SF - Exponential Distribution

What is exponential distribution used to do?	Describe the waiting times between Poisson events.
What is the cdf of the exponential distribution?	$$F(x;\lambda) = \begin{cases} 1 - e^{-\lambda x} & x \geq 0, \\ 0 & x < 0. \end{cases}$$ Where F(x) is the probability of an event occurring in the time x. *Where λ is the mean no. of occurence in a unit time.*
What is the pdf of the exponential distribution?	$$f(x;\lambda) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0, \\ 0 & x < 0. \end{cases}$$ *This is by differentiating 1 -* $e^{-\lambda t}$.

How can the mean and variance for exponential distribution be derived?	$\mathrm{E}(X) = \int_0^\infty x\,\mathrm{f}(x)\,\mathrm{d}x = \lambda\int_0^\infty x\mathrm{e}^{-\lambda x}\,\mathrm{d}x$ $= \lambda\left\{\left[x\frac{\mathrm{e}^{-\lambda x}}{-\lambda}\right]_0^\infty - \int_0^\infty \frac{\mathrm{e}^{-\lambda x}}{-\lambda}\mathrm{d}x\right\}$ $= \lambda\left\{0 - \left[\frac{\mathrm{e}^{-\lambda x}}{\lambda^2}\right]_0^\infty\right\} = \lambda\left(\frac{1}{\lambda^2}\right)$ $= \frac{1}{\lambda}$ $\mathrm{E}(X^2) = \int_0^\infty x^2\,\mathrm{f}(x)\,\mathrm{d}x = \lambda\int_0^\infty x^2\,\mathrm{e}^{-\lambda x}\,\mathrm{d}x$ $= \lambda\left\{\left[x^2\frac{\mathrm{e}^{-\lambda x}}{-\lambda}\right]_0^\infty + \int_0^\infty \frac{\mathrm{e}^{-\lambda x}}{\lambda}2x\mathrm{d}x\right\}$ $= \lambda\left\{0 - 2\left(\left[x\frac{\mathrm{e}^{-\lambda x}}{\lambda^2}\right]_0^\infty - \int_0^\infty \frac{\mathrm{e}^{-\lambda x}}{\lambda^2}\mathrm{d}x\right)\right\}$ $= \lambda\left\{0 - 2\left(0 + \left[\frac{\mathrm{e}^{-\lambda x}}{\lambda^3}\right]_0^\infty\right)\right\} = \lambda\frac{2}{\lambda^3} = \frac{2}{\lambda^2}$ $\mathrm{Var}(X) = \mathrm{E}(X^2) - \{\mathrm{E}(X)\}^2 = \frac{2}{\lambda^2} - \left(\frac{1}{\lambda}\right)^2 = \frac{1}{\lambda^2}$ *The derivation for E(X) requires integration by parts once. For E(X^2), it's required twice.*
What is the memoryless function of the exponential distribution?	Say an event hasn't occurred after 30 seconds after t = 0. The probability of an event occurring in at least 10 seconds equals observing the event 10 seconds after t = 0.