

Finch Studio™

An Integrated Modeling Environment for
Pharmacometric Analyses



ACoP 2024
November 9th, 2024

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Agenda

Session	Time
Setup and Finch Studio Overview	4:00 – 4:10 pm
User Interface Overview, Exploratory Data Analysis <i>Hands-on</i>	4:10 – 4:30 pm
Run and Evaluate NONMEM Models <i>Hands-on</i>	4:30 – 4:50 pm
Advanced Finch Studio – R Scripts, Custom Commands, Visual Predictive Check, Bootstrap <i>Hands-on</i>	4:50 – 5:00 pm



Starting Finch Studio in Azure

- Double click on the Finch icon on the Azure Windows desktop. Finch will take 15-20 seconds to launch.





Finch Studio: Overview

- Finch Studio is a companion application to be used *with* NONMEM.
- It provides a convenient, powerful user interface for NONMEM to make it easier to develop and organize your models, explore your data, summarize results, and create TFLs for reports.
- Can be used locally or on cluster environment.

Finch Studio: Interface Overview



Intelligent Code Editor

The power of NONMEM at your fingertips with advanced features including error checking, code completion, syntax highlighting, code folding, and documentation on hover.

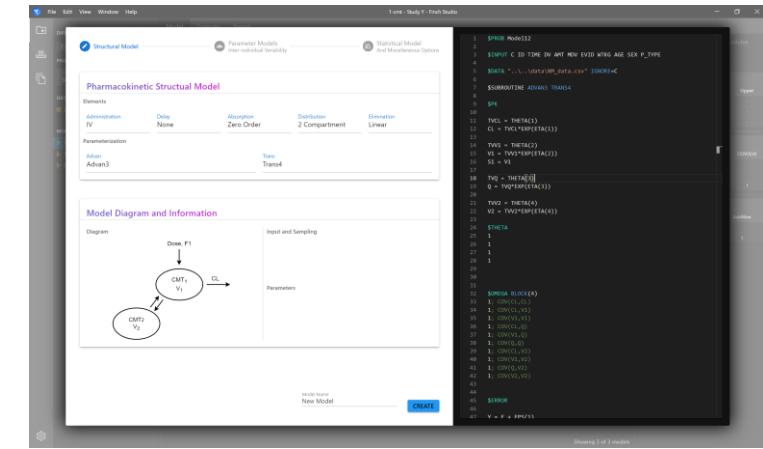
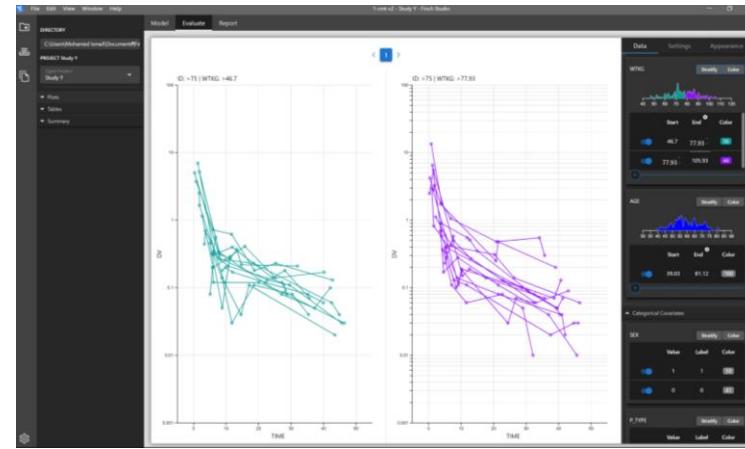
Interactive Plots and Tables

Lightning fast to get the most out of your data and guide your modeling decisions.

Model Library

Choose from a template of >100 PK and PK/PD models to kickstart your pharmacometric analysis.

The screenshot shows the Compartments software interface. On the left, there's a sidebar with 'PROJECT Study 1' and a 'DIRECTOR' section. The main workspace contains a code editor with R code for a one-compartment model, a 'Parameters' table, and a 'Results' table. The 'Results' table shows data for '1-comp w/o cl' and '2-comp'. The bottom has a toolbar with buttons for Run, Stop, and Save.



Hands-on Session: Finch Studio Basics 1

User Interface Overview, Exploratory Data Analysis



Load Project

- In the “Recent Projects” Section, click on .
- Explore the content of the “Exercises\Drug-1” directory:
 - Study-F1003-Asian-PK
 - data
 - F1003-Asian-PK-Study.csv
 - models
 - 1-cmt-pk-v1
 - mod1.ctl, model.json
 - 1-cmt-pk-v2-complete
 - mod1.ctl, model.json
 - 1-cmt-pk-v3-complete
 - mod1.ctl, model.json
 - scripts
 - vpc-F1003.R, vpc-F1003-by-race.R
 - projectCommands.json



Load Project

- Your screen should look like this:

The screenshot shows the Finch Studio software interface. The title bar reads "1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio". The main window displays a pharmacokinetic model script:

```
1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
```

The left sidebar shows the project structure under "PROJECT Study-F1003-Asian-PK" and lists models "1-cmt-pk-v1", "1-cmt-pk-v2-complete", and "1-cmt-pk-v3-complete". The right sidebar contains tabs for "Parameters", "Scripts", and "Initial / Final". The "Parameters" tab shows initial values for Theta parameters:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

The "Initial / Final" tab shows Omega parameters:

Cov	Cor	Omega
CL		0.0474
V		0.00 0.0400

The "Sigma" tab shows Proportional parameters:

Cov	Cor	Sigma
Proportional		0.0861

The bottom status bar indicates "Showing 1 of 3 models".



View Options

- Adjust text size:

The screenshot shows the Finch Studio interface with the 'View' menu open. An orange arrow points to the 'Zoom In' and 'Zoom Out' options in the menu, which are highlighted with a red box. The main workspace displays a pharmacokinetic model named '1-cmt-pk-v1' with code like '\$PK' and 'TVKA = THETA(1)'. The right panel shows 'Parameters' and 'Scripts' sections, and the bottom panel shows a results table.

File Edit View Window Help

DIRECTORY C:\Users\Sarah-Pc\Documents\Workshop\Drug-1\Study-F1003-Asian-PK\models\1-cmt-pk-v1

PROJECT Open R Study

DATA C:\data\

MODELS + 1-cmt-pk-v1

RESULTS MODEL RUN SETTINGS FILES CONSOLE Filter Column

Model Description Ref nInd/nObs OFV

1-cmt-pk-v1 None

Evaluate

1-cmt-pk-v1

Compare Close

\$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2

\$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP

\$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@

\$SUBROUTINES ADVAN2 TRANS2

\$PK

11 TVKA = THETA(1)

Save Run Model

Showing 1 of 3 models

Parameters Scripts

Initial / Final

exp(0) Theta

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Cov Cor Omega

CL	V
0.0474	
0.00	0.0400

Cov Cor Sigma

Proportional
0.0861



Mapping Your Data

- Finch recognizes NONMEM variable columns (ID, TIME, DV, etc). It does not recognize user-defined covariates (WTKG, AGEBL, etc.) since each modeler may name the column something different
- To maximize functionality within Finch, start off by mapping the data, telling Finch what variable types correspond to which columns.
 - **cont-cov:** continuous covariate
 - Makes the continuous covariate available in interactive plots and automatically places the covariate in the catab \$TABLE record when creating a new control stream
 - Use for variables such as Weight and Age
 - **cat-cov:** categorical covariate
 - Makes the categorical covariate available in interactive plots and automatically places the covariate in the catab \$TABLE record when creating a new control stream
 - Use for variables such as Sex, Race, and Phenotype
 - **cat-var:** categorical variable
 - Use for variables that may warrant stratification but that are not necessarily covariates
 - Examples: Study Period, Dose Level, Cohort
 - **blq:** indicator variable for data below the lower limit of quantification



Map Data

- Map the data as indicated:

The figure consists of four screenshots of the Finch Studio interface, illustrating the step-by-step process of mapping data types for a CSV file.

Screenshot 1: Shows the project structure. A red arrow points to the 'data\F1003-Asian-PK-Study.csv' file under the 'PROJECT Study-F1003-Asian-PK' section, with the word 'click' overlaid.

Screenshot 2: Shows the 'DATA' view for the selected CSV file. A red arrow points to the 'DV' column, with the word 'click' overlaid.

Screenshot 3: Shows the 'DATA' view after mapping. The 'DV' column now has a 'cat-cov' button. A red arrow points to the 'cat-cov' button, with the word 'select' overlaid.

Screenshot 4: Shows the 'DATA' view with all columns mapped. The 'RACEN' and 'WTKG' columns have 'cat-cov' buttons, while others like 'ID', 'TIME', 'EVID', 'AMT', and 'Race' have 'other' buttons. A red box highlights the 'RACEN' and 'WTKG' rows.

Column	Type
ID	other
TIME	other
EVID	other
AMT	other
DV	cat-cov
RACEN	cat-cov
WTKG	cat-cov
Race	other



Exploratory Data Analysis

- Exploring and completely understanding your data **before** you begin modeling **will save you time in the long run.**



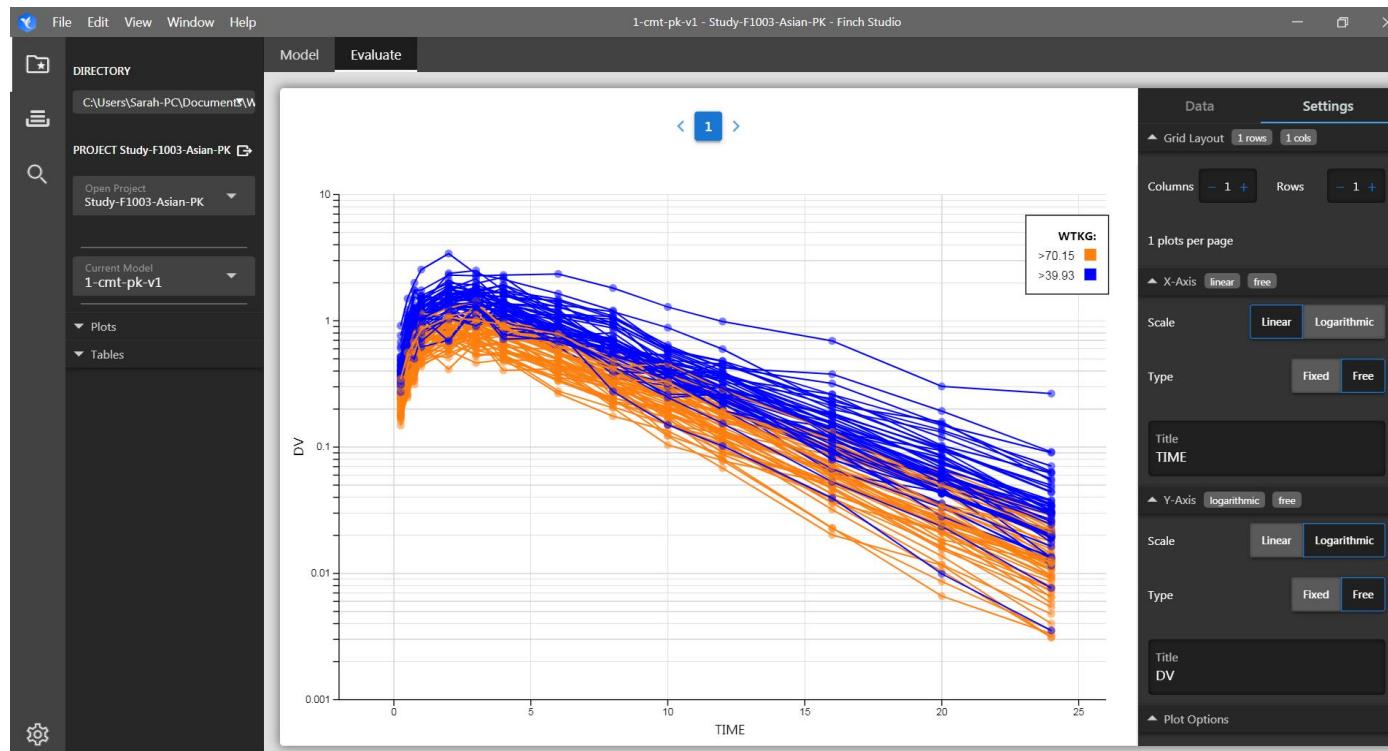
Exploratory Data Analysis

- Exploring and completely understanding your data **before** you begin modeling **will save you time in the long run.**
 - Provides insight about which models and features to test
 - 1, 2, or 3 distinct disposition phases?
 - Is there a lag time observed?
 - Nonlinear PK present?
 - Provides insight about which covariates to test
 - Are there PK differences between subgroups when coloring/stratifying data by covariates of interest.
 - Are any covariates highly correlated such that we don't need to test both of them (i.e. WTKG, IBW, CrCL, etc).
 - Can identify outlying measurements that either need to be double check, monitored during the modeling phase for excessive influence, or discarded.
 - Can identify mistakes in the dataset
 - For example, subject weight recorded as 250 kg is likely a mistake, especially if among an otherwise health weight distribution population.



Exploratory Data Analysis

- Once data is mapped, Finch Studio provides many useful features to explore your data in tabular and graphical formats.





View Data

- Quick access to tabular data:

The screenshot shows the Finch Studio interface. On the left, there's a sidebar with icons for File, Edit, View, Window, and Help. Below these are sections for DIRECTORY (C:\Users\Sarah-PC\Documents\Workshop) and PROJECT Study-F1003-Asian-PK. Under DATA, a file named 'data\F1003-Asian-PK-Study.csv' is listed with a 'View' button next to it, which is highlighted by a large orange arrow. Under MODELS, '1-cmt-pk-v1' is selected, shown with a blue border. The main central area is titled '1-cmt-pk-v1' and contains model code. To the right, there are tabs for Parameters, Scripts, and a table for Initial / Final values. The 'Parameters' tab is active, showing a table for Theta parameters with columns for Name, Lower, Initial, and Upper. The 'Initial' row has values: KA [1/hr] 0, CL [L/hr] 0, and V [L] 82.1. The 'Scripts' tab is also visible.

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-



View Data

- Quick access to tabular data:

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian



View Data

- Useful display and summary statistics features:

The screenshot shows a data grid titled "One Row Per ID" within a Finch Studio window. The grid displays pharmacokinetic data for 12 time points (TIME) for a single subject (ID 1). The columns represent variables: ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. The data shows a dose of 150 at time 0, followed by multiple observations with varying DV values (e.g., 0.268167396, 0.473321449, 0.748538174, etc.) and WTKG values (e.g., 80.79, 80.79, 80.79, etc.). All entries are categorized under the Race "Caucasian".

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian

Records per page: All ▾ 1-1500 of 1500

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:

show/hide/freeze columns

One Row Per ID

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian

Records per page: All ▾ 1-1500 of 1500

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:

show/hide/freeze columns

One Row Per ID

Column	Show	Freeze
ID	<input checked="" type="checkbox"/>	<input type="checkbox"/>
TIME	<input checked="" type="checkbox"/>	<input type="checkbox"/>
EVID	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AMT	<input checked="" type="checkbox"/>	<input type="checkbox"/>
DV	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RACEN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
WTKG	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Race	<input checked="" type="checkbox"/>	<input type="checkbox"/>

1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasia
1	0.25	0	0	0.268167396	5	80.79	Caucasia
1	0.5	0	0	0.473321449	5	80.79	Caucasia
1	0.75	0	0	0.748538174	5	80.79	Caucasia
1	1	0	0	0.719452574	5	80.79	Caucasia
1	2	0	0	1.064801105	5	80.79	Caucasia
1	3	0	0	0.936965958	5	80.79	Caucasia
1	4	0	0	0.78004118	5	80.79	Caucasia
1	6	0	0	0.561505514	5	80.79	Caucasia
1	8	0	0	0.339858647	5	80.79	Caucasia
1	10	0	0	0.257502743	5	80.79	Caucasia
1	12	0	0	0.181382976	5	80.79	Caucasia

Records per page: All ▾ 1-1500 of 1500

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:

show/hide/freeze columns

One Row Per ID

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian

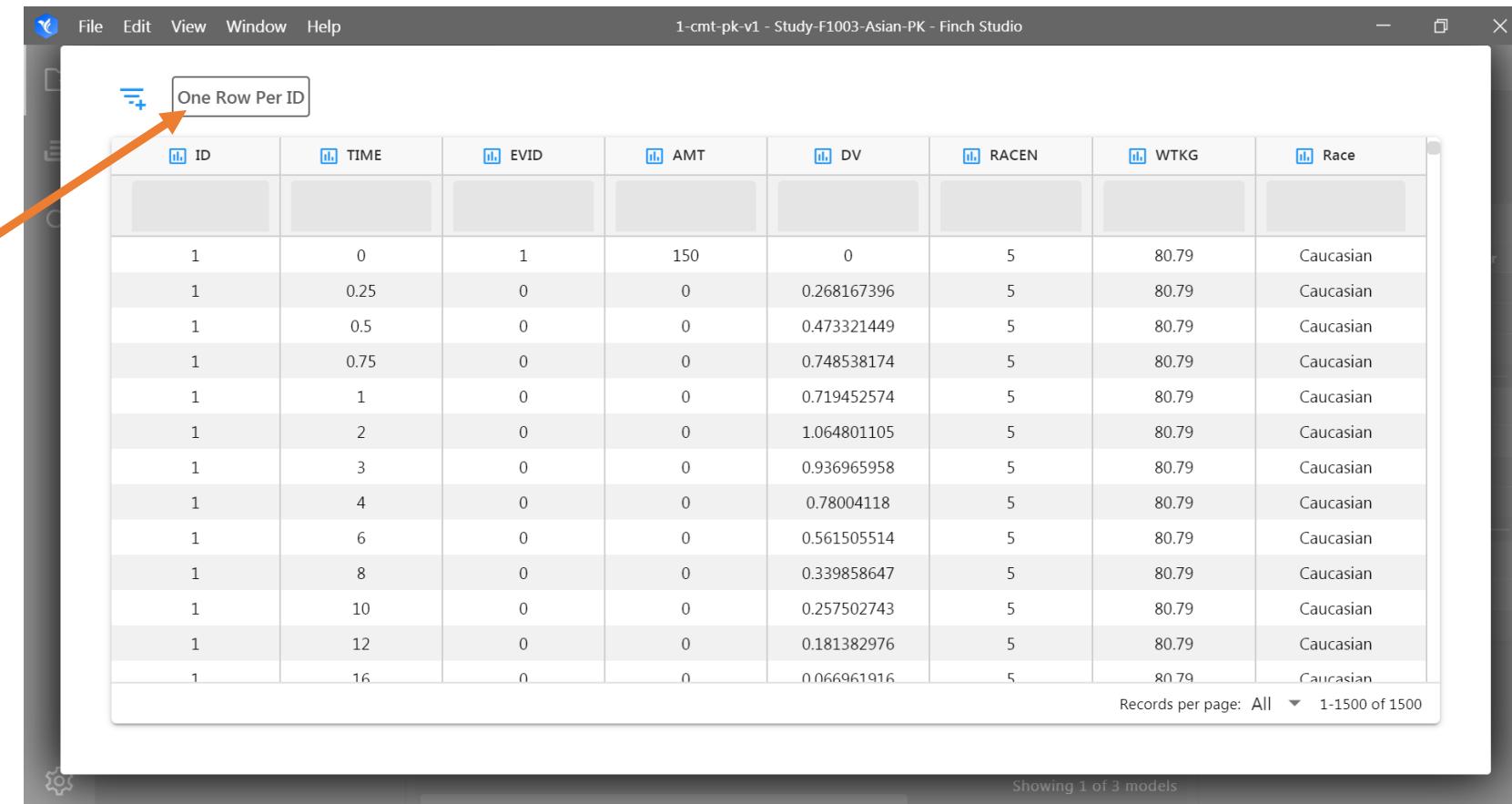
Records per page: All ▾ 1-1500 of 1500

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:



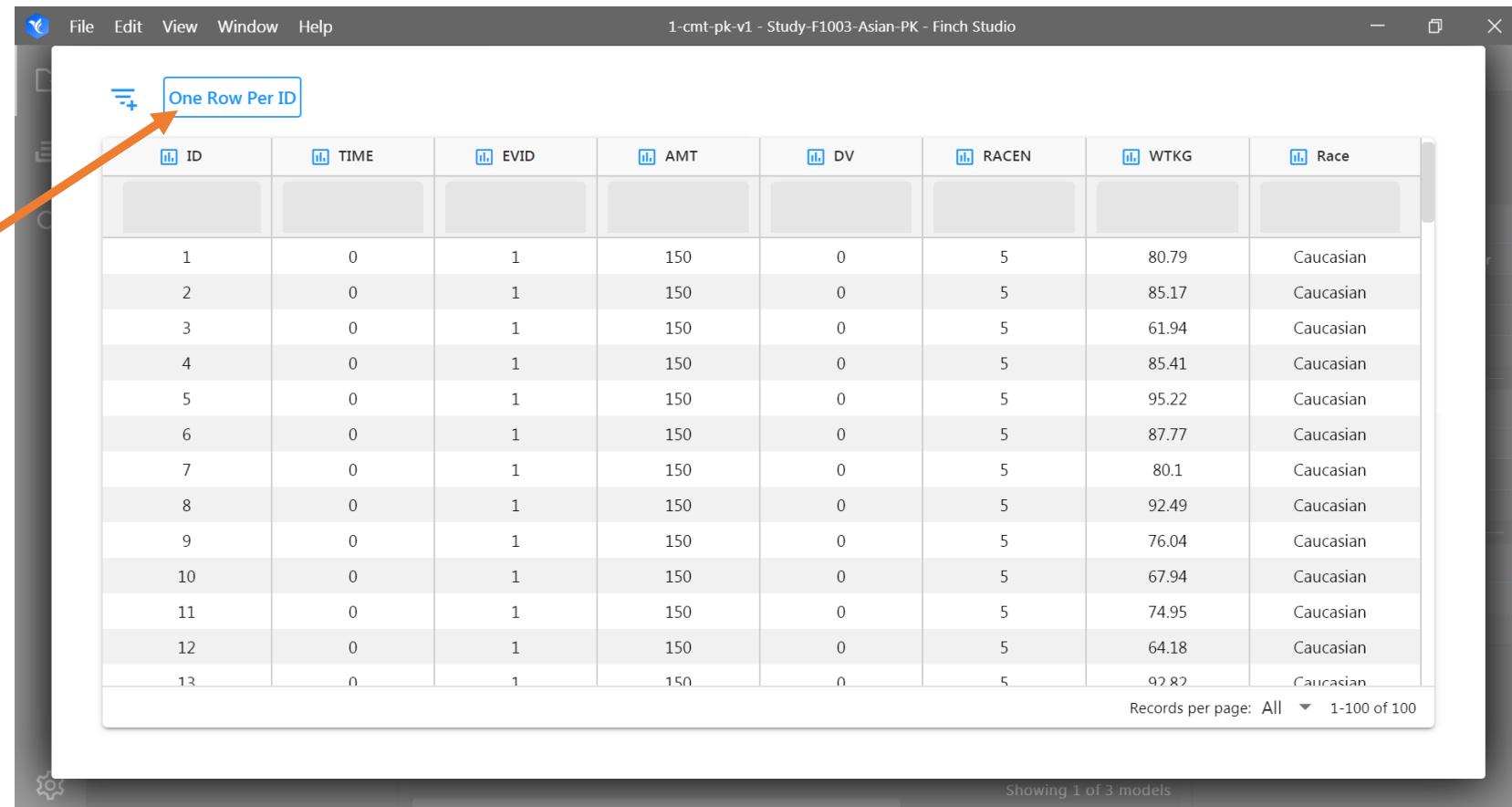
The screenshot shows a data grid titled "1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio". The grid has columns labeled ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. The data consists of 12 rows, each representing a different time point for a single subject (ID 1). The "One Row Per ID" feature is highlighted with a callout and an orange arrow.

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian



View Data

- Useful display and summary statistics features:



The screenshot shows a data grid in Finch Studio with 13 rows of patient data. The columns are labeled: ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. All patients have an ID of 1 and a TIME of 0, with EVID, AMT, DV, RACEN, WTKG, and Race values varying by row. The first row has a highlighted 'One Row Per ID' button in its header cell.

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
2	0	1	150	0	5	85.17	Caucasian
3	0	1	150	0	5	61.94	Caucasian
4	0	1	150	0	5	85.41	Caucasian
5	0	1	150	0	5	95.22	Caucasian
6	0	1	150	0	5	87.77	Caucasian
7	0	1	150	0	5	80.1	Caucasian
8	0	1	150	0	5	92.49	Caucasian
9	0	1	150	0	5	76.04	Caucasian
10	0	1	150	0	5	67.94	Caucasian
11	0	1	150	0	5	74.95	Caucasian
12	0	1	150	0	5	64.18	Caucasian
13	0	1	150	0	5	92.82	Caucasian



View Data

- Useful display and summary statistics features:

The screenshot shows a data grid in Finch Studio with the following columns: ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. The WTKG column is highlighted with an orange arrow pointing to the text "view summary stats".

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
2	0	1	150	0	5	85.17	Caucasian
3	0	1	150	0	5	61.94	Caucasian
4	0	1	150	0	5	85.41	Caucasian
5	0	1	150	0	5	95.22	Caucasian
6	0	1	150	0	5	87.77	Caucasian
7	0	1	150	0	5	80.1	Caucasian
8	0	1	150	0	5	92.49	Caucasian
9	0	1	150	0	5	76.04	Caucasian
10	0	1	150	0	5	67.94	Caucasian
11	0	1	150	0	5	74.95	Caucasian
12	0	1	150	0	5	64.18	Caucasian
13	0	1	150	0	5	92.82	Caucasian

Records per page: All ▾ 1-100 of 100

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:

The screenshot shows a Finch Studio interface with a data grid and a summary statistics panel.

Data Grid: The main area displays a table with 13 rows and 8 columns. The columns are labeled: ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. All rows have a value of 1 in the EVID column and 150 in the AMT column.

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5		
2	0	1	150	0	5		
3	0	1	150	0	5		
4	0	1	150	0	5		
5	0	1	150	0	5		
6	0	1	150	0	5		
7	0	1	150	0	5		
8	0	1	150	0	5		
9	0	1	150	0	5		
10	0	1	150	0	5		
11	0	1	150	0	5		
12	0	1	150	0	5		
13	0	1	150	0	5		

Summary Statistics: To the right of the data grid is a panel titled "STATS". It contains a table with 9 rows, each showing a statistic and its corresponding value.

Statistic	Value
n	100
nNull	0.00
mean	71.4
median	70.1
min	39.9
max	103
sd	14.3
variance	203

Text: The text "view summary stats" is located to the right of the statistics panel.

Page Navigation: At the bottom of the interface, there are buttons for "Records per page: All" and "1-100 of 100".

Footer: The footer displays the text "Showing 1 of 3 models".



View Data

- Useful display and summary statistics features:

The screenshot shows a data grid in Finch Studio with 13 rows of data. The columns are labeled ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. A summary statistics modal is open over the grid, specifically for the 'Race' column. The modal has tabs for 'COUNTS' and 'STATS'. The 'COUNTS' tab shows two rows: 'Caucasian' with a count of 50 (50.0%) and 'Asian' with a count of 50 (50.0%). An orange arrow points from the text 'or counts for categorical variables' to the 'Race' column header in the grid. The bottom right corner of the grid shows 'Records per page: All ▾ 1-100 of 100'.

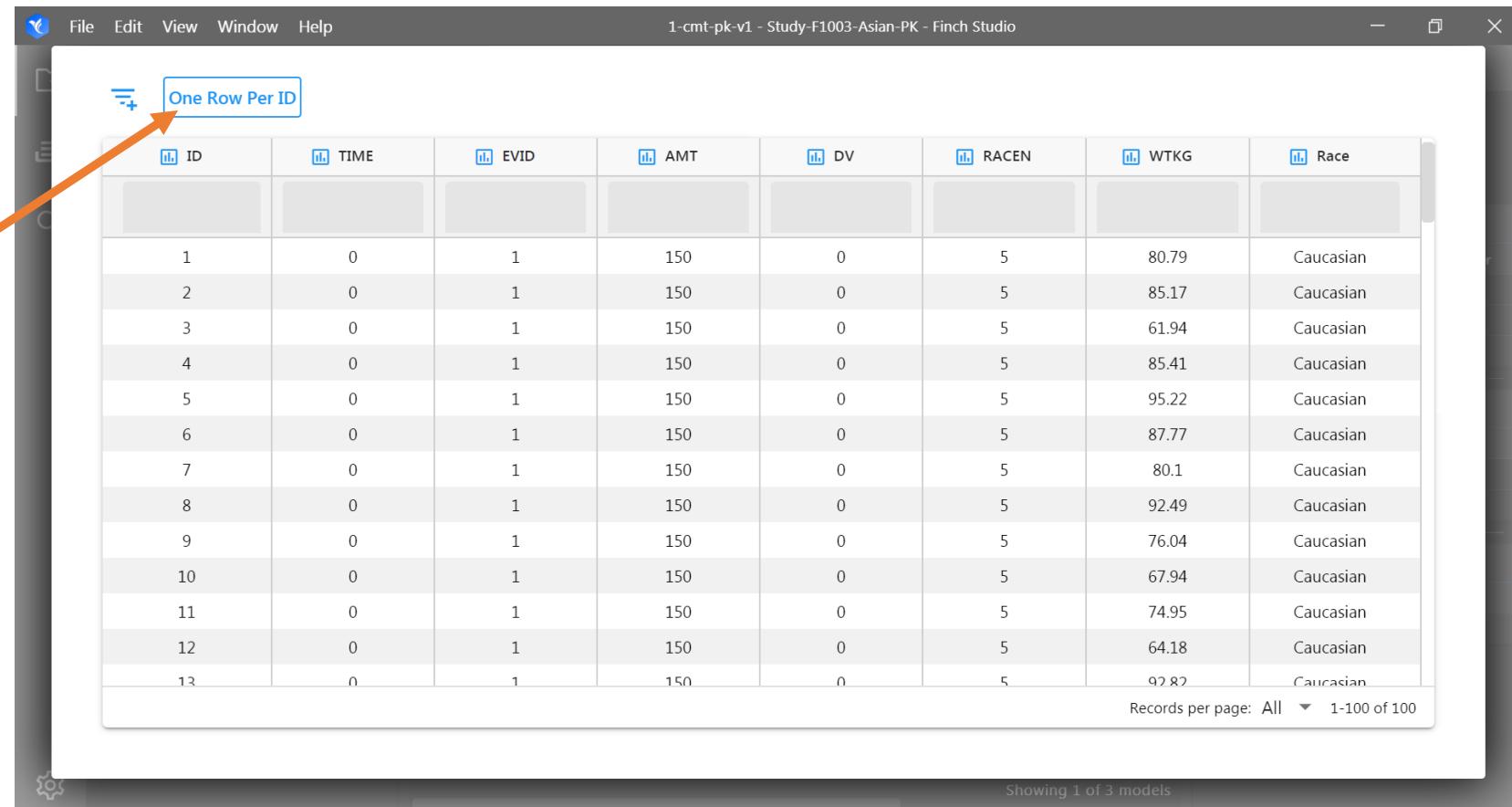
ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5		Caucasian
2	0	1	150	0	5		Caucasian
3	0	1	150	0	5		Caucasian
4	0	1	150	0	5		Asian
5	0	1	150	0	5	95.22	Caucasian
6	0	1	150	0	5	87.77	Caucasian
7	0	1	150	0	5	80.1	Caucasian
8	0	1	150	0	5	92.49	Caucasian
9	0	1	150	0	5	76.04	Caucasian
10	0	1	150	0	5	67.94	Caucasian
11	0	1	150	0	5	74.95	Caucasian
12	0	1	150	0	5	64.18	Caucasian
13	0	1	150	0	5	92.82	Caucasian

or counts for
categorical variables



View Data

- Useful display and summary statistics features:



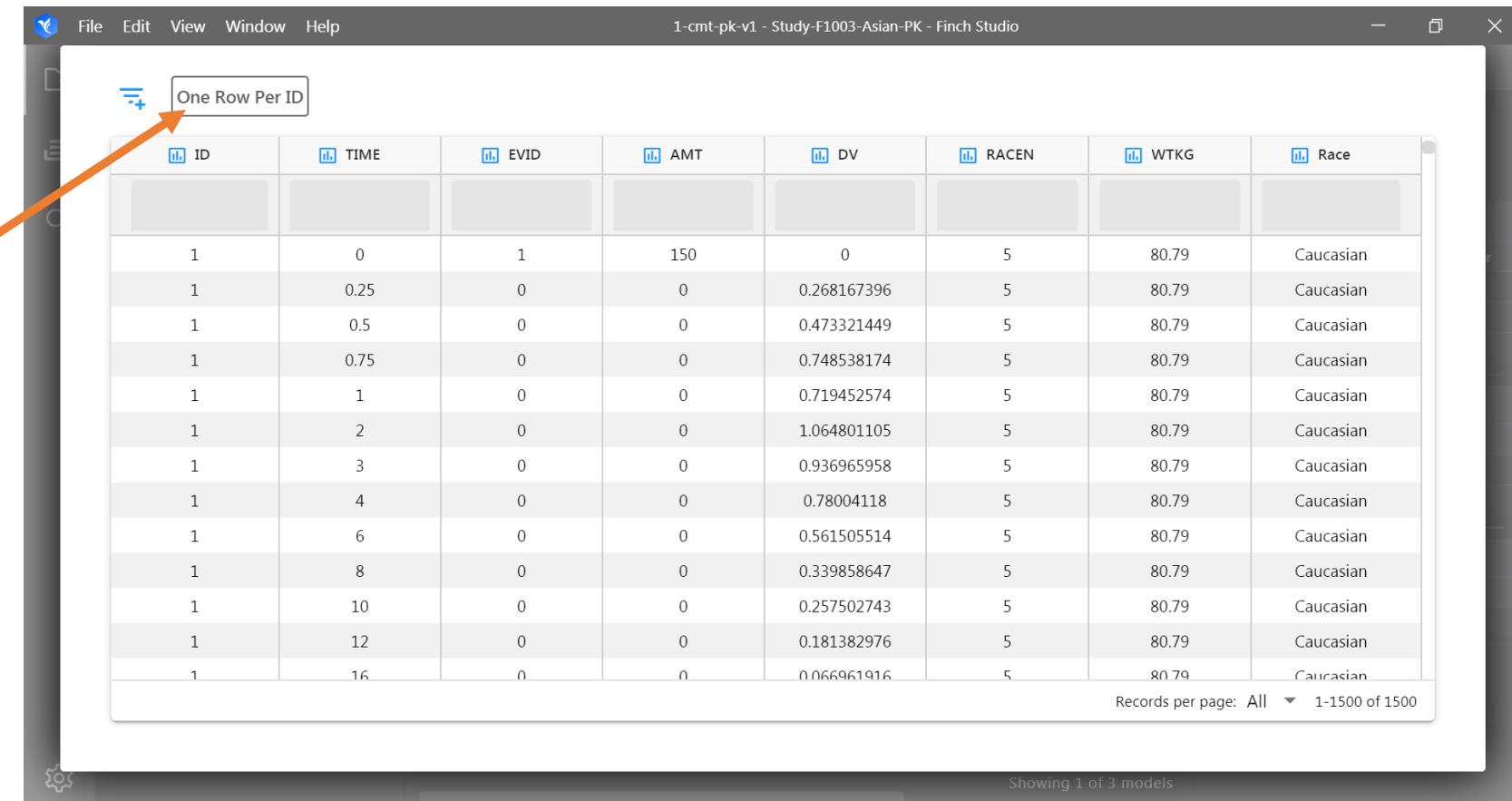
The screenshot shows a data grid in Finch Studio with 13 rows of pharmacokinetic data. The columns are labeled: ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. The data consists of 13 rows of values corresponding to these columns. The first column (ID) contains values 1 through 13. The second column (TIME) contains all zeros. The third column (EVID) contains all 1s. The fourth column (AMT) contains all 150s. The fifth column (DV) contains all 0s. The sixth column (RACEN) contains all 5s. The seventh column (WTKG) contains values ranging from 61.94 to 92.82. The eighth column (Race) contains all 'Caucasian' entries. At the bottom right of the grid, there is a status bar with the text 'Records per page: All ▾ 1-100 of 100'. The top of the window has a menu bar with File, Edit, View, Window, Help, and the title '1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio'. The bottom of the window has a footer with the text 'Showing 1 of 3 models'.

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
2	0	1	150	0	5	85.17	Caucasian
3	0	1	150	0	5	61.94	Caucasian
4	0	1	150	0	5	85.41	Caucasian
5	0	1	150	0	5	95.22	Caucasian
6	0	1	150	0	5	87.77	Caucasian
7	0	1	150	0	5	80.1	Caucasian
8	0	1	150	0	5	92.49	Caucasian
9	0	1	150	0	5	76.04	Caucasian
10	0	1	150	0	5	67.94	Caucasian
11	0	1	150	0	5	74.95	Caucasian
12	0	1	150	0	5	64.18	Caucasian
13	0	1	150	0	5	92.82	Caucasian



View Data

- Useful display and summary statistics features:



The screenshot shows a data grid titled "1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio". The grid has columns labeled ID, TIME, EVID, AMT, DV, RACEN, WTKG, and Race. The data consists of 12 rows, each representing a measurement for a single subject (ID 1). The "One Row Per ID" feature is highlighted with a callout and an orange arrow.

ID	TIME	EVID	AMT	DV	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian



View Data

- Useful display and summary statistics features:

One Row Per ID

ID	TIME	EVID	AMT	DV ↑	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
1	0.25	0	0	0.268167396	5	80.79	Caucasian
1	0.5	0	0	0.473321449	5	80.79	Caucasian
1	0.75	0	0	0.748538174	5	80.79	Caucasian
1	1	0	0	0.719452574	5	80.79	Caucasian
1	2	0	0	1.064801105	5	80.79	Caucasian
1	3	0	0	0.936965958	5	80.79	Caucasian
1	4	0	0	0.78004118	5	80.79	Caucasian
1	6	0	0	0.561505514	5	80.79	Caucasian
1	8	0	0	0.339858647	5	80.79	Caucasian
1	10	0	0	0.257502743	5	80.79	Caucasian
1	12	0	0	0.181382976	5	80.79	Caucasian
1	16	0	0	0.066961916	5	80.79	Caucasian

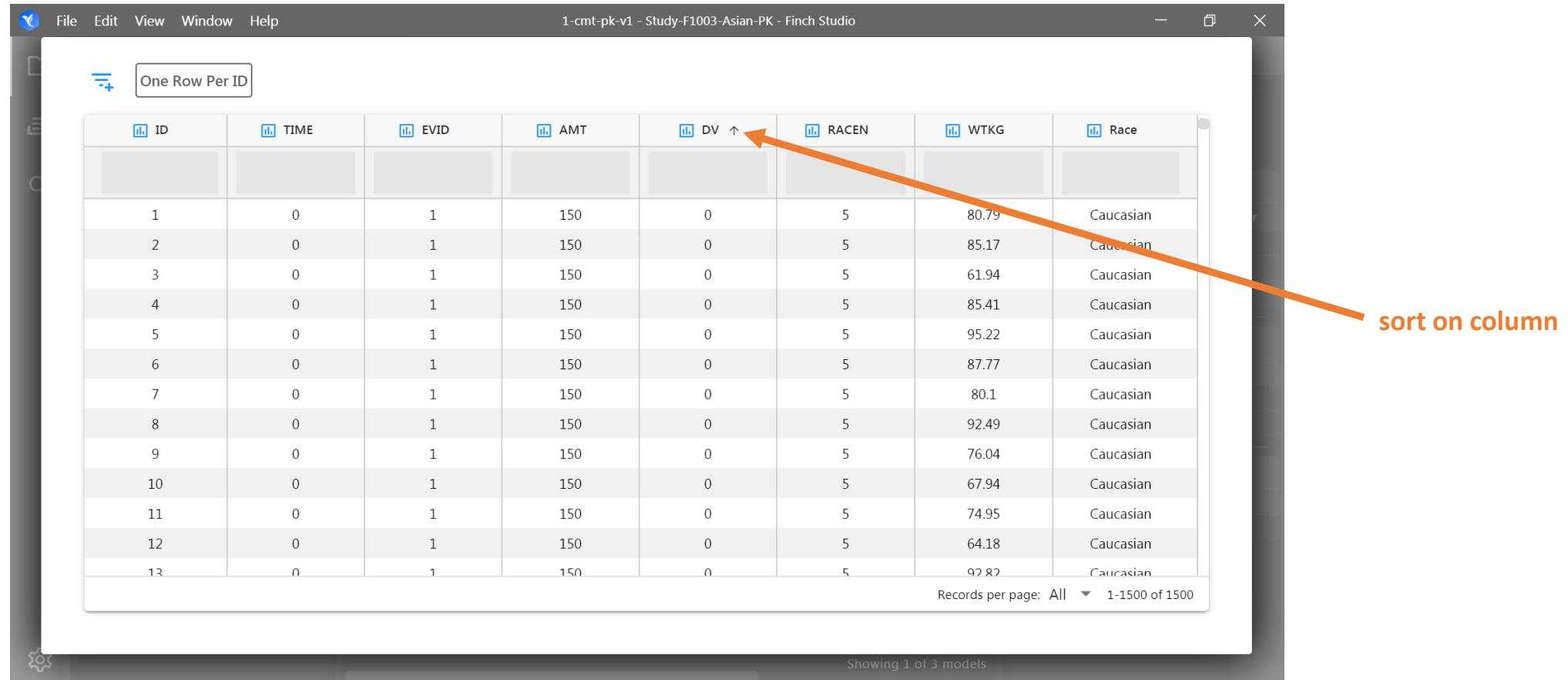
Records per page: All ▾ 1-1500 of 1500

Showing 1 of 3 models



View Data

- Useful display and summary statistics features:



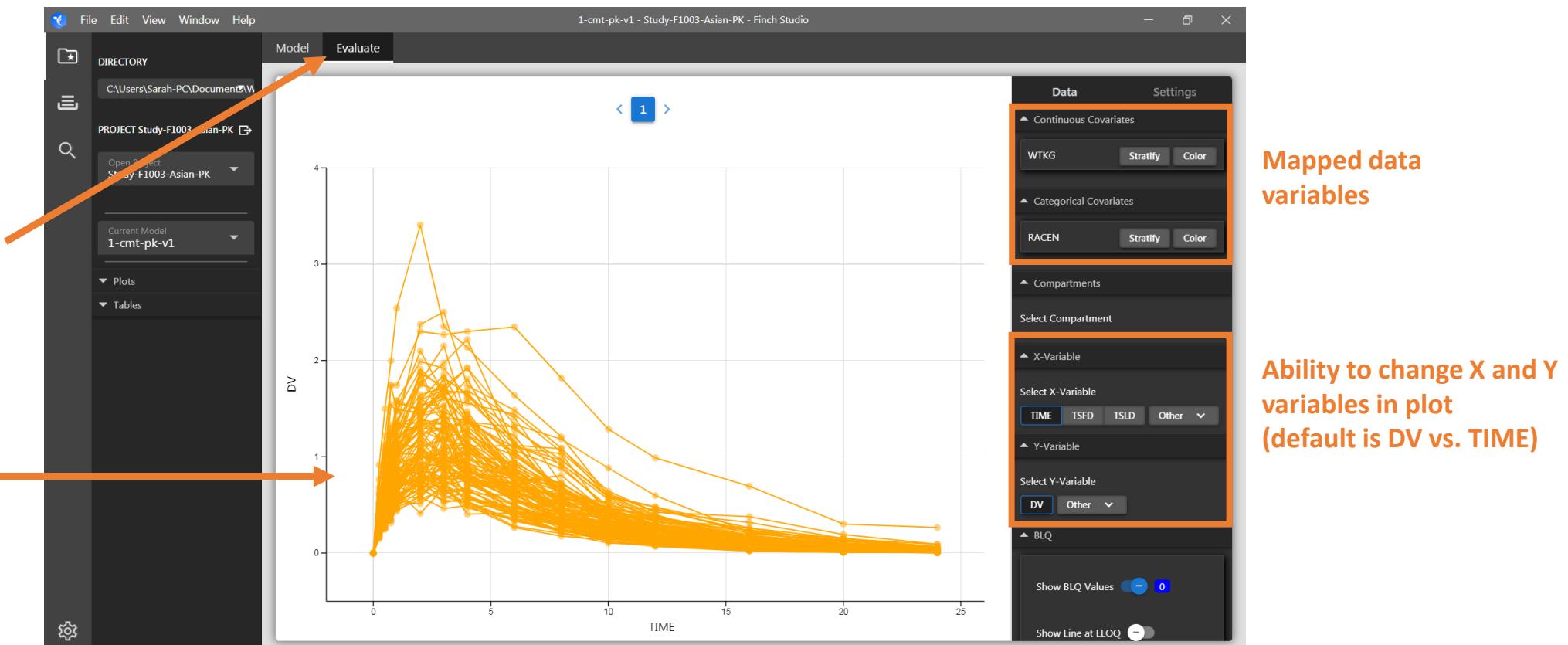
sort on column

ID	TIME	EVID	AMT	DV ↑	RACEN	WTKG	Race
1	0	1	150	0	5	80.79	Caucasian
2	0	1	150	0	5	85.17	Caucasian
3	0	1	150	0	5	61.94	Caucasian
4	0	1	150	0	5	85.41	Caucasian
5	0	1	150	0	5	95.22	Caucasian
6	0	1	150	0	5	87.77	Caucasian
7	0	1	150	0	5	80.1	Caucasian
8	0	1	150	0	5	92.49	Caucasian
9	0	1	150	0	5	76.04	Caucasian
10	0	1	150	0	5	67.94	Caucasian
11	0	1	150	0	5	74.95	Caucasian
12	0	1	150	0	5	64.18	Caucasian
13	0	1	150	0	5	92.82	Caucasian



Explore Data

- Before we begin modeling, let's start with some exploratory data analysis.
- Navigate from the **Model** tab, which displays the control stream, to the **Evaluate** tab.



Plot of raw observed concentration vs. time data

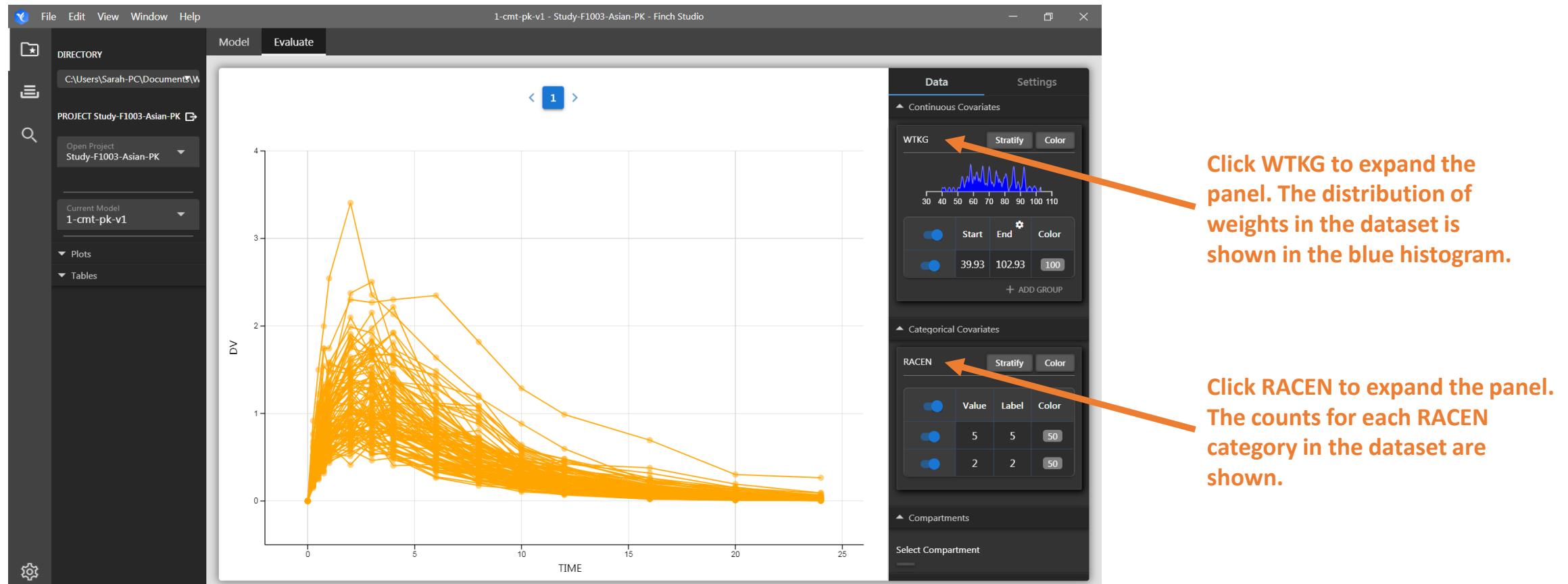
Mapped data variables

Ability to change X and Y variables in plot (default is DV vs. TIME)



Explore Data

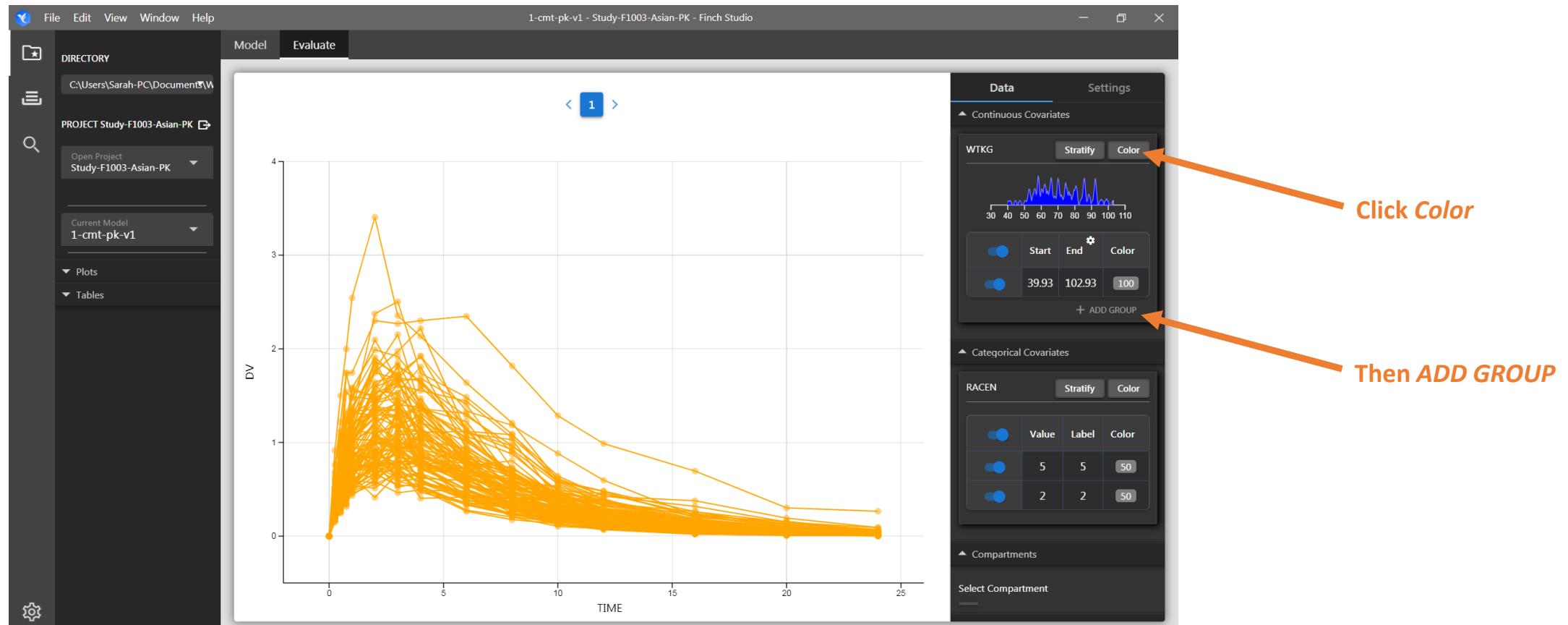
- Let's start by checking for an effect of Weight and/or Race on our observed PK data.





Explore Data

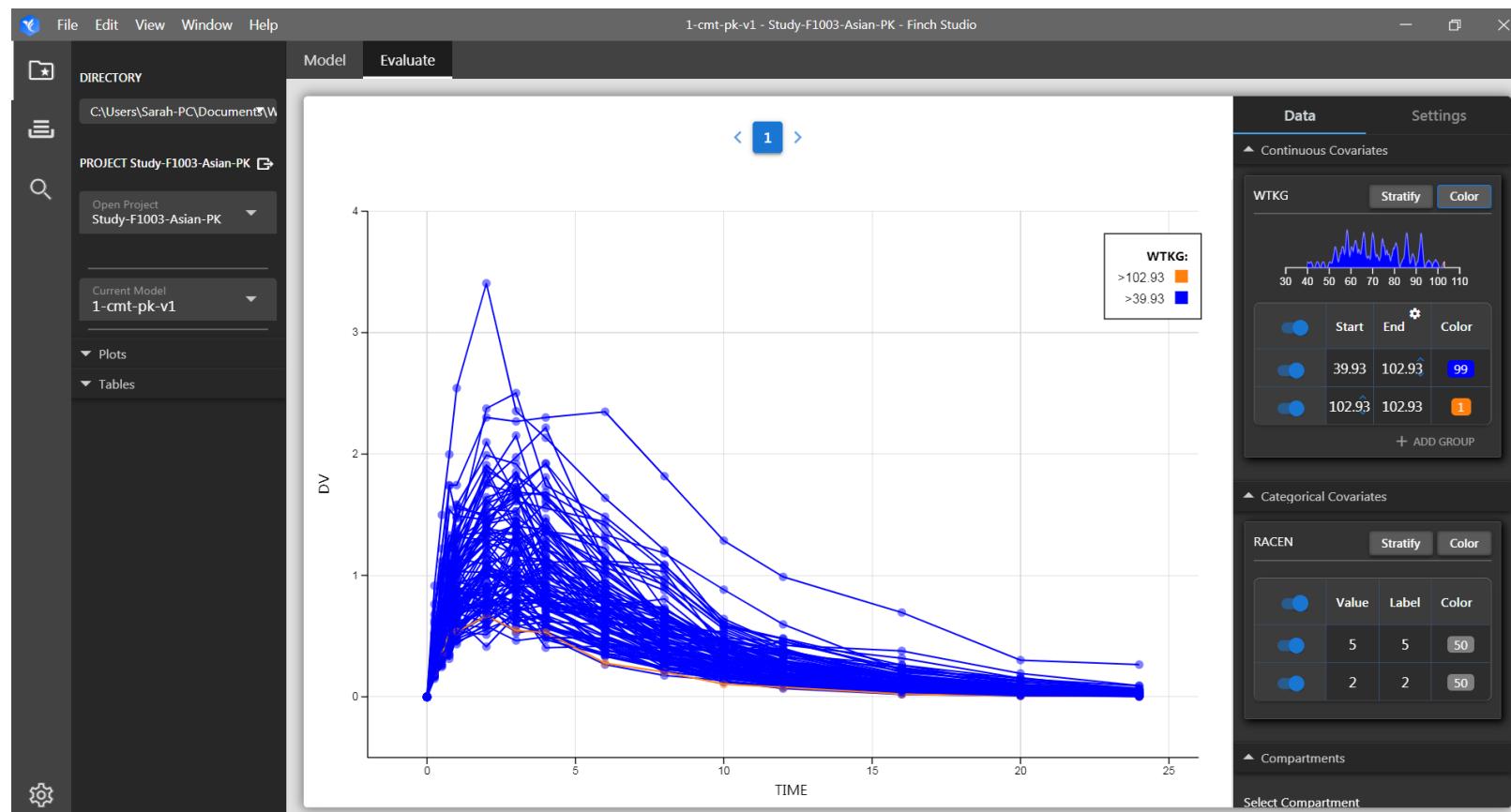
- Color by Weight





Explore Data

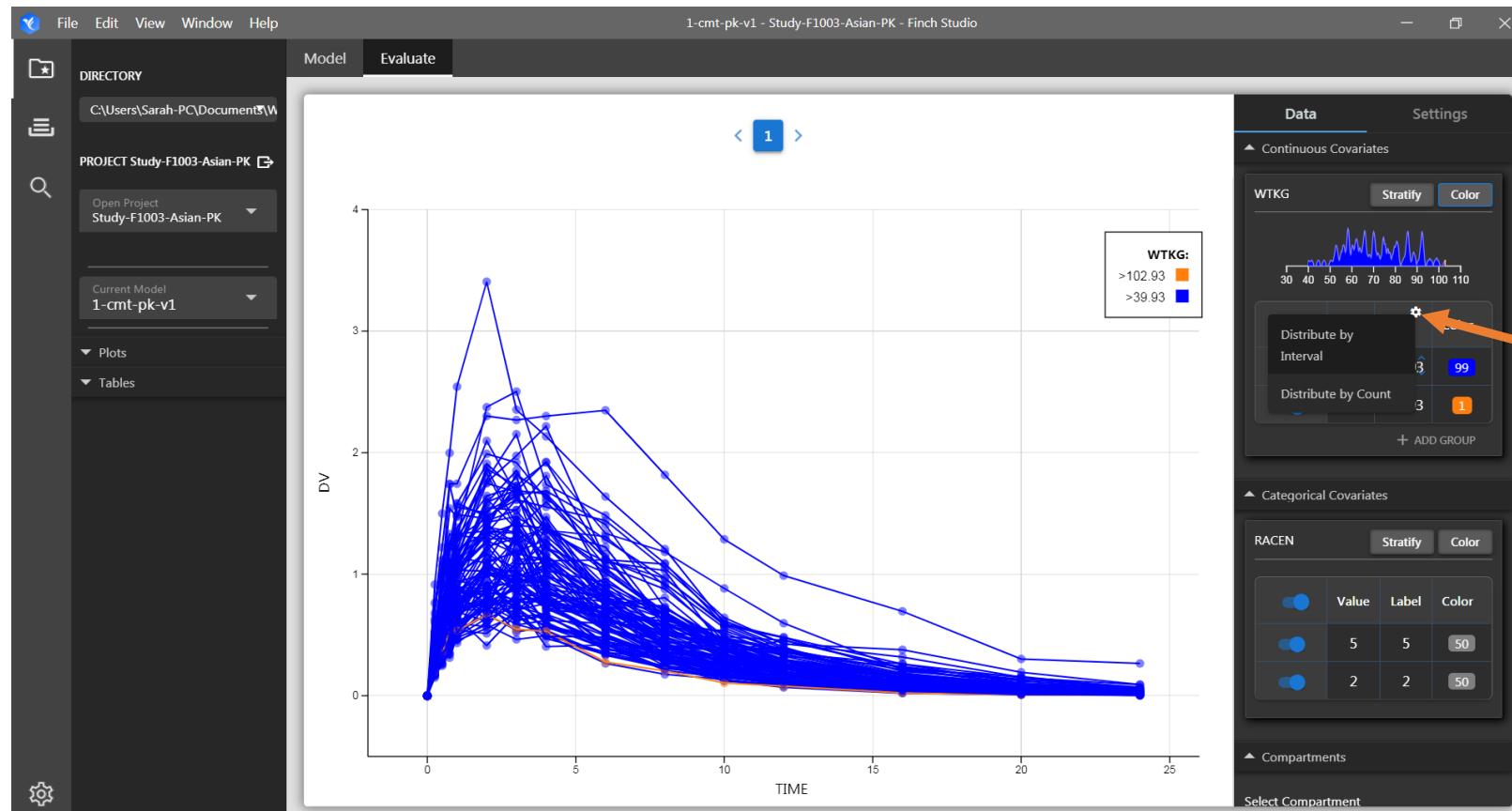
- Color by Weight





Explore Data

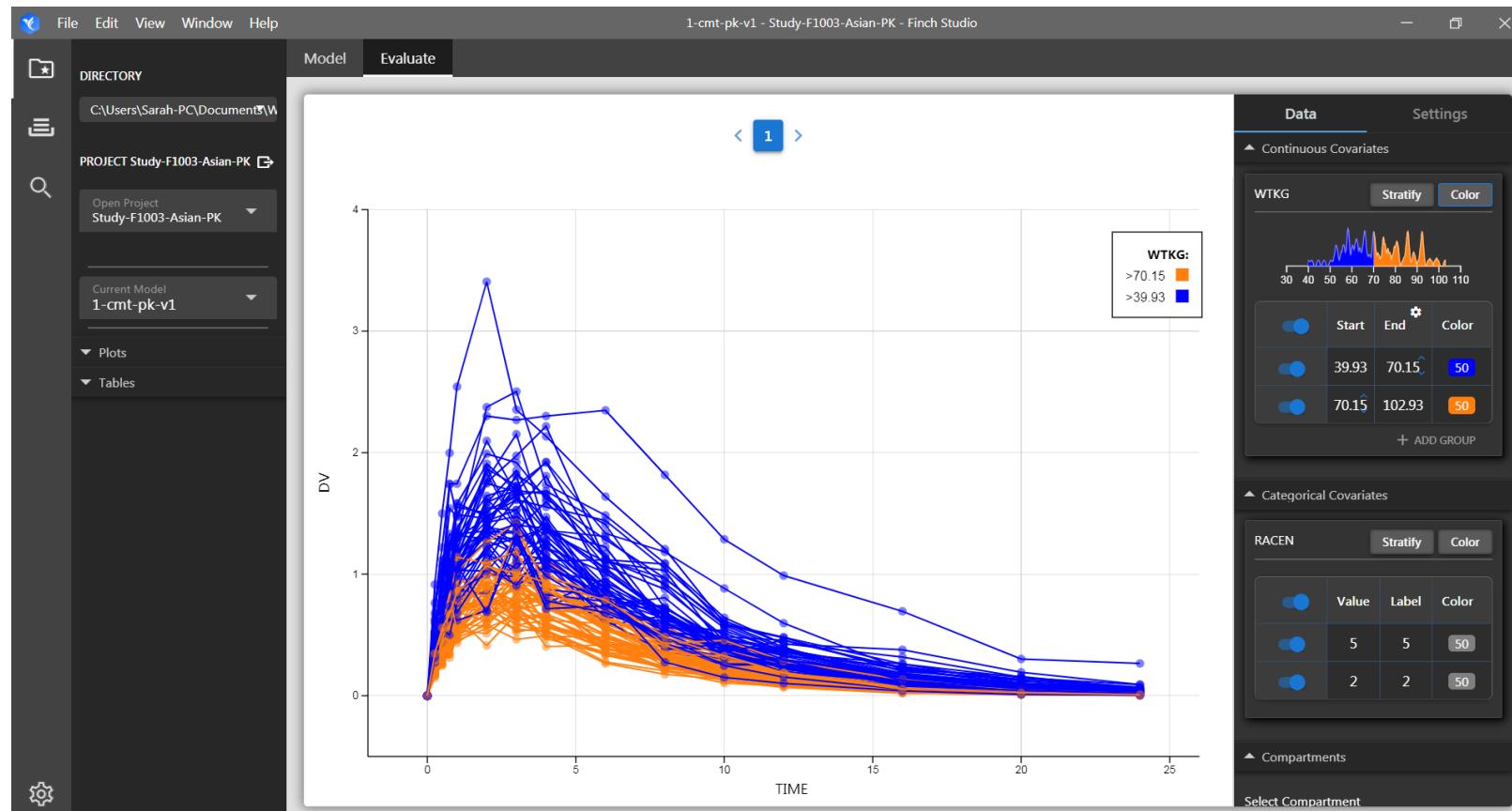
- Color by Weight





Explore Data

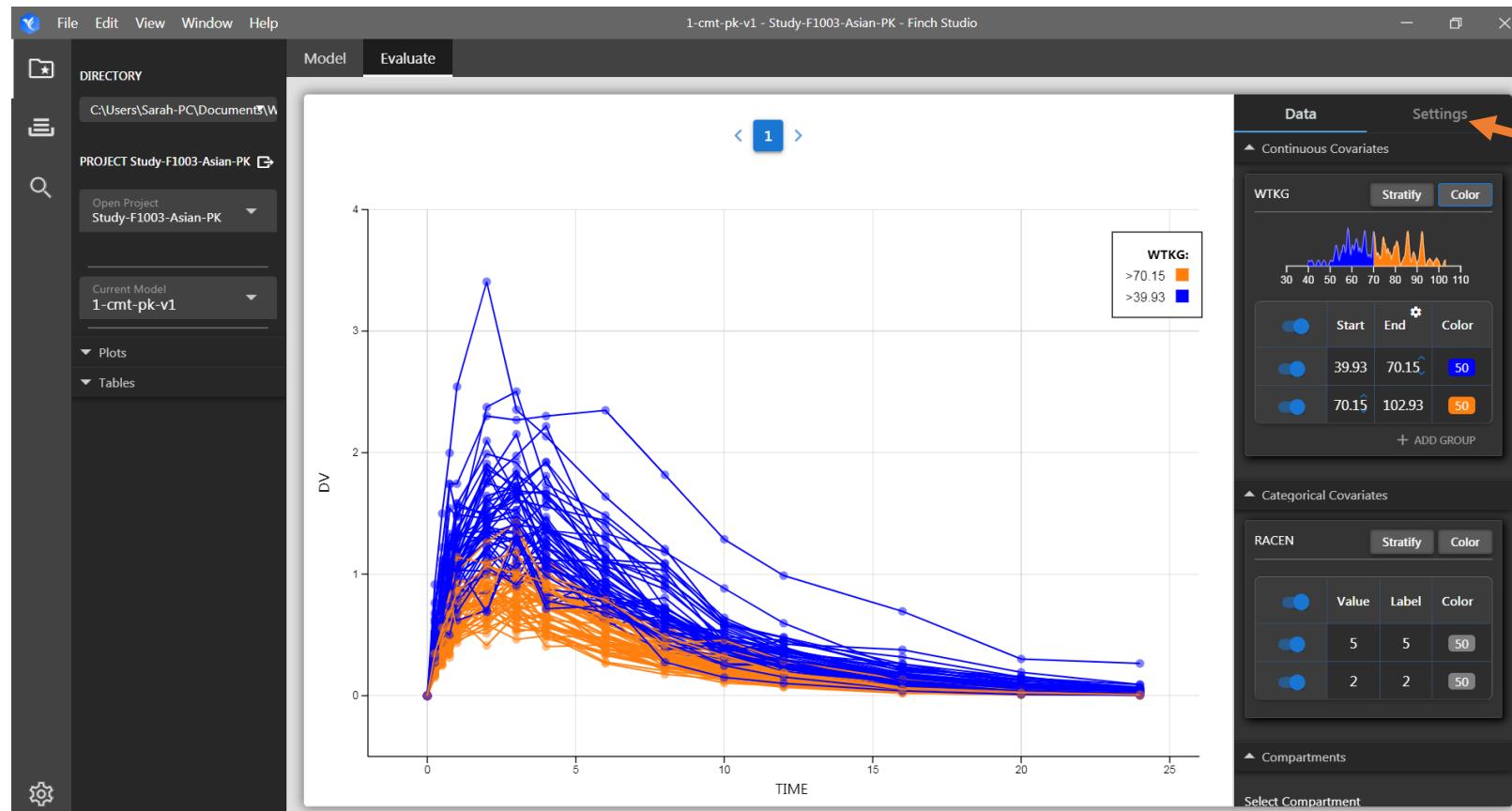
- Color by Weight





Explore Data

- Color by Weight

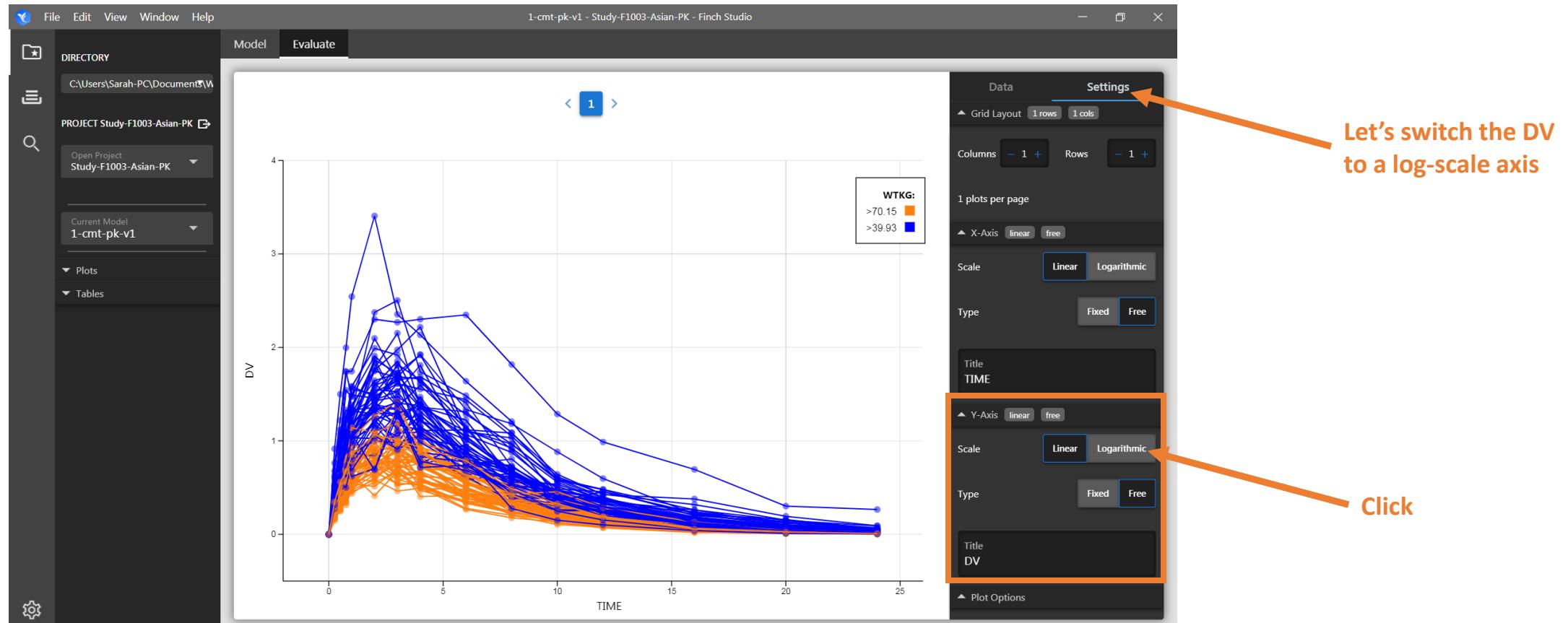


Let's switch the DV
to a log-scale axis



Explore Data

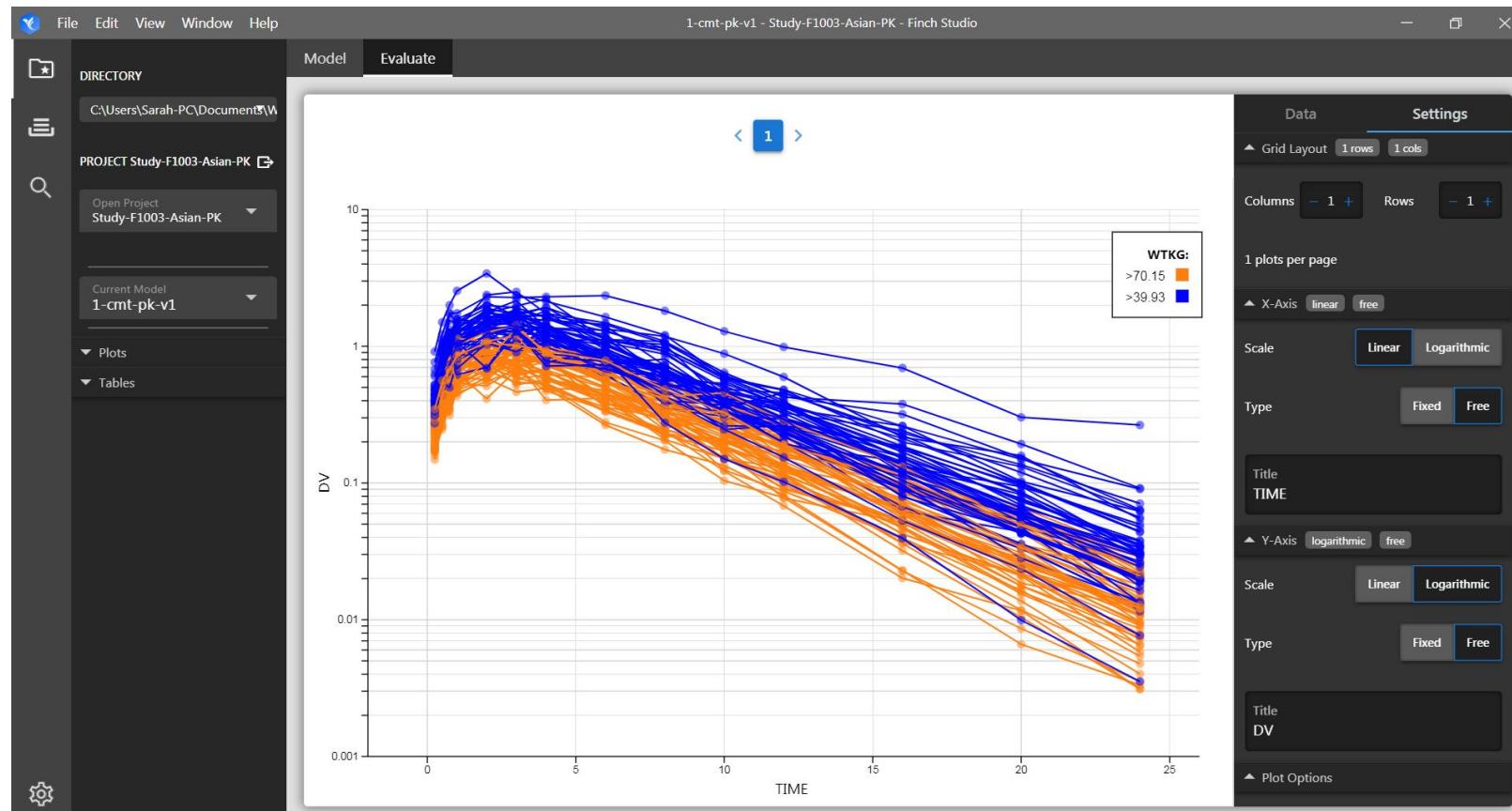
- Color by Weight





Explore Data

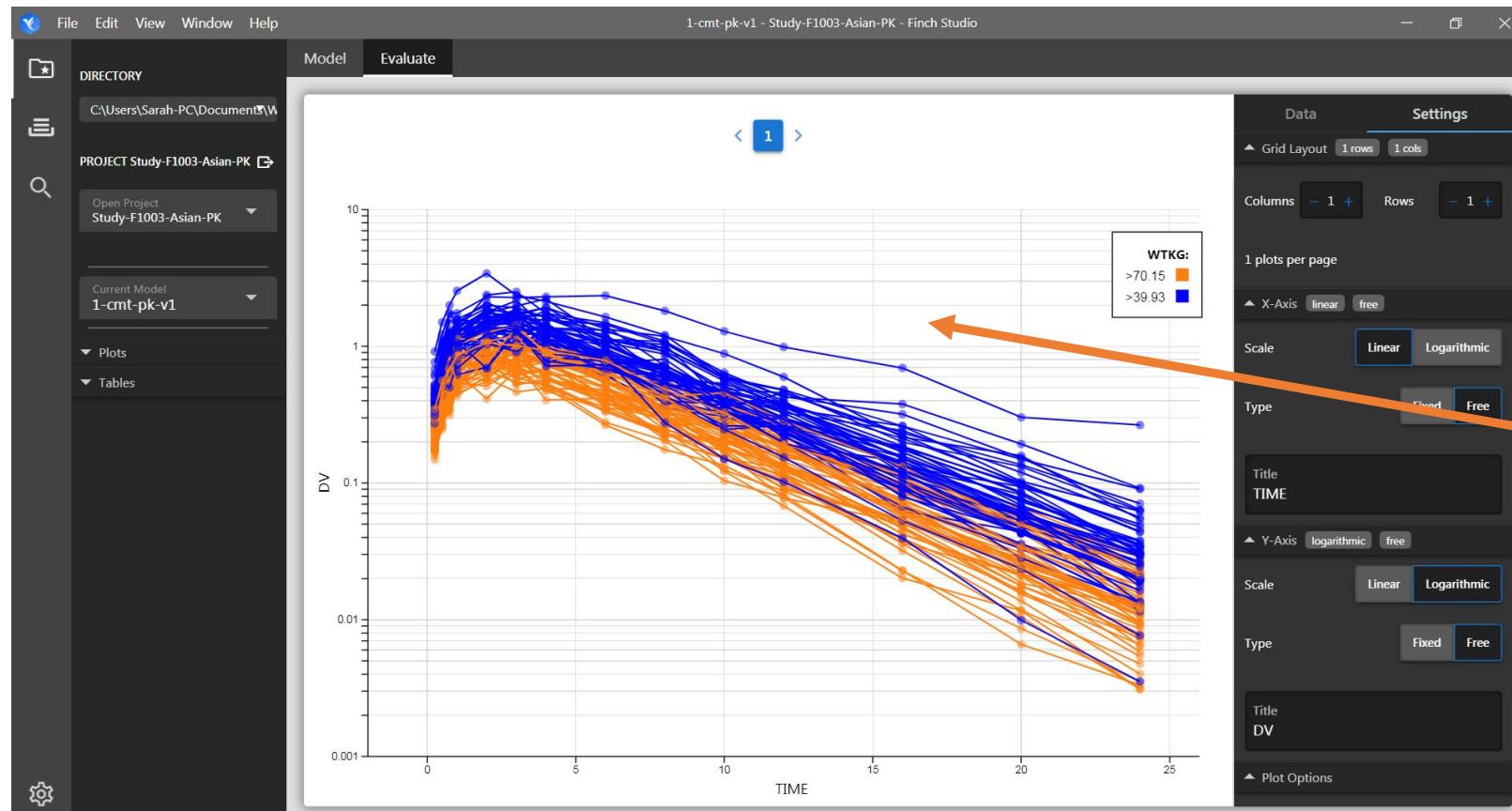
- Color by Weight





Explore Data

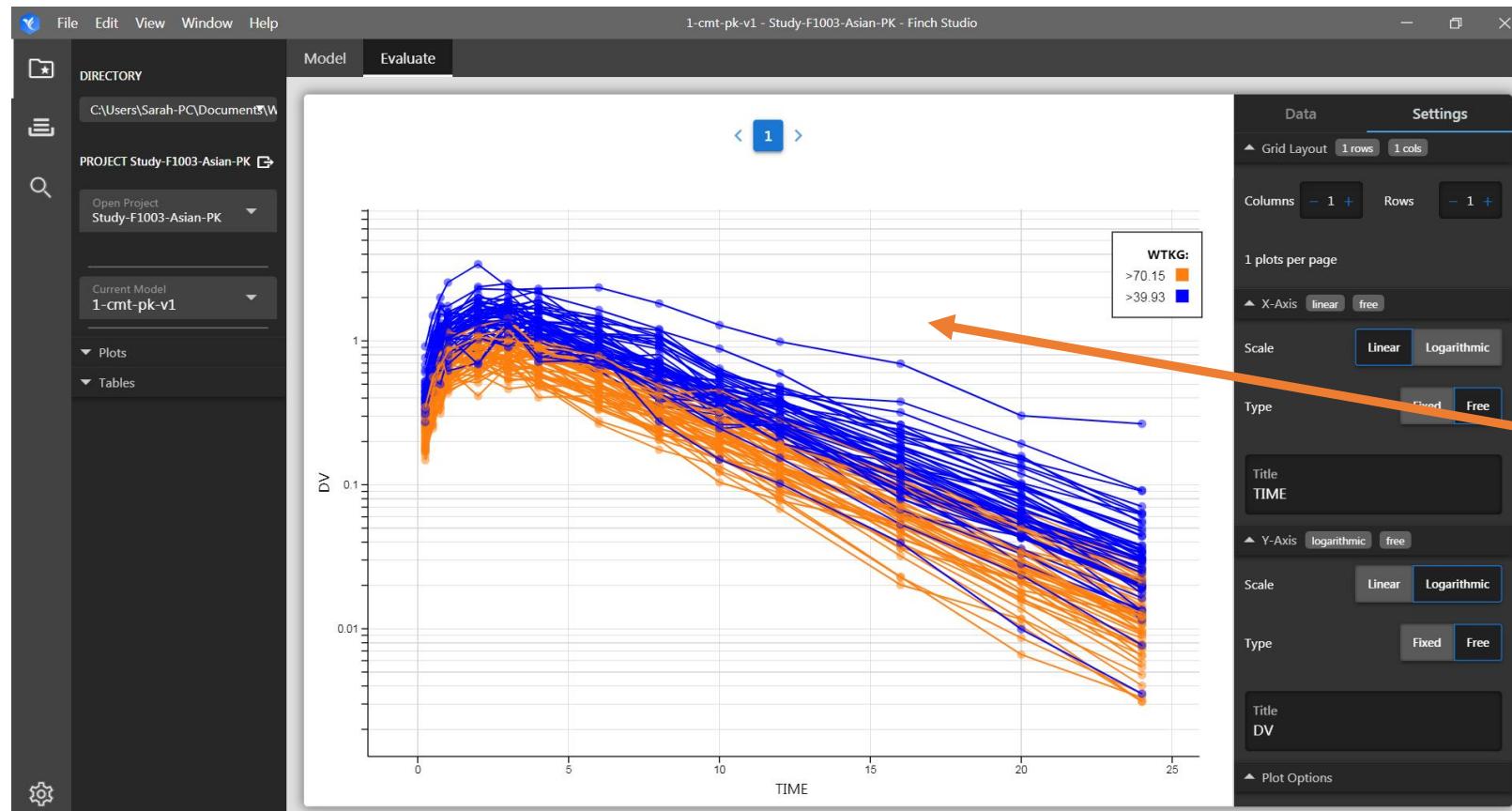
- Color by Weight





Explore Data

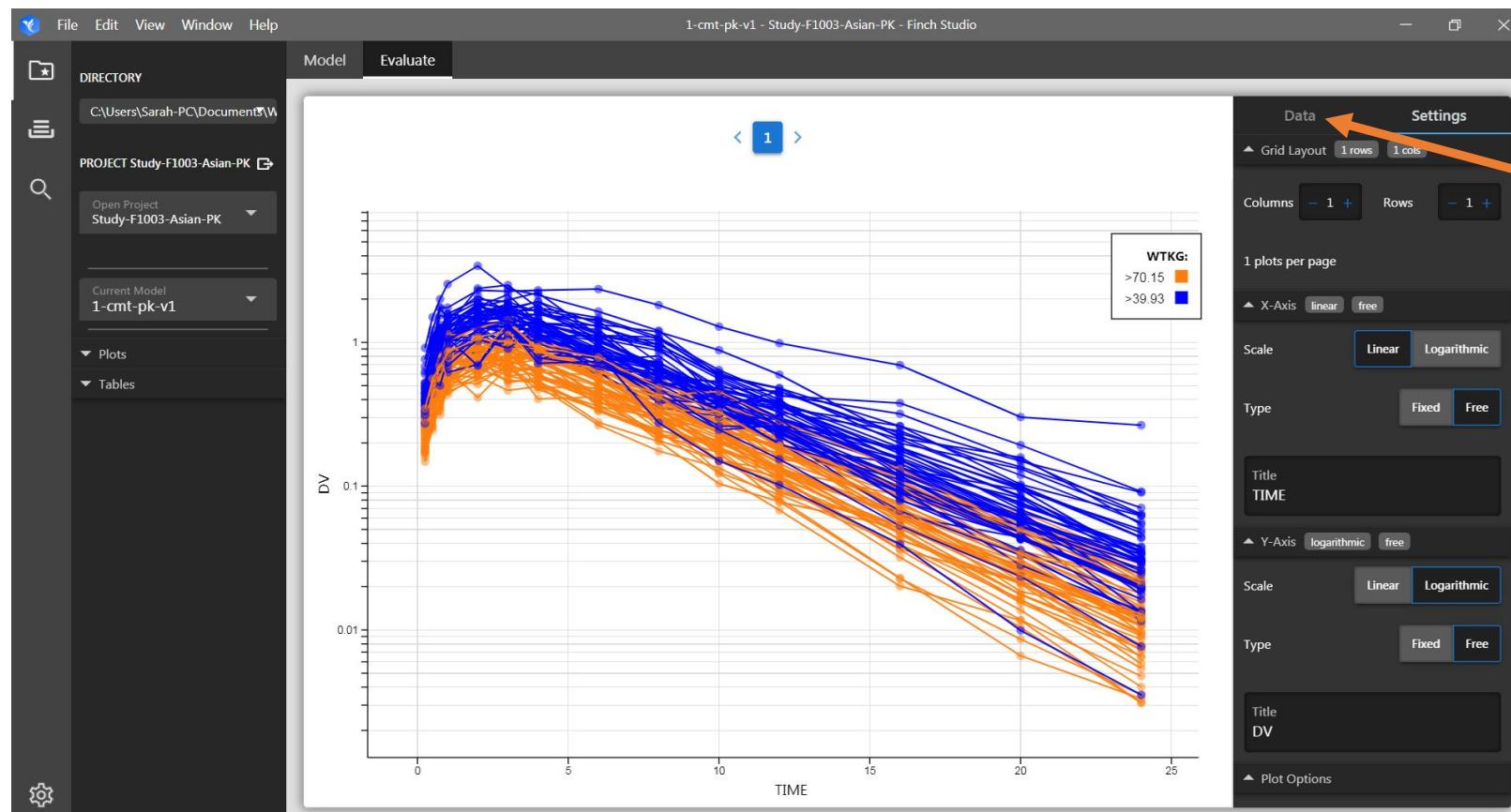
- Color by Weight





Explore Data

- Stratify by Weight

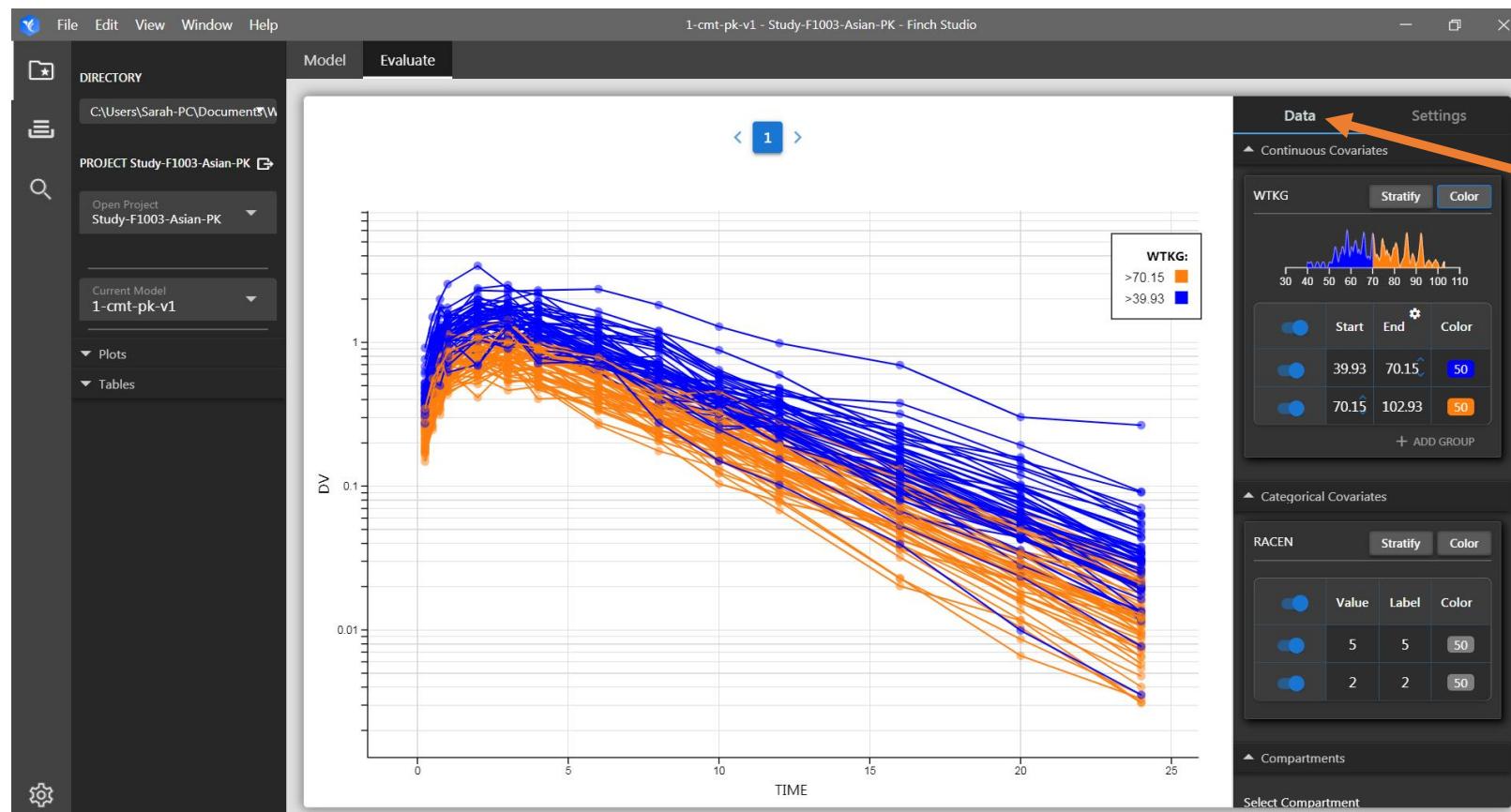


Now let's stratify by weight; go back to the *Data* tab



Explore Data

- Stratify by Weight

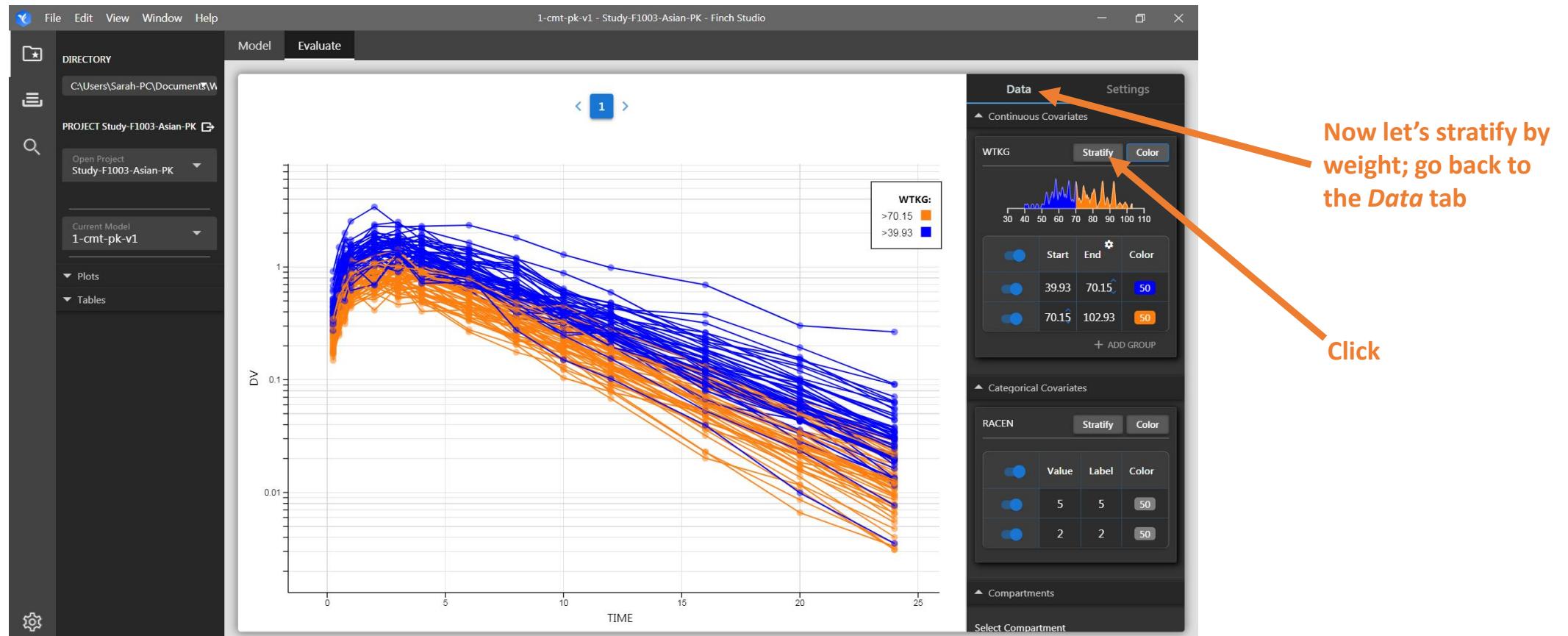


Now let's stratify by weight; go back to the *Data* tab



Explore Data

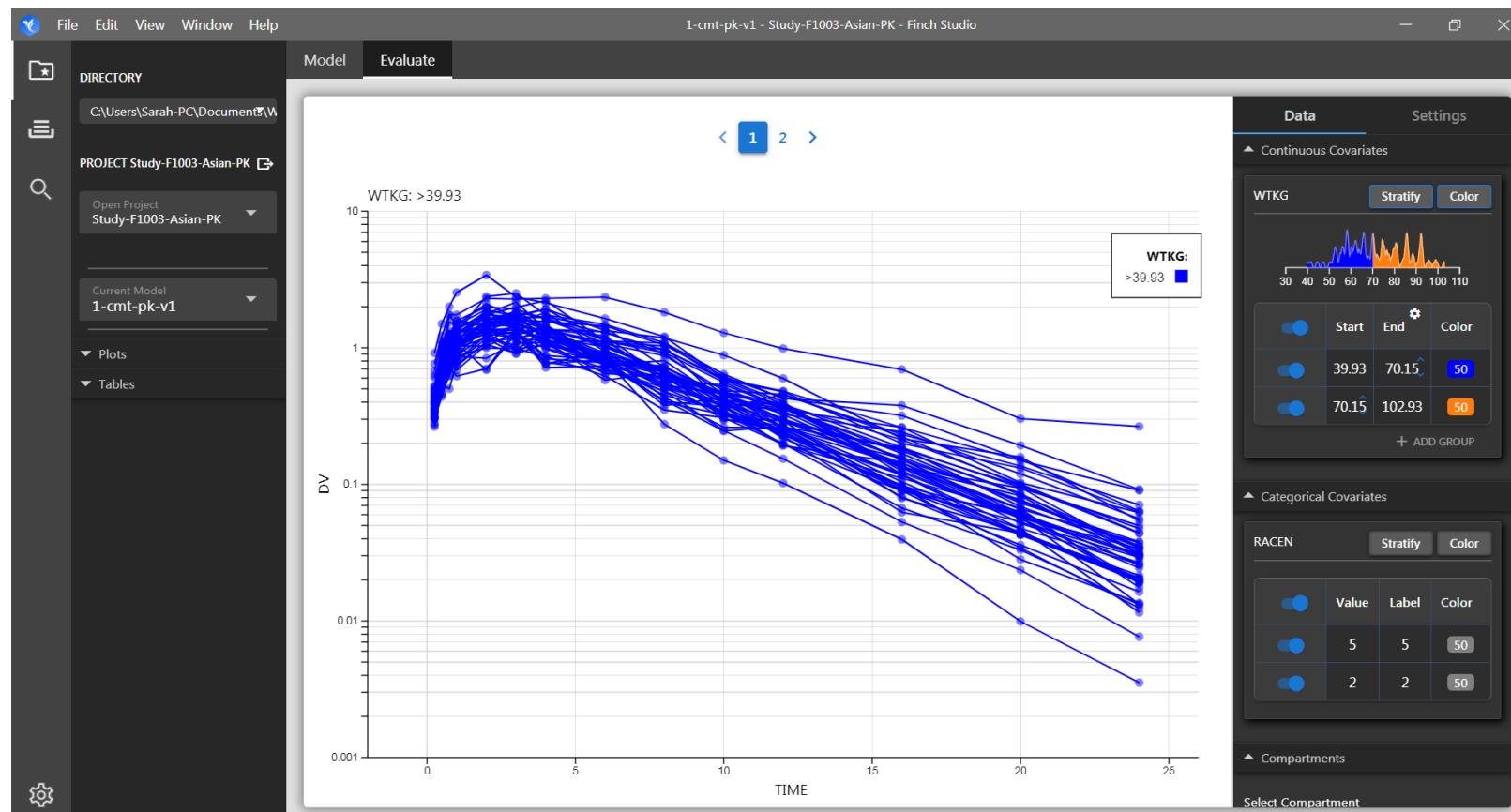
- Stratify by Weight





Explore Data

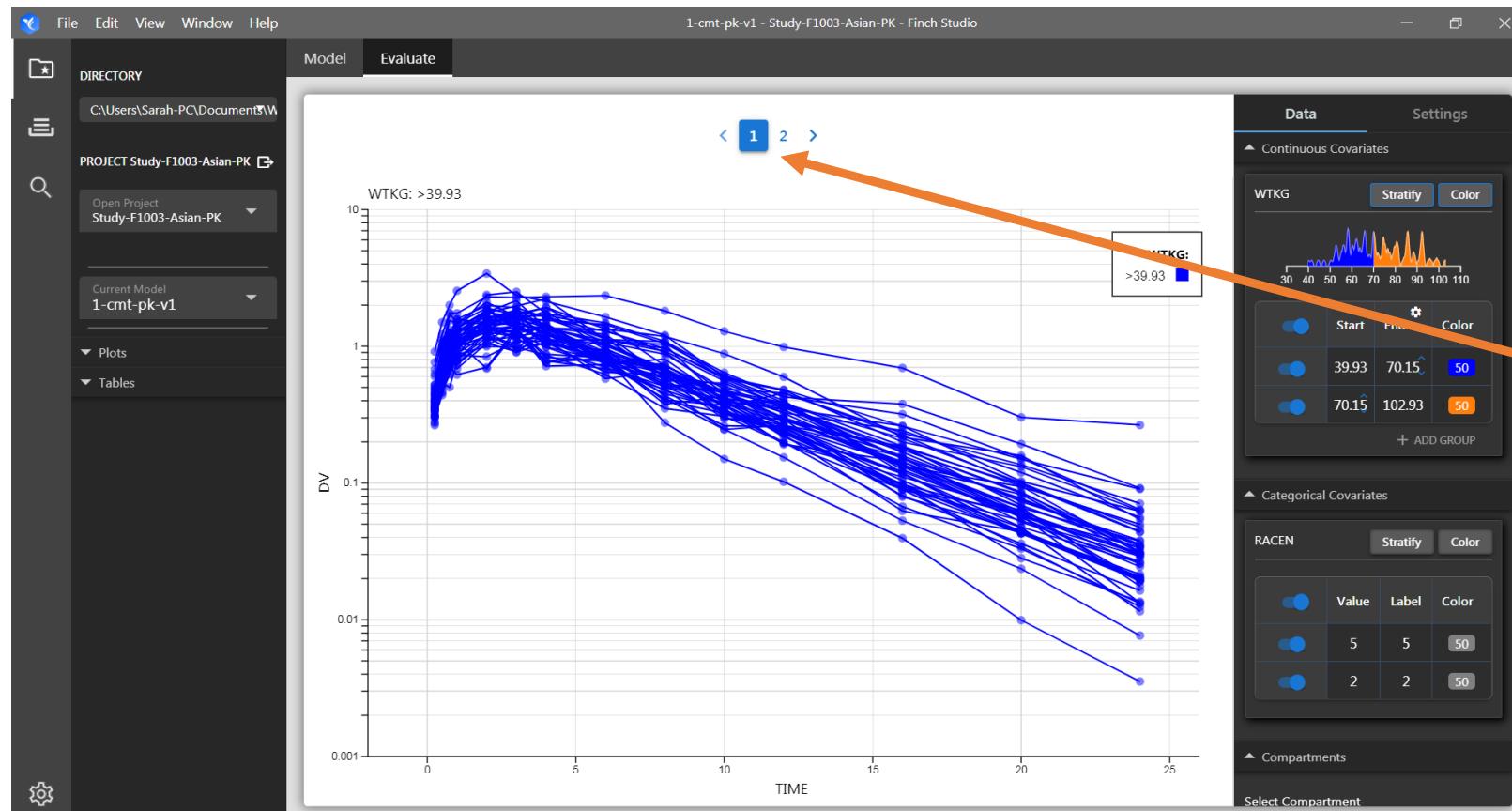
- Stratify by Weight





Explore Data

- Stratify by Weight

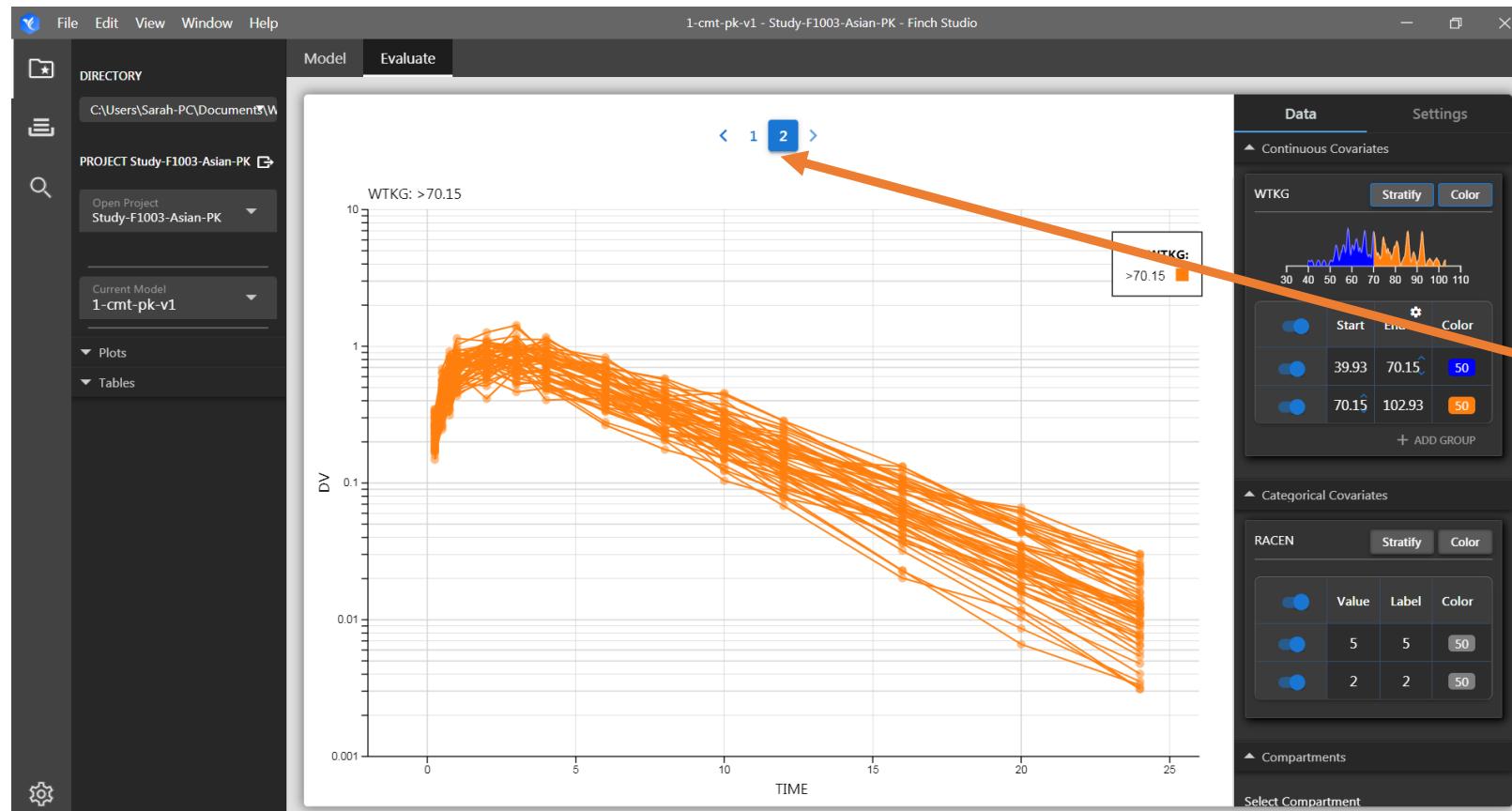


We can move through the stratified plot pages here



Explore Data

- Stratify by Weight

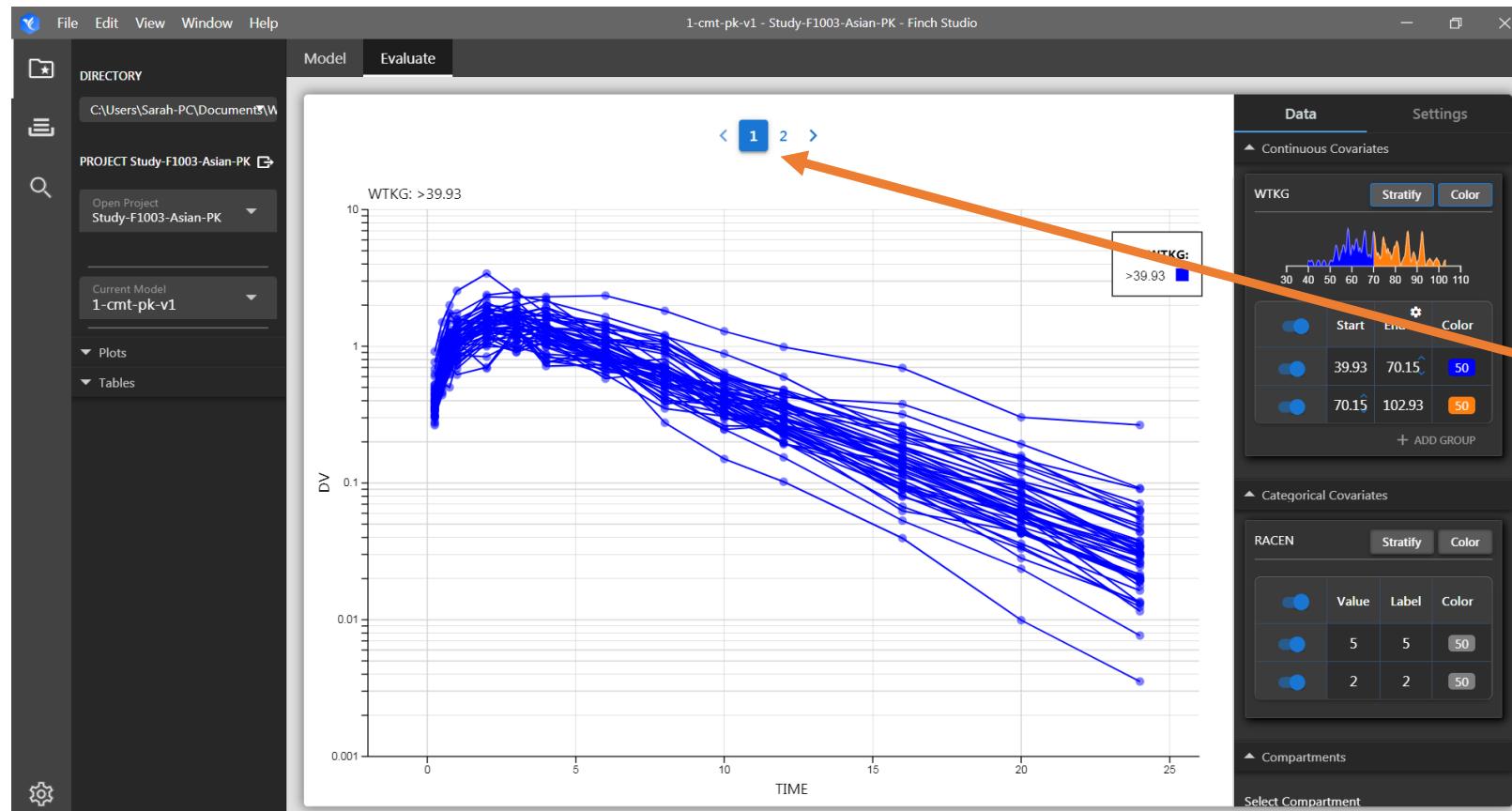


We can move through the stratified plot pages here



Explore Data

- Stratify by Weight

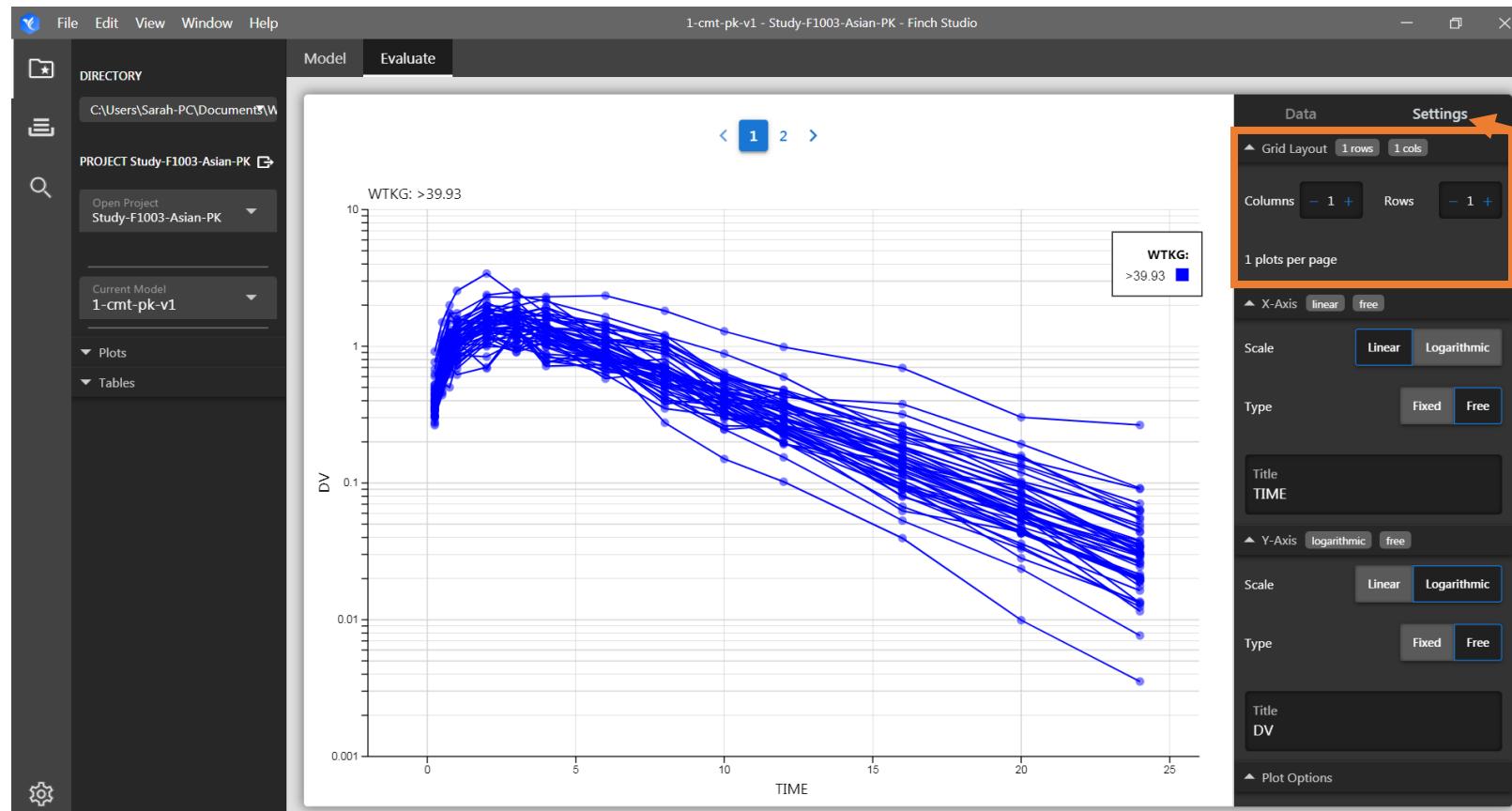


We can move through the stratified plot pages here



Explore Data

- Stratify by Weight

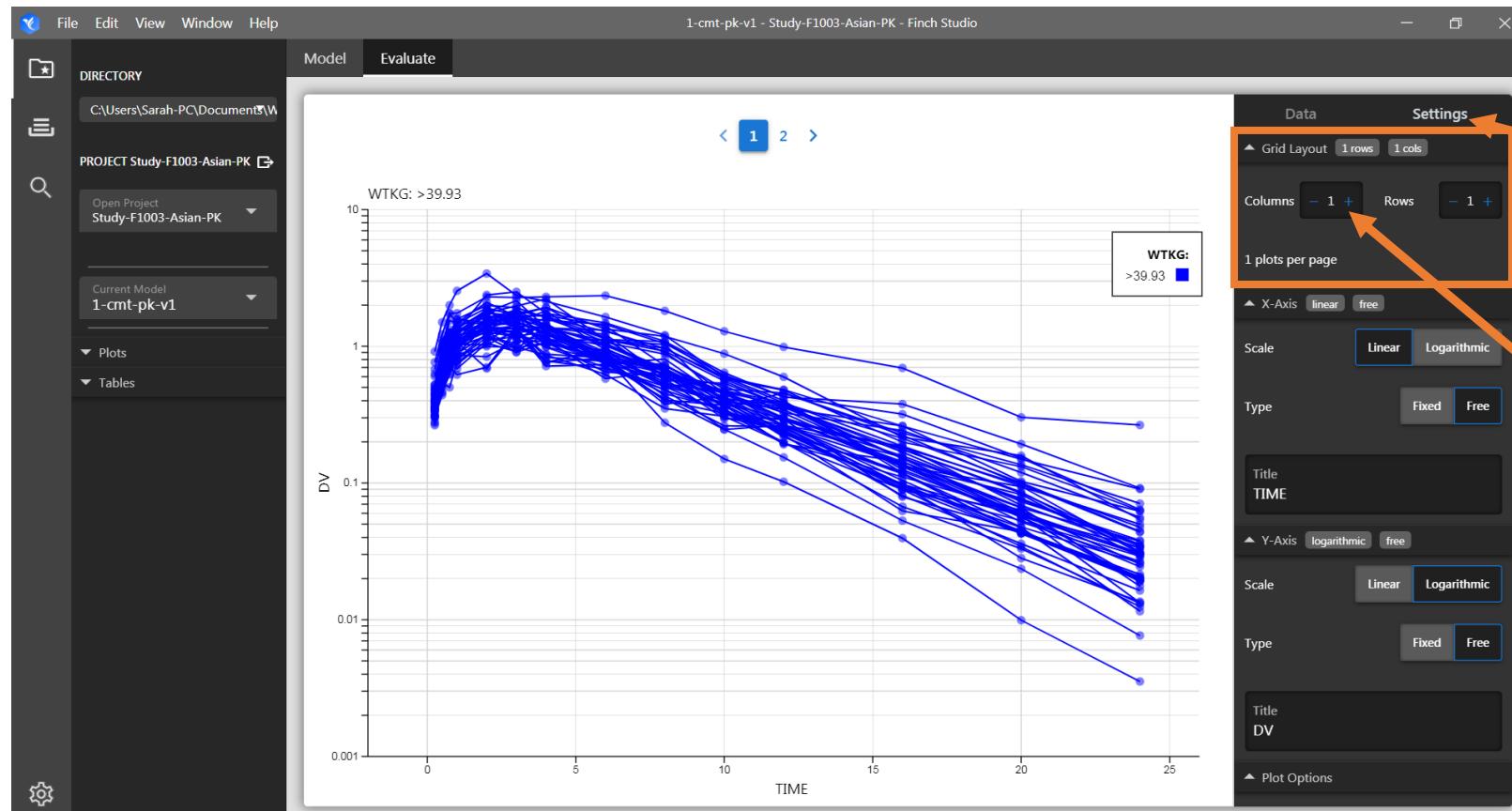


Back on the *Settings* tab, we can adjust the layout and number of plots per page



Explore Data

- Stratify by Weight



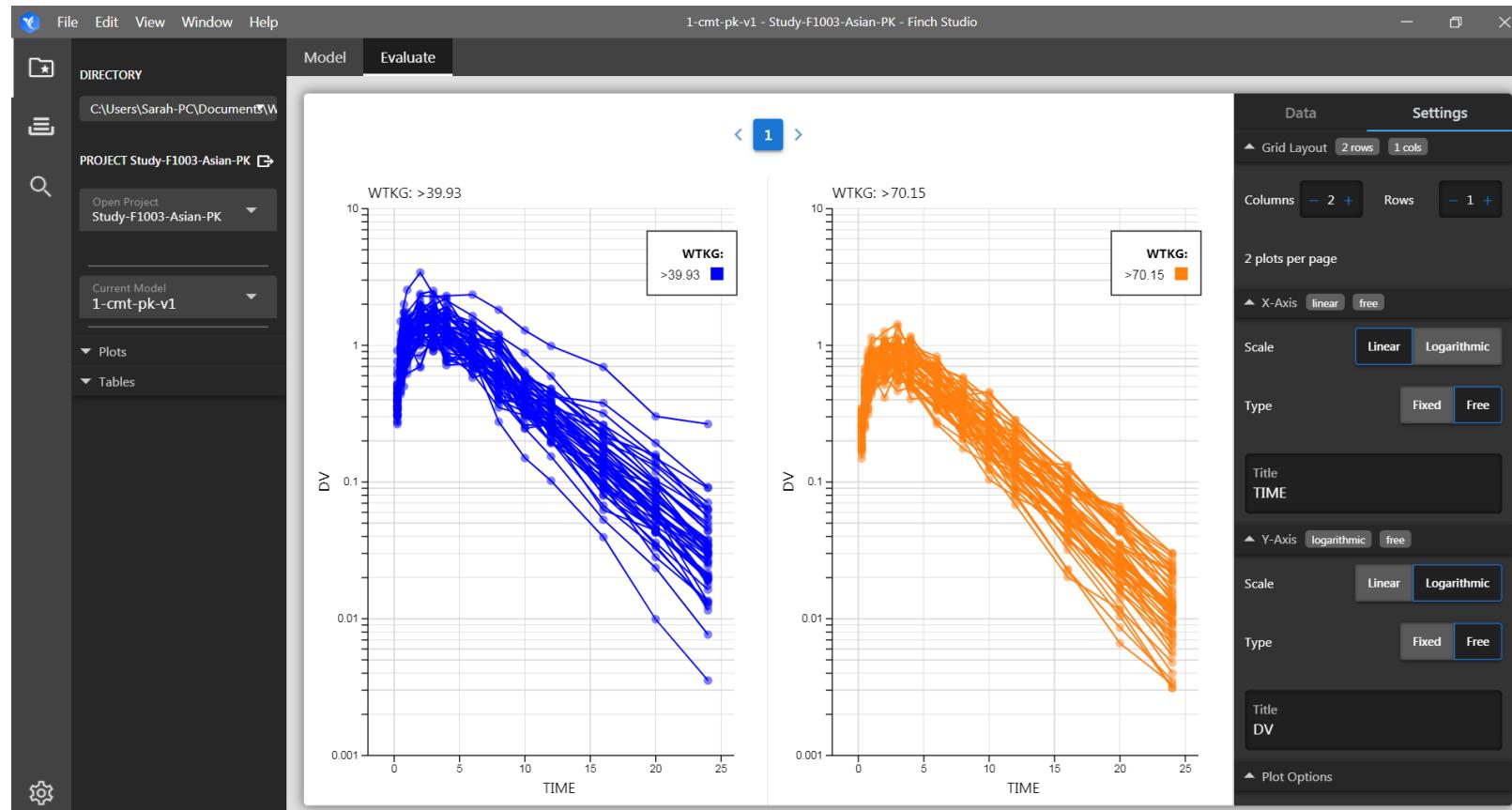
Back on the *Settings* tab,
we can adjust the layout
and number of plots per
page

Let's increase to two columns



Explore Data

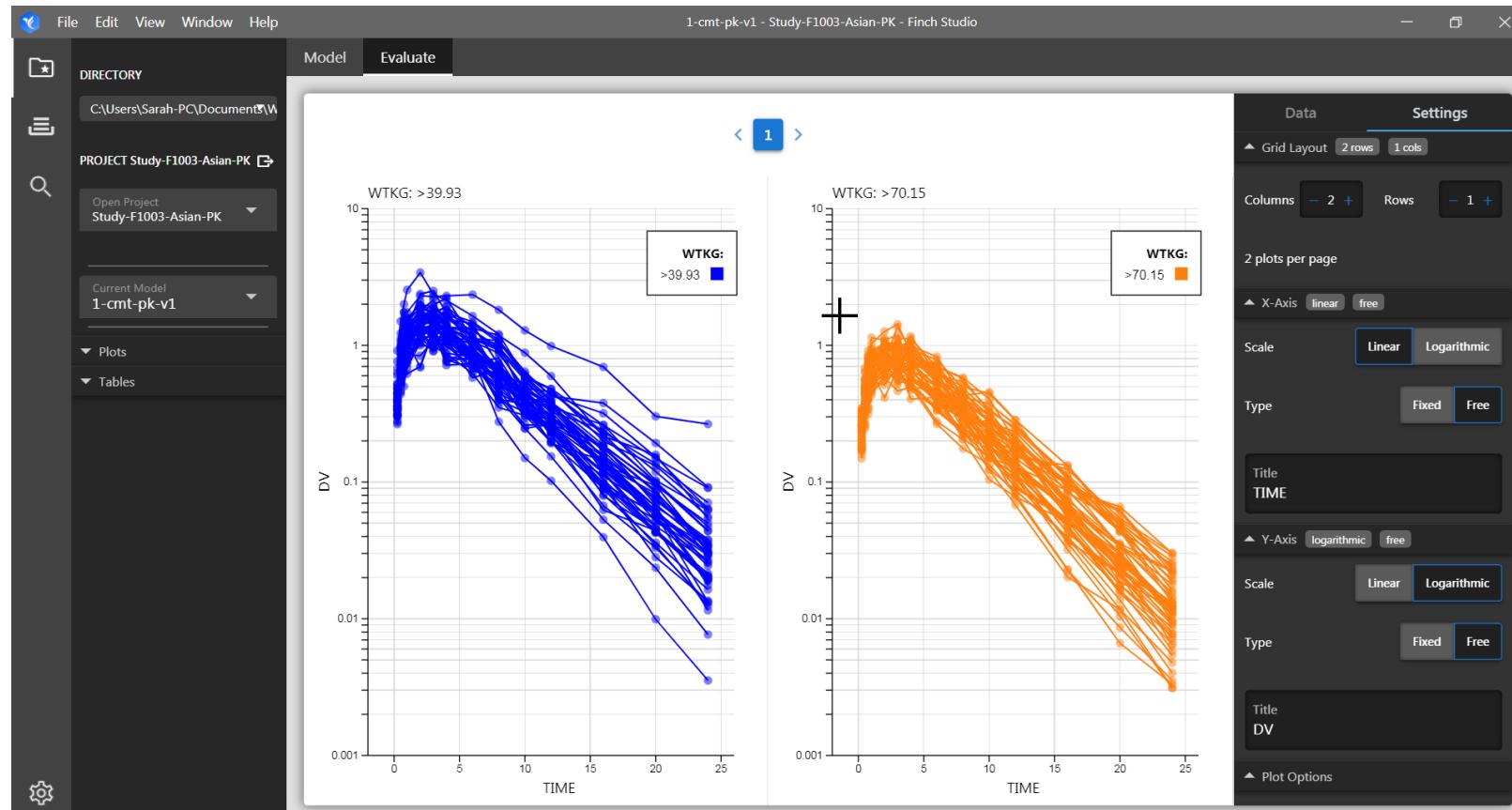
- Stratify by Weight





Explore Data

- Stratify by Weight

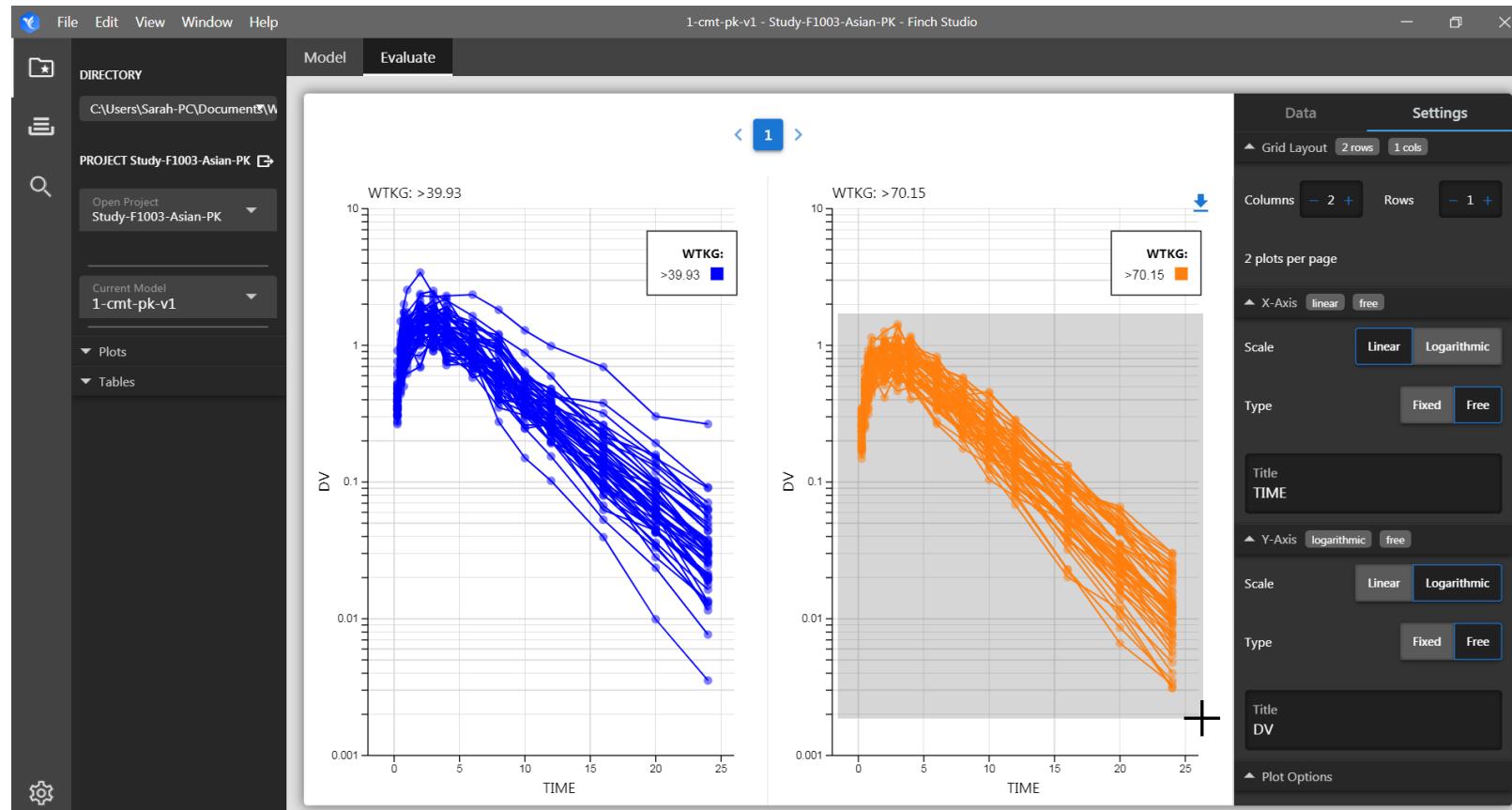


We can select a desired plot area



Explore Data

- Stratify by Weight

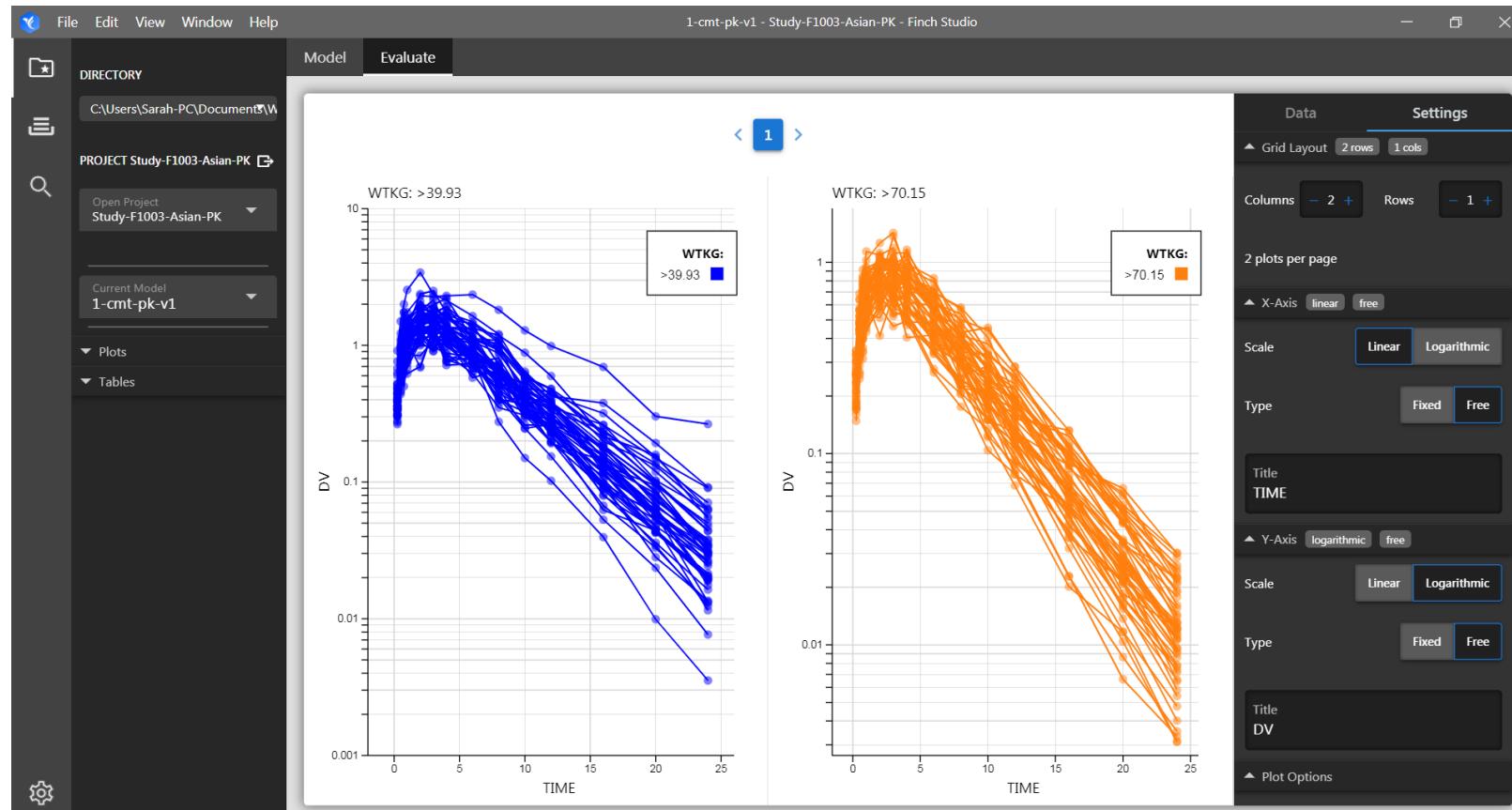


We can select a desired plot area



Explore Data

- Stratify by Weight

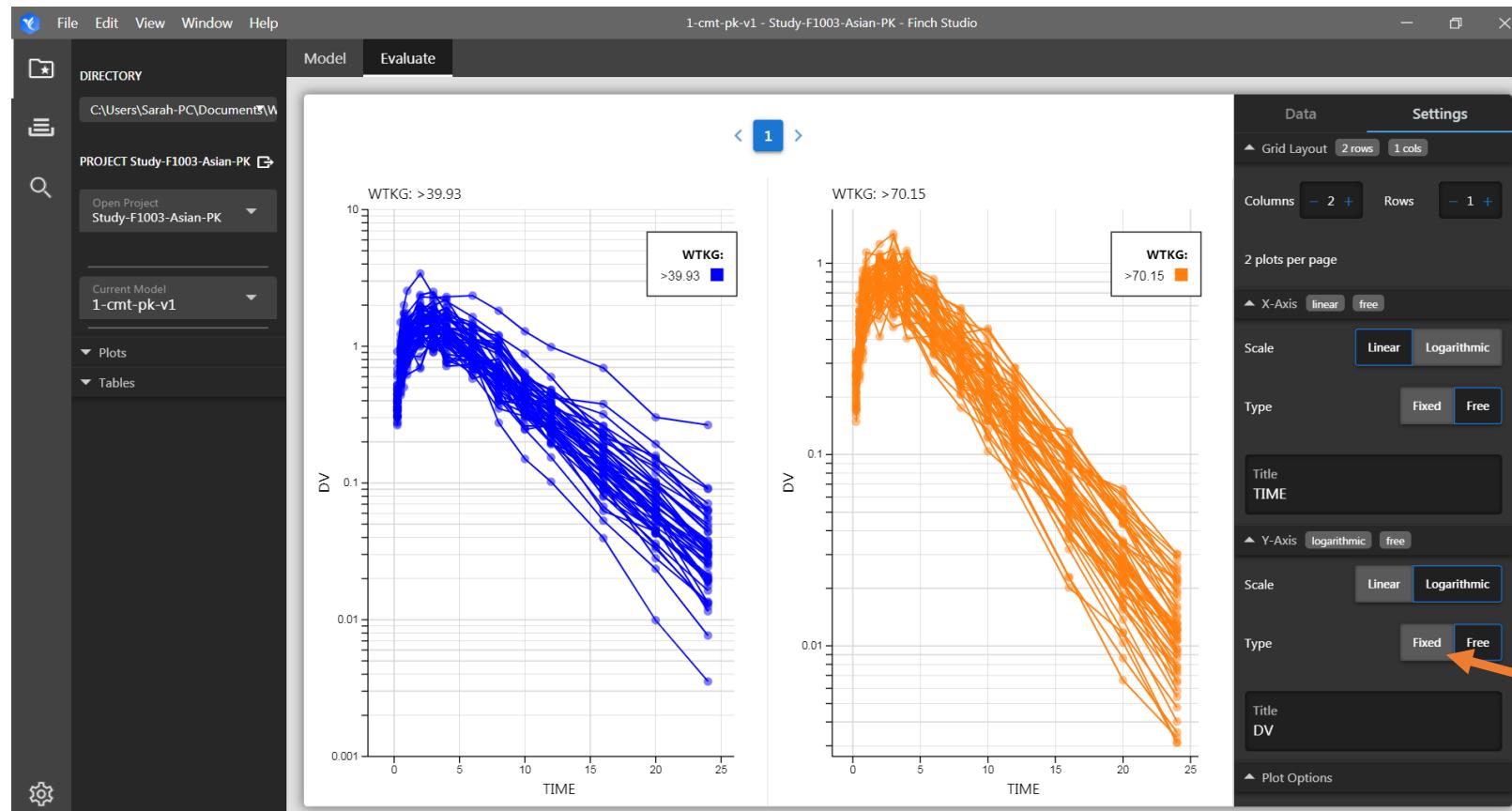


We can select a desired plot area



Explore Data

- Stratify by Weight



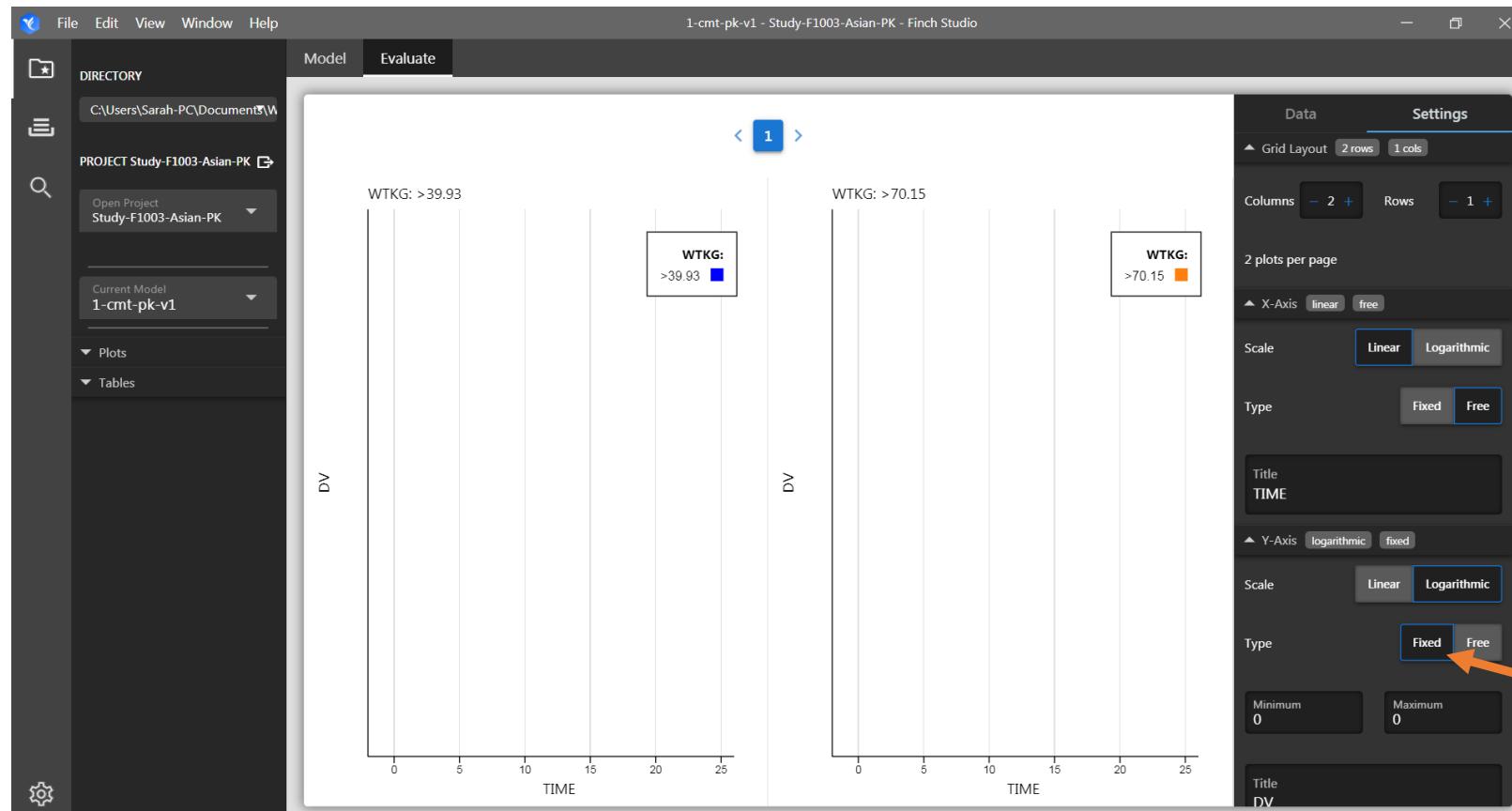
We can select a desired plot area

Let's switch the y-axis from free scales to fixed scales to aid comparison between the two weight bins



Explore Data

- Stratify by Weight

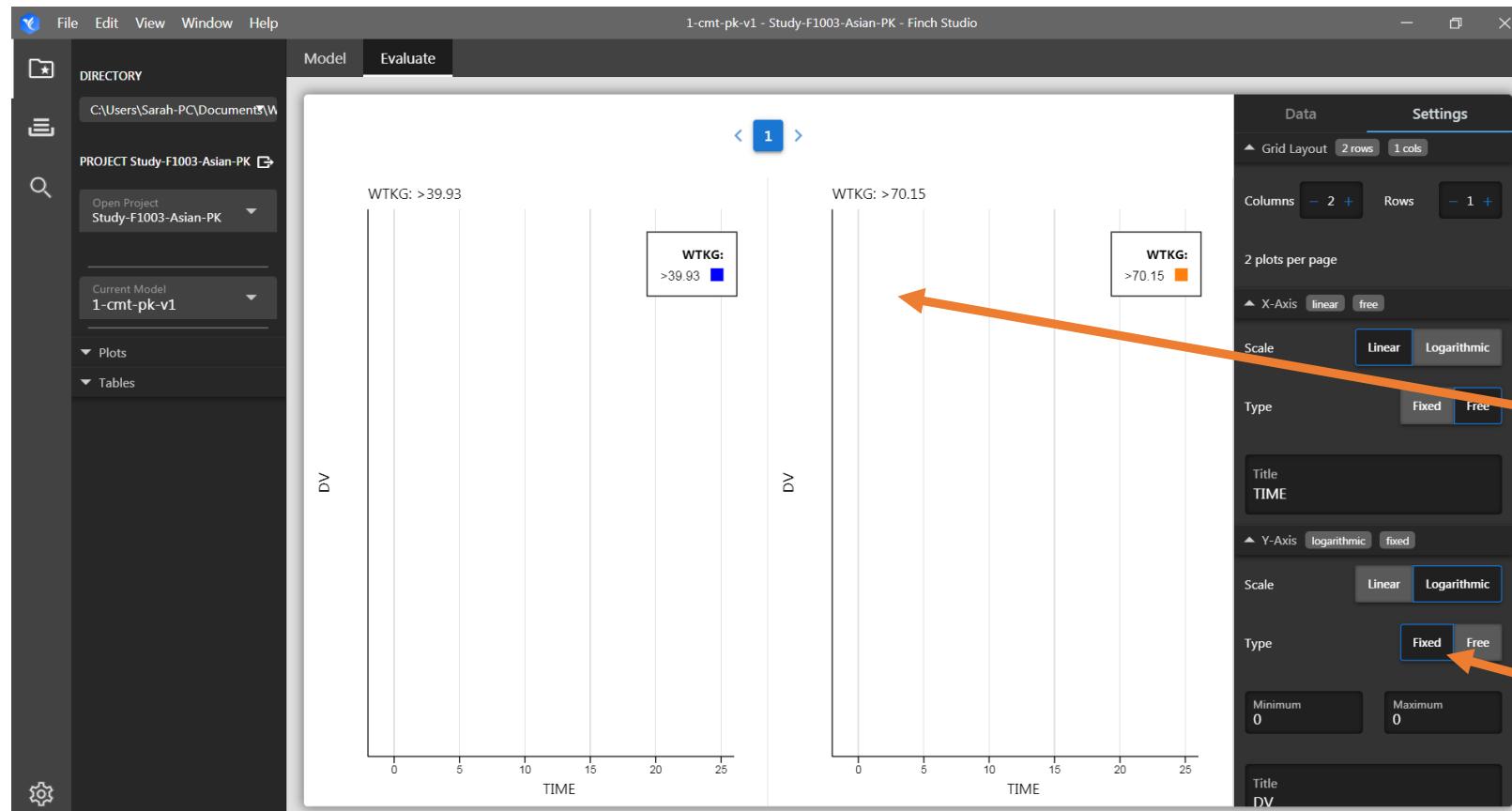


Let's switch the y-axis from free scales to fixed scales to aid comparison between the two weight bins



Explore Data

- Stratify by Weight



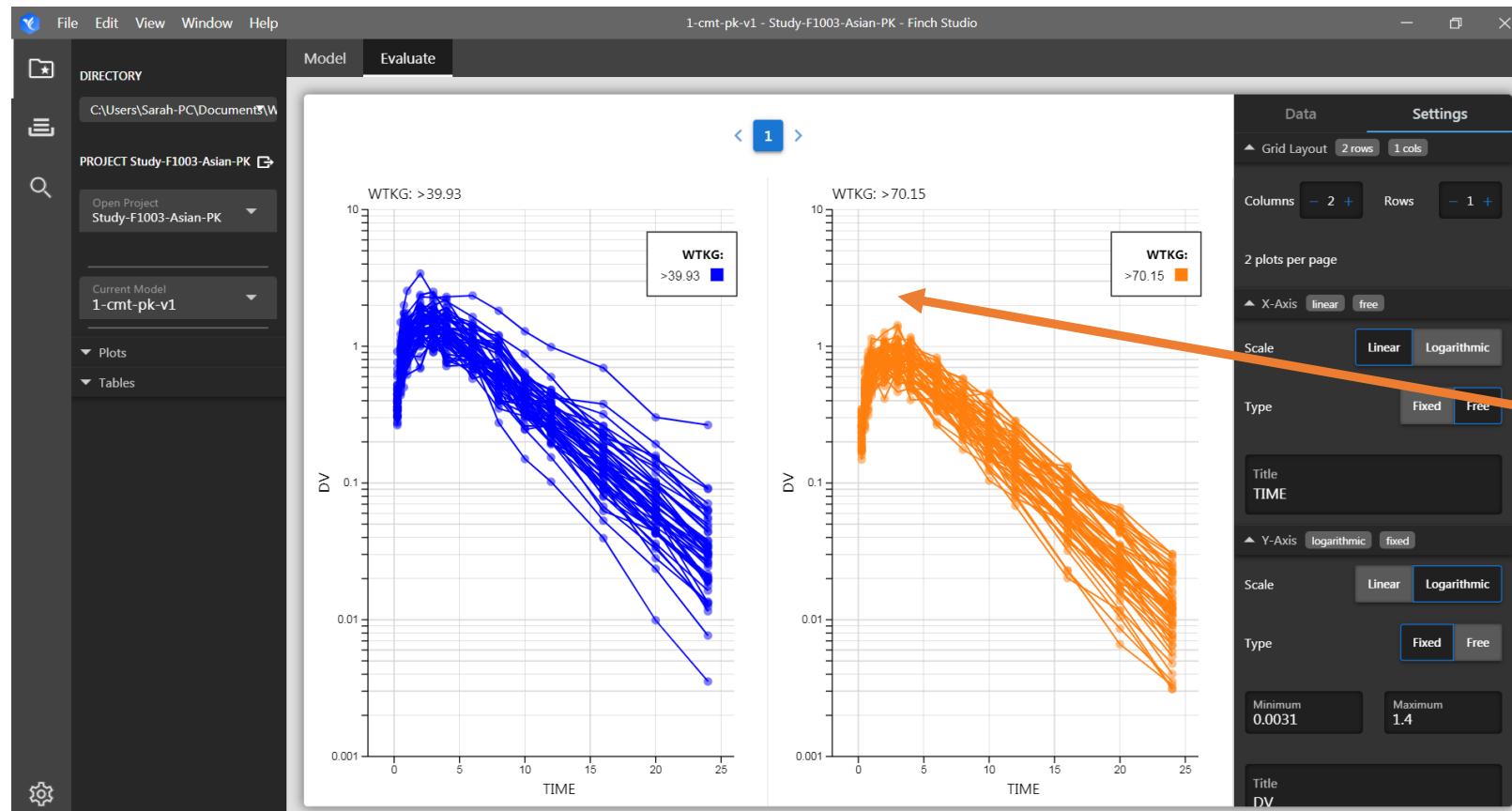
Double-click within
the plot area to
autofit to all the data

Let's switch the y-axis from
free scales to fixed scales to
aid comparison between the
two weight bins



Explore Data

- Stratify by Weight

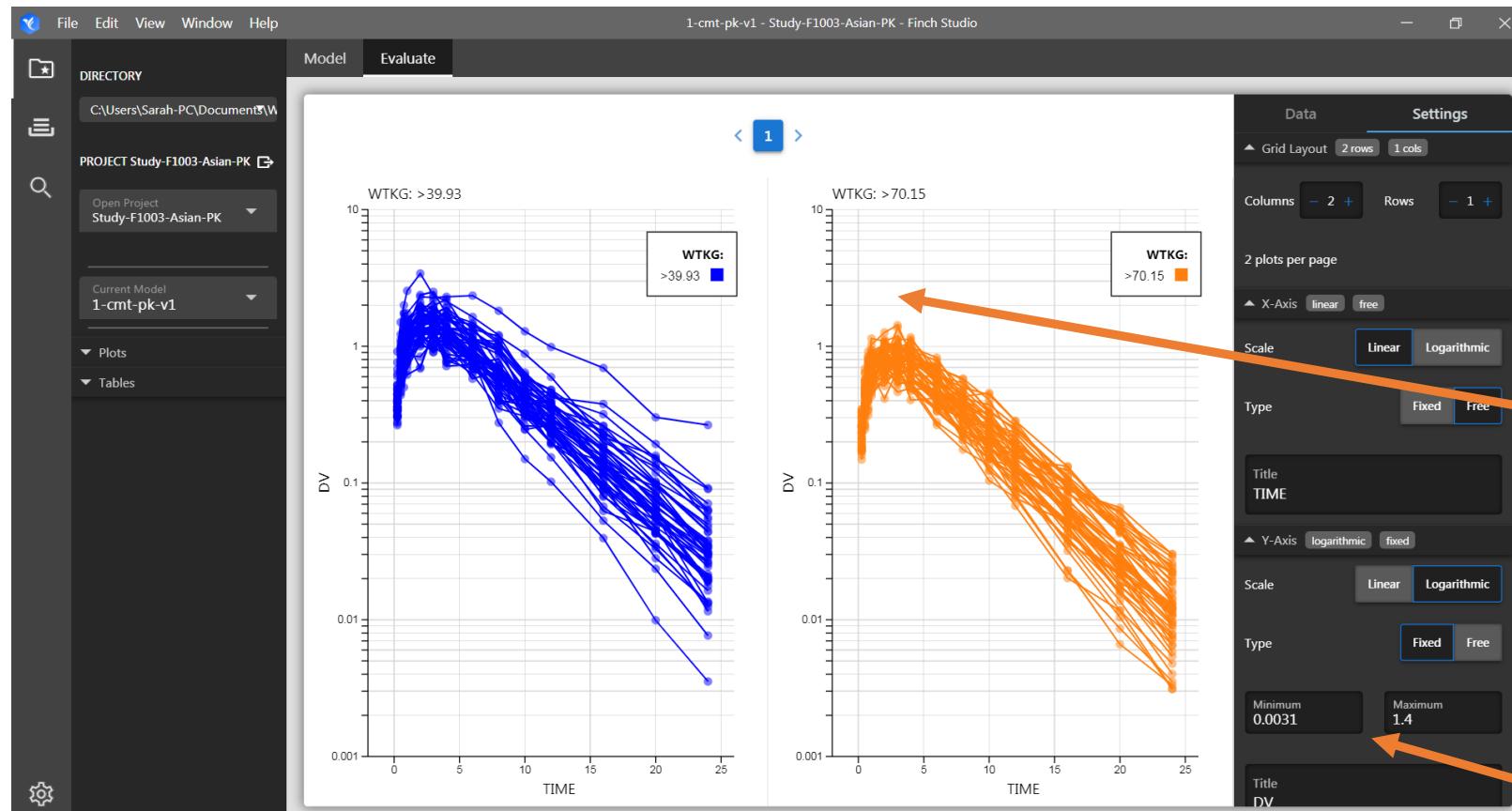


Double-click within
the plot area to
autofit to all the data



Explore Data

- Stratify by Weight



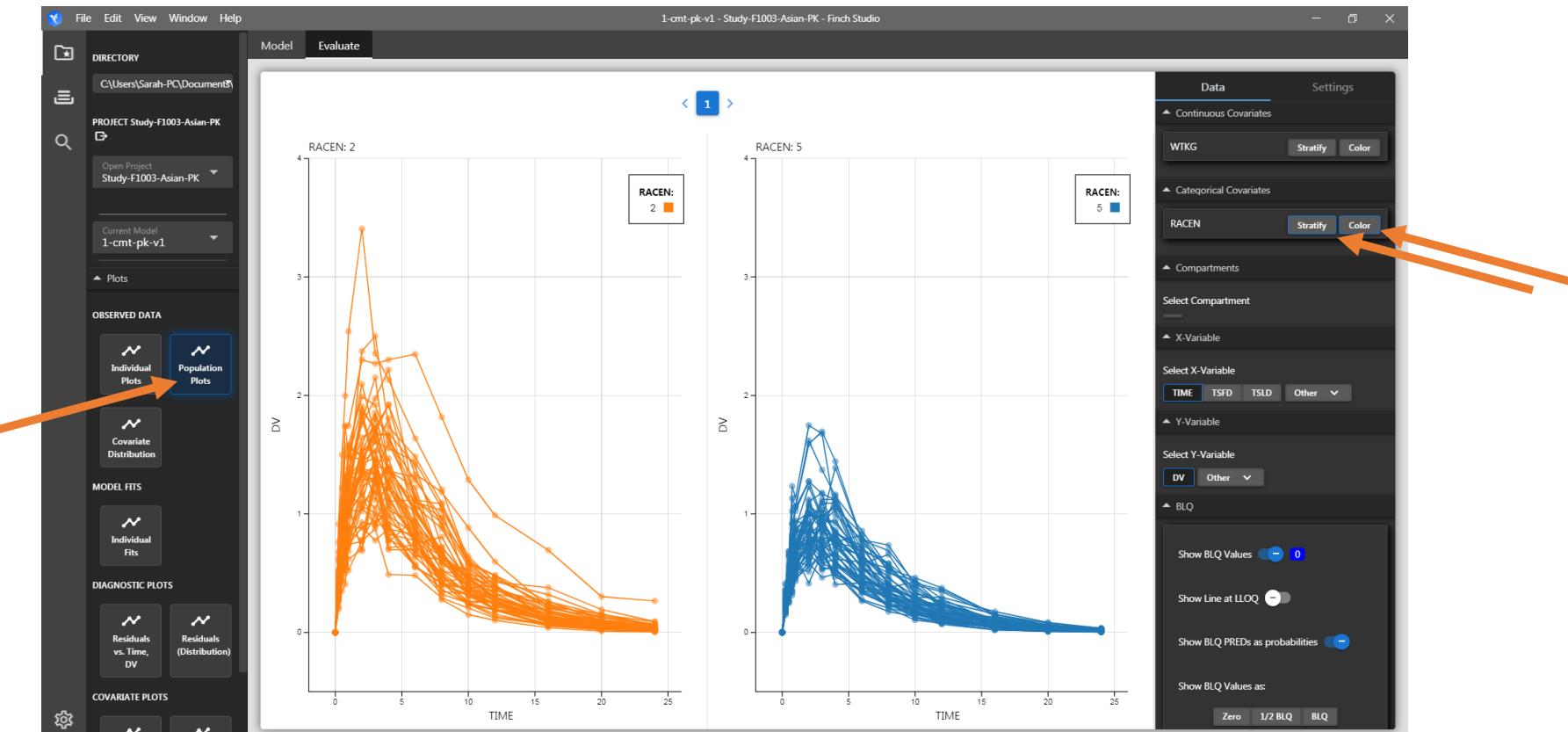
Double-click within the plot area to autofit to all the data

If the double-click/autofit does not yield adequate results, we can also adjust limits manually here



Explore Data

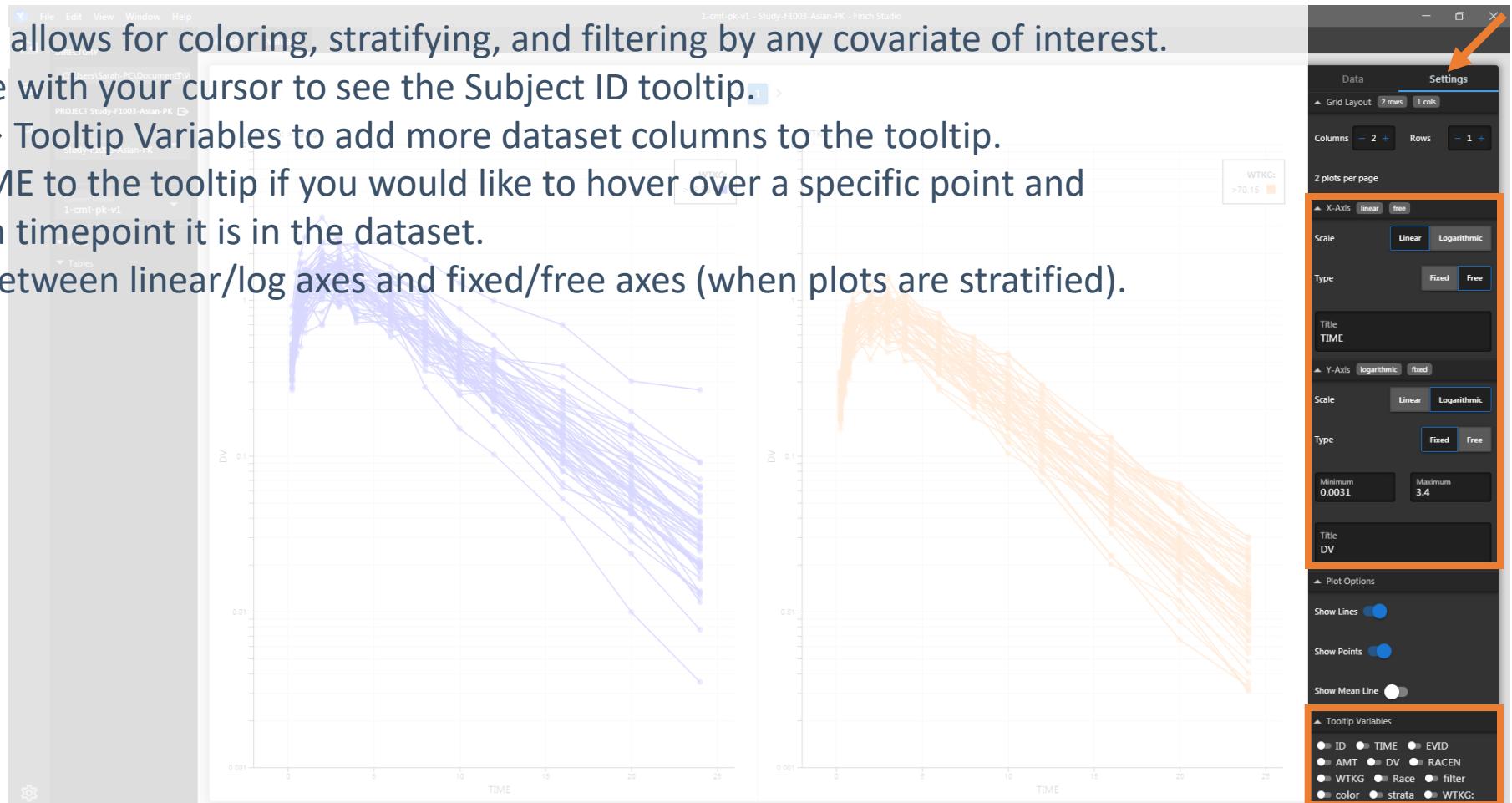
- Is there a difference in PK between race groups? Is there a difference between weight groups?
- Take some time to play with the various options for data exploration. Investigate the interplay between Weight, Race, and observed drug exposures.





Explore Data

- Data exploration allows for coloring, stratifying, and filtering by any covariate of interest.
- Hover over a line with your cursor to see the Subject ID tooltip.
- Go to Settings → Tooltip Variables to add more dataset columns to the tooltip.
 - I.e., add TIME to the tooltip if you would like to hover over a specific point and know which timepoint it is in the dataset.
- You can toggle between linear/log axes and fixed/free axes (when plots are stratified).





Explore Data

- Take some time to play with the various options for data exploration.
Investigate the interplay between Weight, Race, and observed drug exposures.



Hands-on Session: Finch Studio Basics 2

Run and Evaluate NONMEM Models



Run a Model

- Return to the Model tab.

The screenshot shows the Finch Studio application window. At the top, there's a menu bar with File, Edit, View, Window, Help, and tabs for Model and Evaluate. The Model tab is highlighted with an orange arrow pointing to it. Below the menu is a directory tree showing a project named 'Study-F1003-Asian-PK' containing files like 'data\F1003-Asian-PK-Study.csv'. The main workspace displays a script editor with R code for a pharmacokinetic model. To the right of the script editor are three panels: 'Parameters' (listing initial values for KA, CL, and V), 'Omega' (covariance matrix for CL and V), and 'Sigma' (proportional error term). At the bottom, there's a results table showing one model entry and a status bar indicating 'Showing 1 of 3 models'.

```
C:\> Users > Mohamed Ismail > Desktop > Exercises-original > Exercises > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA "...../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

CL	V
0.0474	
0.00	0.0400

Proportional
0.0861



Run a Model

- Model tab overview:

selected model

control stream / built-in text editor

results table

Parameters tab

Toggle view between Initial/Final parameter estimates

The screenshot shows the Finch Studio interface with the following components highlighted:

- Left Sidebar (PROJECT Study-F1003-Asian-PK):** Shows the project structure with "1-cmt-pk-v1" selected.
- Main Area:**
 - Control Stream / Built-in Text Editor:** Displays the model code:

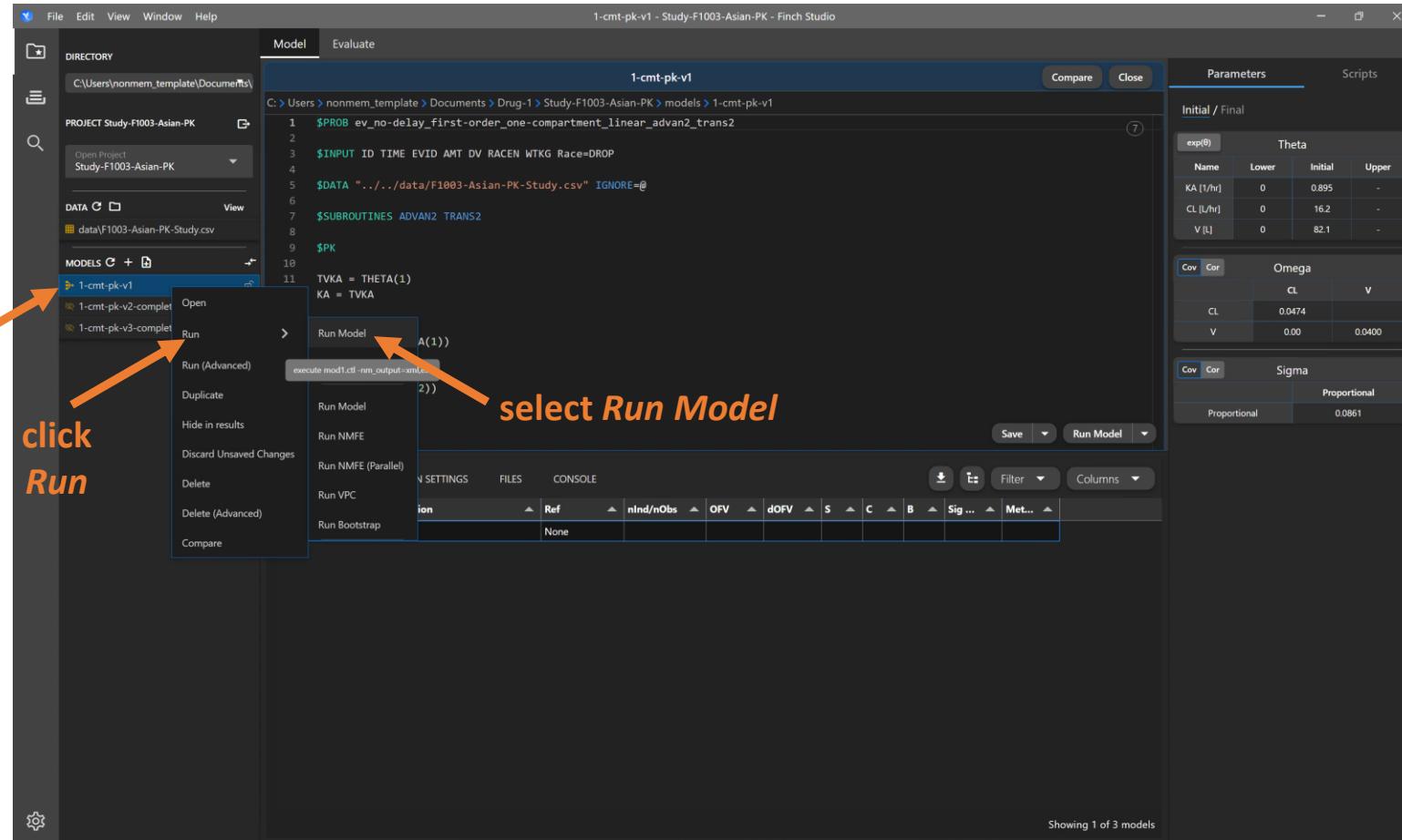
```
C: > Users > Mohamed Ismail > Desktop > Exercises-original > Exercises > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_AMT DV RACEN WTKG Race=DROP
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVANZ TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```
 - Results Table:** Shows the results for the selected model "1-cmt-pk-v1".
- Parameters Tab:** Shows parameter estimates for "Initial / Final" and "Theta".

Name	Lower	Initial	Upper
KA [1/hr]	0	0.7	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-



Run a Model

- Let's run model 1-cmt-pk-v1:





Run a Model

- While running:

The screenshot shows the Finch Studio software interface. The main window title is "1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio". The code editor displays a PK model script:

```
C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay first-order one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10 TVKA = THETA(1)
11 KA = TVKA
12
13 TVCL = THETA(2)
14 CL = TVCL*EXP(ETA(1))
15
16 TVV = THETA(3)
17 V = TVV*EXP(ETA(2))
18 S2 = V
19
20 $ERROR
21
```

The parameters table on the right lists:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

The results table at the bottom shows:

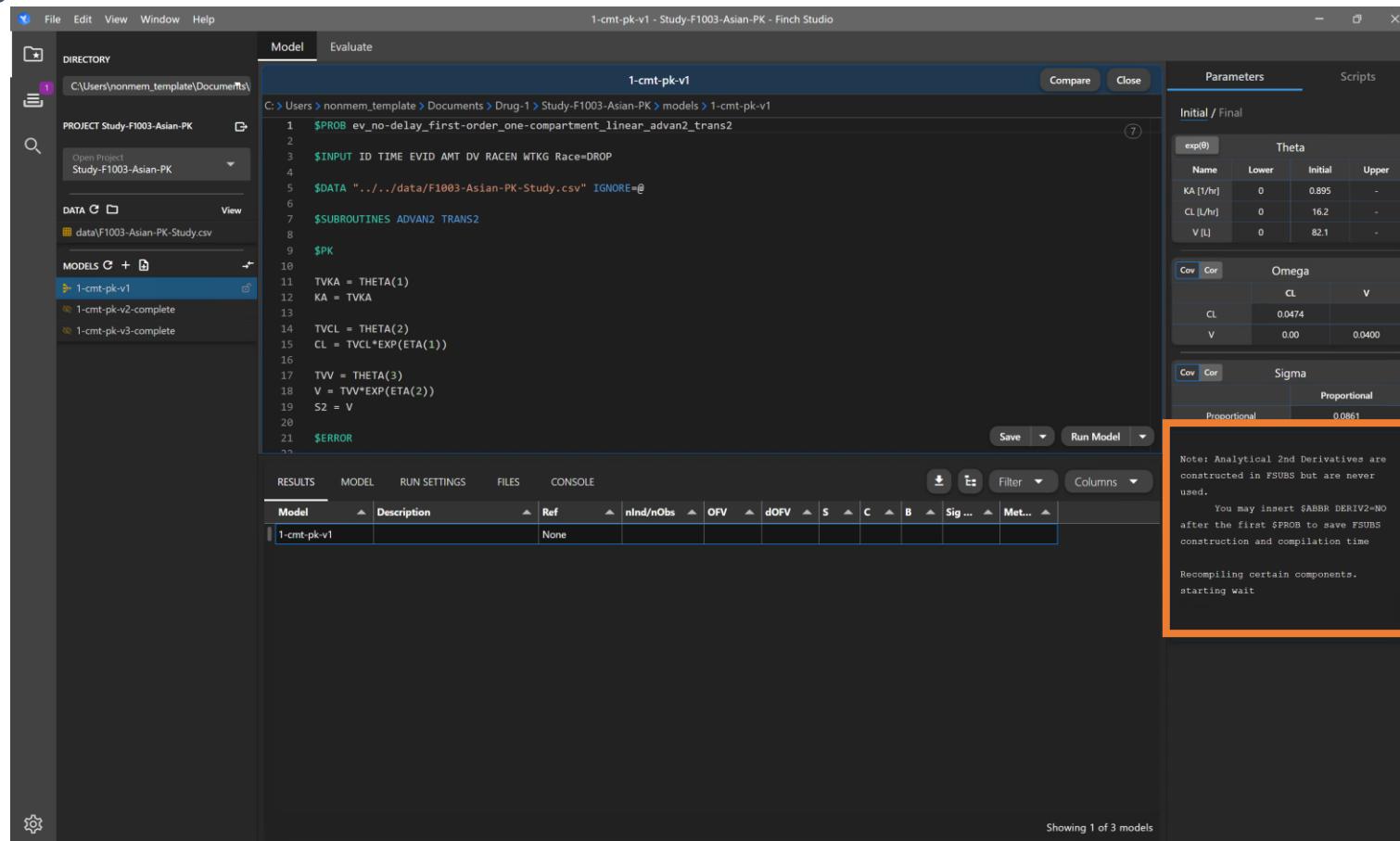
Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
1-cmt-pk-v1	None									

Note: Analytical 2nd Derivatives are constructed in FSUBS but are never used.
You may insert \$ABBR DERIV2=NO after the first \$PROB to save FSUBS construction and compilation time
Recompiling certain components.
starting wait



Run a Model

- While running:



The screenshot shows the Finch Studio interface with a dark theme. On the left, there's a sidebar with 'PROJECT Study-F1003-Asian-PK' and a 'DATA' section containing 'data\F1003-Asian-PK-Study.csv'. Below it are three models: '1-cmt-pk-v1' (selected), '1-cmt-pk-v2-complete', and '1-cmt-pk-v3-complete'. The main area displays the model code for '1-cmt-pk-v1':

```
C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay first-order one-compartment linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10 TVKA = THETA(1)
11 KA = TVKA
12
13 TVCL = THETA(2)
14 CL = TVCL*EXP(ETA(1))
15
16 TVV = THETA(3)
17 V = TVV*EXP(ETA(2))
18 S2 = V
19
20 $ERROR
21
```

To the right of the code are 'Parameters' and 'Scripts' tabs. The 'Parameters' tab shows initial values for Theta, Omega, and Sigma parameters. The 'Scripts' tab contains notes about FSUBS construction and compilation time.

A red box highlights the 'Console' window at the bottom right, which displays live output text:

```
Note: Analytical 2nd Derivatives are
constructed in FSUBS but are never
used.

You may insert $ABBR DERIV2=NO
after the first $PROB to save FSUBS
construction and compilation time

Recompiling certain components.
starting wait
```

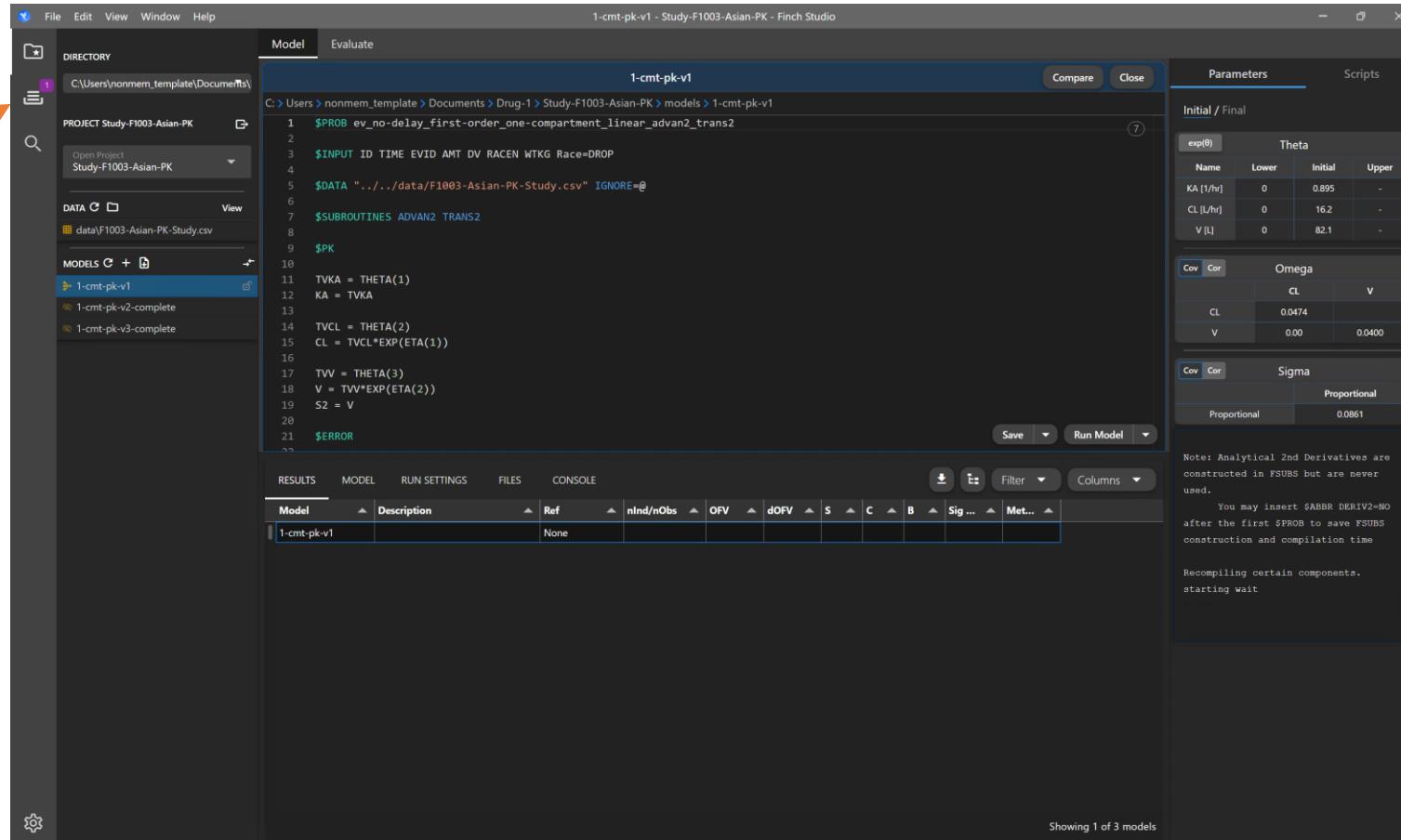
An orange arrow points from the text 'live output' to this console window.



Run a Model

- While running:

we can see
that one run
has appeared
in the queue



The screenshot shows the Finch Studio software interface. On the left, there's a sidebar with 'PROJECT Study-F1003-Asian-PK' and a list of models: '1-cmt-pk-v1' (selected), '1-cmt-pk-v2-complete', and '1-cmt-pk-v3-complete'. An orange arrow points from the text 'we can see that one run has appeared in the queue' to the '1-cmt-pk-v1' entry in the sidebar. The main workspace shows a script editor with the following content:

```
C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10 TVKA = THETA(1)
11 KA = TVKA
12
13 TVCL = THETA(2)
14 CL = TVCL*EXP(ETA(1))
15
16 TVV = THETA(3)
17 V = TVV*EXP(ETA(2))
18 S2 = V
19
20 $ERROR
21
```

To the right of the script editor is a 'Parameters' panel showing 'Initial / Final' values for KA, CL, and V. Below the parameters is a note about FSUBS derivatives. At the bottom of the interface is a results table:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
1-cmt-pk-v1	None									



Run a Model

- While running:

The screenshot shows the Finch Studio software interface. On the left, there's a sidebar with a 'QUEUE' section showing a single process named '1-cmt-pk-v1'. An orange arrow points to this section with the text 'click to view queue'. The main window displays the model code for '1-cmt-pk-v1' and its parameters. The code includes \$PROB, \$INPUT, \$SUBROUTINES, and \$PK sections. Parameters listed include KA, CL, and V. The right side of the interface shows the results table, which currently has one row for '1-cmt-pk-v1' with columns for Model, Description, Ref, nind/nObs, OFV, dOFV, S, C, B, Sig, and Met. A note at the bottom of the results table states: 'Note: Analytical 2nd Derivatives are constructed in FSUBS but are never used. You may insert \$ABBR DERIV2=NO after the first \$PROB to save FSUBS construction and compilation time.' Below the results table, it says 'Recompiling certain components. starting wait'.

click to view queue

```
1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```

Model	Description	Ref	nind/nObs	OFV	dOFV	S	C	B	Sig	Met...
1-cmt-pk-v1	None	100/1400	-6148.10			S	S		3.55	focf

Showing 1 of 3 models



Run a Model

- Run complete:

return to directory panel

The screenshot shows the Finch Studio interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Model Tab:** Evaluate tab is selected.
- Project:** PROJECT Study-F1003-Asian-PK
- DATA:** data/F1003-Asian-PK-Study.csv
- Models:** 1-cmt-pk-v1 (selected), 1-cmt-pk-v2-complete, 1-cmt-pk-v3-complete
- Code Editor:** Displays the model script (1-cmt-pk-v1) with the following content:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Rate=DROP
$DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$ERROR
```
- Parameters:** Initial / Final Theta parameters:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-
- Omega:** Cov Cor parameters:

CL	V
0.0474	
V	0.00
	0.0400
- Sigma:** Proportional parameters:

Proportional
0.0861
- RESULTS Table:** Shows the results for the 1-cmt-pk-v1 model:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	foci
- Console:** Displays the execution log:

```
Elapsed covariance time in seconds: 4.48
Elapsed postprocess time in seconds: 0.14
Elapsed finaloutput time in seconds: 0.66
Done with nonmem execution
F1: ..
execute done
```



Run a Model

- Run complete:

The screenshot shows the Finch Studio software interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Model Tab:** Evaluate tab is selected.
- Project:** Study-F1003-Asian-PK
- DATA:** data/F1003-Asian-PK-Study.csv
- MODELS:** 1-cmt-pk-v1 (selected), 1-cmt-pk-v2-complete, 1-cmt-pk-v3-complete
- Code Editor:** Displays the model script (1-cmt-pk-v1) with the following content:

```
C: > Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Rate=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```
- RESULTS Table:**

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	foci
- Parameters Panel:** Shows Initial / Final values for Theta parameters: KA (0, 0.895), CL (0, 16.2), V (0, 82.1).
- Scripts Panel:** Shows covariance matrices for Omega and Sigma, and execution logs indicating the model has been run and completed successfully.



View Model Results

- Key run results are automatically displayed in table on RESULTS tab:

The screenshot shows the Finch Studio interface with the Model tab selected. On the left, the project structure is visible, including a file named 'data/F1003-Asian-PK.csv'. The central area displays the model code:

```
C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Rate=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```

To the right, the Parameters and Scripts sections are shown. Below them, the RESULTS table displays the following data:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	foci

An orange arrow points from the text "Results automatically appear in table" to the RESULTS table.

RESULTS table details:
Showing 1 of 3 models

RESULTS table data:
Model: 1-cmt-pk-v1
Description: None
nInd/nObs: 100/1400
OFV: -6148.10
dOFV: (empty)
S: S
C: S
B: (empty)
Sig.: 3.55
Met.: foci

Parameters section data:
Initial / Final
exp(0) Theta
Name Lower Initial Upper
KA [1/hr] 0 0.895 -
CL [L/hr] 0 16.2 -
V [L] 0 82.1 -

Scripts section data:
Elapsed covariance time in seconds: 4.48
Elapsed postprocess time in seconds: 0.14
Elapsed finaloutput time in seconds: 0.66
Done with nonmem execution
File ..
execute done

RESULTS table data:
Model: 1-cmt-pk-v1
Description: None
nInd/nObs: 100/1400
OFV: -6148.10
dOFV: (empty)
S: S
C: S
B: (empty)
Sig.: 3.55
Met.: foci



View Model Results

- Key run results are automatically displayed in table on **RESULTS** tab:

The screenshot shows the Finch Studio interface with the 'RESULTS' tab selected. The main area displays a table of model run results. To the right of the table is a dropdown menu titled 'Columns' containing various statistical and diagnostic metrics. An orange arrow points from the text 'select which columns to display in table' to this 'Columns' dropdown.

RESULTS tab content (approximate data):

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	focel

Column selection dropdown (approximate items):

- Model
- Description
- Ref
- nInd/nObs
- OFV
- dOFV
- AIC
- BIC
- S
- C
- B
- Sig Digs
- Method

select which
columns to display
in table



View Model Results

- PARAMETERS tab:

The screenshot shows the Phoenix WinNonlin software interface. The top menu bar includes File, Edit, View, Window, Help, Model, and Evaluate. The title bar indicates the project is "Study-F1003-Asian-PK" and the model is "1-cmt-pk-v1". The left sidebar shows the directory "C:\Users\nonmem_template\Documents\PROJECT Study-F1003-Asian-PK" and lists models: 1-cmt-pk-v1, 1-cmt-pk-v2-complete, and 1-cmt-pk-v3-complete. The main workspace displays the model code:

```
C: > Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v1
1 $PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
2
3 $INPUT ID TIME EVID AMT DV RACEN WTKG Rate=DROP
4
5 $DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(1))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(2))
19 S2 = V
20
21 $ERROR
```

The RESULTS table shows the following data for the 1-cmt-pk-v1 model:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	foci

The right panel is titled "Parameters" and shows the "Initial / Final" section for the "Theta" group. The table includes columns for Name, Lower, Initial, and Upper. The "Initial" values are highlighted in blue.

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

An orange arrow points to the "Initial" column of the first row (KA), with the text "click to view final parameter estimates".



View Model Results

- PARAMETERS tab:

The screenshot shows the Finch Studio software interface. The top navigation bar includes File, Edit, View, Window, Help, Model, and Evaluate. The Model tab is active, displaying a script named "1-cmt-pk-v1". The script content is as follows:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA ".../data/F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRAN$2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$ERROR
```

The Parameters tab shows the following parameter estimates:

Parameter	Initial	Final	RSE(%)	Shr...
KA (1/hr)	0.895	0.784	1.23	
CL (L/hr)	16.2	16.9	3.95	
V (L)	82.1	84.1	3.44	

The RESULTS tab displays the following model statistics:

Model	Description	Ref	nind/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	focei

The CONSOLE tab shows the following output:

```
6.46
Elapsed covariance time in seconds:
4.48
Elapsed postprocess time in seconds:
0.14
Elapsed finaloutput time in seconds:
0.66
Done with nonmem execution
F:1 ..
execute done
```



View Model Results

- PARAMETERS tab:

The screenshot shows the Finch Studio interface with the following details:

- Model Tab:** Displays the model code for "1-cmt-pk-v1".

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA ../../data/F1003-Asian-PK-Study.csv IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$ERROR
```
- Evaluate Tab:** Shows the results table for the model.

Model	Description	Ref	nind/nObs	OFV	dOFV	S	C	B	Sig...	Met...
1-cmt-pk-v1	None	100/1400	-6148.10			S	S		3.55	focei
- Parameters Tab:** Displays parameter estimates.

Parameter	Initial	Final	RSE(%)	Shr...
KA (1/hr)	0.895	0.784	1.23	
CL (L/hr)	16.2	16.9	3.95	
V(L)	82.1	84.1	3.44	

Parameter	Final	CV(%)	RSE(%)	Shr...
CL	0.150	40.2	14.2	0.51
OM(1, ...)	0.00	-	-	-
V_	0.108	33.8	14.3	1.17

Parameter	Final	CV(%)	RSE(%)	Shr...
Propo...	0.0207	14.4	3.79	6.98
- CONSOLE Tab:** Displays the run outcome and error messages.

```
6.46
Elapsed covariance time in seconds: 4.48
Elapsed postprocess time in seconds: 0.14
Elapsed finaloutput time in seconds: 0.66
Done with nonmem execution
F:1 ...
execute done
```

run outcome /
error messages



View Model Results

- PARAMETERS tab:

The screenshot shows the Finch Studio interface with the Model and Parameters tabs selected.

Model Tab Content:

```
29
30 ✓ $THETA
31 (0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
32 (0, 16.2) ; CL ; L/hr ; Clearance
33 (0, 82.1) ; V ; L ; Volume of Distribution
34
35 ✓ $OMEGA_BLOCK(2)
36 0.0474 ; CL
37 0.00 0.0400 ; V
38
39 ✓ $SIGMA
40 0.0861 ; Proportional
41
```

Parameters Tab Content:

	Initial	Final	RSE(%)	Shr...
KA (1/hr)	0.05	0.784	1.23	
CL (L/hr)	1.2	16.9	3.95	
V (L)	8.1	84.1	3.44	
CL_	0.150	40.2	14.2	0.51
OM(1, ...)	0.00	-	-	
V_	0.108	33.8	14.3	1.17
Propo...	0.207	14.4	3.79	6.98

Below the table, the status bar indicates: "MINIMIZATION SUCCESSFUL", "NO. OF FUNCTION EVALUATIONS USED: 158", "NO. OF SIG. DIGITS IN FINAL EST.: 3.5".

Execution details at the bottom include:
Elapsed covariance time in seconds: 4.48
Elapsed postprocess time in seconds: 0.14
Elapsed finaloutput time in seconds: 0.66
Done with nonmem execution
F:1 ..
execute done

Displayed parameter names can be defined in the control stream



View Model Results

- PARAMETERS tab:

The screenshot shows the Finch Studio interface with the 'Model' tab selected. The central area displays a model script for a 1-cmt pharmacokinetic model. The 'PARAMETERS' tab is also visible, showing parameter estimates, their standard errors, and relative standard errors (RSE%). The 'OMEGA' section of the parameters table is highlighted with orange arrows pointing to specific rows.

Model Script (1-cmt):

```
1 $PROB Model112
2
3 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
4
5 $DATA ../../data/NM_data.csv IGNORE=C
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA*EXP(ETA(1))
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(2))
16
17 TVV = THETA(3)
18 V = TVV*EXP(ETA(3))
19 S2 = V
20
21
22 $THETA
23 (0, .5) ; KA ; 1/hr ; Absorption rate constant
24 (0, 5 ) ; CL ; L/hr ; Clearance
25 (0, 20) ; V2 ; L ; Volume of distribution
26
27
28 $OMEGA BLOCK(3)
```

Parameters Table:

	Initial	Final	RSE(%)
KA (1/hr)	0.500	0.317	14.9
CL (L/hr)	5.00	14.1	7.3
V2 (L)	20.0	1.68	19.5

	Final	CV(%)	RSE(%)	Shrink(%)
COV(KA,KA)	0.175	43.8	127	20.99
OM(1,2)	0.00	0.00	Infinity	-
COV(CL,CL)	0.16	42.2	30.6	22.04
OM(1,3)	0.00	0.00	Infinity	-
OM(2,3)	0.00	0.00	Infinity	-
COV(V,V)	0.0304	1.5	434	95.31

	Final	CV(%)	RSE(%)	Shrink(%)
Proportional	0.143	37.9	27.3	9.19
SIG(1,2)	0.00	0.00	Infinity	-
Additive	0.0164	12.8	34.7	9.19

FEATURES

back-transform log
transformed thetas
(e.g., if MU referencing)

hide omegas
fixed to zero

select equation for
%CV calculation



View Model Results

- PARAMETERS tab:

The screenshot shows the Finch Studio interface with the Model tab selected. The central area displays a pharmacokinetic model script for a 1-cmt study. The Parameters tab is open, showing a table of estimated parameters (Initial/Final) and their associated Omega variance parameters. An orange arrow points to the Omega row for the covariance term COV(V,V), which has a value of 0.0304.

	Initial	Final	RSE(%)
KA (1/hr)	1.65	1.37	14.9
CL (L/hr)	148	1.32e+6	7.3
V2 (L)	4.85e+8	5.37	19.5

	Final	CV(%)	RSE(%)	Shrink(%)
COV(KA,KA)	0.175	43.8	127	20.99
OM(1,2)	0.00	0.00	Infinity	-
COV(CL,CL)	0.164	42.2	50.6	22.04
OM(1,3)	0.00	0.00	Infinity	-
OM(2,3)	0.00	0.00	Infinity	-
COV(V,V)	0.0304	17.6	434	95.31

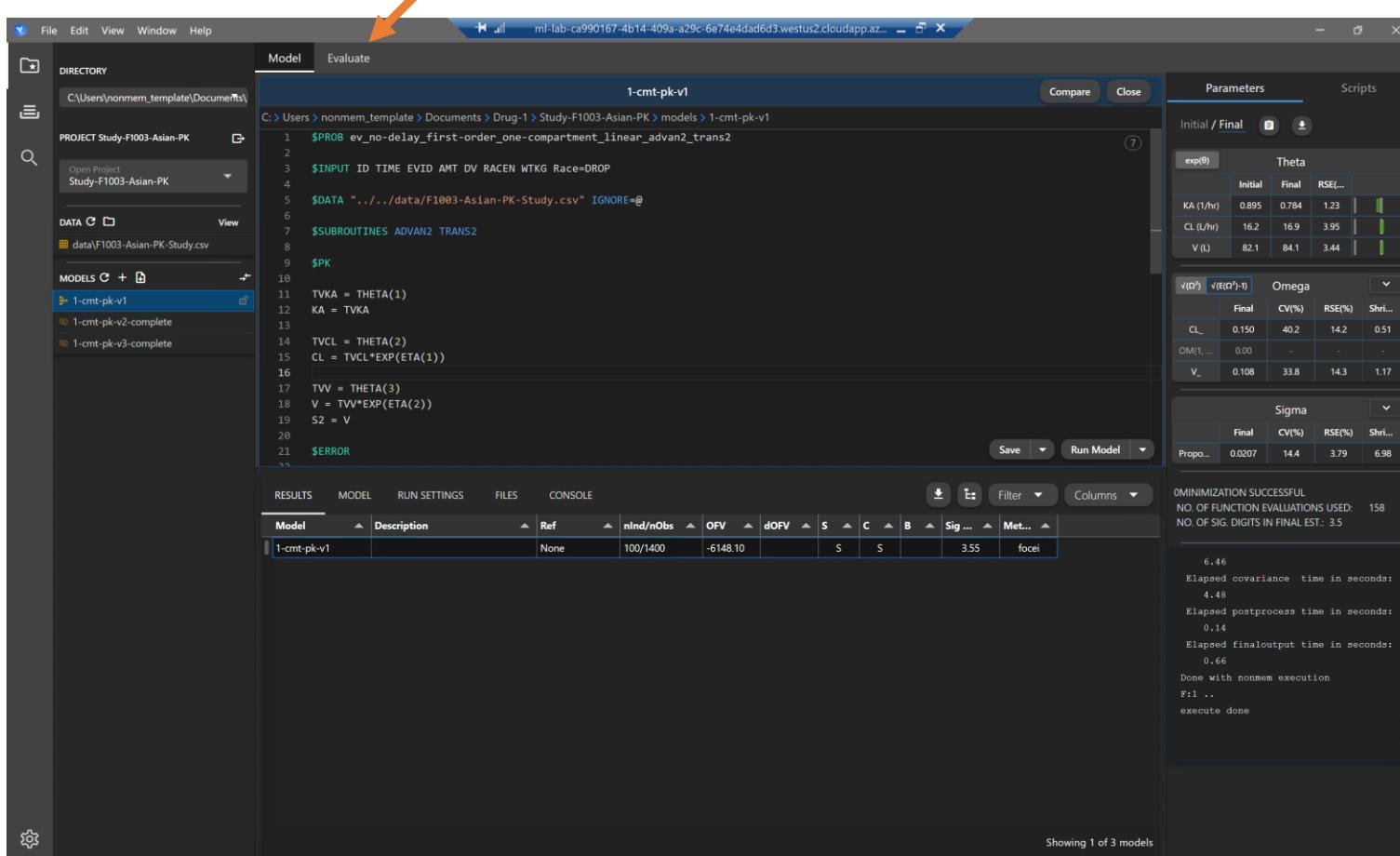
Eta-Bar:	-0.000613	Sigma		
P-Value:	0.451	Final	CV(%)	RSE(%)
Proportional	0.143	37.9	27.3	9.19
SIG(1,2)	0.00	0.00	Infinity	-
Additive	0.0164	12.8	34.7	9.19

hover over omega
variance parameters to
see eta-bar and p-value;
if $p < 0.05$, row will be
highlighted in yellow



Evaluate Model Results – Diagnostic Plots

- Let's check out some diagnostic plots to Evaluate the model fit.



The screenshot shows the NONMEM software interface. The top navigation bar has tabs for 'Model' and 'Evaluate'. The 'Evaluate' tab is highlighted with an orange arrow. The main workspace displays a script named '1-cmt-pk-v1' which includes code for \$PROB, \$INPUT, \$DATA, \$SUBROUTINES, and \$PK. To the right of the script are two tables: 'Parameters' and 'Scripts'. The 'Parameters' table shows initial and final values for Theta parameters: KA (0.895), CL (16.2), and V (82.1). The 'Scripts' table shows final values for Omega parameters: CL (0.150), OM (0.00), and V (0.108). Below the script and parameter tables is a 'RESULTS' table with columns for Model, Description, Ref, nind/nObs, OFV, dOFV, S, C, B, Sig, and Met. The '1-cmt-pk-v1' row is selected. At the bottom of the screen, there is a 'CONSOLE' window displaying command-line output related to the optimization process.

Model	Description	Ref	nind/nObs	OFV	dOFV	S	C	B	Sig	Met..
1-cmt-pk-v1	None	100/1400	-6148.10			S	S		3.55	focei

RESULTS MODEL RUN SETTINGS FILES CONSOLE

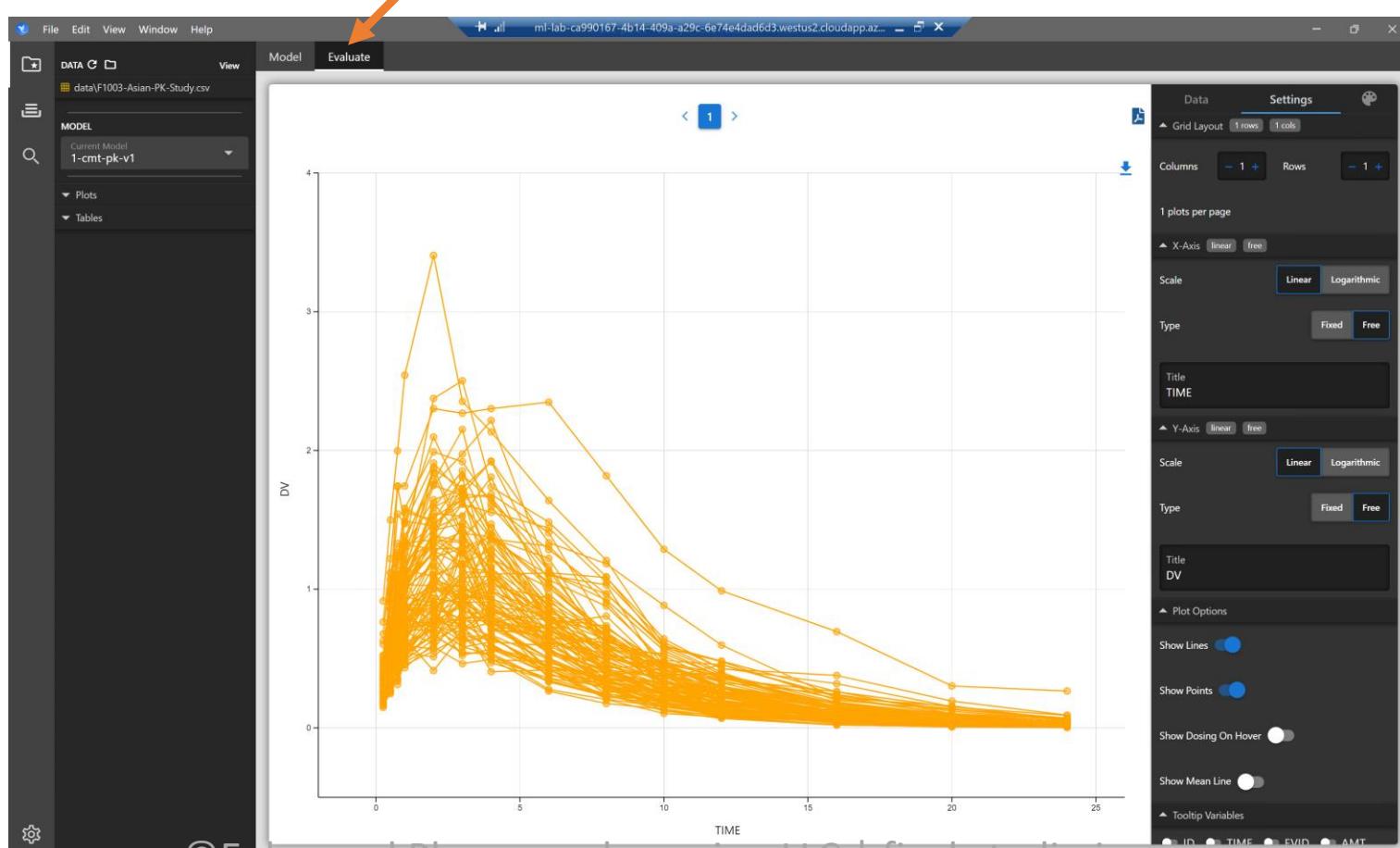
Showing 1 of 3 models

```
6.46
Elapsed covariance time in seconds: 4.48
Elapsed postprocess time in seconds: 0.14
Elapsed finaloutput time in seconds: 0.66
Done with nonmem execution
F:1 ...
execute done
```



Evaluate Model Results – Diagnostic Plots

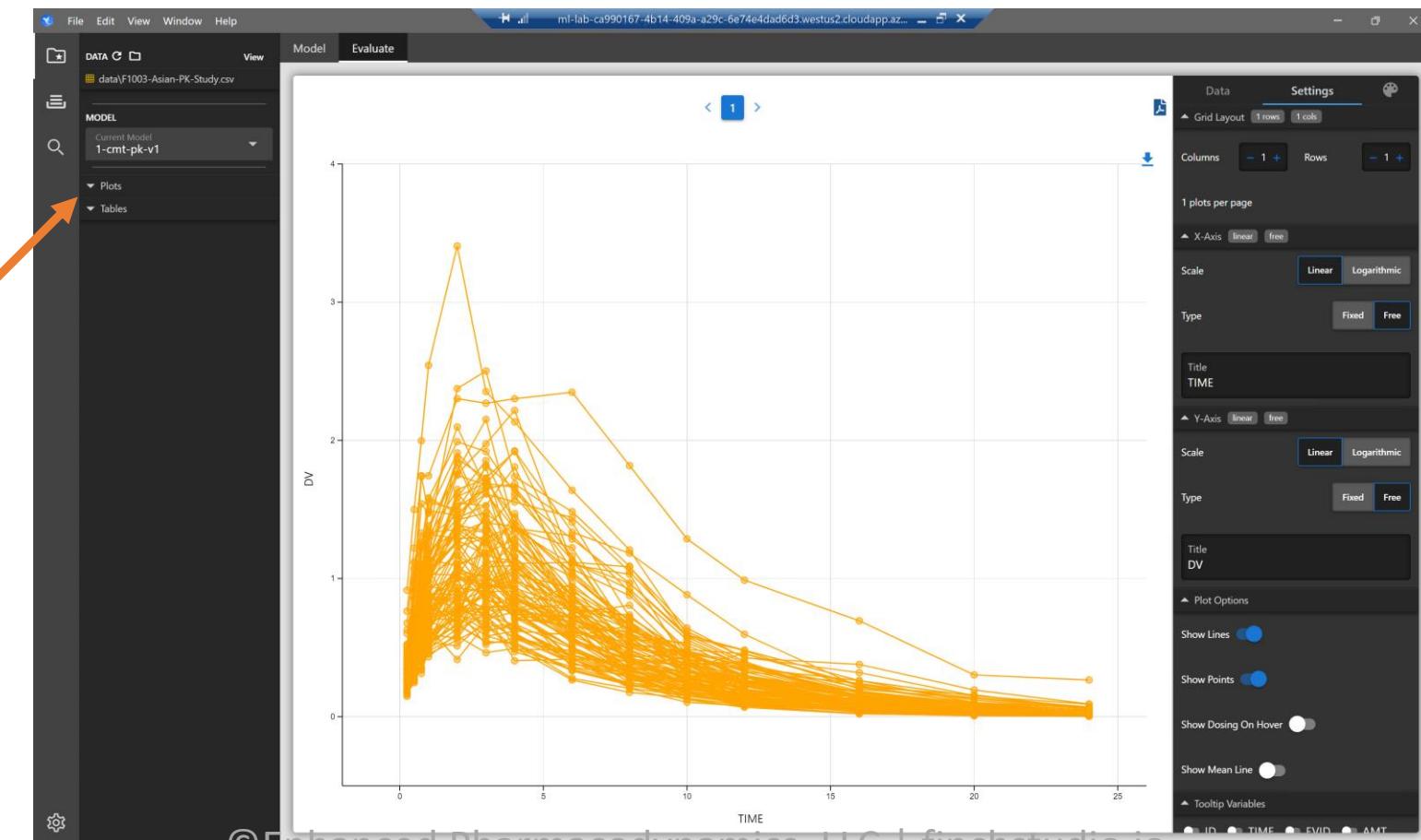
- Let's check out some diagnostic plots to Evaluate the model fit.





Evaluate Model Results – Diagnostic Plots

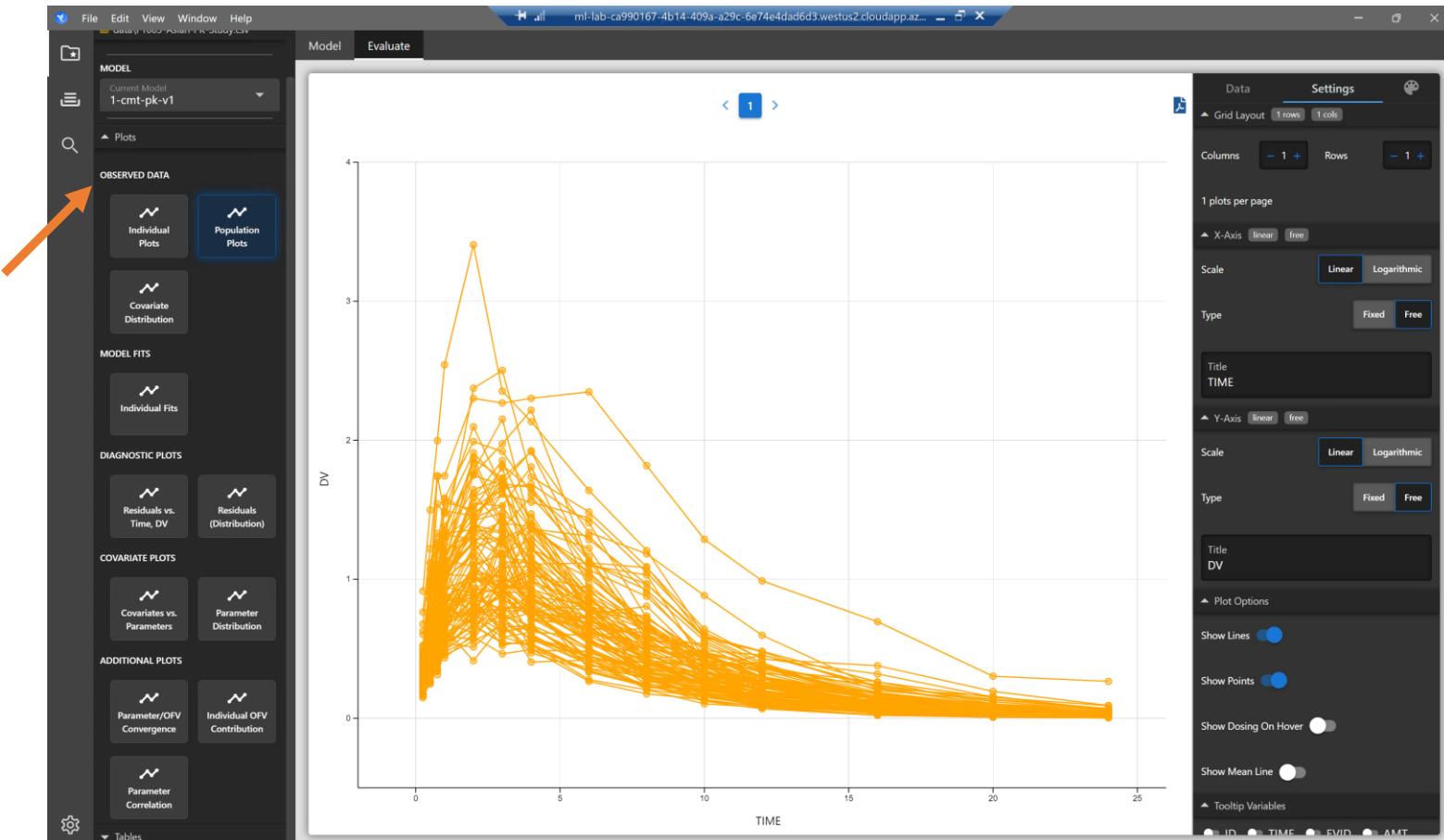
- On the Evaluate tab, expand the *Plots* menu in the left panel:





Evaluate Model Results – Diagnostic Plots

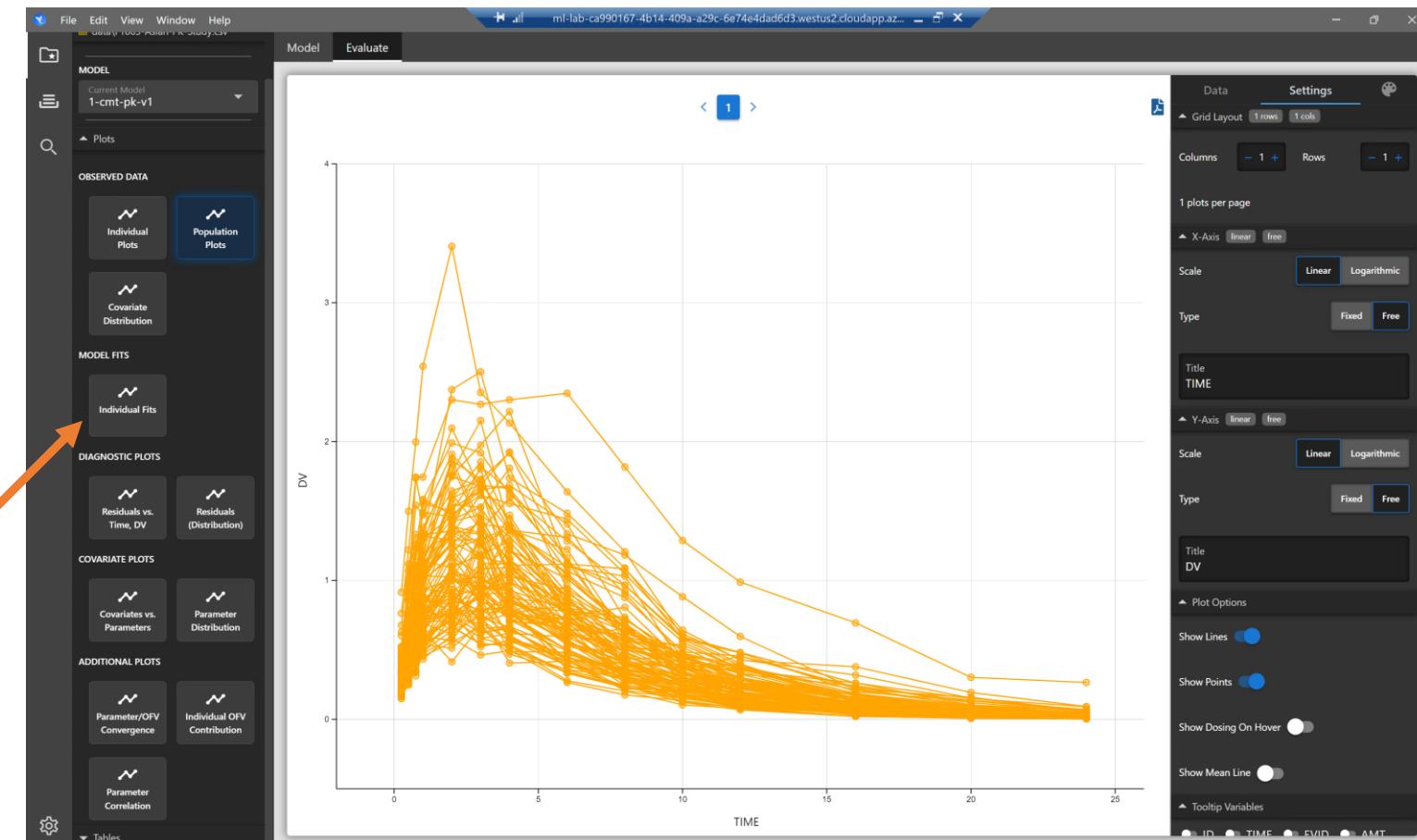
- On the Evaluate tab, expand the *Plots* menu in the left panel:





Evaluate Model Results – Diagnostic Plots

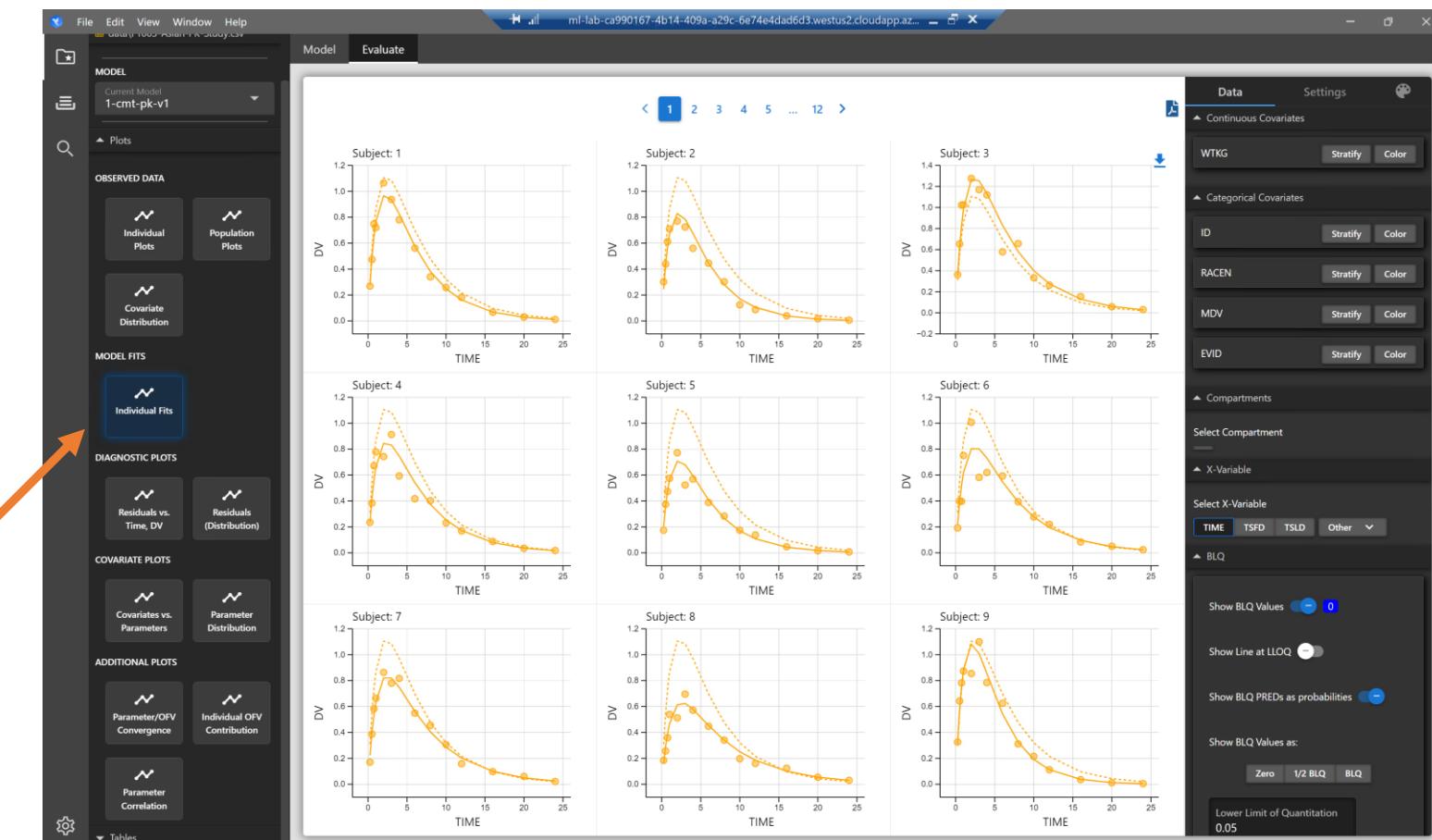
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

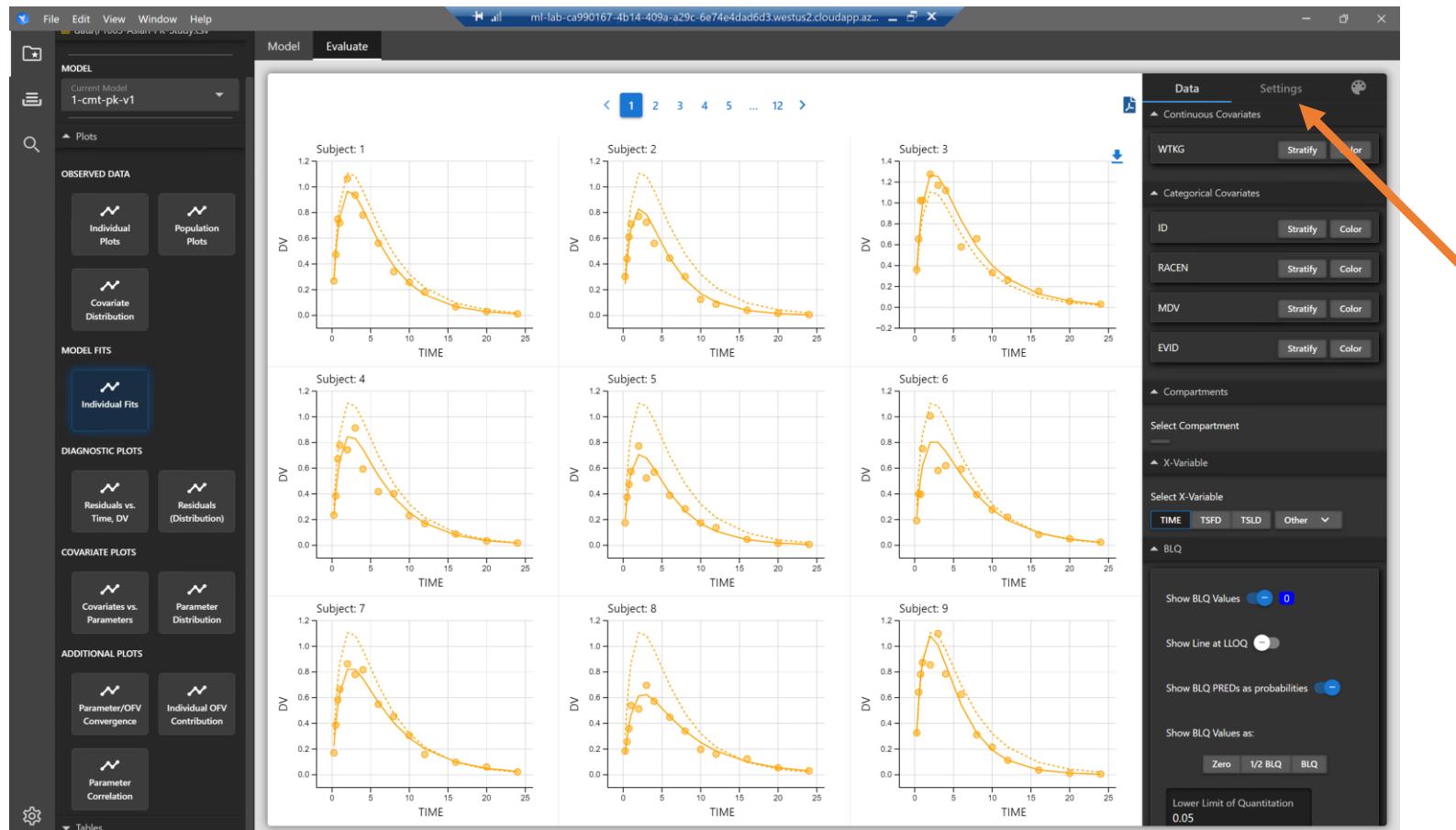
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

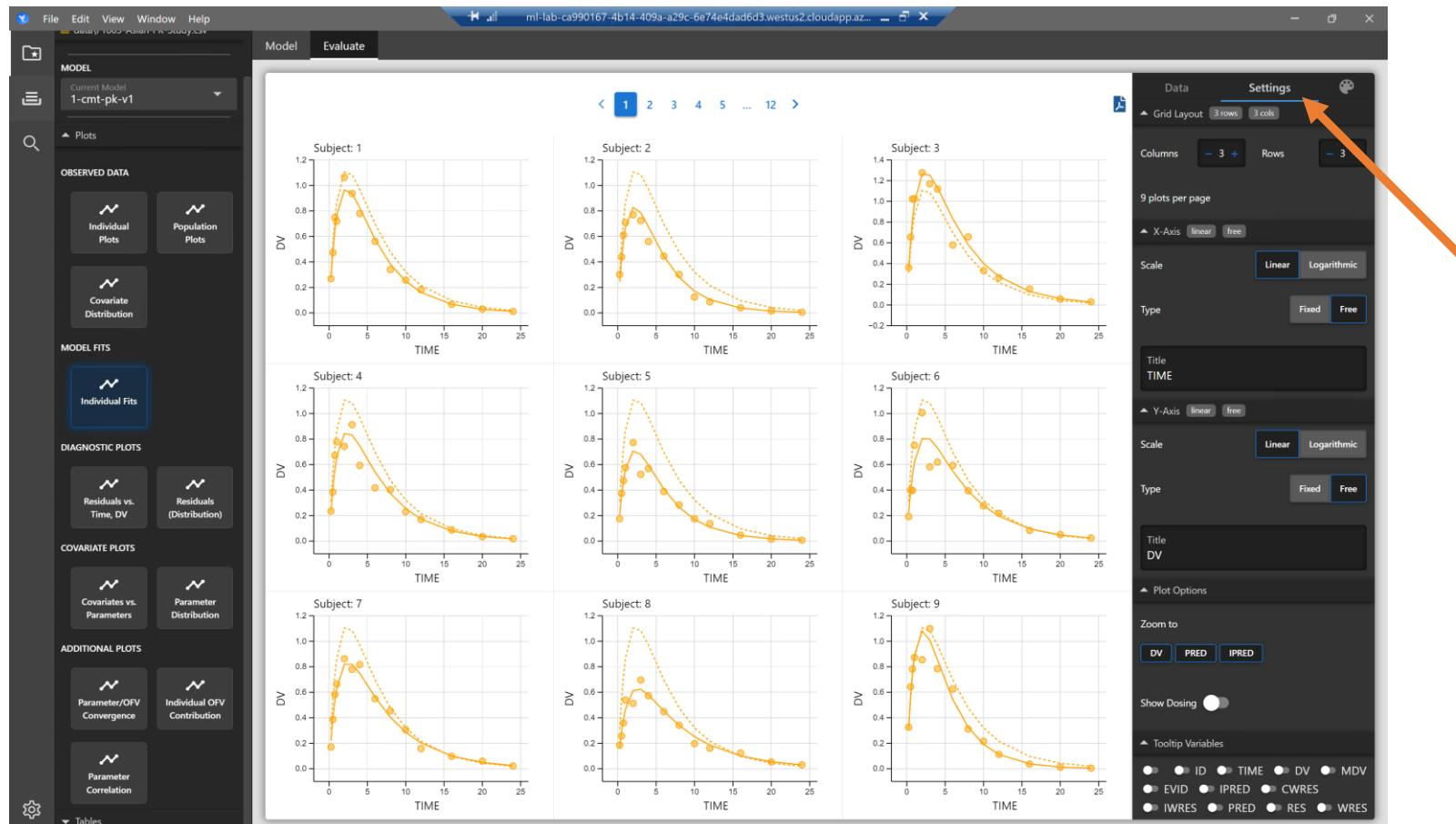
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

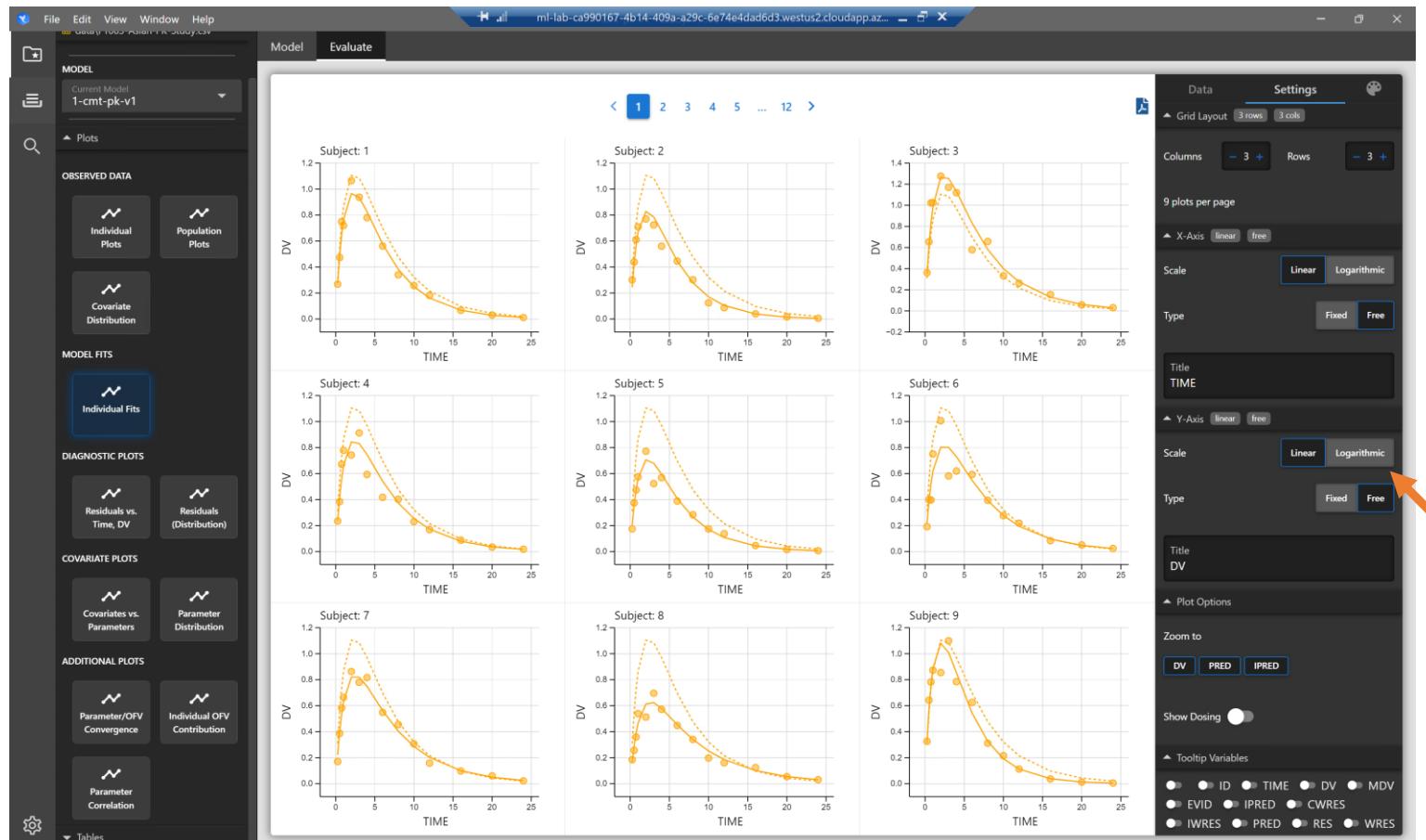
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

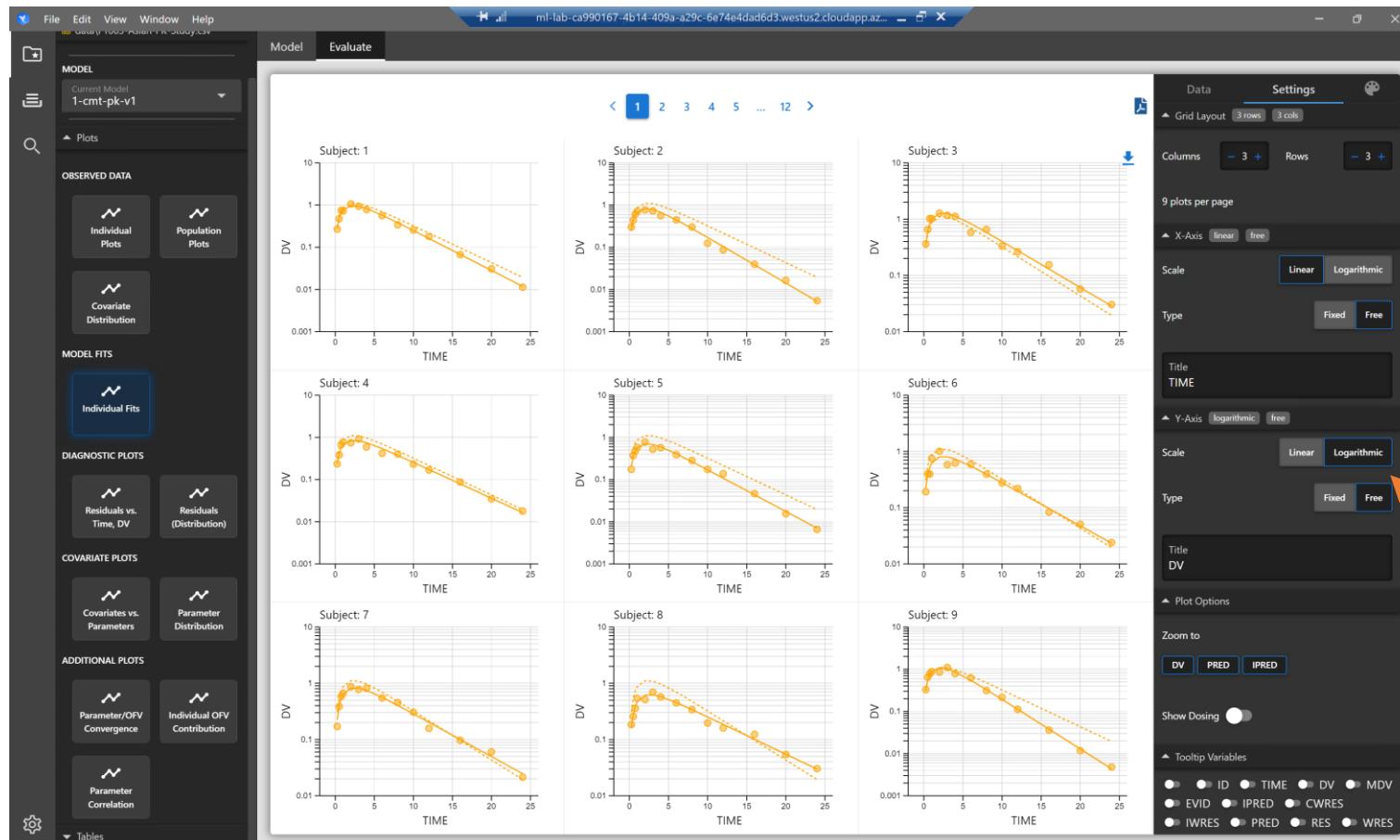
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

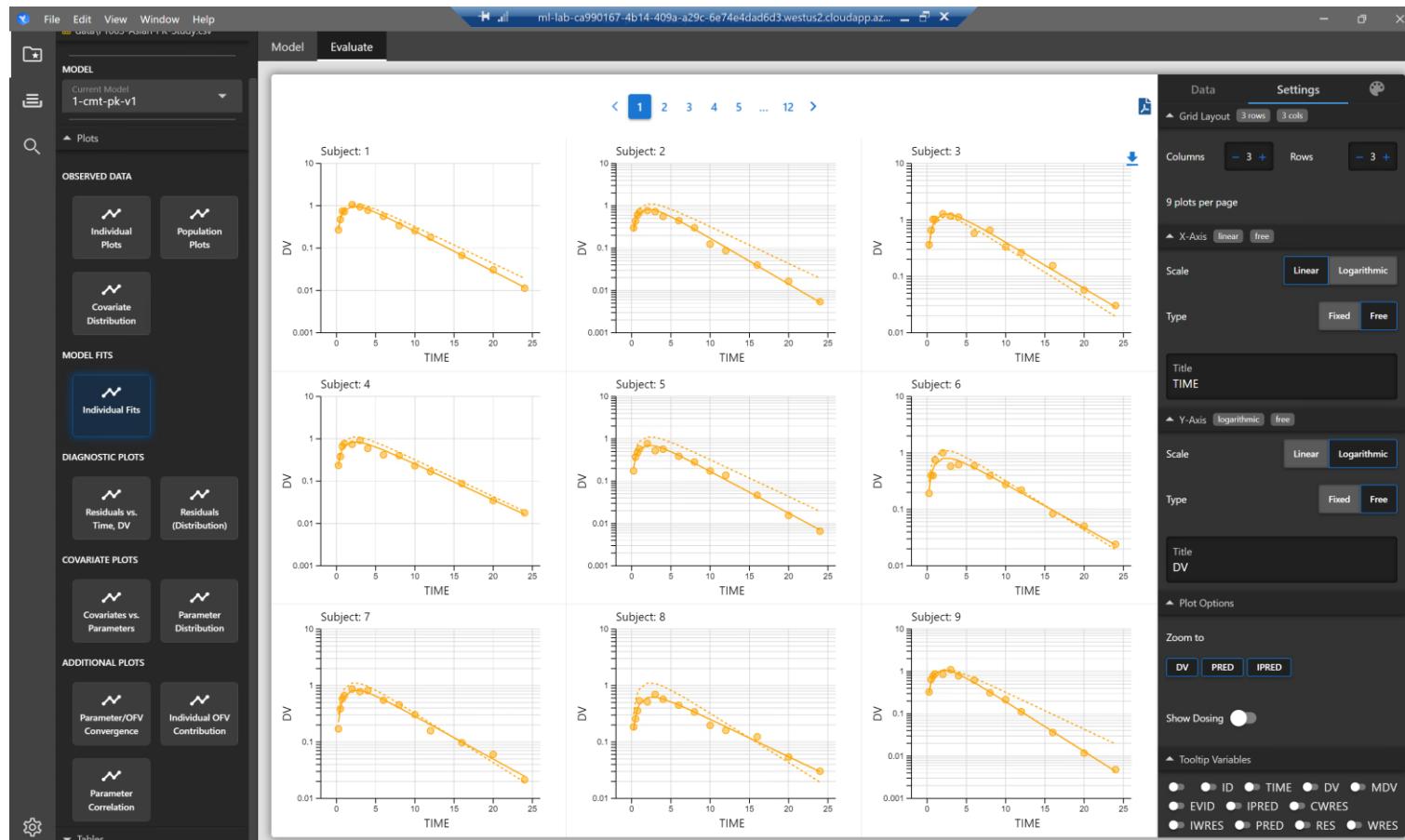
- Let's look at some *Individual Fits*:





Evaluate Model Results – Diagnostic Plots

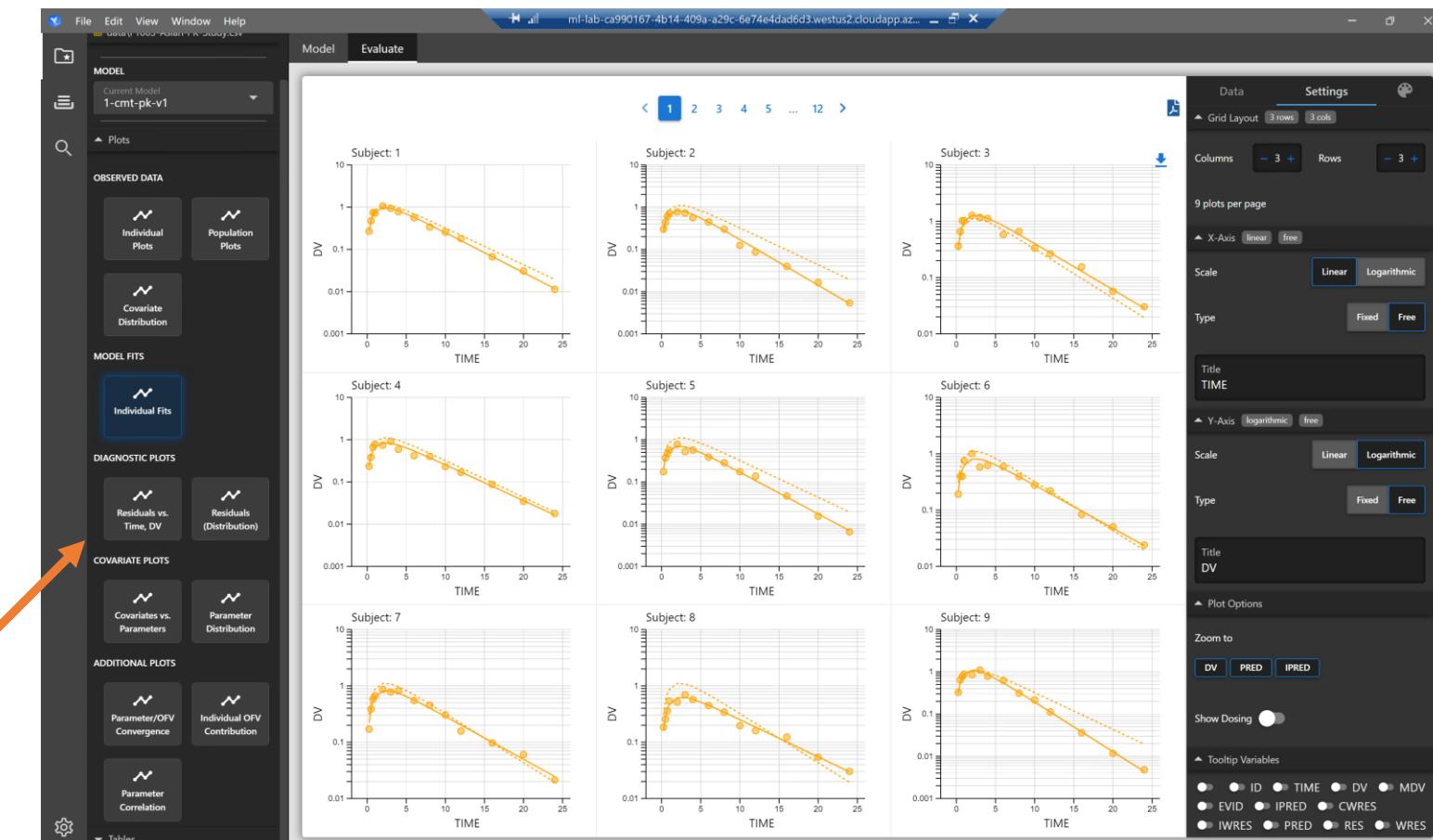
- How do the individual fits look?





Evaluate Model Results – Diagnostic Plots

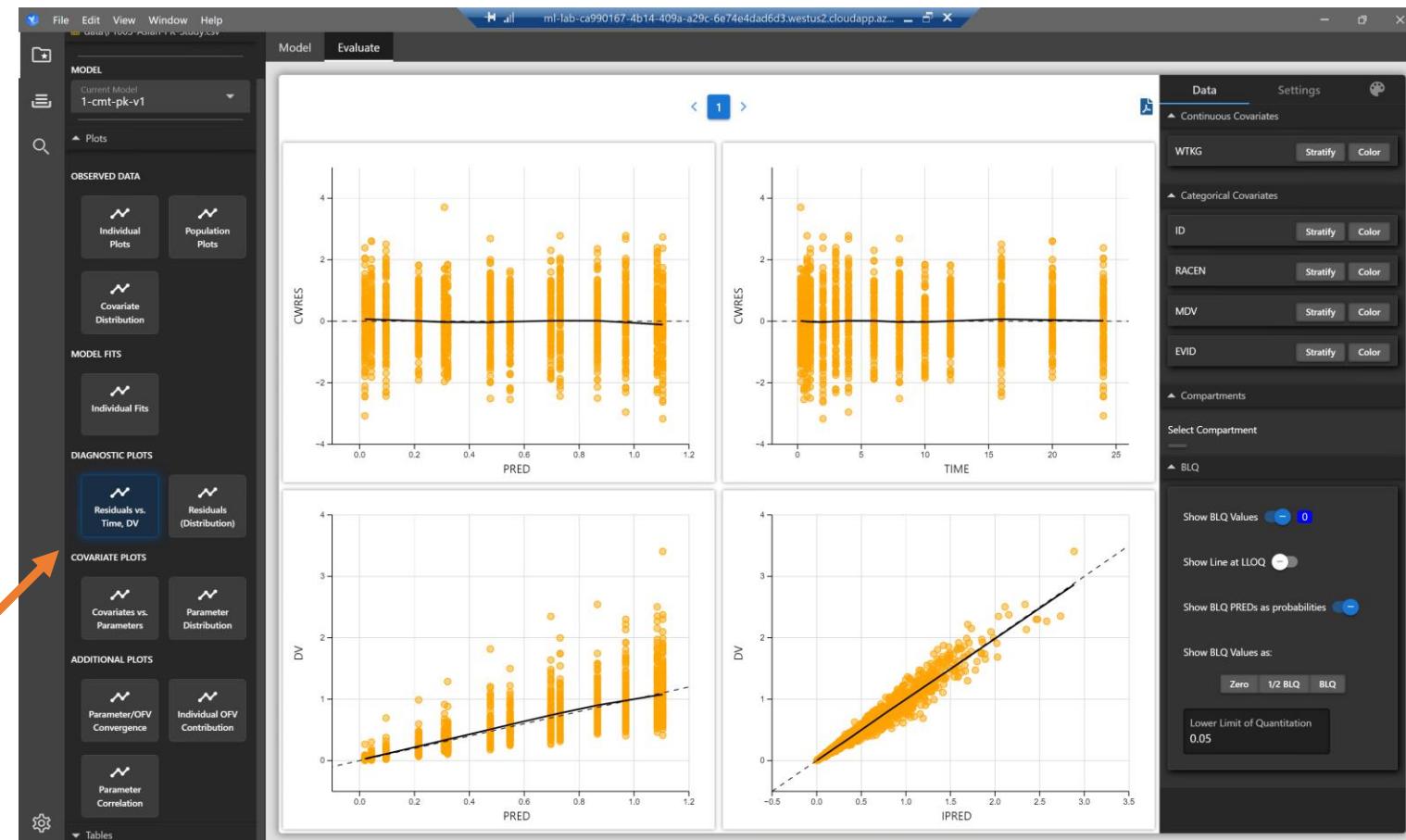
- Now let's look at some residual plots:





Evaluate Model Results – Diagnostic Plots

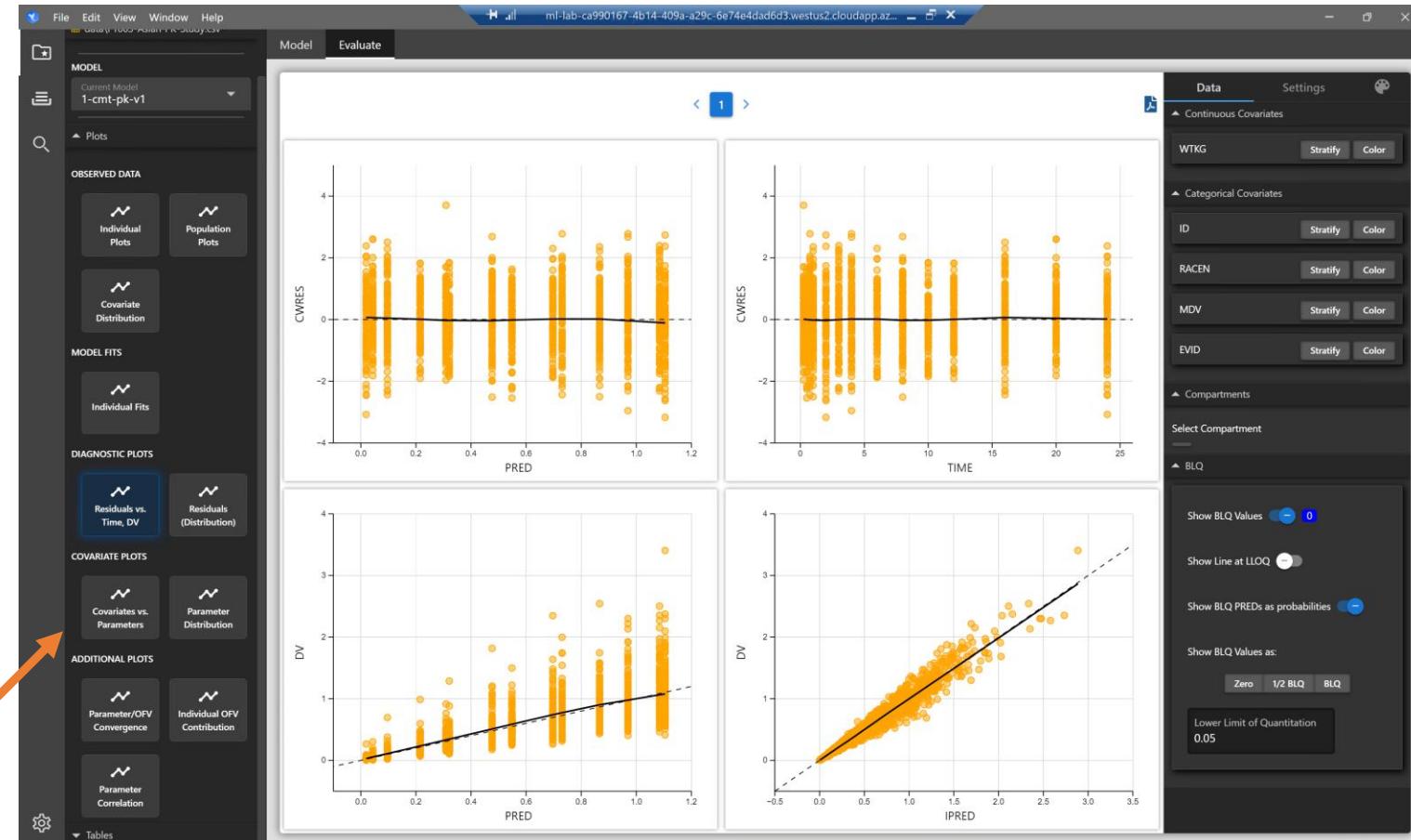
- Now let's look at some residual plots:





Covariate Model Example

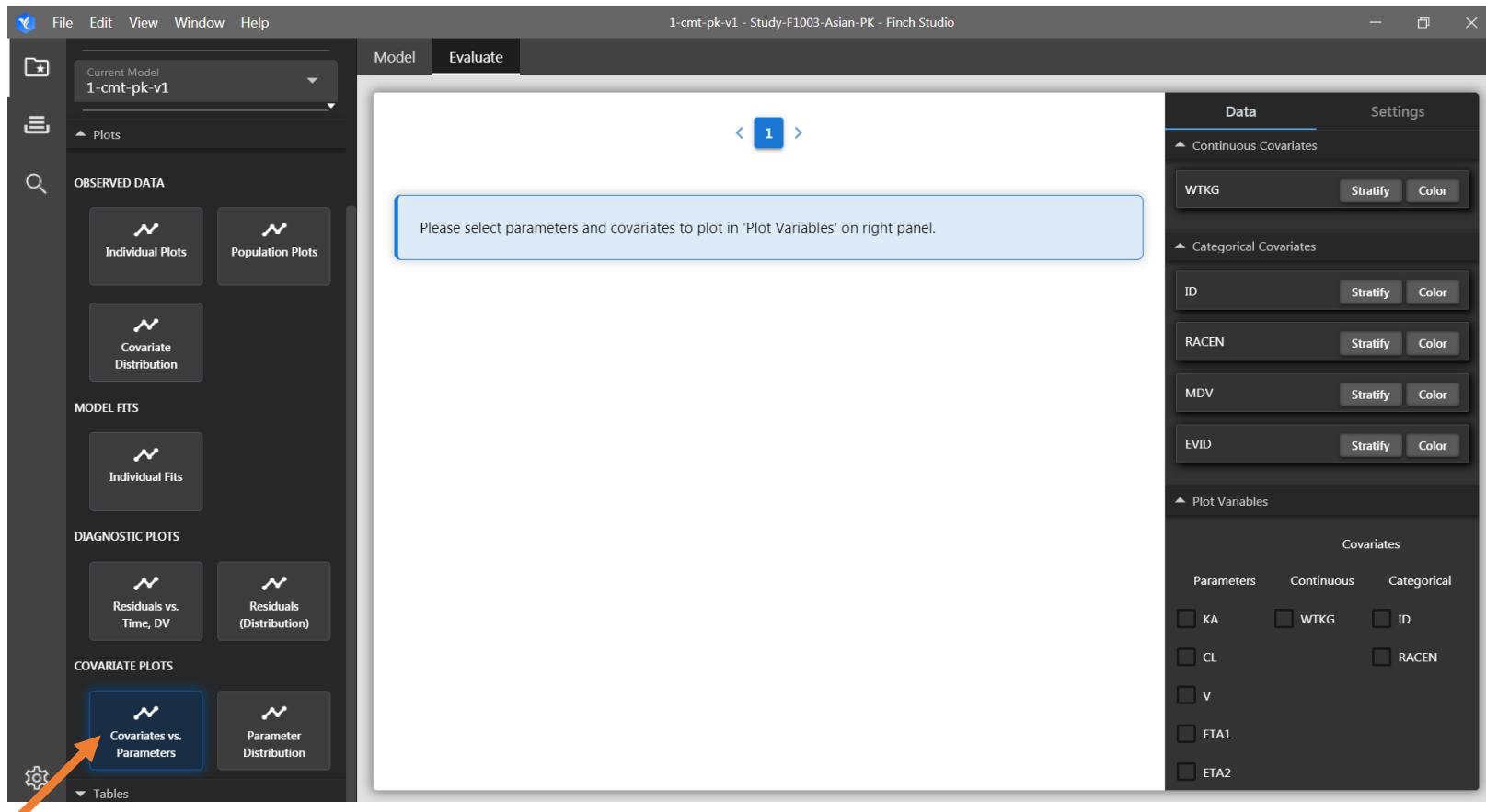
- Generate Covariates vs. Parameters plots for 1-cmt-pk-v1:





Covariate Model Example

- Generate *Covariates vs. Parameters* plots for 1-cmt-pk-v1:





Covariate Model Example

- Generate *Covariates vs. Parameters* plots for 1-cmt-pk-v1:

Please select parameters and covariates to plot in 'Plot Variables' on right panel.

1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio

File Edit View Window Help

Model Evaluate

Current Model
1-cmt-pk-v1

Plots

OBSERVED DATA

Individual Plots Population Plots

Covariate Distribution

MODEL FITS

Individual Fits

DIAGNOSTIC PLOTS

Residuals vs. Time, DV Residuals (Distribution)

COVARIATE PLOTS

Covariates vs. Parameters Parameter Distribution

Data Settings

Continuous Covariates

WTKG Stratify Color

Categorical Covariates

ID Stratify Color

RACEN Stratify Color

MDV Stratify Color

EVID Stratify Color

Plot Variables

Covariates

Parameters Continuous Categorical

KA WTKG ID

CL RACEN

v

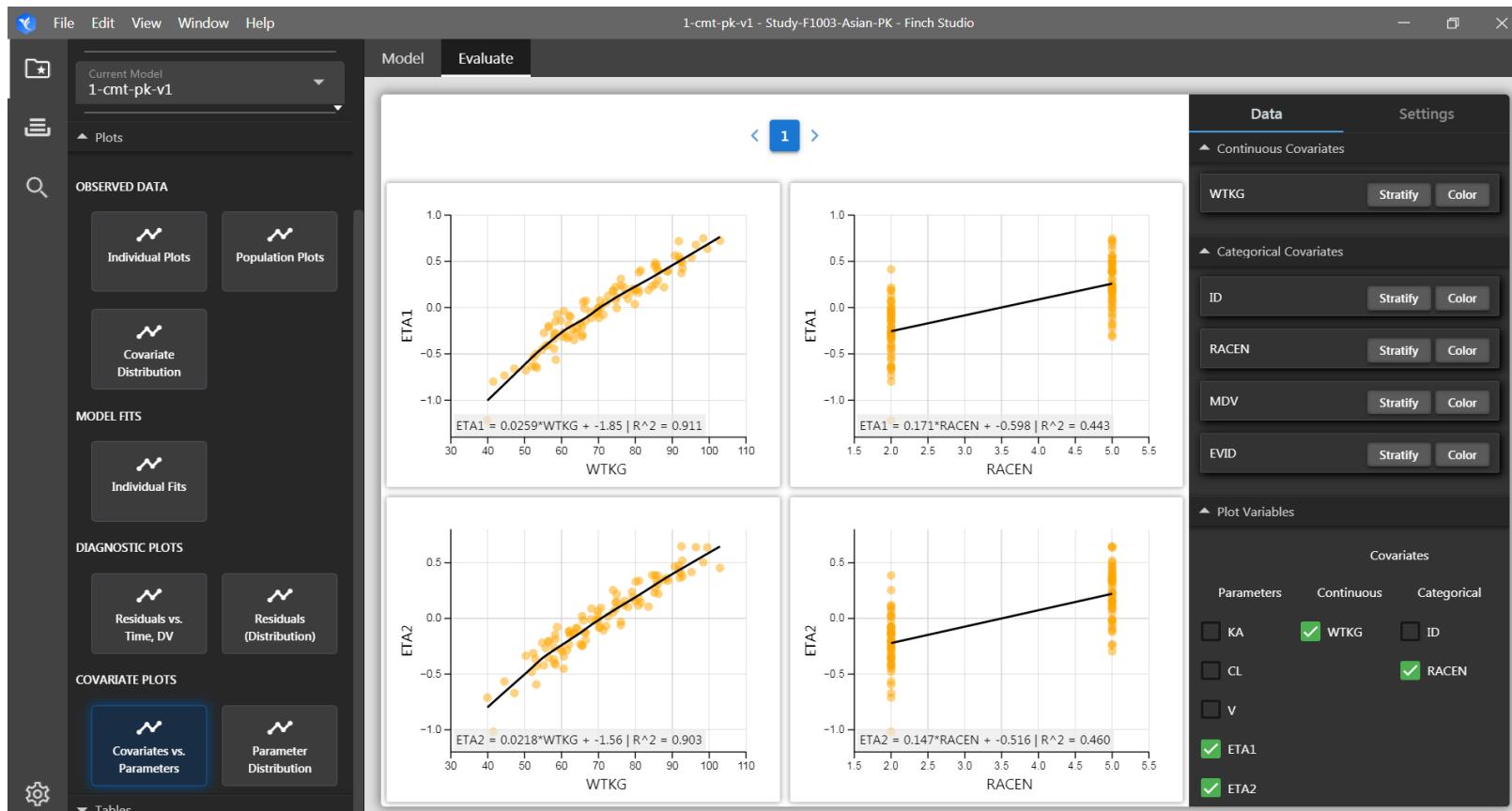
ETA1

ETA2



Covariate Model Example

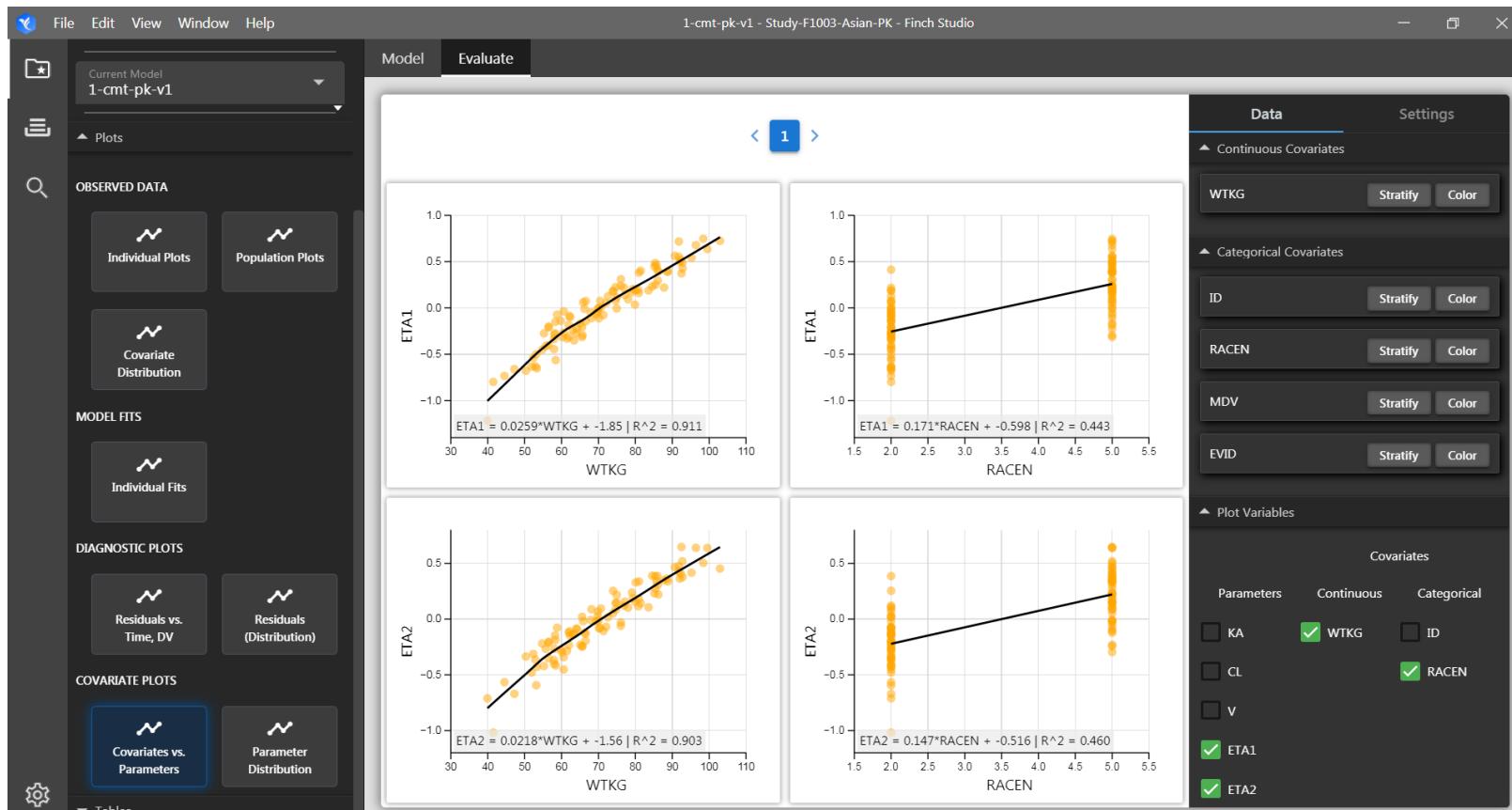
- Generate *Covariates vs. Parameters* plots for 1-cmt-pk-v1:





Covariate Model Example

- Strong relationship between covariates and random effects.
- Need to add covariates into the model!





Covariate Model Example

- Create a new model with a power function of WTKG centered on 71 on CL:
 - Duplicate *1-cmt-pk-v1* to create *1-cmt-pk-v2*.
 - Use the final parameter estimates from the parent model and add a useful description.
 - Remember to add an initial estimate for THETA(4).
- Run the *1-cmt-pk-v2* model.
- Create another new model with a power function of WTKG centered on 71 on V:
 - Duplicate *1-cmt-pk-v2* to create *1-cmt-pk-v3*.
 - Use the final parameter estimates from the parent model and add a useful description.
 - Remember to add an initial estimate for THETA(5).
- Run the *1-cmt-pk-v3* model.
- Explore some useful features of the editor:
 - Documentation on hover
 - Autocompletion
 - Code folding
 - Syntax highlighting
 - Error checking (on Save)

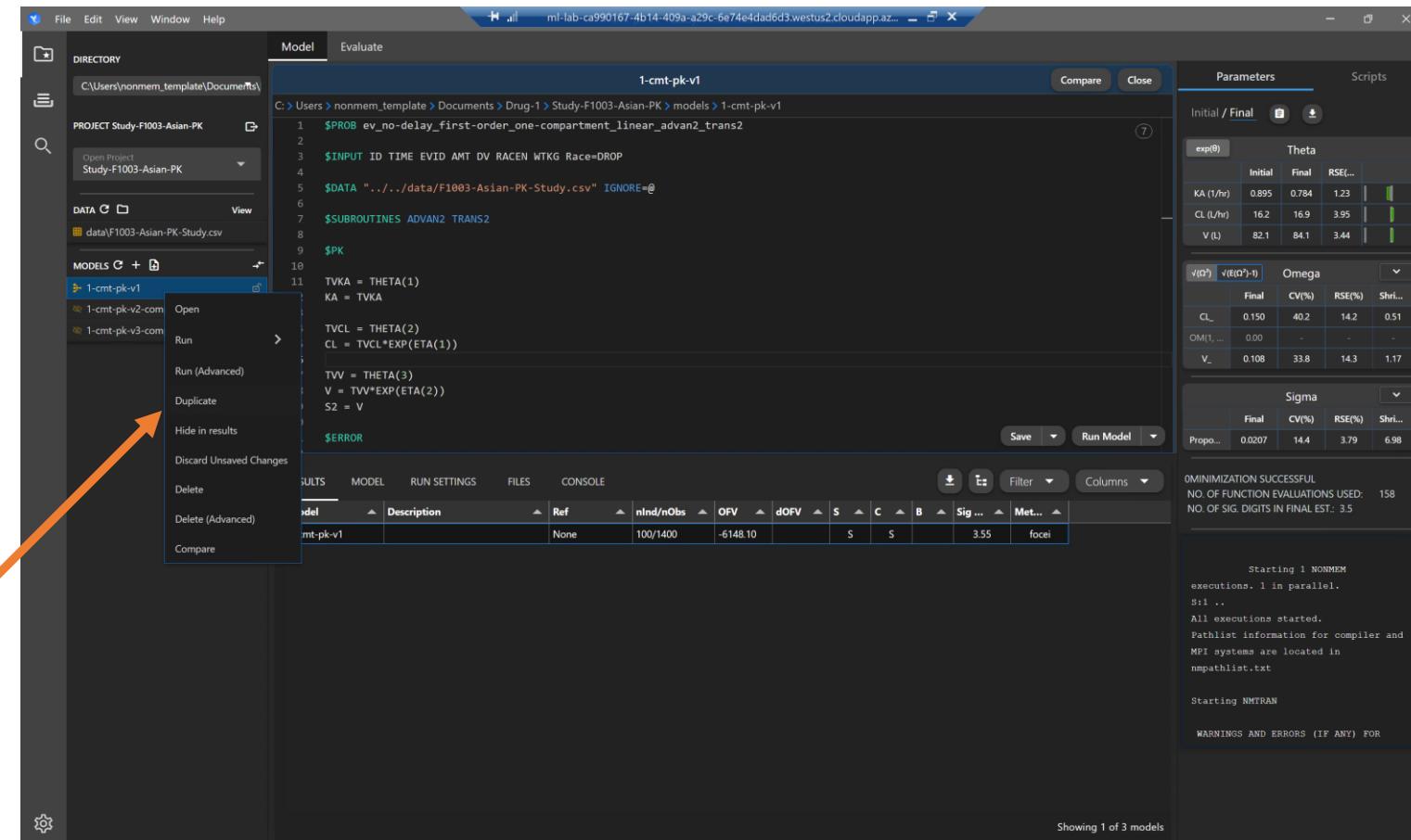
```
TVCL = THETA(2)*(WTKG/71)**THETA(4)  
CL = TVCL*EXP(ETA(1))
```

```
TVV = THETA(3)*(WTKG/71)**THETA(5)  
V = TVV*EXP(ETA(2))
```



Duplicate Model

- Right click on a model and select “Duplicate Model”





Duplicate Model

- If duplicating from a completed model, you may use final estimates as initial estimates for the new model

New model name
Reference model
Option to replace initial estimates with final estimates from parent model

The screenshot shows the Phoenix Modeler interface with the 'Duplicate' dialog box open. The dialog box contains the following fields:

- Model Name:** 1-cmt-pk-v2
- Reference Model:** 1-cmt-pk-v1
- Tags:** (empty)
- Parameters:** A section with a checkbox for "Use Final Estimates from Parent" (which is checked) and a slider for "Significant Digits" set to 3. There is also a checkbox for "Fix Parameter Estimates".
- Description:** Adding WTKG on CL
- Notes:** (empty)
- Buttons:** Duplicate (highlighted in blue)

Arrows from the text labels point to the following areas:

- New model name: Points to the "Model Name" field.
- Reference model: Points to the "Reference Model" dropdown.
- Option to replace initial estimates with final estimates from parent model: Points to the "Use Final Estimates from Parent" checkbox.
- Description for new model: Points to the "Description" text area.
- Notes for new model: Points to the "Notes" text area.



Sidenote – Build a New Model Control Stream

- New model control streams can also be generated as blank model templates:

The screenshot shows the Finch Studio interface with the '2-cmt' model open. The left sidebar displays the project structure under 'PROJECT Study Y'. The 'MODELS' dropdown menu is highlighted with an orange arrow, showing options like '1-cmt', '2-cmt-complete', and '2-cmt' (which is currently selected). The main workspace shows the model code for a 2-compartment pharmacokinetic model. On the right, the 'Parameters' panel shows estimated values for Theta and Omega parameters. The bottom navigation bar includes tabs for 'RESULTS', 'MODEL', 'RUN SETTINGS', and 'CONSOLE'.

```
2-cmt
1
2 $PROB Mode112
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN2 TRANS2
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV = THETA(3 )
19 V = TVV*EXP(ETA(3))
20 S2 = V
21
22
23 $THETA
24 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
25 (0, 14.1) ; CL ; L/hr ; Clearance
26 (0, 1.68) ; V2 ; L ; Volume of distribution
27
28 $OMEGA BLOCK(3)
29 0.125 0.125 0.125
30 0.125 0.125 0.125
31 0.125 0.125 0.125
```



Sidenote – Build a New Model Control Stream

- Or from the built-in Model Library (which is growing every month):

The screenshot shows the Finch Studio interface with the 'Model' tab selected. On the left, there's a sidebar with 'DIRECTORY' (C:\Users\sfcook\Documents\Drug X), 'PROJECT Study Y' (Open Project, Study Y), 'DATA' (data\NM_data.csv), and 'MODELS' (1-cmt, 2-cmt-complete, 2-cmt). The '2-cmt' model is highlighted with a blue selection bar and has an orange arrow pointing to it from the bottom-left. The main central area displays the model code for '2-cmt':

```
1 $PROB Mode112
2
3 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
4
5 $DATA ../../data/NM_data.csv IGNORE=C
6
7 $SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA*EXP(ETA(1))
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(2))
16
17 TVV = THETA(3 )
18 V = TVV*EXP(ETA(3))
19 S2 = V
20
21
22 $THETA
23 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
24 (0, 14.1) ; CL ; L/hr ; Clearance
25 (0, 1.68) ; V2 ; L ; Volume of distribution
26
27
28 $OMEGA BLOCK(3)
29 (0, 125) ; COV(CL,CL) ; Covariance between CL and CL
30 (0, 125) ; COV(V,V) ; Covariance between V and V
31 (0, 125) ; COV(CL,V) ; Covariance between CL and V
```

To the right of the code editor are two tables: 'Parameters' and 'Modules'. The 'Parameters' table shows initial and final values for Theta, Omega, and Sigma. The 'Modules' table shows covariance values for various parameters.



Sidenote – Build a New Model Control Stream

- Or from the built-in Model Library:

The screenshot shows the Finch Studio interface. On the left, there's a sidebar with various project and model management icons. The main workspace is divided into several sections: a top navigation bar with File, Edit, View, Window, Help; a central panel titled "Structural Model" with tabs for Administration, Delay, Absorption, Distribution, and Elimination; a "Parameter Models" section; and a "Statistical Model" section. Below these are two boxes: "Pharmacokinetic Structural Model" and "Model Diagram and Information". The "Model Diagram and Information" box contains tabs for Diagram and Input and Sampling Parameters. At the bottom, there's a "Model Name" field set to "New Model" and a "CREATE" button. To the right of the workspace is a large code editor window displaying R script. The code includes sections for \$PROB, \$INPUT, \$DATA, \$OMEGA, and \$TABLE commands. A vertical bar on the right side of the code editor shows RSE (%) values: 20.99, 22.04, and 95.31, with a "Shrink(%)" button above them. At the bottom of the code editor, it says "Showing 3 of 3 models".

```
$PROB Model12
$INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
$DATA "...\\..\\data\\NM_data.csv" IGNORE=C
Model not found
$OMEGA BLOCK(2)
1; COV(K,K)
1; COV(K,V)
1; COV(V,V)
Model not found
$TABLE ID TIME DV MDV EVID IPRED CWRES IWRES ONEHEADER NOPRINT FILE=patab1 ; model parameters
$TABLE ID K V ONEHEADER NOPRINT FILE=patab1 ; model parameters
$TABLE ID SEX P_TYPE ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
$TABLE ID WTKG AGE ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```



Use the Built-in Text Editor

- A dot appears next to models with unsaved control stream changes.

The screenshot shows the Finch Studio interface with the following details:

- Left Sidebar (DIRECTORY):** Shows the project structure: C:\Users\scook\Documents\Drug X > PROJECT Study Y > DATA > MODELS. The '2-cmt' model is selected and highlighted with a blue background.
- Top Bar:** File, Edit, View, Window, Help. The title bar says "2-cmt - Study Y - Finch Studio".
- Central Editor Area:** A code editor showing a PK model script:

```
1 2 > $PROB Model112 ...
4   $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANSA4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3)
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28 (0, 14.1) ; CL ; L/hr ; Clearance
29 (0, 1.68) ; V2 ; L ; Volume of distribution
30 (0, 6.25) ; Q ; L/min ; Total clearance
31
```
- Right Panel (Parameters):** Shows parameters for the 'exp(0)' component under the 'Theta' section. The table includes columns for Initial, Final, CV(%), RSE(%), and Shrink(%).

	Initial	Final	CV(%)	RSE(%)	Shrink(%)
COV(K,KA)	0.175	43.8	127	20.99	-
OM(1,2)	0.00	0.00	Infinity	-	-
COV(CL,CL)	0.164	42.2	30.6	22.04	-
OM(1,3)	0.00	0.00	Infinity	-	-
OM(2,3)	0.00	0.00	Infinity	-	-
COV(V,V)	0.0304	17.6	434	95.31	-
- Bottom Panel (RESULTS):** A table showing model results for three models: 1-cmt, 2-cmt-complete, and 2-cmt. The table includes columns for Model, Description, Ref, nInd/nObs, OFV, dOFV, S, C, B, Sig Digs, and Method.

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt-complete		None								
2-cmt	2 cmt model, combined RUV	1-cmt								



Use the Built-in Text Editor

- A sidenote about file naming convention used by Finch...

For each model, Finch displays the path to the control stream at the top of the text editor.

Click anywhere within the path to open the corresponding directory in *File Explorer*.

Open the directories for 2-cmt and 1-cmt to examine the contents.

The screenshot shows the Finch Studio interface with the 'Model' tab selected. The title bar displays the path: C:\Users>sfcook>Documents>Drug X>Study Y>models>2-cmt. An orange arrow points to this path. The main area contains the following code:

```
39
40 $ERROR
41
42 IPRED=F
43 IRES=DV-IPRED
44 W=SQRT(IPRED**2*SIGMA(1,1)+SIGMA(2,2))
45 IWRES=IRES/W
46
47 Y = F + F*EPS(1) + EPS(2)
48
49 $SIGMA
50 0.143 ; Proportional
51 0.0164 ; Additive
52
53
54 $ESTIMATION METHOD=CONDITIONAL INTERACTION MAXEVAL=9999 PRINT=5 NOABORT
55 NOTHETABOUNDTEST NOMEGABOUNDTEST NOSIGMABOUNDTEST NSIG=1 SIGL=3
56
57 $COVARIANCE UNCONDITIONAL
58
59
60
61
62
63 $TABLE ID TIME DV MDV EVID IPRED CWRES IWRES ONEHEADER NOPRINT FILE=sdtab1
64 $TABLE ID KA CL V2 Q V3 ETAS(1:LAST) ONEHEADER NOPRINT FILE=patab1 ; model parameters
65 $TABLE ID AMT SEX P_TYPE ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
66 $TABLE ID WTKG AGE ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

Below the code editor, there are tabs for RESULTS, MODEL, RUN SETTINGS, and CONSOLE. The RESULTS tab is active, showing a table with three rows:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt-complete		None								
2-cmt	2 cmt model, combined RUV	1-cmt								

At the bottom of the table, it says "Showing 3 of 3 models".



Use the Built-in Text Editor

- Save changes to the control stream:

```
• 2-cmt
C: > $PROB Model112 ...
4   $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANSA
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3)
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28 (0, 14.1) ; CL ; L/hr ; Clearance
29 (0, 1.68) ; V2 ; L ; Volume of distribution
30 (0, 0.0001) ; Q ; L/min ; Total clearance
31 (0, 0.0001) ; V3 ; L ; Central compartment volume
32 (0, 0.0001) ; S2 ; L ; Peripheral compartment volume
33 (0, 0.0001) ; S ; L ; Central compartment volume
34 (0, 0.0001) ; B ; L ; Peripheral compartment volume
35 (0, 0.0001) ; Sig Digs ; Number of significant digits
36 (0, 1.27) ; Method ; FoaFi
```

Save Run Model

Final	CV(%)	RSE(%)	Shrink(%)	
COV(KA KA)	0.175	43.8	127	20.99
OM(1,2)	0.00	0.00	Infinity	-
COV(CL CL)	0.164	42.2	30.6	22.04
OM(1,3)	0.00	0.00	Infinity	-
OM(2,3)	0.00	0.00	Infinity	-
COV(V V)	0.0304	17.6	434	95.31

Final	CV(%)	RSE(%)	Shrink(%)
Sigma			



Use the Built-in Text Editor

- Save changes to the control stream:

The screenshot shows the Finch Studio interface. On the left is a sidebar with 'DIRECTORY' (C:\Users\sfcook\Documents\Drug X), 'PROJECT Study Y' (Open Project, Study Y), 'DATA' (data\NM_data.csv), and 'MODELS' (1-cmt, 2-cmt-complete, 2-cmt selected). The main area displays a script editor with the following content:

```
• 2-cmt
C: > $PROB Model112 ...
4   $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANSA
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TV2 = THETA(3)
19 V2 = TV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28 (0, 14.1) ; CL ; L/hr ; Clearance
29 (0, 1.68) ; V2 ; L ; Volume of distribution
30 (0, 0.001) ; Q ; hr^-1 ; Elimination rate constant
```

To the right of the script editor are 'Parameters' and 'Modules' sections. The 'Parameters' section shows initial and final values for Theta, Omega, and Sigma. An orange arrow points to the 'Run Model' button at the bottom of the script editor.

We can opt to Run NMTRAN on save as a preliminary check

At the bottom of the screen, there is a results table:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt-complete		None								
2-cmt	2 cmt model, combined RUV	1-cmt								

Showing 3 of 3 models



Use the Built-in Text Editor

- Save changes to the control stream:

We can opt to Run NMTRAN on save as a preliminary check

```
1 > $PROB Model112 ...
2   $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
3
4   $DATA ../../data/NM_data.csv IGNORE=C
5
6   $SUBROUTINES ADVAN4 TRANSA
7
8   $PK
9
10  TVKA = THETA(1)
11  KA = TVKA*EXP(ETA(1))
12
13  TVCL = THETA(2)
14  CL = TVCL*EXP(ETA(2))
15
16  TV2 = THETA(3 )
17  V2 = TV2*EXP(ETA(3))
18  S2 = V2
19
20  Q = THETA(4)
21  V3 = THETA(5)
22
23
24
25
26  $THETA
27  (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28  (0, 14.1) ; CL ; L/hr ; Clearance
29  (0, 1.68) ; V2 ; L ; Volume of distribution
30  (0, 0.001) ; Q ; L/min ; Elimination rate constant
31
32
33
```

RESULTS MODEL RUN SETTINGS CONSOLE

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt-complete		None								
2-cmt	2 cmt model, combined RUV	1-cmt								

Showing 3 of 3 models



Use the Built-in Text Editor

- *Save changes to the control stream:*

The screenshot shows the Finch Studio software interface. The top menu bar includes File, Edit, View, Window, Help, and a title bar "2-cmt - Study Y - Finch Studio". On the left, there's a sidebar with sections for DIRECTORY (C:\Users\sfcook\Documents\Drug X), PROJECT Study Y (Open Project, Study Y), DATA (data\NM_data.csv), and MODELS (1-cmt, 2-cmt-complete, 2-cmt). The main workspace is titled "2-cmt" and displays the following model code:

```
1 > $PROB Model12 ...
2 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
3
4 $DATA ../../data/NM_data.csv IGNORE=C
5
6 $SUBROUTINES ADVAN4 TRANSA
7
8 $PK
9
10 TVKA = THETA(1)
11 KA = TVKA*EXP(ETA(1))
12
13 TVCL = THETA(2)
14 CL = TVCL*EXP(ETA(2))
15
16 TV2 = THETA(3)
17 V2 = TV2*EXP(ETA(3))
18 S2 = V2
19
20 Q = THETA(4)
21 V3 = THETA(5)
22
23
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28 (0, 14.1) ; CL ; L/hr ; Clearance
29 (0, 1.68) ; V2 ; L ; Volume of distribution
30 (0, 5) ; Q ; hr^-1 ; Elimination rate constant
```

Below the code editor are buttons for Save, Run Model, and Filter. A table at the bottom lists models: 1-cmt, 2-cmt-complete, and 2-cmt (selected), with columns for Model, Description, Ref, nInd/nObs, OFV, dOFV, S, C, B, Sig Digs, and Method.

The right side of the interface contains tabs for Parameters and Modules. The Parameters tab shows tables for Initial / Final Theta values and Omega covariance parameters. The Omega table includes columns for Final, CV(%), RSE(%), and Shrink(%). The Sigma table follows a similar structure. A red box highlights the "WARNINGS AND ERRORS (IF ANY) FOR PROBLEM 1" section, which contains two warnings about population and sigma usage.

- ▶ live NM-TRAN output



Compare Model Control Streams

2-cmt (Left) | 1-cmt (Right)

C: > Users > sfcook > Documents > Drug X > Study Y > models > 2-cmt

```
1-
2 $PROB Model12
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8-$SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18-TV2 = THETA(3 )
19-V2 = TV2*EXP(ETA(3))
20-S2 = V2
21
22-Q = THETA(4)
23-V3 = THETA(5)
24
25-
26 $THETA
27-(0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28-(0, 14.1) ; CL ; L/hr ; Clearance
29-(0, 1.68) ; V2 ; L ; Volume of distribution
30-(0, 6) ; Q ; L/hr ; intercompartmental clearance
31-(0, 82) ; V3 ; L ; Peripheral volume
32
33
34 $OMEGA BLOCK(3)
35-0.175 ; COV(KA,KA)
```

```
1 $PROB Model12
2
3 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
4
5 $DATA ../../data/NM_data.csv IGNORE=C
6
7+$SUBROUTINES ADVAN2 TRANS2
8
9 $PK
10
11 TVKA = THETA(1)
12 KA = TVKA*EXP(ETA(1))
13
14 TVCL = THETA(2)
15 CL = TVCL*EXP(ETA(2))
16
17+TV2 = THETA(3 )
18+V = TV2*EXP(ETA(3))
19+S2 = V
20
21
22 $THETA
23+(0, .5) ; KA ; 1/hr ; Absorption rate constant
24+(0, 5 ) ; CL ; L/hr ; Clearance
25+(0, 20) ; V2 ; L ; Volume of distribution
26
27
28 $OMEGA BLOCK(3)
29+2; COV(KA,KA)
```

Save ▾ Run Model ▾



Model Display Options

- Click the small gray bar to the left of the model name in the **RESULTS** table to color-code the entry:

The screenshot shows the Finch Studio software interface. On the left is a sidebar with 'DIRECTORY', 'PROJECT Study Y', 'DATA', and 'MODELS' sections. The 'MODELS' section has three entries: '1-cmt', '2-cmt', and '2-cmt-complete', with '2-cmt-complete' selected. The main workspace shows a script editor with the following content:

```
2-cmt-complete
C > Users > sfcook > Documents > Drug X > Study Y > models > 2-cmt-complete
1
2 $PROB Model12
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```

Below the script editor is a 'RESULTS' table:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

An orange arrow points to the small gray bar next to the '2-cmt' entry in the 'Model' column.



Model Display Options

- Click the small gray bar to the left of the model name in the **RESULTS** table to color-code the entry:

The screenshot shows the Finch Studio software interface. On the left, there's a sidebar with 'DIRECTORY' (C:\Users\sfcook\Documents\Drug X), 'PROJECT Study Y' (Open Project, Study Y), 'DATA' (data.csv), and 'MODELS' (1-cmt, 2-cmt, 2-cmt-complete). The '2-cmt-complete' model is selected. The main area shows the model code:

```
2-cmt-complete
C > Users > sfcook > Documents > Drug X > Study Y > models > 2-cmt-complete
1
2 $PROB Model12
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```

Below the code is a 'RESULTS' table:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt	model, combined RUV	None	100/600	-1104.40		S	S		1.27	focei
1-cmt	model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

An orange arrow points to the small gray bar to the left of the '1-cmt' entry in the 'Model' column of the RESULTS table.



Model Display Options

- Click the small gray bar to the left of the model name in the **RESULTS** table to color-code the entry:

The screenshot shows the Finch Studio interface with a dark theme. On the left is a sidebar with 'DIRECTORY' (C:\Users\sfcook\Documents\Drug X), 'PROJECT Study Y' (Open Project, Study Y), 'DATA' (data.csv), and 'MODELS' (1-cmt, 2-cmt, 2-cmt-complete). The main area shows a code editor with a model script:

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```

To the right are tabs for 'Parameters' and 'Modules'. Under 'Parameters', there are tables for 'Initial / Final' and 'Omega' (Final, CV(%), RSE(%), Shrink(%)) with data for COV(KA,KA), OM(1,2), COV(CL,CL), OM(1,3), OM(2,3), and COV(V2,V2). Below is a 'Sigma' table.

The bottom section contains tabs for 'RESULTS', 'MODEL', 'RUN SETTINGS', and 'CONSOLE'. The 'RESULTS' table lists models:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

Text at the bottom says 'Showing 2 of 3 models'.



Model Display Options

- Click the small gray bar to the left of the model name in the **RESULTS** table to color-code the entry:

The screenshot shows the Finch Studio interface with a dark theme. On the left is a sidebar with 'DIRECTORY' (C:\Users\sfcook\Documents\Drug X), 'PROJECT Study Y' (Open Project, Study Y), 'DATA' (data.csv), and 'MODELS' (1-cmt, 2-cmt, 2-cmt-complete). The main area shows a code editor with a model script:

```
2-cmt-complete
C: > Users > sfcook > Documents > Drug X > Study Y > models > 2-cmt-complete
1
2 $PROB Model12
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```

To the right are 'Parameters' and 'Modules' sections, and below is a 'Sigma' table:

	Final	CV(%)	RSE(%)	Shrink(%)
COV(KA,KA)	0.00000860	0.293	40.5	99.19
OM(1,2)	0.00	0.00	Infinity	-
COV(CL,CL)	0.119	35.5	17.6	2.95
OM(1,3)	0.00	0.00	Infinity	-
OM(2,3)	0.00	0.00	Infinity	-
COV(V2,V2)	0.0317	18.0	106	78.63

The bottom section shows the 'RESULTS' table:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

Showing 2 of 3 models



Model Display Options

- Create *Tags*:

go to the MODEL tab

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25 *THETA
26 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
27
```

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

RESULTS MODEL RUN SETTINGS CONSOLE

OMINIZATION SUCCESSFUL
NO. OF FUNCTION EVALUATIONS USED: 604
NO. OF SIG. DIGITS IN FINAL EST: 1.5

Starting NMTRAN

WARNINGS AND ERRORS (IF ANY) FOR PROBLEM 1



Model Display Options

- Create *Tags*:

The screenshot shows the Finch Studio interface with the 'Model' tab selected. In the center, the '2-cmt' model code is displayed:

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
```

The 'Model Info' section on the left shows the model name '2-cmt' and a reference model '1-cmt'. Below it is a 'Tags' section with a button labeled 'Add Tag' and a '+' icon. The 'Description' section contains the text '2 cmt model, combined RUV'. The 'Notes' section is currently empty.

On the right, the 'Parameters' panel displays three tables of statistical results:

Initial / Final			
Theta			
	Initial	Final	RSE(%)
KA (1/hr)	0.317	0.938	6.34
CL (L/hr)	14.1	8.36	4.41
V2 (L)	1.68	6.20	19
Q (L/hr)	6.00	5.97	6.17
V3 (L)	82.0	78.7	5.19

Omega			
	Final	CV(%)	RSE(%)
COV(KA,KA)	0.00000860	0.293	40.5
OM(1,2)	0.00	0.00	Infinity
COV(CL,CL)	0.119	35.5	17.6
OM(1,3)	0.00	0.00	Infinity
OM(2,3)	0.00	0.00	Infinity
COV(V2,V2)	0.0317	18.0	106
			78.63

Sigma			
	Final	CV(%)	RSE(%)
Proportio...	0.114	33.8	6.96
SIG(1,2)	0.00	0.00	Infinity
Additive	3.22e-9	0.00567	343
			6.69

At the bottom, a message indicates 'OMINIZATION SUCCESSFUL' with details: NO. OF FUNCTION EVALUATIONS USED: 604 and NO. OF SIG. DIGITS IN FINAL EST: 1.5. The status bar at the bottom right shows 'Starting NMTRAN' and 'WARNINGS AND ERRORS (IF ANY) FOR PROBLEM 1'.

Here we can define **Tags** and also edit the Info, Description, and Notes for existing models.



Model Display Options

- Create *Tags*:

The screenshot shows the Finch Studio interface with the '2-cmt' model selected. The left sidebar shows project structure and models. The main area displays the model code:

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
```

The 'Model Info' panel shows the model name is '2-cmt', it's a '2 cmt model, combined RUV'. The 'Tags' section has an 'Add Tag' button highlighted by an orange arrow. The 'Description' and 'Notes' sections are empty.

The right side of the screen shows the 'Parameters' panel with tables for 'Initial / Final' and 'Sigma' parameters, and a log of the minimization process.

Here we can define *Tags* and also edit the Info, Description, and Notes for existing models.



Model Display Options

- Create *Tags*:

The screenshot shows the Finch Studio interface with the 'Model' tab selected. In the center, the '2-cmt' model code is displayed:

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
```

The 'Model Info' panel on the left shows the model name '2-cmt' and a 'Tags' section with a text input field containing 'No covariates' and a blue '+' button. A red arrow points to this '+' button.

The right side of the screen displays the 'Parameters' and 'Modules' panels, showing various pharmacokinetic parameters and their estimated values.

Here we can define *Tags* and also edit the Info, Description, and Notes for existing models.



Model Display Options

- Create *Tags*:

The screenshot shows the Finch Studio interface with the '2-cmt' model selected. The left sidebar displays the project structure and models. The main area shows the model code:

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
```

The 'Parameters' panel on the right shows the following data:

	Initial	Final	RSE(%)
KA (1/hr)	0.317	0.938	6.34
CL (L/hr)	14.1	8.36	4.41
V2 (L)	1.68	6.20	19
Q (L/hr)	6.00	5.97	6.17
V3 (L)	82.0	78.7	5.19

Below this are tables for Omega and Sigma, both showing final values, CV(%), RSE(%), and Shrink(%). The Omega table includes rows for COV(KA,KA), OM(1,2), COV(CL,CL), OM(1,3), OM(2,3), and COV(V2,V2). The Sigma table includes rows for Proportio..., SIG(1,2), and Additive.

At the bottom, a message indicates 'OMINIZATION SUCCESSFUL' with details: NO. OF FUNCTION EVALUATIONS USED: 604, NO. OF SIG. DIGITS IN FINAL EST: 1.5. The console log shows 'Starting NMTRAN'.

Here we can define *Tags* and also edit the Info, Description, and Notes for existing models.



Model Display Options

- Back in the **RESULTS** table, we can *Filter* based on *Tags* and/or *Color*:

The screenshot shows the Finch Studio interface. On the left, the project structure is displayed with a '2-cmt' model selected. The main area shows the model code:

```
2-cmt
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```

To the right, the 'Parameters' panel shows estimated values for Theta, Omega, and Sigma. An orange arrow points to the 'Filter' button in the bottom right corner of the results table.

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei

At the bottom, a message indicates 'OMINIZATION SUCCESSFUL'.



Model Display Options

- Back in the **RESULTS** table, we can *Filter* based on *Tags* and/or *Color*:

The screenshot shows the Finch Studio interface with the following details:

- Left Sidebar:** Includes a DIRECTORY tree (C:\Users\sfcook\Documents\Drug X), PROJECT Study Y (Open Project: Study Y), DATA (data.csv), and MODELS (1-cmt, 2-cmt, 2-cmt-complete). The 2-cmt model is selected.
- Center Panel:** Displays the model code for "2-cmt":

```
1 $PROB Model12
2
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TVV2 = THETA(3 )
19 V2 = TVV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
```
- Bottom Center:** RESULTS table showing two models:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt		None	100/600	-1104.40		S	S		1.27	focei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	focei
- Right Panel:** Parameters table showing Initial/Final values for Theta, Omega, and Sigma parameters.
- Bottom Right:** Log output showing minimization success and NMTRAN startup.



Covariate Model Example

- Create a new model with a power function of WTKG centered on 71 on CL:
 - Duplicate *1-cmt-pk-v1* to create *1-cmt-pk-v2*.
 - Use the final parameter estimates from the parent model and add a useful description.
 - Remember to add an initial estimate for THETA(4).
- **Run the *1-cmt-pk-v2* model.**
- Create another new model with a power function of WTKG centered on 71 on V:
 - Duplicate *1-cmt-pk-v2* to create *1-cmt-pk-v3*.
 - Use the final parameter estimates from the parent model and add a useful description.
 - Remember to add an initial estimate for THETA(5).
- **Run the *1-cmt-pk-v3* model.**
- Explore some useful features of the editor:
 - Documentation on hover
 - Autocompletion
 - Code folding
 - Syntax highlighting
 - Error checking (on Save)

```
TVCL = THETA(2)*(WTKG/71)**THETA(4)  
CL = TVCL*EXP(ETA(1))
```

```
TVV = THETA(3)*(WTKG/71)**THETA(5)  
V = TVV*EXP(ETA(2))
```



Covariate Model Example

- First, let's examine dOFV and compare parameter estimates across the three runs:

The screenshot shows the Finch Studio interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Project Area:** DIRECTORY (C:\Users\Sarah-PC\Documents\Workshop\Drug-1\Study-F1003-Asian-PK), PROJECT Study-F1003-Asian-PK, Open Project (Study-F1003-Asian-PK).
- Model Area:** Model tab selected, Evaluate button. Model name: 1-cmt-pk-v1. Model code:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
```

Buttons: Save, Run Model.
- Results Area:** RESULTS tab selected, showing a table of models and their statistics:

Model	Description	Ref	nInd/nObs	OFV	dOFV
1-cmt-pk-v1		None	100/1400	-6148.10	
1-cmt-pk-v2	Add WTKG on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73
1-cmt-pk-v3	Add WTKG on V	1-cmt-pk-v2	100/1400	-6645.45	-242.62

Text at bottom: Showing 3 of 5 models.
- Parameters Area:** Parameters tab selected, Initial / Final section. Theta parameters:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Omega parameters:

CL	V
0.0474	
0.00	0.0400

Sigma parameters:

Proportional	0.0861
seconds:	0.00
Elapsed finaloutput time in seconds:	1.18
Done with nonmem execution	
F:1 ..	
execute done	



Covariate Model Example

- First, let's examine dOFV and compare parameter estimates across the three runs:

The screenshot shows the Finch Studio interface for a pharmacokinetic model named "1-cmt-pk-v1". The central workspace displays the model code:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
```

The "RESULTS" table at the bottom compares three models based on OFV and dOFV:

Model	Description	Ref	nInd/nObs	OFV	dOFV
1-cmt-pk-v1		None	100/1400	-6148.10	
1-cmt-pk-v2	Add WTKG on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73
1-cmt-pk-v3	Add WTKG on V	1-cmt-pk-v2	100/1400	-6645.45	-242.62

The right panel shows parameters and their estimates:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Other tabs in the right panel include Theta, Omega, Sigma, and Cor.



Covariate Model Example

- First, let's examine dOFV and compare parameter estimates across the three runs:

File Edit View Window Help

DIRECTORY C:\Users\Sarah-PC\Documents\Workshop\Drug-1\Study-F1003-Asian-PK\models\1-cmt-pk-v1

PROJECT Study-F1003-Asian-PK

Open Project Study-F1003-Asian-PK

DATA View data\F1003-Asian-PK-Study.csv

MODELS + 1-cmt-pk-v1

1-cmt-pk-v1

1-cmt-pk-v2-complete

1-cmt-pk-v3-complete

1-cmt-pk-v2

1-cmt-pk-v3

RESULTS MODEL RUN SETTINGS FILES CONSOLE Filter Column

Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
None	100/1400	-6148.10		S	S		3.55	focei
1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	focei
1-cmt-pk-v2	100/1400	-6645.45	-242.62	S	S		3.39	focei

Showing 3 of 5 models

1-cmt-pk-v1 - Study-F1003-Asian-PK - Finch Studio

Compare Close

Parameters Scripts

Initial / Final

exp(θ) Theta

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Cov Cor Omega

CL	V
0.0474	
V	0.00 0.0400

Cov Cor Sigma

Proportional	0.0861
Proportional	0.0861

Elapsed finaloutput time in seconds: 1.18
Done with nonmem execution F:1 .. execute done



Covariate Model Example

- First, let's examine dOFV and compare parameter estimates across the three runs:

The screenshot shows the Finch Studio interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Project Area:** DIRECTORY (C:\Users\Sarah-PC\Documents\Workshop\Drug-1\Study-F1003-Asian-PK), PROJECT Study-F1003-Asian-PK, Open Project (Study-F1003-Asian-PK).
- Model Area:** Model tab selected, Evaluate tab visible. Model name: 1-cmt-pk-v1. Model code:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
```

Buttons: Compare, Close, Save, Run Model.
- Results Table:** Showing 3 of 5 models. Headers: Ref, nInd/nObs, OFV, dOFV, S, C, B, Sig, Met. Data:

Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig	Met
None	100/1400	-6148.10		S	S		3.55	focei
1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	focei
1-cmt-pk-v2	100/1400	-6645.45	-242.62	S	S		3.39	focei
- Parameters Panel:** Initial / Final, Theta, Omega, Sigma. Parameters table:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-
- Console Output:** Elapsed finaloutput time in seconds: 1.18, Done with nonmem execution F:1 .. execute done.



Covariate Model Example

- First, let's examine dOFV and compare parameter estimates across the three runs:

The screenshot shows the Finch Studio interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Project Area:** DIRECTORY (C:\Users\Sarah-PC\Documents\Workshop\Drug-1\Study-F1003-Asian-PK), PROJECT Study-F1003-Asian-PK, DATA (data\F1003-Asian-PK-Study.csv), MODELS (1-cmt-pk-v1, 1-cmt-pk-v2-complete, 1-cmt-pk-v3-complete, 1-cmt-pk-v2, 1-cmt-pk-v3). An orange arrow points to the "1-cmt-pk-v1" model in the list.
- Model Tab:** Evaluate tab selected. Model name: 1-cmt-pk-v1. Script content:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
```
- Parameters Panel:** Initial / Final, Theta, Omega, Sigma. Parameters listed:

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

CL	V
0.0474	
0.00	0.0400

Proportional	0.0861
seconds:	0.00
Elapsed finaloutput time in seconds:	1.18
Done with nonmem execution F:1 ..	
execute done	
- RESULTS Table:** Shows the following data:

Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
None	100/1400	-6148.10		S	S		3.55	focei
1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	focei
1-cmt-pk-v2	100/1400	-6645.45	-242.62	S	S		3.39	focei



Covariate Model Example

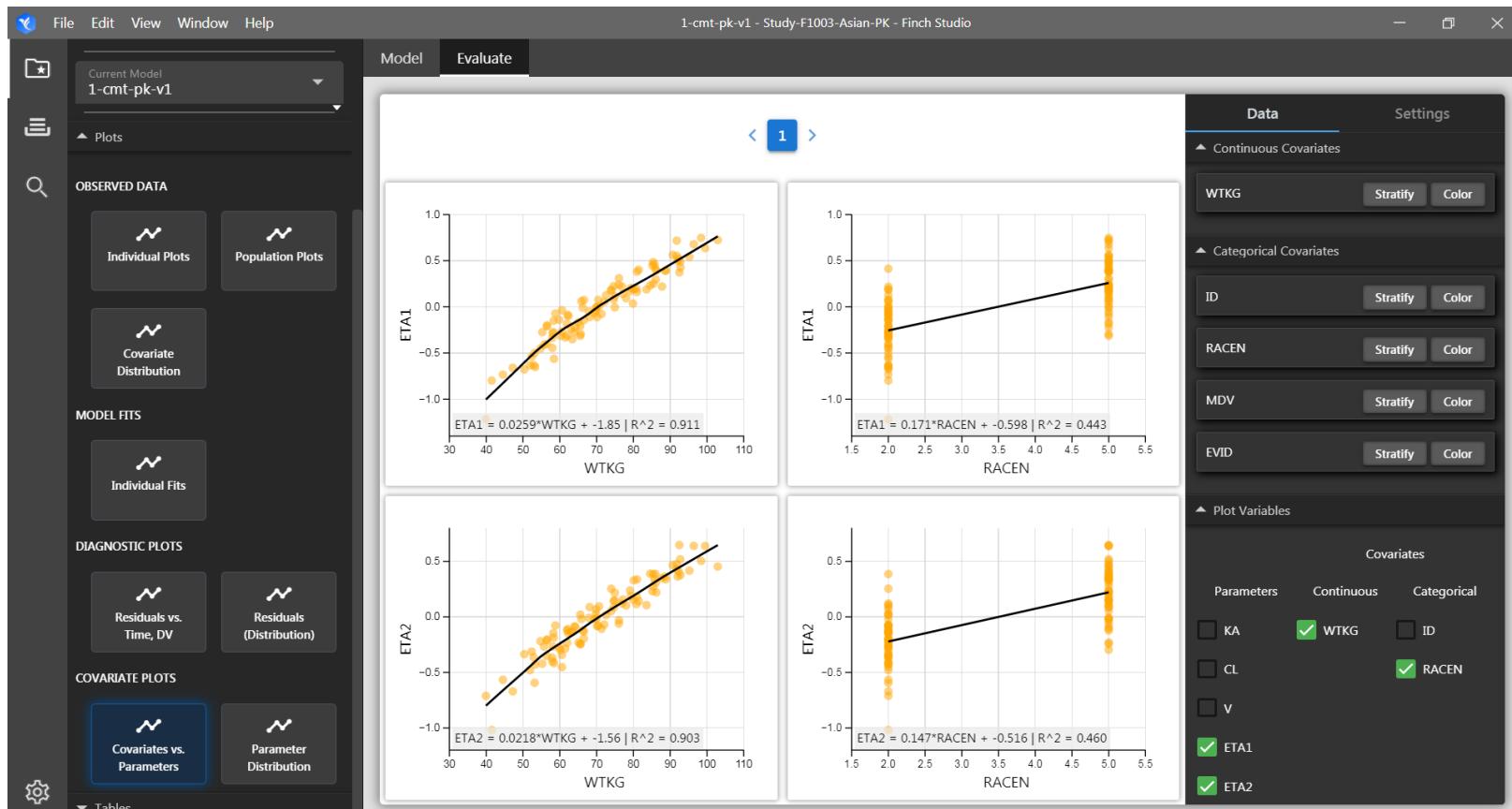
- First, let's examine dOFV and compare parameter estimates across the three runs:

	1-cmt-pk-v1	1-cmt-pk-v2	1-cmt-pk-v3
Reference	None	1-cmt-pk-v1	1-cmt-pk-v2
Description		Add WTKG on CL	Add WTKG on V
Notes			
Tags			
Method	focei	focei	focei
OFV	-6148.10	-6402.83	-6645.45
dOFV	Reference	-254.72	-497.35
SigDigits	3.55	3.80	3.39
KA (1/hr)	0.784 (1.23%)	0.783 (1.23%)	0.782 (1.22%)
CL (L/hr)	16.9 (3.95%)	17.3 (1.12%)	17.3 (1.11%)
V (L)	84.1 (3.44%)	84.0 (3.44%)	85.8 (1.11%)
WTonCL		1.83 (3.13%)	1.85 (3.03%)
WTonV			1.58 (3.7%)
CL_	0.150 {40.2%} (14.2%) [0.00491%]	0.0103 {10.2%} (13.5%) [6.00%]	0.0105 {10.3%} (13.1%) [4.90%]
OM(1,2)	0.00 {0.00%}	0.00 {0.00%}	0.00 {0.00%}
V_	0.108 {33.8%} (14.3%) [0.674%]	0.111 {34.3%} (14.1%) [0.563%]	0.00765 {8.76%} (17.2%) [12.4%]
Proportional	0.0207 (3.79%) [6.98%]	0.0206 (3.78%) [6.57%]	0.0206 (3.77%) [5.84%]



Covariate Model Example

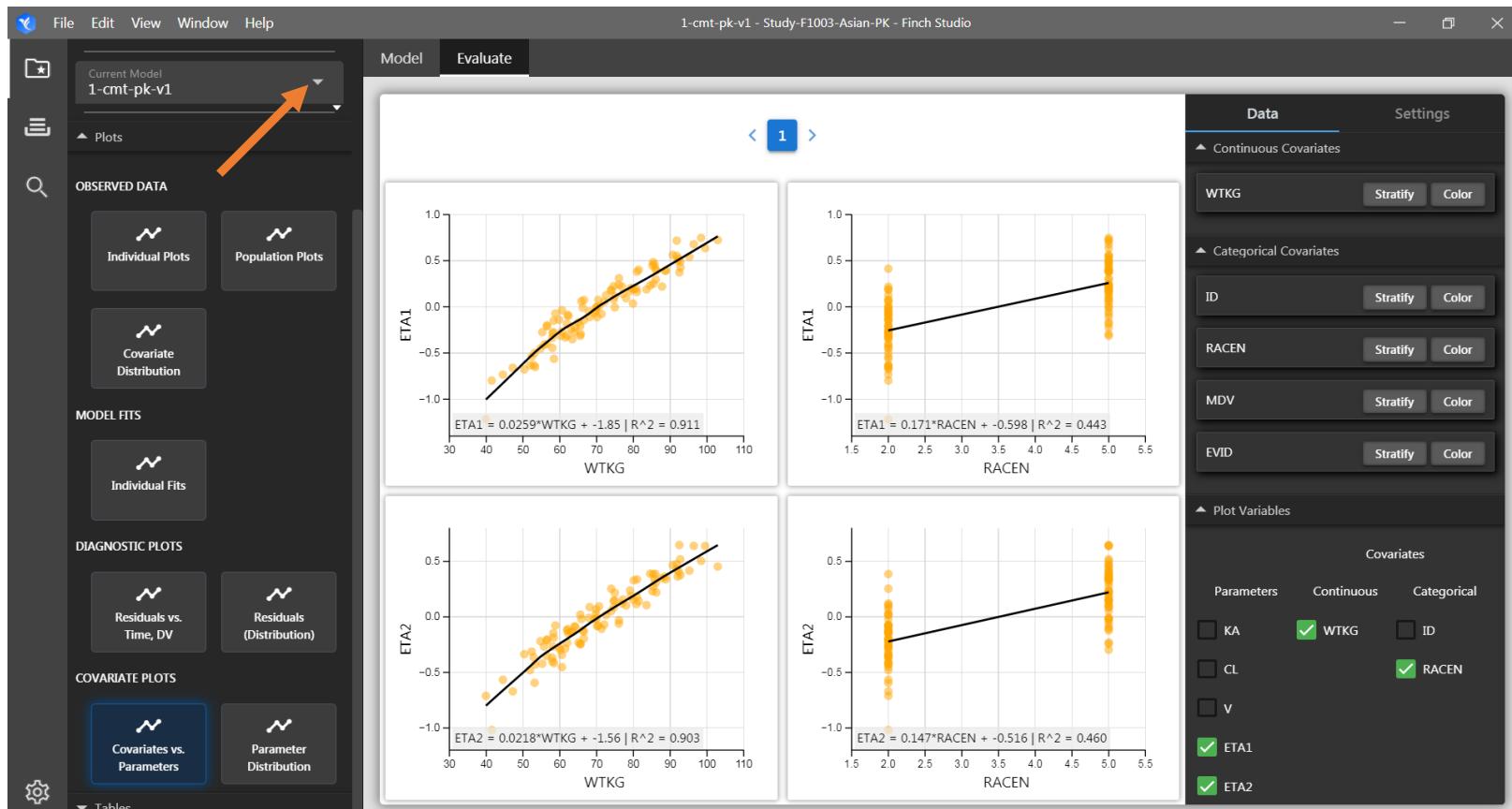
- Going back to the covariates vs parameters plots





Covariate Model Example

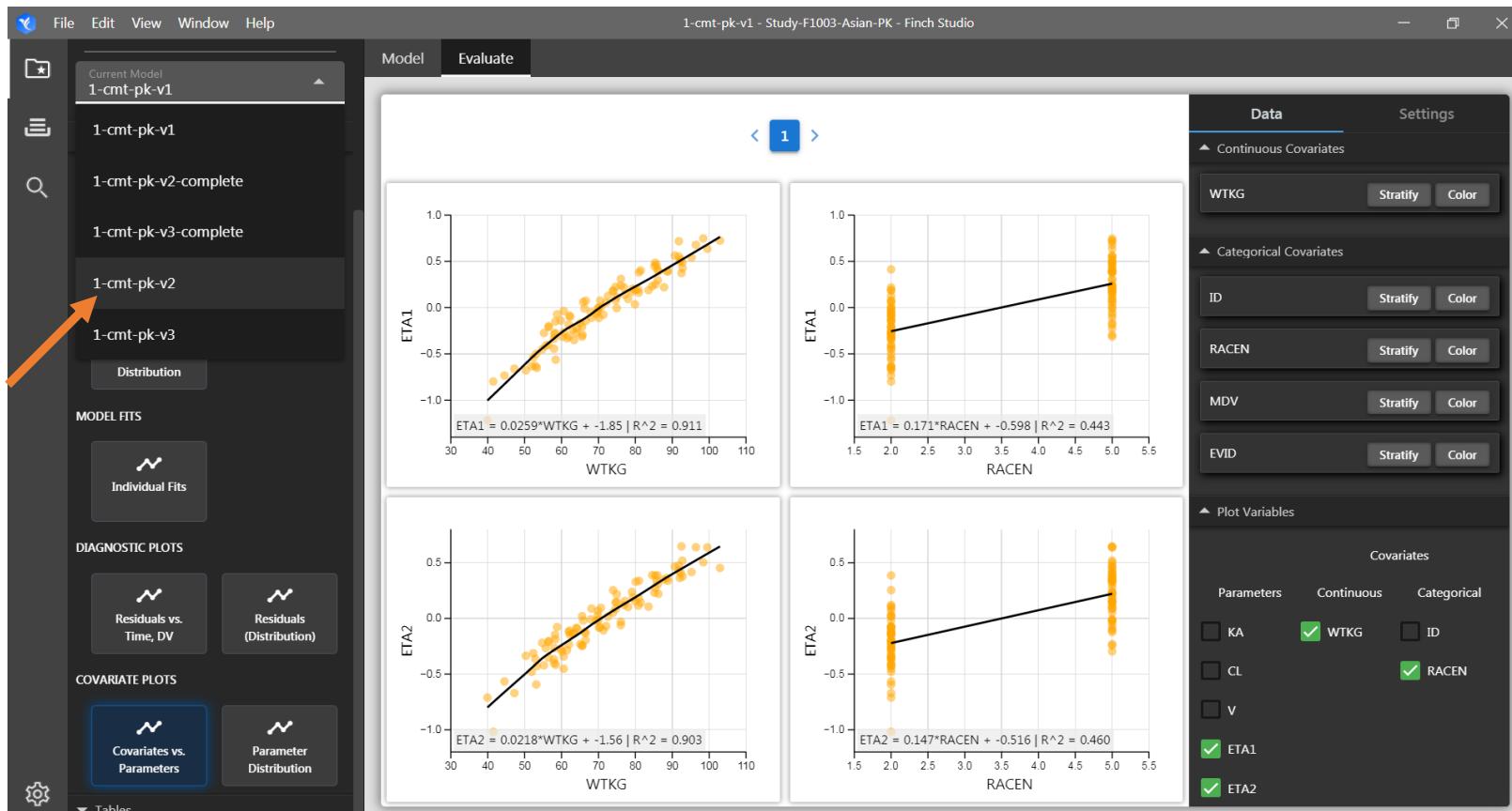
- We can easily toggle between models to evaluate the same plots:





Covariate Model Example

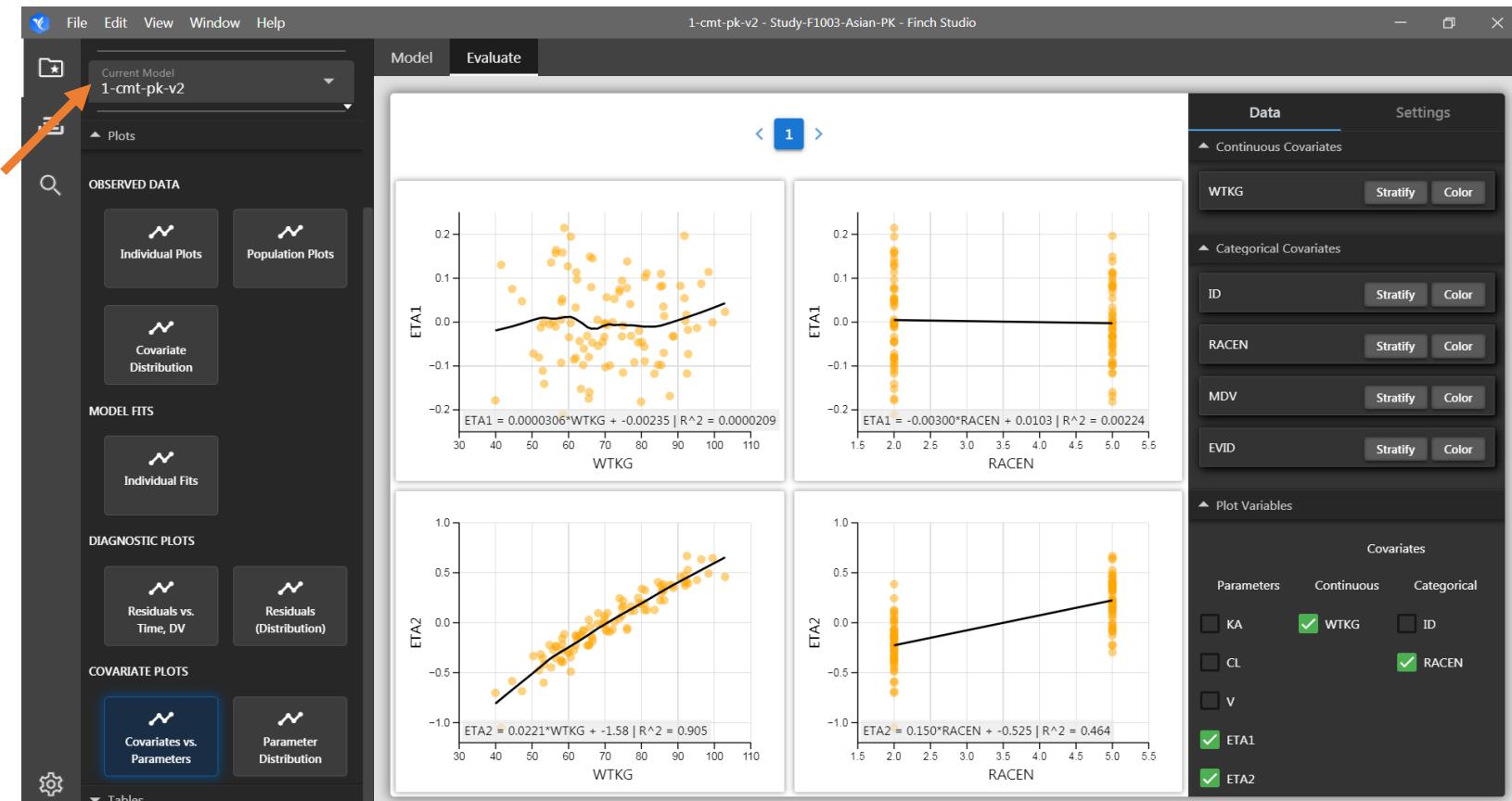
- We can easily toggle between models to evaluate the same plots:





Covariate Model Example

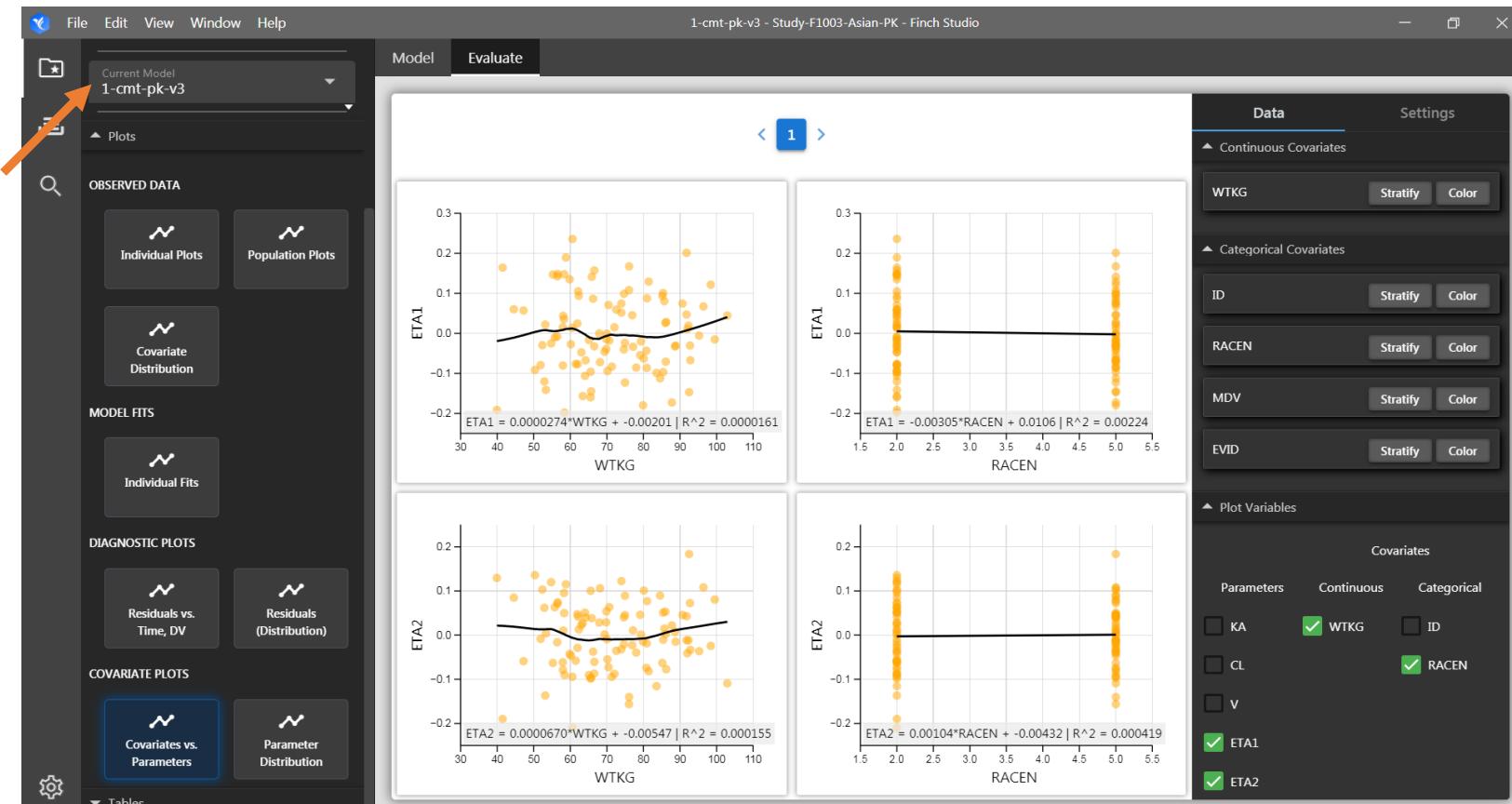
- We can easily toggle between models to evaluate the same plots:





Covariate Model Example

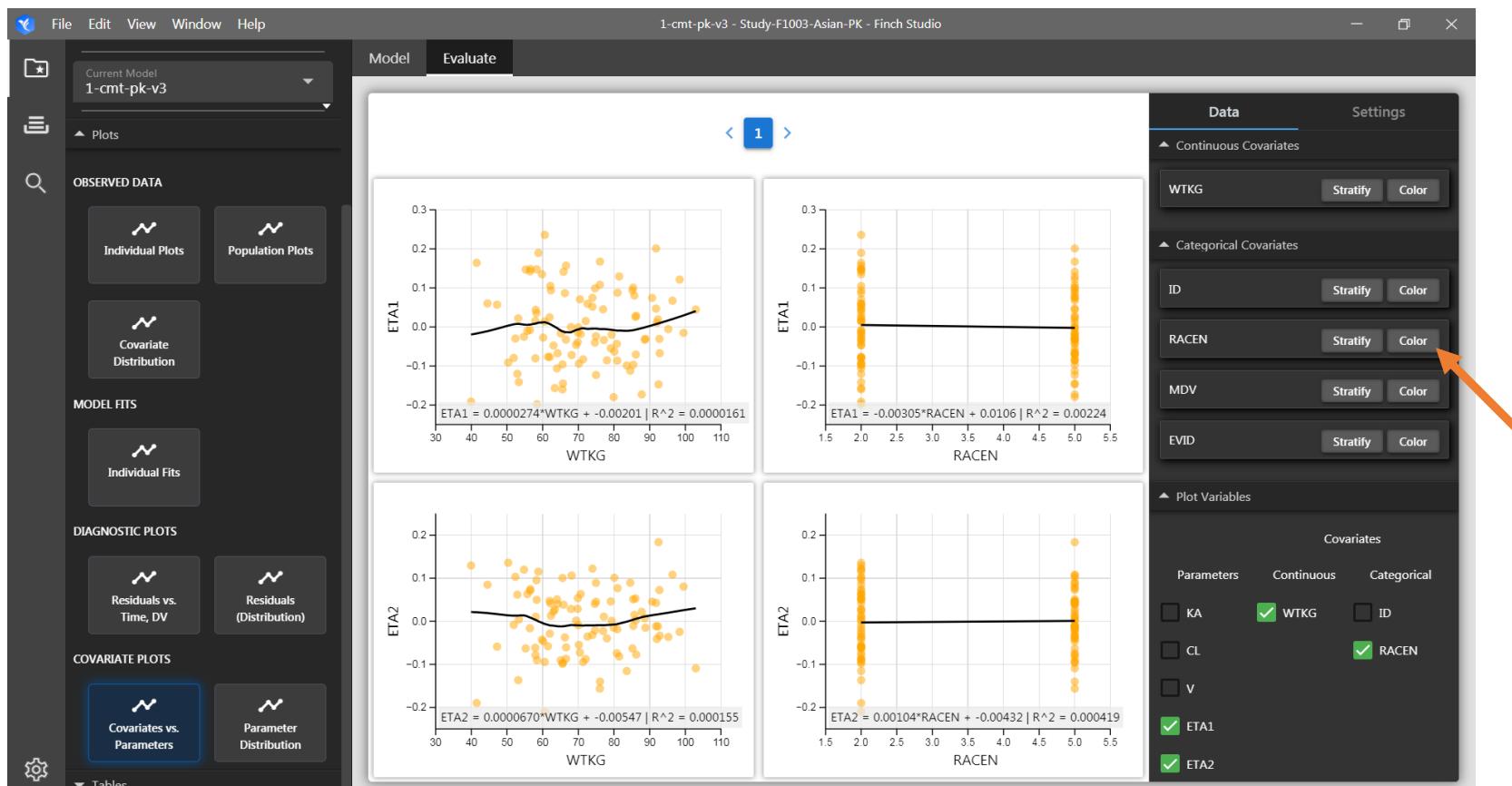
- We can easily toggle between models to evaluate the same plots:





Covariate Model Example

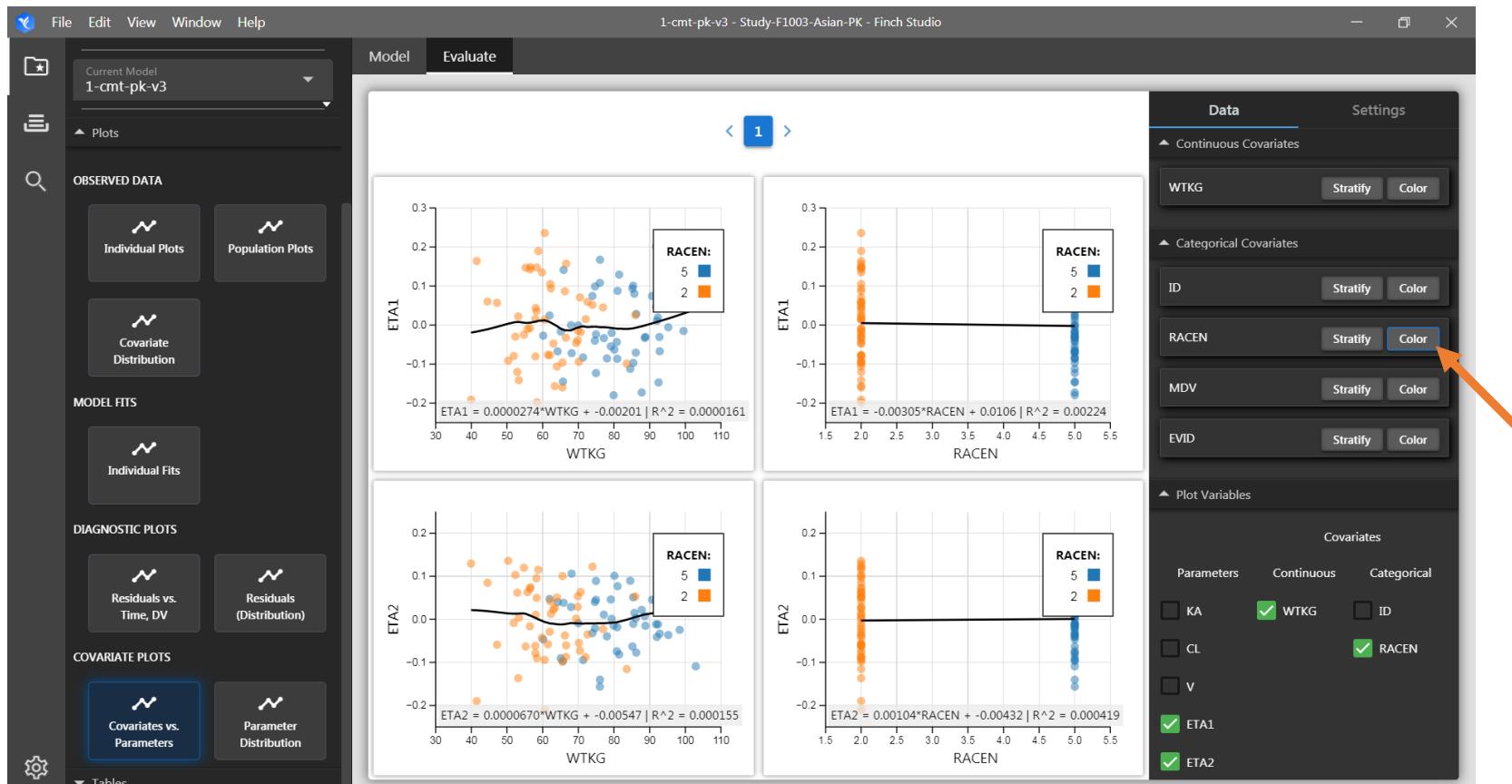
- Let's also *Color by RACEN*:





Covariate Model Example

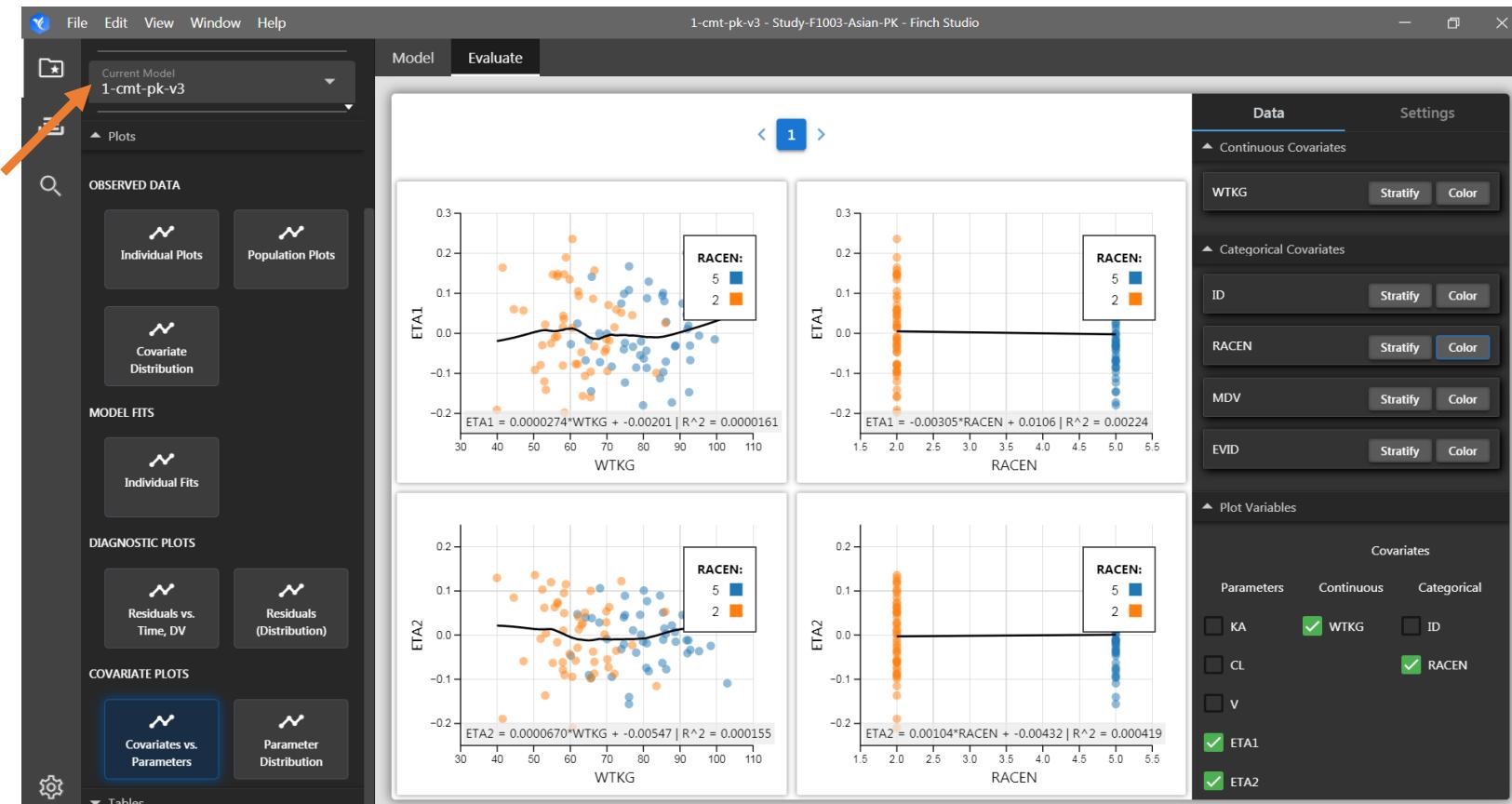
- Let's also *Color by RACEN*:





Covariate Model Example

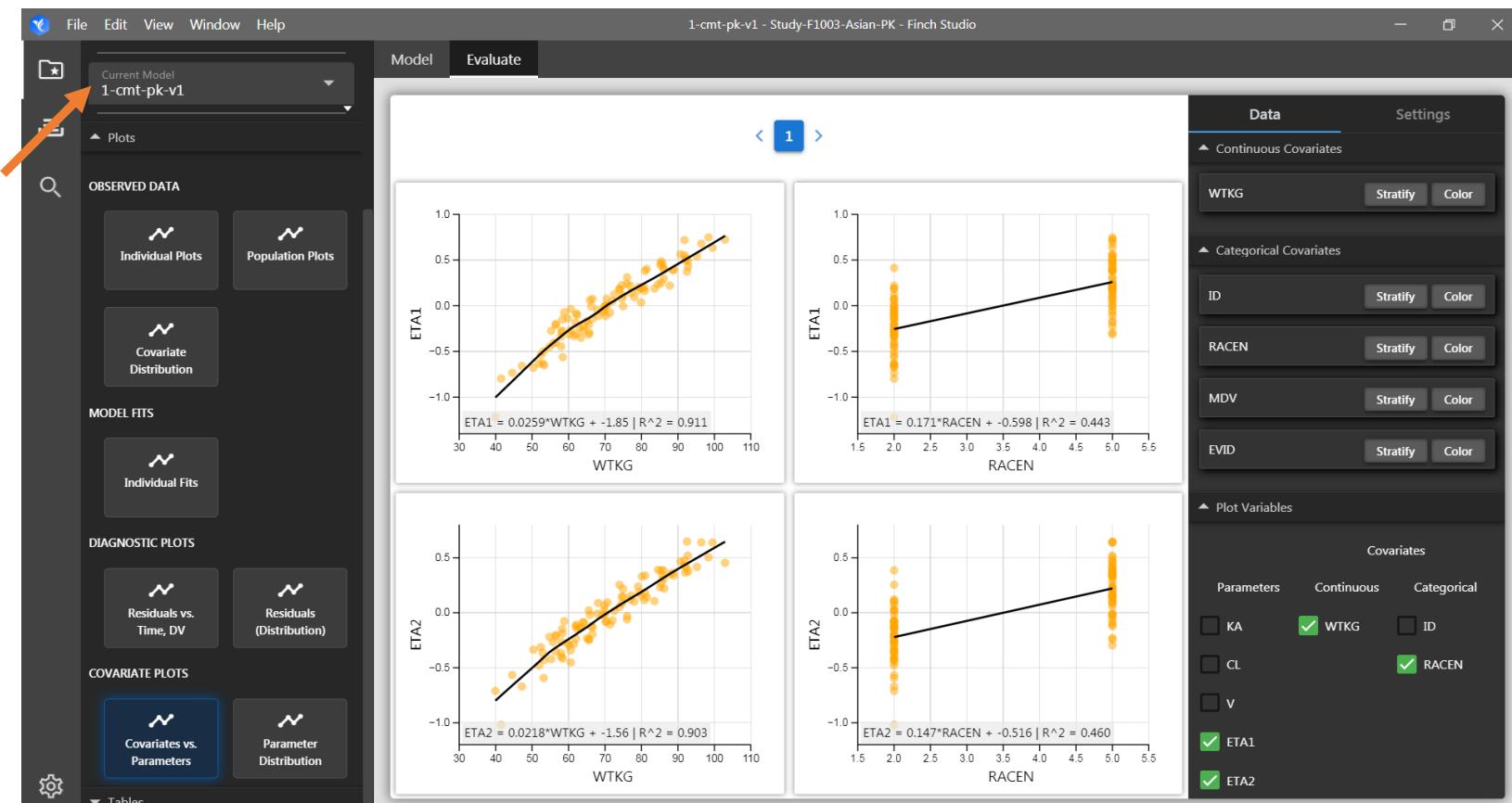
- Let's also *Color by RACEN*:





Covariate Model Example

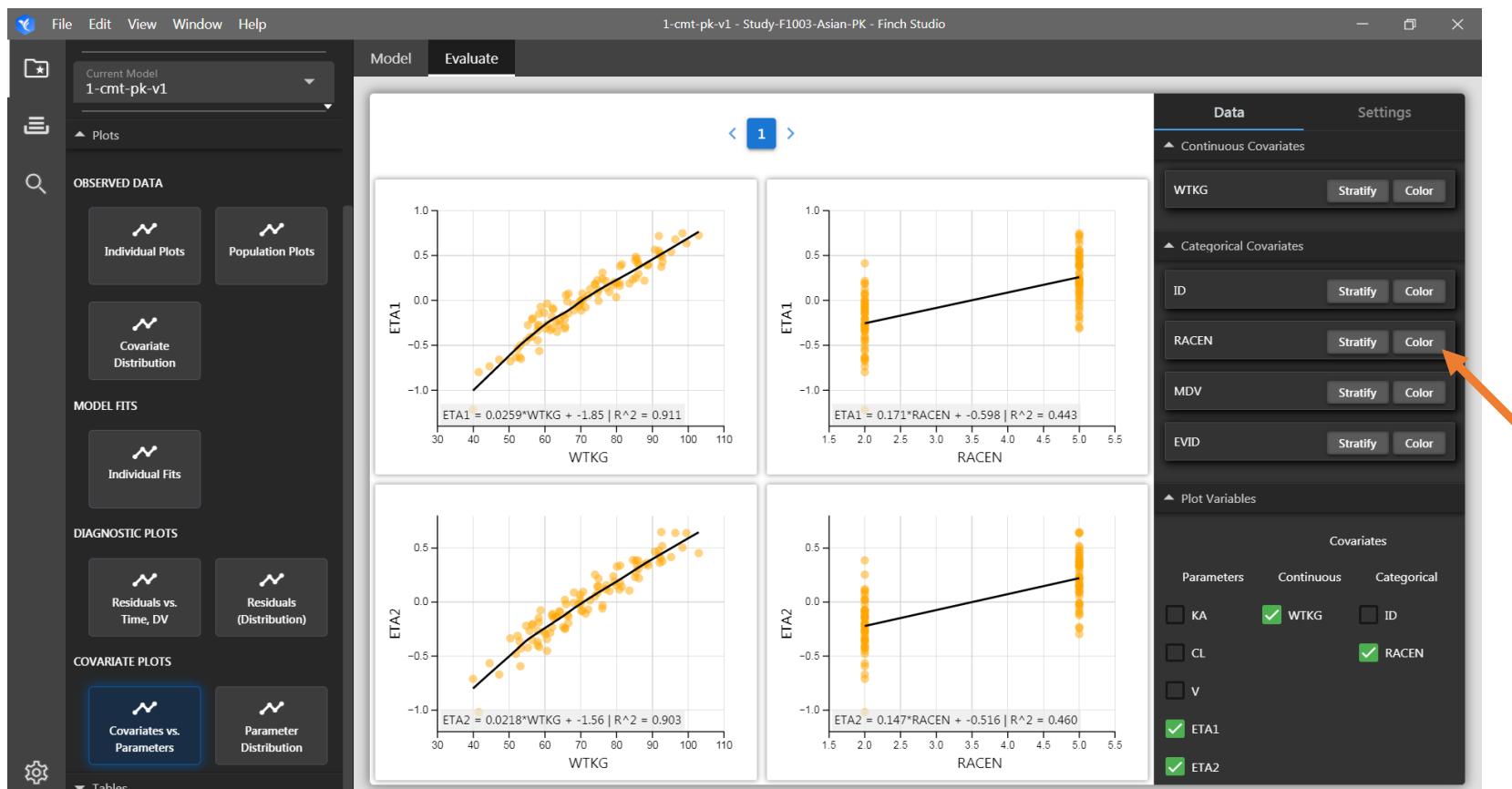
- Let's also *Color by RACEN*:





Covariate Model Example

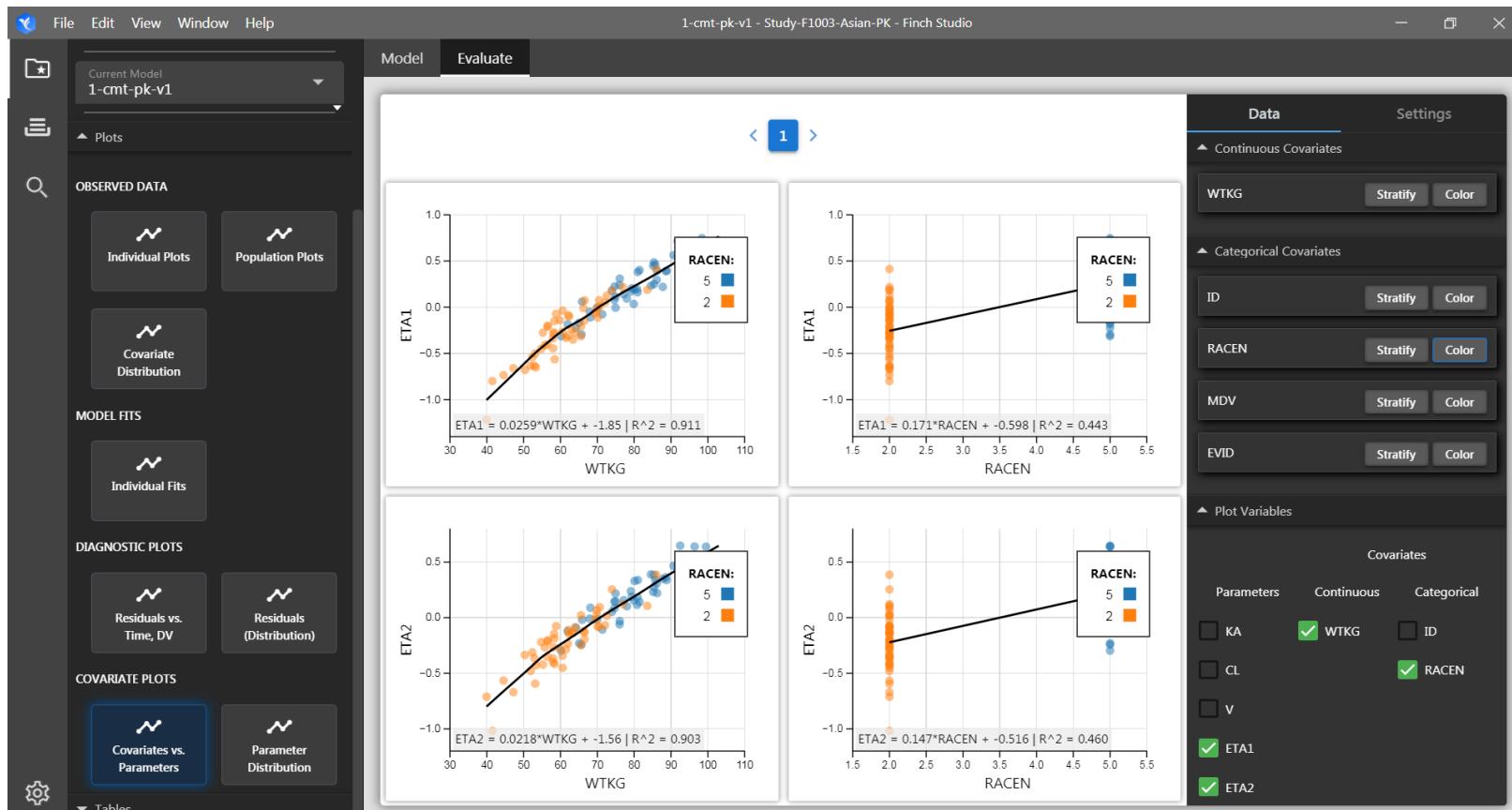
- Let's also *Color by RACEN*:





Covariate Model Example

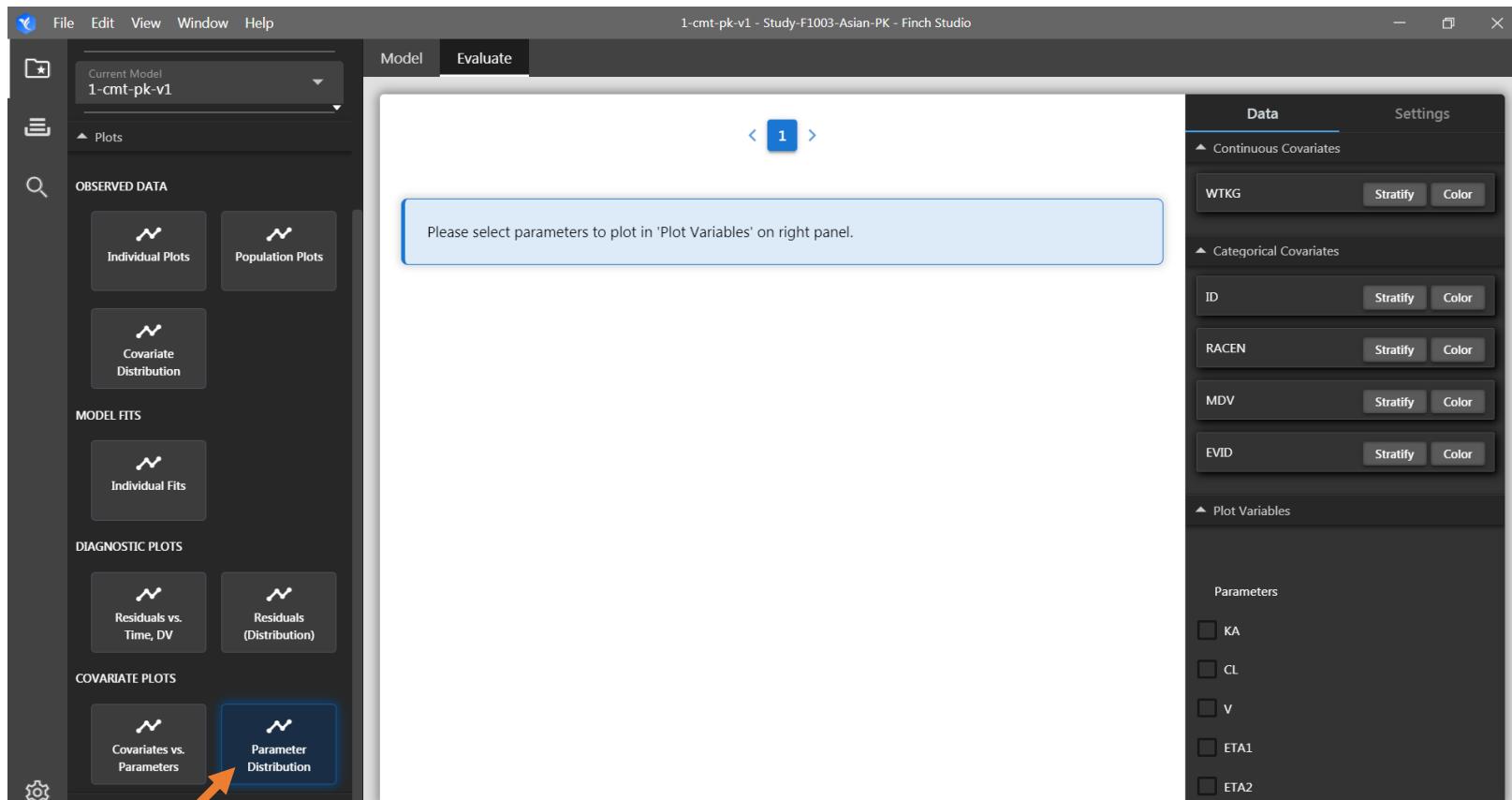
- Let's also *Color by RACEN*:





Covariate Model Example

- We can look at *Parameter Distributions*, as well:





Covariate Model Example

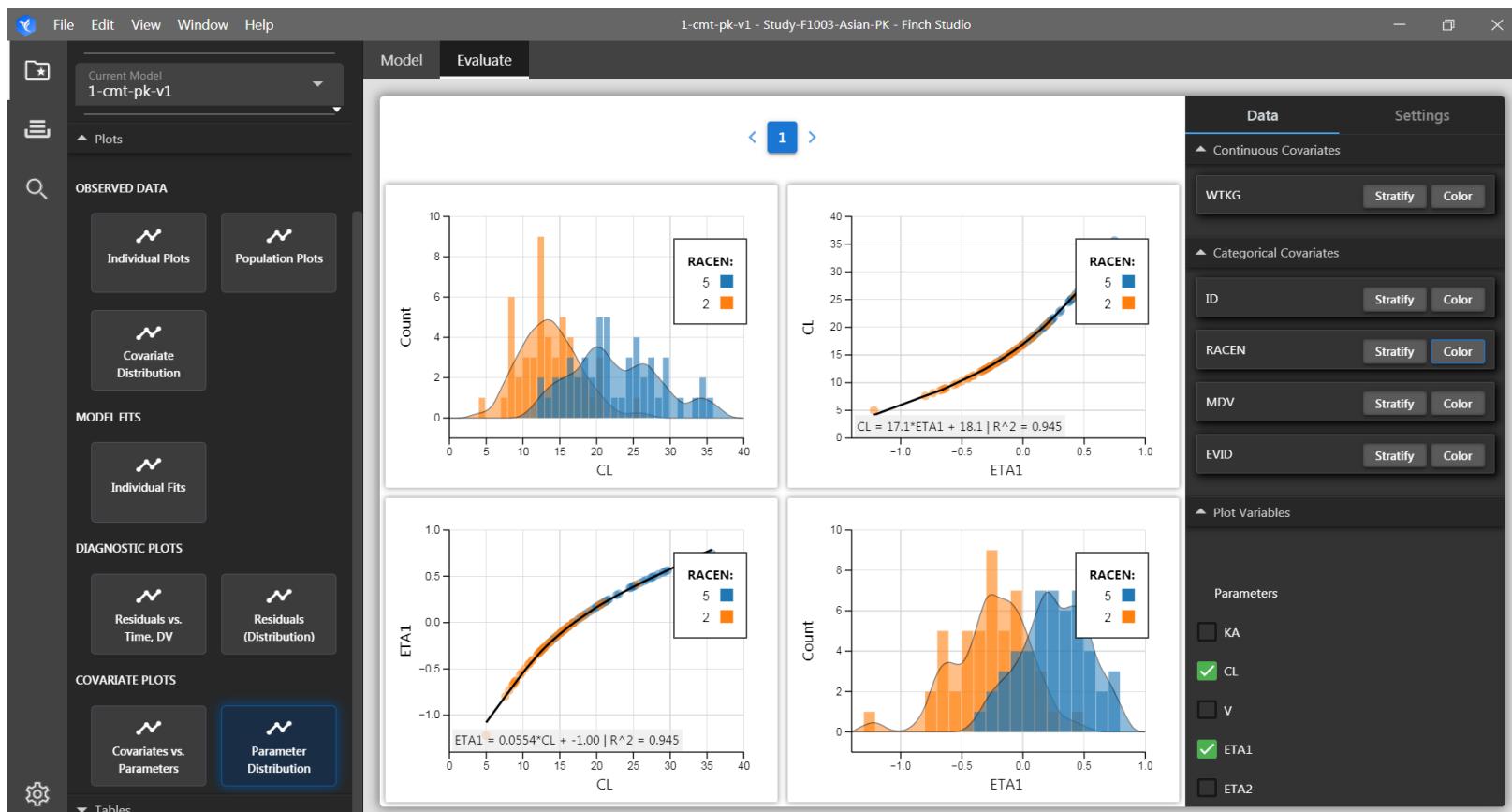
- We can look at *Parameter Distributions*, as well:

The screenshot shows the Finch Studio software interface with the 'Evaluate' tab active. On the left, there's a sidebar with various plot types: Individual Plots, Population Plots, Covariate Distribution, Individual Fits, Residuals vs. Time, DV, Residuals (Distribution), Covariates vs. Parameters, and Parameter Distribution. The 'Covariate Distribution' option is highlighted. The main central area has a message box that says 'Please select parameters to plot in "Plot Variables" on right panel.' Below this message is a page number '1'. To the right, there's a 'Data' panel with sections for Continuous Covariates (WTKG) and Categorical Covariates (ID, RACEN, MDV, EVID). Under 'Plot Variables', there's a list of parameters: KA, CL, v, ETA1, and ETA2. Orange arrows point from the message box to the 'Stratify' and 'Color' buttons for ID, RACEN, MDV, and ETA1.



Covariate Model Example

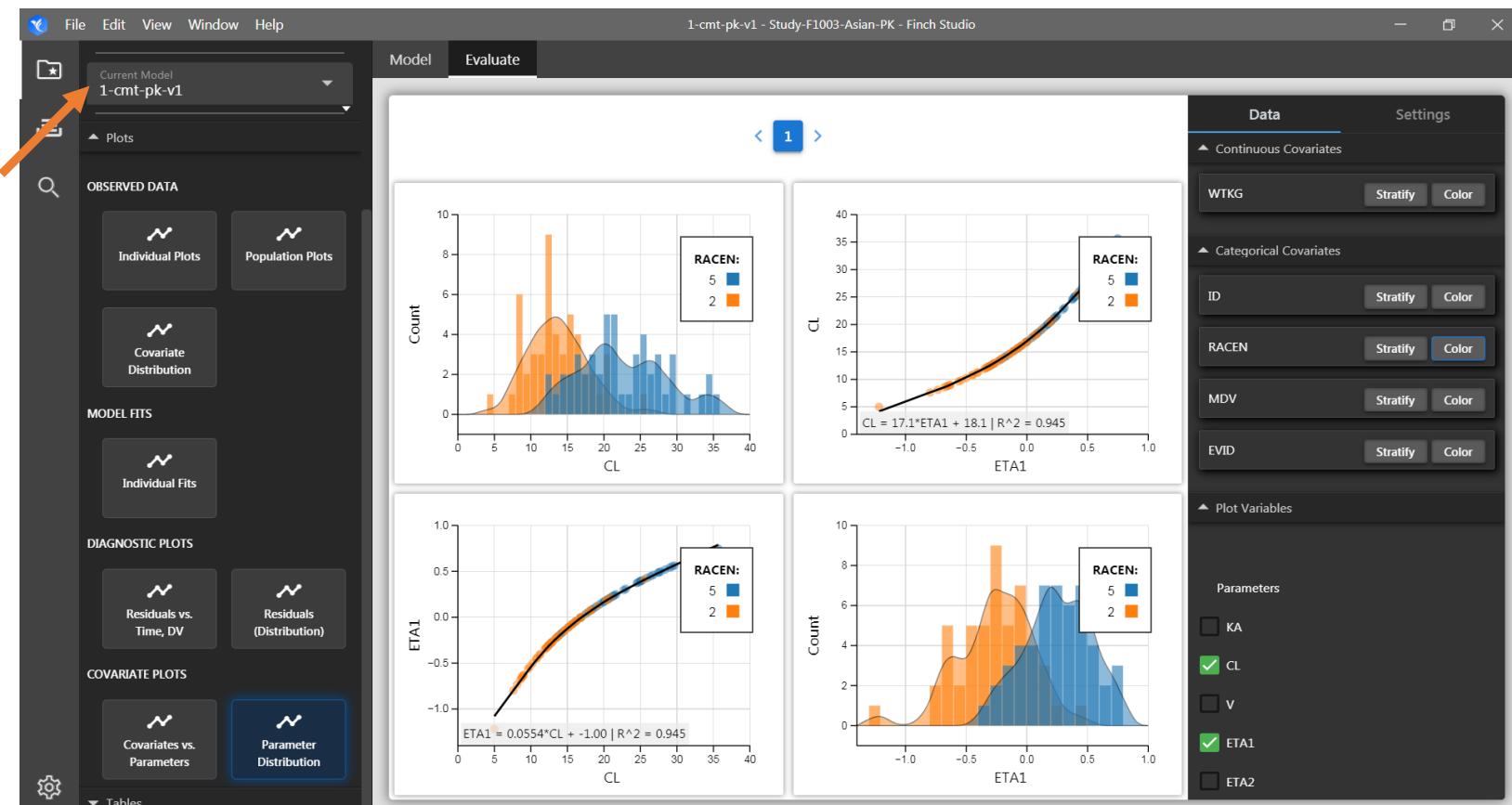
- We can look at *Parameter Distributions*, as well:





Covariate Model Example

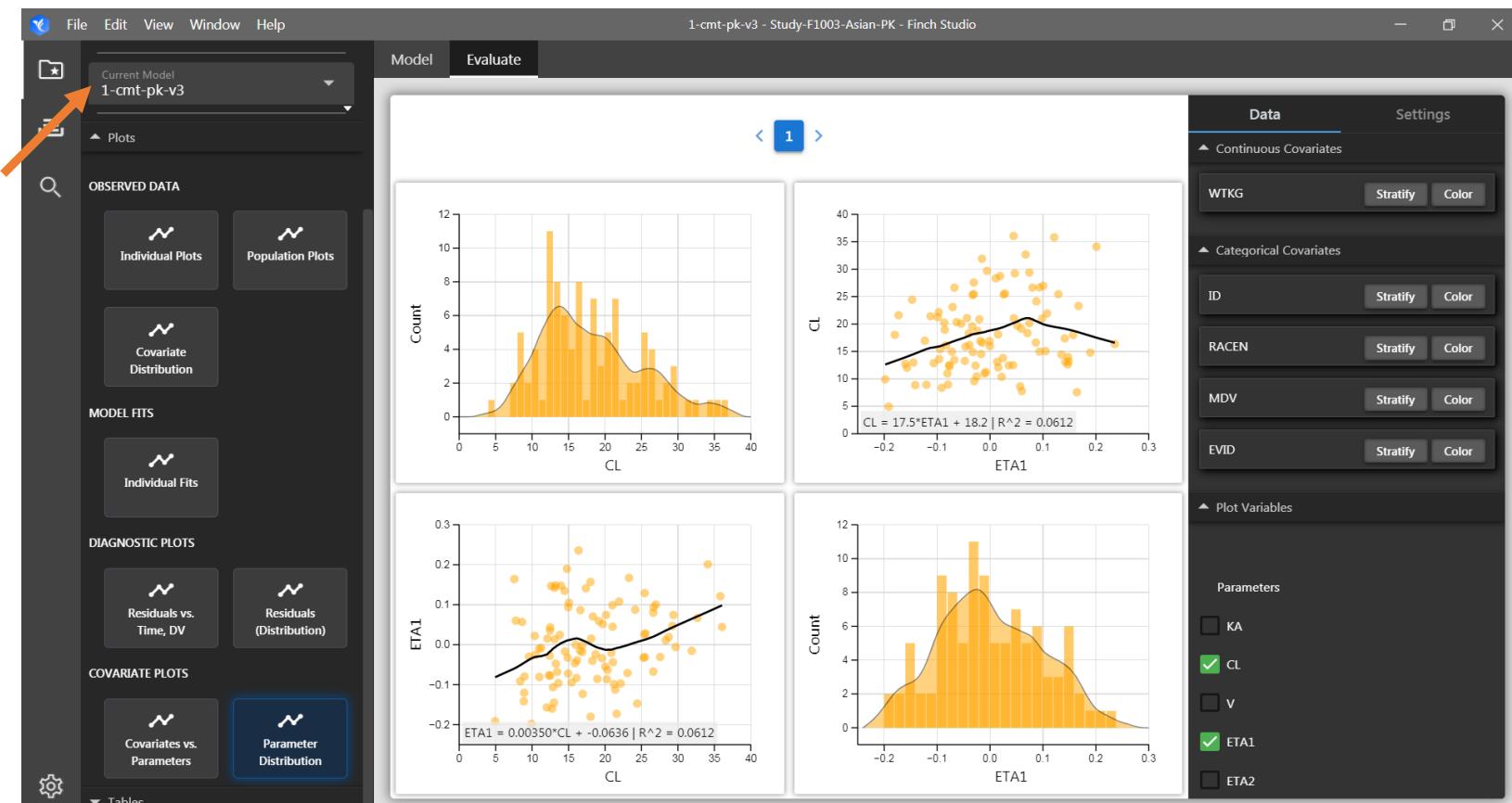
- We can look at *Parameter Distributions*, as well:





Covariate Model Example

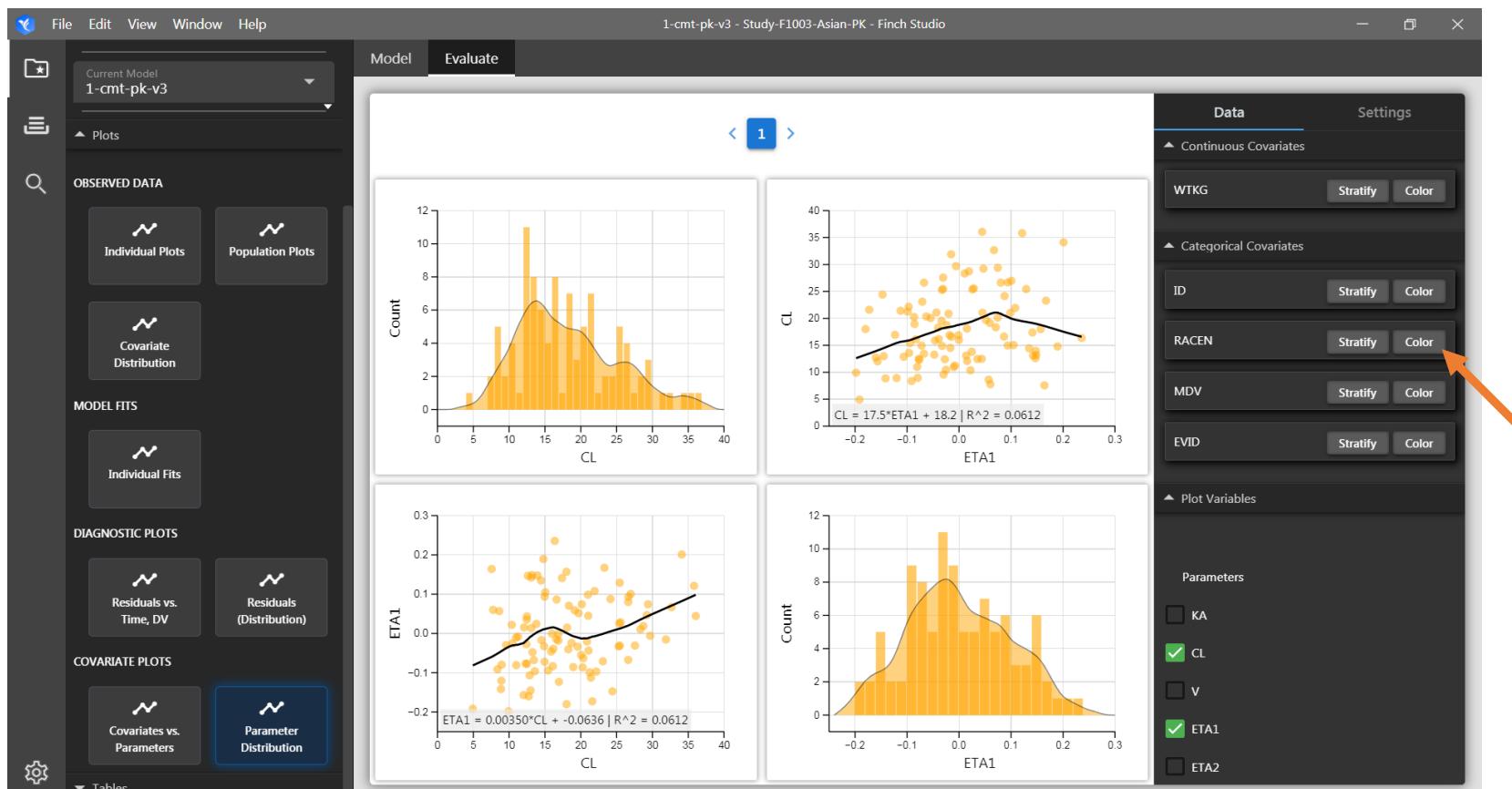
- We can look at *Parameter Distributions*, as well:





Covariate Model Example

- We can look at *Parameter Distributions*, as well:





Covariate Model Example

- We can look at *Parameter Distributions*, as well:





Covariate Model Example

- While we're here:





Covariate Model Example

- While we're here:





Covariate Model Example

- While we're here:





Covariate Model Example

- While we're here:





Covariate Model Example

- While we're here:

The screenshot shows the Finch Studio application window titled "1-cmt-pk-v3 - Study-F1003-Asian-PK - Finch Studio". The interface has a dark theme with a top navigation bar and tabs for "Model" and "Evaluate".
The left sidebar includes sections for "DIRECTORY", "PROJECT Study-F1003-Asian-PK", "Current Model 1-cmt-pk-v3", "Plots", "Tables", and "OBSERVED DATA". An orange arrow points from the text "Observed Summary Stats" in the "OBSERVED DATA" section to the "Observed Summary Stats" button.
The main central area displays a message: "Please select variables to summarise in 'Summary Variables' on right panel." with a blue border.
The right sidebar is titled "Data" and contains sections for "Continuous Covariates" (WTKG) and "Categorical Covariates" (RACEN). It also includes a "Summary Variables" section with a radio button for "One Row Per ID" and a "Summarize as:" table:

Statistics	Counts
<input type="checkbox"/> ID	<input type="checkbox"/> ID
<input type="checkbox"/> TIME	<input type="checkbox"/> TIME
<input type="checkbox"/> EVID	<input type="checkbox"/> EVID
<input type="checkbox"/> AMT	<input type="checkbox"/> AMT
<input type="checkbox"/> DV	<input type="checkbox"/> DV
<input type="checkbox"/> RACEN	<input type="checkbox"/> RACEN
<input type="checkbox"/> WTKG	<input type="checkbox"/> WTKG
<input type="checkbox"/> Race	<input type="checkbox"/> Race



Covariate Model Example

- While we're here:

Please select variables to summarise in 'Summary Variables' on right panel.

One Row Per ID

WTKG



Covariate Model Example

- While we're here:

The screenshot shows the Finch Studio interface for a project titled "Study-F1003-Asian-PK". The "Evaluate" tab is selected. On the left, the "OBSERVED DATA" panel has a "Summary Stats" button highlighted. The main area displays a table for the covariate "WTKG".

Overall (N = 100)	
WTKG	
Mean (SD)	71.4 (14.3)
Median [Min, Max]	70.1 [39.9, 103]
Missing	0 (0.00%)

On the right, the "Data" panel shows "Continuous Covariates" (WTKG selected) and "Categorical Covariates" (RACEN). Under "Summary Variables", "WTKG" is checked under "Summarize as: Statistics".



Covariate Model Example

- While we're here:

The screenshot shows the Finch Studio software interface. The top menu bar includes File, Edit, View, Window, Help, Model, and Evaluate. The central workspace displays a summary table for the 'WTKG' covariate, showing Overall statistics for N = 100: Mean (SD) 71.4 (14.3), Median [Min, Max] 70.1 [39.9, 103], and Missing 0 (0.00%). To the right, the 'Data' panel is open, showing 'Continuous Covariates' (WTKG) and 'Categorical Covariates' (RACEN). For RACEN, there are 'Stratify' and 'Split' buttons, with 'Split' highlighted by an orange arrow. The 'Summary Variables' section includes a toggle for 'One Row Per ID' and a 'Summarize as:' section with checkboxes for Statistics (ID, TIME, EVID, AMT, DV, RACEN, WTKG, Race) and Counts (ID, TIME, EVID, AMT, DV, RACEN, WTKG, Race). The 'WTKG' checkbox is checked.



Covariate Model Example

- While we're here:

The screenshot shows the Finch Studio software interface with the following details:

- File Bar:** File, Edit, View, Window, Help.
- Project Area:** DIRECTORY (C:\Users\Sarah-PC\Documents\Workshop\Drug), PROJECT Study-F1003-Asian-PK, Current Model: 1-cmt-pk-v3.
- Left Sidebar:** OBSERVED DATA (Observed Summary Stats).
- Central Panel:** Evaluate tab selected. A table titled "WTKG" compares RACEN: 2 (N = 50), RACEN: 5 (N = 50), and Overall (N = 100).

	RACEN: 2 (N = 50)	RACEN: 5 (N = 50)	Overall (N = 100)
WTKG			
Mean (SD)	61.3 (9.49)	81.5 (10.6)	71.4 (14.3)
Median [Min, Max]	60.6 [39.9, 86.0]	80.9 [60.1, 103]	70.1 [39.9, 103]
Missing	0 (0.00%)	0 (0.00%)	0 (0.00%)
- Right Sidebar:** Data tab selected. Continuous Covariates: WTKG (Stratify, Split). Categorical Covariates: RACEN (Stratify, Split). Summary Variables: One Row Per ID (selected), Summarize as: Statistics (ID, TIME, EVID, AMT, DV, RACEN, WTKG) and Counts (ID, TIME, EVID, AMT, DV, RACEN, WTKG, Race).

Hands-on Session: Advanced Finch Studio

R Scripts, Custom Commands, Visual Predictive Check



Customize Run Settings

- Run settings can be customized and additional commands defined:

The screenshot shows the Finch Studio software interface. The main window displays a model editor with the following code:

```
C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v3
31 (0, 0.05) ; KA ; 1/hr ; Absorption Rate Constant
32 (0, 17.3) ; CL ; L/hr ; Clearance
33 (0, 84.0) ; V ; L ; Volume of Distribution
34 (1.83) ; WTonCL
35 (1) ; WTonV
36
37 $OMEGA BLOCK(2)
38 0.0103 ; CL
39 0.00 0.111 ; V
40
41 $SIGMA
42 0.0206 ; Proportional
43
44 $ESTIMATION METHOD=1 INTER NOABORT MAXEVAL=9999 PRINT=5 NSIG=3 NOTHETABOUNDTEST
45 NOMEGABOUNDTEST NOSIGMABOUNDTEST
46
47 $COVARIANCE PRINT=E UNCONDITIONAL
48
49 $TABLE ID TIME DV EVID IPRED CWRES IWRES ONEHEADER NOPRINT FILE=sdtab1
50 $TABLE ID KA CL V ETAS(1:LAST) ONEHEADER NOPRINT FILE=patab1 ; model parameters
51 $TABLE ID RACEN ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
52 $TABLE ID WTKG ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

The right side of the interface shows a "Parameters" table with columns for Initial, Final, and RSE%.

	Initial	Final	RSE%
KA (1/hr)	0.783	0.782	1.22
CL (L/hr)	17.3	17.3	1.11
V(L)	84.0	85.8	1.11
WTonCL	1.83	1.85	3.03
WTonV	1.00	1.58	3.7

The bottom right corner of the interface shows the output of the run:

```
MINIMIZATION SUCCESSFUL
NO. OF FUNCTION EVALUATIONS USED: 217
NO. OF SIG. DIGITS IN FINAL EST.: 3.4

11.62
Elapsed covariance time in seconds: 11.04
Elapsed postprocess time in seconds: 0.18
Elapsed finaloutput time in seconds: 0.60
Done with nonmem execution
File ..
execute done
```



Customize Run Settings

- Run settings can be customized and additional commands defined:

The screenshot shows the Finch Studio software interface. On the left, there's a sidebar with 'PROJECT Study-F1003-Asian-PK' expanded, showing 'data\F1003-Asian-PK-Study.csv' under 'DATA'. Below it, 'MODELS' list includes '1-cmt-pk-v1', '1-cmt-pk-v2-complete', '1-cmt-pk-v3-complete', '1-cmt-pk-v2', and '1-cmt-pk-v3' (which is selected). The main area has tabs 'Model' and 'Evaluate'. Under 'Model', the code for '1-cmt-pk-v3' is displayed:

```
C: > Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v3
31 (0, 0.03) ; KA ; 1/min ; Absorption Rate Constant
32 (0, 17.3) ; CL ; L/hr ; Clearance
33 (0, 84.0) ; V ; L ; Volume of Distribution
34 (1.83) ; WTonCL
35 (1) ; WTonV
36
37 $OMEGA BLOCK(2)
38 0.0103 ; CL
39 0.00 0.111 ; V
40
41 $SIGMA
42 0.0206 ; Proportional
43
44 $ESTIMATION METHOD=1 INTER NOABORT MAXEVAL=9999 PRINT=5 NSIG=3 NOTHETABOUNDTEST
45 NOMEGABOUNDTEST NOSIGMABOUNDTEST
46
47 $COVARIANCE PRINT=E UNCONDITIONAL
48
49 $TABLE ID TIME DV MDV EVID IPRED CWRES IWRES ONEHEADER NOPRINT FILE=sdtab1
50 $TABLE ID KA CL V ETAS(1:L:M) ONEHEADER NOPRINT FILE=patab1 ; model parameters
51 $TABLE ID RACEN ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
52 $TABLE ID WTKG ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

An orange arrow points to the line '\$COVARIANCE PRINT=E UNCONDITIONAL'. The right side of the screen shows the 'Parameters' and 'Scripts' panes, and the 'RESULTS' tab displays a table of model runs:

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	foci
1-cmt-pk-v2	Adding weight on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	foci
1-cmt-pk-v3	Adding weight on V	1-cmt-pk-v1	100/1400	-6645.45	-497.35	S	S		3.39	foci

The bottom right corner of the results table says 'Showing 3 of 5 models'. The 'Evaluate' tab shows the output of the run, including:

```
MINIMIZATION SUCCESSFUL
NO. OF FUNCTION EVALUATIONS USED: 217
NO. OF SIG. DIGITS IN FINAL EST.: 3.4

11.62
Elapsed covariance time in seconds: 11.04
Elapsed postprocess time in seconds: 0.18
Elapsed finaloutput time in seconds: 0.60
Done with nonmem execution
File ..
execute done
```



Customize Run Settings

- Run settings can be customized and additional commands defined:

The screenshot shows the Finch Studio software interface. On the left, there's a project tree for 'Study-F1003-Asian-PK' containing various model files like '1-cmt-pk-v1', '1-cmt-pk-v2-complete', '1-cmt-pk-v3-complete', '1-cmt-pk-v2', and '1-cmt-pk-v3'. The '1-cmt-pk-v3' file is selected. The main area displays the model code:

```
C:\> nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v3
...
32 (0, 17.3) ; CL ; L/hr ; Clearance
33 (0, 84.0) ; V ; L ; Volume of Distribution
34 (1.83) ; WTonCL
35 (1) ; WTonV
36
37 $OMEGA BLOCK(2)
38 0.0103 ; CL
39 0.00 0.111 ; V
40
41 $SIGMA
42 0.0206 ; Proportional
43
44 $ESTIMATION METHOD=1 INTER NOABORT MAXEVAL=9999 PRINT=5 NSIG=3 NOTHETABOUNDTEST
NOMEGABOUNDTEST NOSIGMABOUNDTEST
45
46 $COVARIANCE PRINT=E UNCONDITIONAL
47
48 $TABLE ID TIME DV MDV EVID IPRED CWRES ONEHEADER NOPRINT FILE=sdtab1
50 $TABLE ID KA CL V ETAS(:LAST) ONEHEADER NOPRINT FILE=patab1 ; model parameters
51 $TABLE ID RACEN ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
52 $TABLE ID WTKG ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

Below the code editor are tabs for 'RESULTS', 'MODEL', 'RUN SETTINGS', 'FILES', and 'CONSOLE'. The 'RUN SETTINGS' tab is active, showing a 'PROJECT' section with a 'Primary Command' set to 'Run Model: execute mod1.ctl -nm_output=xml.ext' and an 'Additional Commands' section containing 'VPC: vpc mod1.ctl -sample=200', 'Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst', 'Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel', 'Run VPC: vpc mod1vpc.ctl -sample=200', and 'Run Bootstrap: bootstrap mod1.ctl -samples=50'. To the right, the 'Parameters' panel shows tables for 'Theta' and 'Omega' with initial and final values, and the 'Sigma' panel shows the same for the covariance matrix. The 'Console' panel at the bottom displays the output of the run, including optimization details and execution logs.



Customize Run Settings

- Run settings can be customized and additional commands defined:

The screenshot shows the Finch Studio application interface. On the left, there's a project tree for 'Study-F1003-Asian-PK' containing various model files like '1-cmt-pk-v1', '1-cmt-pk-v2-complete', '1-cmt-pk-v3-complete', '1-cmt-pk-v2', and '1-cmt-pk-v3'. The '1-cmt-pk-v3' file is currently selected. The main area displays the model code for '1-cmt-pk-v3'.

```
C:\> nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v3
...
32 (0, 17.3) ; CL ; L/hr ; Clearance
33 (0, 84.0) ; V ; L ; Volume of Distribution
34 (1.83) ; WtOnCL
35 (1) ; WtOnV
36
37 $OMEGA BLOCK(2)
38 0.0103 ; CL
39 0.00 0.111 ; V
40
41 $SIGMA
42 0.0206 ; Proportional
43
44 $ESTIMATION METHOD=1 INTER NOABORT MAXEVAL=9999 PRINT=5 NSIG=3 NOTHETABOUNDTEST
NOMEGABOUNDTEST NOSIGMABOUNDTEST
45
46 $COVARIANCE PRINT=E UNCONDITIONAL
47
48 $TABLE ID TIME DV MDV EVID IPRED CWRES ONEHEADER NOPRINT FILE=sdtab1
50 $TABLE ID KA CL V ETAS(:LAST) ONEHEADER NOPRINT FILE=patab1 ; model parameters
51 $TABLE ID RACEN ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
52 $TABLE ID WTKG ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

Below the code editor, the 'RUN SETTINGS' tab is selected. It shows a 'PROJECT' section with a 'Primary Command' set to 'Run Model: execute mod1.ctl -nm_output=xml.ext' and an 'Additional Commands' section containing 'VPC: vpc mod1.ctl -sample=200'. To the right, under 'GLOBAL', there is also a 'Primary Command' set to 'Run Model: execute mod1.ctl -nm_output=xml.ext' and an 'Additional Commands' section with several entries: 'Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst', 'Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel', 'Run VPC: vpc mod1vpc.ctl -sample=200', and 'Run Bootstrap: bootstrap mod1.ctl -samples=50'.

On the far right, the 'RESULTS' panel displays the output of the run. It includes a 'Parameters' table for 'Theta' and 'Omega' with initial and final values, and a 'Sigma' table for 'Propo...' with final values. The output text at the bottom indicates 'MINIMIZATION SUCCESSFUL' with 217 function evaluations and 34 significant digits.

The flexibility of custom commands allows users to connect Finch with external programs such as PsN . We'll use visual predictive check as an illustrative example.



Customize Run Settings

- Run settings can be customized and additional commands defined:

The flexibility of custom commands allows users to connect Finch with external programs such as PsN . We'll use visual predictive check as an illustrative example.

By default, *Run Model* uses PsN execute, but NONMEM can also be run via NMFE.

Run Model: execute mod1.ctl -nm_output=xml,ext

Additional Commands +

VPC: vpc mod1.ctl -sample=200

Run Model: execute mod1.ctl -nm_output=xml,ext

Additional Commands +

Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst

Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel

Run VPC: vpc mod1vpc.ctl -sample=200

Run Bootstrap: bootstrap mod1.ctl -samples=50

Parameter	Initial	Final	RSE(%)	Shr...
KA (1/hr)	0.783	0.782	1.22	
CL (L/hr)	17.3	17.3	1.11	
V (L)	84.0	85.8	1.11	
WTonCL	1.83	1.85	3.03	
WTonV	1.00	1.58	3.7	

Parameter	Initial	Final	RSE(%)	Shr...
CL_	0.0105	10.3	13.1	5.38
OM1_	0.00	-	-	-
V_	0.00765	8.76	17.2	12.86

Parameter	Initial	Final	RSE(%)	Shr...
Propo...	0.0206	14.3	3.77	5.84

MINIMIZATION SUCCESSFUL
NO. OF FUNCTION EVALUATIONS USED: 217
NO. OF SIG. DIGITS IN FINAL EST: 3.4

Elapsed covariance time in seconds: 11.62
Elapsed postprocess time in seconds: 11.04
Elapsed finaloutput time in seconds: 0.18
Done with nonmem execution
F1: ..
execute done



Visual Predictive Check (VPC)

- A simulation-based diagnostic
 - Simulate DV for a large number of replicate datasets (often 200-1,000) with the original dataset design (i.e., same independent variables)
 - Variability introduced by random sampling from OMEGA and SIGMA matrices
- Assess graphically whether simulations from the model reproduce the central trend and variability in the observed data when plotted against an independent variable (usually time)

Karlsson and Savic (2007) *Clin Pharmacol Ther* 82(1), 17.

Bergstrand et al. (2011) *AAPS J* 13(2), 143.



Running a VPC in Finch/PsN

- PsN provides many useful options for running a VPC
- Examples
 - Binning options
 - Stratification (e.g., by dose or certain covariate values)
 - Independent variables other than time (e.g., time since previous dose)
 - Prediction-corrected VPCs
- It is also often possible to run a relatively generic VPC at the PsN command line and to apply custom options in post-processing, which is what we'll do here.
- Recommended resources
 - Karlsson and Savic (2007) *Clin Pharmacol Ther* 82(1), 17.
 - Bergstrand et al. (2011) *AAPS J* 13(2), 143.
 - **PsN VPC and NPC User Guide** (<https://uupharmacometrics.github.io/PsN/docs.html>)
 - Keizer et al. (2013) *CPT Pharmacometrics Syst Pharmacol* 2, e50.



Running a VPC in Finch/PsN

- Creating a VPC plots occurs in two steps
- First, VPC PsN module is executed. This is what creates the raw simulation outputs.
- Second, a plotting script is run. This takes the simulation output and creates the VPC graphic.
 - Default R package used within the plotting script is the ‘vpc’ package by Ron Keizer.



Running a VPC in Finch/PsN

The screenshot shows the Finch Studio software interface. On the left, there's a sidebar with a 'DIRECTORY' section pointing to 'C:\Users\Mohamed Ismail\Documents\Fin', a 'PROJECT Study-F1003-Asian-PK' section with an 'Open Project' dropdown set to 'Study-F1003-Asian-PK', and a 'DATA' section containing 'data\F1003-Asian-PK-Study.csv'. Below these are sections for 'MODELS' (with '1-cmt-pk-v1' selected), 'DATA', and 'SCRIPTS'. The main central area displays a code editor for '1-cmt-pk-v1' containing PK modeling code. A modal window titled 'Navigate to Run Settings' is overlaid on the code editor, with an orange arrow pointing from its bottom right towards the 'Run Model' button in the code editor's toolbar. To the right of the code editor is a 'Parameters' panel showing 'Initial / Final' values for KA, CL, and V, and 'Omega' and 'Sigma' covariance matrices. At the bottom, a results table lists three models: '1-cmt-pk-v3-comp...', '1-cmt-pk-v2-comp...', and '1-cmt-pk-v1', along with their descriptions, reference models, and various performance metrics like OFV and dOFV.

1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advanc2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)

(0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
(0, 16.2) ; CL ; L/hr ; Clearance
(0, 82.1) ; V ; L ; Volume of Distribution
$OMEGA BLOCK(2)
```

RESULTS MODEL RUN SETTINGS FILES CONSOLE

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig ...	Met...
1-cmt-pk-v3-comp...	Add WTKG on V	1-cmt-pk-v2-complete	100/1400	-6645.45	-242.62	S	S		3.39	focel
1-cmt-pk-v2-comp...	Add WTKG on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	focel
1-cmt-pk-v1	None		100/1400	-6148.10		S	S		3.55	focel

Showing 3 of 3 models



Running a VPC in Finch/PsN

Add a custom project command to run a VPC tailored for this project

1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA " . , ,\data\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
```

Parameters

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Initial / Final

Theta	CL	V
exp(0)	0.0474	0.00

Cov Cor

Omega	CL	V
CL	0.0474	
V	0.00	0.0400

Cov Cor

Sigma	Proportional
Proportional	0.0861

RESULTS MODEL RUN SETTINGS FILES CONSOLE

Run in Separate Window

PROJECT Primary Command

Run Model: execute d1.ctl -nm_output=xml,ext

Additional Commands +

GLOBAL Primary Command

Run Model: execute mod1.ctl -nm_output=xml,ext

Additional Commands +

Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst

Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel

Run VPC: vpc mod1.ctl -sample=200

Run Bootstrap: bootstrap mod1.ctl -samples=50



Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface with a modal dialog for running a VPC. The modal has the following fields:

- Command Name:** Run VPC Asian PK
- Command:** vpc mod1.ctl -samples=500 -stratify_on=RACEN
- Save** button (highlighted with an orange arrow)

Annotations on the screen include:

- Provide name for command** (above the Command Name field)
- Variables to stratify the VPC on** (above the Command field)
- Number of simulation replicates** (left side of the Command field)
- Save when finished** (right side of the Save button)

At the bottom of the modal, there is an orange box containing the following text:

Additional PsN VPC options can be found in the user guide at: <https://uupharmacometrics.github.io/PsN/docs.html>



Running a VPC in Finch/PsN

Right click on first model

Select command to run

1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
KA = TVKA
THETA(2)
*EXP(ETA(1))
HETA(3)
*EXP(ETA(2))
```

Model Evaluate

PARAMETERS

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

OMEGA

CL	V
0.0474	
0.00	0.0400

SIGMA

Proportional
0.0861

RESULTS

Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt-pk-v3-complete	Add WTKG on V	1-cmt-pk-v2-complete	100/1400	-6645.45	-242.62	S	S	3.39	focei
1-cmt-pk-v2-complete	Add WTKG on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S	3.80	focei
1-cmt-pk-v1		None	100/1400	-6148.10		S	S	3.55	focei

Showing 3 of 3 models



Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface with a project titled "Study-F1003-Asian-PK". The central window displays a model script for a 1-compartment pharmacokinetic model (1-cmt-pk-v1). The script includes commands for reading input data from a CSV file and defining parameters like KA, CL, and V. A callout box with the text "Monitor output on right panel" points to the right-hand side of the interface, where a "Parameters" panel shows initial values for these parameters. Below the script, a status message indicates "Starting 2 NONMEM executions. 2 in parallel." An orange arrow points from the text in the callout box to the "Run Model" button in the bottom right corner of the main window.

1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(2))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$THETA
(0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
(0, 16.2) ; CL ; L/hr ; Clearance
```

Monitor output on right panel

Run Model

Parameters

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

Initial / Final

Cov Cor

CL	V
0.0474	0.00
0.0400	0.0400

Omega

Cov Cor

Proportional
0.0861

Sigma

Starting 2 NONMEM executions. 2 in parallel.
S:1 .. S:2 .. Waiting for all NONMEM runs to finish:
F:1 ..



Running a VPC in Finch/PsN

When vpc finishes, click
bread crumb path to
open the model directory

1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(2))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$THETA
(0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
(0, 16.2) ; CL ; L/hr ; Clearance
```

RESULTS MODEL RUN SETTINGS FILES CONSOLE

PROJECT Primary Command Run Model: execute mod1.ctl -nm_output=xml,ext

Additional Commands + Run VPC Asian PK: vpc mod1.ctl -samples=500 -stratify_on=RACE

GLOBAL Primary Command Run Model: execute mod1.ctl -nm_output=xml,ext

Additional Commands + Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst

Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel

Run VPC: vpc mod1.ctl -sample=200

Run Bootstrap: bootstrap mod1.ctl -samples=50

Parameters Scripts

Name	Lower	Initial	Upper
KA [1/hr]	0	0.895	-
CL [L/hr]	0	16.2	-
V [L]	0	82.1	-

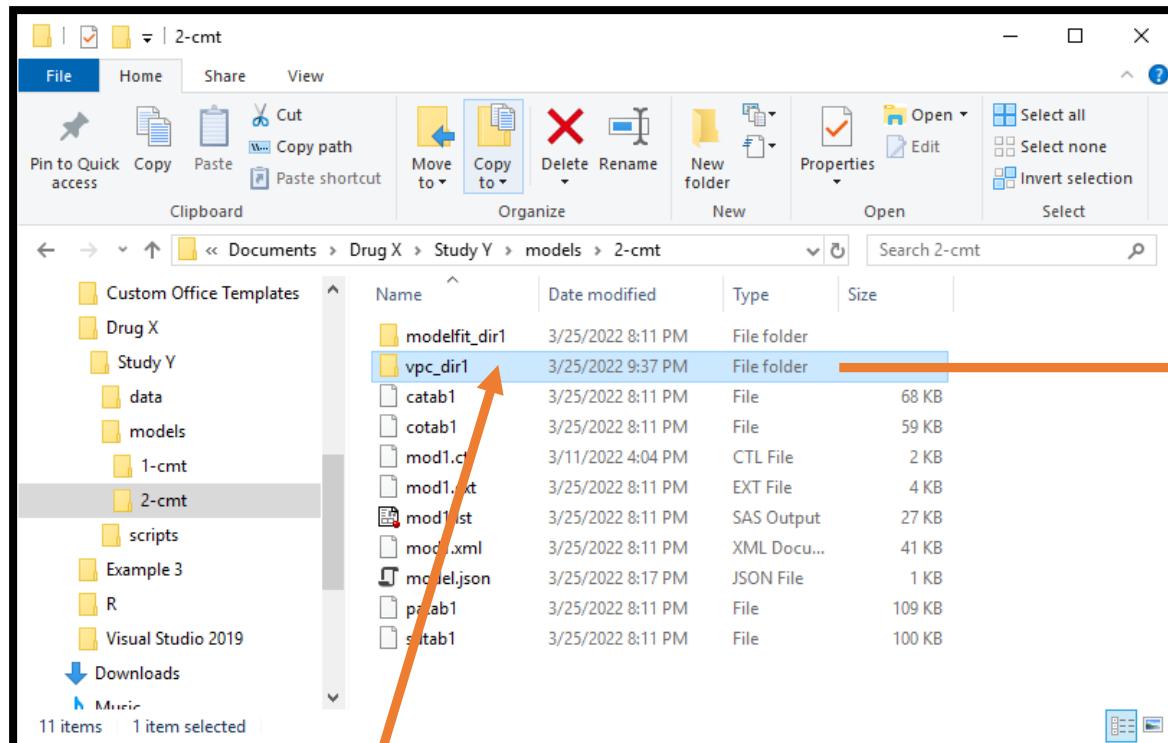
Cov	Cor	CL	V
		0.0474	
		V	0.0400

Cov	Cor	Sigma
		Proportional
		0.0861

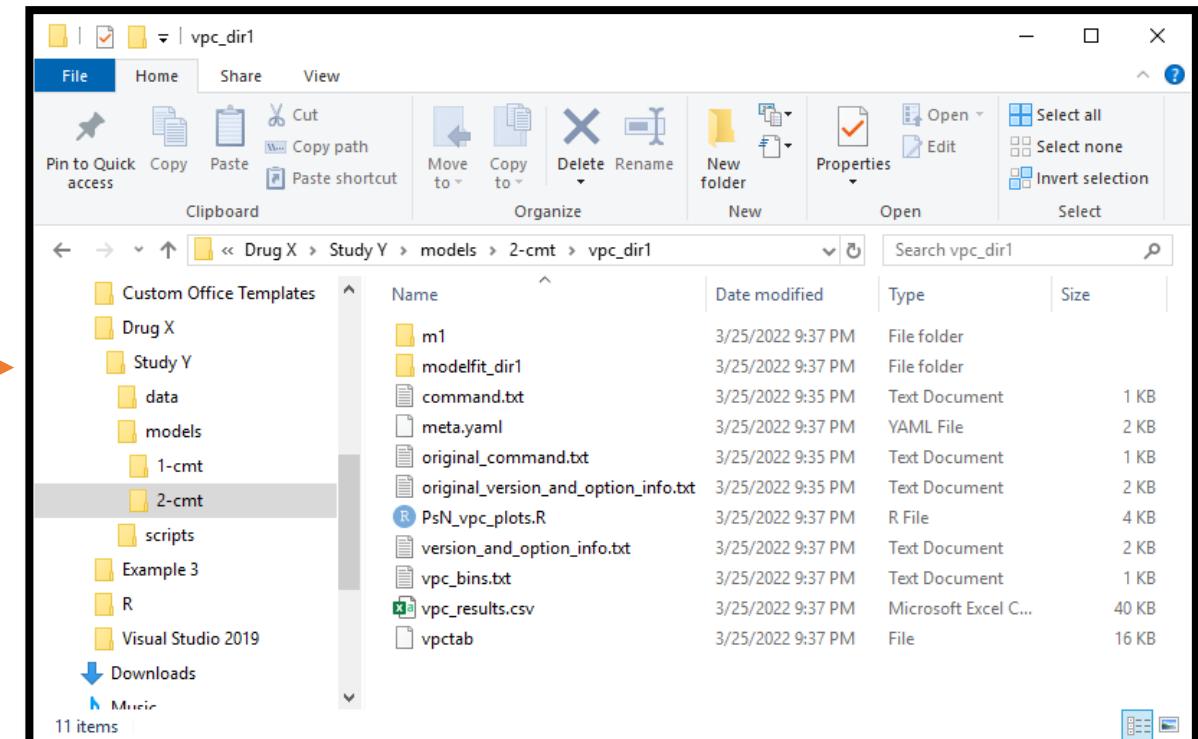
Done reading and formatting data, finishing run.
Auto binning evaluating N = 2 3 4 5 6 7 8 9 10
Auto binning: using 10 bins
Auto binning: bin edges -0.25,1.5,2.5,5,7,9,11,14,18,22,26
Auto binning evaluating N = 2 3 4 5 6 7 8 9 10
Auto binning: using 10 bins
Auto binning: bin edges -0.25,1.5,2.5,5,7,9,11,14,18,22,26
vpc done



Running a VPC in Finch/PsN



We now have a VPC directory (`vpc_dir1`)



- The `vpc_dir1` directory contains the raw output of our VPC simulations
- Next, we will run an R script to post-process these results and create VPC plots



Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface. On the left, the project structure is visible, including a 'PROJECT Study-F1003-Asian-PK' and several model files like '1-cmt-pk-v1', '1-cmt-pk-v2-complete', and '1-cmt-pk-v3-complete'. The main area displays the '1-cmt-pk-v1' model script:

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...\\data\\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$THETA
(0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
(0, 16.2) ; CL ; L/hr ; Clearance
```

The right side of the interface shows the 'Scripts' tab, which contains a dropdown menu titled 'Scripts (Local)' with two items: 'vpc-F1003-by-race.R' and 'vpc-F1003.R'. An orange arrow points from the text 'Open Scripts Tab' to the 'Scripts' tab header, and another orange arrow points from the text 'Click Script (Local) Dropdown' to the 'Scripts (Local)' dropdown menu.

Open Scripts Tab
Click Script (Local)
Dropdown

Scripts (Local) directory exists within the project directory. You may store post-processing scripts specific to your project here.



Running a VPC in Finch/PsN

File Edit View Window Help

Model Evaluate

1-cmt-pk-v1

C:\> Users > Mohamed Ismail > Documents > Finch > examples > FinchLumab-Original > Study-F1003-Asian-PK > models > 1-cmt-pk-v1

```
$PROB ev_no-delay_first-order_one-compartment_linear_advan2_trans2
$INPUT ID TIME EVID AMT DV RACEN WTKG Race=DROP
$DATA "...,\data\F1003-Asian-PK-Study.csv" IGNORE=@
$SUBROUTINES ADVAN2 TRANS2
$PK
TVKA = THETA(1)
KA = TVKA
TVCL = THETA(2)
CL = TVCL*EXP(ETA(1))
TVV = THETA(3)
V = TVV*EXP(ETA(2))
S2 = V
$THETA
(0, 0.895) ; KA ; 1/hr ; Absorption Rate Constant
(0, 16.2) ; CL ; L/hr ; Clearance
```

Save Run Model

RESULTS MODEL RUN SETTINGS FILES CONSOLE

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt-pk-v3-complete	Add WTKG on V	1-cmt-pk-v2-complete	100/1400	-6645.45	-242.62	S	S		3.39	focei
1-cmt-pk-v2-complete	Add WTKG on CL	1-cmt-pk-v1	100/1400	-6402.83	-254.73	S	S		3.80	focei
1-cmt-pk-v1		None	100/1400	-6148.10		S	S		3.55	focei

Showing 3 of 3 models

Run both VPC scripts by clicking on them

Once a script is started, you will be able to monitor the progress of the script at the bottom right of the application.



Running a VPC in Finch/PsN

File Edit View Window Help

DIRECTORY C:\Users\nonmem_template\Documents

PROJECT Study-F1003-Asian-PK

Open Project Study-F1003-Asian-PK

DATA View data\F1003-Asian-PK-Study.csv

MODELS + 1-cmt-pk-v1 1-cmt-pk-v2-complete 1-cmt-pk-v3-complete 1-cmt-pk-v2 1-cmt-pk-v3

Model Evaluate

1-cmt-pk-v3

C:\> Users > nonmem_template > Documents > Drug-1 > Study-F1003-Asian-PK > models > 1-cmt-pk-v3

```
32 (0, 17.3) ; CL ; L/hr ; Clearance
33 (0, 84.0) ; V ; L ; Volume of Distribution
34 (1.83) ; WtOnCL
35 (1) ; WtOnV
36
37 $OMEGA BLOCK(2)
38 0.0103 ; CL
39 0.00 0.111 ; V
40
41 $SIGMA
42 0.0206 ; Proportional
43
44 $ESTIMATION METHOD=1 INTER NOABORT MAXEVAL=9999 PRINT=5 NSIG=3 NOTHETABOUNDTEST
45 NOMEGABOUNDTEST NOSIGMABOUNDTEST
46
47 $COVARIANCE PRINT=E UNCONDITIONAL
48
49 $TABLE ID TIME DV MDV EVID IPRED CWRES IRES ONEHEADER NOPRINT FILE=sdtab1
50 $TABLE ID KA CL V ETAS(1:LAST) ONEHEADER NOPRINT FILE=patab1 ; model parameters
51 $TABLE ID RACEN ONEHEADER NOPRINT FILE=catab1 ; categorical covariates
52 $TABLE ID WTKG ONEHEADER NOPRINT FILE=cotab1 ; continuous covariates
```

Save Run Model

RESULTS MODEL RUN SETTINGS FILES CONSOLE

Run in Separate Window

PROJECT Primary Command

Run Model: execute mod1.ctl -nm_output=xml.ext

Additional Commands +

VPC by Race: vpc mod1.ctl -sample=200 -stratify_on=RACEN

VPC: vpc mod1.ctl -sample=200

GLOBAL Primary Command

Run Model: execute mod1.ctl -nm_output=xml.ext

Additional Commands +

Run NMFE: C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst

Run NMFE (Parallel): C:\nm74g64\run\nmfe74 mod1.ctl mod1.lst -parallel=5

Run VPC: vpc mod1vpc.ctl -sample=200

Run Bootstrap: bootstrap mod1.ctl -samples=50

Parameters Scripts

> Scripts

> Scripts (Local)

vpc-F1003-by-race.R

vpc-F1003.R

Running C:\Users\nonmem_template\Documents\Study-F1003-Asian-PK\scripts\vpc-F1003.R

Attaching package: 'dplyr' The following objects are masked from 'packagestats': filter, lag The following objects are masked from 'packagebase': intersect, setdiff, setequal, union Warning message: In dir.create(file.path(dirname(file_name))) : 'C:\Users\nonmem_template\Documents\Study-F1003-Asian-PK\models\1-cmt-pk-v3\output' already exists

CLOSE

Running C:\Users\nonmem_template\Documents\Study-F1003-Asian-PK\scripts\vpc-F1003-by-race.R

CLOSE

Run both VPC scripts by clicking on them

Once a script is started, you will be able to monitor the progress of the script at the bottom right of the application.



Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface with the following details:

- Left Sidebar:** Shows the project structure under "PROJECT Study-F1003-Asian-PK".
- Model Editor:** Displays an R script titled "1-cmt-pk-v1". The script includes code for defining parameters (\$PROB, \$INPUT, \$DATA), subroutines (\$SUBROUTINES), and PK parameters (\$PK). It also includes theta definitions (\$THETA) and absorption rate constants (\$KA).
- Bottom Left:** A callout box with orange text and an arrow points to the "output" folder in the file list.
- Bottom Center:** A callout box with orange text and an arrow points to the "FILES" tab in the navigation bar.
- Bottom Right:** A callout box with orange text and an arrow points to the "No Remote Connection Found" message in the status bar.
- File List:** Shows a list of files generated by the model, including "Rplots.pdf", "output", "vpc.dir1", "modelfit.dir1", "mod1.lst", "mod1.ext", "cotab1", "mod1.xml", "mod1.xml", "cotab1", "patab1", "sdtab1", and "model.json".
- Scripts Tab:** Shows a list of local scripts: "vpc-F1003-by-race.R" and "vpc-F1003.R".

Double click on the output folder (this is the location we saved the plot outputs within the R script)



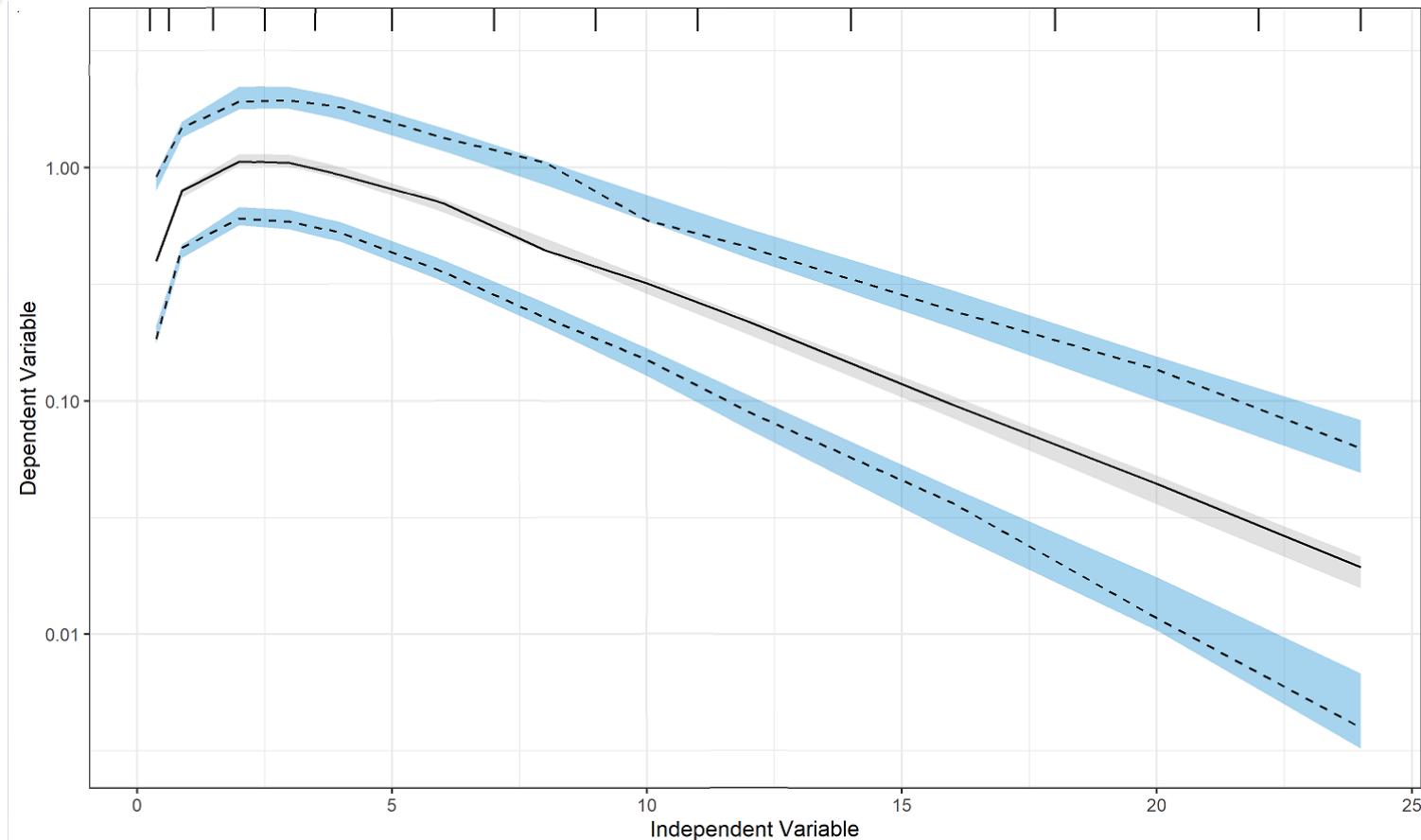
Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface. On the left, the project structure is visible, including a 'PROJECT Study-F1003-Asian-PK' and several model files: '1-cmt-pk-v1' (selected), '1-cmt-pk-v2-complete', and '1-cmt-pk-v3-complete'. In the center, the 'Model' tab is active, displaying the code for '1-cmt-pk-v1'. The code includes sections for PROB, INPUT, DATA, SUBROUTINES, PK, and THETA parameters. On the right, the 'Scripts' tab shows two scripts: 'vpc-F1003-by-race.R' and 'vpc-F1003.R'. Below the code editor, the 'FILES' tab is selected, showing a list of output files: 'vpc-by-race.png' (352.43 KB, modified 10/27/2022, 3:08:40 PM) and 'vpc-all.png' (199.84 KB, modified 10/27/2022, 3:06:37 PM). A message at the bottom of the file list says 'No Remote Connection Found' and provides a link to 'Open SSH/SFTP Remote Connection'. At the bottom of the main window, there is an orange callout text: 'Double click on the images to open in default program.'



Running a VPC in Finch/PsN

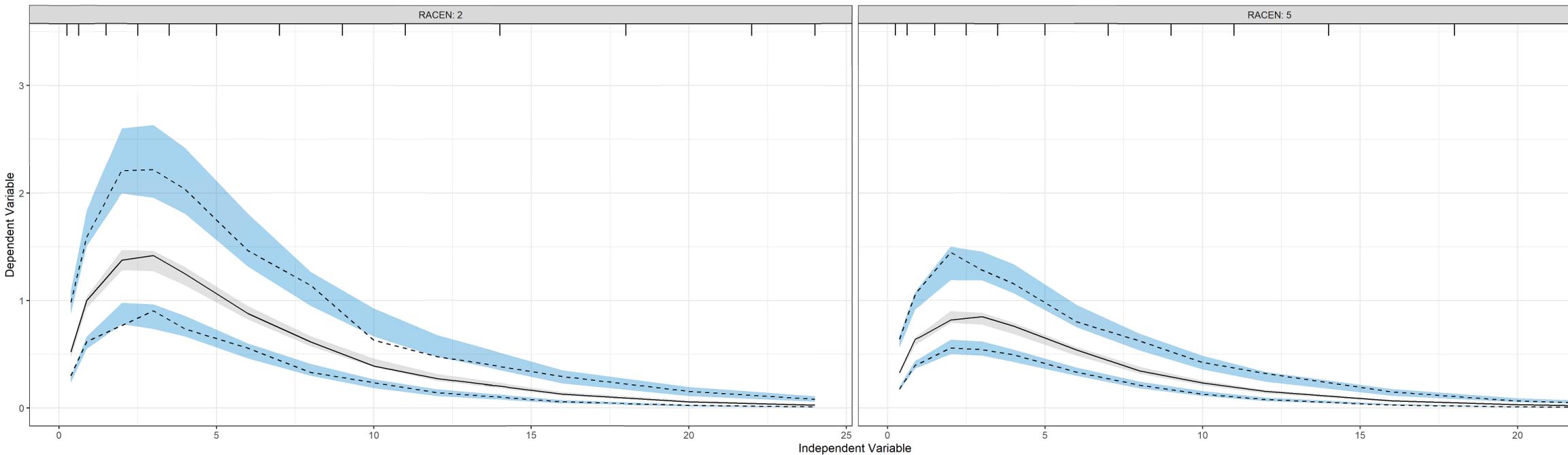
1-cmt-pk-v3





Running a VPC in Finch/PsN

1-cmt-pk-v3





Running a VPC in Finch/PsN

The screenshot shows the Finch Studio interface. On the left, the project structure for 'Study Y' is visible, including a 'data\NM_data.csv' file. In the center, a code editor displays a PK model script for a 2-compartment model ('2-cmt'). The script includes parameters like \$PROB, \$INPUT, \$DATA, \$SUBROUTINES, \$PK, and \$THETA, along with their definitions. On the right, the 'Modules' panel is open, showing the 'VPC' module under 'PsN'. A specific script named 'vpc.R' is listed under 'Scripts (Local)'. An orange arrow points to the small edit icon next to 'vpc.R', with the text: 'Click the small symbol at right to open and edit the script in RStudio'.

File Edit View Window Help

DIRECTORY
C:\Users\sfcook\Documents\Drug X\

PROJECT Study Y
Open Project Study Y

DATA C DATA
data\NM_data.csv

MODELS C + 1-cmt 2-cmt

2-cmt - Study Y - Finch Studio

C: > Users > sfcook > Documents > Drug X > Study Y > models > 2-cmt

```
1
2 $PROB Model12
3
4 $INPUT C ID TIME DV AMT MDV EVID WTKG AGE SEX P_TYPE
5
6 $DATA ../../data/NM_data.csv IGNORE=C
7
8 $SUBROUTINES ADVAN4 TRANS4
9
10 $PK
11
12 TVKA = THETA(1)
13 KA = TVKA*EXP(ETA(1))
14
15 TVCL = THETA(2)
16 CL = TVCL*EXP(ETA(2))
17
18 TV2 = THETA(3 )
19 V2 = TV2*EXP(ETA(3))
20 S2 = V2
21
22 Q = THETA(4)
23 V3 = THETA(5)
24
25
26 $THETA
27 (0, 0.317) ; KA ; 1/hr ; Absorption rate constant
28 (0, 14.1) ; CL ; L/hr ; Clearance
29 (0, 1.68) ; V2 ; L ; Volume of distribution
```

Save Run Model

RESULTS MODEL RUN SETTINGS CONSOLE

Model	Description	Ref	nInd/nObs	OFV	dOFV	S	C	B	Sig Digs	Method
1-cmt	1 cmt model, combined RUV	None	100/600	-1104.40		S	S		1.27	foc ei
2-cmt	2 cmt model, combined RUV	1-cmt	100/600	-2160.59	-1056.19	S	S		1.51	foc ei

Showing 2 of 2 models

Parameters Modules

VPC Visual Predictive Check PsN

Scripts Scripts (Local) vpc.R



Running a VPC in Finch/PsN

The screenshot shows the RStudio interface with the following details:

- File Menu:** File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, Help.
- Code Editor:** A file named "vpc.R" is open. The code is a script for generating VPC plots from PsN output. It includes comments explaining the purpose, authorship, and usage of the script.
- Environment Tab:** Shows the Global Environment pane with the message "Environment is empty".
- Console Tab:** Displays the command `~/Drug X/Study Y/scripts/` followed by the R help text for `demo()`, `?help()`, `?help.start()`, and `q()`.

**The script uses Ron Keizer's *vpc* R package
(documentation at vpc.ronkeizer.com).**



Running a VPC in Finch/PsN

The VPC is a widely used diagnostic tool in pharmacometrics (see e.g. [here](#)), showing how certain statistics (percentiles) for observed data compare to those same statistics for data simulated from a model. Historically, these plots are most commonly created using **PsN** and **Xpose**, using NONMEM as the simulation engine) or with Monolix. The aim of this `vpc` package for R is to provide:

- fully R-based computation of the VPC with plotting handled by `ggplot2`
- package that is more flexible regarding input (use simulated data from R, NONMEM, Monolix, Stan, or any other simulation tool)
- easier to customize, e.g. request any prediction / confidence interval or binning strategy upon plotting.
- easier to extend / theme

The package is available on [CRAN](#), and is being developed at [GitHub](#). This documentation is still in development, and should be seen as a more convenient overview of core functionality, compared to the more detailed *in-package* help. please let us know if you feel some essential information is missing.

Quick start

```
install.packages("vpc")
library("vpc")
vpc(sim = simple_data$sim, obs = simple_data$obs)
```



Running a VPC in Finch/PsN

The screenshot shows an RStudio interface with the following details:

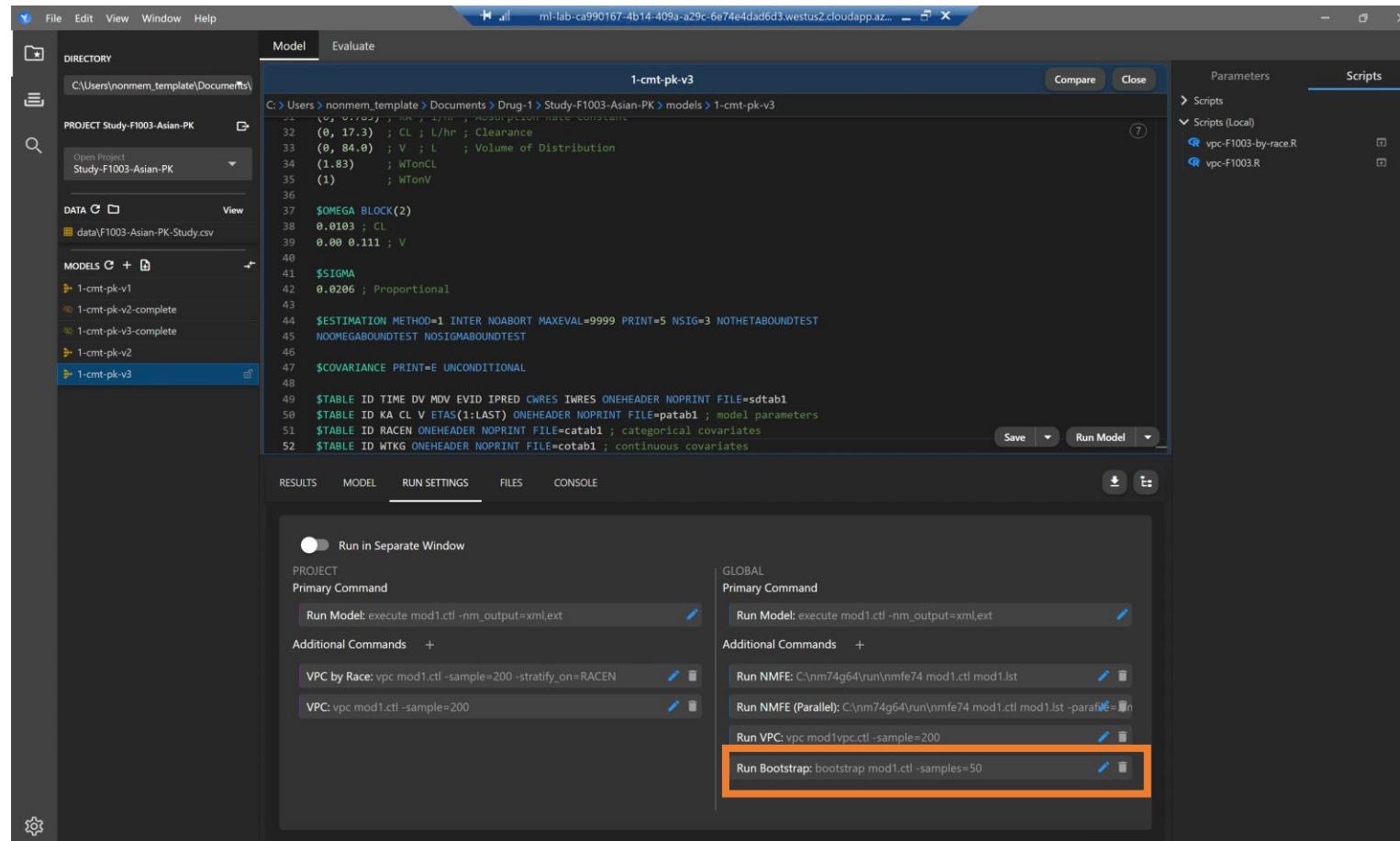
- File:** vpc.R
- Code:** The script contains two main parts: creating a `vpcdb` object and plotting the results. The `vpcdb` creation part includes setting up simulated and observed data frames, defining bin separators, and specifying prediction-correction parameters. The plotting part uses the `plot_vpc` function with various parameters to generate a VPC plot.
- Environment:** Shows "Global Environment" with "Environment is empty".
- Plots:** A large plot area is visible on the right side of the interface.
- Console:** Displays the R command `~/Drug X/study Y/scripts/` and standard R help text.

The core of the script is in the creation of the `vpc database object (vpc function)` and the `plotting of the vpc data (plot_vpc function).`



Running a Bootstrap Analysis

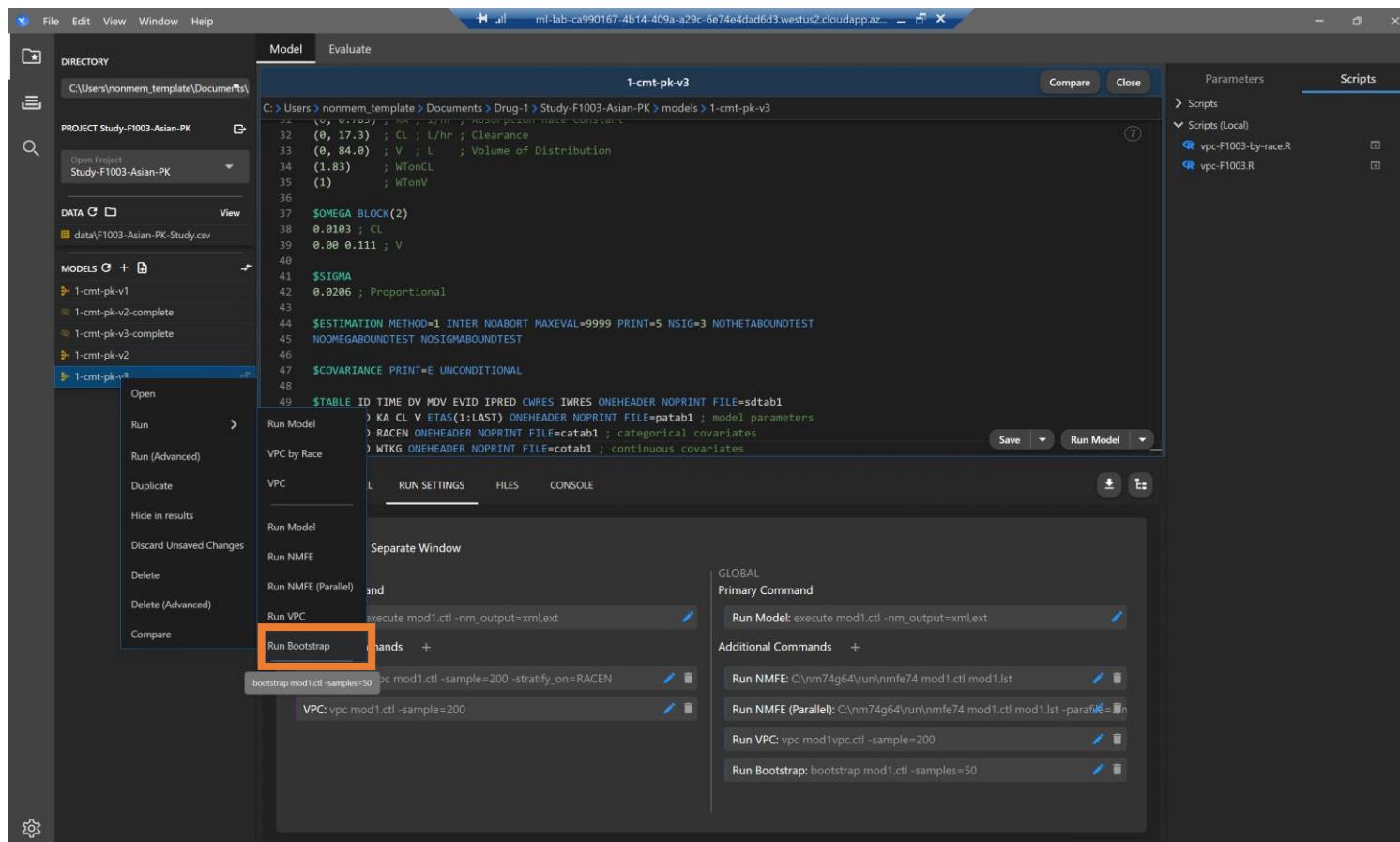
- A bootstrap command (PsN) is supplied with Finch Studio. You may change the parameters of the command as needed.





Running a Bootstrap Analysis

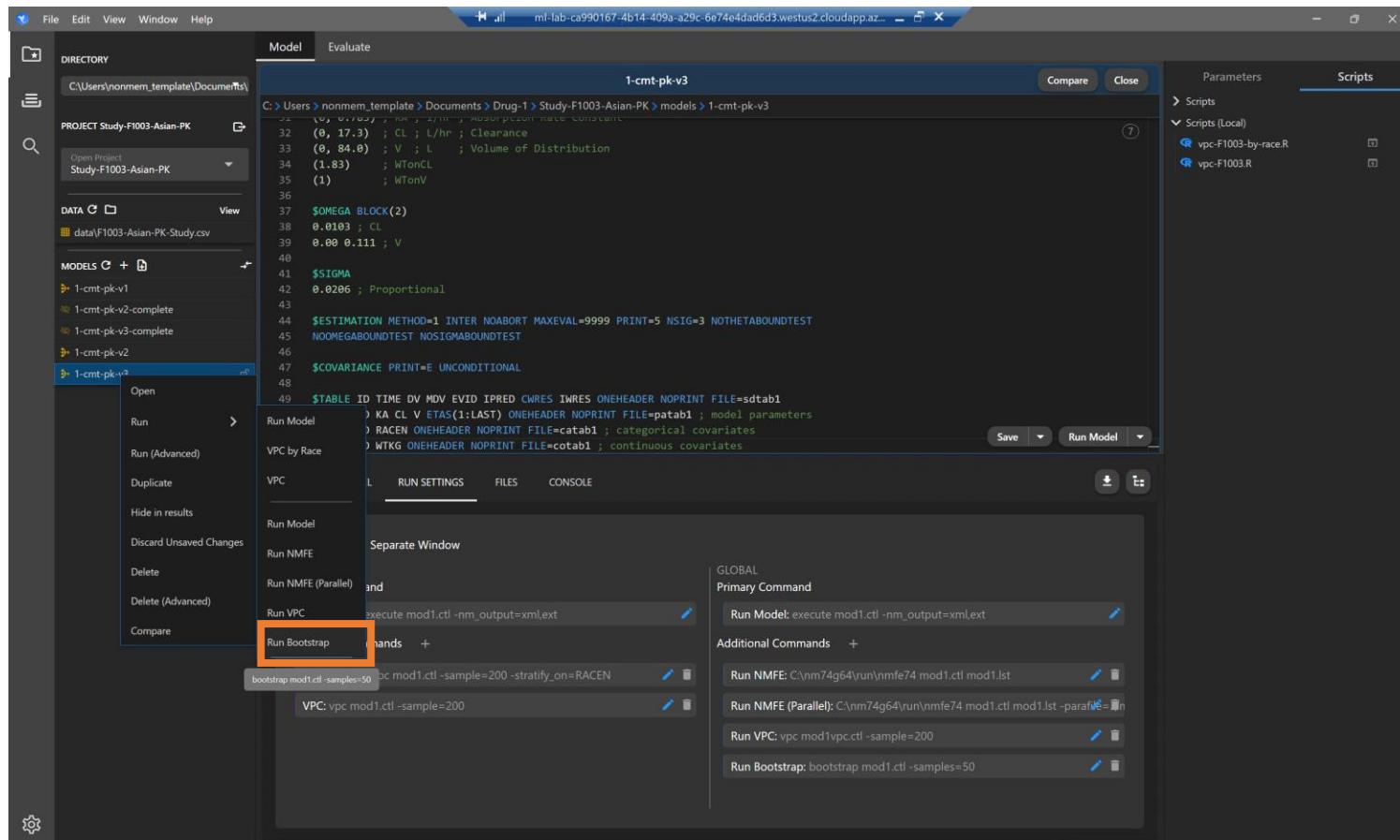
- Right click on the model and click run bootstrap.





Running a Bootstrap Analysis

- Right click on the model and click run bootstrap.





Plotting MCMC Outputs

- You can extend Finch Studio as much as you like with the use of R scripts and custom run commands.
- Navigate to the mcmc project for an example on a custom R script to plot the parameter search history of MCMC runs.



Finch Studio Documentation

- Finch Studio has many additional features to make your modeling experience more enjoyable and efficient.
- Visit docs.finchstudio.io to learn about other features.
- Documentation is a work in progress and is being updated at a rapid pace, so please check back frequently to see documentation on additional features.



Thank You!

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