1. (10 points) Abby's data set from her experiment on Monday is

$$(x_1, y_1), (x_2, y_2), \ldots, (x_{50}, y_{50}).$$

The averages $\bar{x}$ and $\bar{y}$ are both 0. The correlation coefficient for Monday's data set is found to be r.

Abby ran the experiment again on Tuesday, and obtained exactly the same data set. What is the correlation coefficient R for both Monday and Tuesday's combined data set

$$(x_1, y_1), (x_2, y_2), \ldots, (x_{50}, y_{50}), (x_1, y_1), (x_2, y_2), \ldots, (x_{50}, y_{50})?$$

2. (2 points) **True or False:** It is possible to find non-zero vectors $\mathbf{u}$, $\mathbf{v}$ for which $\|\mathbf{u}+2\mathbf{v}\| = \|\mathbf{u}\| - \|2\mathbf{v}\|$.

3. (2 points) **True or False:** the point $\mathbf{p} = (0, 3, -1)$ is inside the triangle with vertices at $\mathbf{a} = (0, 3, 6)$, $\mathbf{b} = (-6, 0, 0)$ and $\mathbf{c} = (2, 4, -6)$. (Remark: $\mathbf{p}$ is inside the triangle with vertices $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ when $\mathbf{p}$ is a convex linear combination of $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$.)

4. (3 points) Let $\mathbf{v}$ be a fixed nonzero vector in $\mathbf{R}^3$. Geometrically, the collection of vectors $\mathbf{w} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \in \mathbf{R}^3$ satisfying the condition

$$\|\mathbf{w} - \mathbf{v}\|^2 - \|\mathbf{w}\|^2 = 1$$

is a

a) line.

b) plane.

c) $\mathbf{R}^3$.

d) sphere.

e) might take different shapes depending on what $\mathbf{v}$ and $\mathbf{w}$ are.

5. (3 points) Suppose we have two vectors $\mathbf{v}$ and $\mathbf{w}$ in $\mathbf{R}^n$, where

$$\|\mathbf{v}\| = 2\sqrt{2}, \quad \|\mathbf{w}\| = 2, \quad \mathbf{v} \cdot \mathbf{w} = 4$$

Which of the following must always be true? (Choose only one.)

- $\mathbf{v} + \mathbf{w}$ is perpendicular to $\mathbf{v} - \mathbf{w}$.
- $\|\mathbf{v} - \mathbf{3w}\| = 10$
- $\|\mathbf{v} - \mathbf{w}\| = 2$