**In-Lab Group Activity for Week 9: Orthogonal Projection and Curve Fitting II**

**Name: Cole Bardin**

***first     last***

**Problem 1: Orthogonal Projection onto a Line / Orthogonal Decomposition**

**a. i.** Find the component ofparallel to the vector . Denote this component as **.**

**Hint**: Use the formula: **PS:** You can see this answer in your head.

**ii.** Now give , the component of perpendicular to the line through . As always, .

**iii.** Find the dot product of the two components.  **0\*3+0\*4+5\*0 = 0**

**b. i.** Find the component ofparallel to the vector . Denote this component as **.**

**Hint**: Use the formula:

**ii.** Now give , the component of perpendicular to the line through . As always, .

**iii.** Find the dot product of the two components.

**Problem 2: Orthogonal Projection onto a Plane / Orthogonal Decomposition**

**a. i.** Find the component ofparallel to the **plane** spanned by the vectors and .

Denote this component as **.** As always, .

**Hint**: Use the formula:  **PS**: You can also see this answer in your head.

**ii.** Now give , the component of perpendicular to the **plane** spanned by and.

**iii.** Find the dot product of the two components and .

**b. i.** Find the component ofparallel to the **plane** spanned by and .

Denote this component as **.** As always, .

**Hint**: Use the formula:

**ii.** Now give , the component of perpendicular to the **plane** spanned by and.

**iii.** Find the dot product of the two components.

**iv.** Why are the two components and the same in both parts **a** and **b**?

Because the planes spanned by and are: \_ \_ \_

**i.** orthogonal **ii.** the same **iii.** do not intersect

**Problem 3: Curve Fitting:** Four data points were observed (0,3), (1,1) (2, 5), (3, 15). Thus, the *x*-values and *y*-values are: and **.** The plot shows these data points and both the best-fit **line** and the best-fit **parabola**.

**a.** Record the design matrix *D* you would use to find the best-fit **line**:

Design matrix *D* for best-fit line:

The inverse of

**b.** The product for your design matrix should be: .

Find the inverse of and place it in the adjacent box.

**c.** Solve the normal equation to find the vector with the best-fit parameters for the line. **Hint**:

Parameter vector

**d.** It can be shown that the best-fit **line** gives the estimates . Find the **error** vector: **,** then give the **root mean square error**. Below, since there are four data points.

3

**e.** Let's start over and try a **parabolic** fit. Record the new design matrix *D* you would use to find the best-fit **parabola**:

**f.** Nice! The parabola fits perfectly. The RMSE for the parabolic fit is:

For free, the best parabola is:

. Not required.

**i.** 0 **ii.** 1 **iii.** 4 **iii.**