

Bug in `distr::CompoundDistribution` ?

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CompoundDistribution

I suspect, there is a bug in `distr::CompoundDistribution` function, in case when both arguments are discrete distributions. Namely, that the distribution function `distr::p()` returns not the $P(\chi \leq 1)$ value (as written in the help) but $P(\chi < 1)$.

Let us create a “toy” compound distribution:

$$\chi = \sum_{i=1}^{\eta} \xi_i,$$

where i.i.d summands $\xi_i \sim DiscreteDistr$ and a degenerate distribution $\eta \sim Bern(p = 1)$ which means $P(\eta = 1) = 1$.

```
CP1 <- distr::CompoundDistribution(  
  NumbOfSummandsDistr = distr::Binom(prob=1,size=1),  
  SummandsDistr = distr::Binom(prob=0.5,size=6))  
  
distr::p(CP1)(1)
```

```
## [1] 0.015625
```

According to the help page of the `distr::p()` function, it returns the value

$$P(\chi \leq x).$$

However, we know that the distribution of χ is Binomial with `size=6` and `prob=0.5`. Therefore, $P(\chi \leq 1)$ is the following

```
pbinom(q = 1, size = 6, prob = 0.5)
```

```
## [1] 0.109375
```

```
dbinom(x = 0, size = 6, prob = 0.5) + dbinom(x = 1, size = 6, prob = 0.5)
```

```
## [1] 0.109375
```

And `distr::p(CP1)(1)` actually equals $P(\chi \leq 0)$, or, alternatively, $P(\chi < 1)$,:

```
pbinom(q = 0, size = 6, prob = 0.5)
```

```
## [1] 0.015625
```

```
dbinom(x = 0, size = 6, prob = 0.5)
```

```
## [1] 0.015625
```

Small note:

```
distr::p(CP1)(0)
```

```
## [1] 0
```

convpow

Does not reproduce this error. Here we use the properties of the Binomial distribution.

```
Compound_version <- distr::CompoundDistribution(  
  NumbOfSummandsDistr = distr::Binom(prob=1,size=2),  
  SummandsDistr = distr::Binom(prob=0.5,size=6))
```

```
p(Compound_version)(1)
```

```
## [1] 0.0002441406
```

```
convpow_version <- distr::convpow(D1 = distr::Binom(prob=0.5,size=6), N=2)  
p(convpow_version)(1)
```

```
## [1] 0.003173828
```

```
pbinom(q = 1, size = 12, prob = 0.5)
```

```
## [1] 0.003173828
```

```
pbinom(q = 0, size = 12, prob = 0.5)
```

```
## [1] 0.0002441406
```