Computing standard deviations:

Given some probability function, $p(x)$, the standard deviation of x is given by

$$\delta x = \sqrt{\overline{x^2} - \overline{x}^2},$$

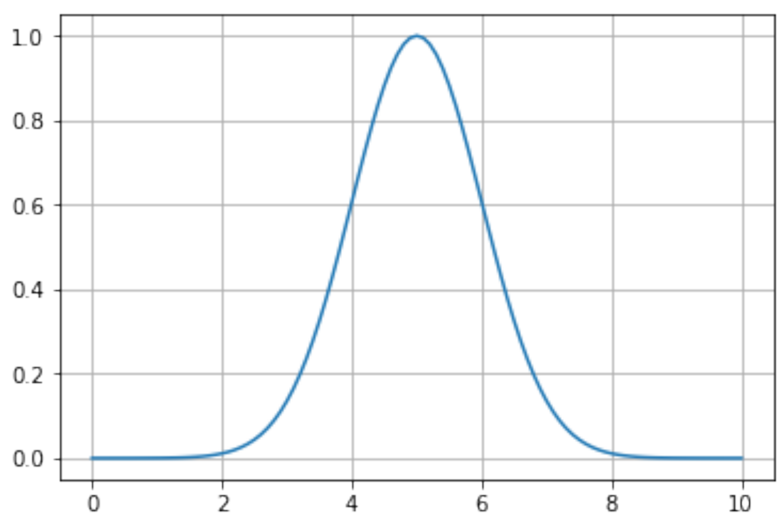
where $\overline{x}$ represents the *average* of x. If $p(x)$ is normalized, then the average is given by

$$\overline{x} = \sum_i p_i(x)\, x_i .$$

In the cells below, we will create and analyze a **Gaussian distribution**. The width of this distribution is defined by the parameter `w`.

In [1]:
```
from pylab import *
%matplotlib inline
```

In [2]:
```
x = linspace(0, 10, 101)   # Array of x values
x0 = 5                     # Center of distribution
w = 1.0                    # Width of distribution
p = exp(-(x-x0)**2 / (2*w**2))
plot(x, p)
grid(True)
show()
```



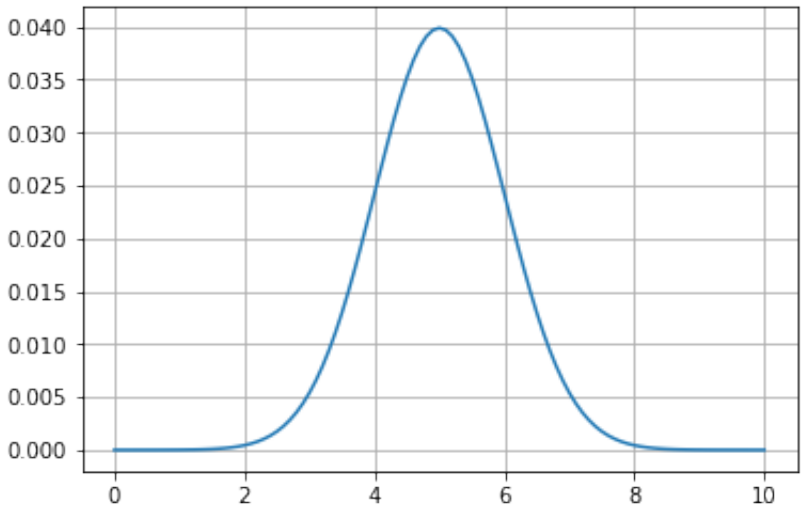
In [3]:
```
sum(p) # Note, this distribution is NOT NORMALIZED.
```

Out[3]: 25.066271792963953

In [4]:
```
p = p / sum(p) # This NORMALIZES the distribution.
sum(p)
```

Out[4]: 1.0

In [5]:
```
plot(x, p)
grid(True)
show()
```



The **AVERAGE** of the distribution:

In [6]:
```
avg_x = sum(p*x)
avg_x**2
```

Out[6]: 25.000000000000007

The **AVERAGE OF THE SQUARE** of the distribution:

In [7]:
```
avg_x2 = sum(p*x**2)
avg_x2
```

Out[7]: 25.999988429164226

The **STANDARD DEVIATION** of the distribution:

In [8]:
```
sqrt(avg_x2 - avg_x**2)
```

Out[8]: 0.9999942145653739