

## RV Catalog, Math 464, Fall 2014

$\mu$  is the mean,  $\sigma^2$  is the variance,  $M(t) = E[e^{tX}]$  is the moment generating function.

**Binomial (2 parameters,  $p \in [0, 1]$  and positive integer  $n$ ) :**

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}, \quad k = 0, 1, 2, \dots, n$$
$$\mu = np, \quad \sigma^2 = np(1-p), \quad M(t) = (pe^t + 1 - p)^n$$

**Geometric (1 parameter  $p \in (0, 1]$ ) :**

$$P(X = k) = p(1-p)^{k-1}, \quad k = 1, 2, \dots$$
$$\mu = \frac{1}{p}, \quad \sigma^2 = \frac{1-p}{p^2}, \quad M(t) = \frac{pe^t}{1 - (1-p)e^t}$$

**Poisson (1 parameter  $\lambda > 0$ ) :**

$$P(X = k) = \frac{e^{-\lambda} \lambda^k}{k!}, \quad k = 0, 1, 2, \dots \quad \mu = \lambda, \quad \sigma^2 = \lambda, \quad M(t) = \exp(\lambda(e^t - 1))$$

**Negative binomial (2 parameters,  $p \in [0, 1]$  and positive integer  $n$ ) :**

$$P(X = k) = \binom{k-1}{n-1} p^n (1-p)^{k-n}, \quad k = n, n+1, n+2, \dots$$
$$\mu = \frac{n}{p}, \quad \sigma^2 = \frac{n(1-p)}{p^2}, \quad M(t) = \left[ \frac{pe^t}{1 - (1-p)e^t} \right]^n$$

**Exponential (1 parameter,  $\lambda > 0$ ) :**

$$f(x) = \lambda e^{-\lambda x}, \quad x \geq 0, \quad \mu = \frac{1}{\lambda}, \quad \sigma^2 = \frac{1}{\lambda^2}, \quad M(t) = \frac{\lambda}{\lambda - t}$$

**Normal (2 parameters,  $\mu$  and  $\sigma^2 > 0$ ) :**

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right), \quad M(t) = \exp(\mu t + \frac{1}{2}\sigma^2 t^2)$$

The standard normal is the special case of  $\mu = 0, \sigma = 1$ .

**Gamma (2 parameters,  $\lambda > 0, w > 0$ ):**

$$f(x) = \frac{\lambda^w}{\Gamma(w)} x^{w-1} e^{-\lambda x}, \quad x \geq 0$$
$$\mu = \frac{w}{\lambda}, \quad \sigma^2 = \frac{w}{\lambda^2}, \quad M(t) = \left( \frac{\lambda}{\lambda - t} \right)^w$$

**Uniform on  $[a, b]$ :**

$$f(x) = \frac{1}{b-a}, \quad a \leq x \leq b, \quad \mu = \frac{a+b}{2}, \quad \sigma^2 = \frac{(b-a)^2}{12}, \quad M_X(t) = \frac{e^{tb} - e^{ta}}{t(b-a)}$$