Dynamical Systems
Week 5 – Monday
Mathematical Modeling (Math 420/620)

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Mathematics & Statistics Colloquia

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Kinds of "Dynamic" Models
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Continuous Time vs Discrete Time?
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Spatial (Continuous) vs ... vs Non-spatial
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Individuals Homogeneous vs Heterogeneous?
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Interactions: Averaged vs More Complex?
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Individuals Homogeneous vs Heterogeneous?

Interactions: Averaged vs More Complex?

Available Analytical and Computational Tools?
Example: Exponential Decay

```r
## Ex: tracking atoms experiencing radioactive decay
Ts = sort(rexp(1e4, 1/100))
Time = seq(0, max(Ts), length=300)
N = Time*0;  # counts of atoms at time t go here.
N[1] = 1e4;
for(i in 2:300) { N[i] = sum(Ts > Time[i]) }  # number not yet decayed
plot(Time, N); curve(1e4*(exp(-x/100)), 0, max(Ts), add=TRUE, col="red")
```
Example: Exponential Decay

```r
## Ex: tracking atoms experiencing radioactive decay
Ts = sort(rexp(50, 1/100))
Time = seq(0, max(Ts), length=300)
N = Time*0;  # counts of atoms at time t go here.
N[1] = 50;
for(i in 2:300) { N[i] = sum(Ts > Time[i]) } # number not yet decayed
plot(Time, N); curve(50*(exp(-x/100)), 0, max(Ts), add=TRUE, col="red")
```
Example: Exponential Decay

Which (implicit) assumptions could be relaxed?

Spatially structured interactions?

Small $N$ vs $N \rightarrow \infty$?

Time-dependent or $N$-dependent rate?

Others?