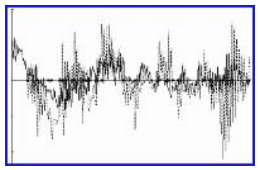
Lehrstuhl
Mathematik VII



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S4 Classes for Distributions

UseR Conference
Vienna, May 2004

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1 Package "distr"

1.1 Motivation

- I have an algorithm / program which works similarly for any distribution
- How to pass a distribution as an argument?
- Construction up to now:
  - a lot of distributions implemented to R — Gaussian, Poisson, Exponential, Gamma, etc.
  - for each:
    - cdf [$\hat{=}$p]
    - density / probability function [$\hat{=}$d]
    - quantile function [$\hat{=}$q]
    - function to simulate r.v.'s [$\hat{=}$r]
  - Naming convention: <prefix><Name>

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- e.g. to get the median of a general distribution:

```
mymedian ← function(vtlg, ...)
{ eval(parse(text=
        paste("x←q", vtlg,
              "(1/2,...)", sep="")))
  return(x)}
```

- better: having a "variable type" distribution and functions `p`, `d`, `q`, `r` defined for this type
- then: **q**(x) returns the quantile function $\rightsquigarrow$
  median ←**function**(X , ...){ **q**(X)(0.5,...)}

$\Longrightarrow$ Development of this concept in a new package "`distr`"

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1.2 Designing Principles

- open, easily extensible by any volunteer in the `R` community
- preserve naming and notation from `R-base`
- suggestive notation for automatically generated methods `r`, `d`, `p`, and `q`

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2 Organization in classes

Distribution classes: Implementation of the concept of random variables / distributions in R. Mother class is the virtual class `Distribution` which (up to now) has the subclass `UnivariateDistribution`. The class of univariate distributions is divided up in absolutely continuous distributions with class `AbscontDistribution` and discrete distributions with class `DiscreteDistribution`.

Parameter classes: Classes for the parameters of distributions.

Simulation classes: Gather all information about a simulation in one object of class `DataClass`; has subclasses `Simulation` and `Contsimulation` (simulation of contaminated data).

Evaluation class: Evaluation of a new procedure (e.g. an estimator) on large set of simulation and storing of all relevant information in an object of class `Evaluation`.

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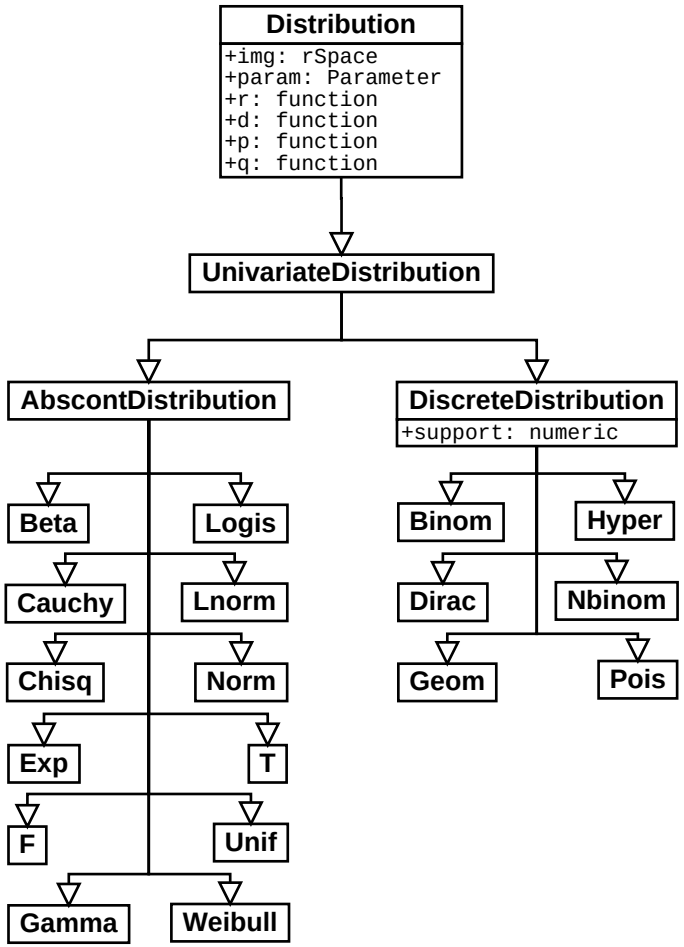

slot param is filled with an object
of the corresponding Parameter class

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3 Possible Operations

Affine linear transformation: Expressions like Y←(3∗X+5)/4 for an object X of class `AbscontDistribution` or `DiscreteDistribution` giving an object Y of class `AbscontDistribution` or `DiscreteDistribution`.

Unary mathematical operations included in the group math are available so that expressions like Y←**exp**(**sin**((3∗ X+5)/4)) are admitted.

Convolution of probability distributions is done via the exact formulas where available, respectively, via explicit calculations. For absolutely continuous summands we implemented an accurate convolution method by means FFT (c.f. Kohl et al. (04)).

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4 Availability

- Homepage on
  `http://www.uni-bayreuth.de/`
  `/departments/math/org/mathe7/DISTR`
- on CRAN soon ...—
  `http://cran.r-project.org/mirrors.html`
- once again: Homepage for R: `http://www.r-project.org/`

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