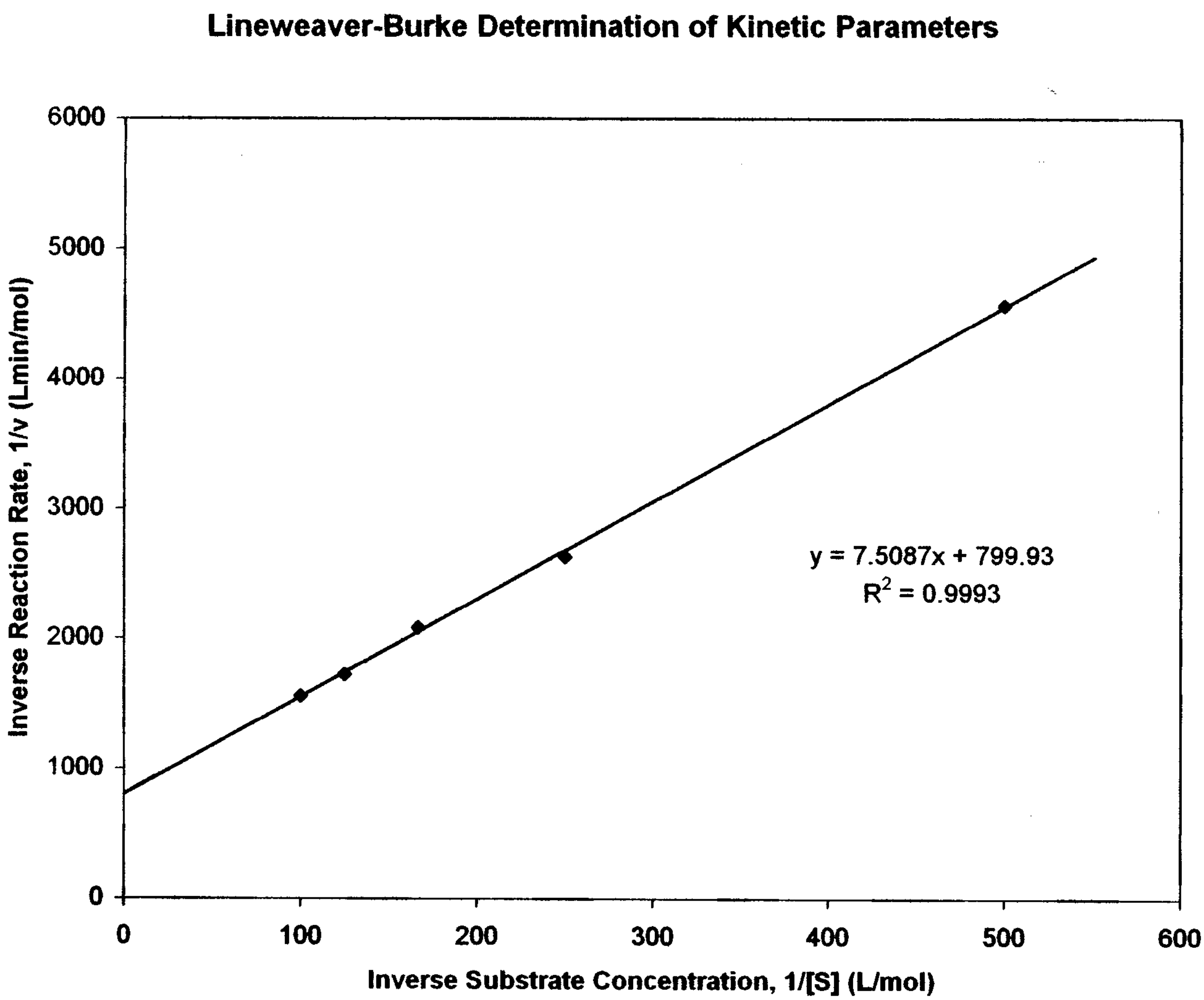
Problem 1. Linearization

S (mol/L)	v (mol/L·min)	1/v (L·min/mol)	1/S (L/mol)
0.01	0.00064	1562.5	100
0.008	0.00058	1724.1	125
0.006	0.000479	2087.7	167
0.004	0.00038	2631.6	250
0.002	0.000219	4566.2	500

slope (K_M/v_{max})	7.5087	K_M (L/mol)	0.00939
intercept ($1/v_{max}$)	799.93	v_{max} (mol/L·min)	0.00125

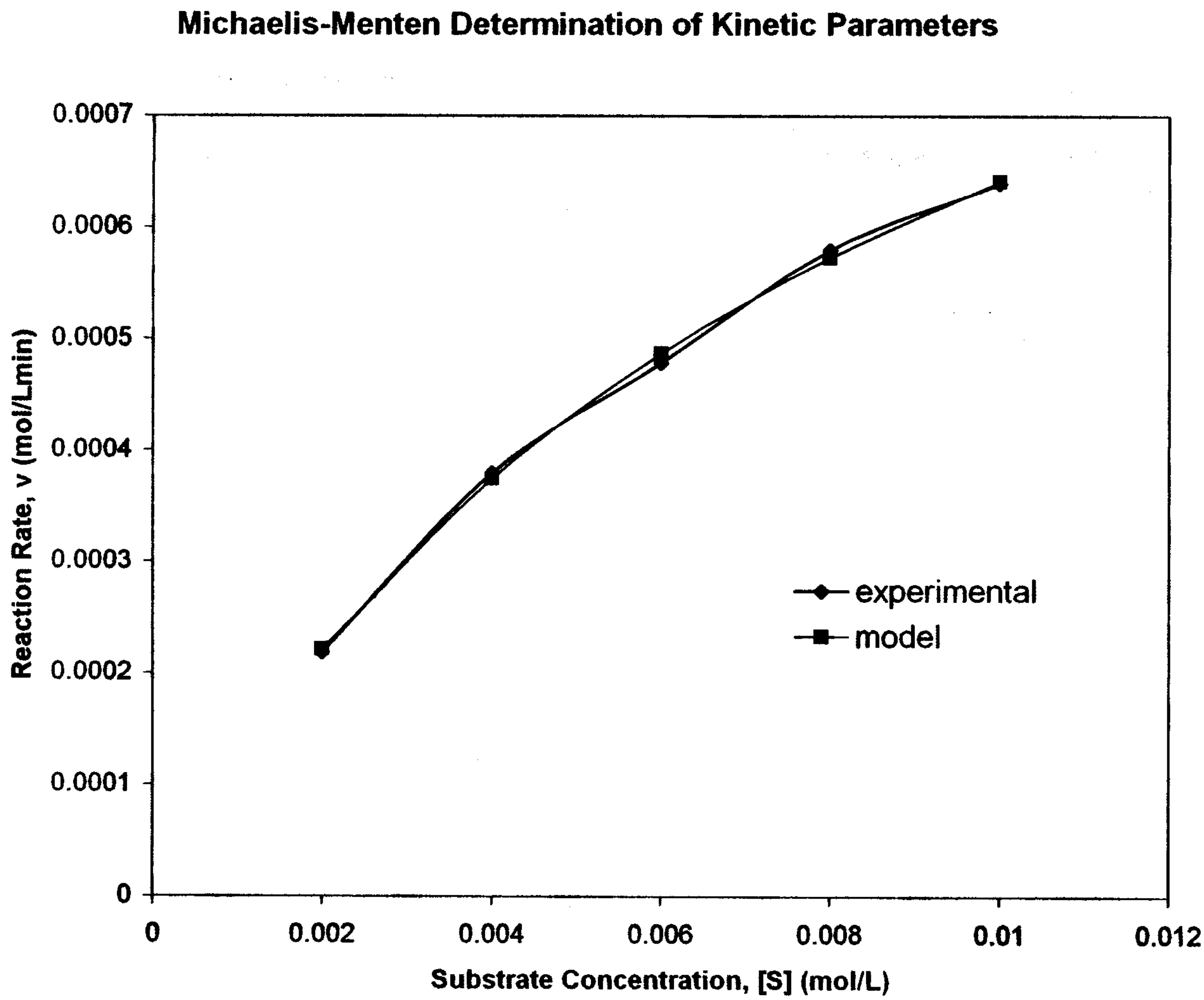
√



Problem 2. Nonlinear Regression

S (mol/L)	v_{exp} (mol/L·min)	v_{mod} (mol/L·min)	Error^2 $(v_{mod}-v_{exp})^2$
0.01	0.00064	0.000641	1.96257E-12
0.008	0.00058	0.000573	4.25196E-11
0.006	0.000479	0.000487	7.13714E-11
0.004	0.00038	0.000375	2.54942E-11
0.002	0.000219	0.000222	6.52476E-12
		Sum Error^2	1.47872E-10

K_M (mol/L)	0.009002418	✓
v_{max} (mol/L·min)	0.001218817	



✓

Problem 3. Modified Data Set

S (mol/L)	v_{exp} (mol/L·min)	1/v (L·min/mol)	1/S (L/mol)	v_{mod} (mol/L·min)	$Error^2$ $(v_{mod}-v_{exp})^2$
0.009	0.00065	1538.5	111.1111111	0.000618	1.02973E-09
0.0081	0.00057	1754.4	123.4567901	0.000585	2.36753E-10
0.0059	0.00048	2083.3	169	0.000489	8.73227E-11
0.0042	0.00037	2702.7	238.0952381	0.000393	5.38494E-10
0.0018	0.00022	4545.5	555.5555556	0.000206	1.97115E-10
				Sum $Error^2$	2.08941E-09

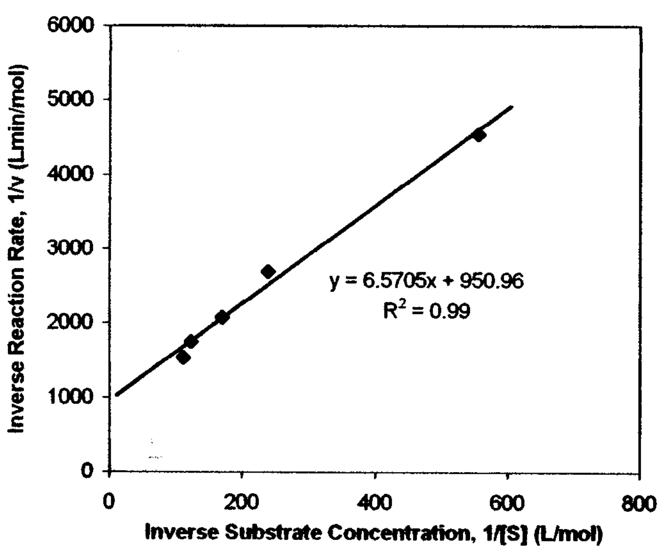
Lineweaver-Burke

slope (K_M/v_{max})	6.5705	K_M (L/mol)	0.00691 ✓
intercept ($1/v_{max}$)	950.96	v_{max} (mol/L·min)	0.00105

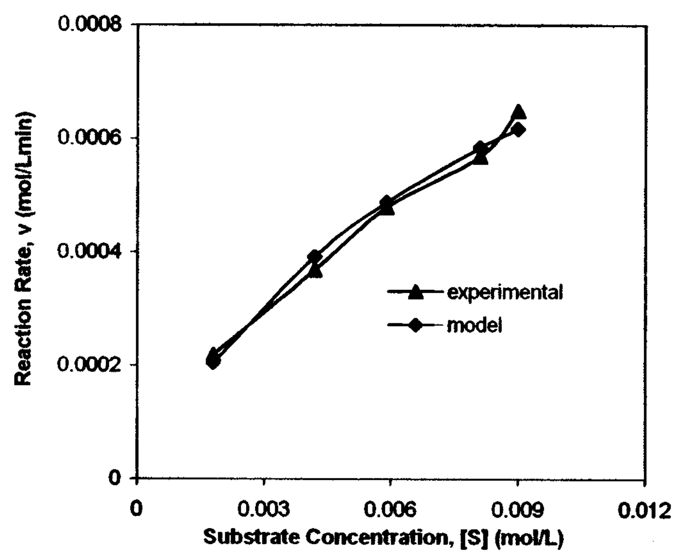
Michaelis-Menten

K_M (mol/L)	0.009001307 ✓
v_{max} (mol/L·min)	0.001235911

Lineweaver-Burke



Michaelis-Menten



...ina

..."noise"

...ata, the

...na linearization

...from those obtained

...ession.

CE421/521 Environmental Biotechnology
Homework Assignment
Michaelis-Menten Kinetics
due September 8, 2005

1. Using linear regression and the Lineaweaver-Burke linearization determine the best fit Michaelis-Menten kinetic parameters (v_m and K_m) for the following experimental data.

S, mol/L	v, mol/L·min
0.01	0.00064
0.008	0.00058
0.006	0.000479
0.004	0.00038
0.002	0.000219

$$V = \frac{V_{max}[S]}{K_M + [S]}$$

$$\frac{1}{V} = \frac{K_M}{V_{max}} \cdot \frac{1}{[S]} + \frac{1}{V_{max}}$$

2. Using a spreadsheet such as Excel (or other computer program) determine the best fit kinetic parameters for the above data set. Minimize the sum of squared error (SSE) between the raw data points and the predicted data points. Use Solver to minimize the SSE by adjusting the v_m and K_m values.

3. Repeat the above steps for the modified data set (both linearization and Solver):

S, mol/L	v, mol/L·min
0.009	0.00065
0.0081	0.00057
0.0059	0.00048
0.0042	0.00037
0.0018	0.00022

4. Based on the results above, what can you say about the use of linearization methods to analyze data from a non-linear model?

With "good" data, the linearization method evaluates the kinetic parameters to within a few percent of those obtained from a nonlinear regression. However, if more "noise" or variability is present in the data, the kinetic parameters obtained via linearization deviate considerably more from those obtained from the nonlinear regression.

great!