

# Sampling Problems

## *ICIC Data Analysis Workshop, 8-11 September 2014*

September 9, 2014

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.