Faster Computing - Part 1

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Initial Remarks

We're going to create models today. This is a model one could call 'noisy geometric growth'. Note: Sandwiching something with two dollar signs on either side creates a math chunk.

$$N_{t+1} = \lambda N_t$$

Now consider that the growth rate could change at different time steps.

$$N_{t+1} = \lambda_t N_t$$

Now add in the noisy growth.

$$N_{t+1} = \lambda_t N_t \lambda_t = \bar{\lambda} e^{Z_t} Z_t \sim normal(0, \sigma^2)$$

Note: the double \ stops an equation and allows you to start a next one on the next line.
This is a logarithmic growth model, normal distribution, with error randomly distributed. For every timestep t, we draw a number from the normal distribution, find our lambda, and apply that to the next timestep knowing the value at the initial timestep (N_0).

Another note on math environments. Can do inline math as well: Ex. we are discussing two parameters: $\bar{\lambda}$ and σ^2. The 1 dollar sign sandwich signifies in-line math.

Now to implement the model:

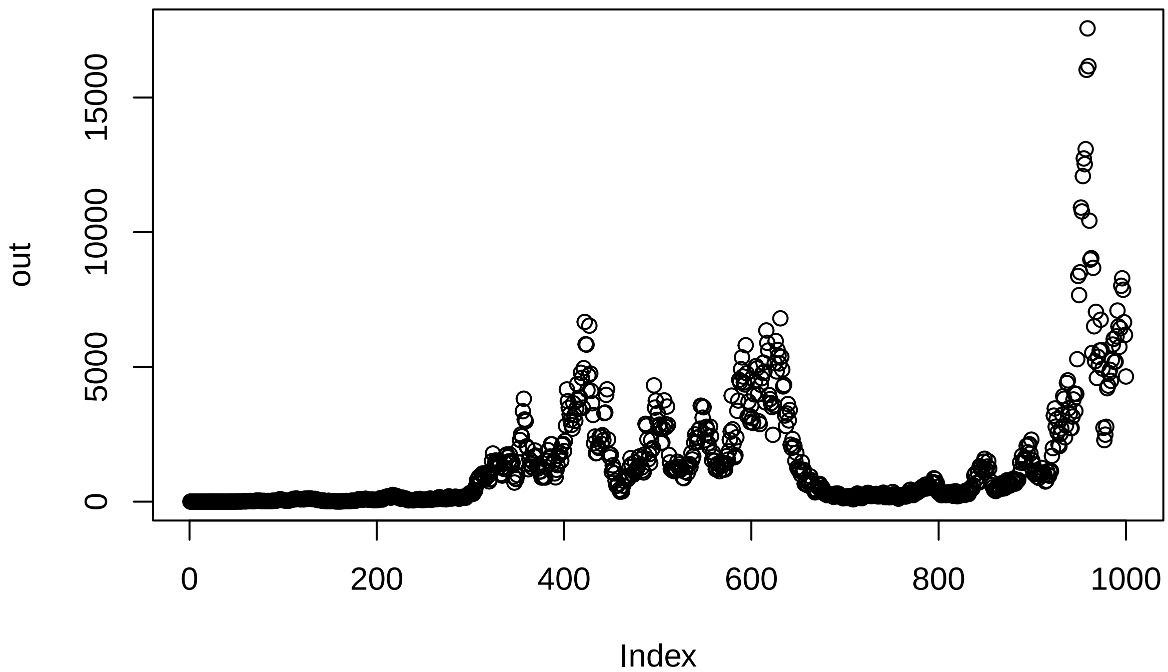
```
geom_growth_base <- function(N0=2, lambda=1.01, sigma=0.2, tmax=999){
  Nvals <- vector('numeric') #create an empty vector to store output
  Nvals[1] <- N0 #create an initial population size

  for(t in 1:tmax){
    Z_t <- rnorm(1, 0, sigma) #pull a random number from a normal distribution
    lambda_t <- lambda*exp(Z_t)
    Nvals[t+1] <- lambda_t*Nvals[t]
  }
  return(Nvals)
}
```

New code chunk that calls that function and then plots the output.

```
set.seed(1)
out <- geom_growth_base()

plot(out)
```



Given data on population sizes, i.e., the N_ts, you could estimate the growth rate as follows.

$$\hat{\lambda}_t = \frac{N_{t+1}}{N_t}$$