



Simulations in R

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Why use simulations?

- Random processes - introduce stochasticity
- Crazy equation/complex systems - numerical simulations
- Test predictions *a priori*
- Bootstrapping
- Test statistical power
- Emergent patterns - individual based modeling

Random Numbers in R

- Generate random numbers from some known distribution

`rdist(n, parameters)`

`rnorm, runif, rbinom, rpois`

- **`dnorm(x)`** - normal probability density for x
- **`pnorm(q)`** - cumulative density function or CDF (area under the curve below x)
- **`qnorm(p)`** - quantile value with a CDF of p

Random Numbers in R

- Generate random numbers from some known distribution

`rdist(n, parameters)`

`rnorm, runif, rbinom, rpois, rbeta, rgamma`

- Multiple times

`replicate(n, function)`

`purrr::rerun(n, function)`

Avoid repetitions

- Write functions to run code repeatedly with different parameters

```
function_name = function(arguments, ...)  
{  
    Commands to execute  
}
```

Building simulation models

1. Define the model
2. Choose your parameters
3. Write it out as code
4. Run the model - time steps
5. Analyze

Example 1

- Simulate a linear model

- $y = b_0 + b_1 * x$

- $y = b_0 + b_1 * x + e$

- $e \sim N(0, \text{var})$

Example 2

Number of prey individuals killed by a predator

Variable of interest: Number of prey eaten as a response to initial population size

$$P = a/(1+a*h*N)$$

(Type 2 functional response curve)

Logistic growth model

- Population growth - change in N_t over t time steps
- Density dependence (Ricker model)

$$B = N_t * \exp(r_0(1 - N/K))$$

$$D = d * N_t$$