Random Variables

Random Variables in R

R has built in functions for working with several common distributions:

- ▶ Normal
- ▶ Uniform
- ▶ Gamma
- ▶ Binomial
- ▶ Chi-square
- ▶ Poisson
- ▶ Multinomial

For a more complete list, type `help(Distributions)`.

Random Variables in R

For every one of these distributions, R has at least 4 functions that

- ▶ Compute the density
- ▶ Compute the CDF
- ▶ Compute the inverse CDF
- ▶ Simulate a random variable

Normal Random Variables

- ▶ Compute the density `dnorm`
- ▶ Compute the CDF `pnorm`
- ▶ Compute the inverse CDF `qnorm`
- ▶ Simulate a random variable `rnorm`

General Random Variables

Different distributions have a corresponding suffix, e.g. `norm` for normal, and their density, CDF, inverse CDF, and random variable generation functions can be obtained by combining the appropriate letter - `d`, `p`, `q`, or `r` - with the corresponding suffix.

Early Random Number Generation

- ▶ Coins, dice, spinning a cardboard disc
- ▶ Tables/books of random numbers based on
  - ▶ Experimental data combined with statistical theory
  - ▶ Randomly selecting numbers from tables/books of other numbers

Deterministic Random Number Generation

Middle Square Method:

▶ Start with a number x with $2a$ digits and square it to get a number with $4a$ digits (pad with 0's if needed)
▶ Retain the middle $2a$ digits of the square
▶ Iterate

This method can yield sequences that get stuck at 0 or have a short "cycle''.

Try starting from 2500 or starting from any two digit number.

All Roads Lead Back to the Uniform

▶ By definition, quantiles of any independent, identically distributed random variable are uniform on $(0, 1)$

▶ A sequence of positive numbers can be transformed to a distribution on $(0, 1)$ by adding a decimal point