Mathematica for Module 9.4

File: *Distributions.nb*

Introduction to Computational Science: Modeling and Simulation for the Sciences
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```
<< Statistics`DiscreteDistributions`
```

Statistical Distributions

■ **Load package containing *Histogram* and view documentation.**

```
<< Graphics`Graphics`
```

```
? Histogram
```

```
Histogram[{x1, x2, ...}] generates a bar graph representing
   a histogram of the univariate data {x1, x2, ...}.  The width
   of each bar is proportional to the  width of the interval
   defining the respective category, and the area of the bar  is
   proportional to the frequency with which the data fall in that
   category. Histogram range and categories may be specified using
   the options HistogramRange and HistogramCategories.  Histogram[
   {f1, f2, ...}, FrequencyData -> True] generates a histogram of
   the univariate frequency data {f1, f2, ...}, where fi is the
   frequency with which the original data fall in category i. More...
```

■ **Generate 10000 uniformly distributed random numbers between 0.0 and 1.0 and generate histogram with 10 categories.**

```
tbl = Table[Random[], {10000}];
Histogram[tbl, HistogramCategories → 10];
```

Normal Distributions

■ **A normal or Gaussian distribution, which statistics frequently employs, has the following probability density function, where *mu* is the mean and *sigma* is the standard deviation:**

```
normalPDF[mu_, sigma_, x_] :=
  Exp[-(x - mu)^2 / 2 / sigma^2] / Sqrt[2 * Pi * sigma^2];
```

■ **Produce a plot of this function with mean 70 and standard deviation 5.**

```
Plot[normalPDF[70, 5, x], {x, 50, 90}];
```

■ **Load package containing *NormalDistribution* and view documentation.**

```
<< Statistics`ContinuousDistributions`
```

```
? NormalDistribution
```

```
NormalDistribution[mu, sigma] represents the normal (Gaussian)
   distribution with mean mu and standard deviation sigma. More...
```

■ **One random number from normal distribution with mean 0 and standard deviation 1**

```
r = NormalDistribution[0, 1];
Random[r]
```

■ **Generate 1000 random numbers from normal distribution with mean 0 and standard deviation 1. Employs *r* from above. Display histogram.**

```
tblNormal = Table[Random[r], {1000}];
Histogram[tblNormal];
```

■ **Generate 1000 random numbers from normal distribution with mean 3 and standard deviation 5. Display histogram.**

```
tblNormal = Table[Random[NormalDistribution[3, 5]], {1000}];
Histogram[tblNormal];
```

Exponential Distributions

■ **If necessary, load package containing ExponentialDistribution and view documentation.**

```
<< Statistics`ContinuousDistributions`
```

```
?ExponentialDistribution
```

```
ExponentialDistribution[lambda] represents the exponential distribution
   with scale inversely proportional to parameter lambda. More...
```

■ **One random number from exponential distribution with lambda 1. In text, the lambda value is *r* in the probability distribution functions $|r|e^{rt}$ with $r < 0$ and $t > 0$ and $|r|e^{rt}$ with $r > 0$ and $t < 0$.**

```
r = ExponentialDistribution[1];
Random[r]
```

■ **Generate 1000 random numbers from exponential distribution with lambda 1. Display histogram.**

```
tblExpM = Table[Random[ExponentialDistribution[1]], {1000}];
Histogram[tblExpM];
```

■ **Generate 1000 random numbers from exponential distribution with lambda 2. Display histogram.**

```
tblExpM = Table[Random[ExponentialDistribution[2]], {1000}];
Histogram[tblExpM];
```

■ **Adding 7 moves to right by 7**

```
Histogram[tblExpM + 7];
```

■ **Generate 1000 random numbers from exponential distribution with lambda -2. Display histogram.**

```
tblExpM = Table[Random[ExponentialDistribution[-2]], {1000}];
Histogram[tblExpM];
```