

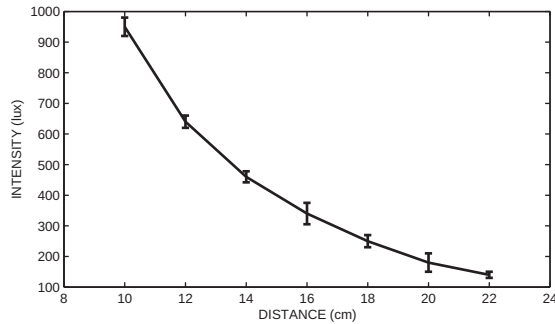
Figure 5-9: Plots of  $y = 2^{(-0.2x+10)}$  with linear, semilog, and log-log scales.

#### Notes for plots with logarithmic axes:

- The number zero cannot be plotted on a log scale (since a log of zero is not defined).
- Negative numbers cannot be plotted on log scales (since a log of a negative number is not defined).

### 5.6 PLOTS WITH ERROR BARS

Experimental data that is measured and then displayed in plots frequently contains error and scatter. Even data that is generated by computational models includes error or uncertainty that depends on the accuracy of the input parameters and the assumptions in the mathematical models that are used. One method of plotting data that displays the error, or uncertainty, is by using error bars. An error bar is typically a short vertical line that is attached to a data point in a plot. It shows the magnitude of the error that is associated with the value that is displayed by the data point. For example, Figure 5-10 shows a plot with error bars for the experimental data from Figure 5-1.



**Figure 5-10: A plot with error bars.**

Plots with error bars can be done in MATLAB with the `errorbar` command. Two forms of the command, one for making plots with symmetric error bars (with respect to the value of the data point) and the other for nonsymmetric error bars at each point, are presented. When the error is symmetric, the error bar extends the same length above and below the data point, and the command has the form:

`errorbar(x,y,e)`

Vectors with horizontal and vertical coordinates of each point.

Vector with the value of the error at each point.

- The lengths of the three vectors `x`, `y`, and `e` must be the same.
- The length of the error bar is twice the value of `e`. At each point the error bar extends from `y(i) - e(i)` to `y(i) + e(i)`.

The plot in Figure 5-10, which has symmetric error bars, was done by executing the following code:

```
xd=[10:2:22];
yd=[950 640 460 340 250 180 140];
ydErr=[30 20 18 35 20 30 10]
errorbar(xd,yd,ydErr)
xlabel('DISTANCE (cm)')
ylabel('INTENSITY (lux)')
```

The command for making a plot with error bars that are not symmetric is:

`errorbar(x,y,d,u)`

Vectors with horizontal and vertical coordinates of each point.

Vector with the upper-bound value of the error at each point.

Vector with the lower-bound value of the error at each point.