# Underdetermined linear system histograms

`https://camillejr.github.io/science-docs/`

## 1 Introduction

For an undertermined linear system (where matrix $\boldsymbol{A}$ is size $(n \times m)$ and $n < m$):

$$\boldsymbol{A}x = b \tag{1}$$

an infinite number of solutions exists. MATLAB implements various methods of computing possible solutions for $x$. In this paper we investigate the differences in the available solutions by analyzing their histograms. Four methods were selected: backslash `\` operator, computing a pseudo-inverse `pinv()`, and two least-squares algorithms `lsqnonneg()` and `lsqr()`.

## 2 Matlab example

We focus on an example where matrix $\boldsymbol{A}$ is size $(100 \times 500)$ and a vector $b$ is size $(100 \times 1)$; both are populated by normally distributed random numbers.

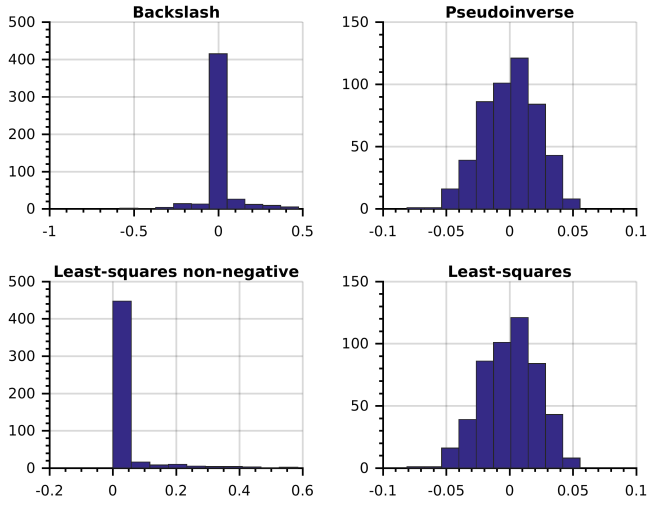


Figure 1: Histograms of four solutions to an undetermined linear system.

## 3 Possible applications

## References

[1] Nathan Kutz, *Data Driven Discovery of Dynamical Systems and PDEs*, an online lecture

[2] Gilbert Strang, *Introduction to Linear Algebra*, Fifth Edition, 2016