**1.2.1**. Supposeand(whereandandare vectors). Put those two statements together into one matrix equation . What are those matricesand? If the matrixisby, what are the shapes ofand?

**Sol**.

**1.2.2**. Supposeandare column vectors with components all,,and,,. Can you multiplytimes(yes or no)? What is the shape of the answer? What number is in row, columnof? What can you say about?

**Sol**. works. where

where

**1.2.3**. (Extension of Problem 2: Practice with subscripts) Instead of that one vector, suppose you havevectorstoin the columns of. Suppose you havevectors,,in the rows of.

(a) Give a "sum of rank one" formula for the matrix-matrix product.

(b) Give a formula for the,entry of that matrix-matrix product. Use sigma notation to add the,entries of each matrix found in Problem 2.

**Sol**. (a)

(b) where, so

**1.2.4**. Supposehas only one column (). So each row ofjust has one number.has columnstoas usual. Write down the column times row formula for. In words, thebycolumn vectoris a combination of the \_\_\_\_\_ .

**Sol**. a combination of the columns of.

**1.2.5**. Start with a matrix. If we want to take combinations of its rows, we premultiply byto get. If we want to take combinations of its columns, we postmultiply byto get. For this question we will do both.

Row operations then column operations: Firstthen

Column operations then row operations: Firstthen

The associative law says that we get the same final result both ways. Verifyfor, , .

**Sol**.

, which is the same as the above one.

**1.2.6**. Ifhas columns,,andis the identity matrix, what are the rank one matricesandand? They should add to.

**Sol**.

**1.2.7**. Fact: The columns ofare combinations of the columns of. Then the column space ofis contained in the column space of . Give an exampla ofandfor whichhas a smaller column space than.

**Sol**.

**1.2.8**. To compute , what order of the same three commands leads to columns times rows (outer products)?

Rows times columns

For i=1 to m

For k=1 to n

For j=1 to p

**Sol**. Columns times rows.

For k=1 to p

For i=1 to m

For j=1 to n