Defining NLME Models in Pumas

```
nlme_model = @model begin
  @param begin
      θ ∈ VectorDomain(3,init=[3.24467E+01, 8.72879E-02, 1.49072E+00])
      Ω ∈ PSDDomain(init=Matrix{Float64}([ 1.93973E-02  1.20854E-02  5.69131E-02
                                           1.20854E-02  2.02375E-02 -6.47803E-03
                                           5.69131E-02 -6.47803E-03  4.34671E-01]))
      Σ ∈ PDiagDomain(init=[1.70385E-02, 8.28498E-02])
  end

  @random begin
      η ~ MvNormal(Ω)
  end

  @pre begin
      V  = θ[1] * exp(η[1])
      Ke = θ[2] * exp(η[2])
      Ka = θ[3] * exp(η[3])
      CL = Ke * V
  end

  @vars begin
      conc = Central / V
  end

  @dynamics begin
      Gut'    = -Ka*Gut
      Central' =  Ka*Gut - Ke*Central
  end

  @derived begin
      dv ~ @. Normal(conc,sqrt(conc^2 *Σ.diag[1] + Σ.diag[end])+eps())
  end
end
```

`@param`: Model parameters (Population averages)

```
@param begin
    θ1 ∈ RealDomain(lower=0.1,   init=2.77,   upper=5.0)
    θ2 ∈ RealDomain(lower=0.008, init=0.0781, upper=0.5)
    θ3 ∈ RealDomain(lower=0.004, init=0.0363, upper=0.9)
    Ω  ∈ PSDDomain(2, init=diagm([5.55, 0.515]))
    σ2 ∈ RealDomain(lower=0.0, init=0.388)
end
```

This specifies the parameters of the model, and their domains:

- `RealDomain`: real values (possibly subject to upper/lower bounds)
- `VectorDomain`: vector of real values
- `PSDDomain`: symmetric positive-definite matrices (e.g. for covariance matrices)
- `PDiagDomain`: postive-valued diagonal matrices

`@random`: Random effects (Individual differences)

```
@random begin
    η ~ MvNormal(Ω)
end
```

Specifies the random effects, dependent on parameters. The random effects are defined by a distribution from Distributions.jl.