Show all work.

1. **(4 points)** Find a basis for the column space of the matrix $A = \begin{pmatrix} 1 & 2 & -3 & 2 \\ 0 & 3 & 4 & -5 \\ 3 & 3 & -13 & 11 \end{pmatrix}$.

2. **(6 points)** For each of the following maps L from one vector space to another, determine whether L is a linear transformation or not, and state your reasoning.

   (a) $L : P_3 \to \mathbb{R}^2$ where $L(f(x)) = \begin{pmatrix} f(0) \\ f(3) \end{pmatrix}$.

   (b) $L : \mathbb{R}^2 \to \mathbb{R}^4$ where $L\left(\begin{pmatrix} x \\ y \end{pmatrix}\right) = \begin{pmatrix} x \\ 2x \\ 0 \\ 3x \end{pmatrix}$.

   (c) $L : \mathbb{R}^3 \to \mathbb{P}_3$ where $L\left(\begin{pmatrix} r_1 \\ r_2 \\ r_3 \end{pmatrix}\right) = (x - r_1)(x - r_2)(x - r_3)$.

3. **(4 points)** Determine (with brief explanation) the kernel and range of the linear transformation on P_4 given by $L(f(x)) = f''(x)$.

4. **(6 points)** Let L be a linear transformation on P_2 given by $L(f(x)) = xf'(x) + f(2)$. Find a matrix A representing L with respect to the standard basis $[1, x, x^2]$.