MATLAB基礎學習與應用

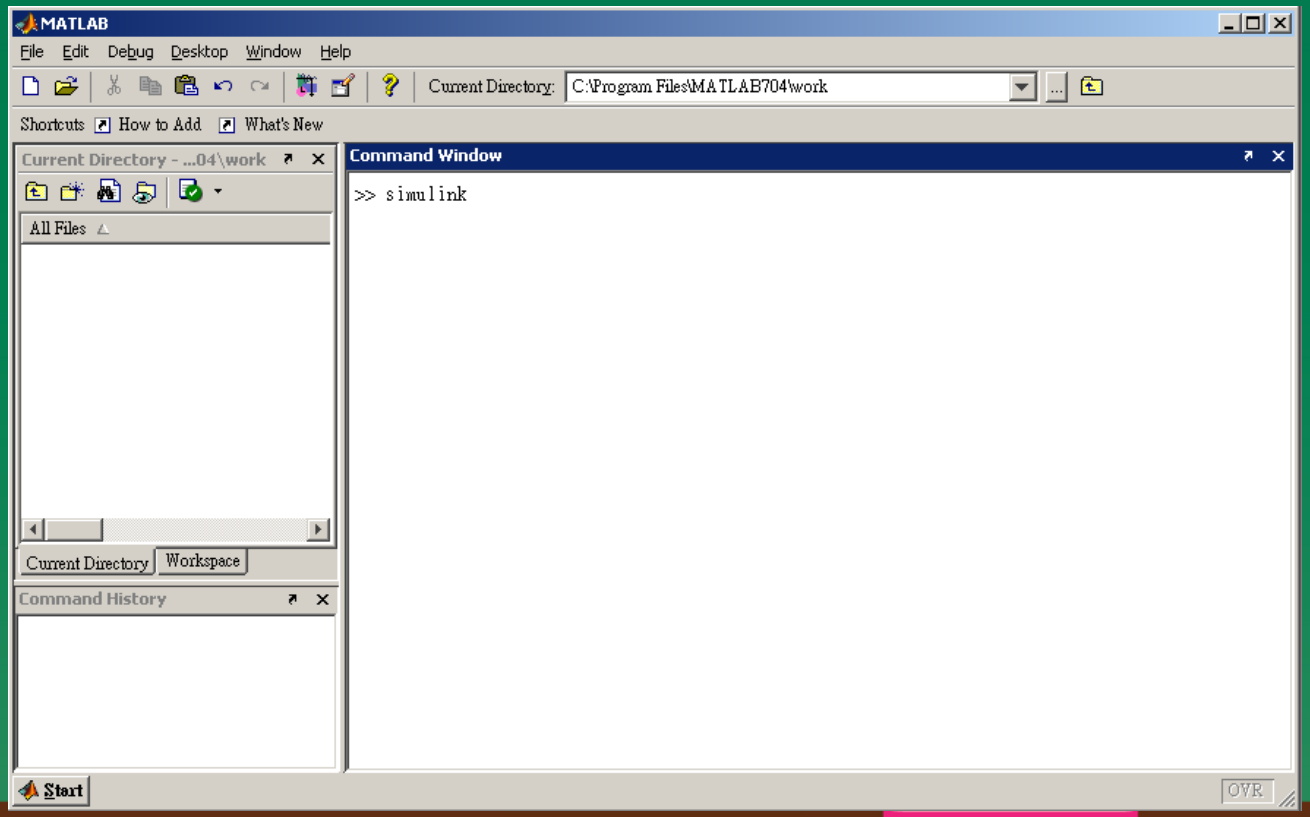
教學投影片

Part 4

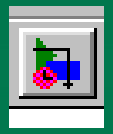
Simulink & DEE

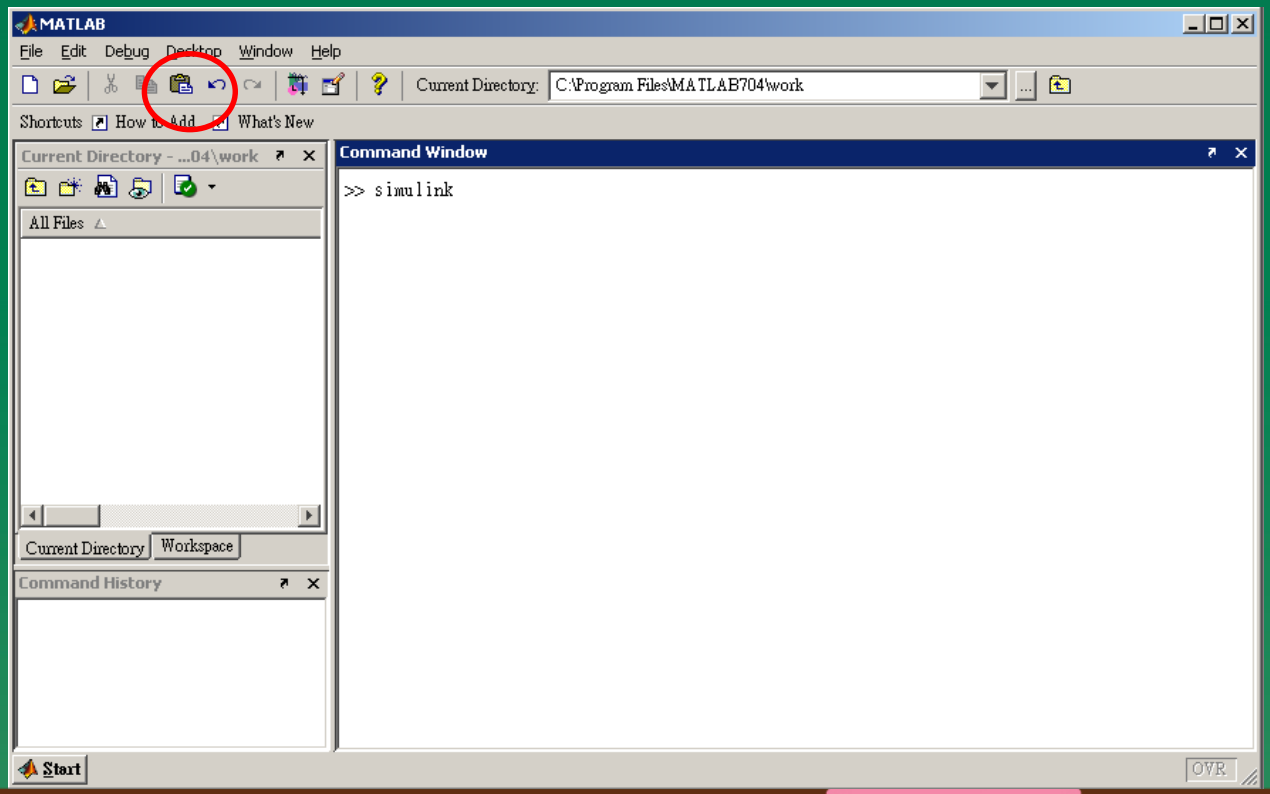
【Q】如何進入Simulink

- *step 1*　進入Matlab
- *step 2*　方法一：在workspace輸入simulink的指令。



【Q】如何進入Simulink

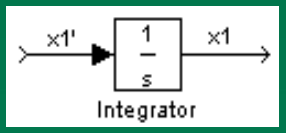
- *step 2* 方法二：點選MATLAB 工具列之 



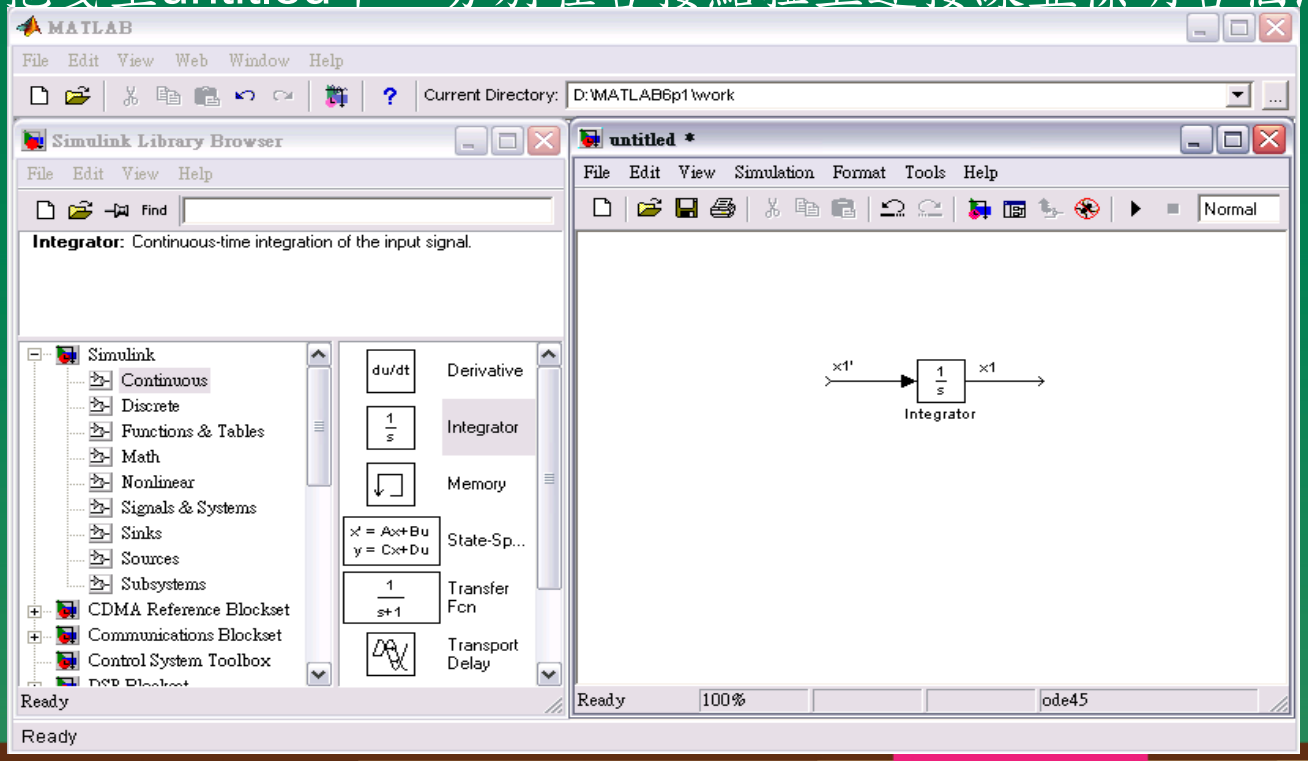
• 如何利用SIMULINK解ODE

Example1： $x_1' = -3x_1 + 2$

Step1： $x_1 = \int x_1' dt$ ⟺

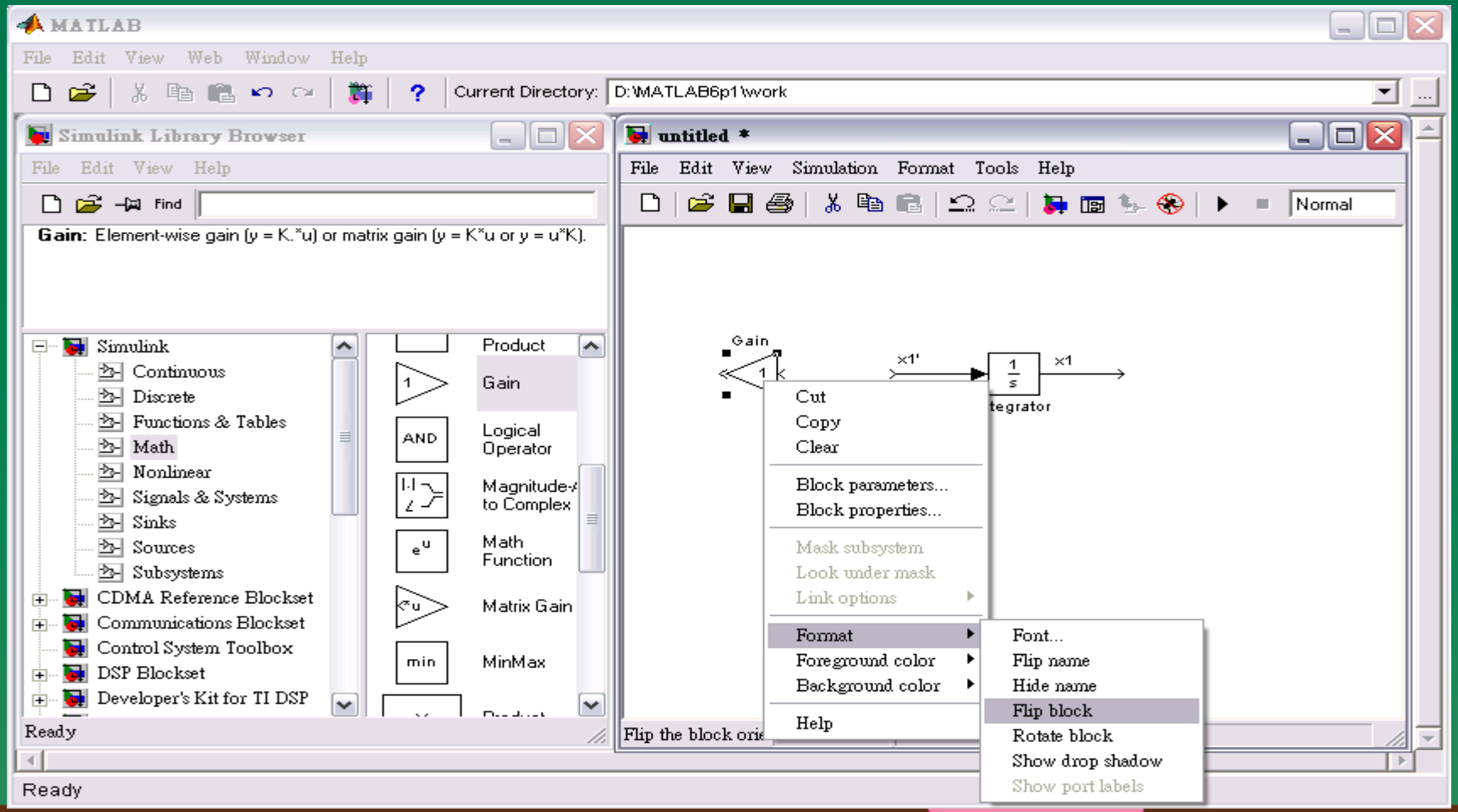


在Library中點選Continuous，在Continuous中選取integrator，按住滑鼠左鍵拖曳至untitled中，分別在各接點拉上連接線並標明各個涵義。

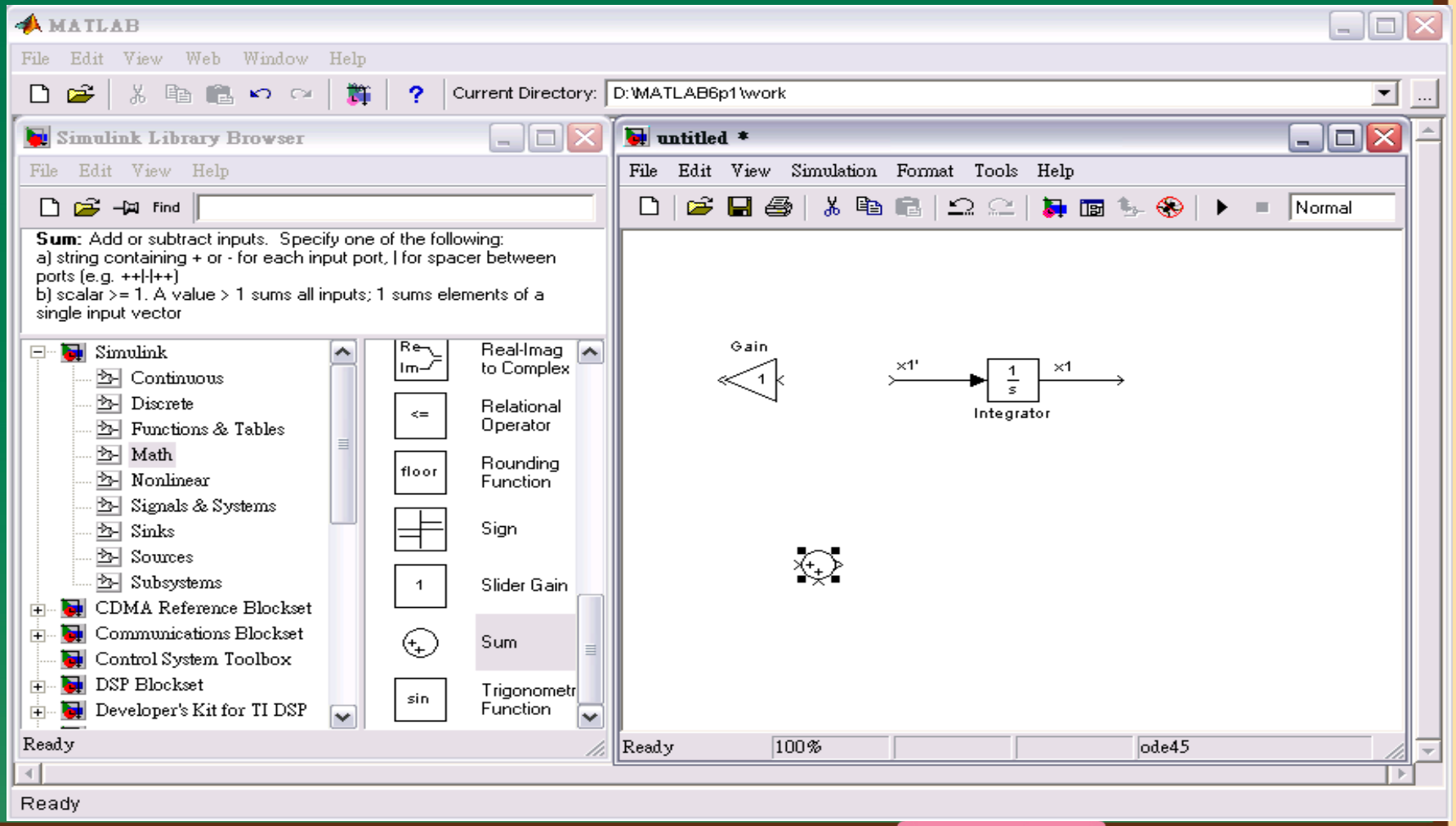


Step1：　$x_1' = -3x_1 + 2$

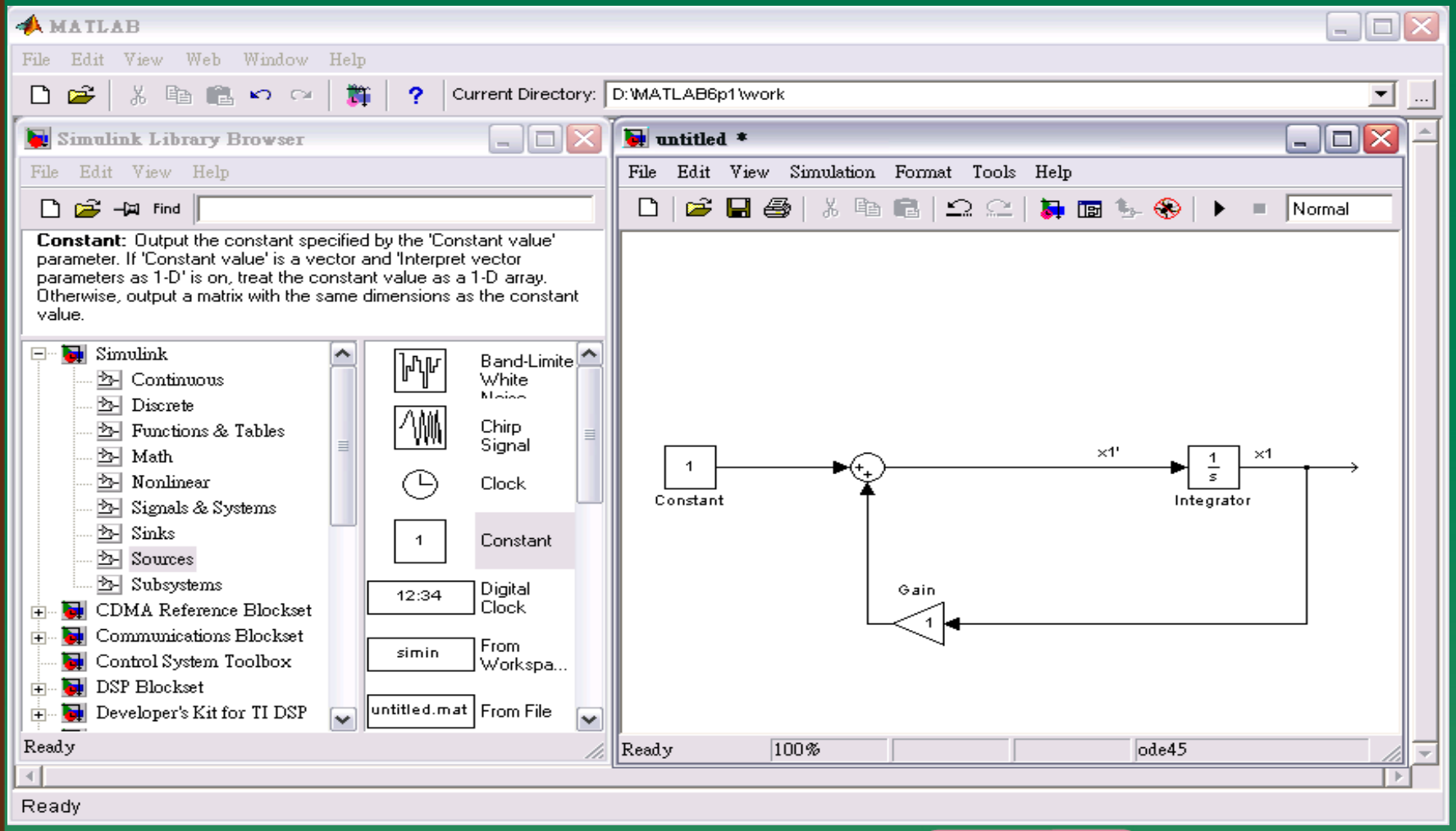
（1）從Math中點選Gain的圖示，拖曳至untitled中，並選取命令列中Format/Flip Block使其轉180°



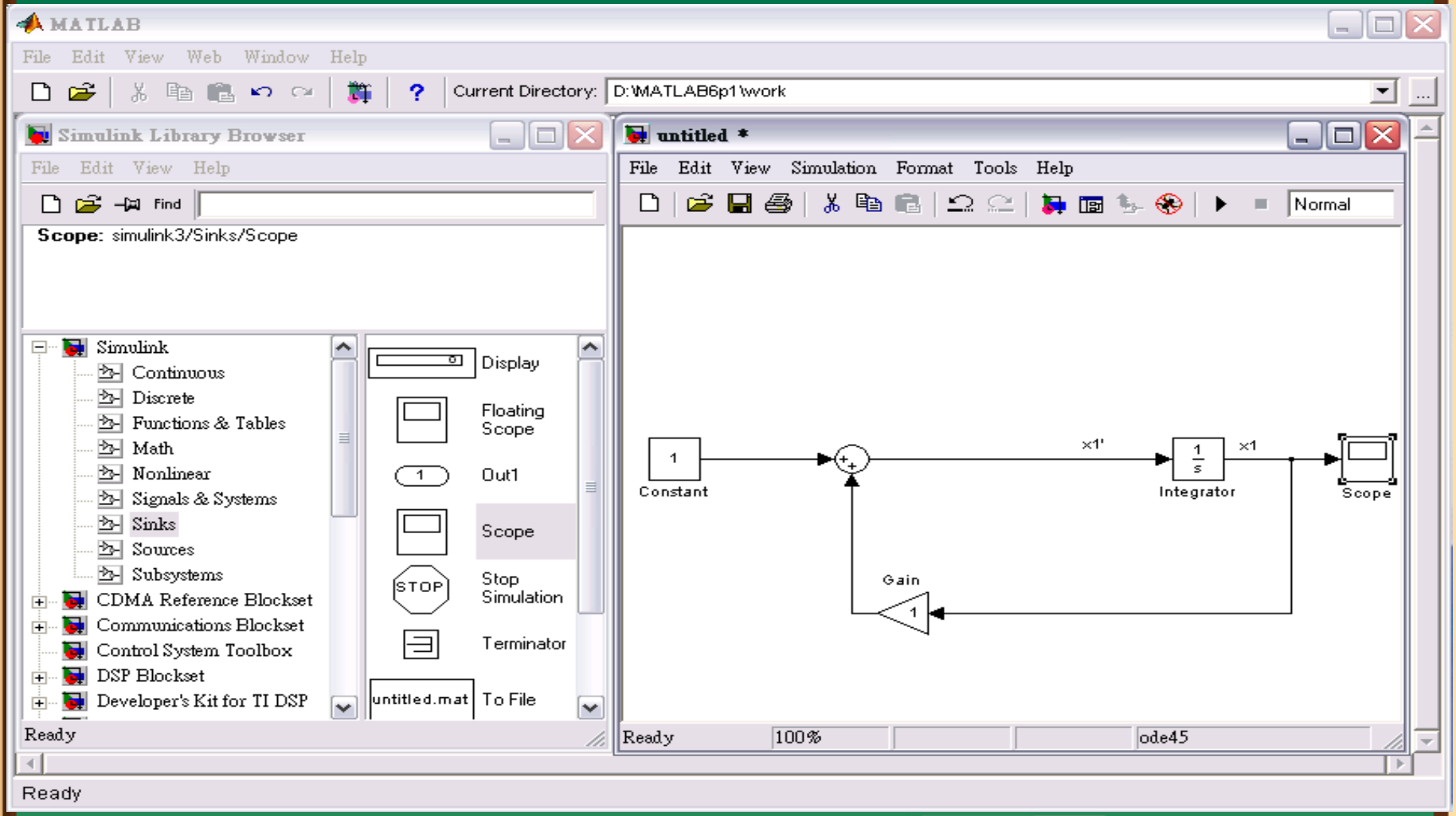
（2）從Math中，拖曳Sum至untitled中



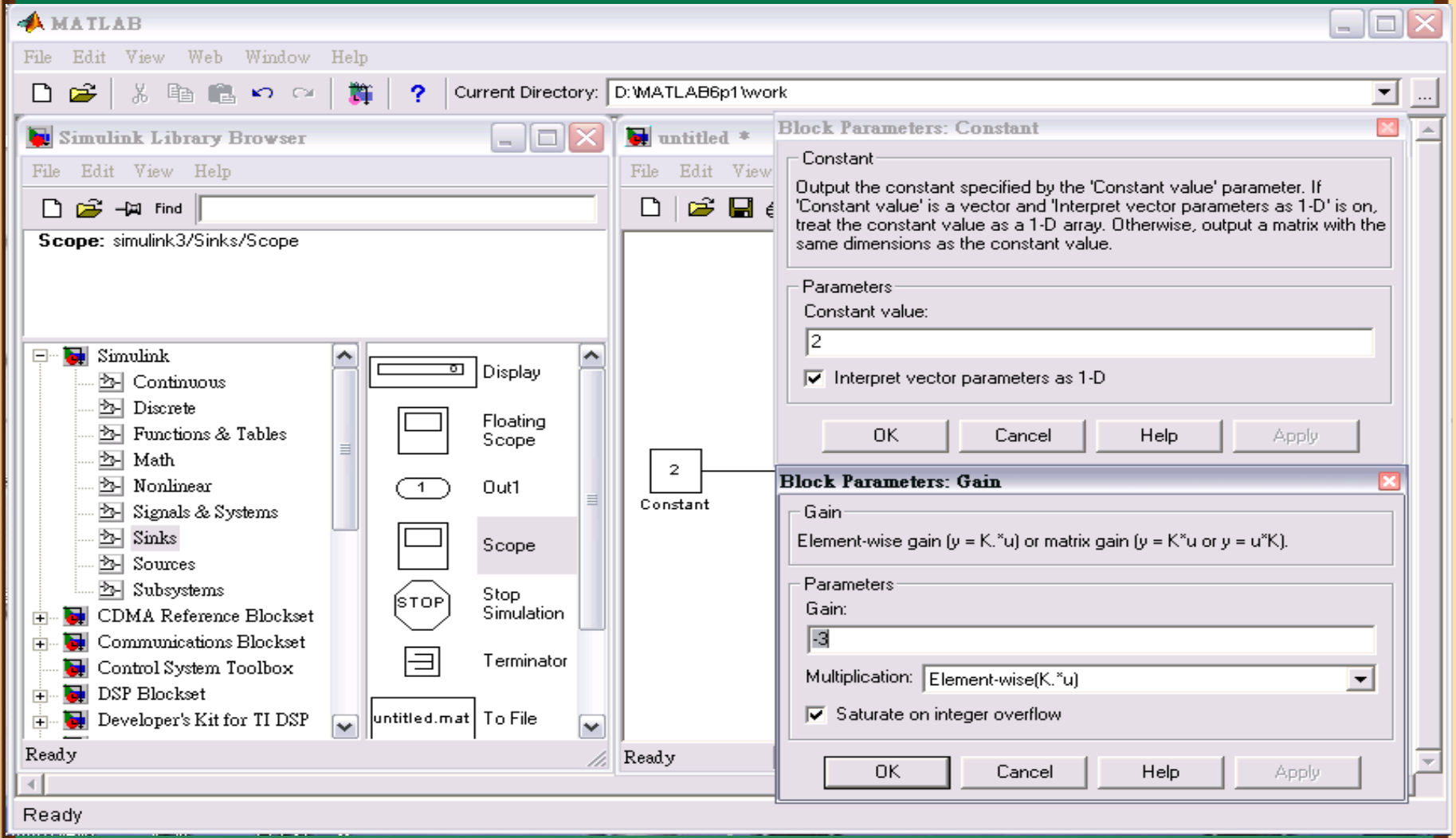
（3）從Source中，用滑鼠拖曳Constant至untitled，並把各點連結起來。



（4）從Sink中拖曳Scope至untitled中，並與連結

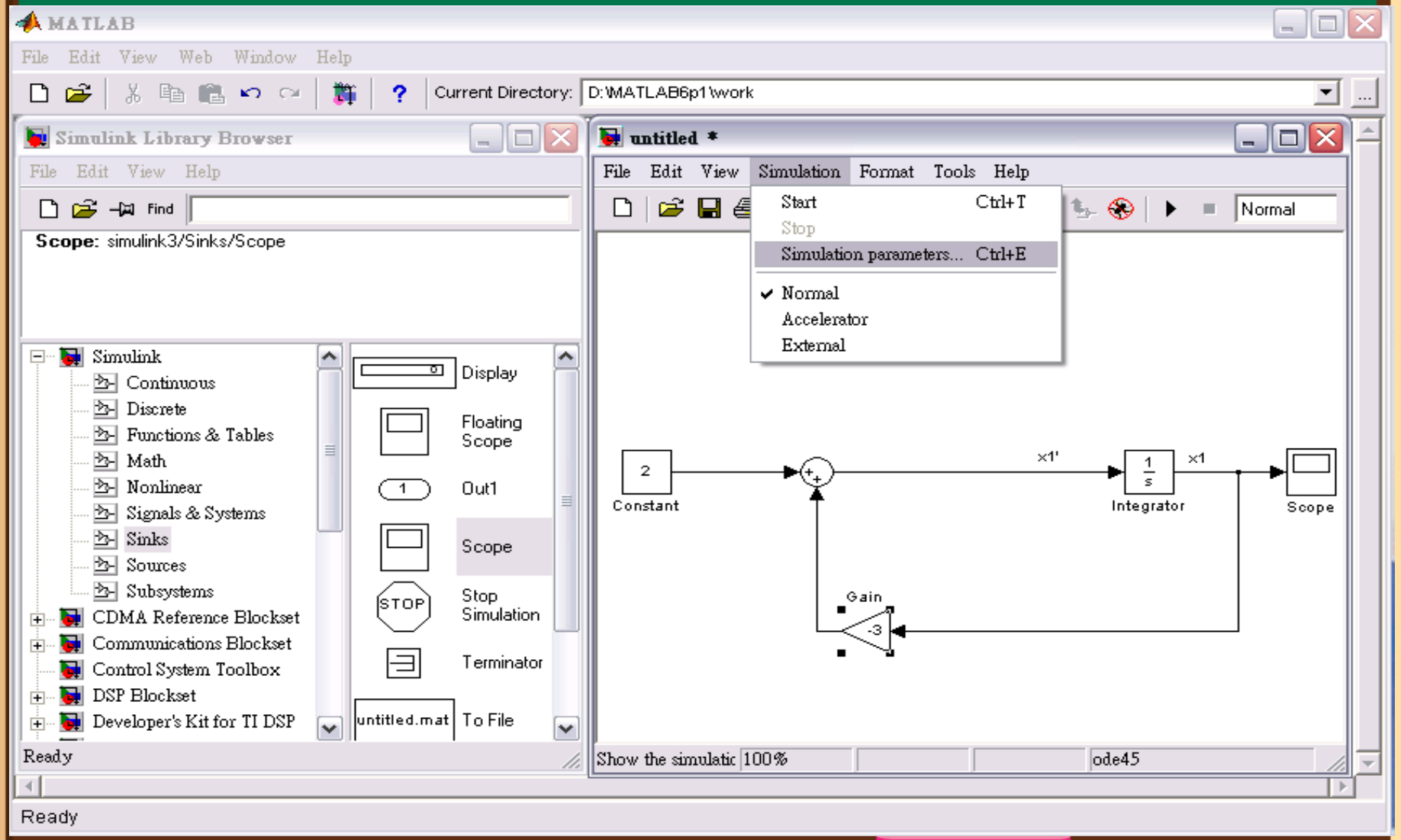


（5）把Constant改為2，把Gain改為-3。

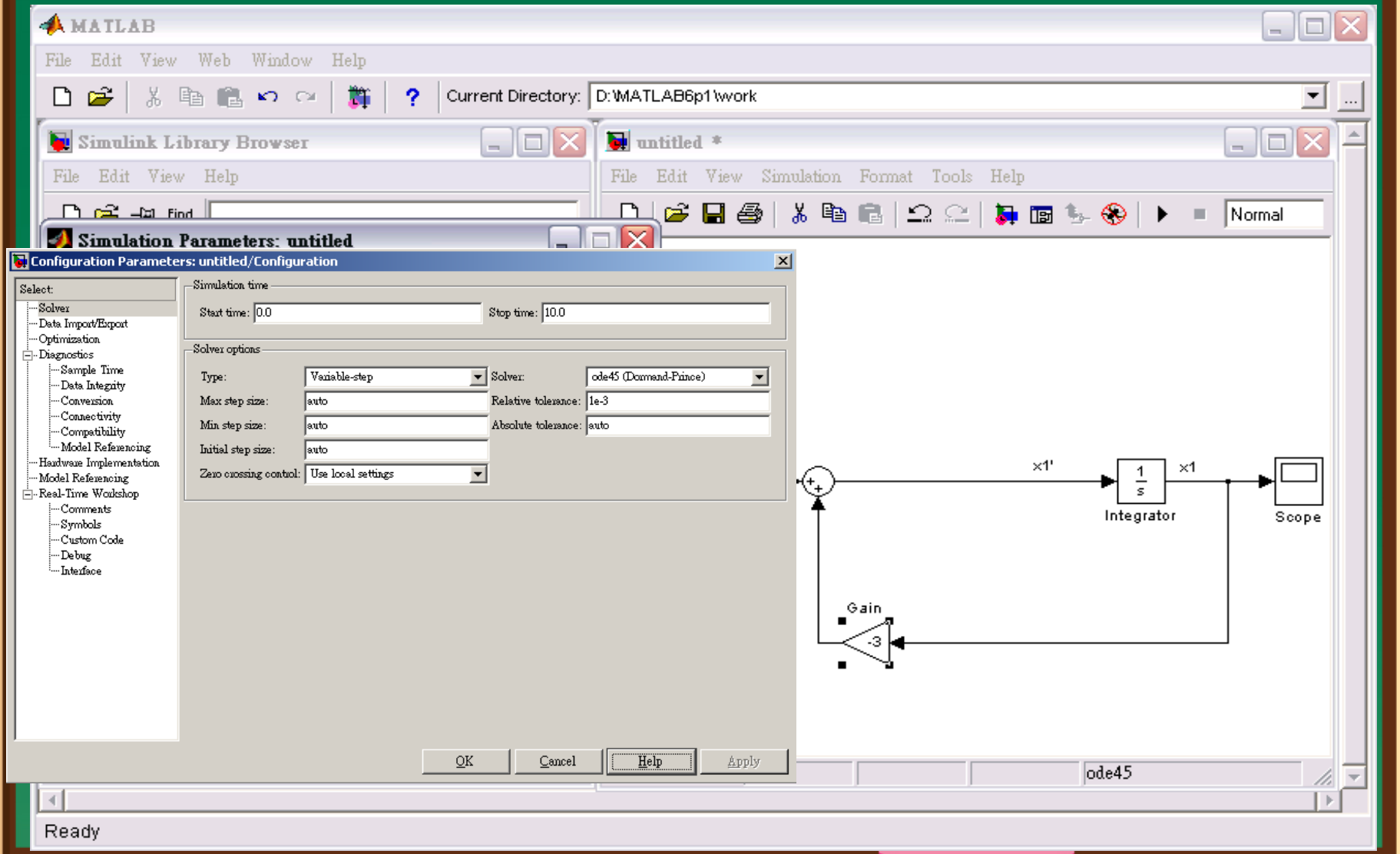


Step3：設定參數

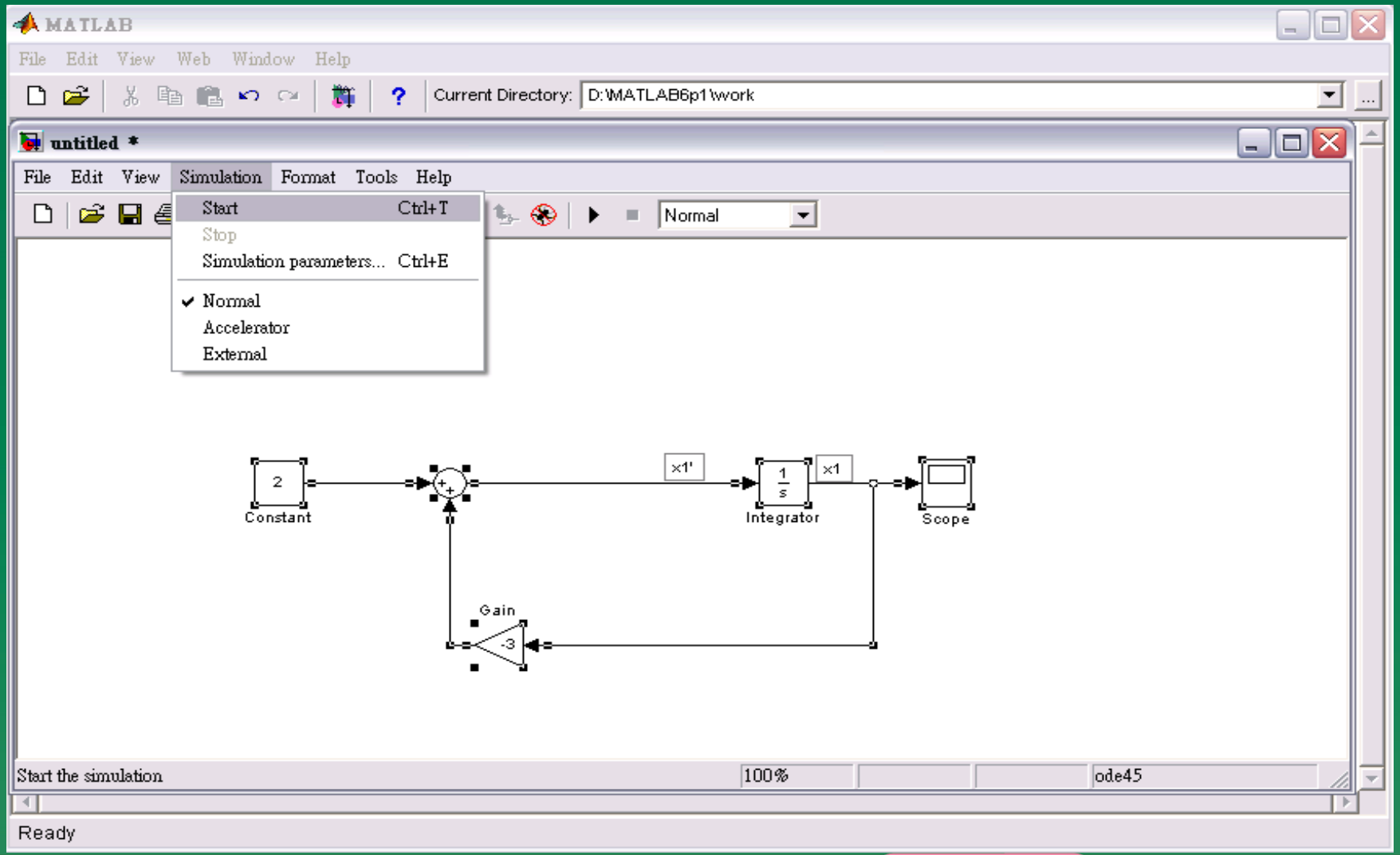
（1）選擇Simulation/Parameters



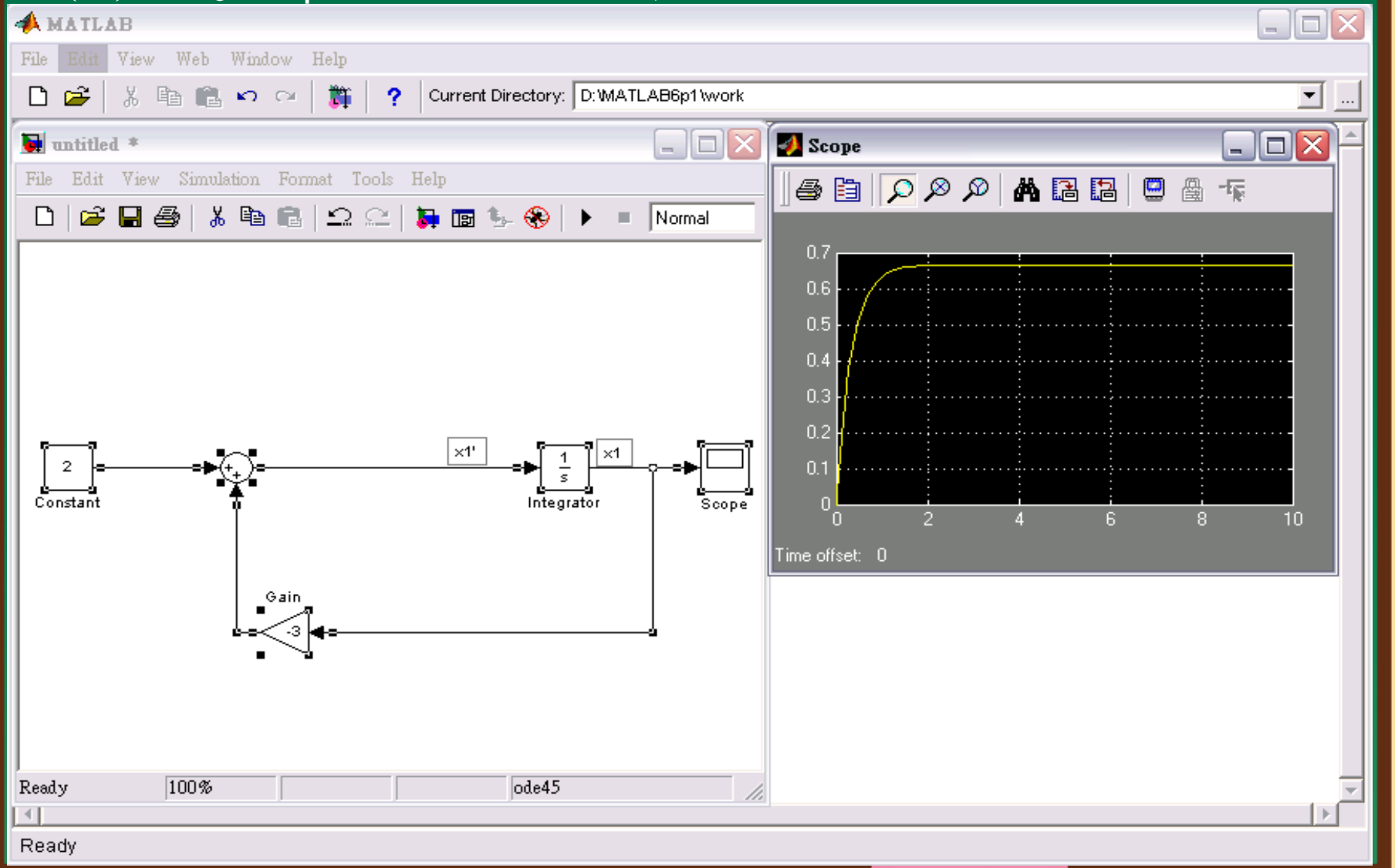
（2）調整適當的起始時間、結束時間和數值方法。



（3）點選Simulation/Start，開始模擬。



（4）點選Scope，顯示模擬的結果。

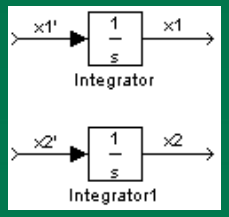


Example2：

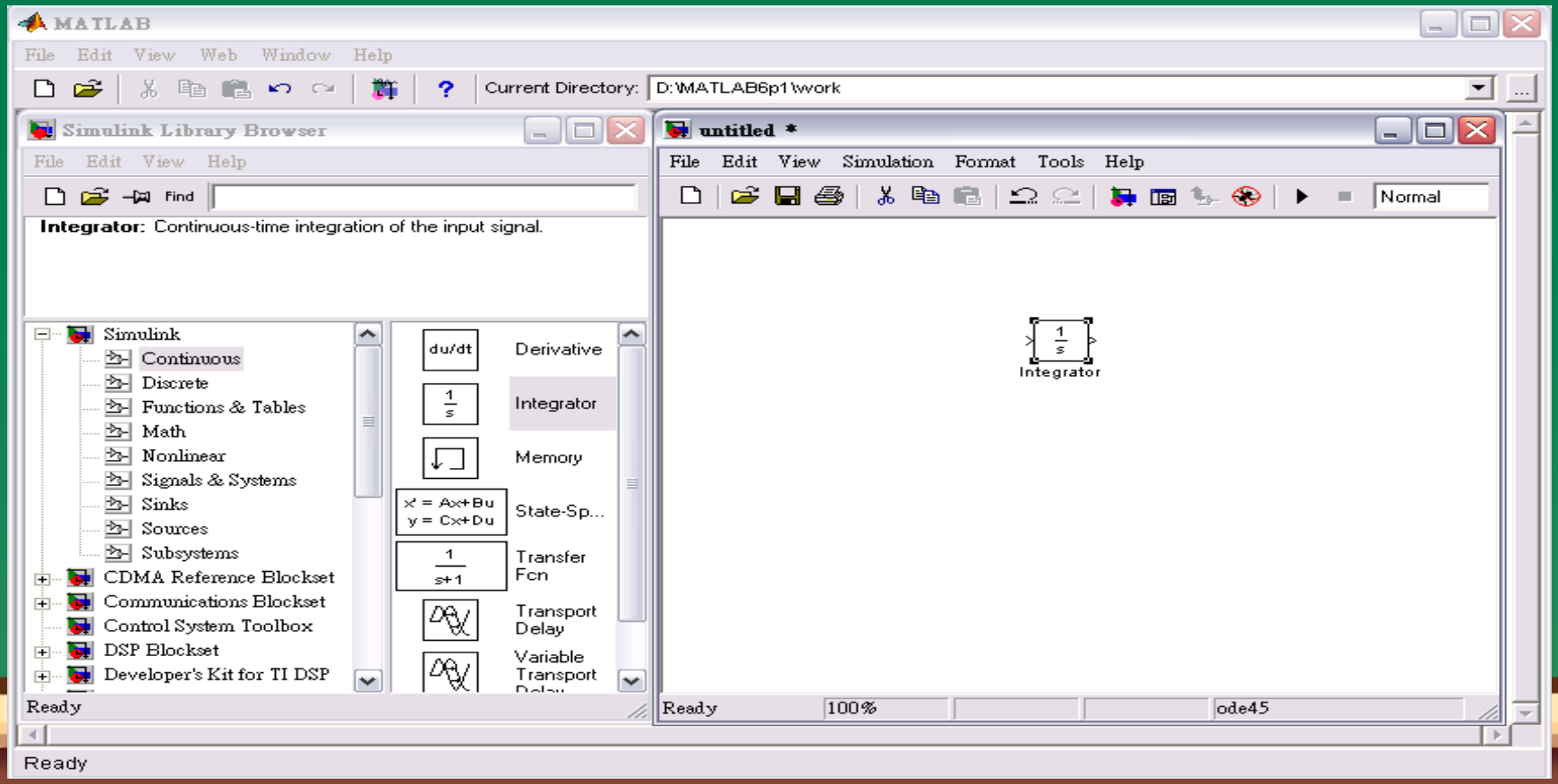
$$\begin{cases} x_1' = x_1 + x_2 e^{-t} \\ x_2' = -x_1 x_2 + \cos(t) \end{cases}, \qquad x_1(0) = 0 \quad x_2(0) = 1$$

Step1：

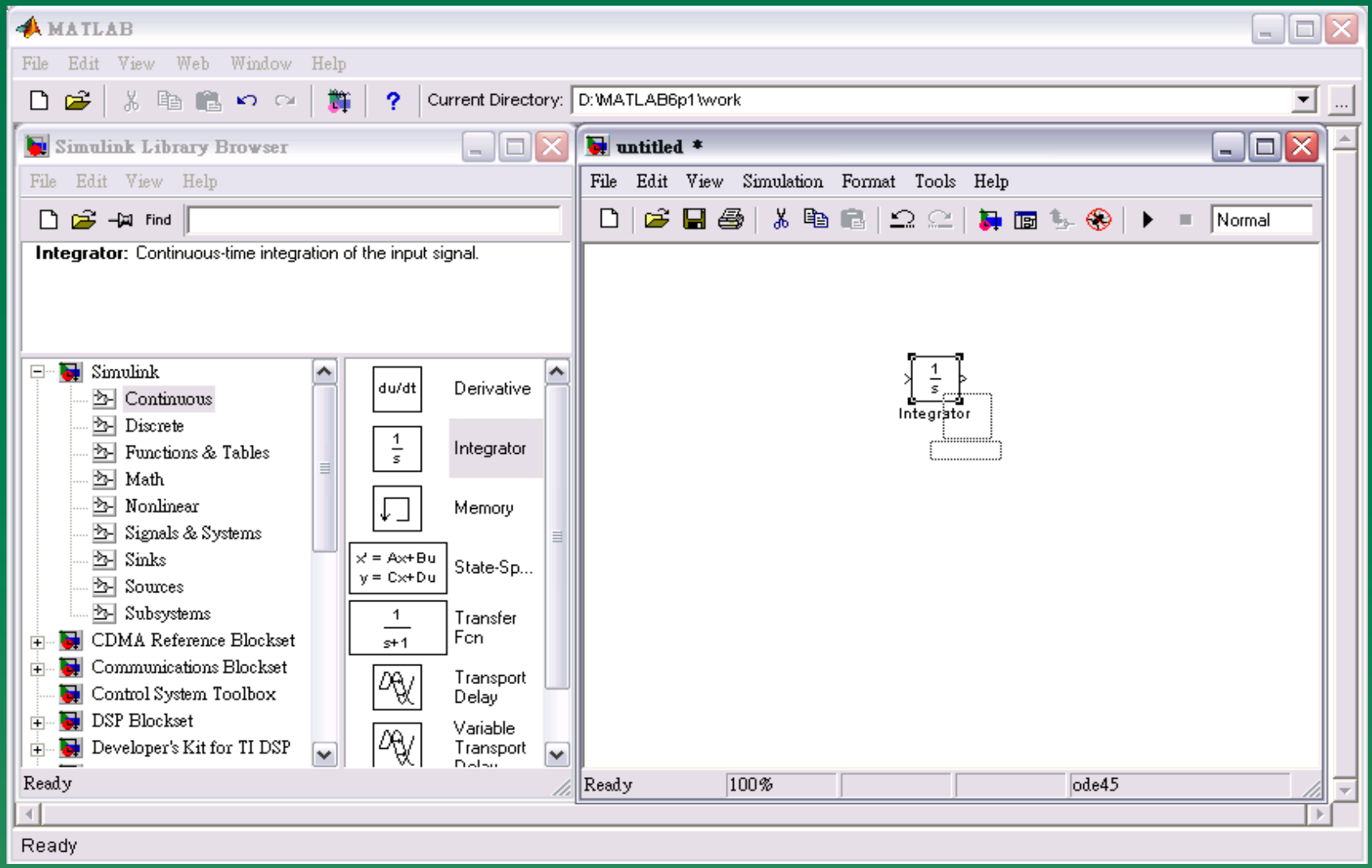
$$\begin{cases} x_1 = \int x_1' dt \\ x_2 = \int x_2' dt \end{cases} \Longleftrightarrow$$



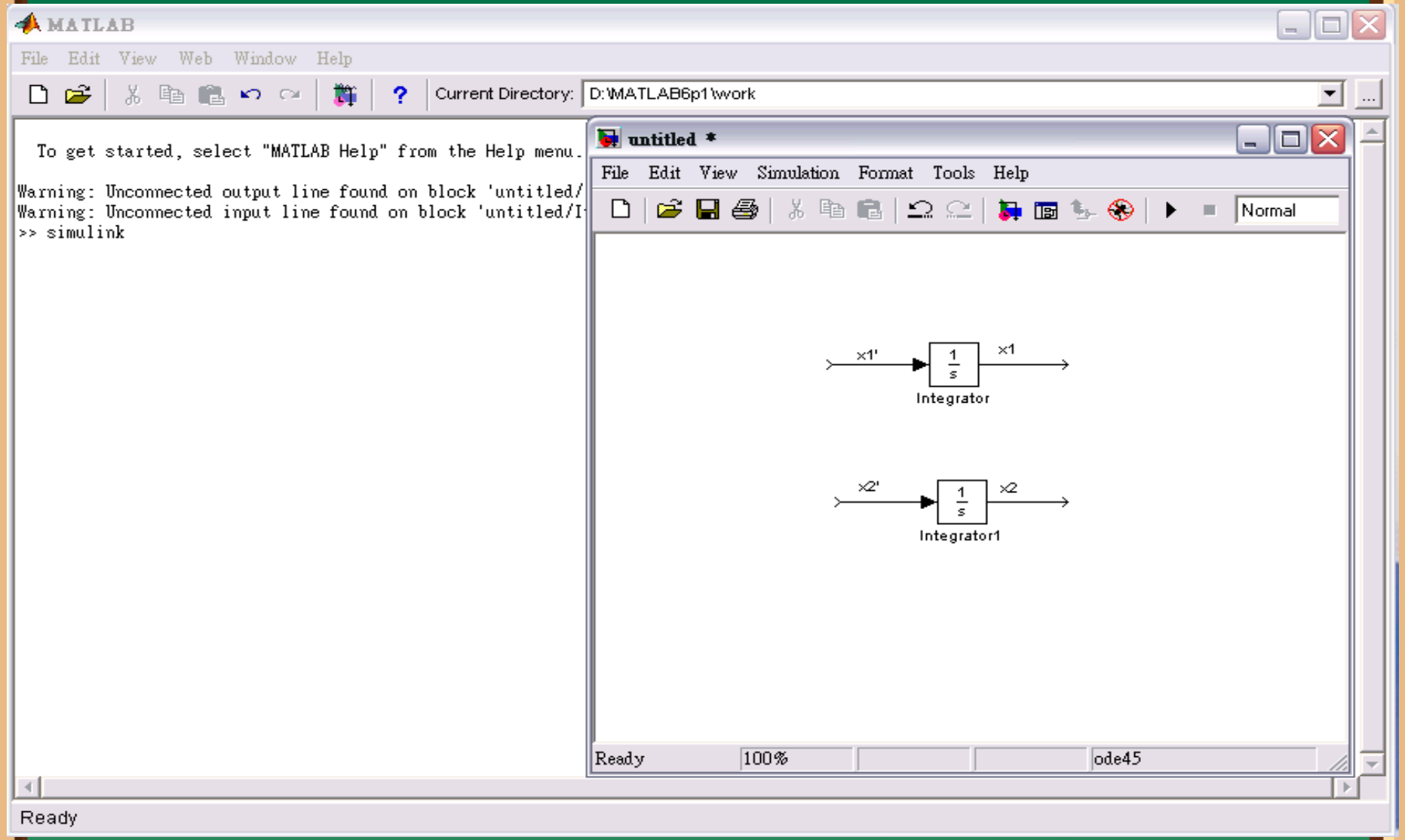
（1）點選Continuous中之Integrator，拖曳至untitled。



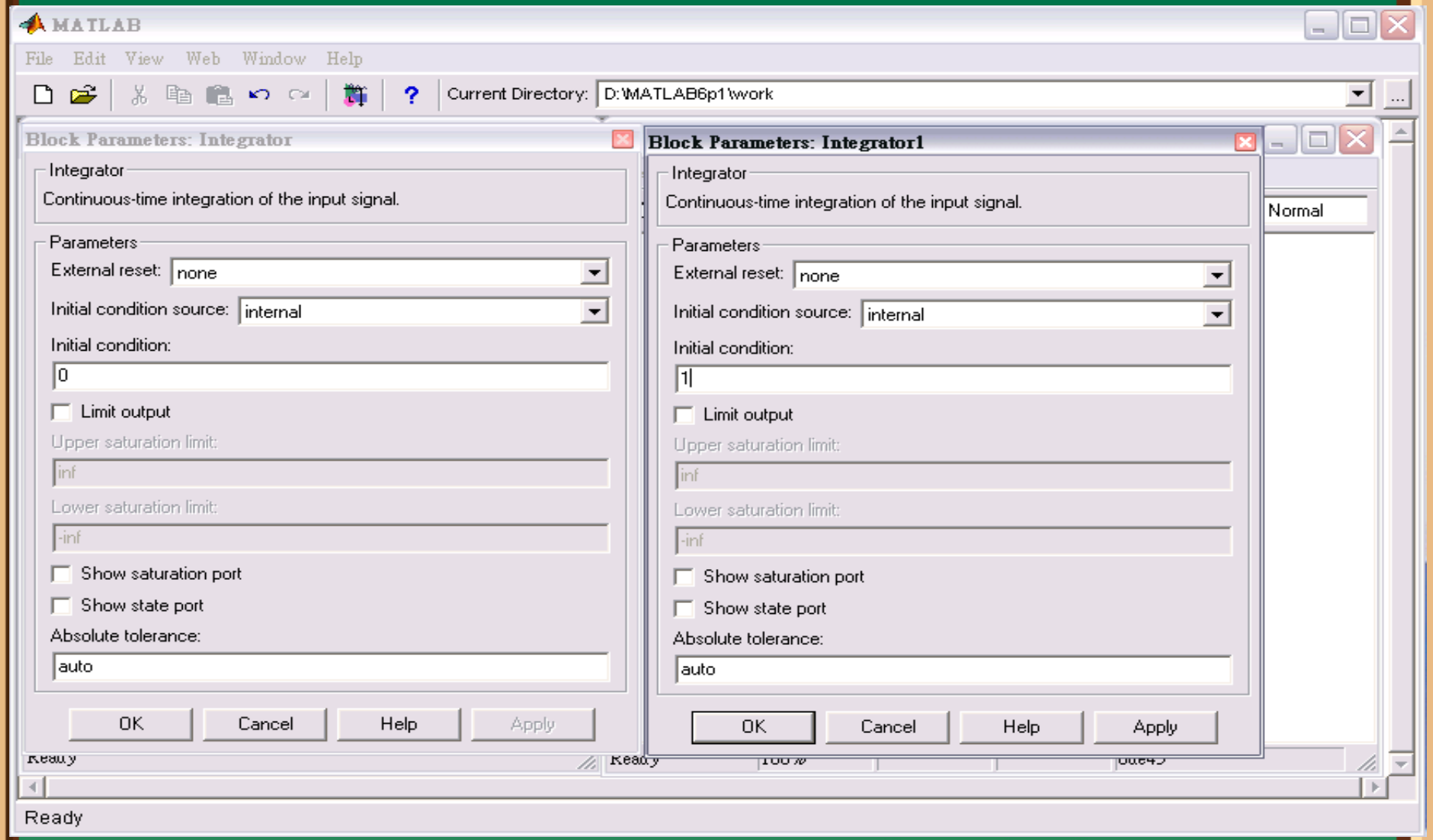
（2）按住滑鼠右鍵可重複複製一個Integrator



（3）標示 x_1 ， x_2 ， x_1' ， x_2'

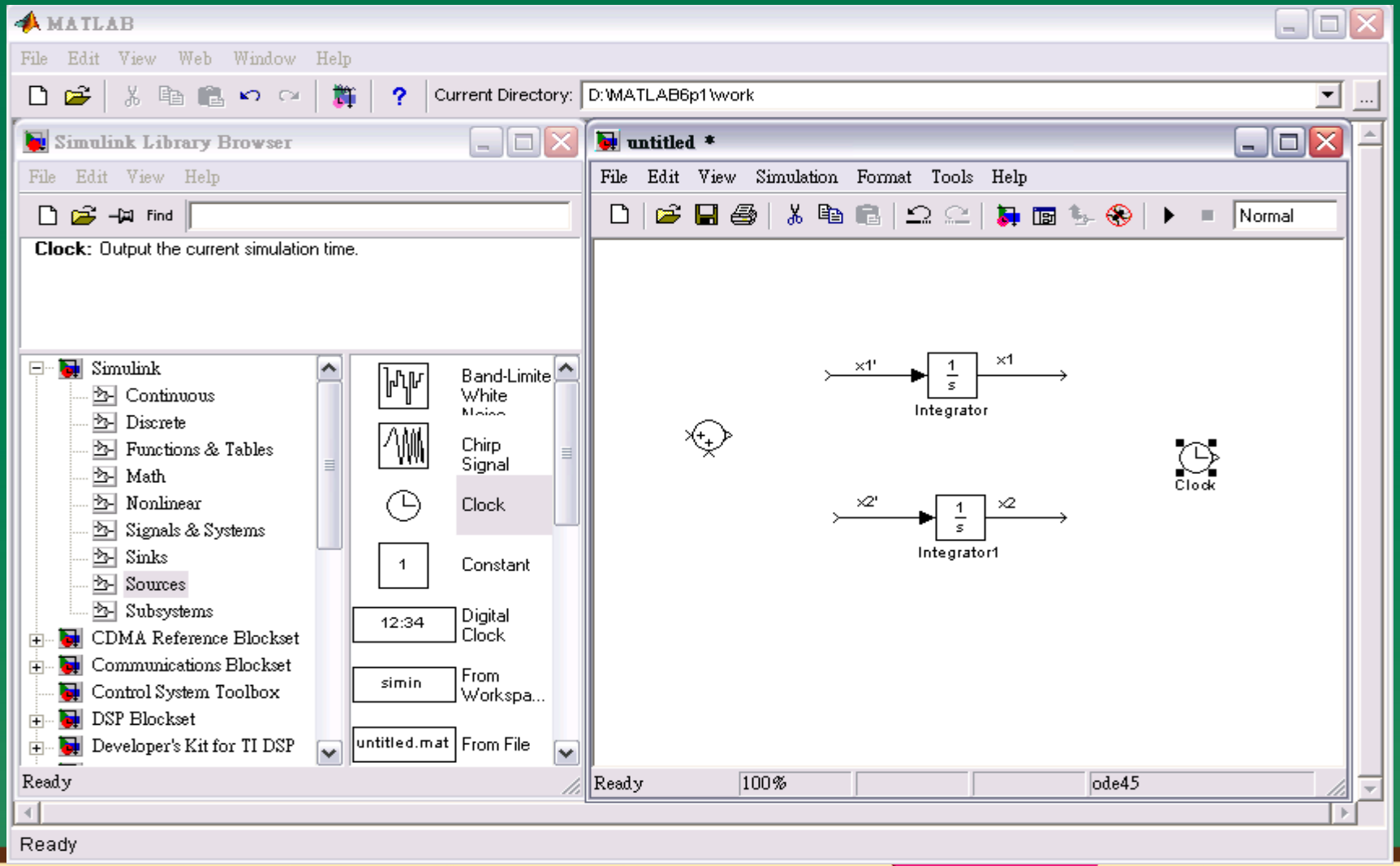


（4）在Integrator上按滑鼠兩次，給定 $x_1(0)=0$ ， $x_2(0)=1$



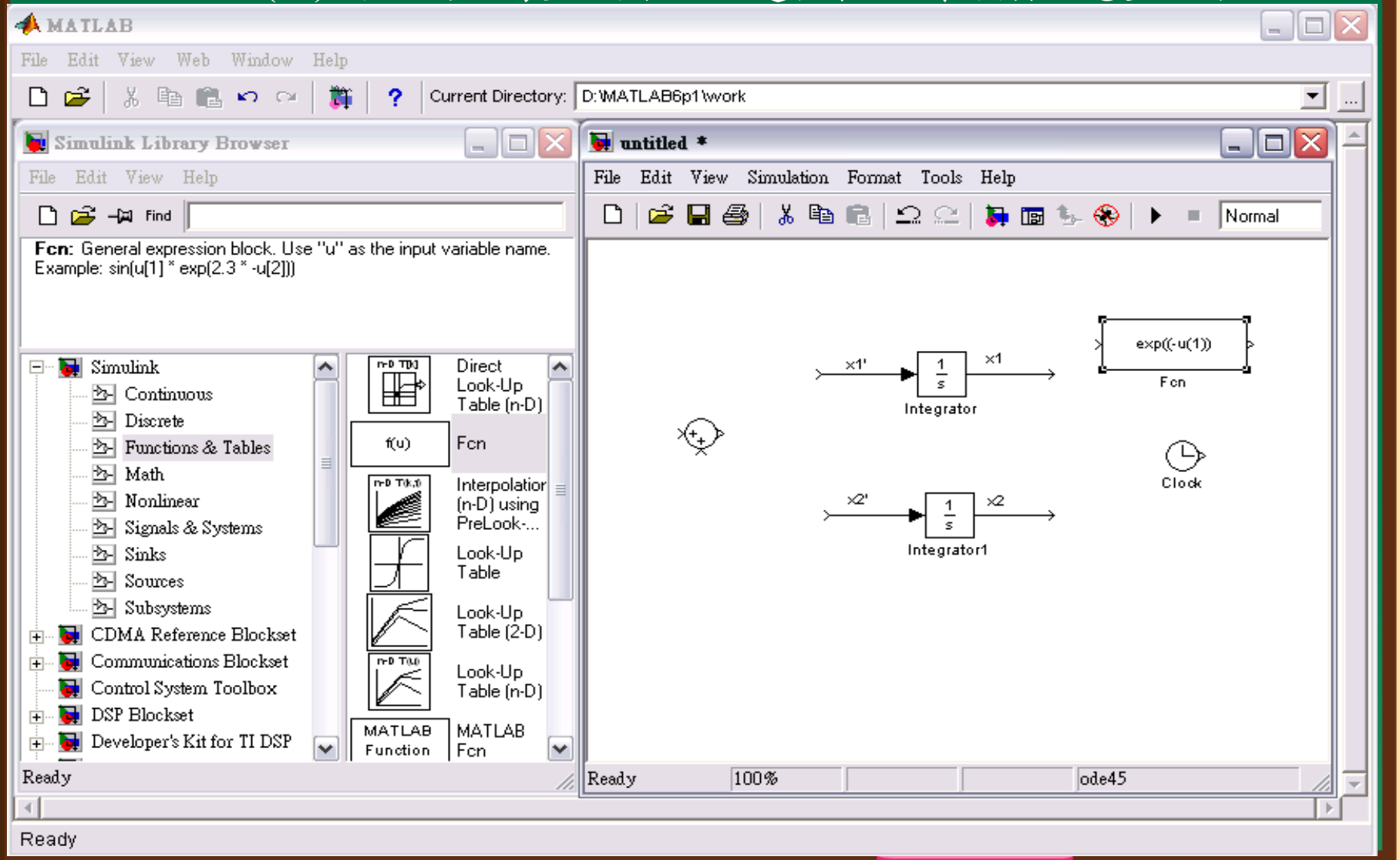
Step2：（1）從Math中拖曳Sum，從Source中拖曳Clock至untitled中

（2）從Functions&Tables中拖曳Fun至untitled中並修改其值為 e^{-u1} 。

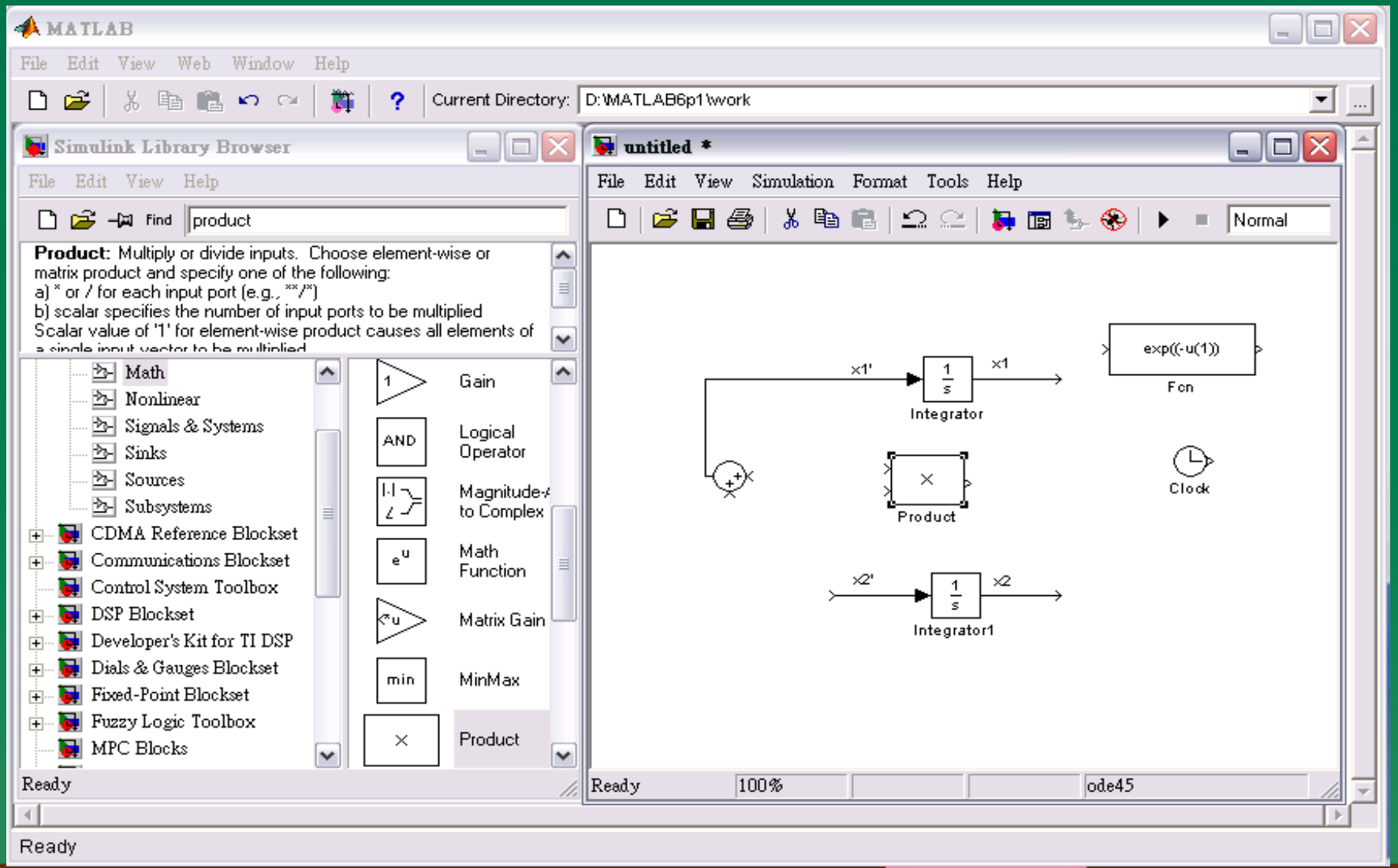


【NOTE】（1）Simulink中外來的變數以u表示

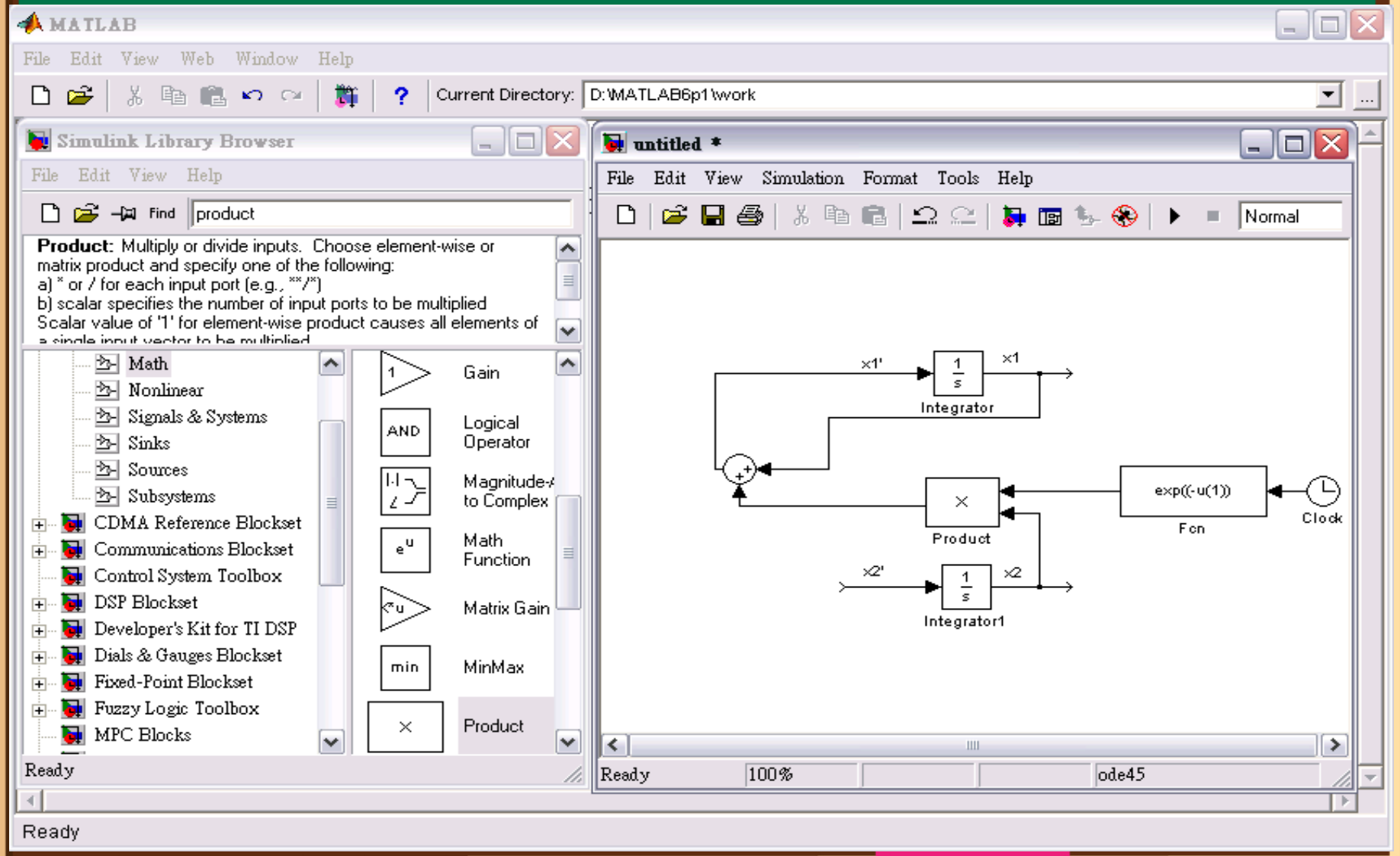
（2）若函數太長，可把Fun邊框拉大則可顯示完整函數



（3）從Math中拖曳Product至untitled中

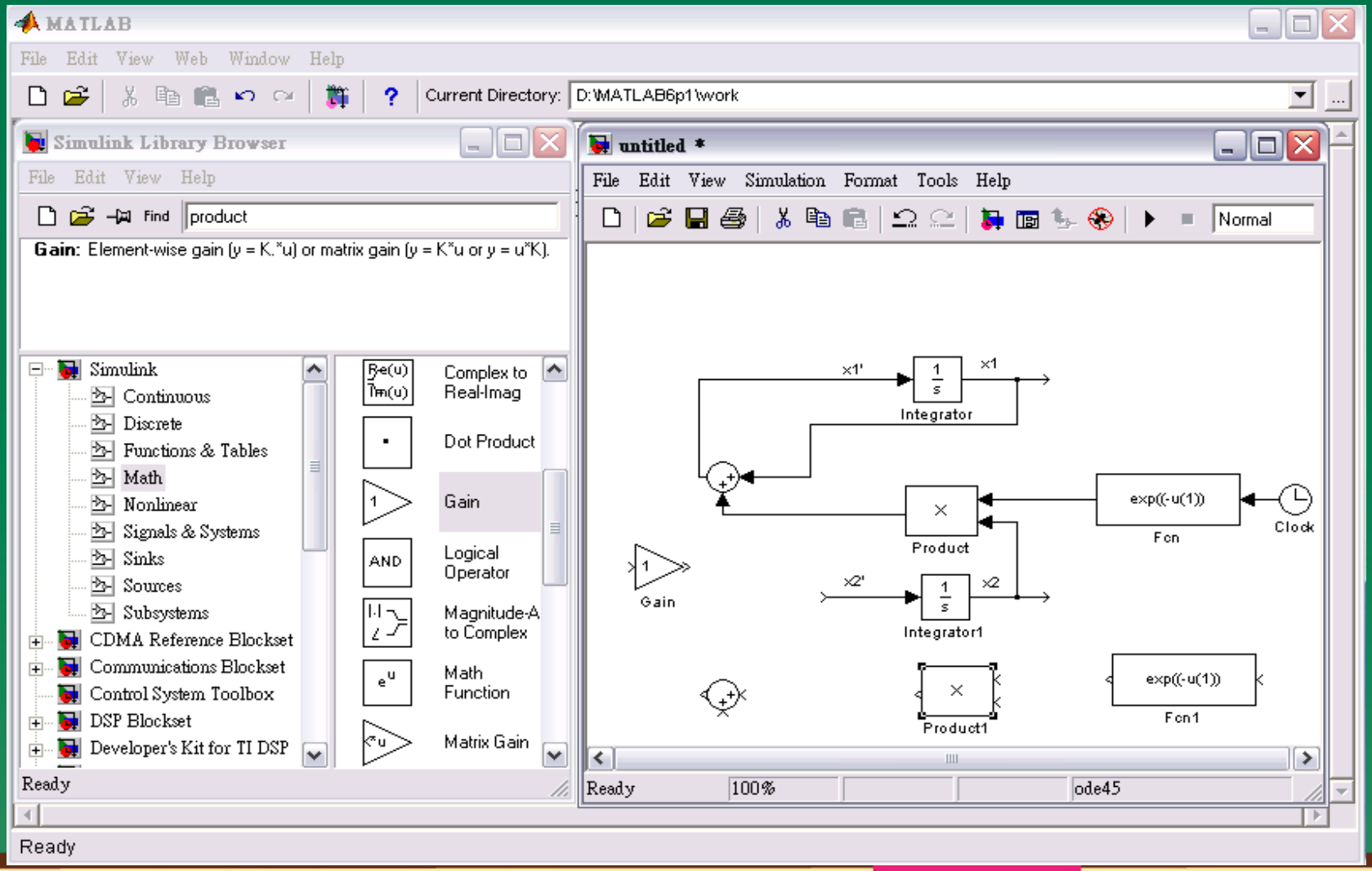


（4）把各點連結起來即可完成 x_1'



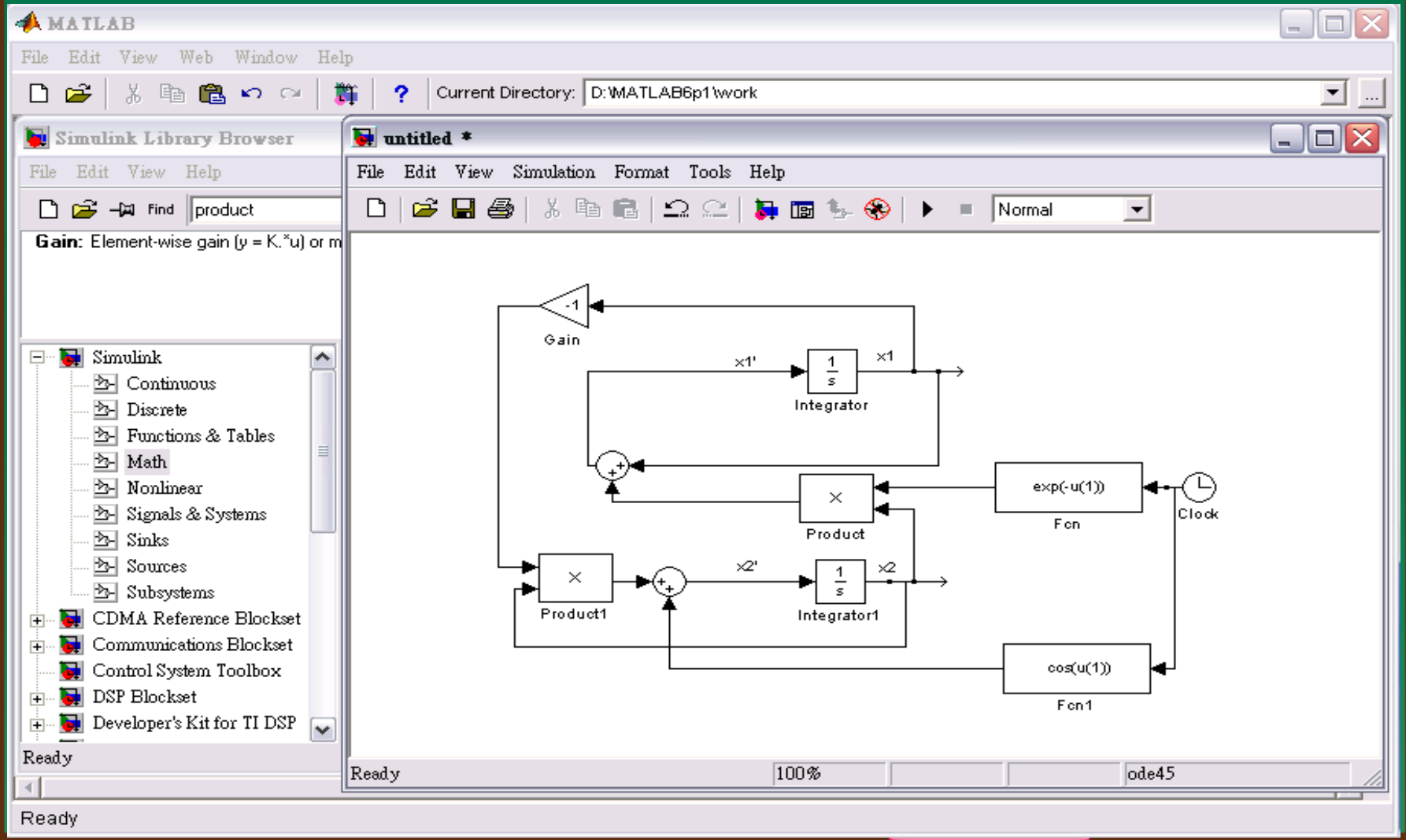
Step3： $x_2' = -x_1 x_2 + \cos(t)$

(1)從Math中拖曳Gain至untitled中，並複製一個Fun、Sum和Produc

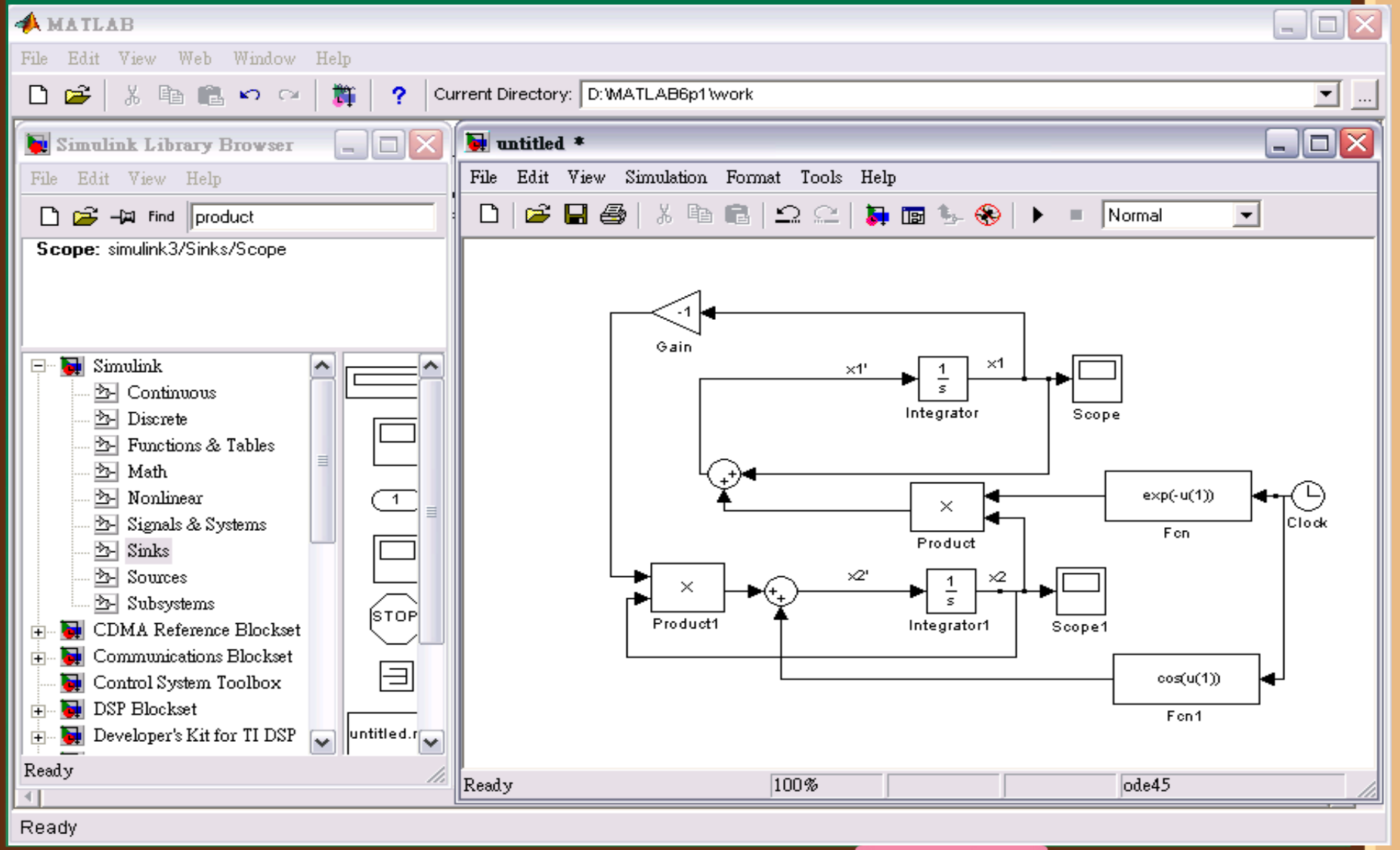


（2）修改Gain之值為-1；Fun1為 $\cos(u(1))$

（3）把各點連結即可完成 x_2'

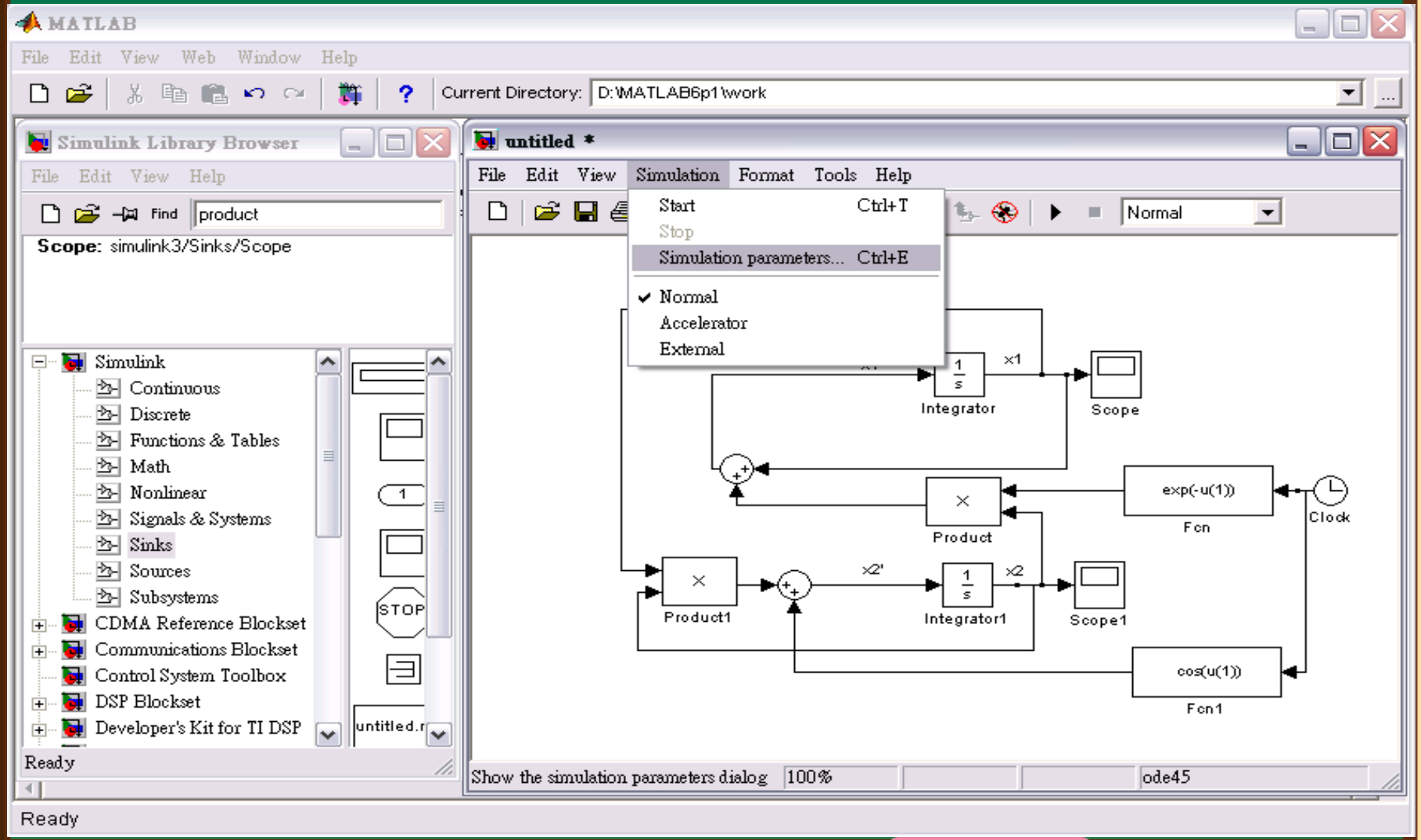


（4）從Sink中拖曳Scope並複製，使其接上 x_1 、 x_2

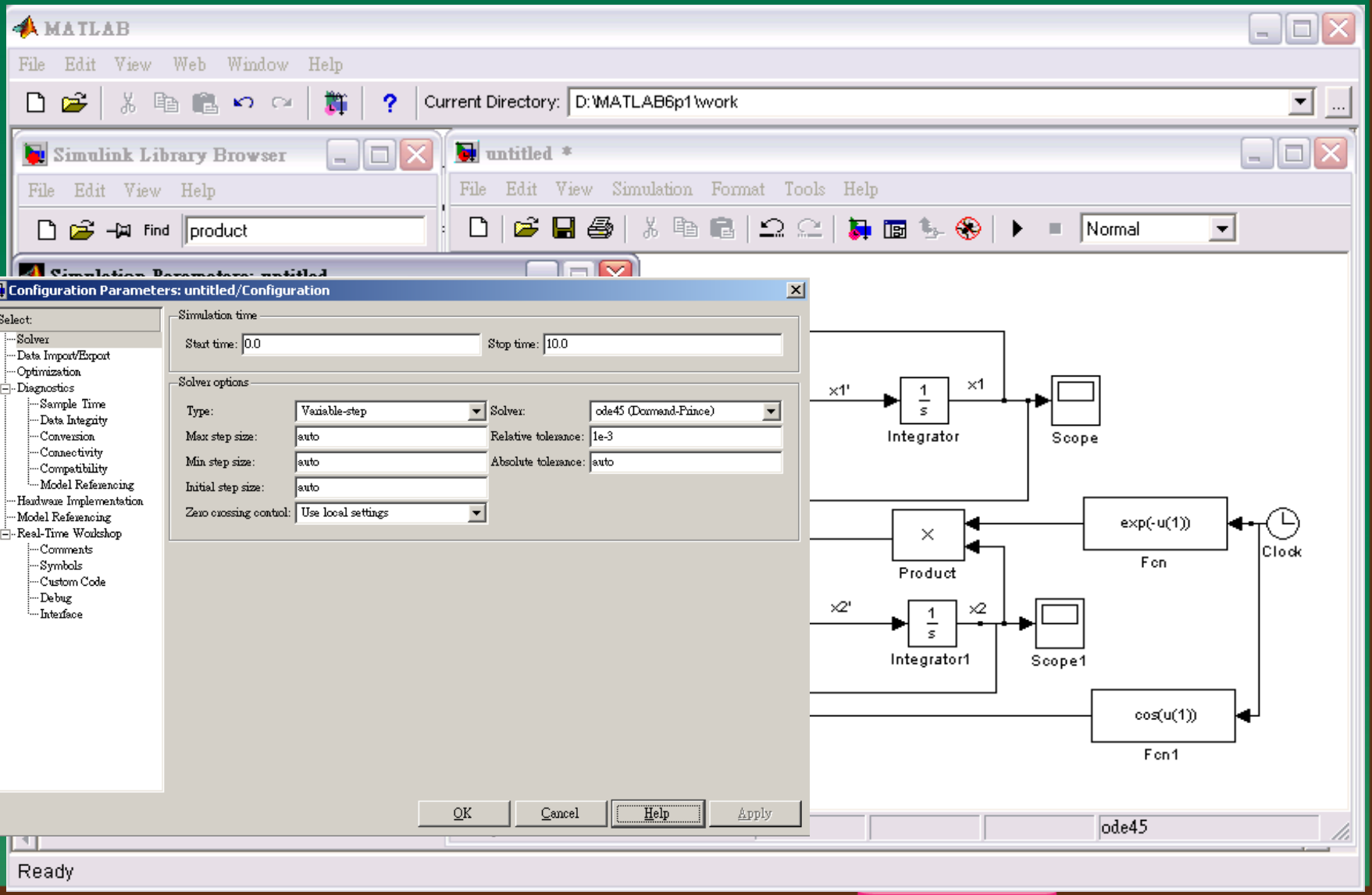


Step4：調整參數設定

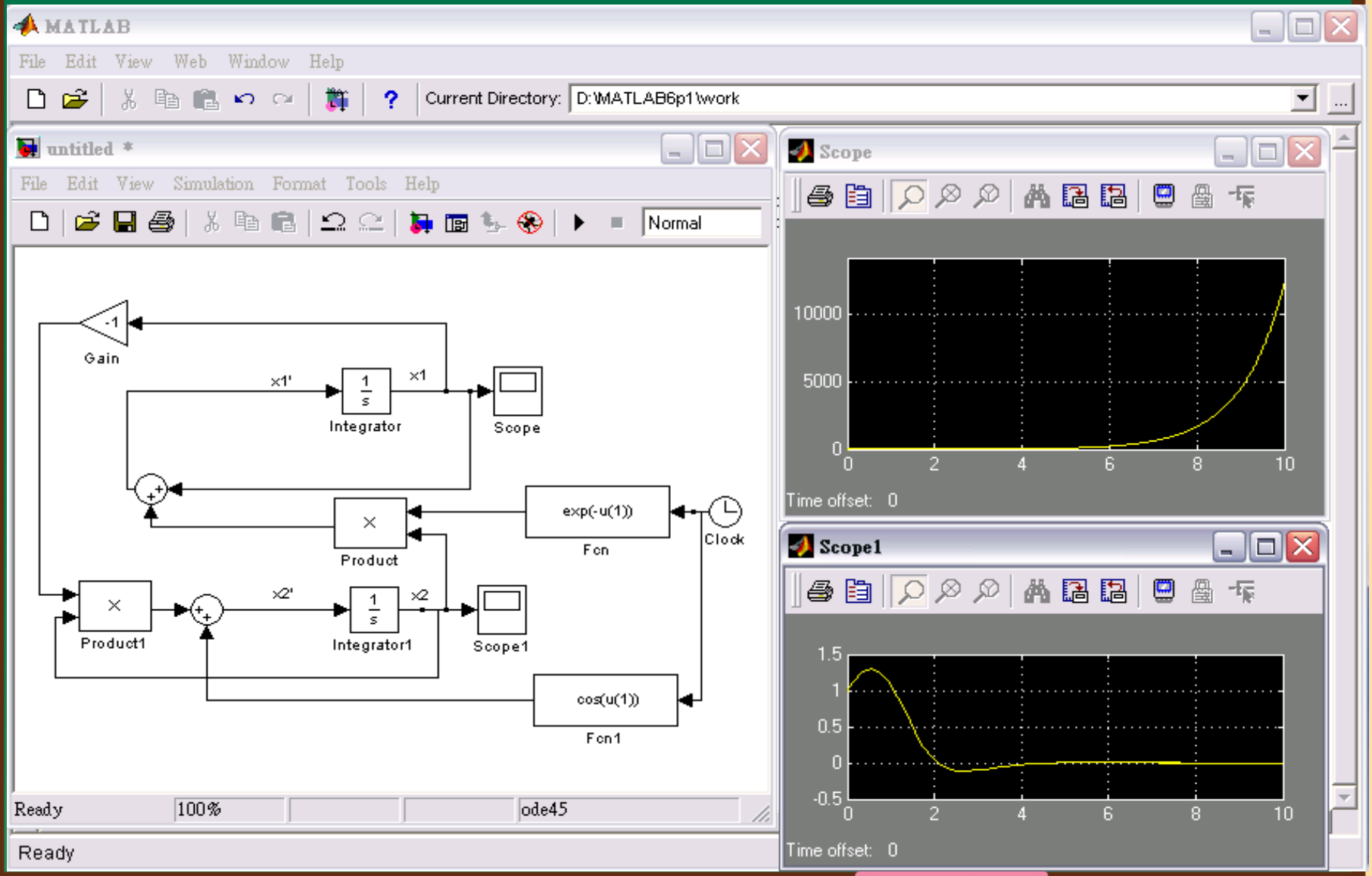
（1）選擇Simulation/Parameters



(2)調整適當的起始時間、結束時間和數值方法。



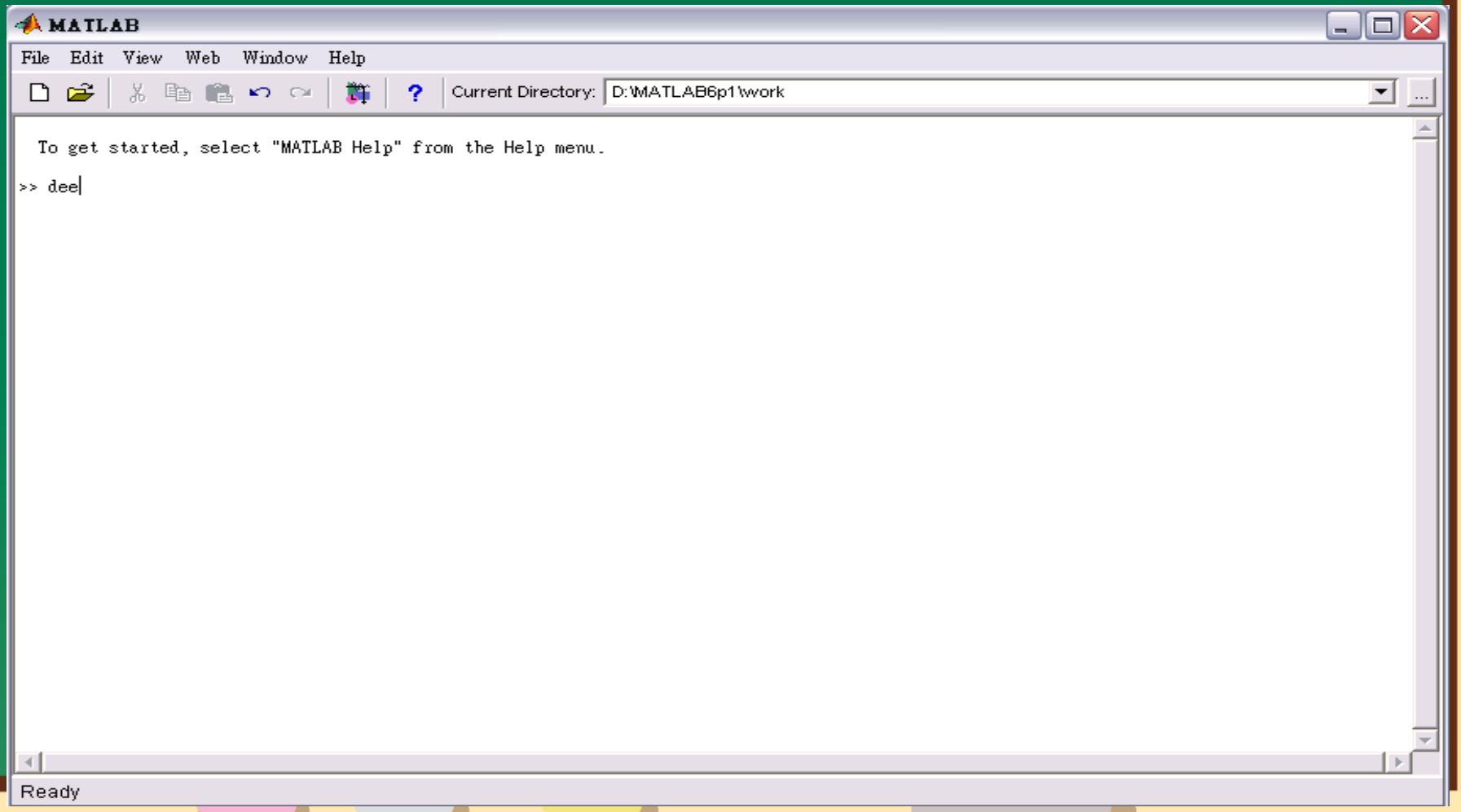
（3）顯示模擬的結果。


MATLAB
File Edit View Web Window Help
Current Directory: D:\MATLAB6p1\work
untitled *
File Edit View Simulation Format Tools Help
Normal
-1
Gain
x1'
1/s
Integrator
x1
Scope
Product
exp(-u(1))
Fcn
Clock
Product1
x2'
Integrator1
x2
Scope1
cos(u(1))
Fcn1
Ready
100%
ode45
Ready
Scope
10000
5000
0
0 2 4 6 8 10
Time offset: 0
Scope1
1.5
1
0.5
0
-0.5
0 2 4 6 8 10
Time offset: 0

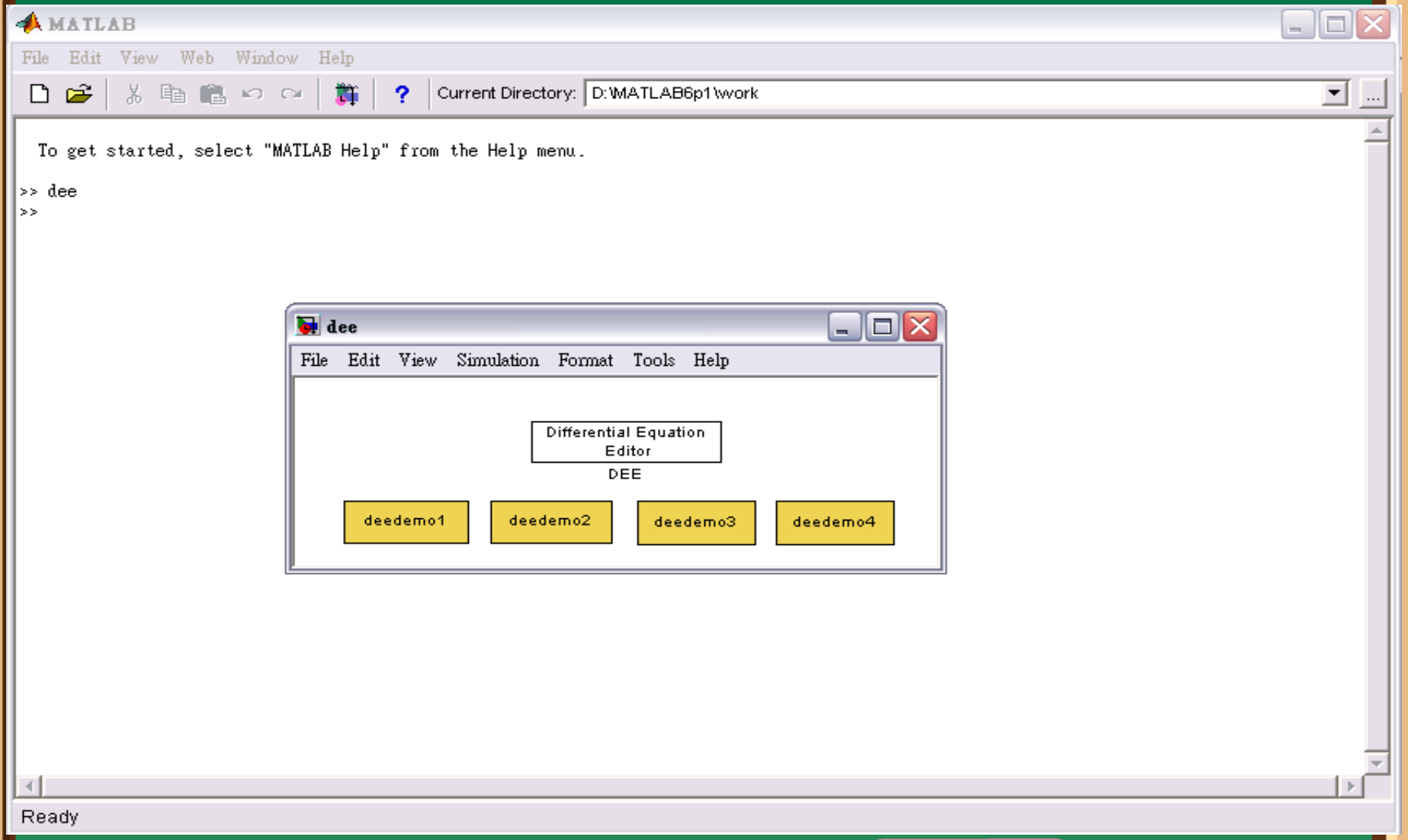
- 如何利用DEE解ODE

＊如何進入DEE？

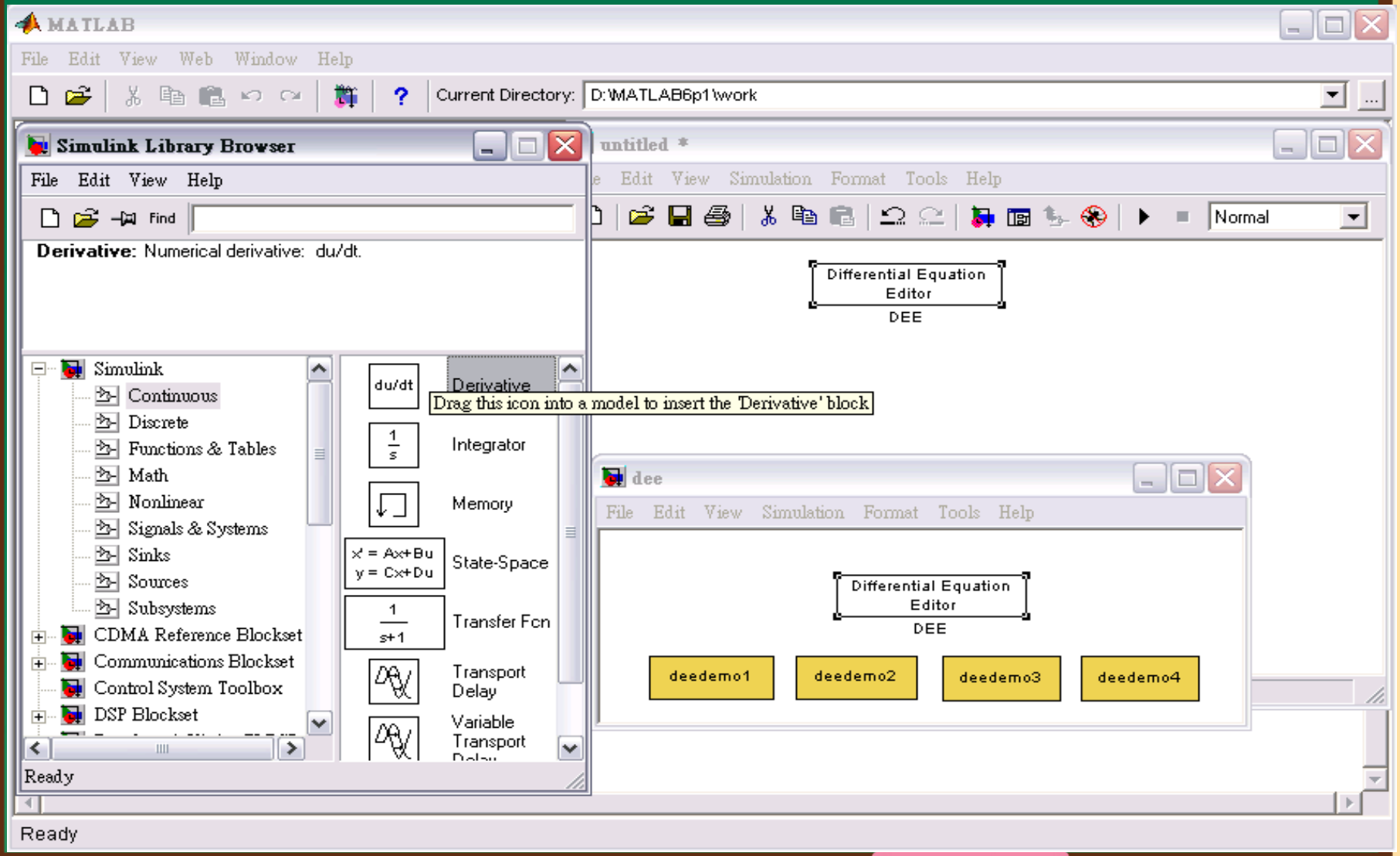
（1）在Workspace輸入dee



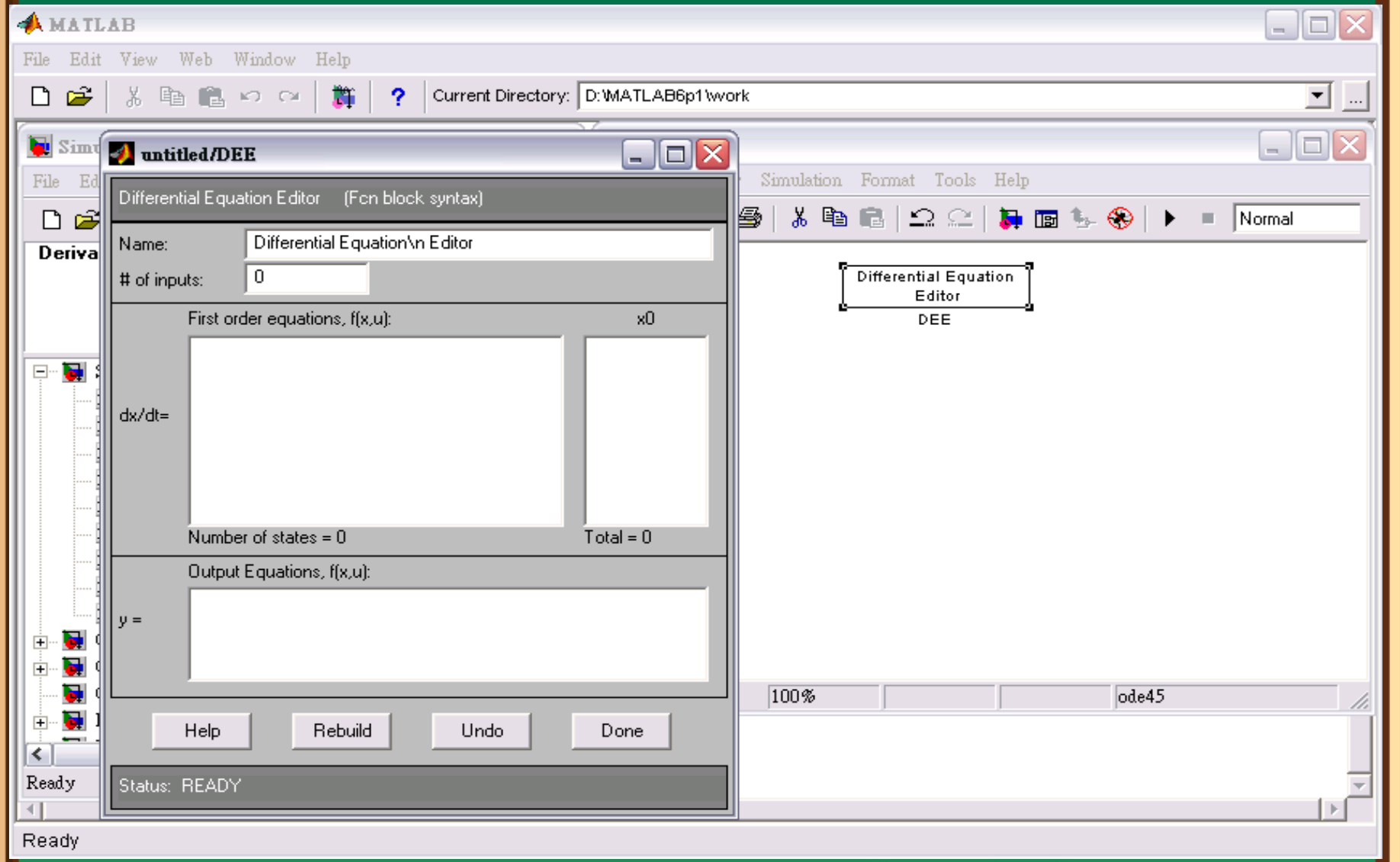
（2）執行後會產生以下結果



（3）打開Simulink，並把dee拖曳至untitled



（4）在dee上用滑鼠點兩下，打開dee



Name：方程式名稱

# of input：外界輸入變數的個數

dx/dt =：微分方程式

x0：微分方程式的起始值

y=：解完方程式後之值

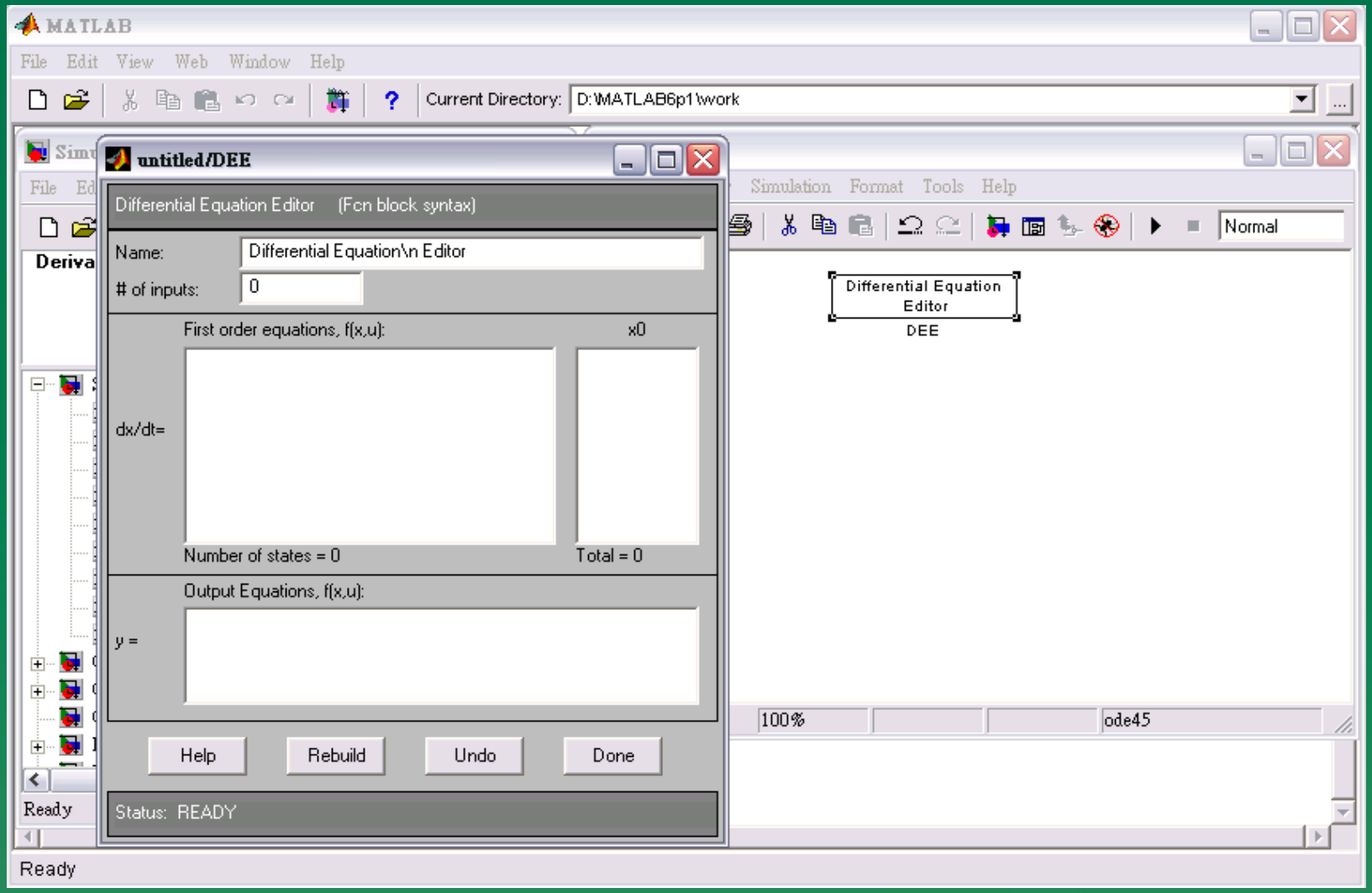
【NOTE】 （1）外界輸入變數以 $u(i)$ 表示

（2）微分方程式變數以 $x(i)$ 表示

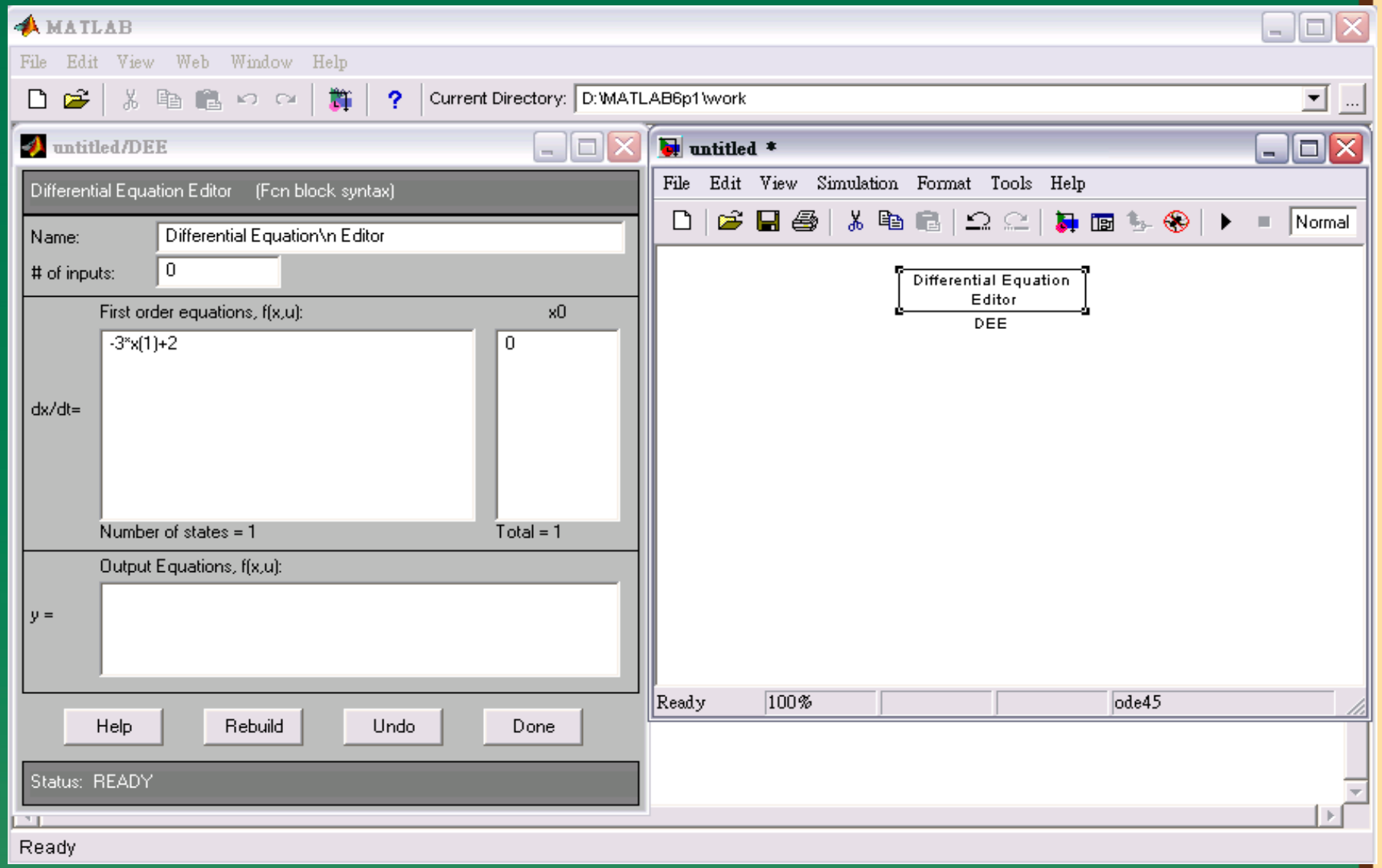
（3）i表示個數

Example1： $x_1' = -3x_1 + 2$

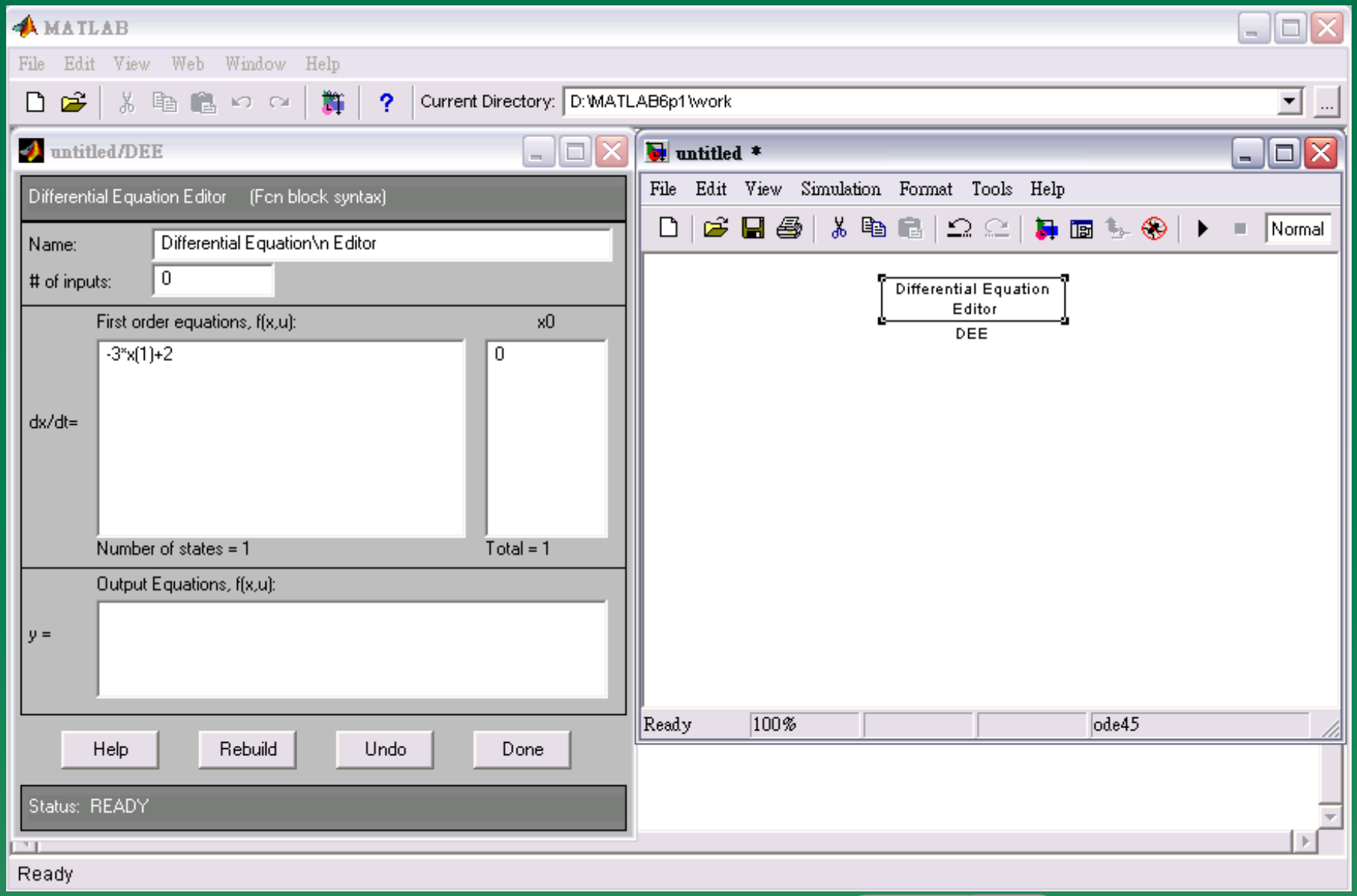
Step1：利用上述方法打開dee



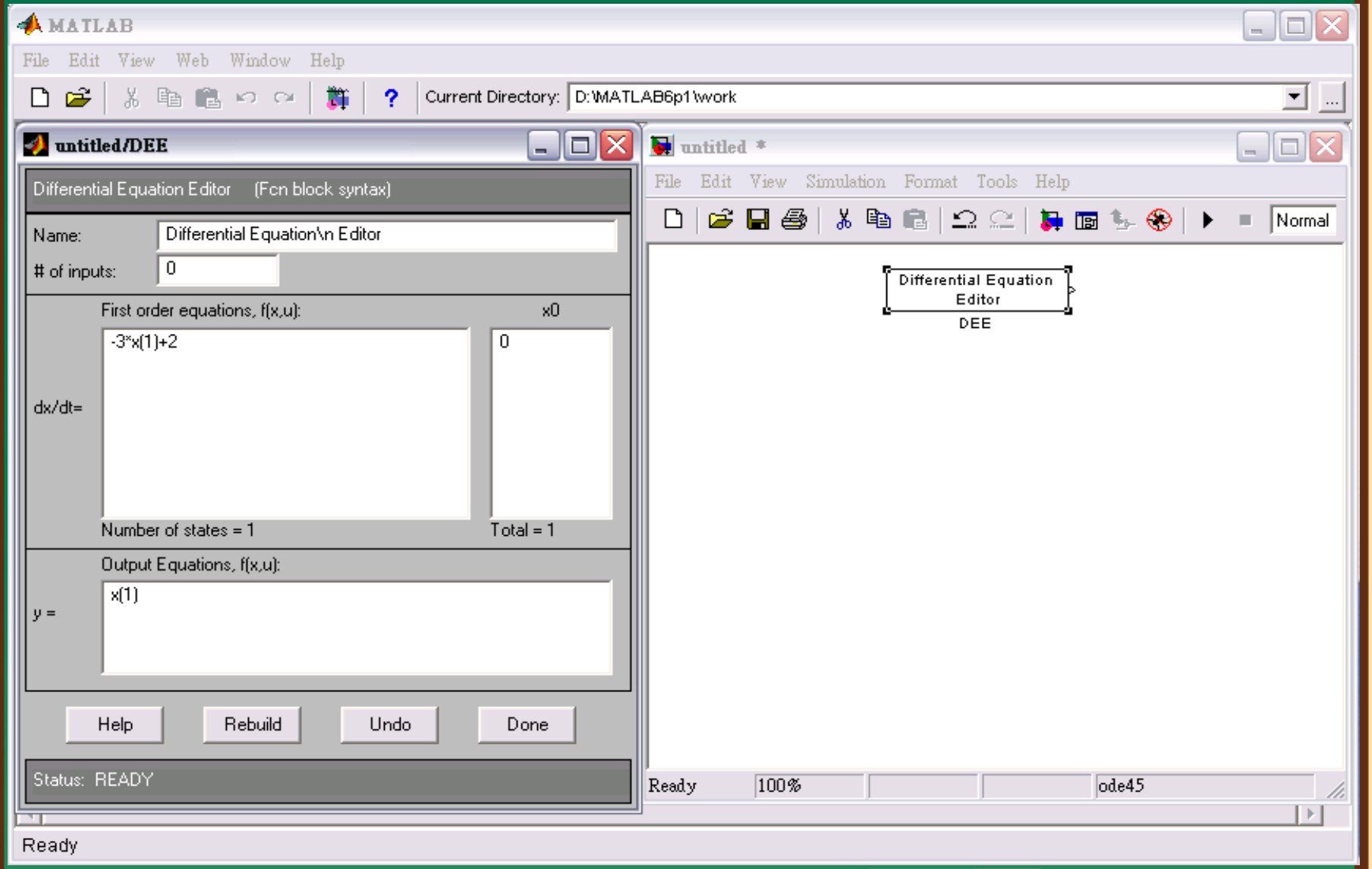
Step2：在的方框內輸入　$-3x(1)+2$



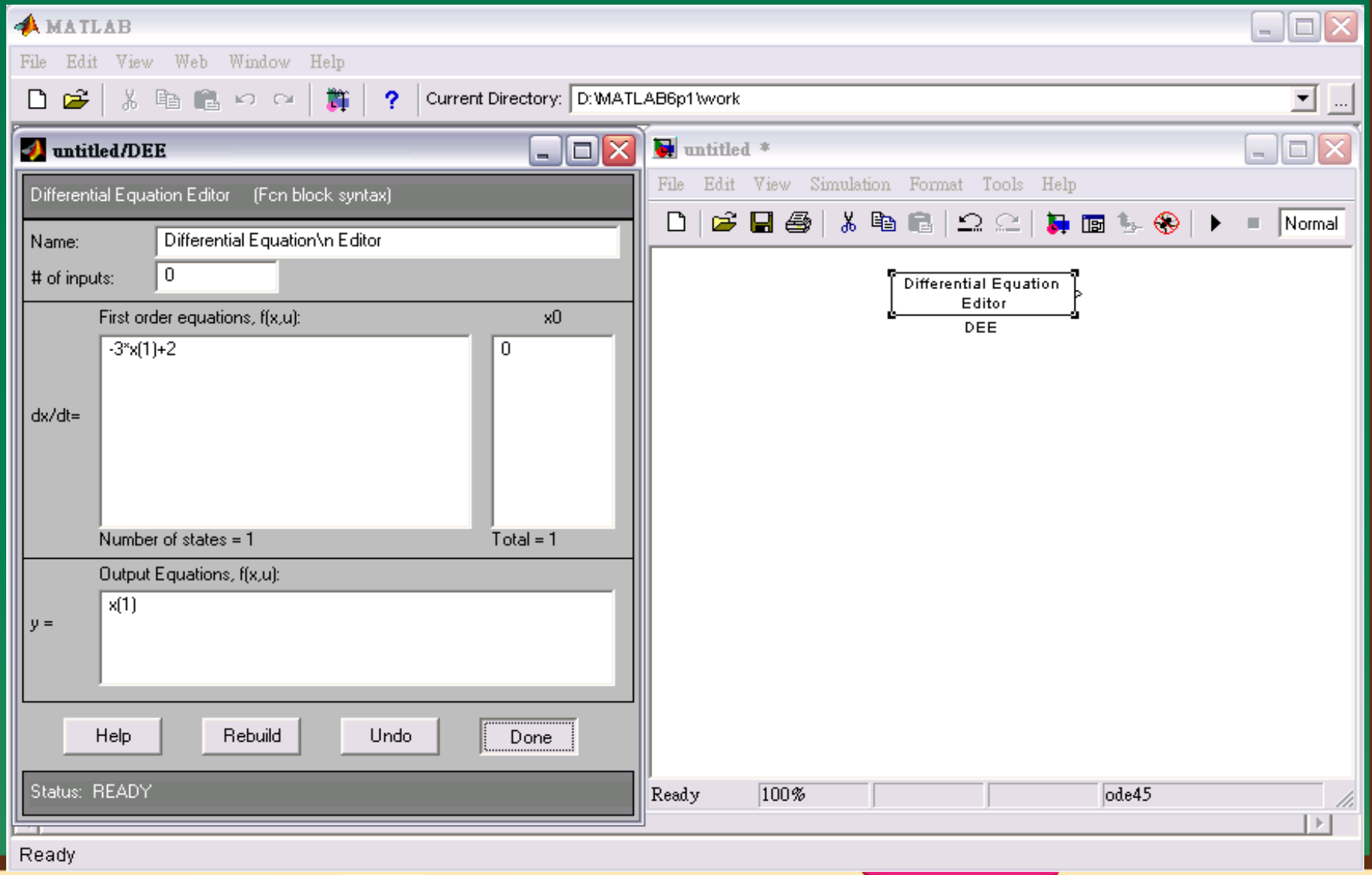
Step3：在的方框中輸入起始值0



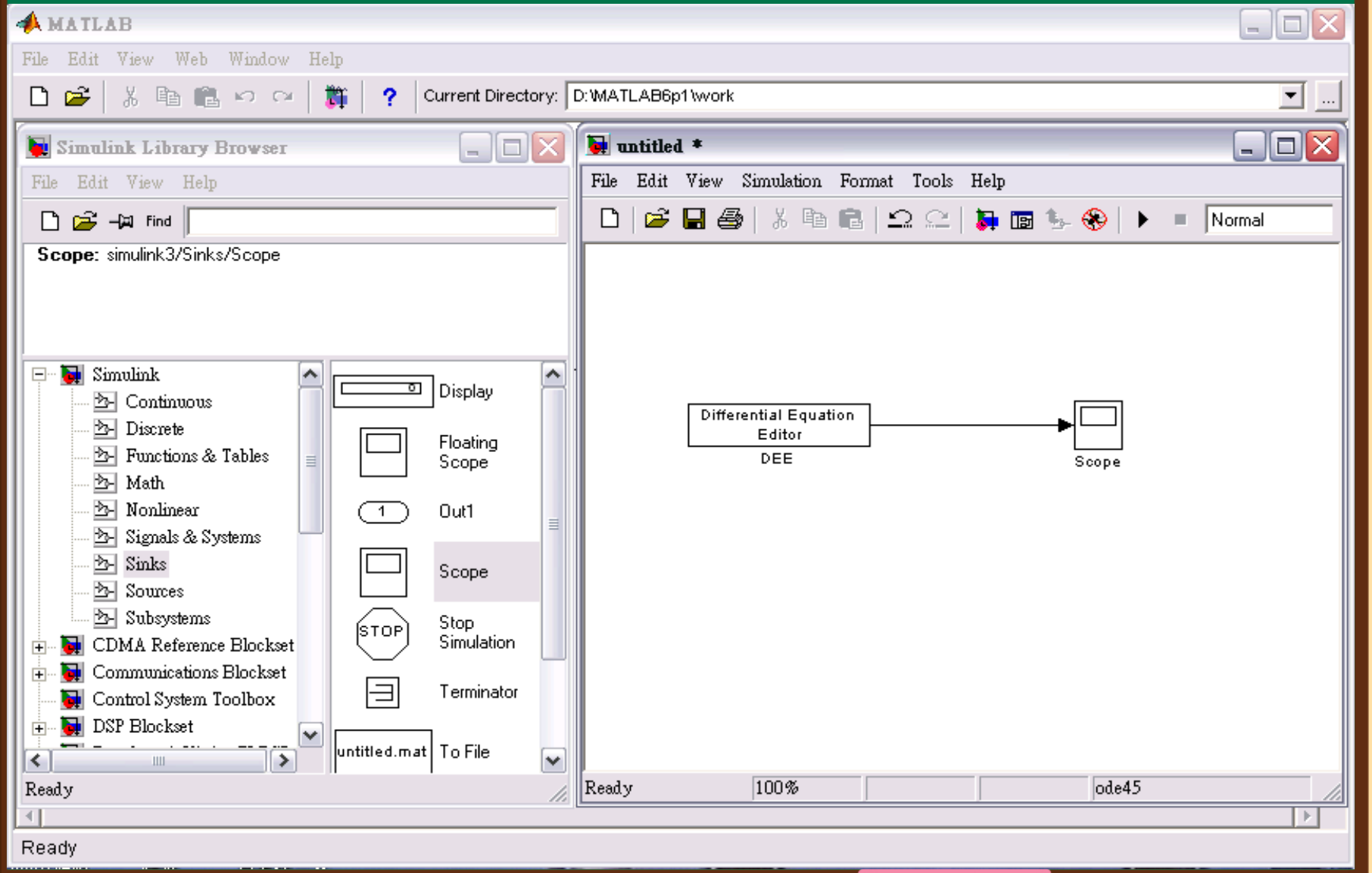
Step4：在　y=　的方框中輸入要解的變數



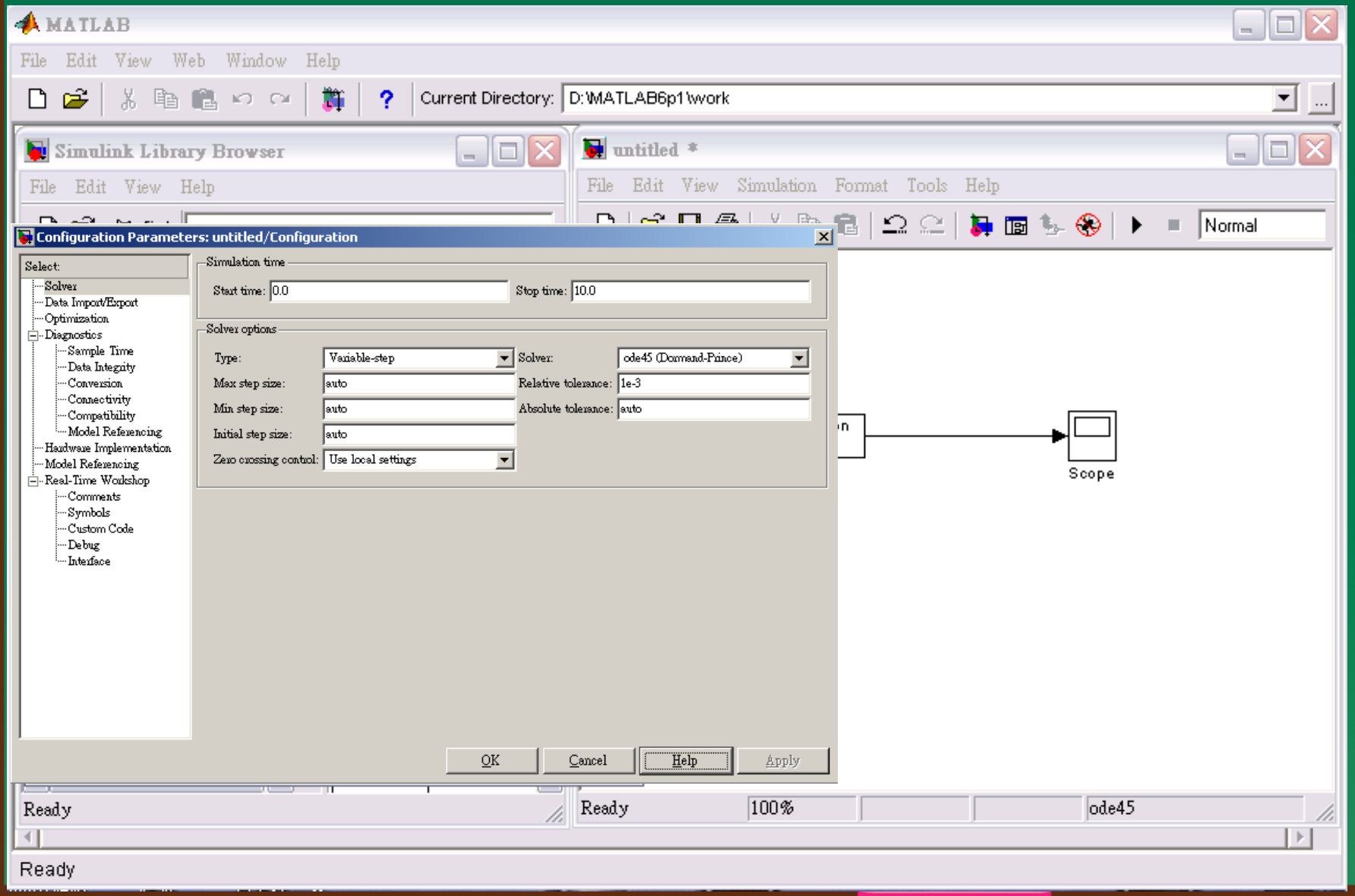
Step5：編輯完成之後，若最下方之Status為READY，則可按下右下角的Done；若無，則需重新檢查或編輯



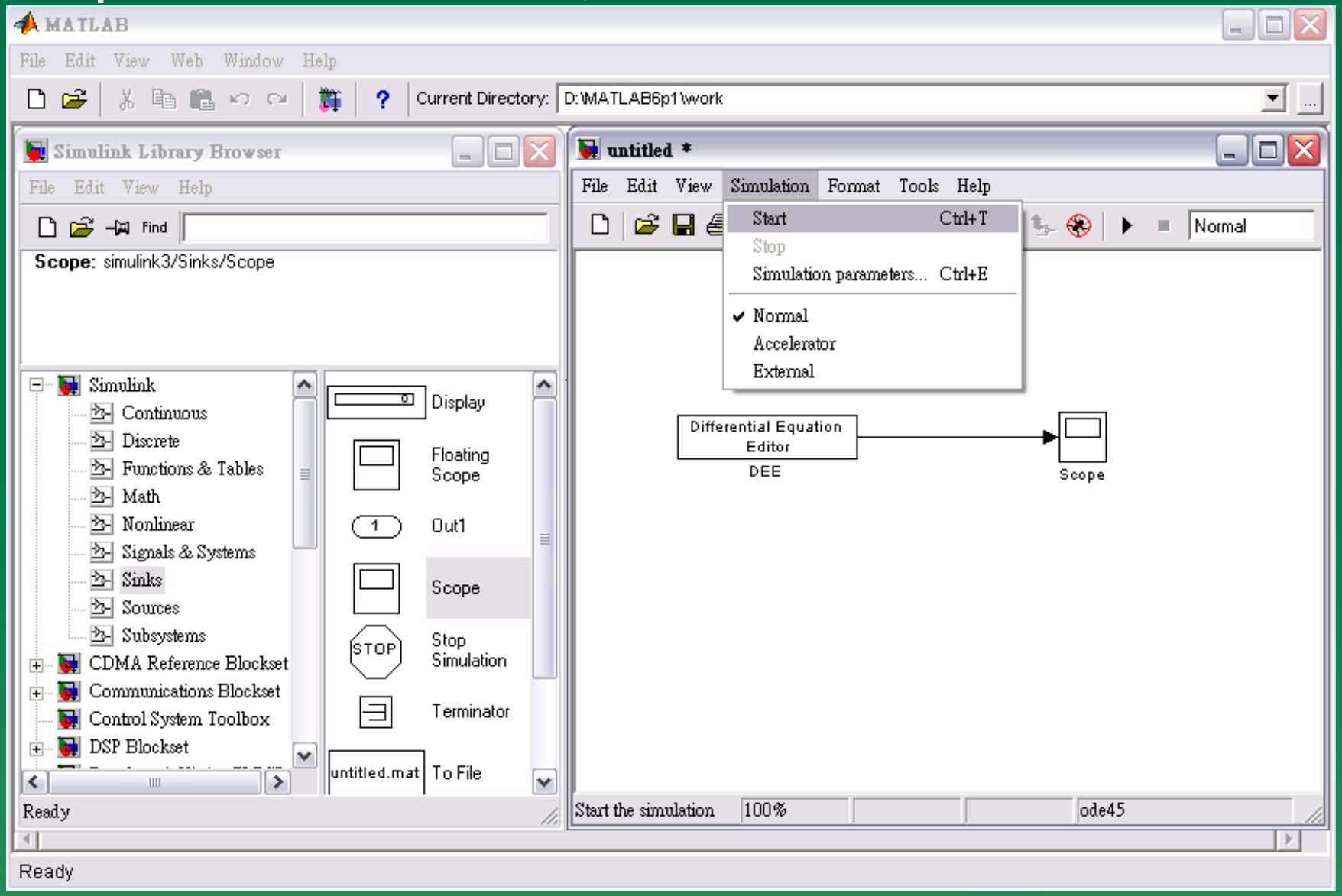
Step6：從Sink中拖曳Scope至untitled中，並把點連結起來



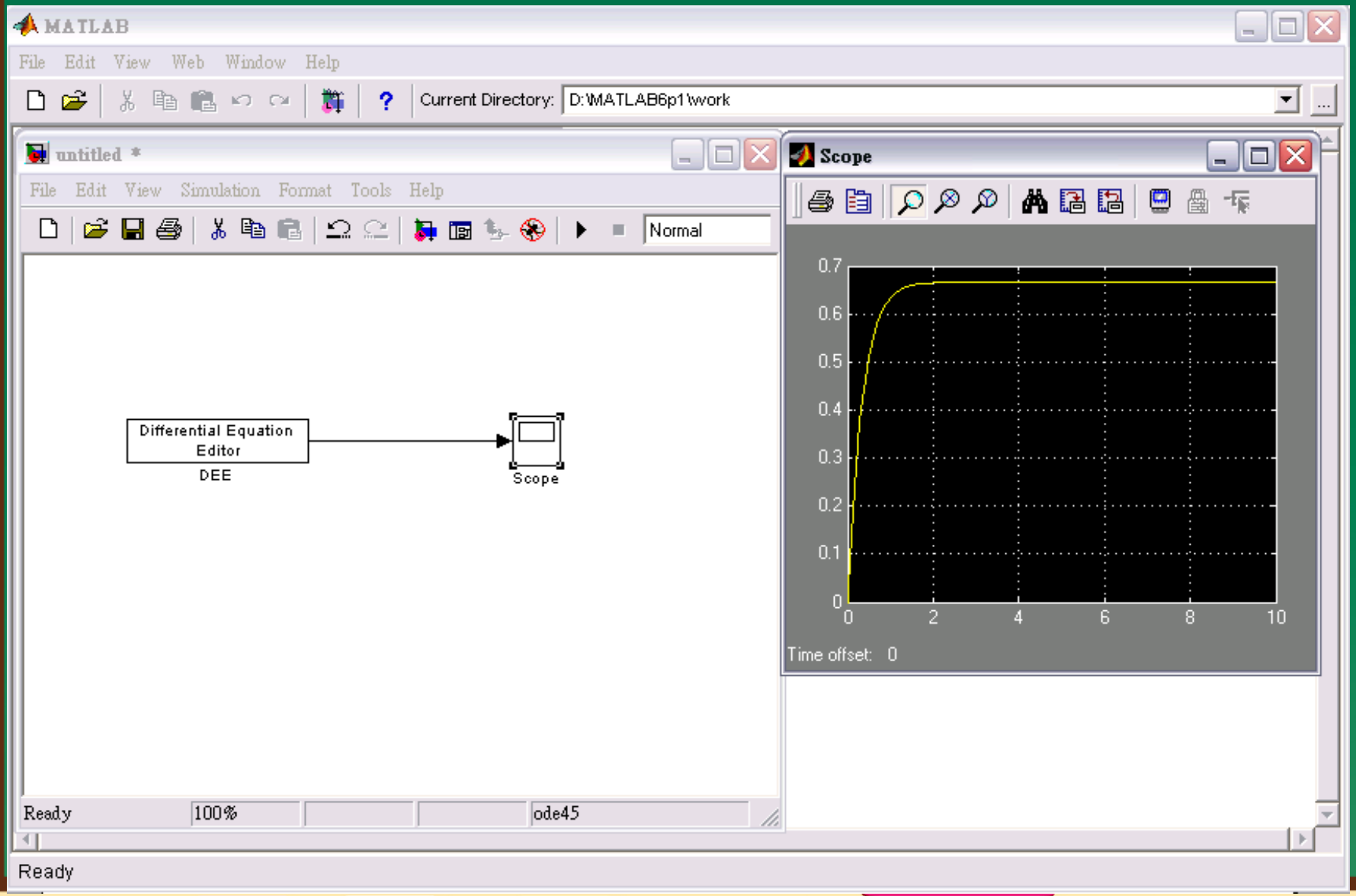
Step7：調整Simulation/Parameters中之時間和數值方法



Step8：按下Simulation/Start開始模擬



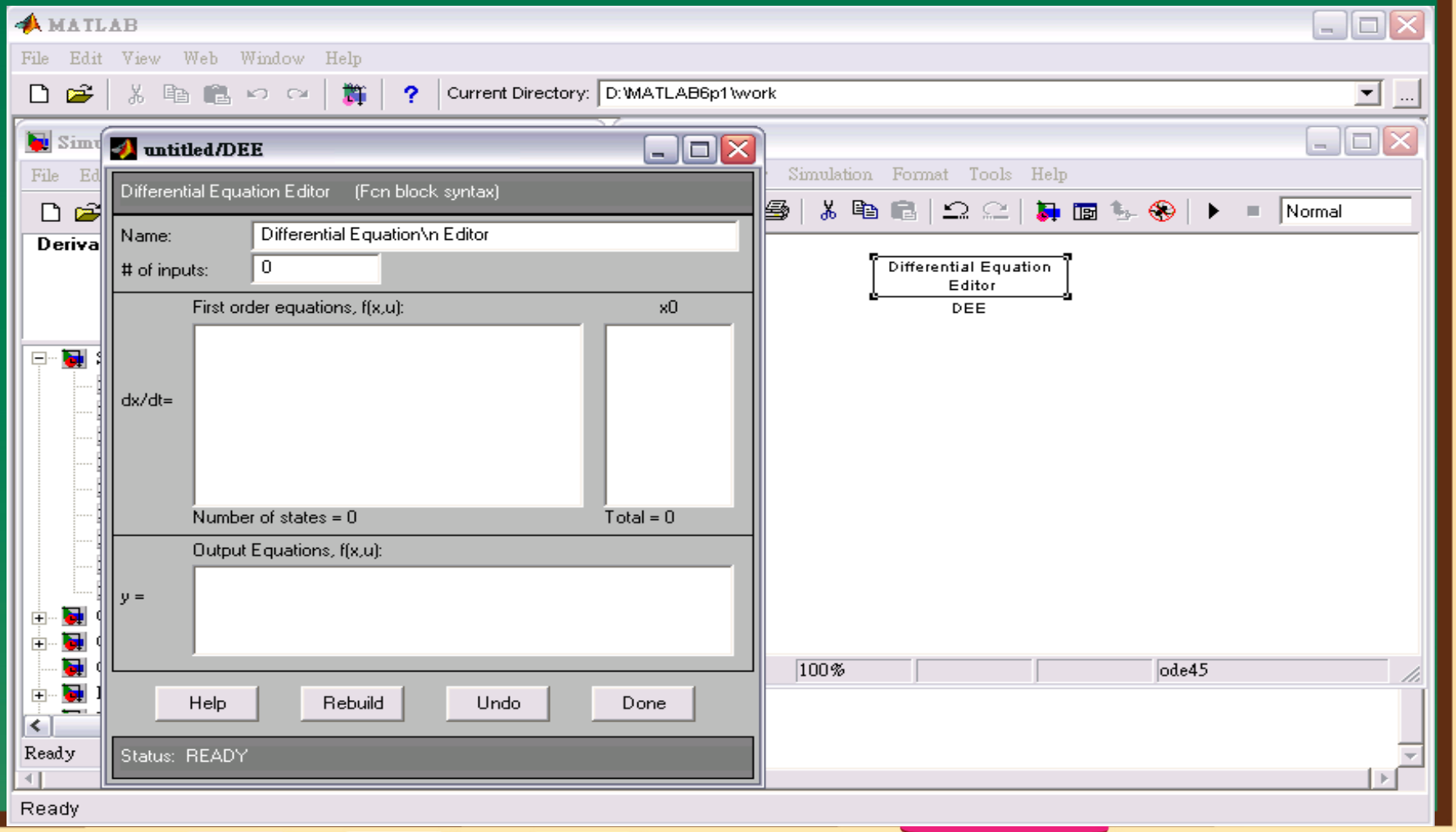
Step9：顯示模擬結果



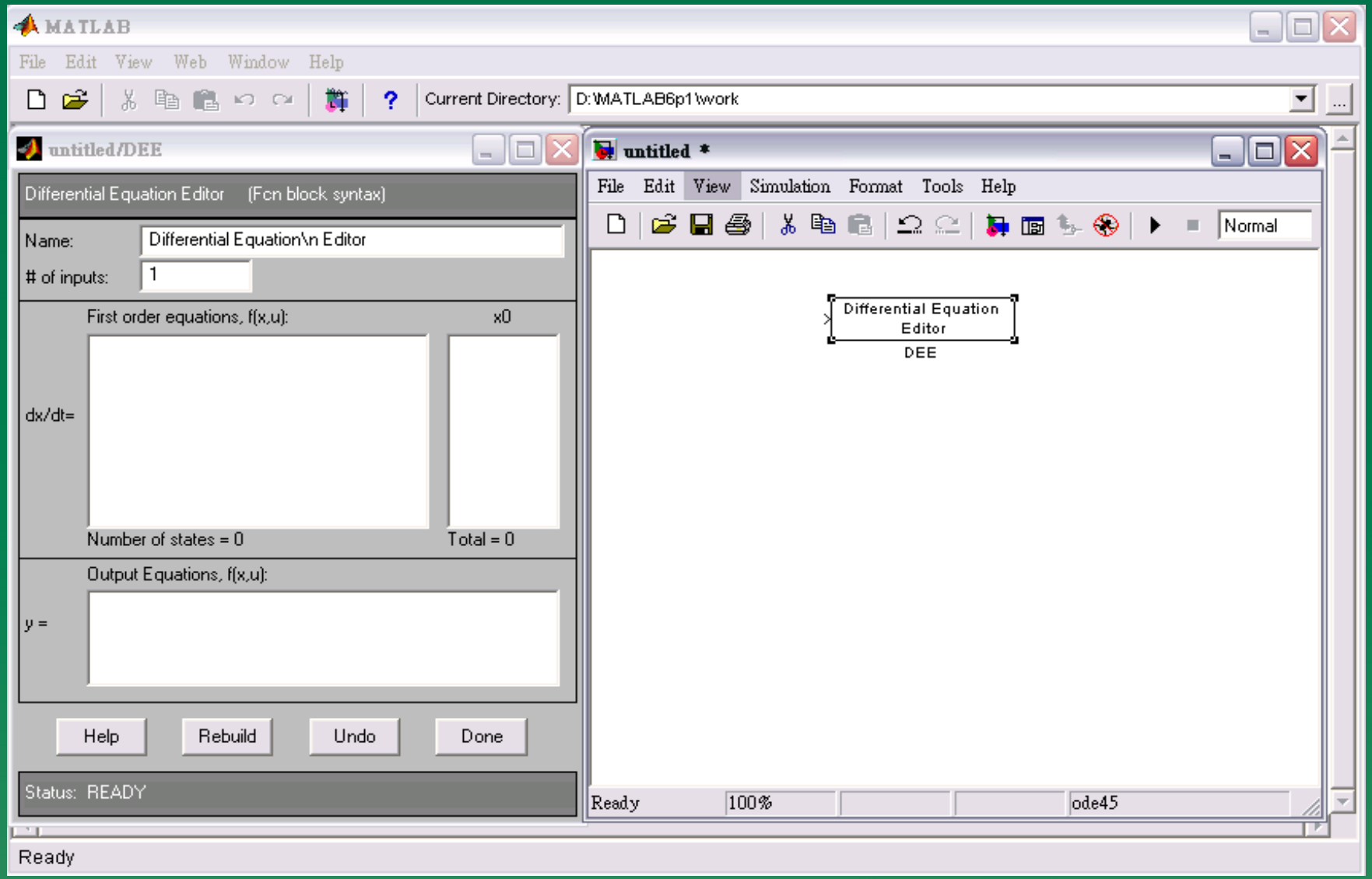
Example1：

$$\begin{cases} x_1' = x_1 + x_2 e^{-t} \\ x_2' = -x_1 x_2 + \cos(t) \end{cases}, \qquad x_1(0) = 0 \quad x_2(0) = 1$$

Step1：利用上述方法打開dee

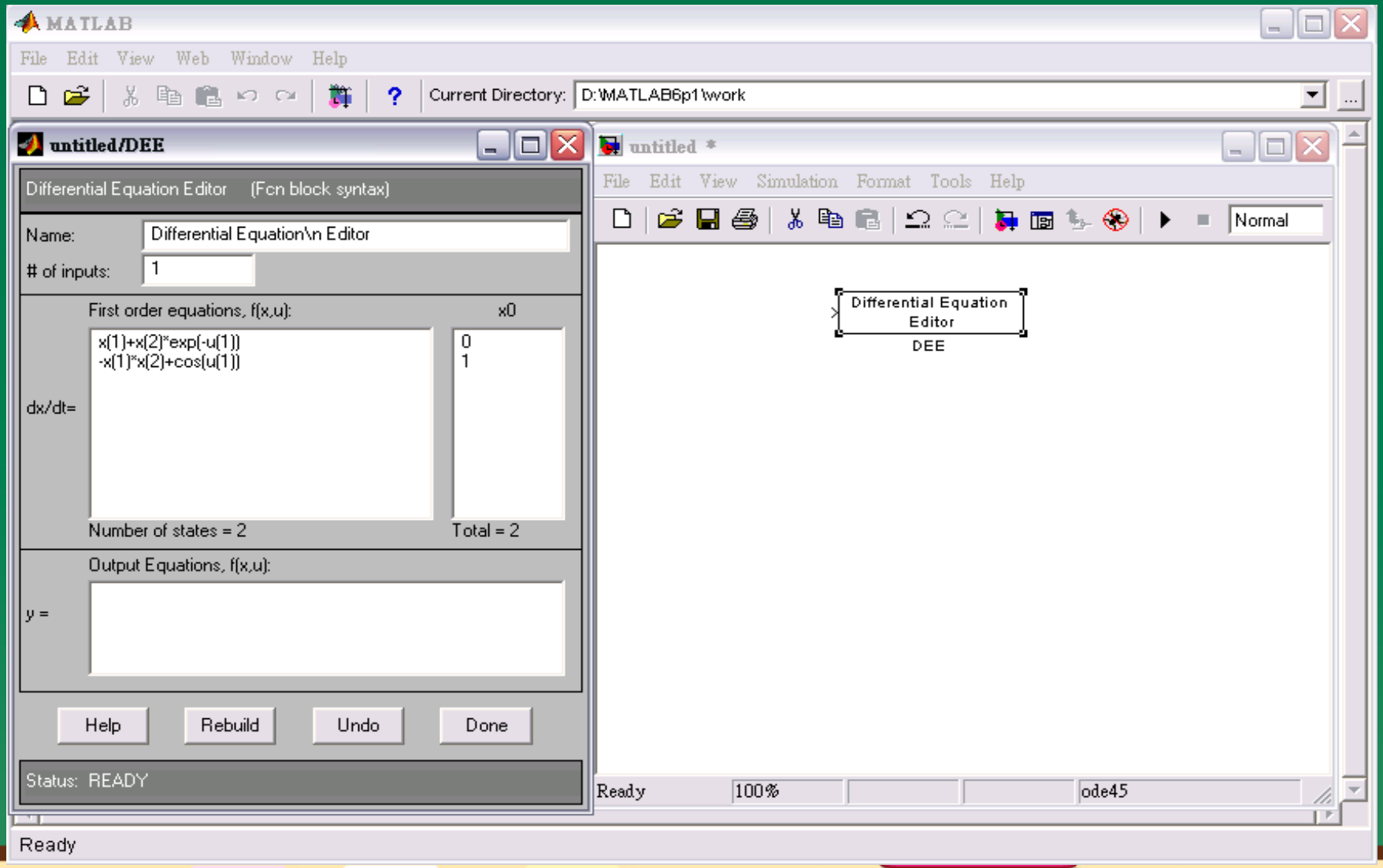


Step2：因為t為外界輸入所以在# of input的方框中輸入1

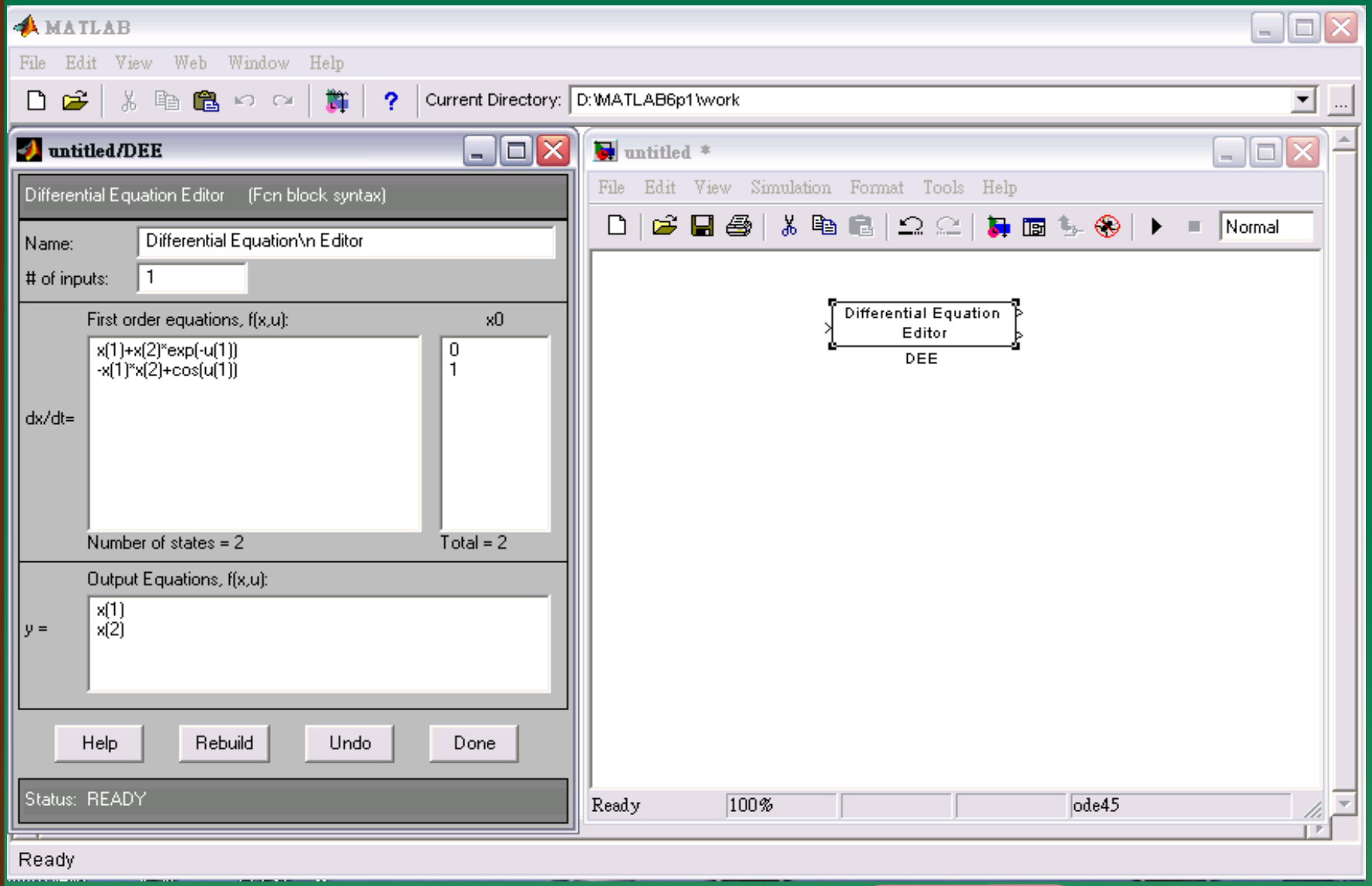


Step3：在的方框內輸入聯立方程式

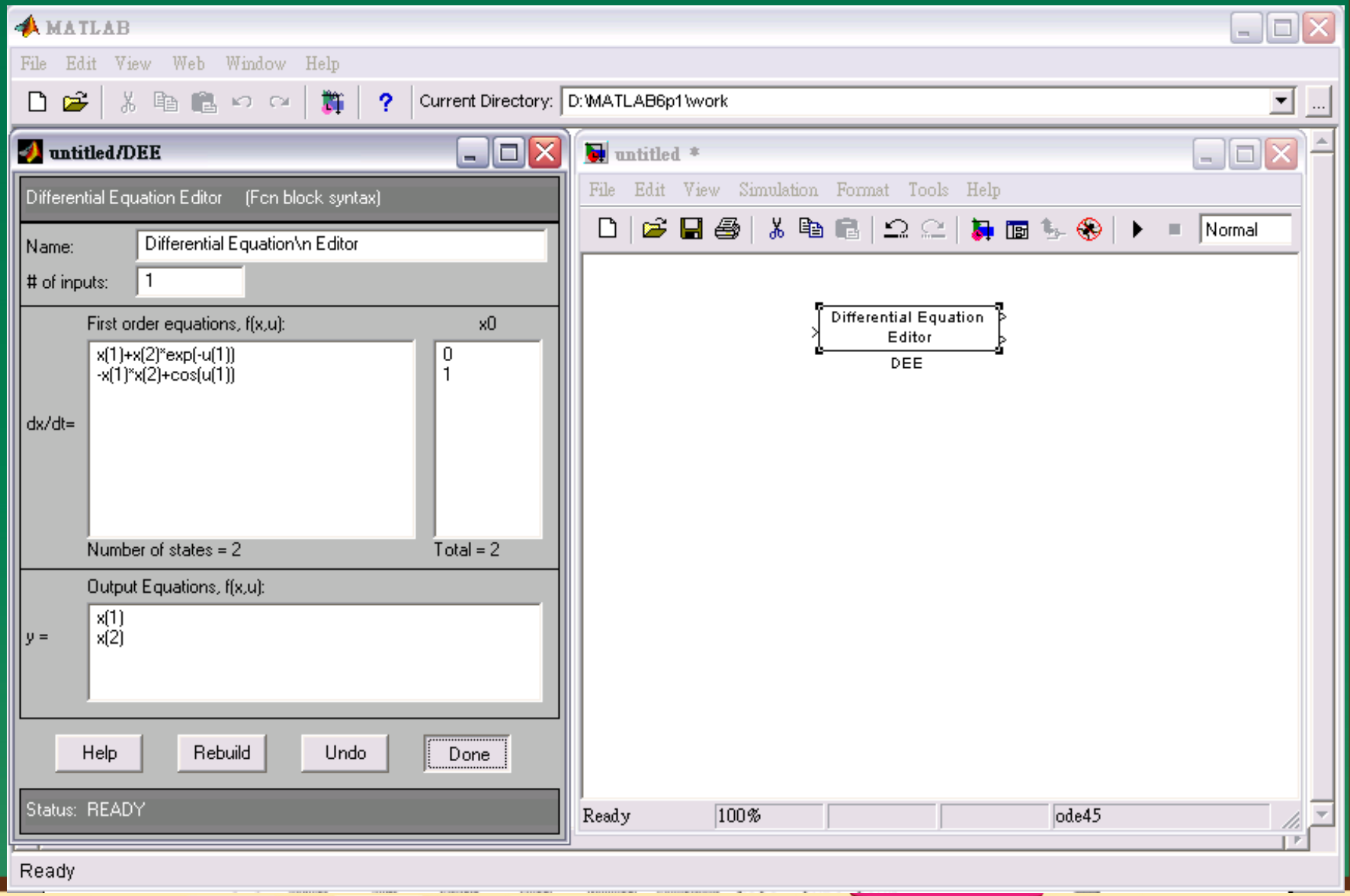
Step4：在的方框中輸入起始值0，1



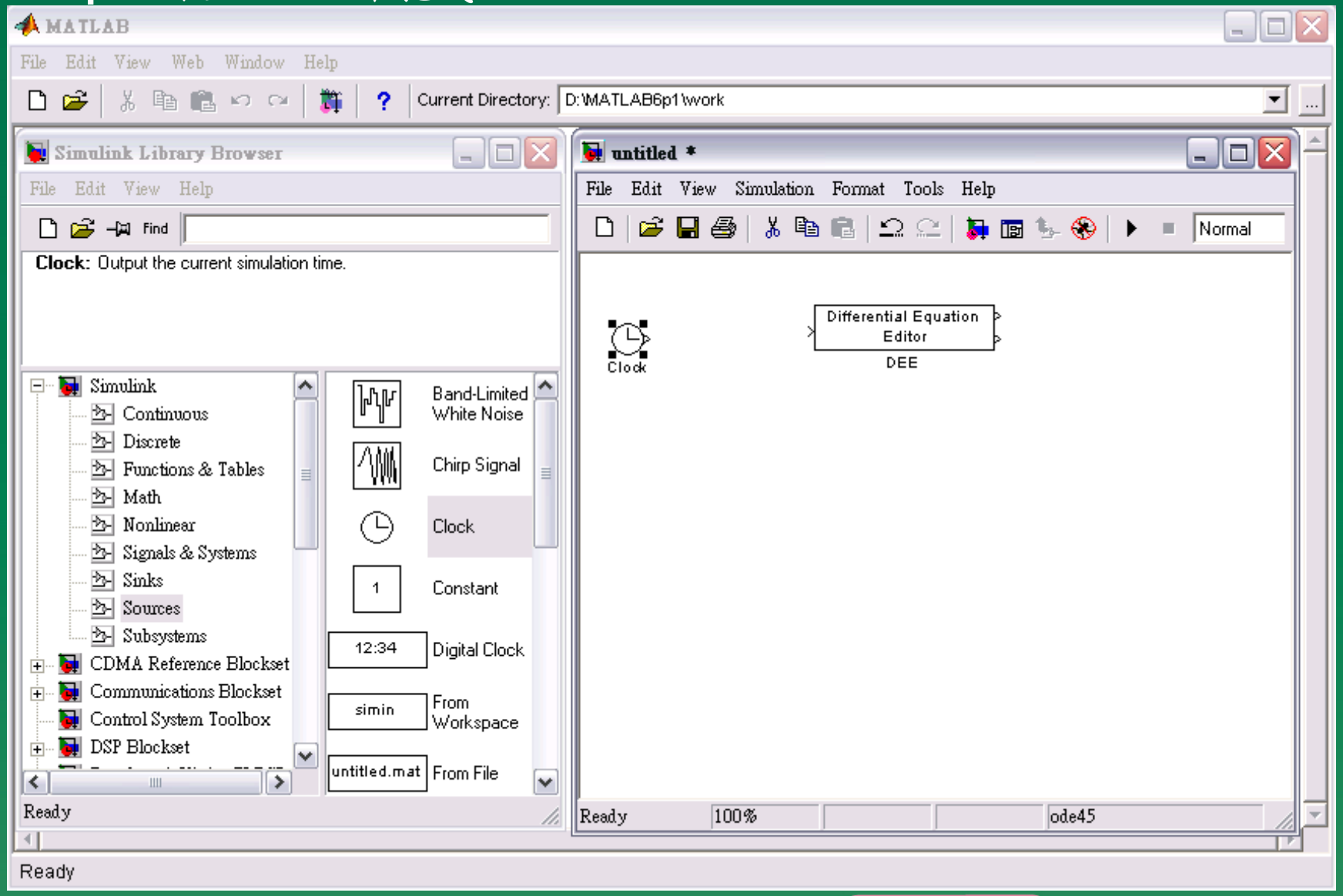
Step5：在的方框中輸入要解的變數



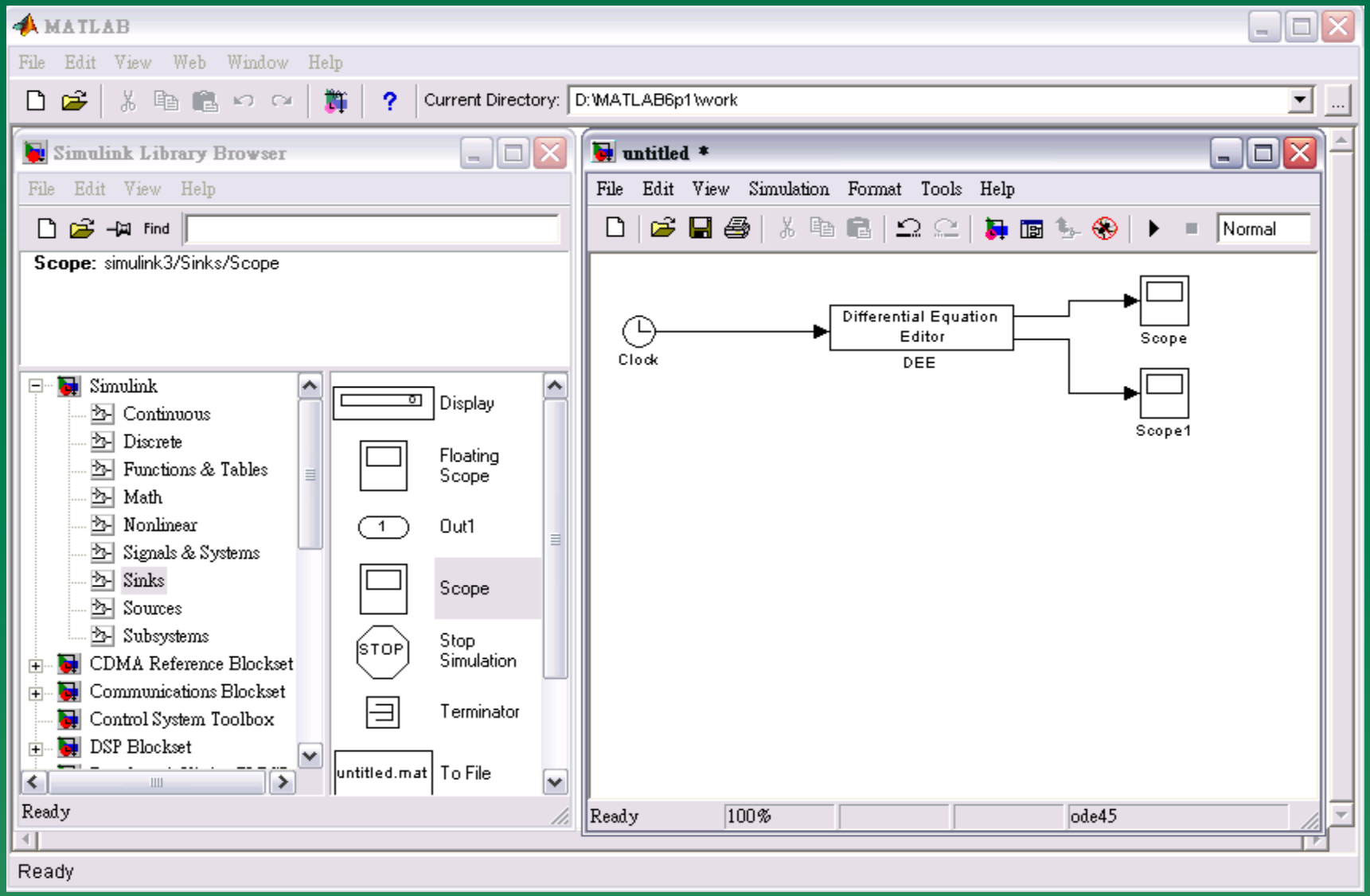
Step6：按下Done即編輯完成DEE



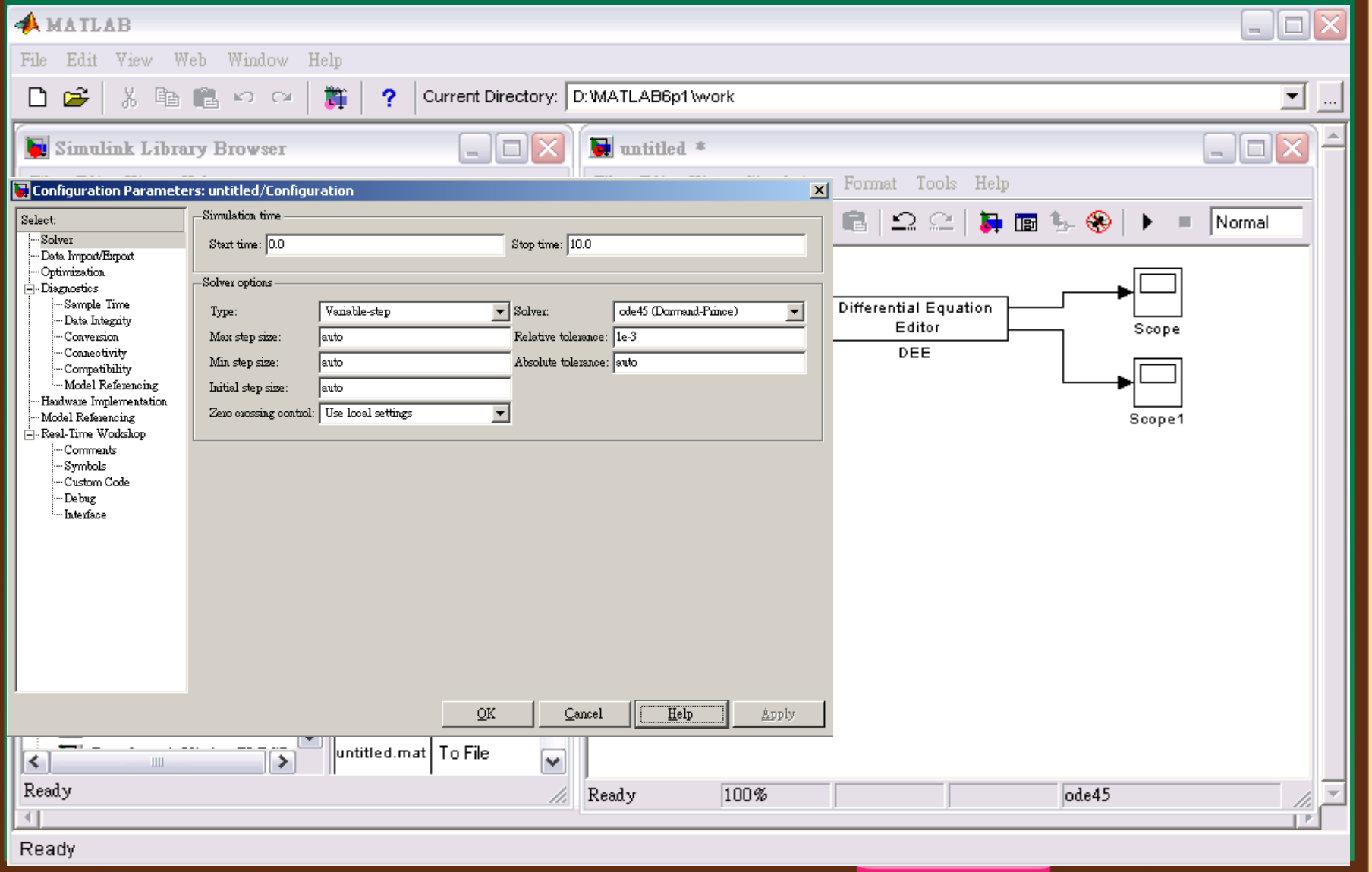
Step7：從Source中拖曳Clock至untitled



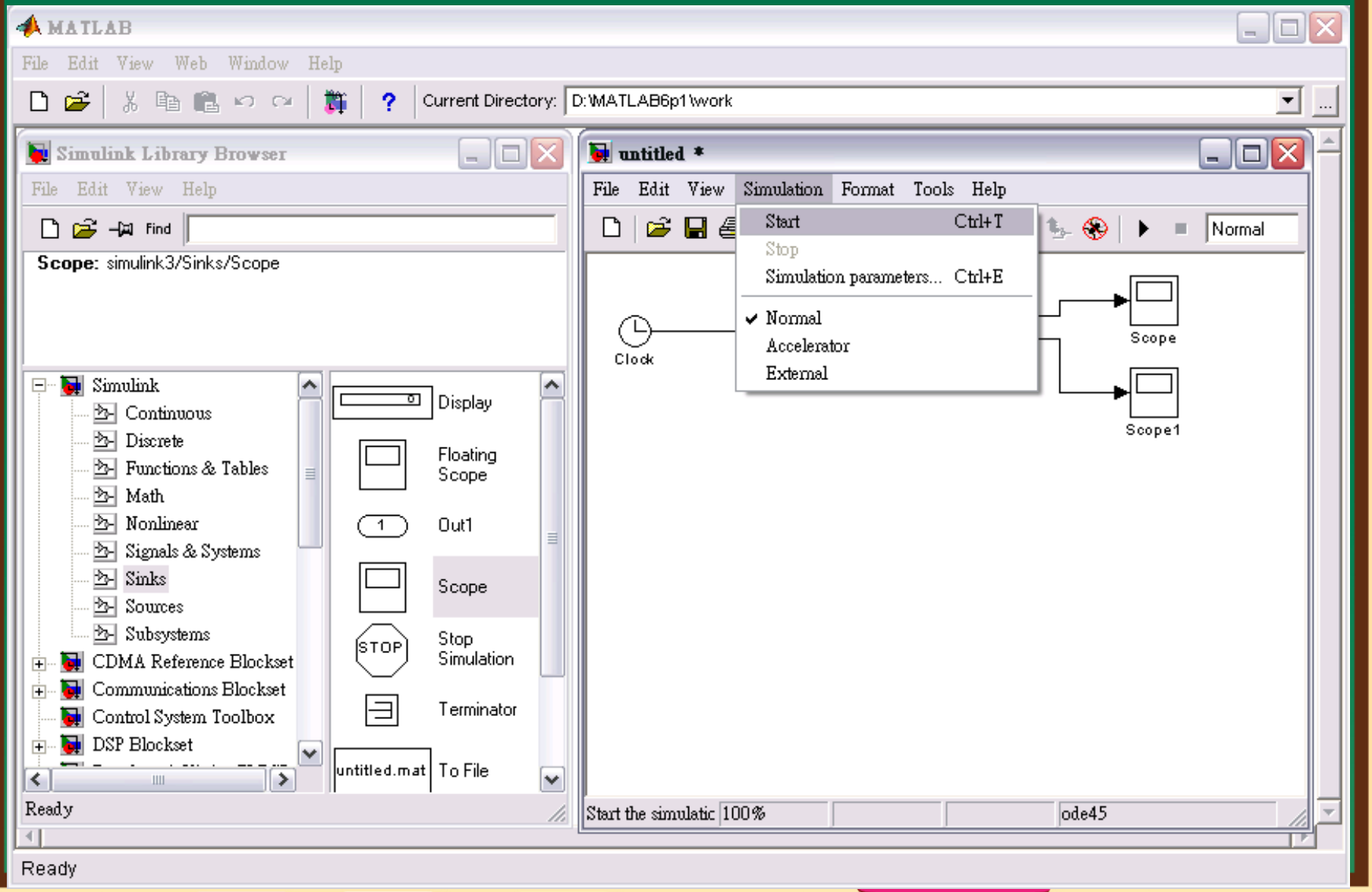
Step8：從Sink中拖曳Scope至untitled並複製一個，並把各點連結起來.



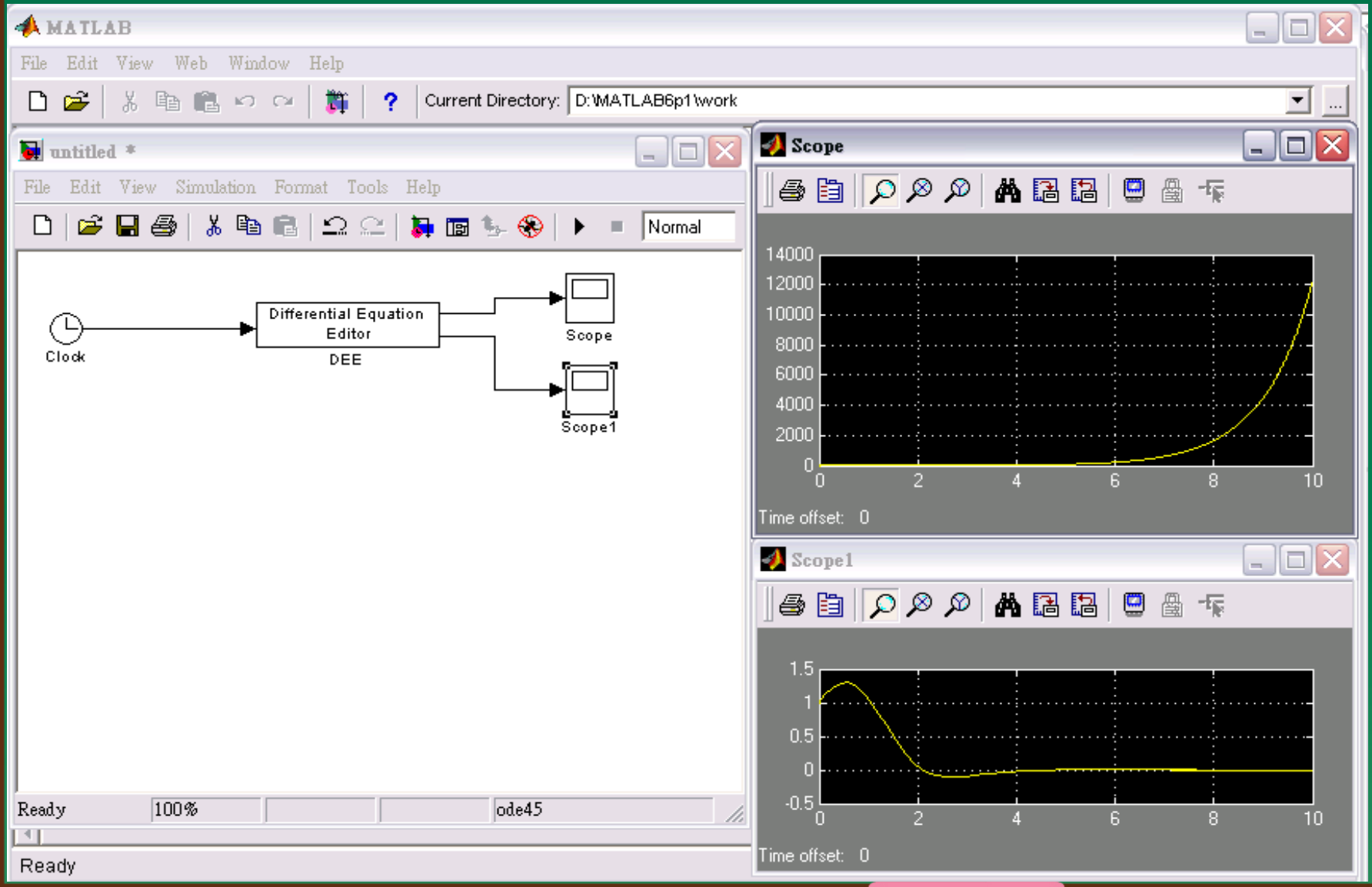
Step9：調整Simulation/Parameters中之時間和數值方法



Step10：按下Simulation/Start開始模擬

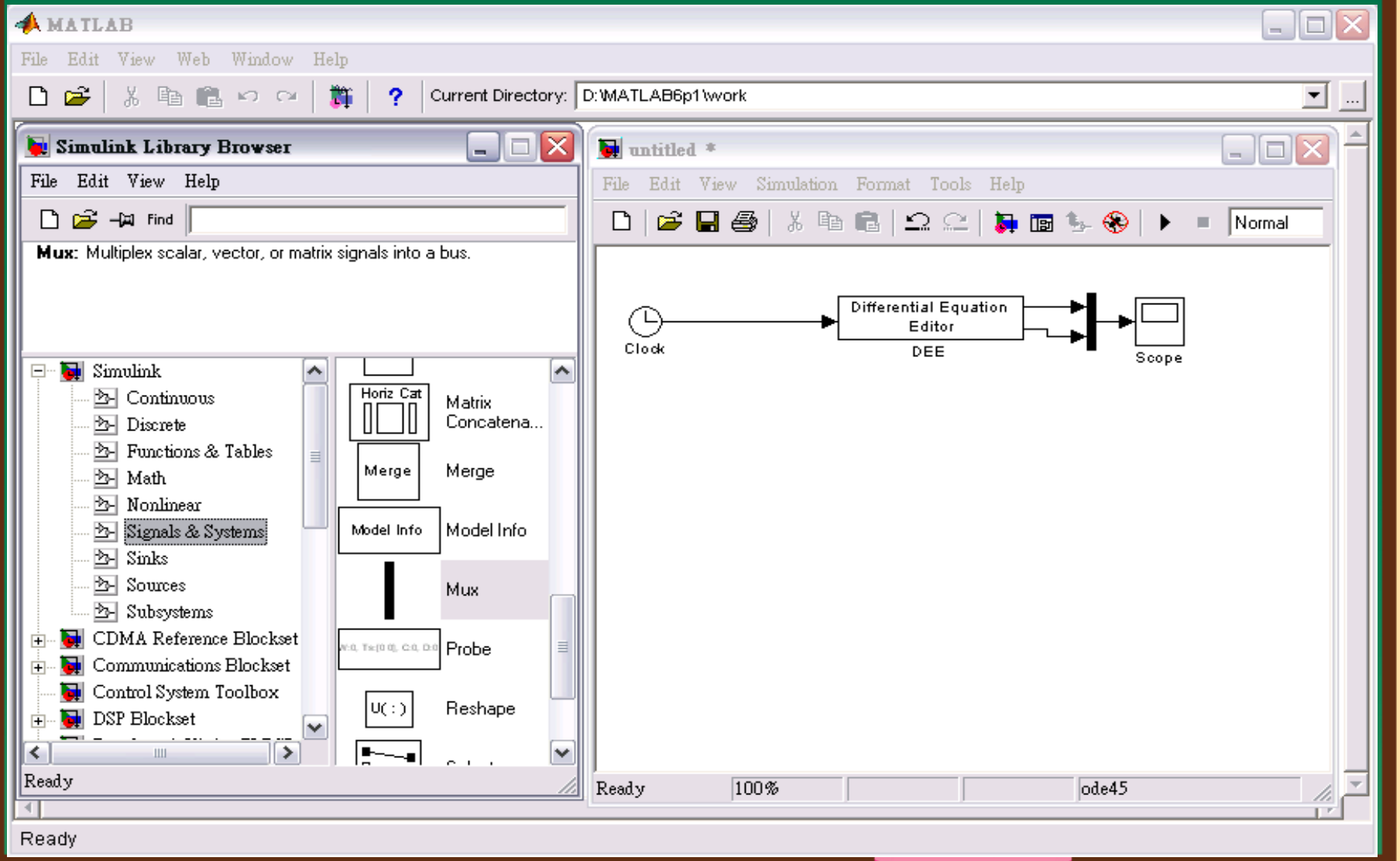


Step11：顯示模擬結果



【NOTE】若要把結果顯示在一張圖上則可利用Mux

Step1：從Signals&Systems中拖曳Mux至untitled中，並把各點連結起來



Step2：重複Step9~Step11則其結果如以下所示