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# Practical Gibbs Sampler

We consider a random vector $X = (X_1, X_2)$ taking values in $\{0, \ldots, n\} \times [0, 1]$. The density of $X$ on its support is proportional to

$$\frac{n!}{(n - x_1)!x_1!}\, x_2^{x_1+\alpha-1}(1 - x_2)^{n-x_1+\beta-1}\,.$$

**1** For $n = 10$, $\alpha = 1$, and $\beta = 2$, implement a Gibbs sampler to generate samples approximately distributed according to the law of $X$. Use graphical diagnostics to verify the convergence of the resulting Markov chain to its stationary distribution.

**2** Estimate $\mathbb{E}(X_1X_2)$.