What did we talk about last class?

Minute essay comments:
- Fighting doctor's associations.
- Validating models of continuous systems.
- A better way to model state in the gravity case.

Let's quickly look at gravity and a symplectic integrator.
Many processes that we might want to simulate involve processes that include some randomness.

We have already seen that just using a mean value is bad.

Using the wrong distribution can also mess things up.
Sources of Random Numbers

- Actual Data
  - Good for verification.
  - Limited for real runs.
- Empirical Distribution
  - Build a distribution from the data.
  - Artificially bounded.
- Theoretical Distribution from fit
  - Ideal solution if good distribution can be found.
The book goes through a bunch of different continuous distributions including lots of details and plots.

- **U(a,b) – Uniform**
  - Use when you don't know any better.

- **expo(β) - Exponential**
  - Inter-arrival times or failure times.

- **gamma(α,β)**
  - Task completion
More Continuous Distributions

- **Weibull(α,β)**
  - Task completion of equipment failure. Rough model in absence of data.

- **N(μ,σ²) - Normal**
  - Errors or sum of many values.

- **LN(μ,σ²) – Lognormal**
  - Task completion with long tail.

- **beta(α₁,α₂)**
  - Rough model or distribution of random proportions.
More Continuous Distributions

- PT5(\(\alpha,\beta\)) – Pearson type V
  - Time to perform task.
- PT6(\(\alpha,\beta\)) – Pearson type VI
  - Time to perform task.
- LL(\(\alpha,\beta\)) – Log-logistic
  - Time to perform task.
- JSB(\(\alpha_1,\alpha_2,a,b\)) - Johnson S\(_B\)
- JSU(\(\alpha_1,\alpha_2,\gamma,\beta\)) - Johnson S\(_U\)
- triang(a,b,m)
There are also established distributions for discrete values.

- **Bernoulli(p)**
  - Coin flip where odds aren't always equal.

- **DU(i,j)** – Discrete Uniform
  - Several outcomes of equal probability. First cut.

- **bin(t,p)** – Binomial
  - Number of successes in $t$ Bernoulli trials.

- **geom(p)** – Geometric
  - Number of tries before a fail.
More Discrete Distributions

- `negbin(s,p)` – Negative Binomial
  - Number of failures before the $s^{th}$ success.
- `Poisson(\lambda)`
  - Number of items demanded from inventory.
You can build your own distributions from empirical data.

If data isn't binned, sort it.

- \( F(x) = \text{indexOf}(x)/n \) if \( x \) is a data point. Otherwise interpolate.

If data is binned you can build \( F(x) \) from the binned data in a similar way.

Both have the downside that values have a limited range.
Minute Essay

> Why do you think that there are so many of these different distributions?