**Exponential Distribution Models**

Probabilities involving the probability density function (pdf) where the pdf is an exponential distribution are given by, where The expected value (*E(x)*) is *E = 1/k*. The exponential function is a continuous distribution that is sometimes used to model the time which elapses before an event. This time is denoted as the *waiting time*. For an engineering application, the exponential function is often used as a model to denote the lifetime of a component.

For example, let us say that the amount of time between incoming phone calls in a particular dentist’s office, in the early afternoon on a weekday, are approximately exponentially distributed with a mean, or expected value, of 2 minutes between calls. We can compute the probability that the next incoming phone call will occur between zero and two minutes by:

= =

The probability that the next call will come into the dentist’s office in the next 8 minutes is:

= =

Problems

1. Compute the probability that the next phone call will come between two and four minutes later.
2. Compute the probability that the next phone call will come between eight and sixteen minutes later.
3. Compute the probability that the next phone call will occur more than six minutes from now.
4. Check to see that the expected value for this probability density function is indeed equal to *two*.

For the problems 5-7, consider a new situation with a new probability density function (pdf). Suppose that the amount of time between cargo ships arriving at a port facility are exponentially distributed with a mean value of 15 hours between arrivals.

5) Write the pdf for the problem described above.

6) Compute the probability that the next cargo ship will arrive exactly 15 hours after the previous ship has arrived.

7) Compute the probability that the next ship will arrive within 24 hours of the previous ship’s arrival.

8) One of the requirements for a function, in order to be a pdf, is that the total area under the entire graph of *f* must be one. Suppose that That is, . Find *k*, in terms of *a,* so that the integrand is a pdf.

9) Find the expected value of in terms of *a.*