

**12.540 Homework #2****Due Wednesday, April 2, 2003****Question 1:** Using the data set listed below:

- (a) Fit a linear regression ( $y=ax+b$ ) to the data using standard weighted squares
- (b) Compute the chi-squared per degree of freedom of the postfit residuals. Is this value consistent with the variations expected from random variations?
- (c) Divide the data into two parts (first and last 5 days points) and use sequential estimation to determine a and b.
- (d) Find the eigenvectors and eigenvalues of the covariance matrix of the estimates of a and b. How do you interpret these results?
- (e) Find the weight mean y (the weighted mean is the weighted least squares solution to the equation  $y = b$ ). Compare this estimate of b with the eigenvalues from part d.

**Data:**

X	Y	+ -
1	1.610	0.957
2	-1.563	1.013
3	-6.418	0.885
4	-14.063	1.119
5	-19.729	1.033
6	-24.932	0.981
7	-28.918	0.941
8	-37.831	0.986
9	-43.902	1.107
10	-51.237	0.990

**Question 2:** Using the data below:

- (a) Estimate A given the model that  $y(t) = A*\cos(X)+C(t)$  where C(t) is a randomly varying function of time.
- (b) Instead of estimating C(t) at each time, use a differencing method to eliminate C(t) from the estimation.
- (c) Does the result with differencing match the “brute force” estimation of 10 values of C and 1 for A. (Hint: Use propagation of variances to determine the covariance matrix of the differenced data.)

**Data:**

T	X	Y	+ -
1	1.1000	9.0880	1.00
1	0.3000	16.1559	1.00
1	-0.1900	17.3318	1.00
2	1.2000	-9.3539	1.00
2	0.1000	-2.6315	1.00
2	-0.1600	-5.5570	1.00
3	1.3000	-25.5732	1.00
3	-0.1000	-19.2691	1.00
3	-0.1100	-18.1897	1.00
4	1.4000	18.7240	1.00
4	-0.3000	27.1561	1.00
4	-0.0400	26.9730	1.00
5	1.5000	23.3217	1.00

5	-0.5000	32.5728	1.00
5	0.0500	33.6475	1.00
6	1.6000	-32.1164	1.00
6	-0.7000	-25.4898	1.00
6	0.1600	-20.7943	1.00
7	1.7000	-16.8615	1.00
7	-0.9000	-9.6664	1.00
7	0.2900	-7.4413	1.00
8	1.8000	-45.7447	1.00
8	-1.1000	-39.8882	1.00
8	0.4400	-33.7515	1.00
9	1.9000	8.6143	1.00
9	-1.3000	13.4211	1.00
9	0.6100	17.7077	1.00
10	2.0000	2.4362	1.00
10	-1.5000	8.2946	1.00
10	0.8000	14.5256	1.00