

# CLIP - A Command-Line Interface to Certara's Phoenix-NLME

Vincent Perri, Michael Wilson, Devin Pastoor, Joga Gobburu, Vijay Ivaturi  
Center for Translational Medicine, School of Pharmacy, University of Maryland, Baltimore, Baltimore, MD

## Introduction

Phoenix-NLME<sup>1</sup> is a module of Certara's Phoenix platform that performs population PK/PD modeling and simulation. As a single-threaded graphical platform, however, there are limitations to perform computationally intensive modeling scenarios.

### Objective

The main objective of this project is to meet this growing need with a command-line alternative to the graphical interface of Phoenix-NLME so that researchers can fully harness to the computing resources available to them.

## Methods

A command-line application was developed as a Python<sup>2</sup> package to provide an easy-to-use and extensible toolkit for novice and advanced users alike to perform routine modeling and simulation tasks. Its input is a single model file comprising a model declaration written in the Phoenix Modeling Language (PML) and its run-time configuration. The PML is used to create Phoenix-NLME's modeling engine, while the run-time configuration specifies its execution.

## Results

With CLIP, researchers can model anywhere from a single-core system to a cluster of computers in order to take full advantage of one's computing resources. The application has been able to accurately estimate and simulate models faster than its equivalent graphical operations and with equivalent accuracy. The method of stochastic simulation and estimation has also been implemented to indicate that the core of this program is extremely extensible and capable of performing non-trivial tasks with higher performance and greater ease.

## Results

**Figure 1: PML Model File**

```

1 coldef: id("id") time("time") dose(A1<-"dose")
2 covr(sex<-"sex") covr(wt<-"wt") covr(age<-"age")
3 obs(CObs<-"conc")
4 data:
5 file: data.csv
6 estimation:
7 iterations: 10000
8 method: 3
9 estimate-covariates: [0,1,2]
10 tables:
11 - file: test1.csv
12 times: [0,1,2,5,10,20,30,40,50,60,70,90,130,150]
13 obs: CObs
14 dose: A1
15 variables: C
16 covr: sex,age,wt
17 ---
18 test() {
19   cfMicro(A1, C1 / V)
20   dosepoint(A1)
21   C = A1 / V
22   error(CEps = 0.0942615)
23   observe(CObs = C * (1 + CEps))
24   stparm(V = tvV * (wt/75)^dVdwt * exp(dVdsex1*(sex==1)) * exp(nV))
25   stparm(C1 = tvC1 * (wt/75)^dCldwt * (age/40)^dCldage * exp(nC1))
26   covariate(sex())
27   covariate(wt)
28   covariate(age)
29   fixef(tvV = c(, 10.1888, ))
30   fixef(tvC1 = c(, 0.139397, ))
31   fixef(dVdwt(enable=c(0)) = c(, 1.20304, ))
32   fixef(dCldwt(enable=c(1)) = c(, 1.16756, ))
33   fixef(dCldage(enable=c(2)) = c(, -0.46234, ))
34   fixef(dVdsex1(enable=c(3)) = c(, 1, ))
35   ranef(diag(nV, nC1) = c(0.10872238, 0.082517582))
36 }
37 ---
38 notes:
39 basedon: model_with_bw.pml
40 description:

```

**Figure 2: Project Workflow**

```

Administrator: Windows PowerShell
PS C:\clip_testing\pk01co3> clip init pk01
Initializing project directory: pk01
Successfully initialized project: pk01
PS C:\clip_testing\pk01co3>

```

**Initiate Project**

```

Administrator: Windows PowerShell
PS C:\clip_testing\pk01co3\pk01\modeling> clip execute model.pml
model.pml: Executing
model.pml: Final parameter estimates

theta=
1 0.103420E+02
2 0.139691E+00
3 0.942354E-01

omega=
0.126981E+00
0.000000E+00 0.117008E+00

sigmaSq=
0.888030E-02
sigmaLchol=
0.942354E-01

-Loglikelihood=
-1501.039
-2*Loglikelihood=
-3002.078
ELS Obj. function=
-4839.955

best fblupLL, ELS= -1499.91973 -4837.71652
1 10.3378579
2 0.139761109
3 0.0942156171
4 0.356297332
5 0.341981674

RUNTIMES
engine runtime (secs) = 0.702
stderr runtime (secs) = 0.000
Normal exit from LB-FOCE engine, exit code= 1
model.pml: Results are in C:\clip_testing\pk01co3\pk01\modeling\model_est_1
PS C:\clip_testing\pk01co3\pk01\modeling>

```

**Execute Model**

```

Administrator: Windows PowerShell
PS C:\clip_testing\pk01co3\pk01\modeling> clip execute --threads=3 model.pml model_with_bw.pml model_with_bw_age.pml
model.pml: Executing
model_with_bw.pml: Executing
model_with_bw_age.pml: Executing
model.pml: Final parameter estimates

```

**Run parallel models**

## Conclusions

CLIP is capable of not only duplicating the functionality of Phoenix-NLME at a faster speed, but it is also capable of more intensive operations not practical to perform in a graphical windows environment. Future development will involve extending this product to the Linux operating system.

## References

1. Certara, L.P., 210 North Tucker Boulevard Suite 350, St. Louis, MO 63101 USA
2. <https://www.python.org>