

## Homework 2

Math 2568 Due: Wednesday, January 23, 2019 at beginning of class

### Problem 1

Determine whether the given pair of vectors is perpendicular.

§1.4, Exercise 8.  $x = (2, 1, 4, 5)$  and  $y = (1, -4, 3, -2)$ .

### Problem 2 (MATLAB)

§2.1, Exercise 14. (MATLAB) Suppose that the four substances  $S_1, S_2, S_3, S_4$  contain the following percentages of vitamins A, B, C and F by weight

Vitamin	$S_1$	$S_2$	$S_3$	$S_4$
A	25%	19%	20%	3%
B	2%	14%	2%	14%
C	8%	4%	1%	0%
F	25%	31%	25%	16%

Mix the substances  $S_1, S_2, S_3$  and  $S_4$  so that the resulting mixture contains precisely 3.85 grams of vitamin A, 2.30 grams of vitamin B, 0.80 grams of vitamin C, and 5.95 grams of vitamin F. How many grams of each substance have to be contained in the mixture?

Discuss what happens if we require that the resulting mixture contains 2.00 grams of vitamin B instead of 2.30 grams.

### Problem 3

§2.2, Exercise 5.

- Find a vector  $u$  normal to the plane  $2x + 2y + z = 3$ .
- Find a vector  $v$  normal to the plane  $x + y + 2z = 4$ .
- Find the cosine of the angle  $\theta$  between the vectors  $u$  and  $v$ .

## Problem 4 (MATLAB)

§2.2, Exercise 10. (MATLAB) Use MATLAB to determine graphically the geometry of the set of solutions to the system of equations:

$$\begin{aligned}x + 3y + 4z &= 5 \\2x + y + z &= 1 \\-4x + 3y + 5z &= 7.\end{aligned}$$

Attempt to use MATLAB to find an exact solution to this system and discuss the implications of your calculations.

**Hint:** After setting up the graphics display in MATLAB, you can use the command `view([0,1,0])` to get a better view of the solution point.

## Problem 5

Determine the augmented matrix and all solutions for each system of linear equations

§2.3, Exercise 11. 
$$\begin{aligned}2x - y + z + w &= 1 \\x + 2y - z + w &= 7.\end{aligned}$$

## Problem 6

Consider the augmented matrices representing systems of linear equations, and decide

- (a) if there are zero, one or infinitely many solutions, and
- (b) if solutions are not unique, how many variables can be assigned arbitrary values.

§2.3, Exercise 14. 
$$\left( \begin{array}{ccc|c} 1 & 0 & 2 & 1 \\ 0 & 5 & 0 & 2 \\ 0 & 0 & 4 & 3 \end{array} \right).$$

## Problem 7 (MATLAB)

Use elementary row operations and MATLAB to put each of the given matrices into row echelon form. Suppose that the matrix is the augmented matrix for a system of linear equations. Is the system consistent or inconsistent?

§2.3, Exercise 24. (MATLAB)

$$\begin{pmatrix} -2 & 1 & 9 & 1 \\ 3 & 3 & -4 & 2 \\ 1 & 4 & 5 & 5 \end{pmatrix}.$$

## Problem 8

§2.4, Exercise 3. The augmented matrix of a consistent system of five equations in seven unknowns has rank equal to three. How many parameters are needed to specify all solutions?

## Problem 9 (MATLAB)

Compute the rank of the given matrix.

§2.4, Exercise 10. (MATLAB)  $\begin{pmatrix} 2 & 1 & 0 & 1 \\ -1 & 3 & 2 & 4 \\ 5 & -1 & 2 & -2 \end{pmatrix}.$