# No Data/Poisson Processes

2/25/2009

# Opening Discussion

- What did we talk about last class?
- A fair number of people would like to include more specific examples of simulations and potentially writing of simulations. I can try to do that more in the second half of the semester, but remember to be careful what you ask for.

# Dealing with Insufficient Data

- Ask SMEs for what they think the bounds and the mean should be.
- Use triangle distribution to match those numbers.
- Find beta distribution that gives you the right shape.

# Poisson Processes

- Arrivals are often well modeled by a Poison process.
- A Poisson process is defined as having three characteristics.
  - Events happen one at a time.
  - The number of events between t and t+s is independent of the number of earlier events.
  - The number of events between t and t+s is independent of t.

# Properties

- If N(t) is a Poisson process then the following is true.

$$P[n(t+s)-N(t)=k]=\frac{e^{-\lambda s}(\lambda s)^k}{k!}$$

  - For k=0,1,2,... and t,s>=0
- If N(t) is a Poisson process with rate of λ then the interarrival times, $A_1$, $A_2$, ... are IID exponentials with mean of 1/λ.

# Nonstationary Poisson Process

- Throw out the third requirement.
- Let Λ(T)=E[N(t)].

$$\lambda(t)=\frac{d}{dt}\Lambda(t)$$

- Then

$$P[N(t+s)-N(t)=k]=\frac{e^{b(t,s)}[b(t,s)]^k}{k!}$$

$$b(t,s)=\Lambda(t,s)-\Lambda(t)=\int_t^{t+s}\lambda(y)\,dy$$

# Related Tangent

- This discussion in the book was actually quite enlightening for an article I read in Physics Today recently.
- The article was about light emission from nanoprocesses.
- The distribution of illumination for these is not a exponential. That implies it is not a Poisson process, and that means there is a more complex mechanism involved.

# Power-law Distribution

- The distribution of on and off times followed a power-law distribution. This is also a common distribution in many other areas, including planetary science.
- Both differential and cumulative distributions have the same form of $x^{-q}$.
- Particle sizes like to follow this with a differential q of about 3.

# Minute Essay

- The midterm is next class. Do you have any other suggestions for questions?
- I'll try to get a review sheet up soon to help you focus your studying, but like my normal tests it can cover anything we have done.
- Feel free to bring a single sheet of paper cheat sheet. I don't know if it will help but it is a good way to study.