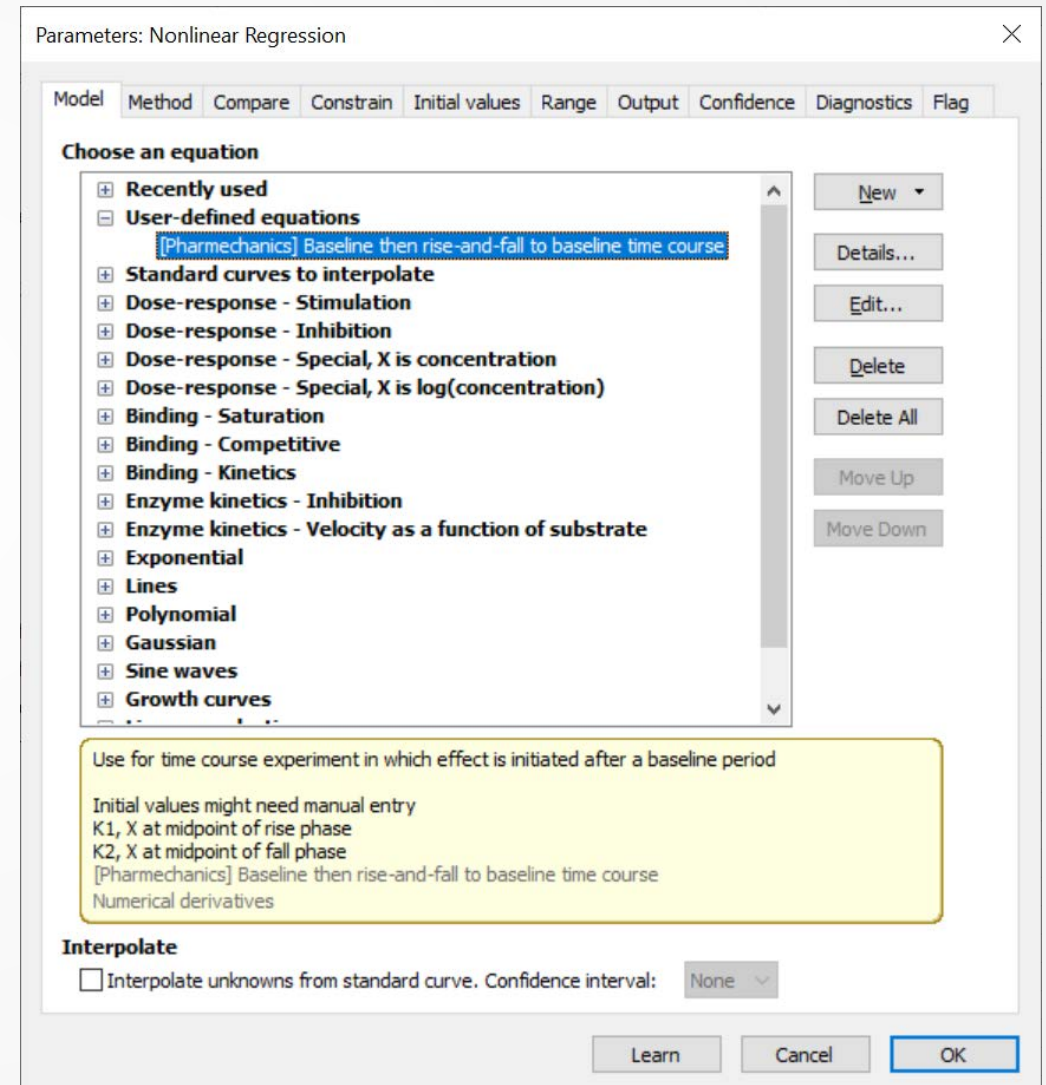
Interpolate

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

# Loading equations individually

An equation can be loaded individually from the Analysis results page on any file.





Open the file containing the equation you want.

The screenshot shows a Windows File Explorer window titled "Downloads". The ribbon includes "File", "Home", "Share", and "View". The "View" tab is active, showing options for "Navigation pane" (Preview pane, Details pane), "Layout" (Extra large icons, Large icons, Medium icons, Small icons, List, Details), "Current view" (Sort by), and "Show/hide" (Item check boxes, File name extensions, Hidden items, Hide selected items, Options). The address bar shows "This PC > Downloads" and a search box labeled "Search Downloads".

Name	Date modified	Type	Size
Other (5)			
[Pharmechanics] Fall to steady state equations	12/24/2020 11:19 AM	GraphPad Prism 9 Pr...	1,010 KB
[Pharmechanics] Fall-and-rise equations	12/24/2020 11:35 AM	GraphPad Prism 9 Pr...	1,854 KB
[Pharmechanics] Rise to steady state equations	12/24/2020 11:22 AM	GraphPad Prism 9 Pr...	1,021 KB
[Pharmechanics] Rise-and-fall equations	12/24/2020 11:36 AM	GraphPad Prism 9 Pr...	1,851 KB
[Pharmechanics] Straight line equations	12/24/2020 11:20 AM	GraphPad Prism 9 Pr...	36 KB

6 items | 1 item selected 764 KB

Rise-and-fall time course equations for AGM.pzf:Curve: Nonlin fit of Baseline then rise-and-fall to baseline - GraphPad Prism 8.4.1 (676)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text

Search...

- ▼ Data with Results
  - ▼ Rise-and-fall to baseline
    - Nonlin fit
  - ▼ Rise-and-fall to steady state
    - Nonlin fit
  - ▼ **Baseline then rise-and-fall to baseline**
    - Nonlin fit**
  - ▼ Baseline then rise-and-fall to steady state
    - Nonlin fit
  - ▼ Baseline then rise-and-fall to baseline with drift
    - Nonlin fit
  - ⊕ New Data Table...
- ▼ Info
  - Project info 1
  - ⊕ New Info...
- ▼ Graphs
  - Curve: Nonlin fit of Rise-and-fall to baseline
  - Curve: Nonlin fit of Rise-and-fall to steady state
  - Curve: Nonlin fit of Baseline then rise-and-fall to baseline**
  - Curve: Nonlin fit of Baseline then rise-and-fall to steady state
  - Curve: Nonlin fit of Baseline then rise-and-fall to baseline with dri
  - ⊕ New Graph...
- ▼ Layouts
  - ⊕ New Layout...

Y value

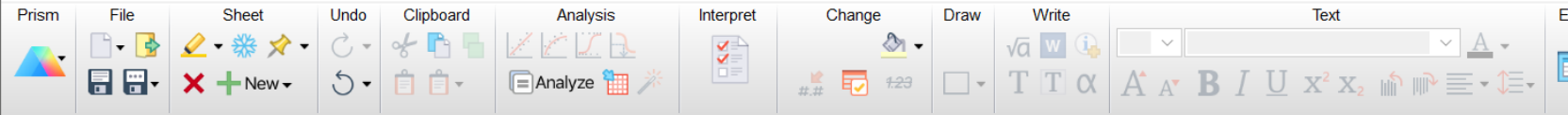
X0 Time

Baseline

Curve: Nonlin fit of Baseline th

Fro... 🔍

Open the results sheet for the equation you want.

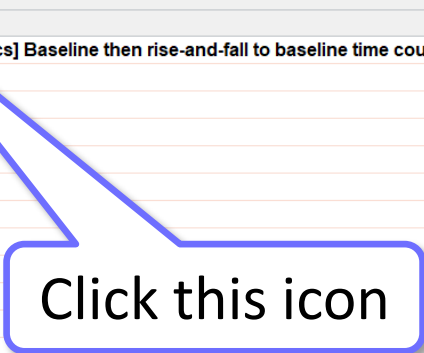


Search...

- Data with Results
  - Rise-and-fall to baseline
    - Nonlin fit
  - Rise-and-fall to steady state
    - Nonlin fit
  - Baseline then rise-and-fall to baseline
    - Nonlin fit**
    - Baseline then rise-and-fall to steady state
      - Nonlin fit
    - Baseline then rise-and-fall to baseline with drift
      - Nonlin fit
  - Info
    - Project info 1
    - New Info...
  - Graphs
    - Curve: Nonlin fit of Rise-and-fall to baseline
    - Curve: Nonlin fit of Rise-and-fall to steady state
    - Curve: **Nonlin fit of Baseline then rise-and-fall to baseline**
    - Curve: Nonlin fit of Baseline then rise-and-fall to steady state
    - Curve: Nonlin fit of Baseline then rise-and-fall to baseline with drift
    - New Graph...
  - Layouts
    - New Layout...

Table of results

	A	B	C
<b>1 [Pharmacokinetics] Baseline then rise-and-fall to baseline time course</b>			
<b>2 Best-fit values</b>			
3 X0	10.03		
4 Baseline	5.236		
5 C	9.949		
6 K1	0.1472		
7 K2	0.08251		
8 Half-time K1	4.709		
9 Half-time K2	8.401		
<b>10 Std. Error</b>			
11 X0	0.006785		
12 Baseline	0.05870		
13 C	0.04231		
14 K1	0.002733		
15 K2	0.001582		
<b>16 Goodness of Fit</b>			
17 Degrees of Freedom	94		
18 R squared	0.9997		
19 Sum of Squares	3.595		
20 Sy.x	0.1956		
<b>21 Constraints</b>			
22 C	C > 0		
23 K1	K1 > 1*K2		
24 K2	K2 > 0		
25			
<b>26 Number of points</b>			
27 # of X values	99		
28 # Y values analyzed	99		
29			
30			
31			
32			
33			
34			
35			
36			
37			



Rise-and-fall time course equations for AGM.pzf:Nonlin fit of Baseline then rise-and-fall to baseline - GraphPad Prism 8.4.1 (676)

File Edit View Insert Change Arrange Family Window Help

Prism File Share

Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

Choose an equation

- Recently used
- User-defined equations
  - [Pharmacokinetics] Baseline then rise-and-fall to baseline time course
- Standard curves to interpolate
- Dose-response - Stimulation
- Dose-response - Inhibition
- Dose-response - Special, X is concentration
- Dose-response - Special, X is log(concentration)
- Binding - Saturation
- Binding - Competitive
- Binding - Kinetics
- Enzyme kinetics - Inhibition
- Enzyme kinetics - Velocity as a function of substrate
- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves

Use for time course experiment in which effect is initiated after a baseline period

Initial values might need manual entry  
K1, X at midpoint of rise phase  
K2, X at midpoint of fall phase  
[Pharmacokinetics] Baseline then rise-and-fall to baseline time course  
Numerical derivatives

Interpolate

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

Text

A	B	C
0.03		
236		
949		
1472		
08251		
709		
401		
006785		
05870		
04231		
002733		
001582		
4		
9997		
595		
1956		
> 0		
1 > 1*K2		
2 > 0		
9		
9		

34  
35  
36  
27

Nonlin fit

Nonlin fit of Baseline then rise-

Table of results

This process loads the equation into the “User-defined equations” list. It only needs to be done once. After that, the new equation will be available every time you open Prism.

Rise-and-fall time course equations for AGM.pzf:Nonlin fit of Baseline then rise-and-fall to baseline - GraphPad Prism 8.4.1 (676)

File Edit View Insert Change Arrange Family Window Help

Prism File Share

Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

Choose an equation

- Recently used
- User-defined equations
  - [Pharmacokinetics] Baseline then rise-and-fall to baseline time course
- Standard curves to interpolate
- Dose-response - Stimulation
- Dose-response - Inhibition
- Dose-response - Special, X is concentration
- Dose-response - Special, X is log(concentration)
- Binding - Saturation
- Binding - Competitive
- Binding - Kinetics
- Enzyme kinetics - Inhibition
- Enzyme kinetics - Velocity as a function of substrate
- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Other curves

Use for time course of an experiment in which effect is initiated after a baseline period

Initial values might need manual entry

K1, X at midpoint of rise phase

K2, X at midpoint of fall phase

[Pharmacokinetics] Baseline then rise-and-fall to baseline time course

Numerical derivatives

Interpolate

Interpolate unknowns from standard curve. Confidence interval: Nonlinear

Learn Cancel OK

Text

A	B	C
0.03		
236		
949		
1472		
08251		
709		
401		
006785		
05870		
04231		
002733		
001582		
4		
9997		
595		
1956		
> 0		
1 > 1*K2		
2 > 0		
9		
9		

34  
35  
36  
37

Nonlin fit

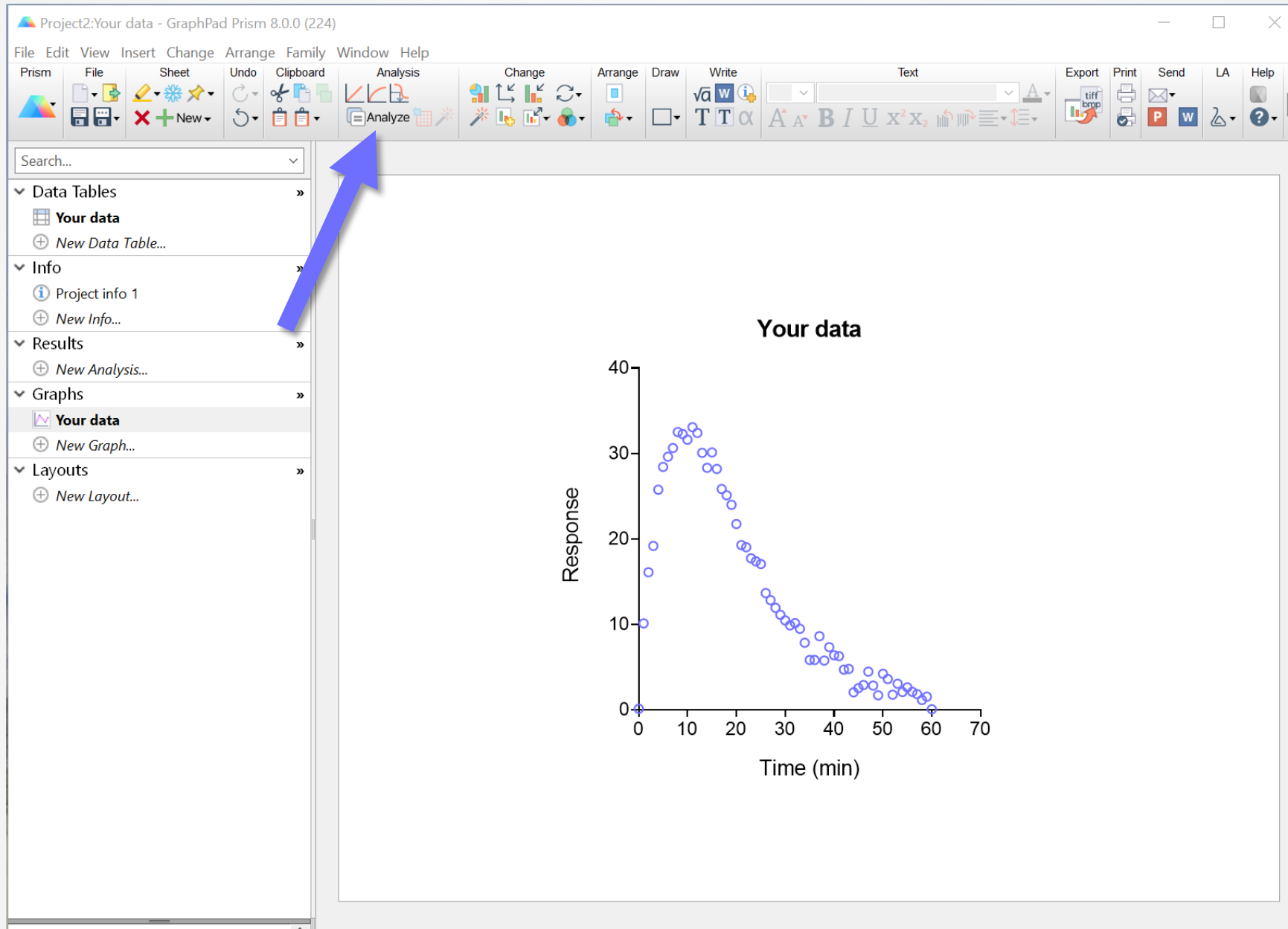
Nonlin fit of Baseline then rise- Table of results

Click OK then close file. Now the equation is available every time you open Prism, in the "User-defined equations" list.

# Using the new equations

- **The new equations are used in the same way as the “Exponential” equations built into Prism.**
- **See following slides for screen clippings**

Open  
your file



Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Search...

- ▼ Data Tables
  - ▢ Your data
  - + New Data Table...
- ▼ Info
  - i Project info 1
  - + New Info...
- ▼ Results
  - + New Analysis...
- ▼ Graphs
  - ▢ Your data
  - + New Graph...
- ▼ Layouts
  - + New Layout...

Analyze Data

Data to analyze  
Table: Your data

Type of analysis

Which analysis?

- [-] **Transform, Normalize...**
  - Transform
  - Transform concentrations (X)
  - Normalize
  - Prune rows
  - Remove baseline and column math
  - Transpose X and Y
  - Fraction of total
- [-] **XY analyses**
  - Nonlinear regression (curve fit)
  - Linear regression
  - Fit spline/LOWESS
  - Smooth, differentiate or integrate curve
  - Area under curve
  - Deming (Model II) linear regression
  - Row means with SD or SEM
  - Correlation
  - Interpolate a standard curve
- [+] **Column analyses**
- [+] **Grouped analyses**
- [+] **Contingency table analyses**


Analyze which data sets?

- A

When you analyze tables or graphs with more than one data set, use this space to select which data set(s) to analyze.

Select All Deselect All

Help Cancel OK





Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

**Choose an equation**

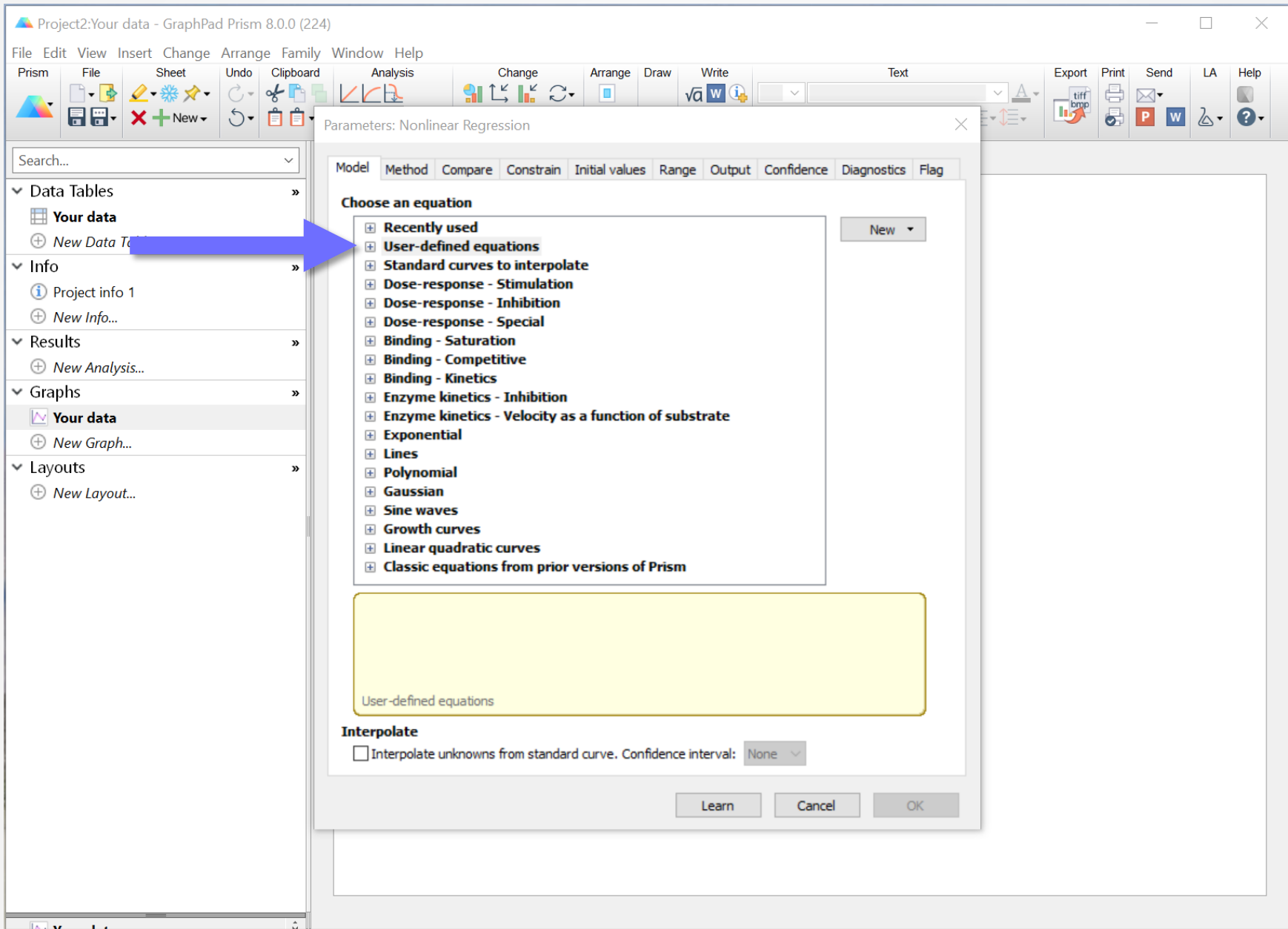
- + Recently used
- + User-defined equations
- + Standard curves to interpolate
- + Dose-response - Stimulation
- + Dose-response - Inhibition
- + Dose-response - Special
- + Binding - Saturation
- + Binding - Competitive
- + Binding - Kinetics
- + Enzyme kinetics - Inhibition
- + Enzyme kinetics - Velocity as a function of substrate
- + Exponential
- + Lines
- + Polynomial
- + Gaussian
- + Sine waves
- + Growth curves
- + Linear quadratic curves
- + Classic equations from prior versions of Prism

User-defined equations

**Interpolate**

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK



Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Parameters: Nonlinear Regression

Search...

- Data Tables
  - Your data
  - New Data Table...
- Info
  - Project info 1
  - New Info...
- Results
  - New Analysis...
- Graphs
  - Your data
  - New Graph...
- Layouts
  - New Layout...

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

**Choose an equation**

- Recently used
  - User-defined equations
    - [Pharmacokinetics] Rise-and-fall to baseline time course
- Standard curves to interpolate
- Dose-response - Stimulation
- Dose-response - Inhibition
- Dose-response - Special, X is concentration
- Dose-response - Special, X is log(concentration)
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- Binding - Kinetics
- Enzyme kinetics - Inhibition
- Enzyme kinetics - Velocity as a function of substrate
- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves

K1 constrained to be > K2, i.e. it is the faster rate.

Initial values might need to be entered manually:  
K1, X at midpoint of rise phase  
K2, X at midpoint of fall phase  
[Pharmacokinetics] Rise-and-fall to baseline time course  
Numerical derivatives

**Interpolate**

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Parameters: Nonlinear Regression

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

**Choose an equation**

- Recently used
- User-defined equations
  - [Pharmacokinetics] Rise-and-fall to baseline time course
- Standard curves to interpolate
- Dose-response - Stimulation
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- Enzyme kinetics - Inhibition
- Enzyme kinetics - Velocity as a function of substrate
- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves

K1 constrained to be > K2, i.e. it is the faster rate.

Initial values might need to be entered manually:  
K1, X at midpoint of rise phase  
K2, X at midpoint of fall phase  
[Pharmacokinetics] Rise-and-fall to baseline time course  
Numerical derivatives

**Interpolate**

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

Search...

Data Tables

- Your data
- New Data Table...

Info

- Project info 1

New Graph...

Layouts

- New Layout...

Click "Details" for guidance on how to use the equation.

Equation Rules for Initial Values Default Constraints Transforms to Report

Experiment setup

Contact info

Data type

Analysis details

Equation

[Pharmechanics] Baseline then rise-and-fall to baseline time course

Tip: Use for time course experiment in which effect is initiated after a baseline period

Initial values might need manual entry

K1, 1/t-half rise phase

K2, 1/t-half fall phase

C, Gradient of rise phase

X0 (if not constant value)

Contact: sam.hoare@pharmechanics.com for technical support

X: Time

X0: Effect start time

Y: Y starts at Baseline, then starting at X0 goes up to a peak, then declines to Baseline

Baseline: Y value baseline, i.e, before effect start

K1: Rate constant 1, units of inverse time

K2: Rate constant 2, units of inverse time

K1 > K2, i.e. K1 is the faster rate

C: Initial rate of rise phase, Y units per unit time.

$$Y = \text{IF}(X < X0, \text{Baseline}, \text{Baseline} + (C / (K1 - K2)) * (\exp(-K2 * (X - X0)) - \exp(-K1 * (X - X0))))$$

Click Close

Clone this equation

Edit equation

Help

Close

Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange

Search...

- ▼ Data Tables
  - Your data
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- ▼ Info
  - Project info 1
  - + New Info...
- ▼ Results
  - + New Analysis...
- ▼ Graphs
  - Your data
  - + New Graph...
- ▼ Layouts
  - + New Layout...

User-defined Equation

Equation Rules for Initial Values Default Constraints Trans

[Pharmechanics] Rise-and-fall to zero time course

Tip: K1 constrained to be > K2, i.e. it is the faster rate.

Initial values might need to be entered manually:  
K1, X at midpoint of rise phase  
K2, X at midpoint of fall phase  
C, peak Y divided by time at peak Y

Contact [sam.hoare@pharmechanics.com](mailto:sam.hoare@pharmechanics.com) for technical support

X: Time  
Y: Y starts at zero, then goes up to a peak, then declines to zero.

K1: Rate constant 1, units of inverse time  
K2: Rate constant 2, units of inverse time

C: Initial rate of rise phase, Y units per unit time.

$$Y = (C / (K1 - K2)) * (\exp(-K2 * X) - \exp(-K1 * X))$$

Clone this equation Edit equation Help Close

Contact Pharmechanics (not GraphPad) for technical support on the equation.

Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Parameters: Nonlinear Regression

Search...

- Data Tables
  - Your data
  - New Data Table...
- Info
  - Project info 1
  - New Info...
- Results
  - New Analysis...
- Graphs
  - Your data
  - New Graph...
- Layouts
  - New Layout...

Model Method Compare Constrain Initial values Range Output Confidence Diagnostics Flag

**Choose an equation**

- Recently used
  - User-defined equations
    - [Pharmacokinetics] Rise-and-fall to baseline time course
- Standard curves to interpolate
- Dose-response - Stimulation
- Dose-response - Inhibition
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- Enzyme kinetics - Velocity as a function of substrate
- Exponential
- Lines
- Polynomial
- Gaussian
- Sine waves
- Growth curves

K1 constrained to be > K2, i.e. it is the faster rate.

Initial values might need to be entered manually:  
K1, X at midpoint of rise phase  
K2, X at midpoint of fall phase  
[Pharmacokinetics] Rise-and-fall to baseline time course  
Numerical derivatives

**Interpolate**

Interpolate unknowns from standard curve. Confidence interval: None

Learn Cancel OK

Run analysis

Project2:Your data - GraphPad Prism 8.0.0 (224)

File Edit View Insert Change Arrange Family Window Help

Prism File Sheet Undo Clipboard Analysis Change Arrange Draw Write Text Export Print Send LA Help

Search...

- ▼ Data Tables »
  - 📊 **Your data**
  - ⊕ New Data Table...
- ▼ Info »
  - 📄 Project info 1
  - ⊕ New Info...
- ▼ Results »
  - 📄 **Nonlin fit of Your data**
  - ⊕ New Analysis...
- ▼ Graphs »
  - 📄 **Your data**
  - ⊕ New Graph...
- ▼ Layouts »
  - ⊕ New Layout...

### Your data

Time (min)	Response
0	0
2	10
4	16
6	26
8	30
10	33
12	32
14	30
16	28
18	26
20	24
22	22
24	20
26	18
28	16
30	14
32	12
34	10
36	9
38	8
40	7
42	6
44	5
46	4
48	3
50	2
52	2
54	2
56	1
58	1
60	0