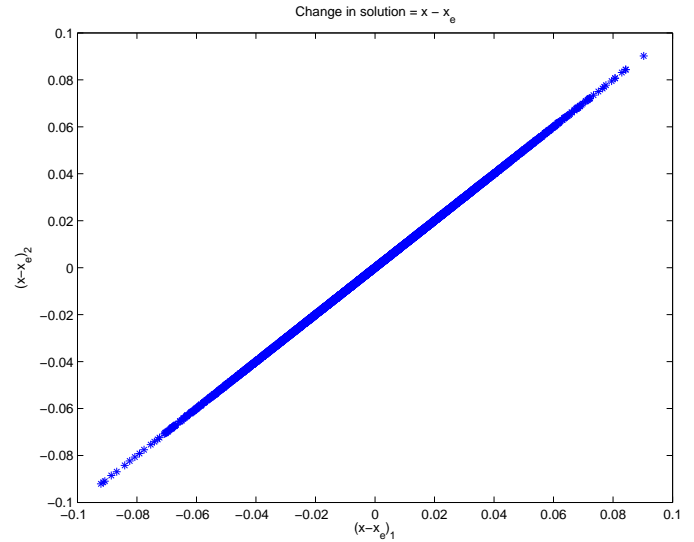
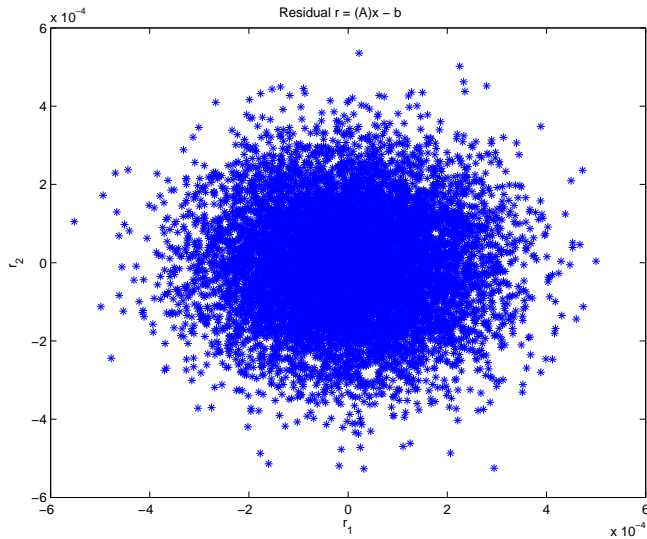


Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, communication with others, scratchpaper, etc.

Name _____

1. In the last in-class exercise, you experimented with taking the discrete Fourier transform (or discrete cosine transform) of the sunspot data and then zeroing out some small components.
 - 1a. (5) What do the components that are large in magnitude tell you about sunspots?
 - 1b. (5) Give two reasons for zeroing out small components of the transform of a series of data like that for sunspots.



2. (10) Consider a linear system $\mathbf{Ax} = \mathbf{b}$ where \mathbf{A} is 2×2 . Suppose we perturb the problem, by changing it to $(\mathbf{A} + \mathbf{E})\mathbf{x}_e = \mathbf{b}$, where $\|\mathbf{E}\|_1/\|\mathbf{A}\|_1 = 10^{-4} \equiv \delta$. We repeat this experiment 10,000 times with different values of \mathbf{E} (all with $\|\mathbf{E}\|_1/\|\mathbf{A}\|_1 \approx \delta$) to get the figures above. Assuming that $\|x\|_1 = 1$, use the following fact to estimate the condition number κ of \mathbf{A} :

$$\frac{\|\mathbf{x} - \mathbf{x}_e\|}{\|\mathbf{x}\|} \leq \frac{\kappa(\mathbf{A})}{1 - \kappa(\mathbf{A})\delta} \delta.$$