Markov Final Exam "Cheat Sheet"

The following "cheat sheet" (everything written below the line) will be provided at the final Exam for Markov Processes.

Distributions

Name	Notation	pmf/pdf	Mean	Variance
Bernoulli	$X \sim Bernoulli(p)$	$f(x) = p^x(1-p)^{1-x}\, I_{\{0,1\}}(x)$	p	$p(1-p)$
Binomial	$X \sim bin(n,p)$	$f(x) = \begin{pmatrix} n \\ x \end{pmatrix} p^x(1-p)^{n-x}\, I_{\{0,1,\ldots,n\}}(x)$	np	$np(1-p)$
Poisson	$X \sim Poisson(\lambda)$	$f(x) = \frac{e^{-\lambda}\lambda^x}{x!}\, I_{\{0,1,\ldots\}}(x)$	λ	λ
Geometric	$X \sim geom_0(p)$	$f(x) = p(1-p)^x\, I_{\{0,1,\ldots\}}(x)$	$(1-p)/p$	$(1-p)/p^2$
Geometric	$X \sim geom_1(p)$	$f(x) = p(1-p)^{x-1}\, I_{\{1,2,\ldots\}}(x)$	$1/p$	$(1-p)/p^2$
Uniform	$X \sim unif(a,b)$	$f(x) = \frac{1}{b-a}\, I_{(a,b)}(x)$	$a + \frac{b}{2}$	$\frac{b^2}{12}$
Exponential	$X \sim exp(rate = \lambda)$	$f(x) = \lambda e^{-\lambda x}\, I_{(0,\infty)}(x)$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Gamma	$X \sim \Gamma(\alpha,\beta)$	$f(x) = \frac{1}{\Gamma(\alpha)}\beta^\alpha x^{\alpha-1}e^{-\beta x}\, I_{(0,\infty)(x)}$	$\frac{\alpha}{\beta}$	$\frac{\alpha}{\beta^2}$

Kolmogorov Equations

- $P'(t) = P(t)Q$ (forward)
- $P'(t) = QP(t)$ (backward)

M/G/1 Mean Queue Length in Equilibrium

$$L = \frac{2\frac{\lambda}{\mu} + \lambda^2\sigma^2 - \left(\frac{\lambda}{\mu}\right)^2}{2\left(1 - \frac{\lambda}{\mu}\right)}$$