

Advanced Stan: 2

User-Defined Functions (Ch. 17)

1. Functions block before data block
2. No constraints or sizes on variables
3. Can't overload functions (yet)
4. Using a function as a distribution
5. Expose in R

Differential Equations (Ch. 18)

- ordinary differential equation system: defined as a function of
 - time (real)
 - current state (real[])
 - parameters of the ODE (real[])
 - real data (real[])
 - int data (int[])
- System calculates derivatives of each state component with respect to time

Simple Harmonic Oscillator

$$\frac{d}{dt}y_1 = -y_2 \qquad \frac{d}{dt}y_2 = -y_1 - \theta y_2$$

- ```
real[] sho(real t, real[] y,
 real[] theta,
 real[] x_r, int[] x_i) {
 real dydt[2];
 dydt[1] <- y[2];
 dydt[2] <- -y[1] - theta[1] * y[2];
 return dydt;
}
```
- add to model, compile, call from R?

## Solve ODE (Ch. 18)

- Calculate the states of the ODE for specific points in time (time is data)
- `integrate_ode()` is a function that takes:
  - ODE system defined as a function (`real`, `real[]`, `real`)
  - initial state (`real[]`)
  - initial time (`int` or `real`, `data`)
  - solution times (`real[]`, `data`)
  - parameters (`real[]`)
  - real data (`real[]`, `data`)
  - int data (`int[]`, `data`)

# Complex data structures

- Slicing
- Ragged arrays
- Missing data
- Quick Example

# Questions?

- Reproducible research
- Collaboration
- Best practices for writing models