SFWR ENG 4E03

Kemal Ahmed
Fall 2015
Note: material covered in Stats 3Y03 Summary will not be covered in this summary

Statistics

Expected Value [μ]: definition of expected (NOT RIGHT!!)
Poisson parameter [λ]:
Exponential distribution: not always for time

Probability Distribution Function (PDF):
Cumulative Distribution Function (CDF):

Uniform Distribution: no memoryless property
Exponential Distribution:

- Memoryless
- Either CDF or PDF of original equation $F = 1 - e^{-\lambda x}$

Think chemistry, i.e. cancelling units

Variance

$$\text{var}(X) = E\left[X^2\right] - \left(E[X]\right)^2$$

- Don't change probability, but square X for calculation only
- For discrete: use the sum of the X's, so $E[X] = \Sigma(P(X=i) \cdot X_i)$ and $E[X^2] = \Sigma(P(X=i) \cdot X_i^2)$

Continuous Random Variable (CRV):

$$\begin{aligned} Var(x) &= E\left[(X-\mu)^2\right] \\ &= \sigma^2 \\ &= \int_{-\infty}^{\infty} (x-\mu)^2 f(x) \mathrm{d}x \\ &= \int x^2 f(x) \mathrm{d}x - \mu^2 \end{aligned}$$

Exponential

- **Mean** [E[X]]: 1/λ
- **Variance** [E[X]]: a.k.a. Expected value
- **Probability Distribution Function (PDF)** [P(X)]: $\lambda e^{-\lambda x}$
- **Cumulative Distribution Function (CDF)** [f(x)]: CDF = ∫PDF, i.e. $1 - e^{-\lambda x}$

Uniform

- **Mean**: $(b-a)^2/12$
- **Variance**: $(a+b)/2$
- **PDF**: $1 / (b-a)$, $a \leq x \leq b$
- **CDF**: 1

Operations Analysis

Device [i]:
[k]: total number of devices
Service Time [S]: time to complete specific job
Visitation [V]: given or projected visits/jobs (closed system); cannot be calculated
[E(V)]: calculated visit/job ratio
Demand [D]: total service demand

$$D_i = E[S_i] \cdot V_i$$

$$D = \sum_{i=0}^{k} D_i$$

Time in system [T]: expected time the job is in the system
Response Time [R]:
Total Jobs [N]:

$$E[T] = \frac{N}{X}$$

$$E[N] = \lambda E[T], \lambda = X$$

Think time [Z]: time it takes the user to put a request in and start, it's kinda like the frequency that users put in requests (seconds / request)

$$E[Z] = E[T] - E[R]$$

If E[Z] = 0, R = N

$$E[N] = \lambda E[R], \lambda = X$$

$$E[T] \geq \max\left(D, ND_{\max} - E[Z]\right)$$

Throughput [X]: out-rate, jobs / hour of full system

$$X \leq \min\left(\frac{1}{D_{\max}}, \frac{N}{D + E[Z]}\right)$$

Note: $\frac{1}{D_{\max}}$ and $\frac{N}{D+E[Z]}$ converge at their lowest point, so equate them

[X_i]: throughput of individual component

$$X_i = E[V_i]X$$

Utilization [ρ]: ratio that the time is busy

$$\rho_i = X_i E[S_i]$$

$$\rho_i = XD_i$$

DTMC

Discrete Time Markov Chains (DTMC):

Geometric Series: $\sum_{i=0}^{\infty} r^i = \frac{r}{1-r}$