Problem Set 1 — ENCE689E Spring 2014

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1. Hydrologic Modeling

(a)

For each time t and each geographic point (x, y), the state variable $\mathbf{y}_t$ is defined as

$$\begin{pmatrix} \text{SWE} \\ T_{\text{snow}} \end{pmatrix}_{x,y}$$

where SWE is snow water equivalent and T_{snow} is snowpack temperature.

2. Review of univariate PDFs

Distribution	PDF $f_X(x)$	Support	Parameters	Notation
Normal Gaussian	$\frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]$	$x \in (-\infty, \infty)$	$\mu \in (-\infty, \infty),\ \sigma > 0$	$X \sim \mathcal{N}(\mu, \sigma^2)$
Lognormal	$\frac{1}{\sqrt{2\pi}\sigma x} \exp\left(-\frac{[\ln(x)-\mu]^2}{2\sigma^2}\right)$	$x \in (0, \infty)$	$\mu \in (-\infty, \infty),\ \sigma > 0$	$X \sim \ln\mathcal{N}(\mu, \sigma^2)$
Gamma [1]	$\frac{1}{\Gamma(k)\, b^k} x^{k-1} e^{-x/b}$	$x \in (0, \infty)$	$k, b \in (0, \infty)$	$X \sim \Gamma(k, b)$
Beta [2]	$\frac{1}{B(a,b)} x^{a-1}(1-x)^{b-1}$	$x \in [0, 1]$	$a, b \in (0, \infty)$	$X \sim \text{Beta}(a, b)$
Exponential	$r\, e^{-r\, x}$	$x \in [0, \infty)$	$r \in (0, \infty)$	$X \sim \text{Exp}(r)$

[1] where $\Gamma(k) = \int_0^\infty s^{k-1} e^{-s}\, ds$

[2] where $B(a, b) = \int_0^1 u^{a-1}(1-u)^{b-1}\, du$