

# Convergence of Euler Methods <sup>1</sup>

1. Download the file `myeuler.m` from the class web site and save it in your working directory as `myeuler.m`.
2. Download the file `mymodeuler.m` from the class web site and save it in your working directory as `mymodeuler.m`.
3. Open MATLAB. Open and read the two files you just saved.
4. Type the following commands (at the prompt and then press `Enter`):  

```
f = inline('sin(t)*cos(x)', 't', 'x')  
myeuler(f, [0, 12], .1, 10) (Euler method)  
hold on  
myeuler(f, [0, 12], .1, 20) (Use the up arrow.)  
myeuler(f, [0, 12], .1, 30)
```

From the comments in the program identify the meaning of each number in these commands.
5. Position the plot window so that it can always be seen. Continue to increase the last number in the above until the graph stops changing (as far as you can see). Record this number and print the final graph. Type `hold off` and kill the plot window.
6. Next type:  

```
mymodeuler(f, [0, 12], .1, 10) (Modified Euler method)  
hold on  
mymodeuler(f, [0, 12], .1, 20) (Use the up arrow.)  
mymodeuler(f, [0, 12], .1, 30)
```
7. Again continue to increase the last number in the above by 10s until the graph stops changing (as far as you can see). Record this number and print the graph.
8. Prepare a brief (< 1 page) written report comparing the Euler and modified Euler methods. Use complete sentences and standard mathematical notation.

Students should observe that numerical solutions seem to converge as  $n$  is increased ( $h$  is decreased). This happens much faster for the modified Euler method than for the Euler method.

---

<sup>1</sup>Copyright ©2004 Todd Young. All rights reserved. Please address comments to [young@math.ohiou.edu](mailto:young@math.ohiou.edu).