Astrostat Lab1: H_0 and the Age of the Universe

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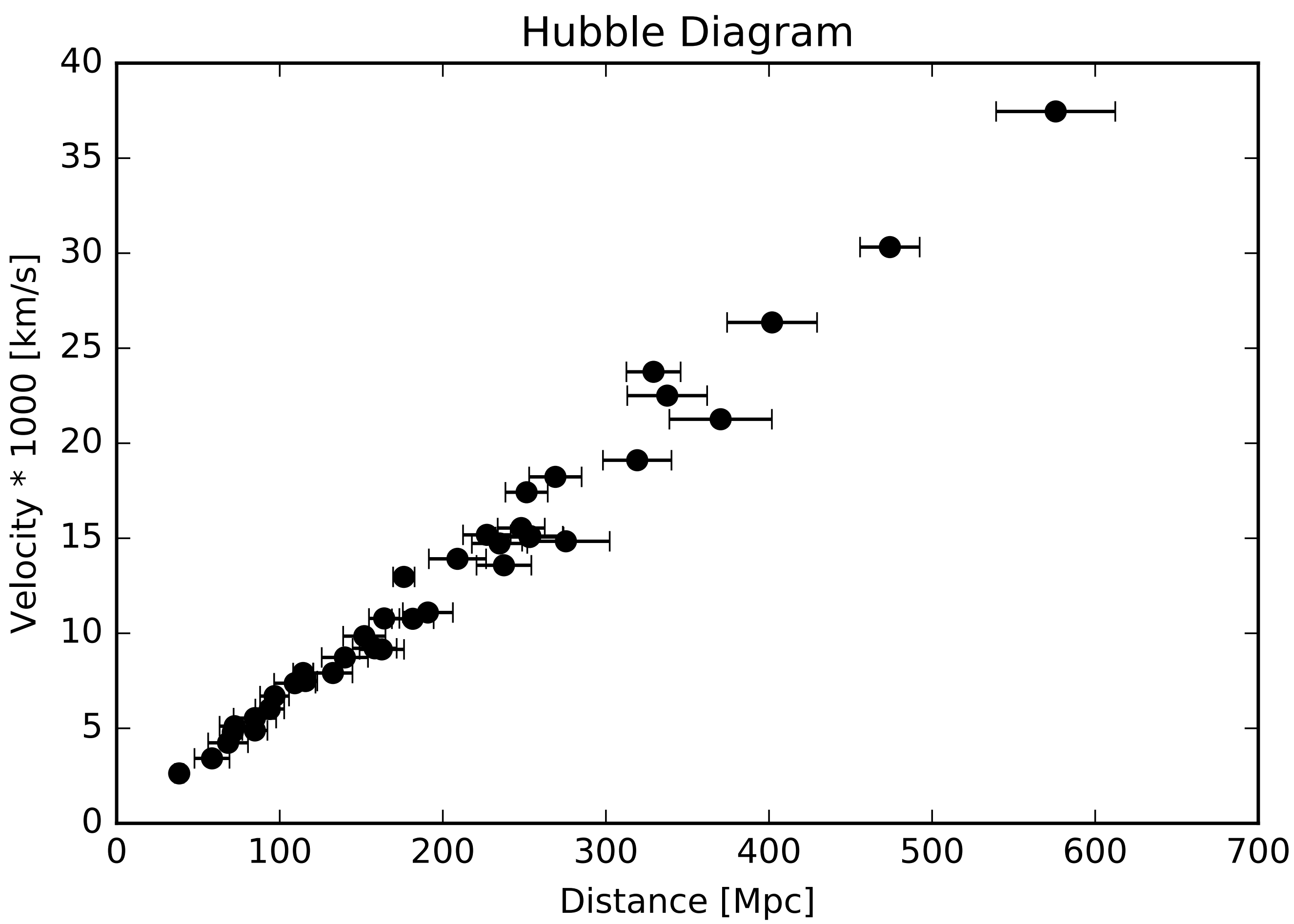
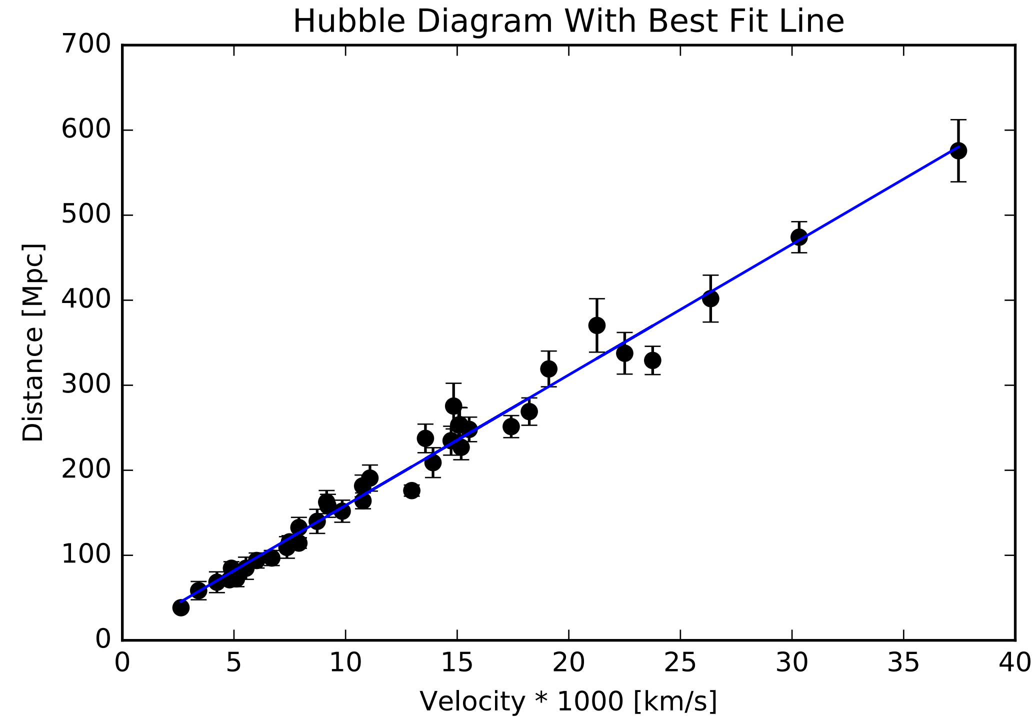
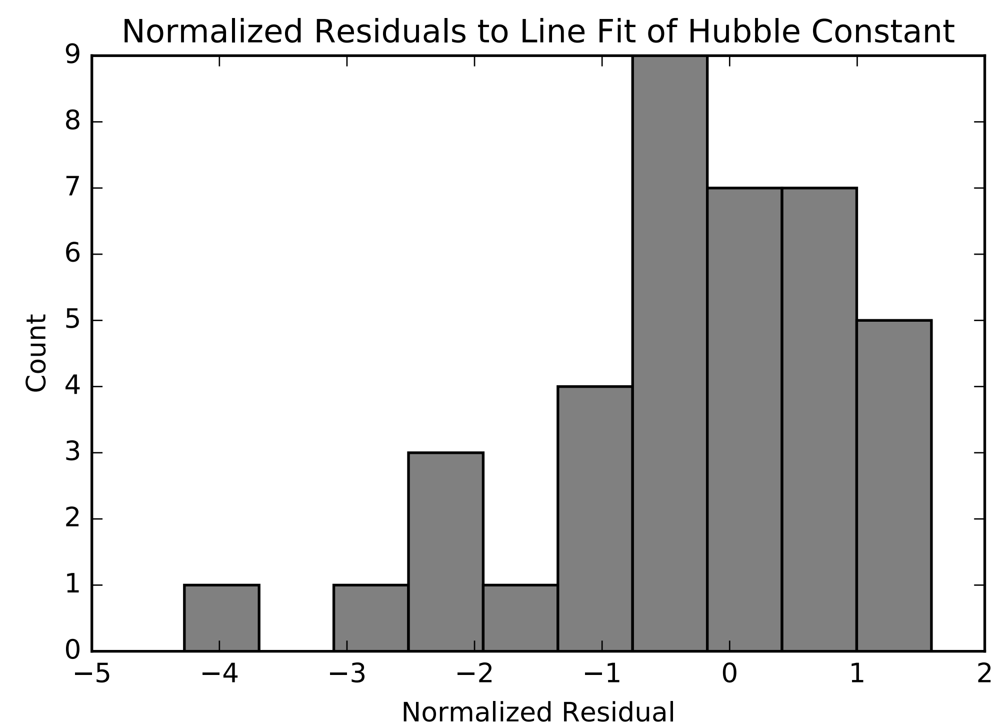


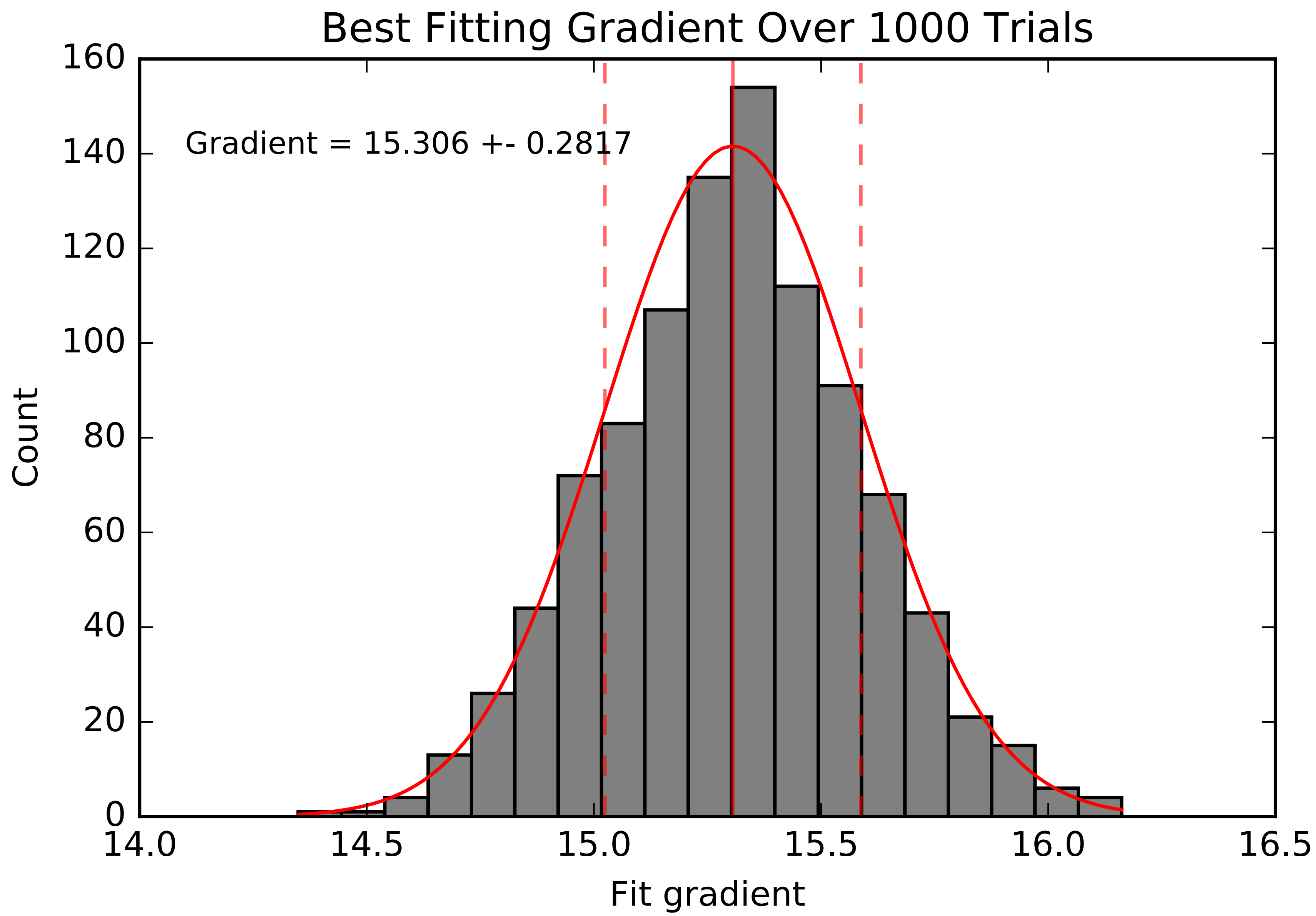
- A Hubble Diagram plots the velocity at which distant objects are receding against their distances from us
- It gives us a look into the expansion history of the universe
- By fitting a line to the diagram, we can obtain H_0, also known as a Hubble constant
- We can estimate the age of the universe by inverting the Hubble constant: age = $1/H_0$

- First used numpy polyfit to fit the data [velocity, distance, distance uncertainty]. But doing so required us to flip the x and y axis
- Looking at the normalized residuals for the unweighted fit, the fit clearly has a bias
- To verify this we:
  - Wrote a normal equation fitting method to check our numbers with numpy (they're the same!)
  - Used a weighted numpy polyfit to calculate H_0 and H_0 uncertainty from the covariance matrix





We get that the age of the universe is:
14.968 +- 0.3249 billion years



- We also did a bootstrapping experiment by tampering with the data. Each point was perturbed by a random draw of their gaussian constructed from their uncertainty and the data fitted again
- Here we present the best fitting gradient over 100 trials