# Exponential and Poisson Generators in CSIM

To model processes characterized by random inter-arrival times, the exponential and poisson distribution generators are often useful.  CSIM provides the functions *expdev()* and *poidev(u)*, as described below with their distribution plots.

**EXPDEV() -**
Each call of the *expdev()* function generates a double precision floating-point random variate having an expected value (mean) of 1.0 and with exponential probability density function as shown in figure 1.

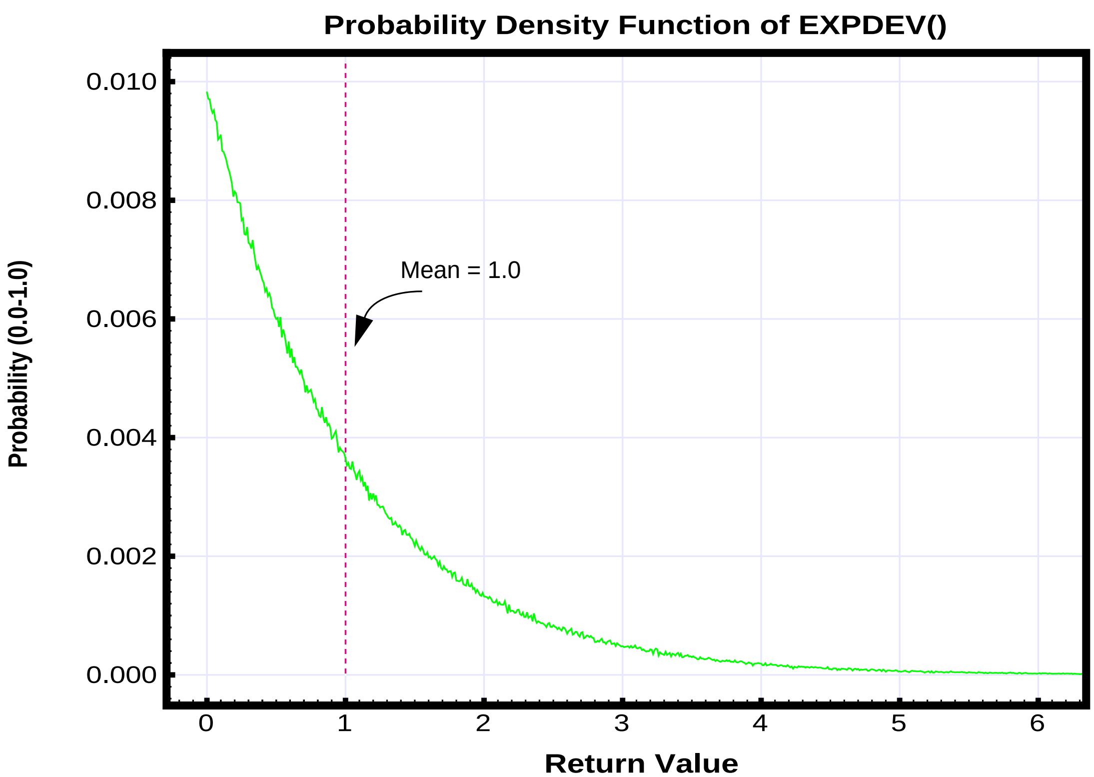


**Figure 1. - PDF of expdev(), measured from 1-million trials.**

The formal definition of expdev is:
*double expdev();*

To generate exponential distributions having means other than 1.0, simply multiply the return value of *expdev()* by the desired mean value.

The exponential distribution occurs frequently in real applications, often as the distribution of waiting times between independent Poisson-random events.

Examples include: the radioactive decay of nuclei, the arrival of network message traffic, etc.. Each call of *expdev*() can be used to produce a delay until the next event, or next message arrival, is to occur.

The exponential random generation function is related to the Poisson distribution, in that the Poisson distribution is the probability of each number of exponentially distributed events occurring within a time period. See POIDEV, below.

The *expdev()* function can be used to replace the BONeS *Poisson Pulse Train* primitive function.

Note - The BONeS *Poisson Pulse Train* primitive function was actually a misnomer, in that it generated exponentially distributed delay values; not Poisson values.

Example output from *expdev()*:

```
0.897609
0.156380
0.184785
0.024292
0.021589
1.915254
2.401391
0.457427
1.158318
0.132728
2.361281
1.129967
1.488386
1.188115
0.651376
0.286942
0.452692
0.183524
0.399839
1.606988
0.116025
```

**POIDEV( μ ) -**
Each call of the *poidev(μ)* function generates an integer value expressed in double precision floating-point. The value is a random variate having an expected value (mean) of μ and with poisson probability density function as shown in figures 2a through 2d for various μ's of 0.5, 1, 2.5, and 20.

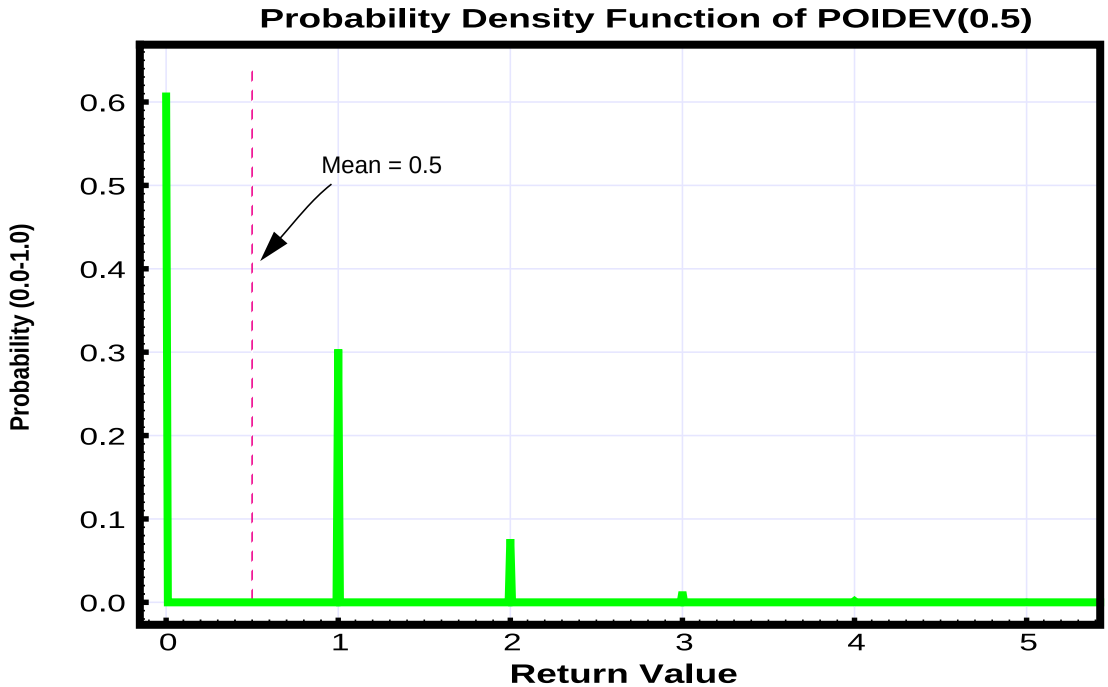


**Figure 2a - PDF of poidev(0.5), collected from 1-million trials.**

The return value of *poidev(u)* represents the number of events that occurred within a time interval, such as would be generated by an exponentially distributed random process. It is an integer, because it represents a number of events.

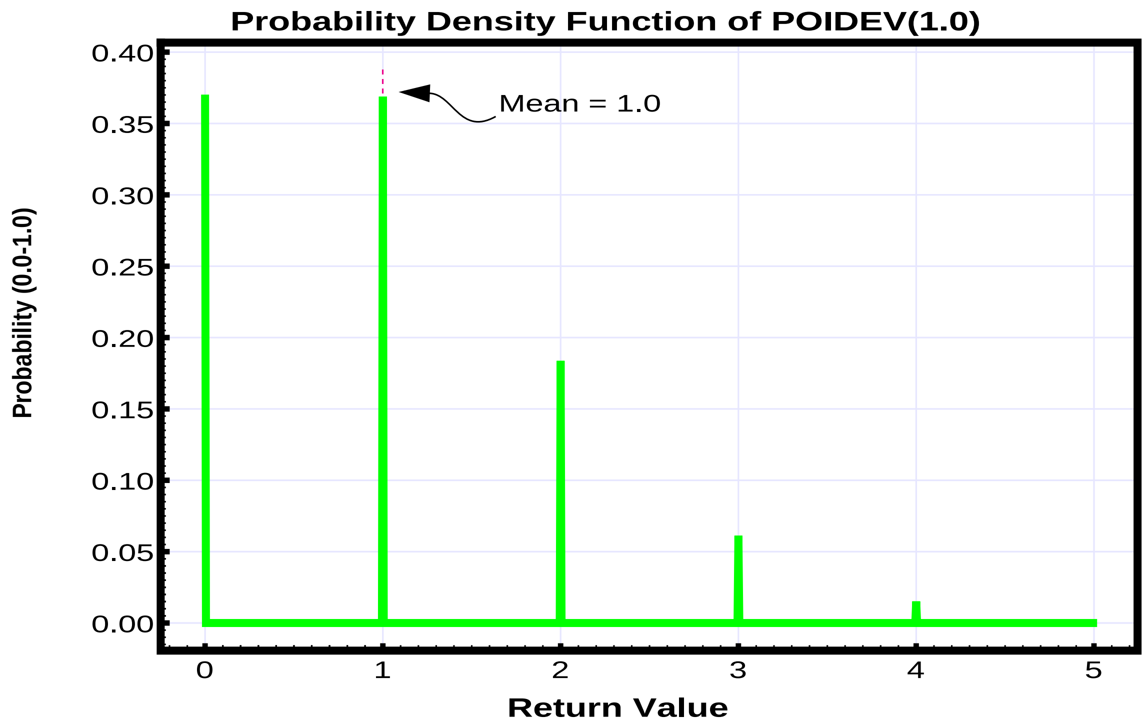


**Figure 2b - PDF of poidev(1.0), collected from 1-million trials.**

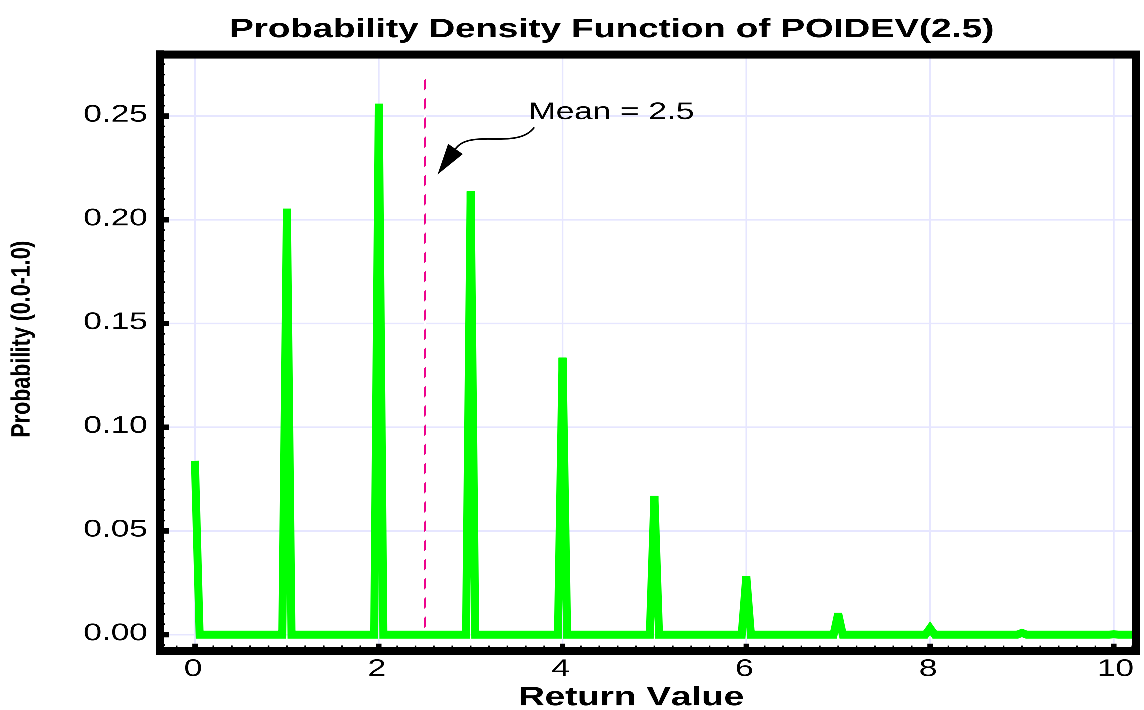


**Figure 2c - PDF of poidev(2.5), collected from 1-million trials.**

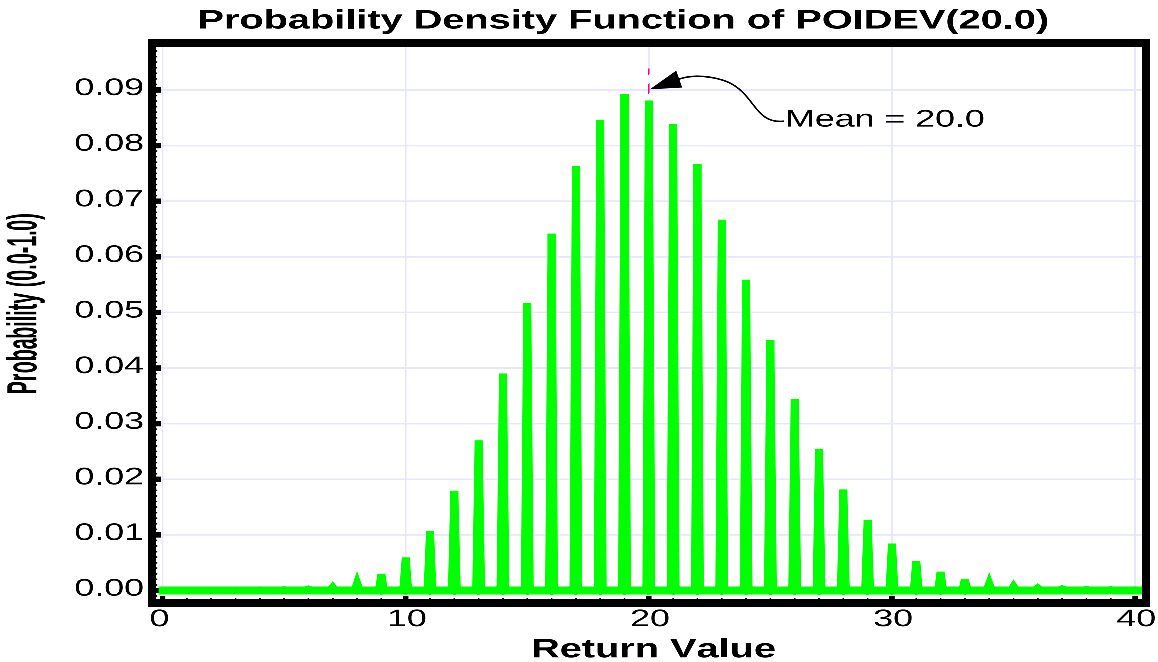


**Figure 2d - PDF of poidev(20.0), collected from 1-million trials.**

Example return values, *poidev(2.5)*:

1.000000
2.000000
1.000000
3.000000
4.000000
5.000000
3.000000
1.000000
2.000000
1.000000
2.000000
3.000000
1.000000
2.000000
0.000000
0.000000
4.000000
0.000000
2.000000
3.000000
4.000000
1.000000
3.000000
3.000000
2.000000
1.000000
0.000000
2.000000