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## 9.2.2 Example: Accuracy of Forward Euler simulation of coffee cooling

MO2.4 MO2.6 MO2.7

Let's consider the error for the Forward Euler simulation of coffee cooling. Figure 9.1 shows that the error decreases by about a factor of 10 for a factor of 10 decrease in $\Delta t$ from 50 to 5 minutes. This would seem to indicate a first order ($p = 1$) method since the error seems proportional to $\Delta t$.

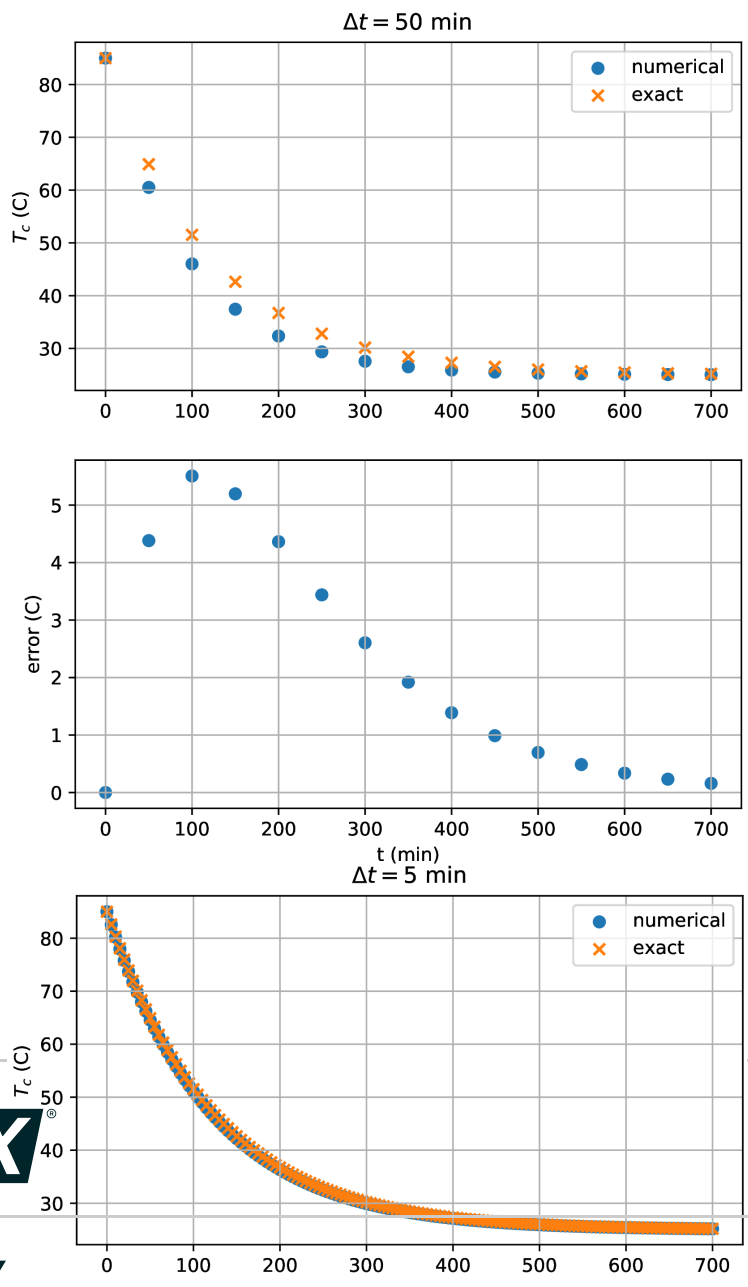
To see more certainly that Forward Euler is $p = 1$, we plot the maximum error ($e_{\max}$) versus a range of $\Delta t$ in Figure 9.2. This plot is done using a log-log scale because the slope then is directly the observed order of accuracy. To see that this is true, recall that the definition of the order of accuracy says that,

$$e_{\max} = O\left(\Delta t^p\right) \tag{9.4}$$

$$\log e_{\max} = O\left(\log\left(\Delta t^p\right)\right) \tag{9.5}$$

$$\Rightarrow \log e_{\max} = O\left(p \log \Delta t\right) \tag{9.6}$$

Thus, $p$ is the slope of the $\log e_{\max}$ versus $\log \Delta t$ plot. As can be seen in Figure 9.2, the slope is 1.

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