1. Consider the power-law distribution $p(S|\alpha) \propto S^{-\alpha}$ from yesterday’s problems.

(a) Generate samples, $S_i$, from this distribution (for some fixed value of $\alpha$), using rejection sampling or otherwise (but if your computer has a mechanism for directly generating power-law samples, please don’t use that!).

- In this case, do we need to know the normalization constant?
- Do you need to make any additional assumptions?

(b) Determine the mean and variance of the samples and check against an analytical calculation.

(c) Plot the distribution and make a histogram of the samples.

2. Consider the bivariate distribution that is uniform between -1 and 1 for the quantity $x - y$ and a (univariate) normal with mean 0 and variance 1 for the quantity $x + y$. How can we draw samples (pairs of random numbers) from this distribution using univariate uniform and normal random number generators?

(a) Estimate the mean and covariance from the samples.

(b) Plot the results in 2d, as well as the 1d marginals, with an appropriate color scheme.

(c) Overlay the contours of the approximate gaussian with the estimated mean and covariance.