

NORTHERN ILLINOIS UNIVERSITY

PHYSICS DEPARTMENT

Physics 374 – Junior Physics Lab

Spring 2021

Problem Set #6

Problem Set Due: Thurs., April 1, 2021

Read Bevington: Chapter 7.1, 7.2

Chapter 7: see also: https://en.wikipedia.org/wiki/Matrix_multiplication

1. Show that the product of a 3x3 matrix $\mathbf{A}$ with a column vector, $\mathbf{x}$, gives a column vector, $\mathbf{b}$, that satisfies the following relation $\mathbf{Ax} = \mathbf{b}$ where:

$$b_i = \sum_{k=1}^3 A_{ik} x_k$$

2. Show that the product of two 3x3 matrices $\mathbf{A}$ and $\mathbf{B}$ gives a third matrix $\mathbf{C}$ that satisfies the following relation $\mathbf{C} = \mathbf{AB}$ where:

$$C_{ij} = \sum_{k=1}^3 A_{ik} B_{kj}$$

3. Under what circumstances can the following be true (show this in detail)?

$$C_{ij} = \sum_{k=1}^3 A_{ki} B_{jk} = \sum_{k=1}^3 A_{ik} B_{kj}$$

4. For $m = 3$ write each element for each vector and matrix given in Eq. 7.13 in Bevington. Write $\boldsymbol{\beta}$ and $\mathbf{a}$ as column vectors, and $\boldsymbol{\alpha}$ as a 3×3 matrix.
5. Show that $\boldsymbol{\alpha}$ is a symmetric matrix [https://en.wikipedia.org/wiki/Symmetric_matrix].
6. Show how Bevington arrived at Eq. 7.20.
7. Derive Eq. 7.21 (making explicit use of the Kronecker delta function [https://en.wikipedia.org/wiki/Kronecker_delta])

8. Show that the symmetric matrix α is related to the curvature of χ^2 by showing how Bevington arrived at Eq. 7.22.
9. Show that the covariance of two parameters given by Eq. 7.23 results in the error matrix ϵ given in Eq. 7.25.