

UNIVERSIDADE FEDERAL FLUMINENSE
ESCOLA DE ENGENHARIA
DEPARTAMENTO DE ENGENHARIA QUÍMICA E DE PETRÓLEO

RESULTADOS ANÁLISE EXPLORATÓRIA DE DADOS DO PROCESSO DE REFORMA DO METANO

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JOÃO FELIPE MITRE DE ARAUJO

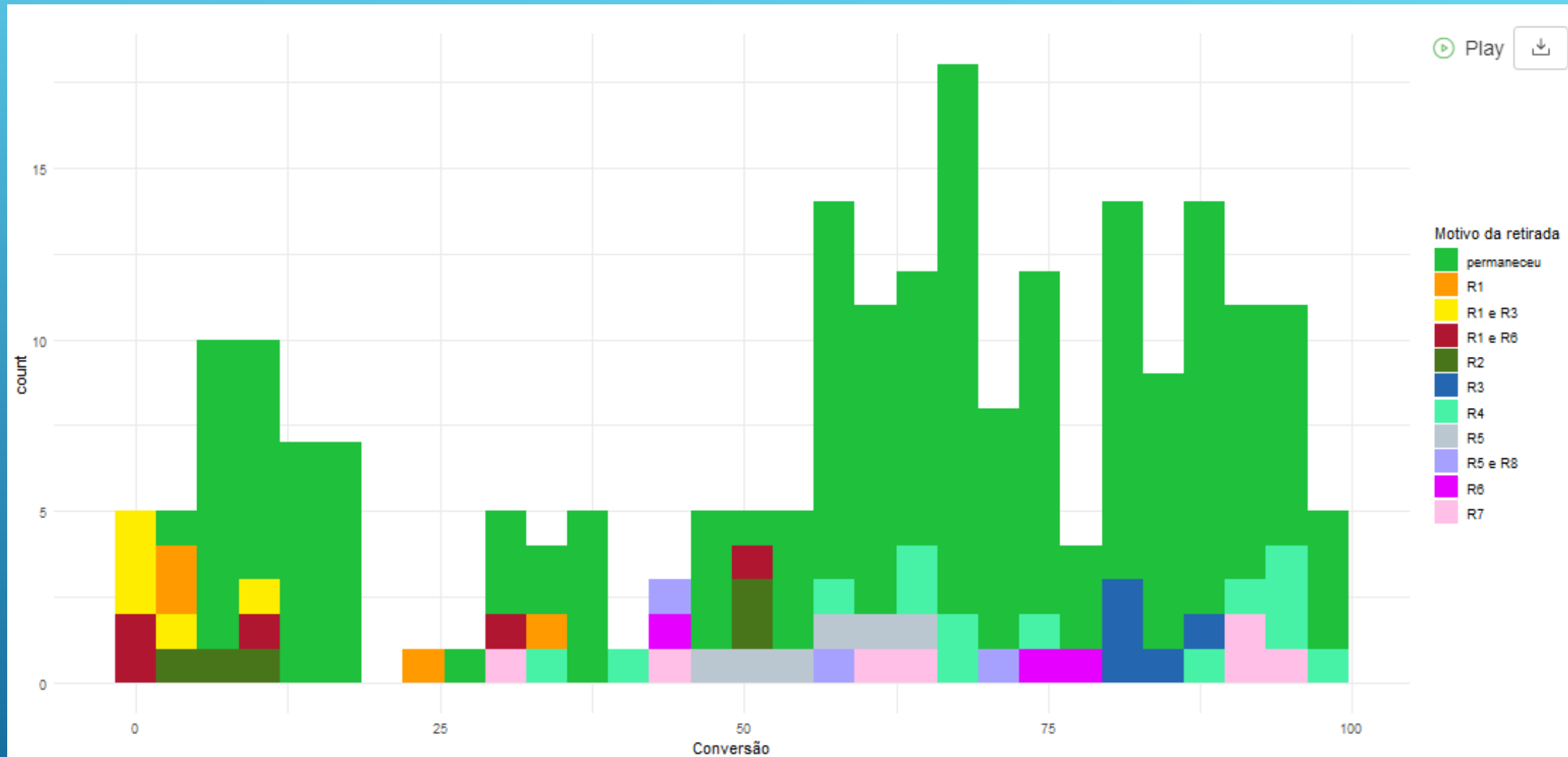
Primeiro Conjunto de dados

 database

222 obs. of 15 variables

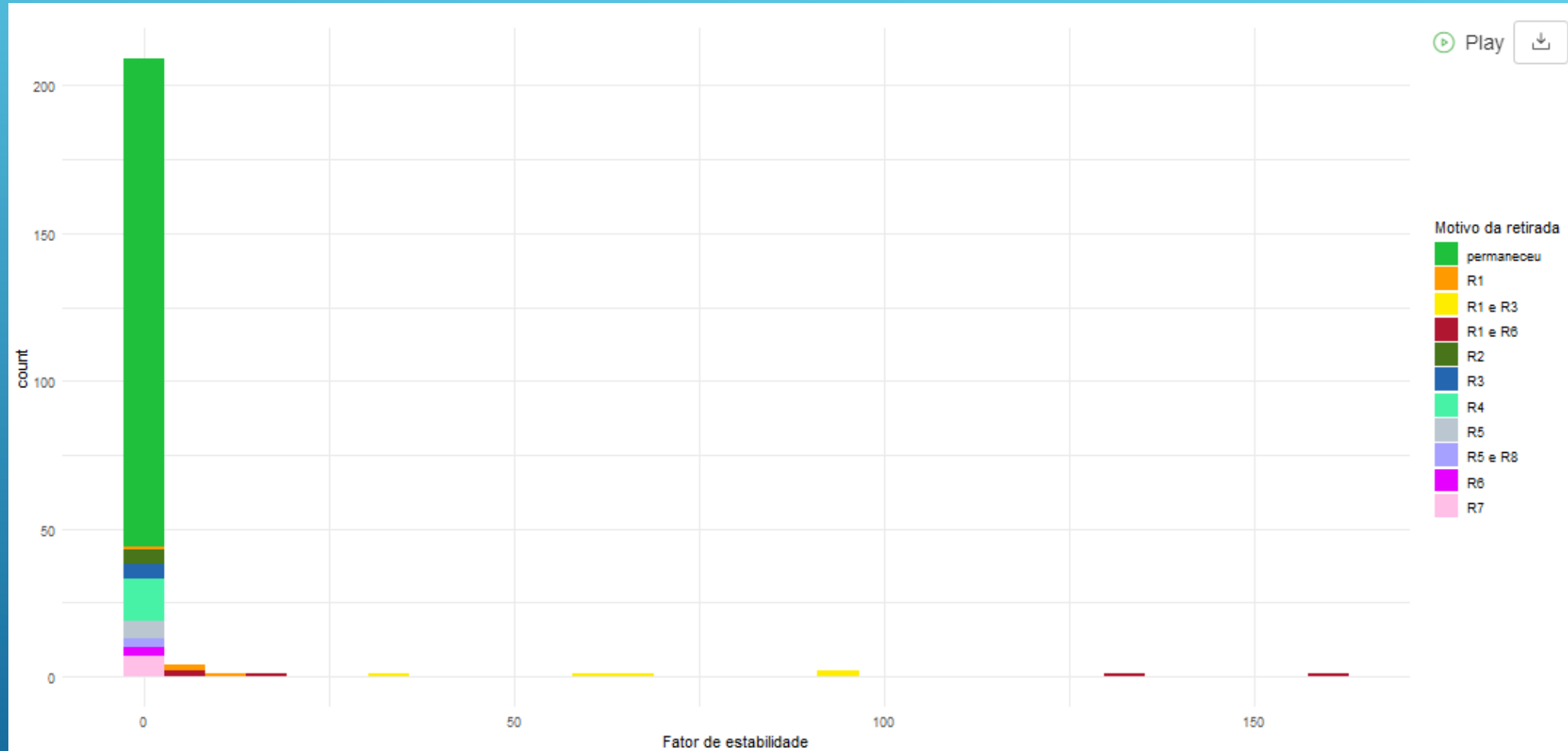
	Shapiro-wilk		Distribuição gamma		Log normal
	w	p-value	V	p-value	p-value
Conversão	0,091102	2,98E-16	-9,7599	5,15E-12	2,20E-16
Fator de estabilidade	0,18131	2,20E-16	35,884	2,20E-16	2,20E-16
Razão molar CH ₄ /CO ₂ na alimentação do reator	0,12639	2,20E-16	57,197	2,20E-16	2,20E-16
Razão molar inerte/metano	0,58294	2,20E-16	NA	NA	NA
WHSV	0,35672	2,20E-16	8,1876	7,06E-09	4,22E-11
Temperatura de reação	0,78736	2,20E-16	-12,198	2,20E-16	2,20E-16
Temperatura de Calcinação	0,91358	4,56E-10	2,8829	4,15E-02	1,61E-07
Temperatura de Redução	0,79355	2,20E-16	-15,055	2,20E-16	2,20E-16
Tamanho de cristalito da fase ativa	0,8033	5,02E-16	4,2982	2,37E-03	3,31E-03
Área específica do catalisador	0,70435	2,20E-16	3,1551	2,57E-02	2,57E-05
Teor total da fase ativa	0,6203	2,20E-16	6,0281	2,02E-05	2,98E-09
Concentração	0,36943	2,20E-16	NA	NA	NA

Conversão



R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250 / R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

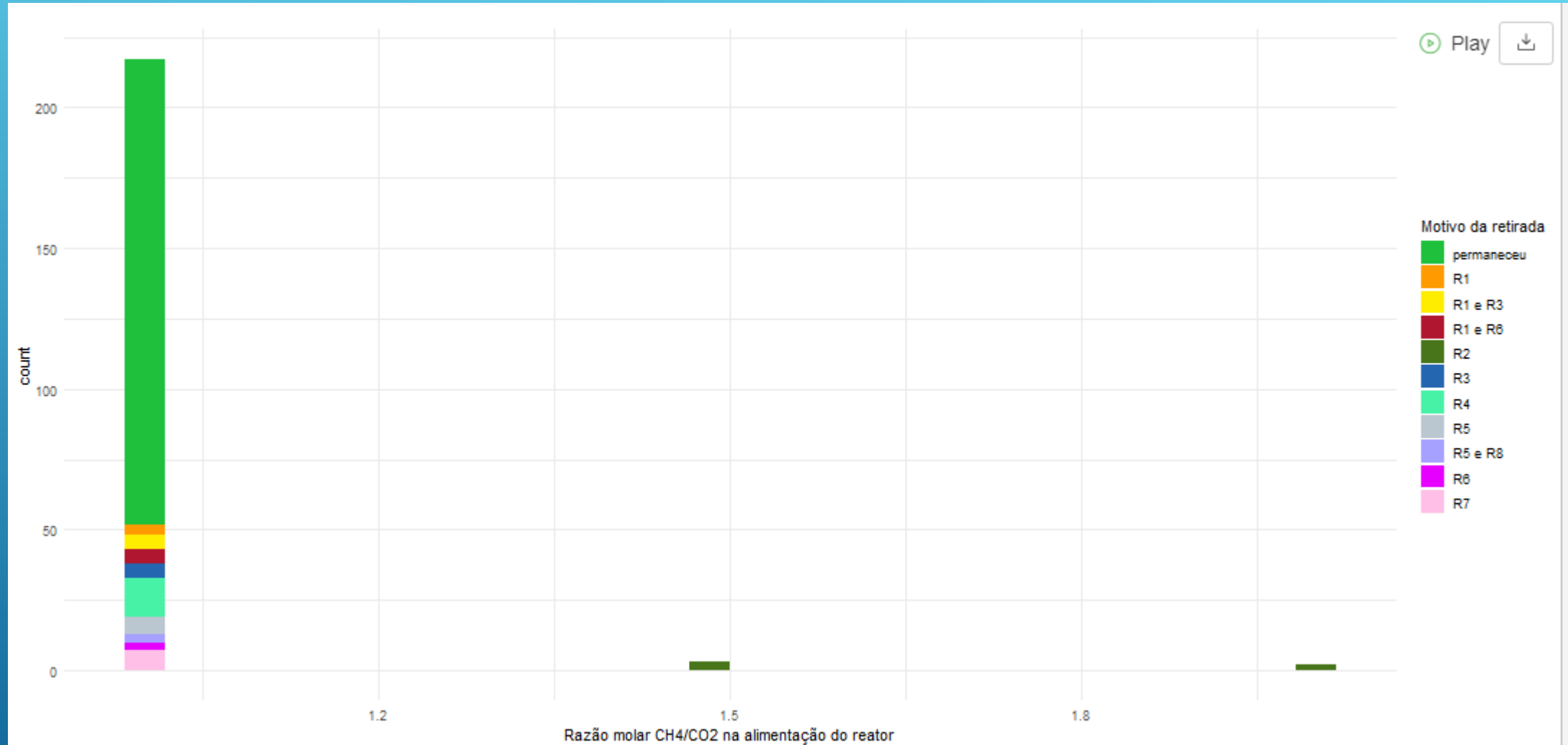
Fator de estabilidade



Retirado superior à 2 – 14 dados retirados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

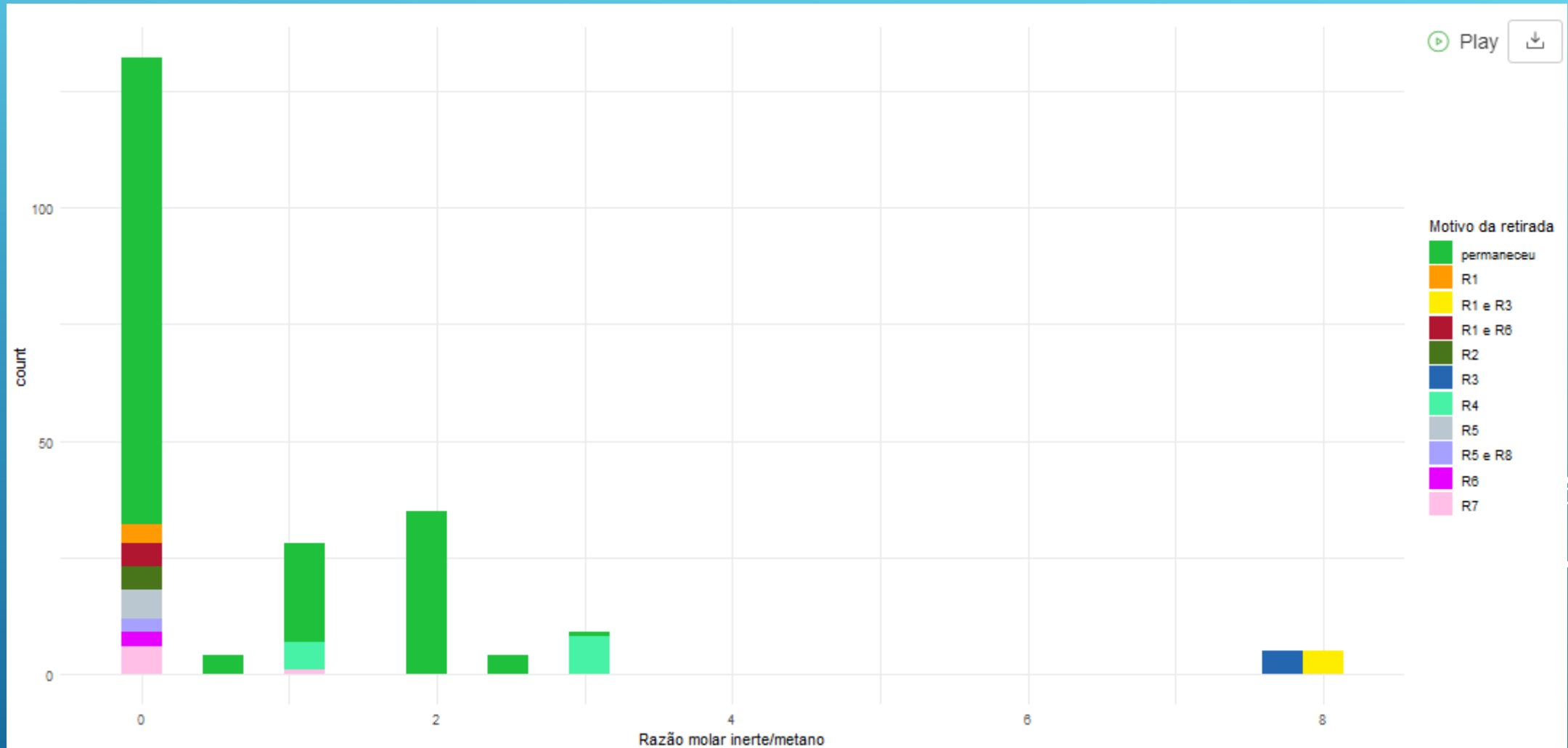
Razão molar CH₄/CO₂ na alimentação do reator



Retirados dados superior à 1,2 – 5 dados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

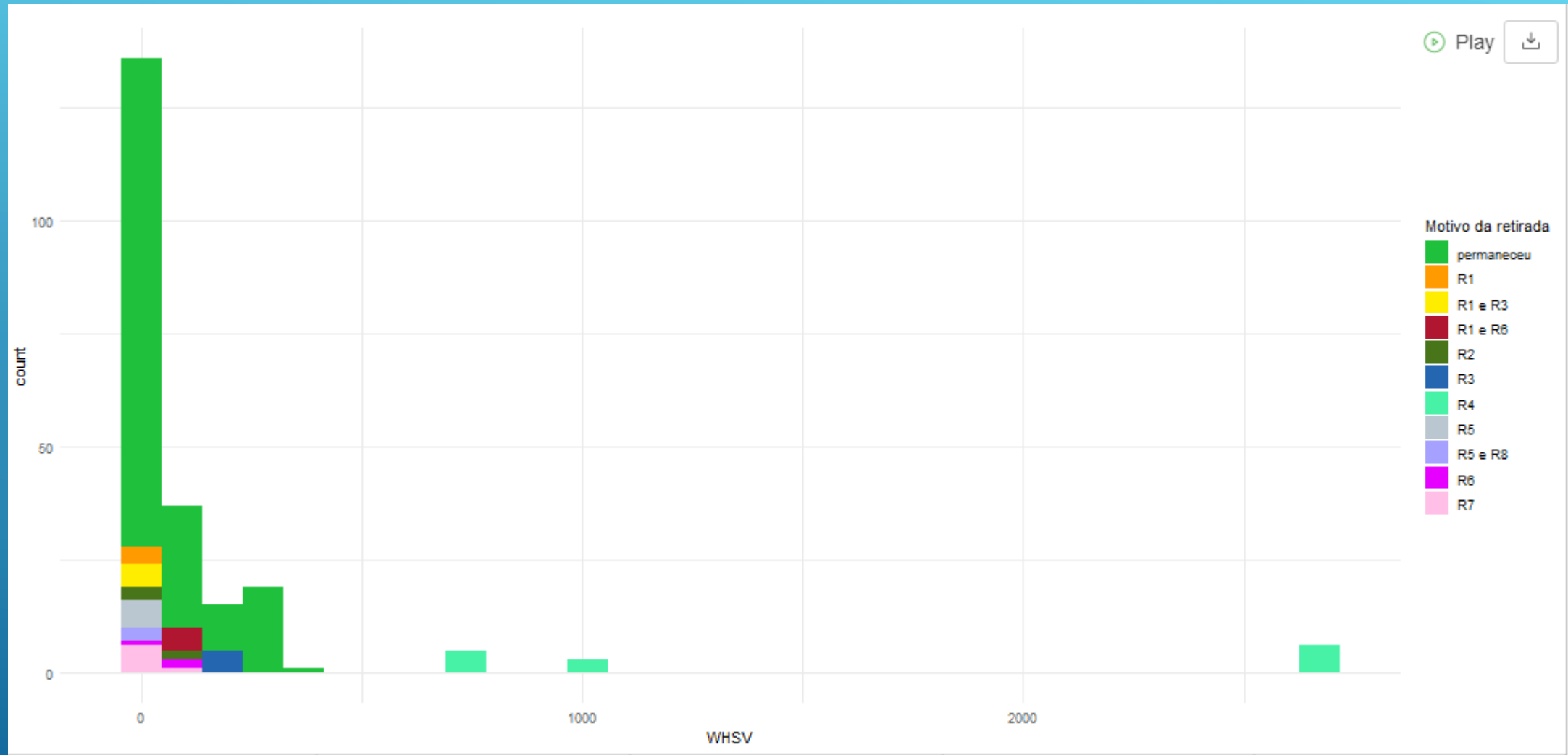
Razão molar inerte/metano



Retirados dados superior à 4 – 5 dados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

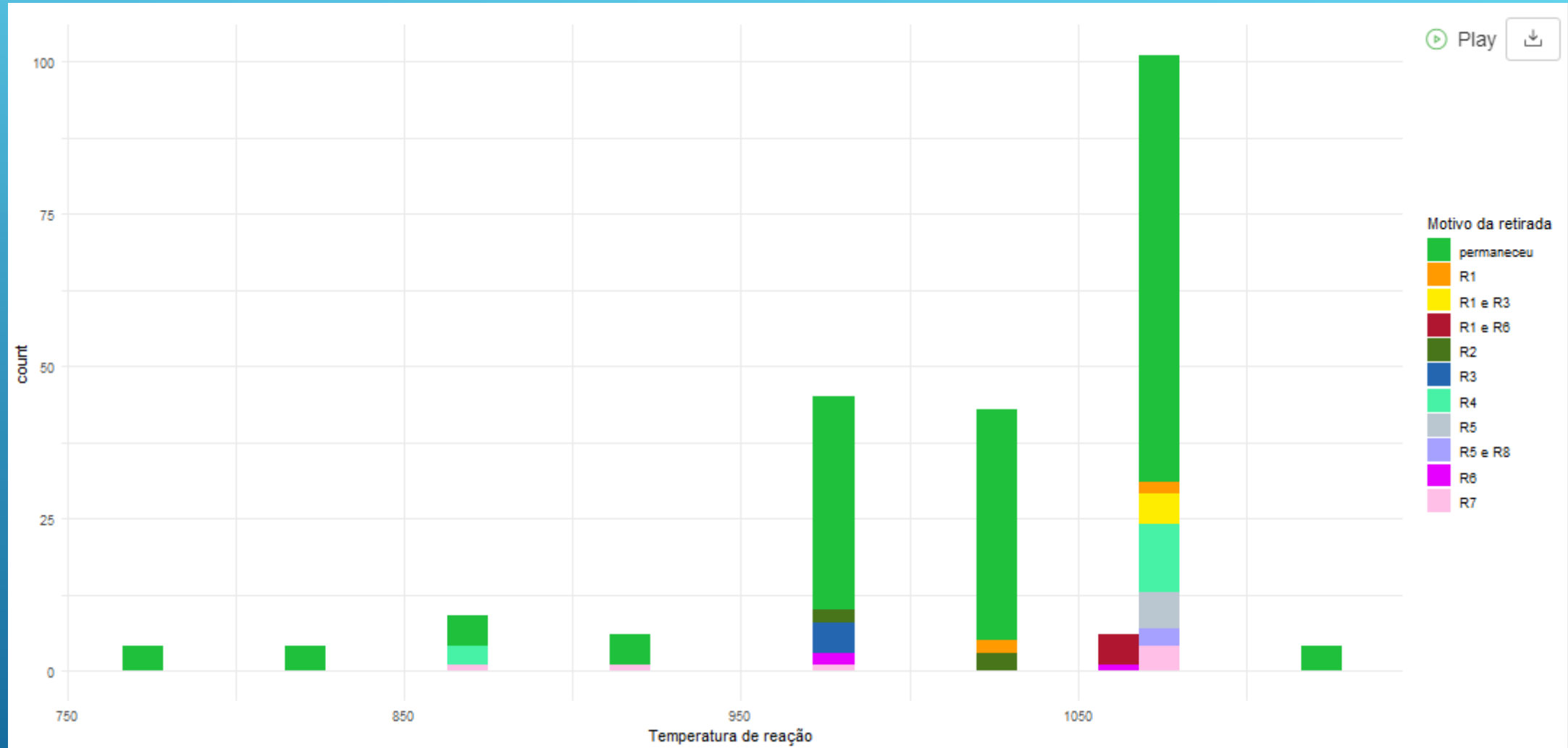
WSHV



Retirados dados superior à 500 – 14 dados

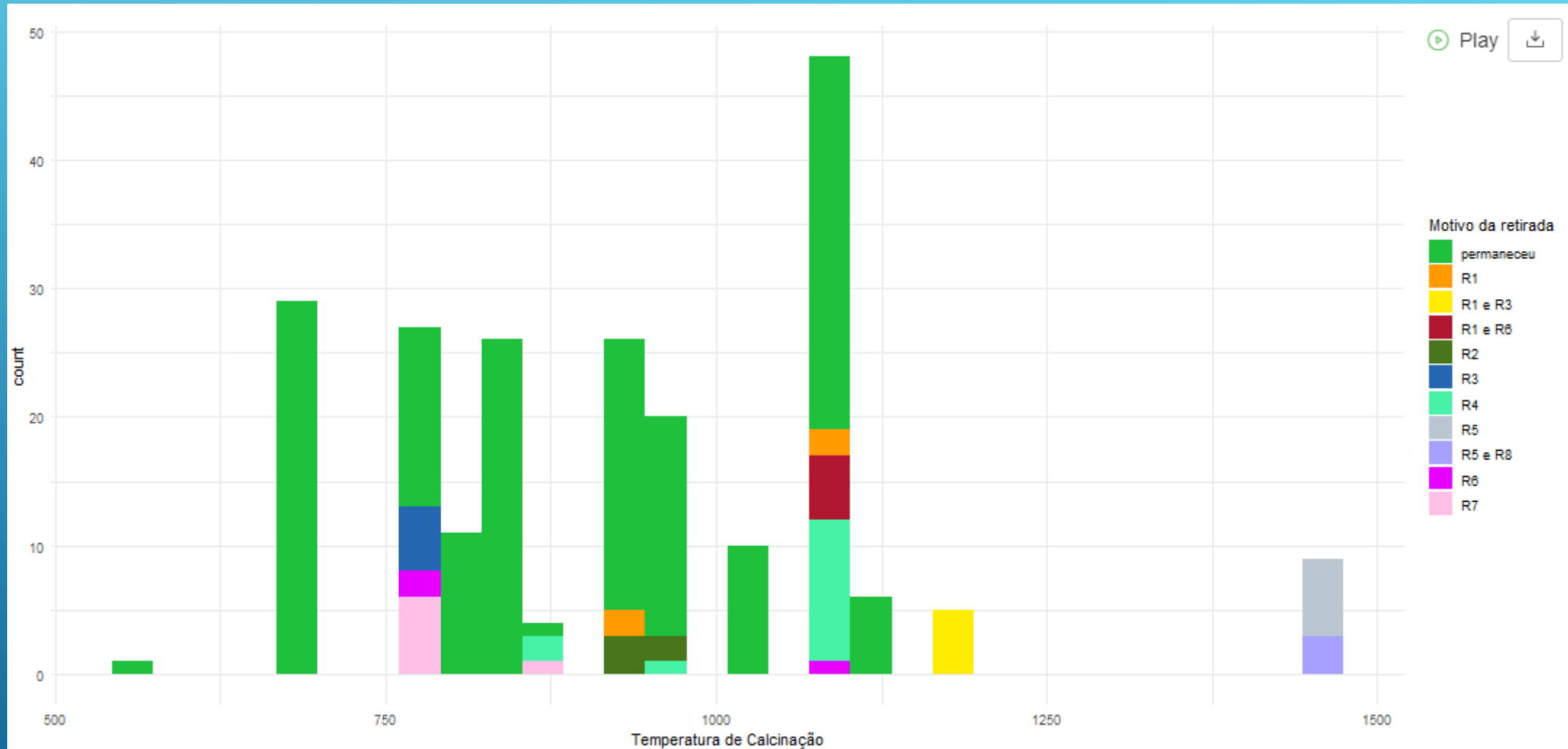
R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

Temperatura de reação



R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

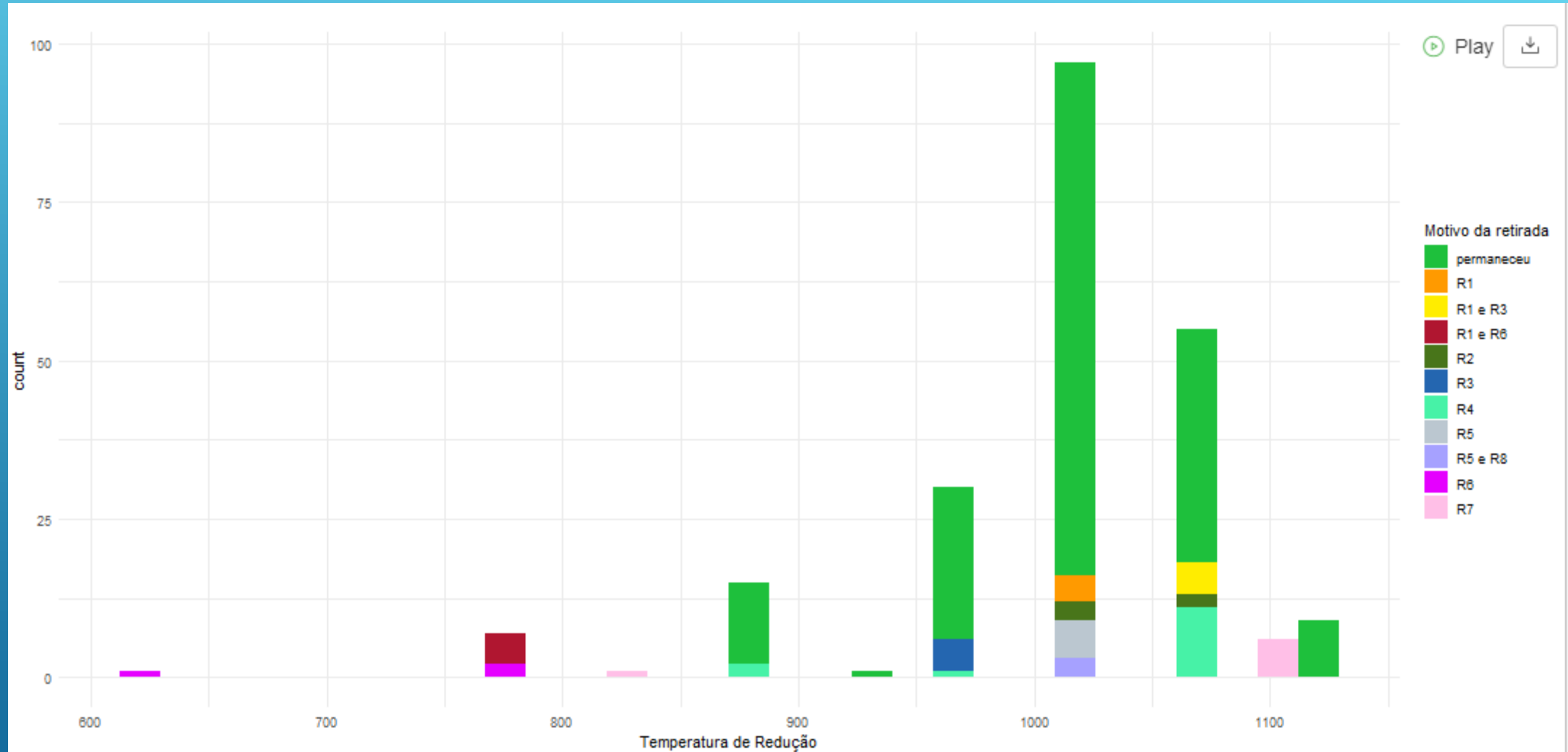
Temperatura de calcinação



Retirados dados superior à 1250 – 9 dados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

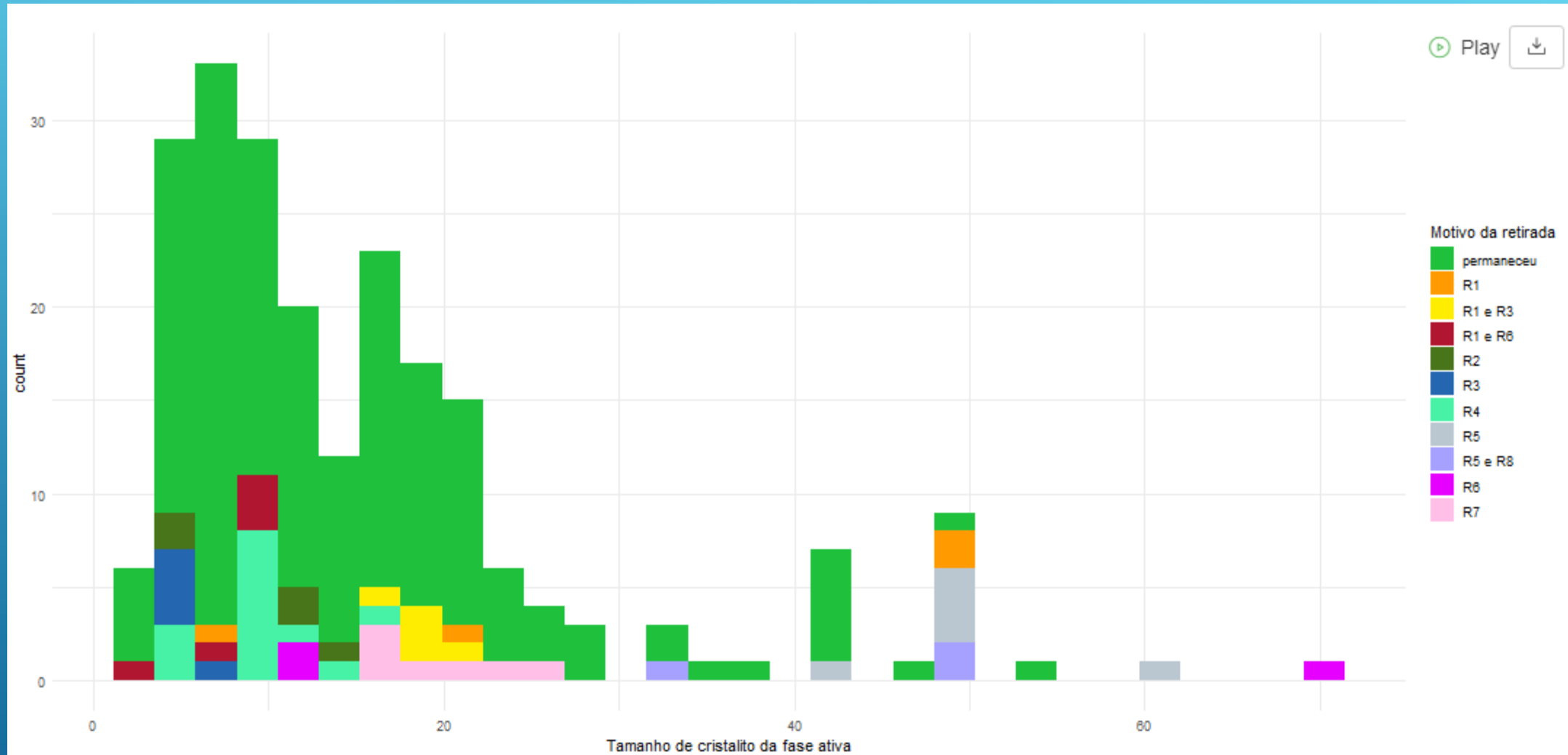
Temperatura de redução



Retirados dados inferior à 800 – 3 dados

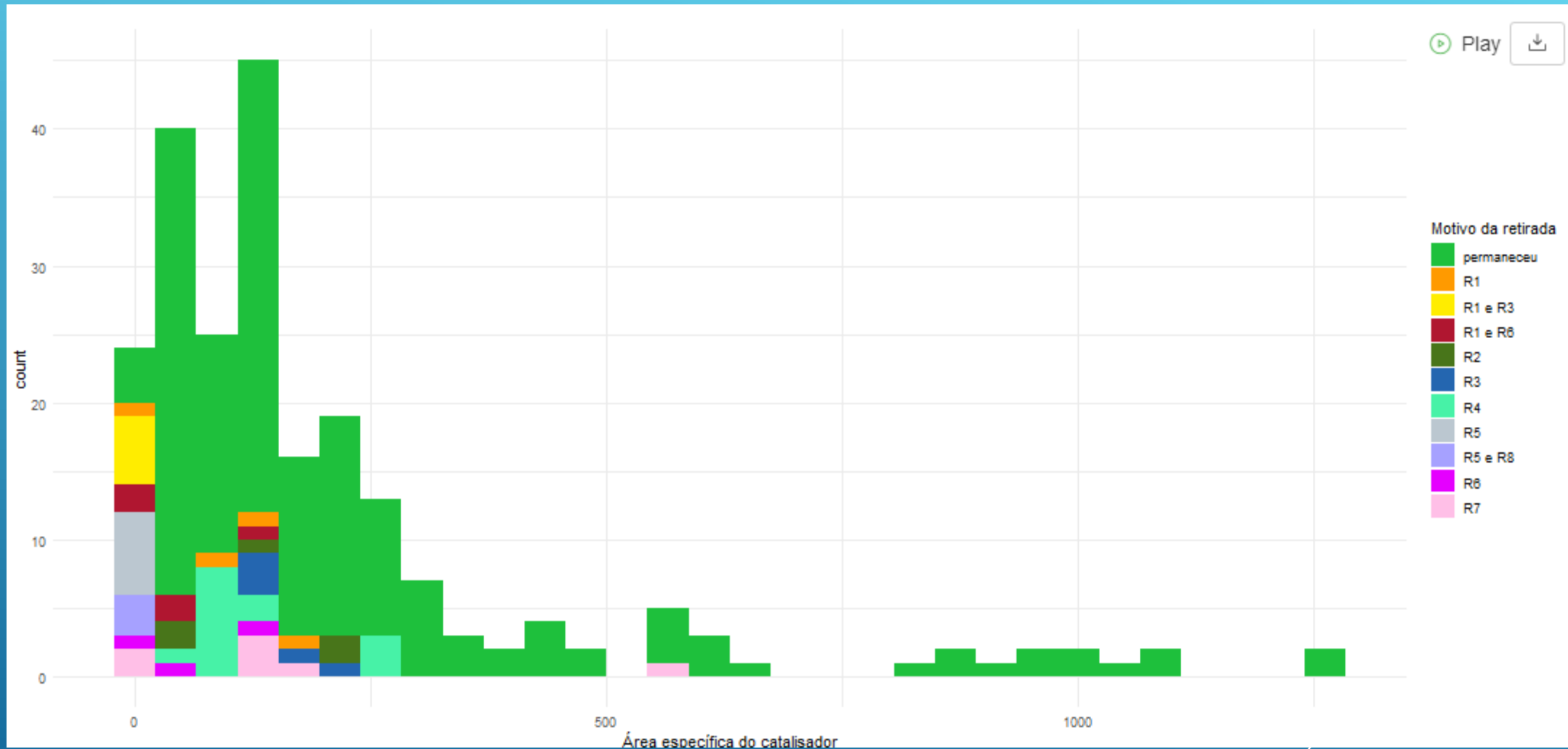
R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

Tamanho de cristalito da fase ativa



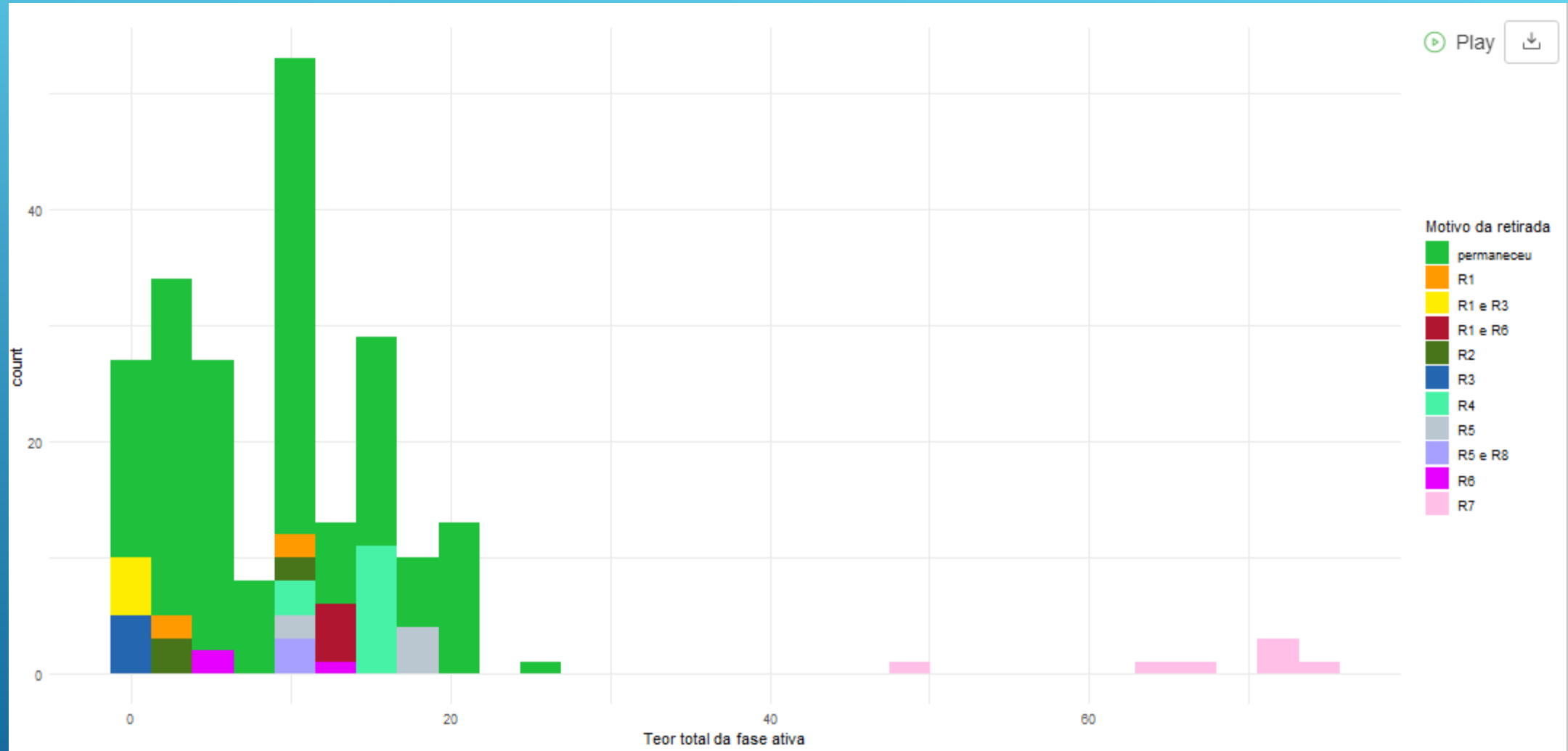
R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

Área específica do catalisador



R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

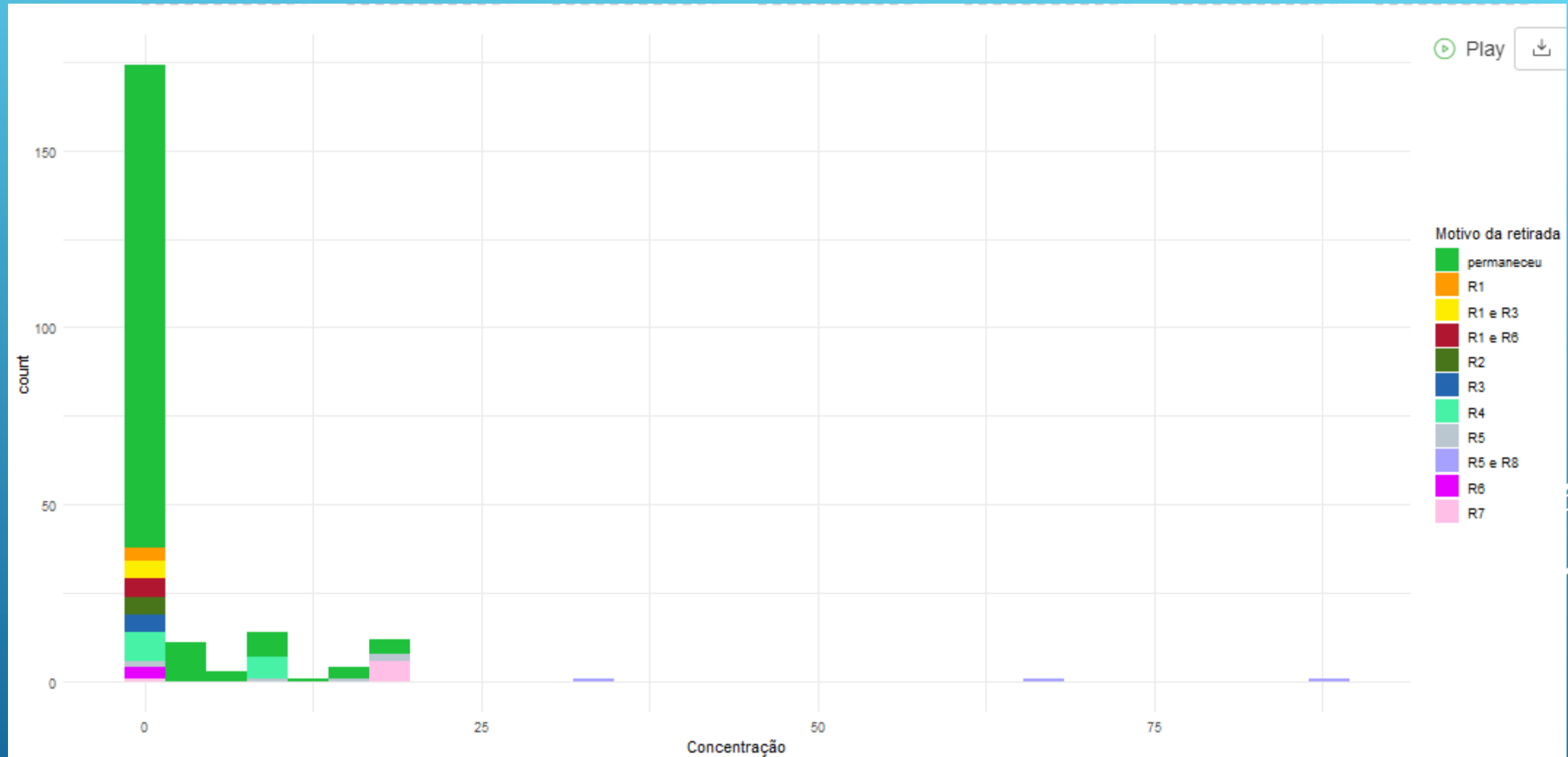
Teor total da fase ativa



Retirados dados superior à 40 – 7 dados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

Concentração



Retirados dados superior à 25 – Já haviam sido retirados

R1- Fator de estabilidade superior à 2 / R2- Razão alimentação superior à 1,2 / R3- Razão inerte/metano superior à 4 / R4- WSHV superior à 500 / R5- Temp. calcinação superior à 1250/ R6- Temp. redução inferior à 800 / R7- Teor da fase ativa superior à 40 / R8- Concentração superior à 25

Fazendo a limpeza

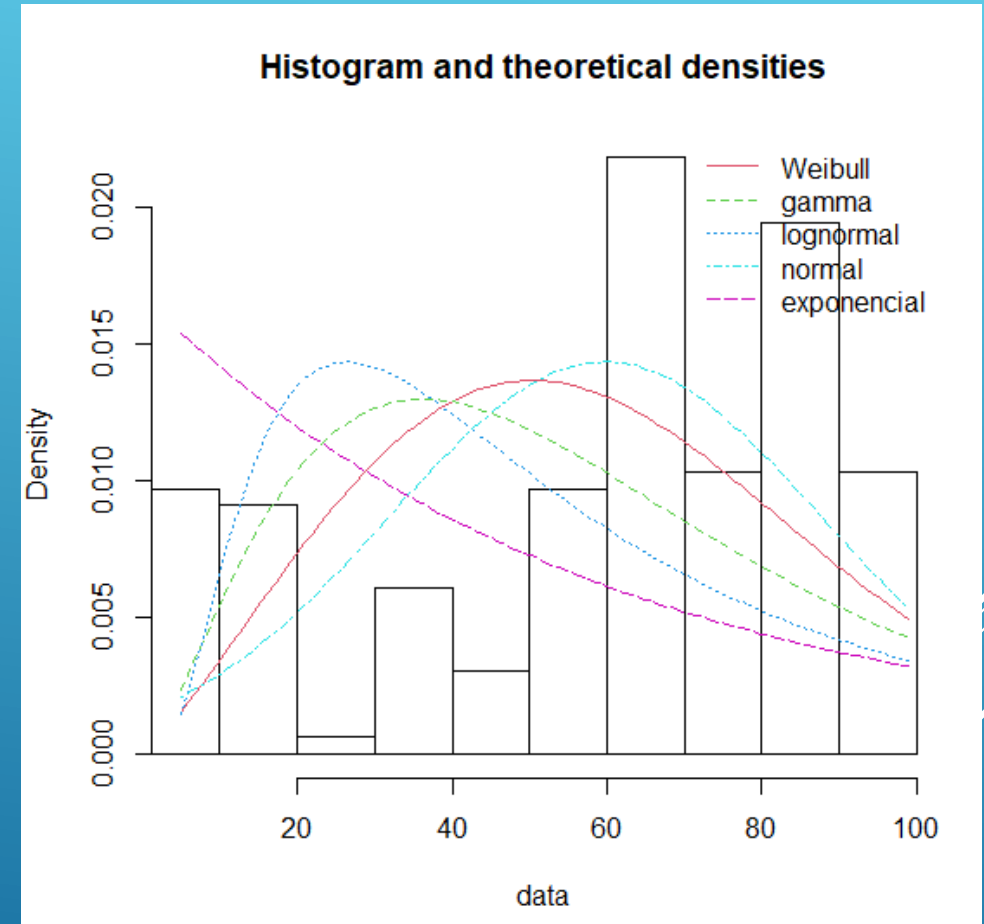
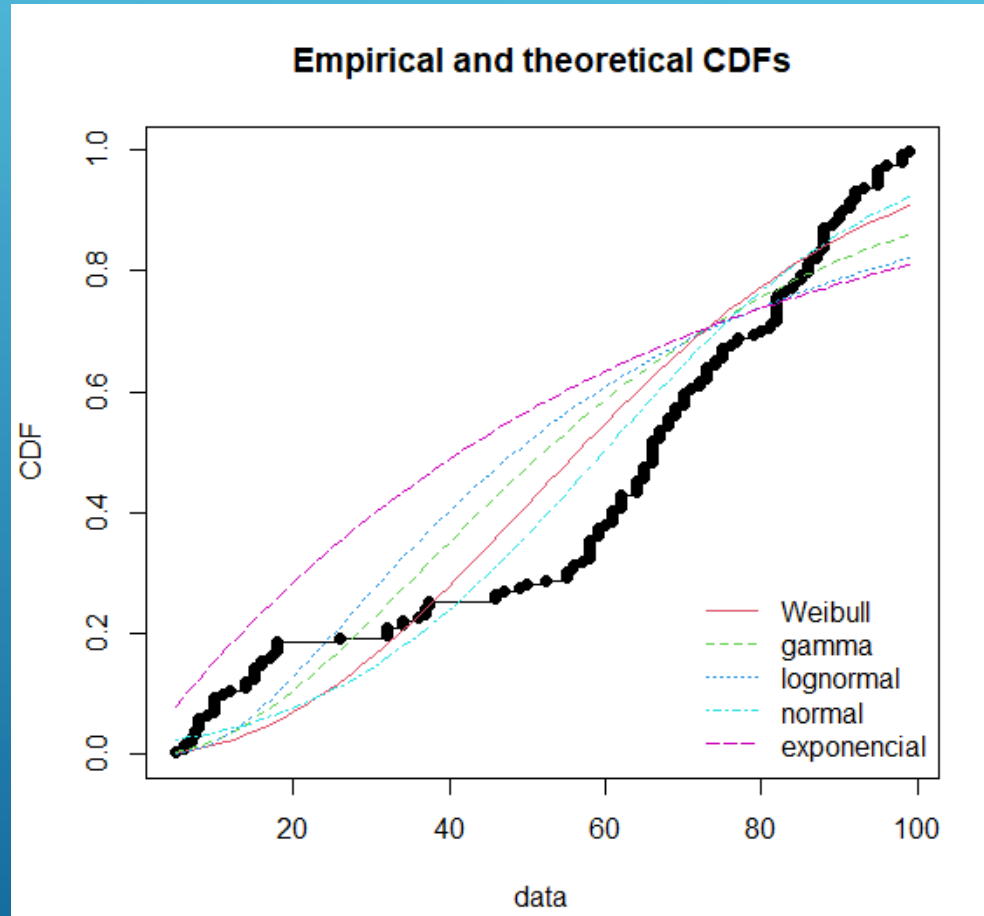
database

165 obs. of 14 variables

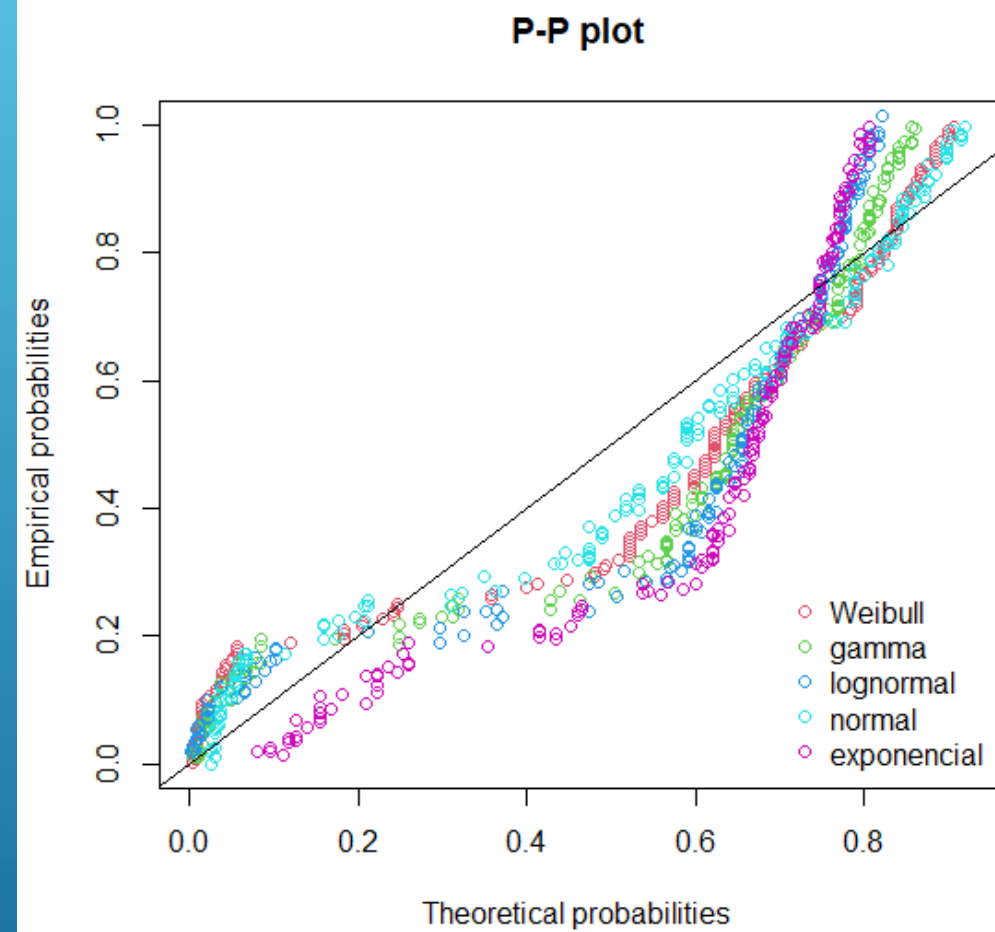
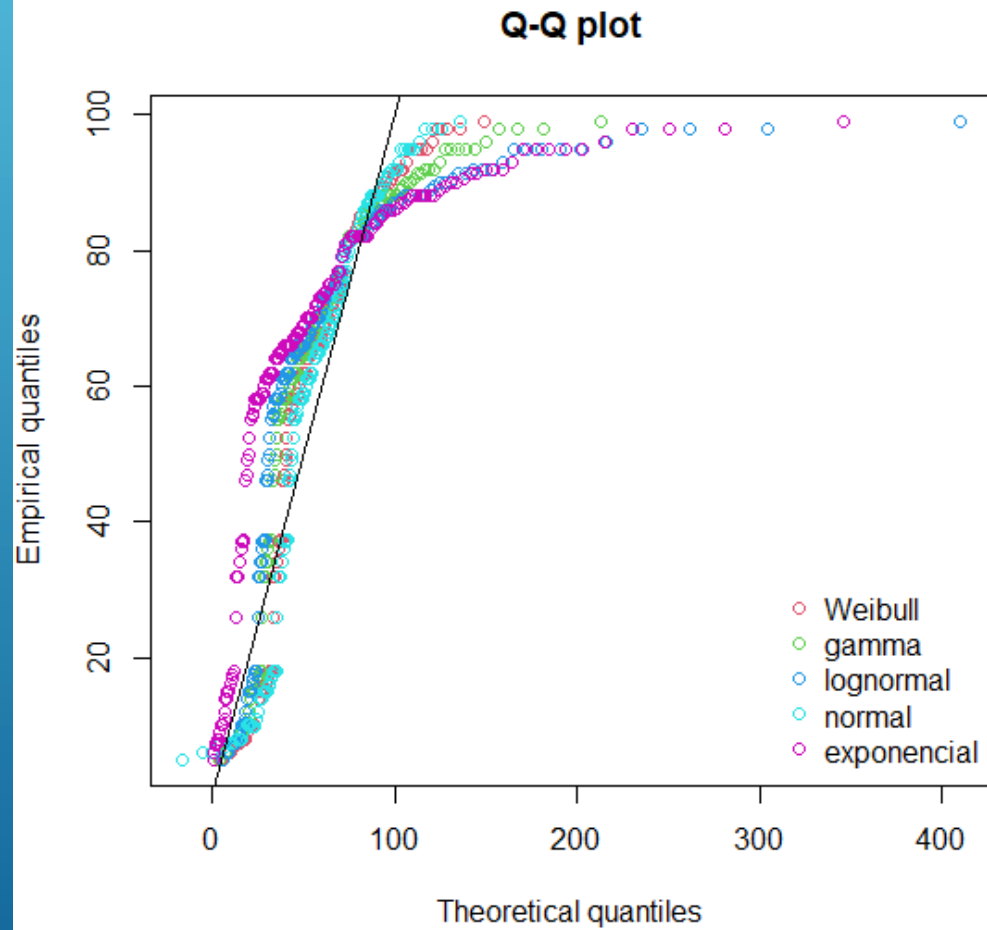


	Shapiro-wilk		Distribuição gamma		Log normal
	w	p-value	V	p-value	p-value
Conversão	0,8966	2,40E-09	-8,1327	8,89E-09	4,69E-15
Fator de estabilidade	0,93895	1,63E-06	-4,862	5,86E-04	6,46E-12
Razão molar CH ₄ /CO ₂ na alimentação do reator	NA	NA	NA	NA	NA
Razão molar inerte/metano	0,70018	2,20E-16	NaN	NA	NA
WHSV	0,71222	2,20E-16	-1,9712	1,63E-01	2,74E-12
Temperatura de reação	0,8044	1,37E-13	-10,377	2,17E-13	1,41E-14
Temperatura de Calcinação	0,92224	9,72E-08	-1,6909	2,32E-01	4,00E-08
Temperatura de Redução	0,84088	4,07E-12	-6,8007	1,52E-06	6,73E-13
Tamanho de cristalito da fase ativa	0,84791	8,31E-12	2,5569	7,06E-02	2,00E-02
Área específica do catalisador	0,73061	4,66E-16	3,2532	2,14E-02	6,63E-03
Teor total da fase ativa	0,92945	3,13E-07	-3,6263	1,03E-02	2,86E-09
Concentração	0,45007	2,20E-16	NaN	NA	NA

Conversão

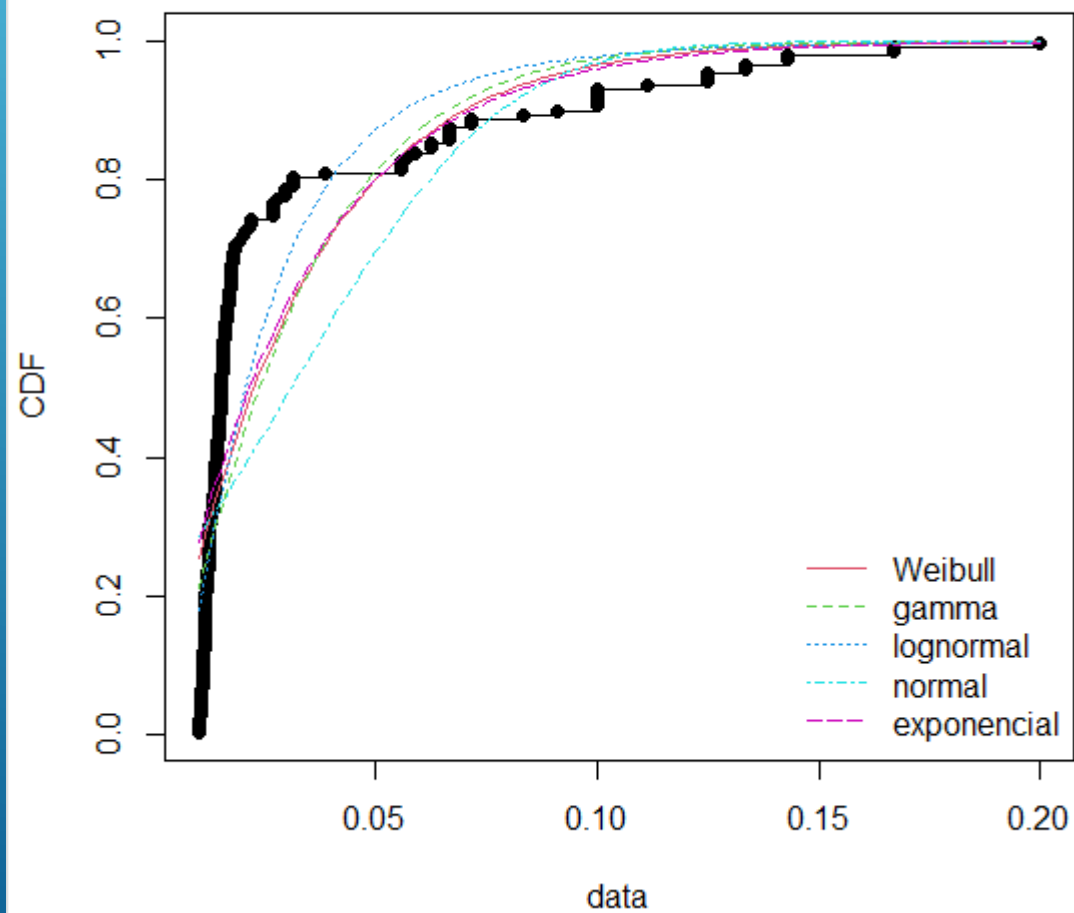


Conversão

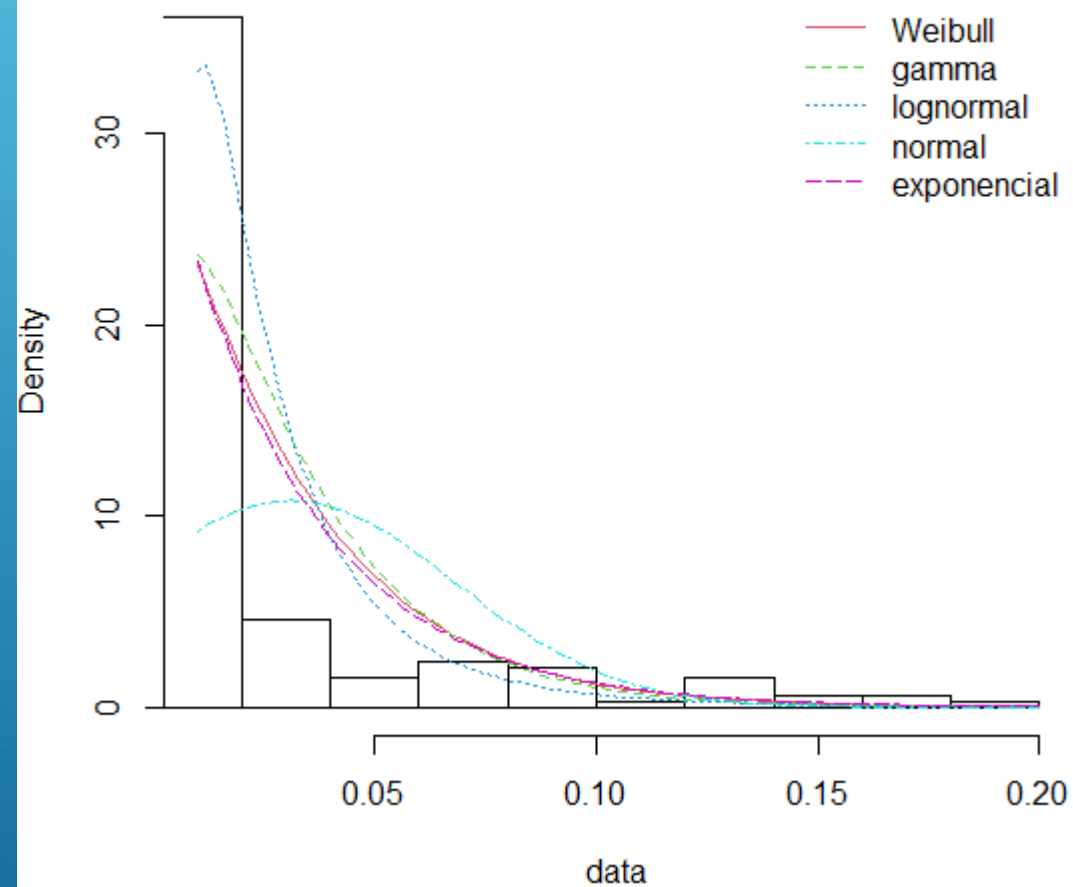


Inverso da Conversão

Empirical and theoretical CDFs

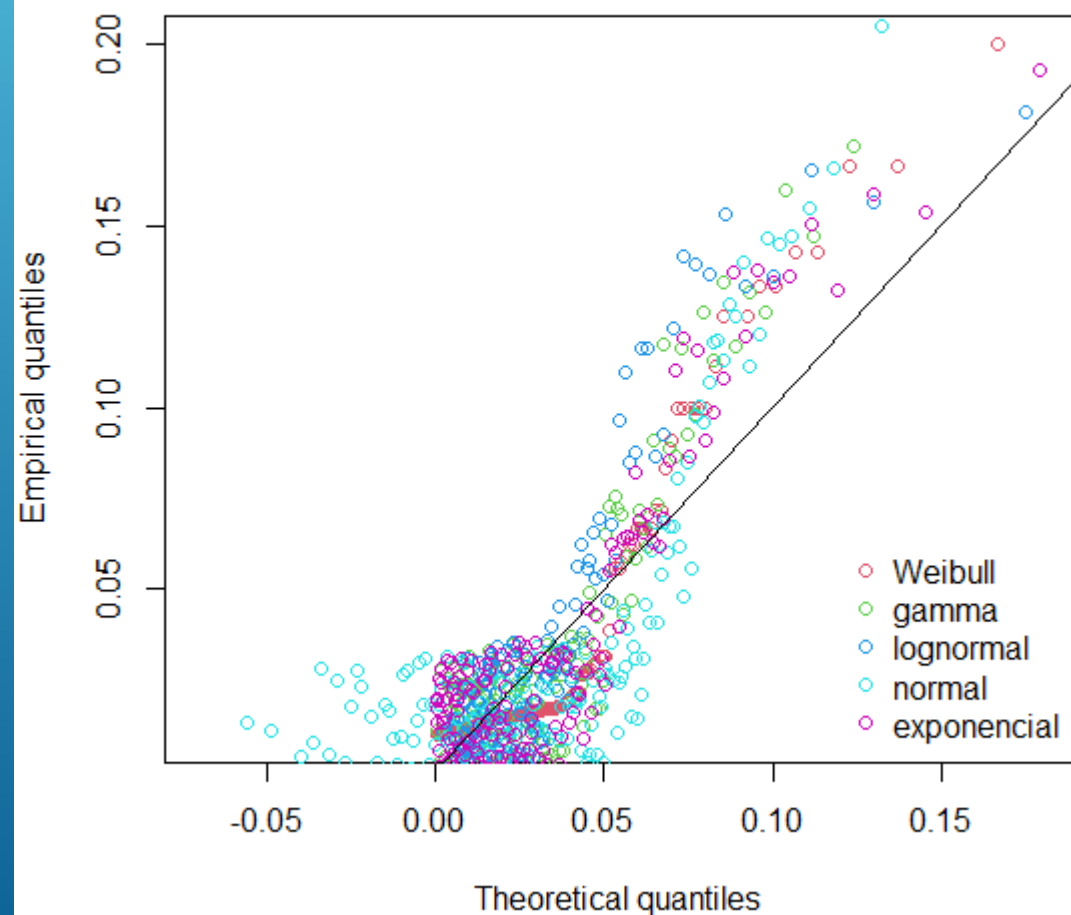


Histogram and theoretical densities

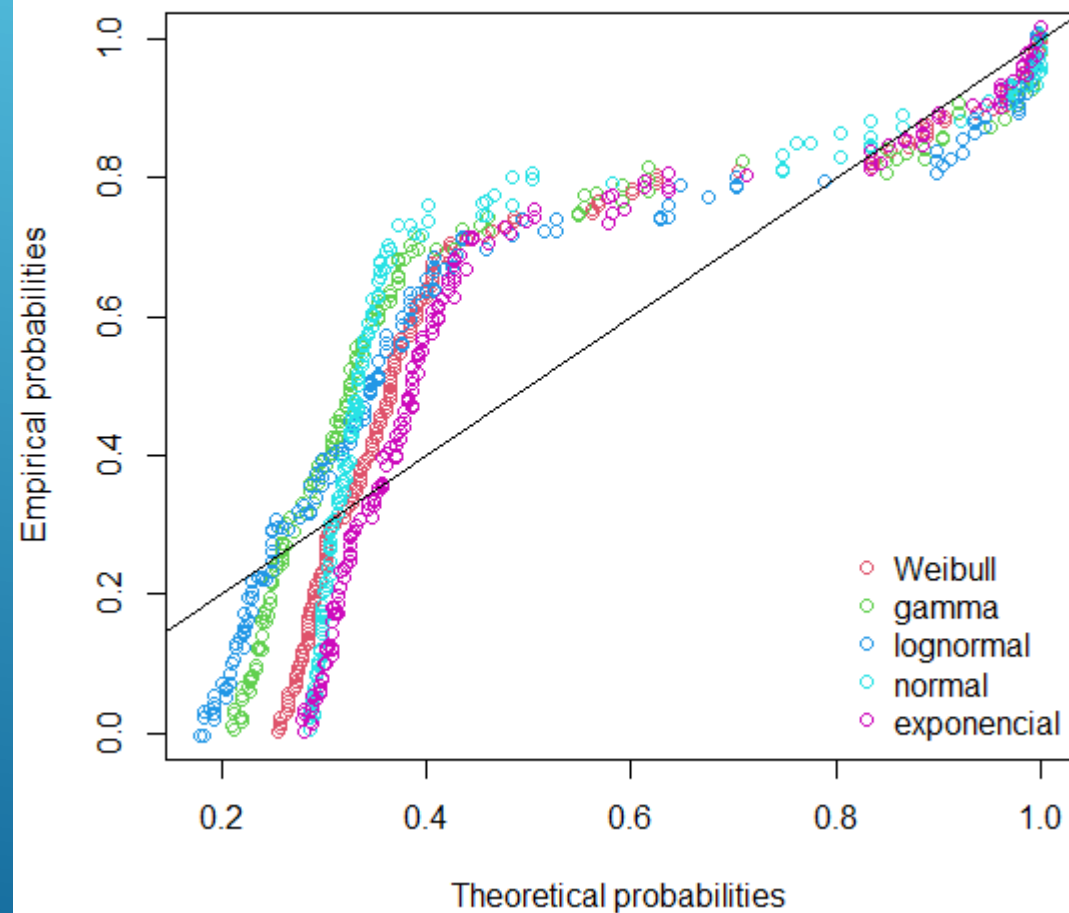


Inverso da Conversão

Q-Q plot



P-P plot



Inverso da Conversão

Goodness-of-fit statistics

	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.2857372	0.3179063	0.2738034	0.3444473
Cramer-von Mises statistic	3.7394400	4.1702483	2.9978868	5.7430975
Anderson-Darling statistic	19.0923962	20.9946257	16.0439888	28.5184007

	exponencial
Kolmogorov-Smirnov statistic	0.2784292
Cramer-von Mises statistic	3.5865221
Anderson-Darling statistic	18.5007047

Goodness-of-fit criteria

	weibull	gamma	lognormal	normal
Akaike's Information Criterion	-814.0492	-822.2948	-890.9423	-616.5504
Bayesian Information Criterion	-807.8373	-816.0829	-884.7304	-610.3385

	exponencial
Akaike's Information Criterion	-814.8351
Bayesian Information Criterion	-811.7291

Hartigans' dip test for unimodality / multimodality

```
data: inv
D = 0.029235, p-value = 0.4201
alternative hypothesis: non-unimodal, i.e., at least bimodal
```

```
> is.amodal(inv)
[1] FALSE
> is.unimodal(inv)
[1] TRUE
> is.bimodal(inv)
[1] FALSE
> is.trimodal(inv)
[1] FALSE
> is.iterquad(inv)
[1] FALSE
> bimodality_coefficient(inv)
[1] 0.8057431
```

Conversão

Goodness-of-fit statistics

	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.2001229	0.2441155	0.2738034	0.1537622
Cramer-von Mises statistic	1.5937753	2.3104726	2.9978868	0.9197814
Anderson-Darling statistic	10.4878638	12.5907609	16.0439888	5.9080474

	exponencial
Kolmogorov-Smirnov statistic	0.3107886
Cramer-von Mises statistic	4.1678573
Anderson-Darling statistic	20.6709371

Goodness-of-fit criteria

	weibull	gamma	lognormal	normal
Akaike's Information Criterion	1587.492	1620.490	1670.184	1569.933
Bayesian Information Criterion	1593.704	1626.702	1676.396	1576.145

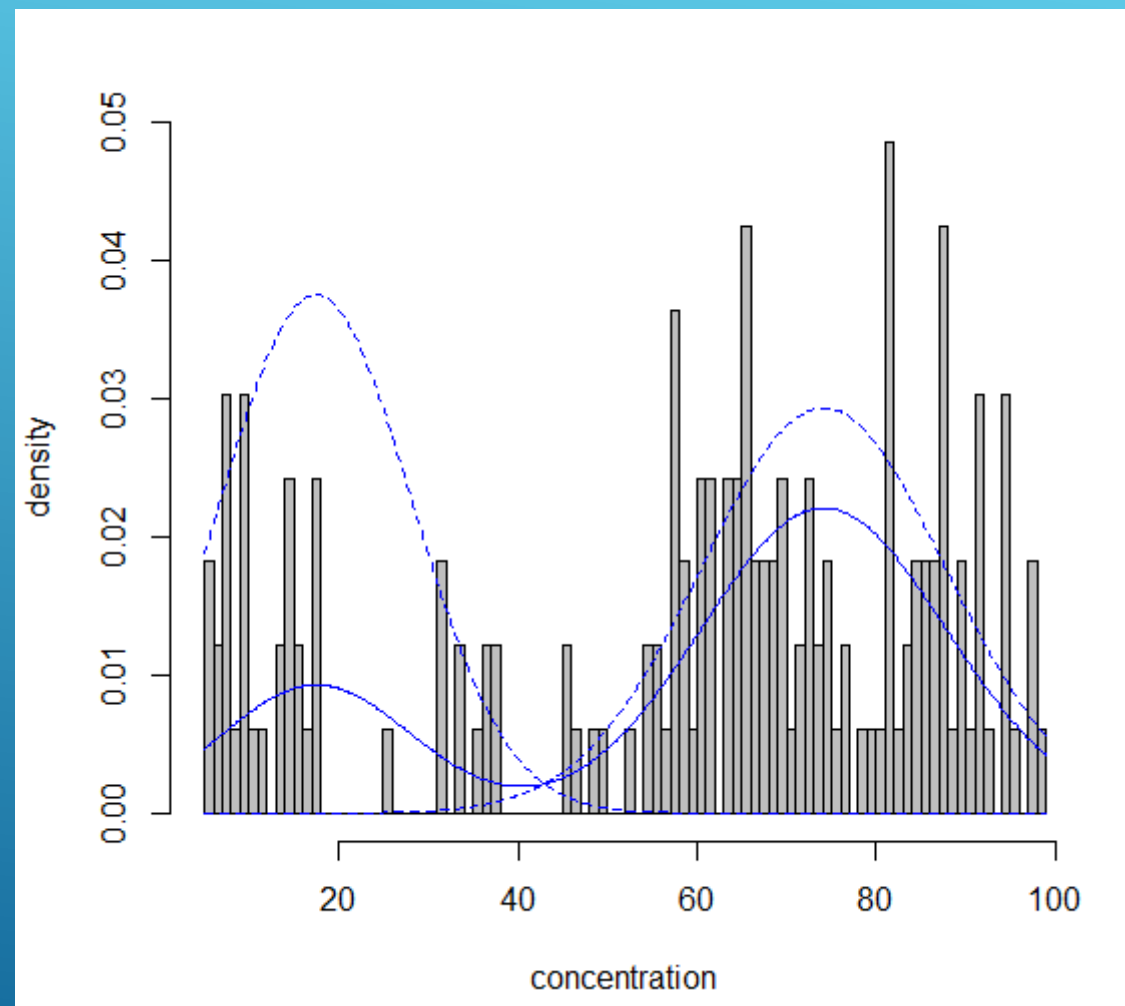
	exponencial
Akaike's Information Criterion	1681.741
Bayesian Information Criterion	1684.847

Hartigans' dip test for unimodality / multimodality

```
data: database$Conversão
D = 0.056121, p-value = 0.0005337
alternative hypothesis: non-unimodal, i.e., at least bimodal
```

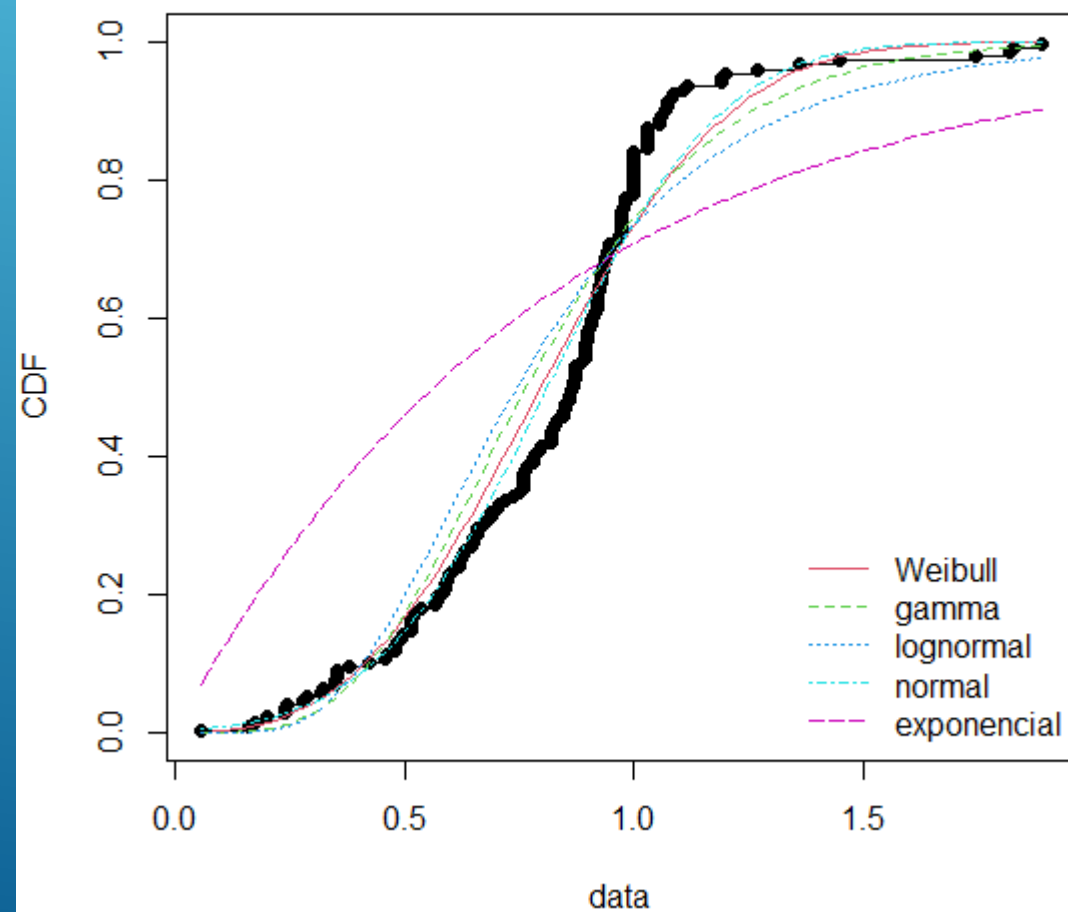
```
> is.amodal(database$`Conversão`)
[1] FALSE
> is.unimodal(database$`Conversão`)
[1] FALSE
> is.bimodal(database$`Conversão`)
[1] TRUE
> is.trimodal(database$`Conversão`)
[1] FALSE
> is.iterquad(database$`Conversão`)
[1] FALSE
> bimodality_coefficient(database$`Conversão`)
[1] 0.6346369
>
```

Conversão

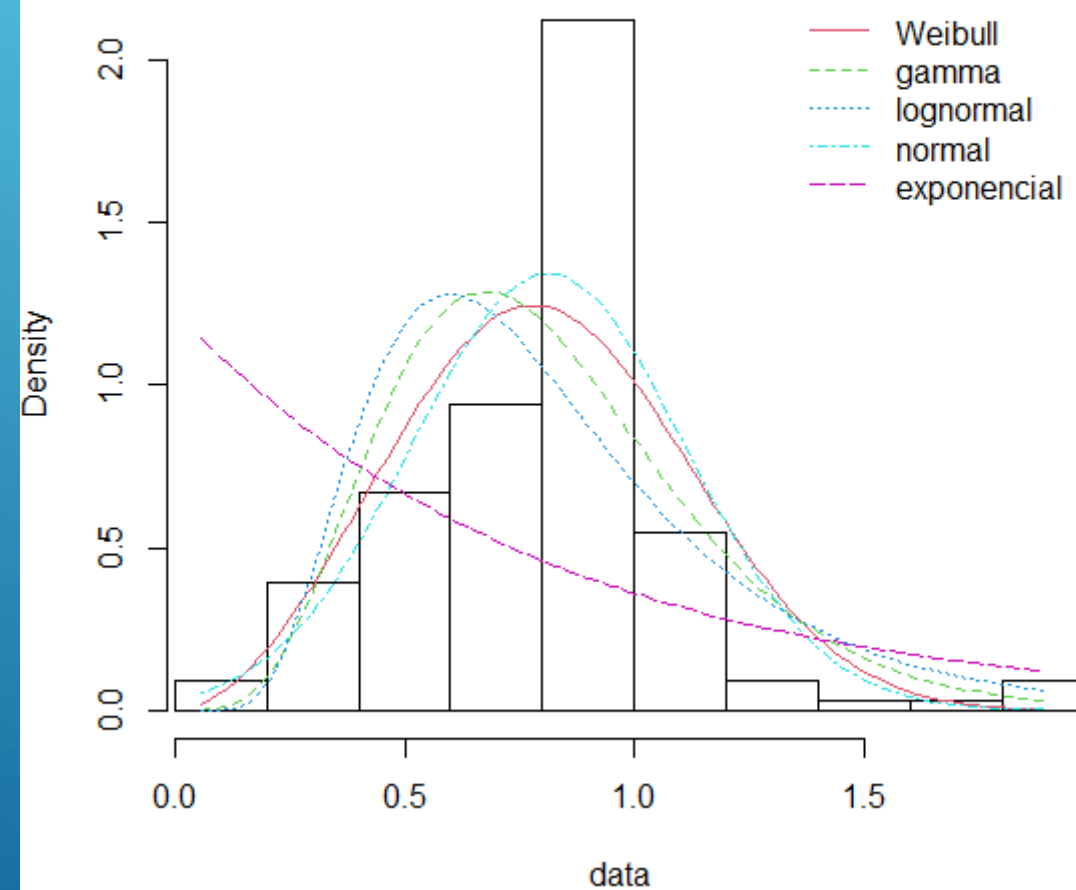


Fator de estabilidade

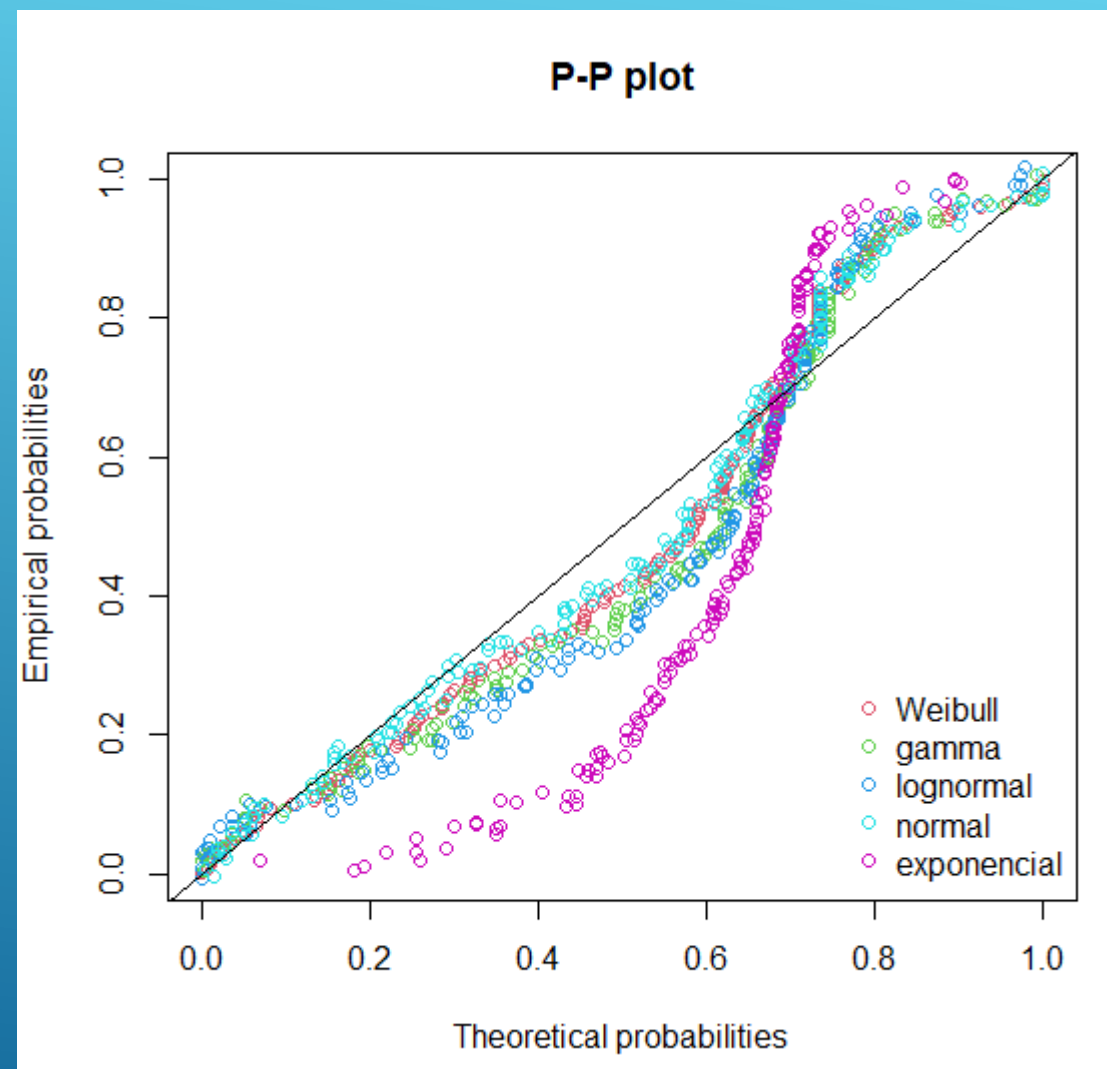
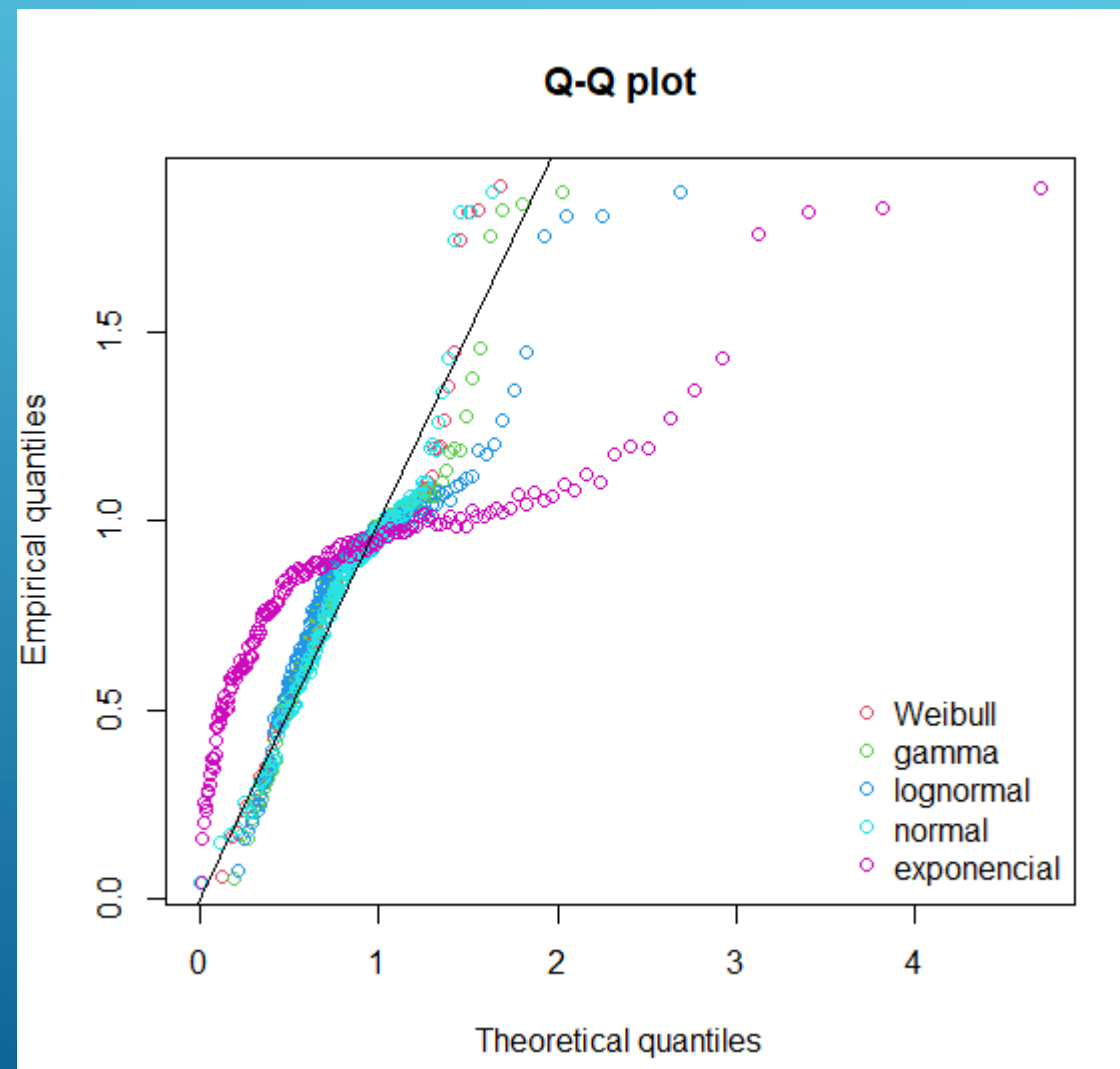
Empirical and theoretical CDFs



Histogram and theoretical densities



Fator de estabilidade



Fator de estabilidade

Goodness-of-fit statistics

	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.1165466	0.1438340	0.1650926	0.1116750
Cramer-von Mises statistic	0.6141825	0.9828807	1.4346944	0.4398934
Anderson-Darling statistic	3.5536416	5.2787641	7.6941885	2.7459802

	exponencial
Kolmogorov-Smirnov statistic	0.3301597
Cramer-von Mises statistic	6.5613700
Anderson-Darling statistic	32.2440178

Goodness-of-fit criteria

	weibull	gamma	lognormal	normal
Akaike's Information Criterion	75.99982	91.11863	124.3662	72.25169
Bayesian Information Criterion	82.21172	97.33053	130.5781	78.46359

	exponencial
Akaike's Information Criterion	263.6670
Bayesian Information Criterion	266.7729

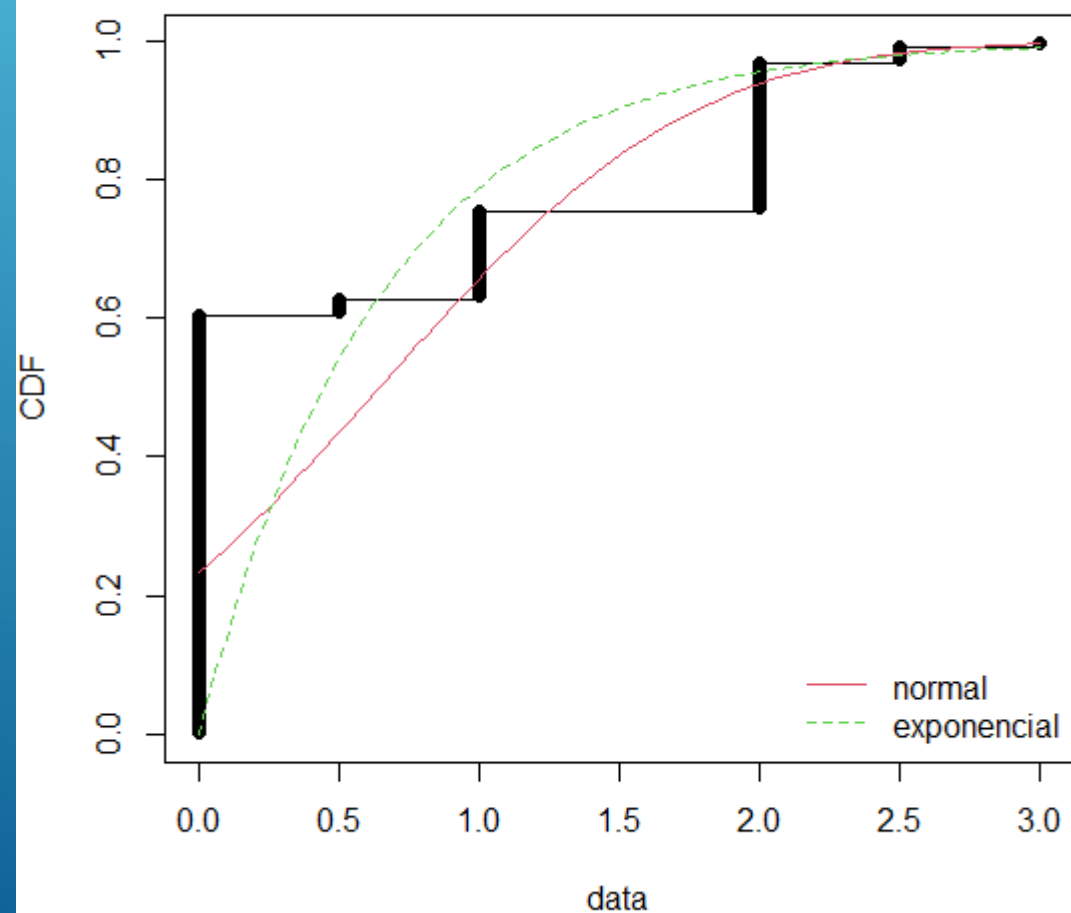
Hartigans' dip test for unimodality / multimodality

```
data: database$`Fator de estabilidade`  
D = 0.025377, p-value = 0.6784  
alternative hypothesis: non-unimodal, i.e., at least bimodal
```

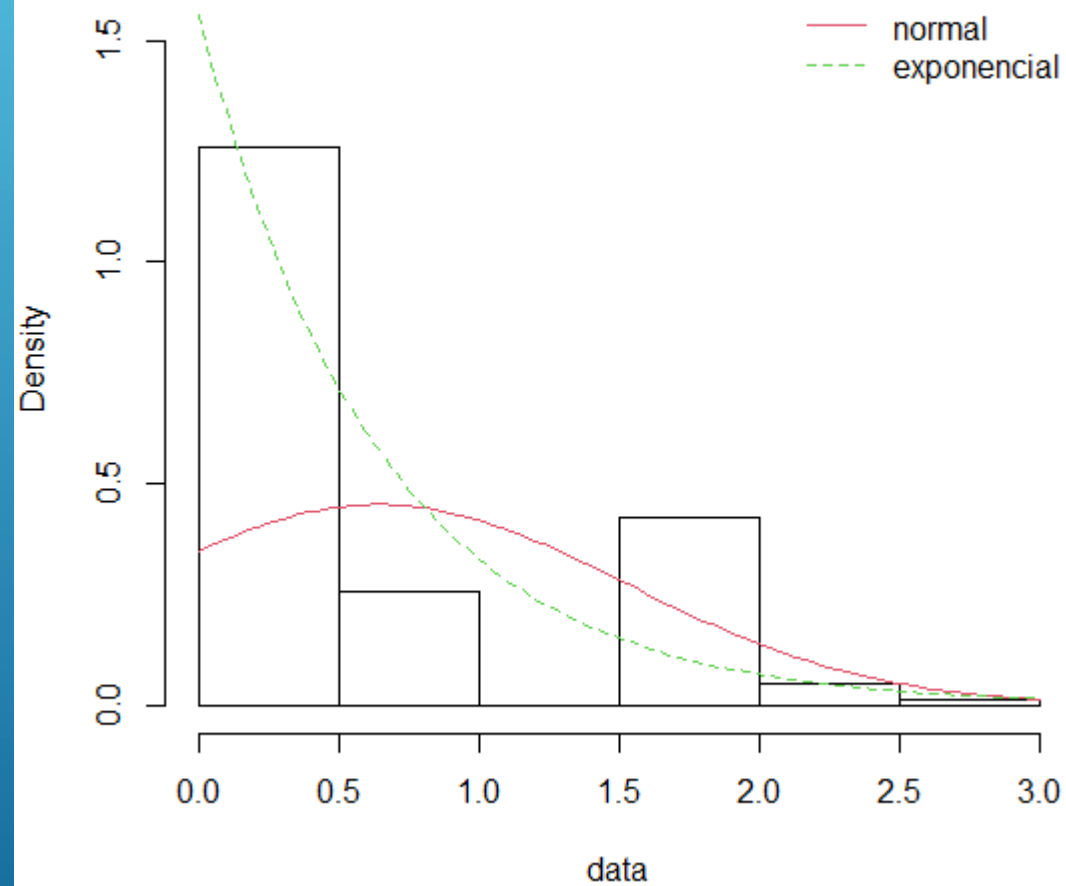
```
> is.amodal(database$`Fator de estabilidade`)  
[1] FALSE  
> is.unimodal(database$`Fator de estabilidade`)  
[1] TRUE  
> is.bimodal(database$`Fator de estabilidade`)  
[1] FALSE  
> is.trimodal(database$`Fator de estabilidade`)  
[1] FALSE  
> is.iterquad(database$`Fator de estabilidade`)  
[1] FALSE  
> bimodality_coefficient(database$`Fator de estabilidade`)  
[1] 0.2288406
```

Razão molar inerte/metano

Empirical and theoretical CDFs

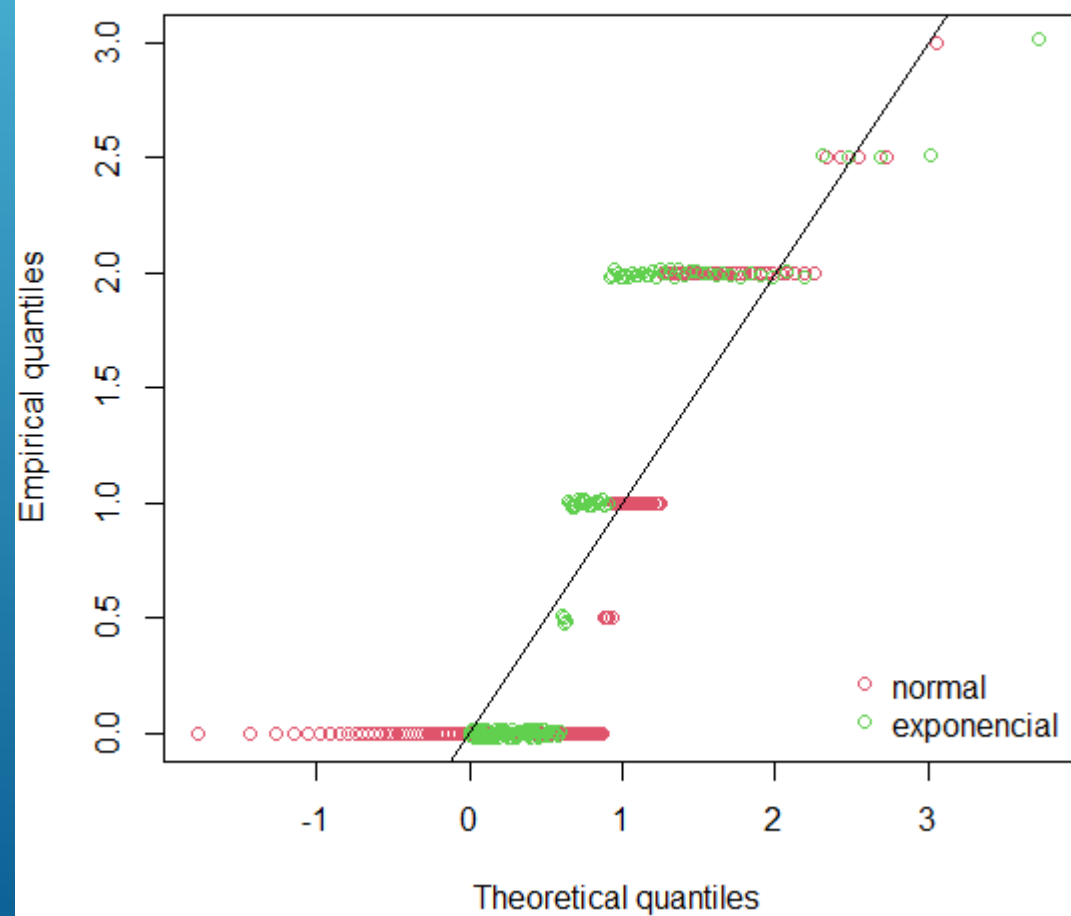


Histogram and theoretical densities

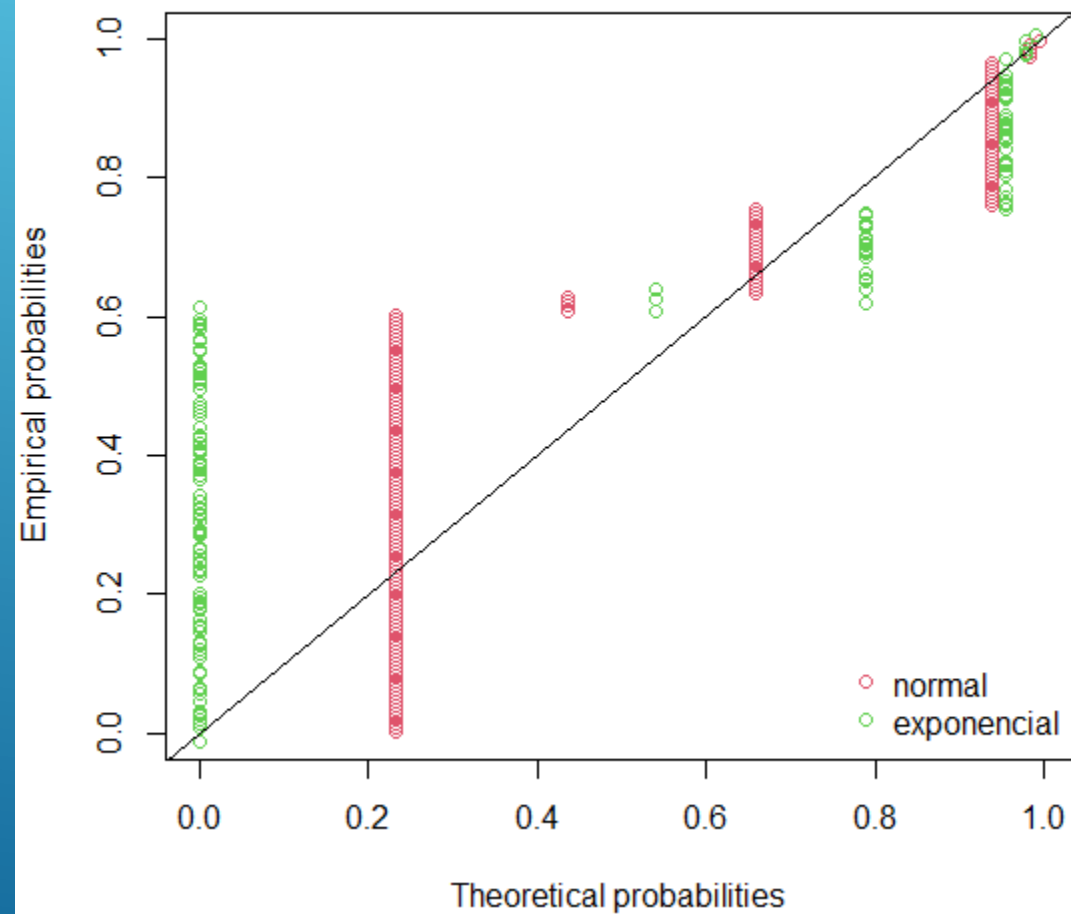


Razão molar inerte/metano

Q-Q plot



P-P plot



Razão molar inerte/metano

Goodness-of-fit statistics

	normal	exponencial
Kolmogorov-Smirnov statistic	0.3732631	0.6060606
Cramer-von Mises statistic	4.0708275	12.9136242
Anderson-Darling statistic	23.3491175	Inf

Goodness-of-fit criteria

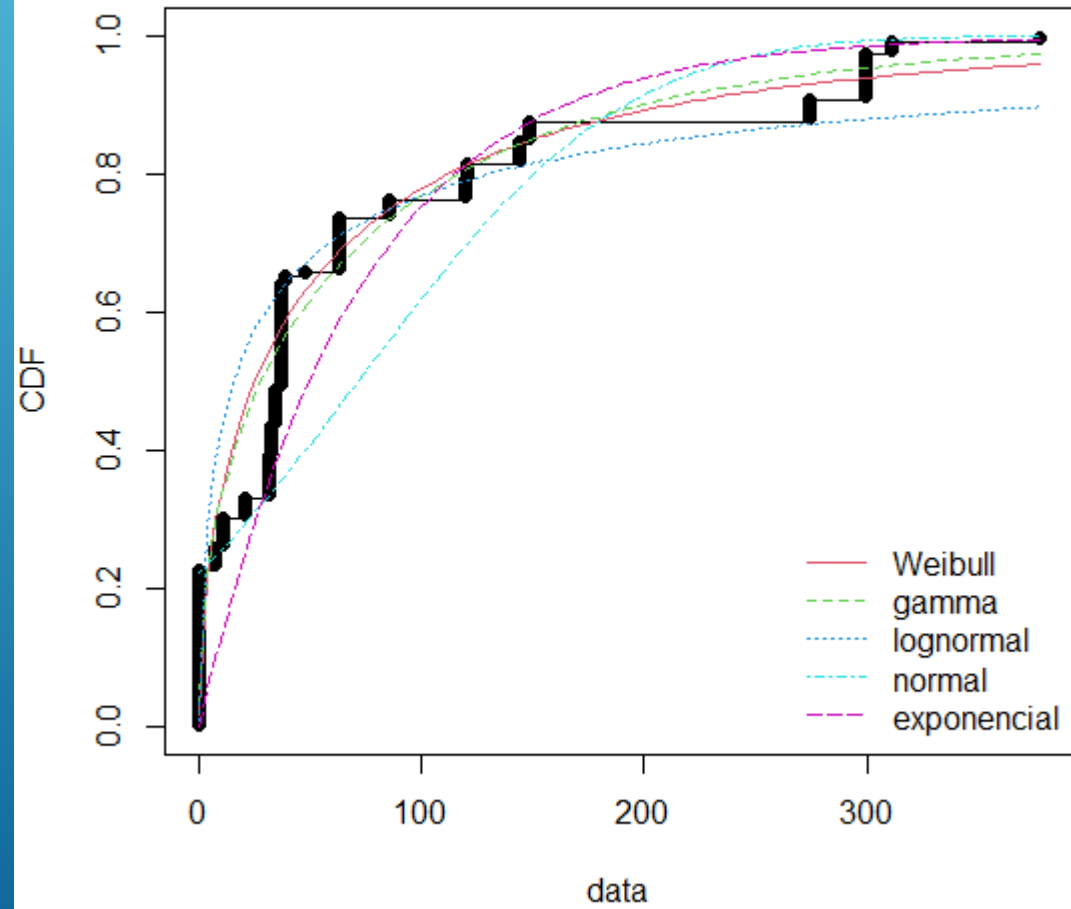
	normal	exponencial
Akaike's Information Criterion	430.2287	185.9729
Bayesian Information Criterion	436.4405	189.0788

Hartigan's dip test for unimodality / multimodality

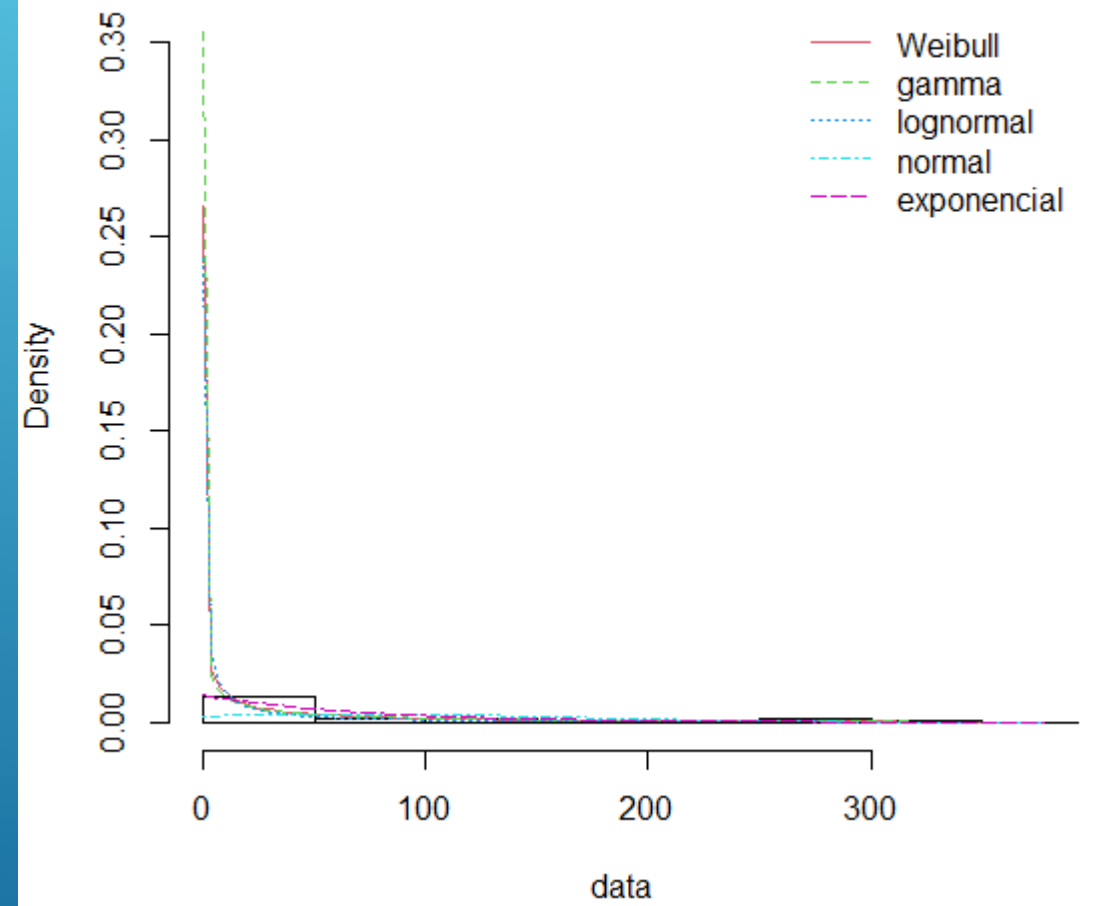
```
data: vari
D = 0.10606, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal
```

```
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] TRUE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.8127566
```

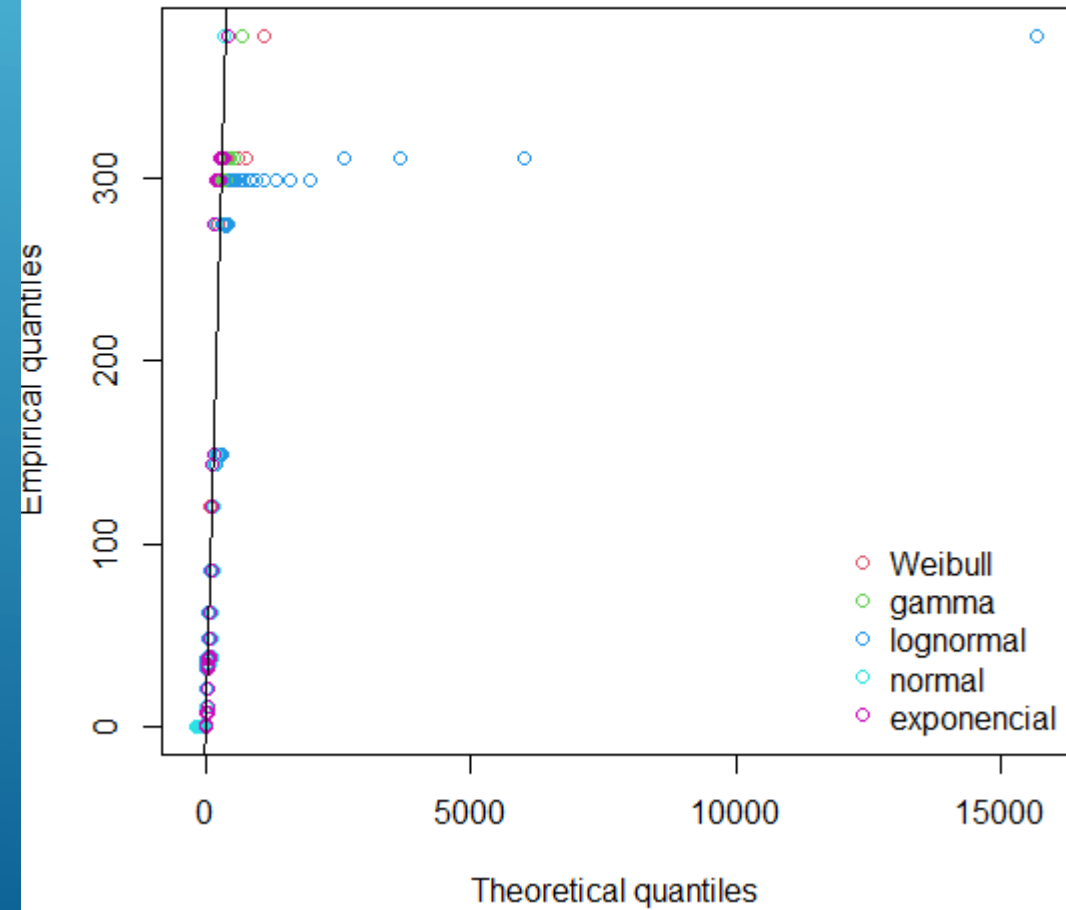
Empirical and theoretical CDFs



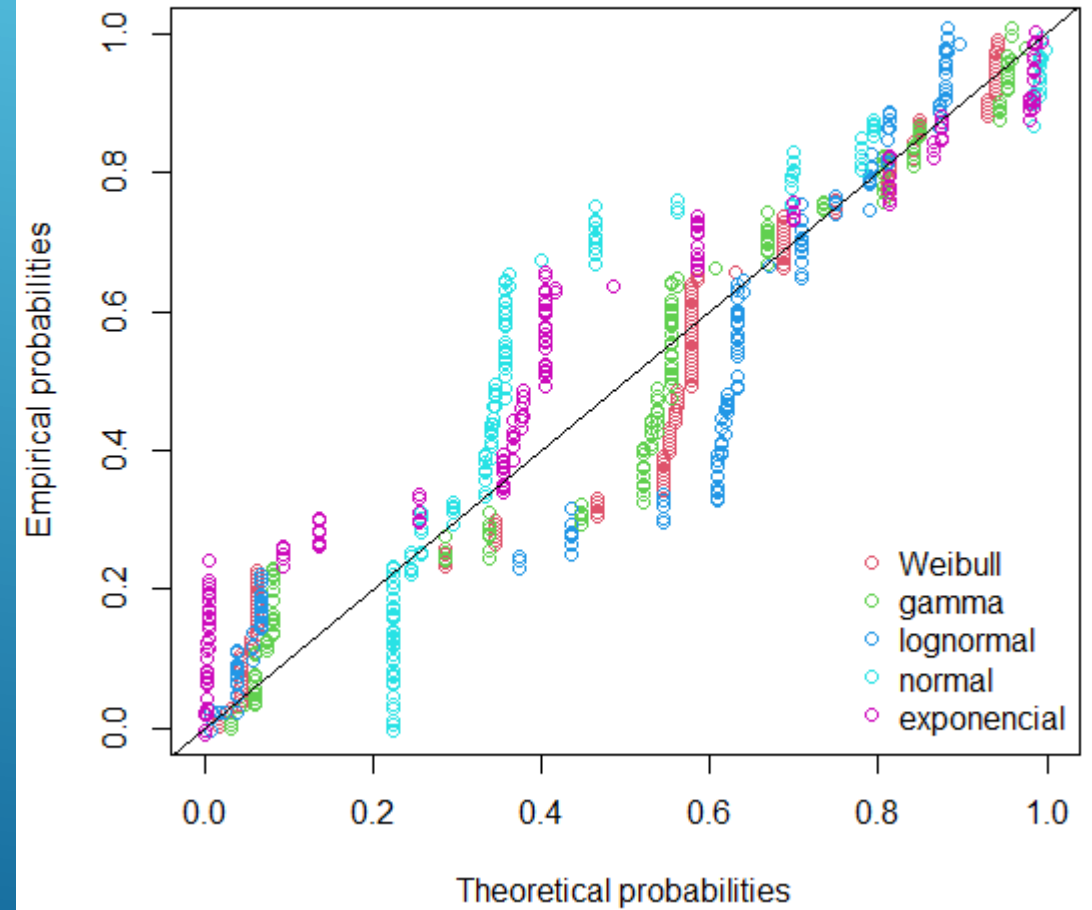
Histogram and theoretical densities



Q-Q plot



P-P plot



WSHV

```
Goodness-of-fit statistics
      weibull      gamma lognormal      normal
Kolmogorov-Smirnov statistic 0.2110521 0.1887511 0.2751249 0.2928212
Cramer-von Mises statistic 1.0649110 0.8230526 2.1463354 3.2663664
Anderson-Darling statistic 6.8708206 4.9844944 11.7555987 18.5463786
      exponencial
Kolmogorov-Smirnov statistic 0.239275
Cramer-von Mises statistic 2.123743
Anderson-Darling statistic 31.424129

Goodness-of-fit criteria
      weibull      gamma lognormal      normal
Akaike's Information Criterion 1640.724 1628.054 1685.528 1970.234
Bayesian Information Criterion 1646.936 1634.266 1691.740 1976.446
      exponencial
Akaike's Information Criterion 1740.985
Bayesian Information Criterion 1744.091
```

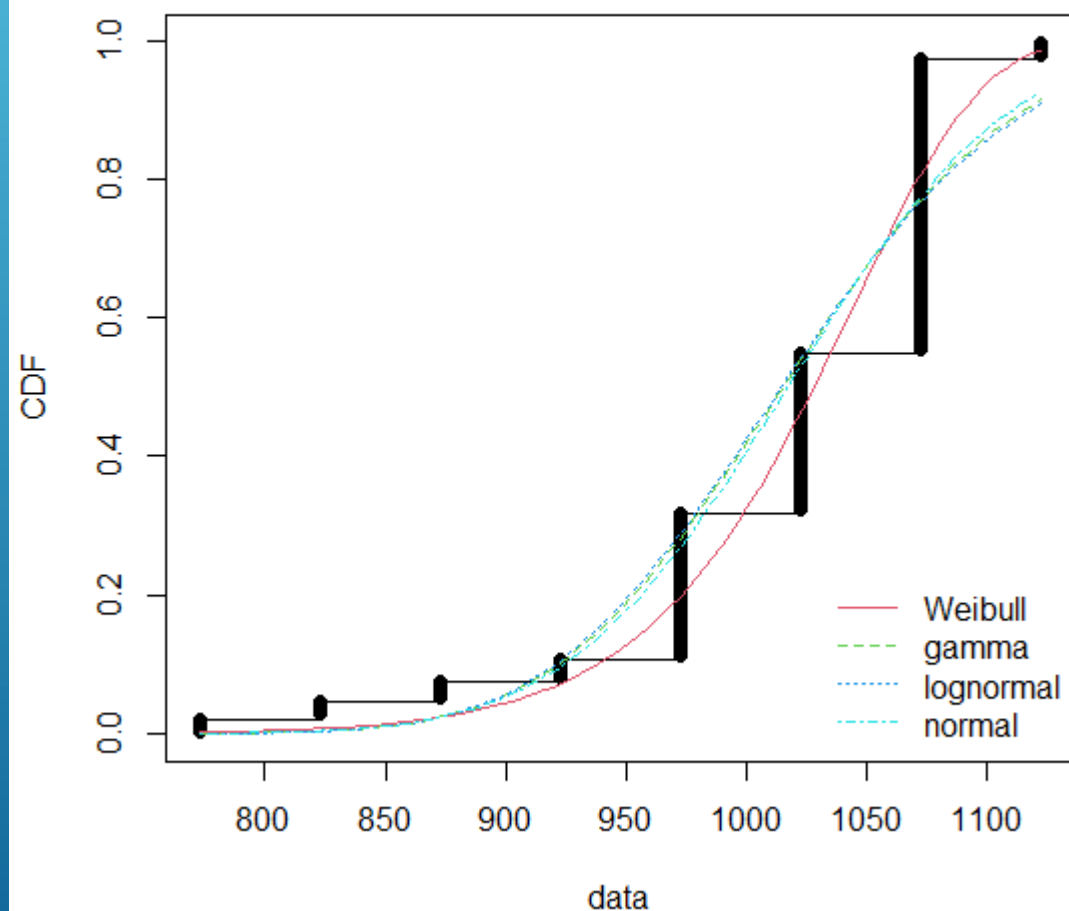
```
Hartigan's dip test for unimodality / multimodality

data: vari
D = 0.11339, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal

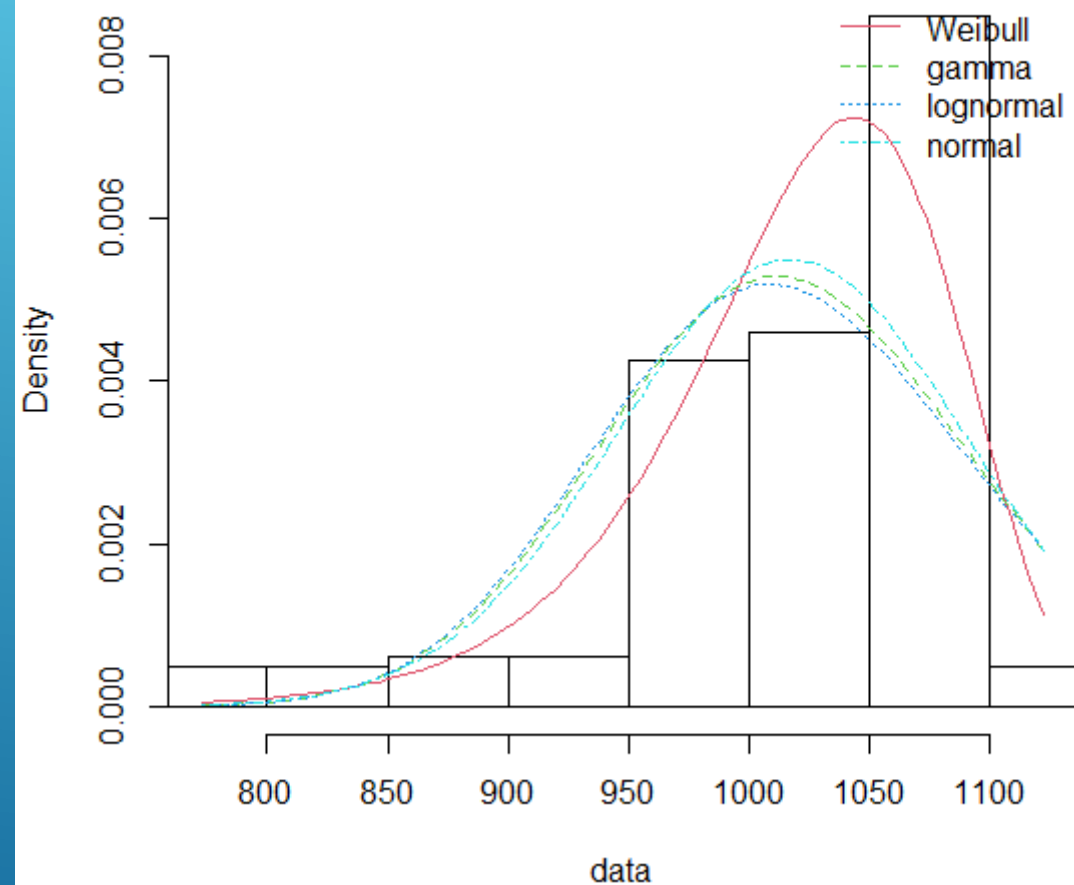
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] TRUE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.8130155
```


Temperatura de reação

Empirical and theoretical CDFs

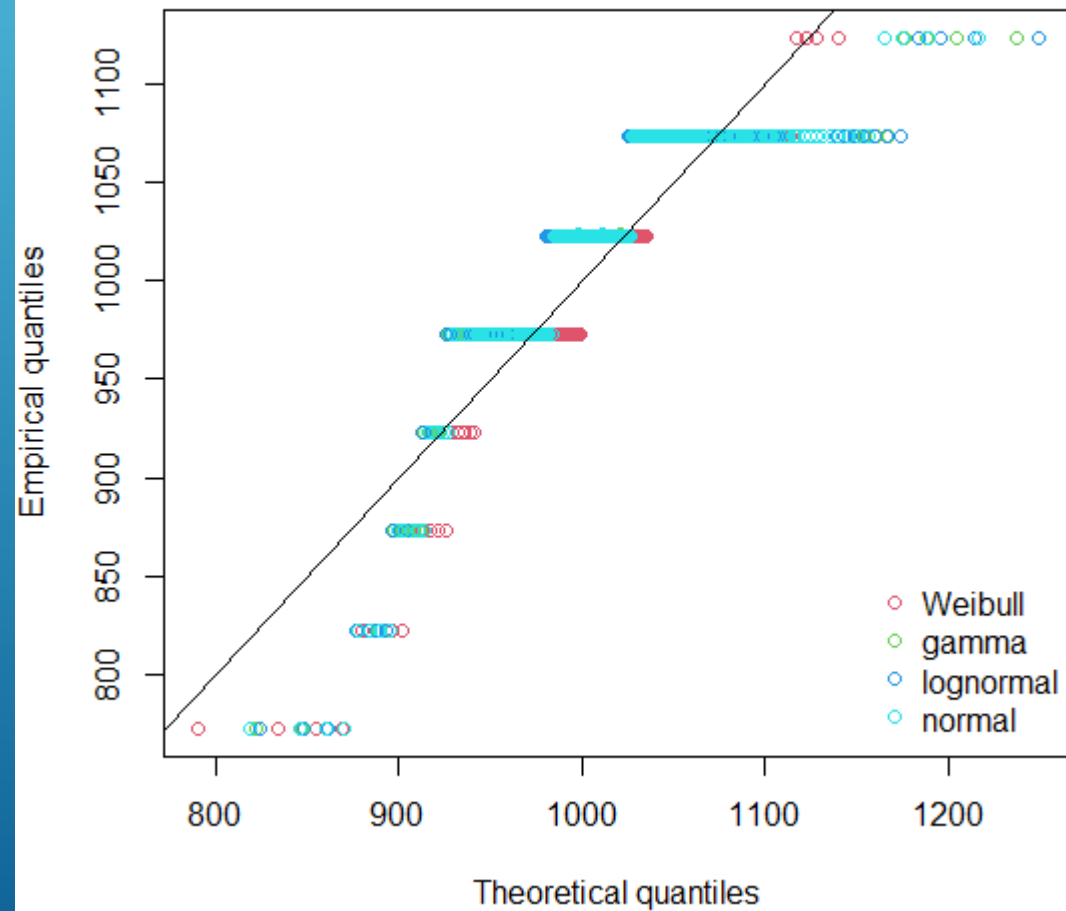


Histogram and theoretical densities

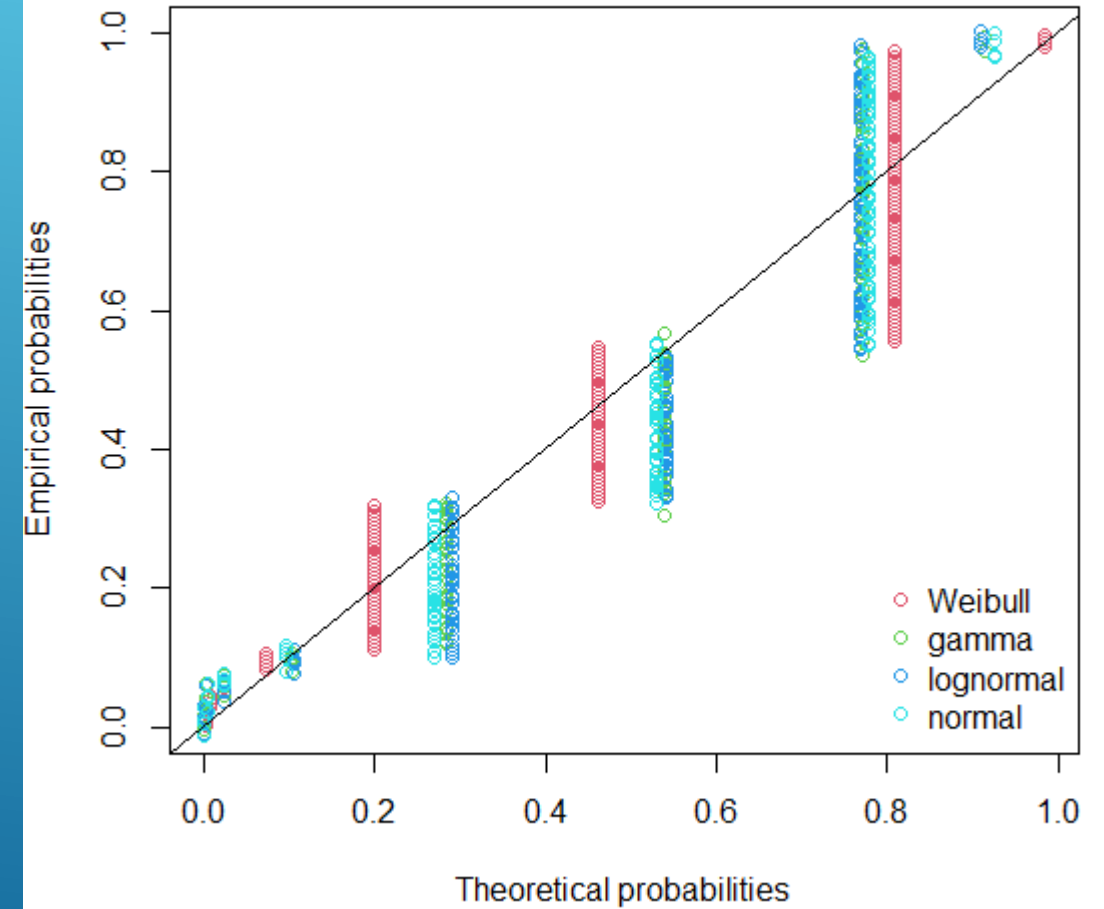


Temperatura de reação

Q-Q plot



P-P plot



Temperatura de reação

```
Goodness-of-fit statistics
```

	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.258270	0.2201686	0.2212901	0.2259482
Cramer-von Mises statistic	1.549880	1.9486912	2.0165668	1.8290064
Anderson-Darling statistic	9.554344	11.7162678	12.0903945	11.0454908


```
Goodness-of-fit criteria
```

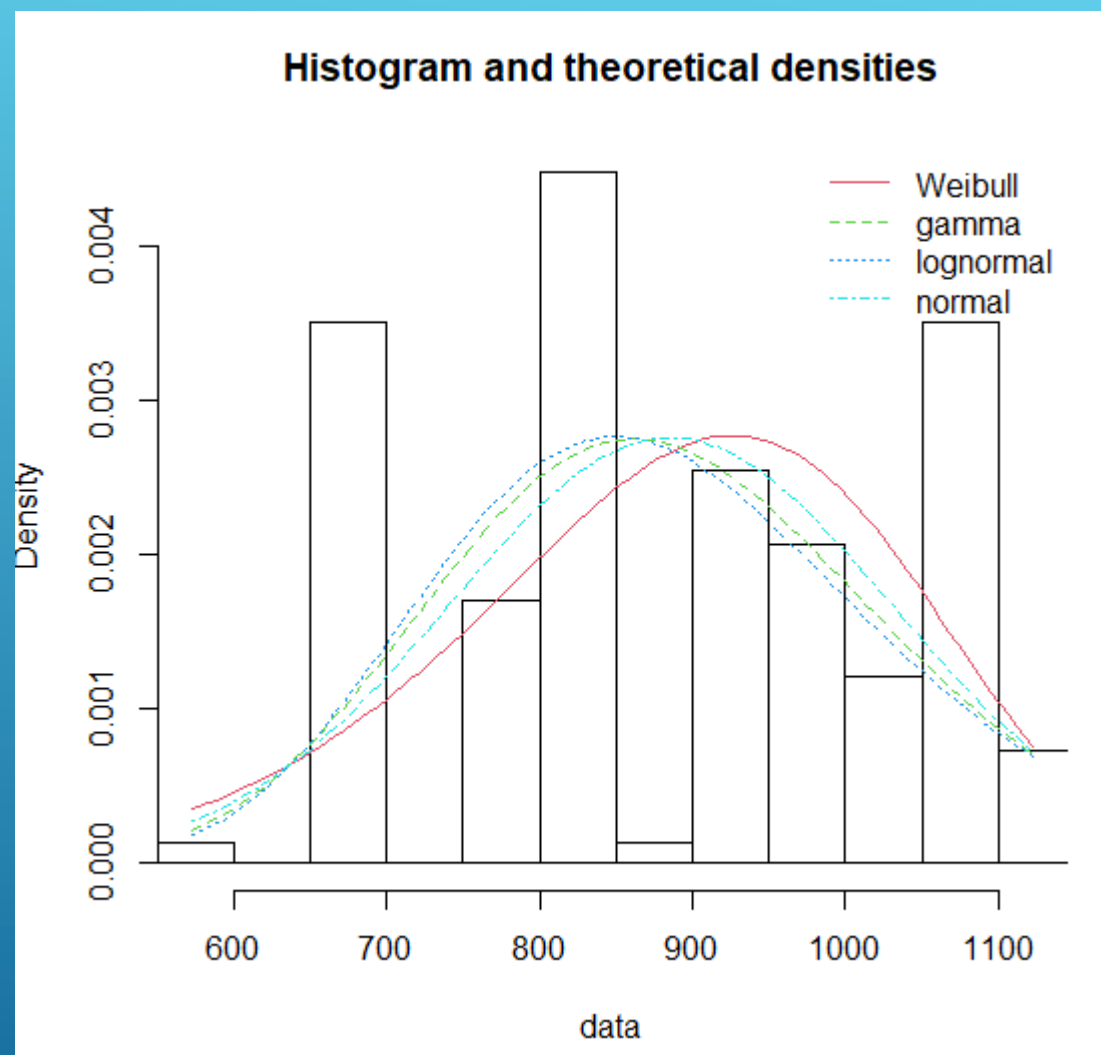
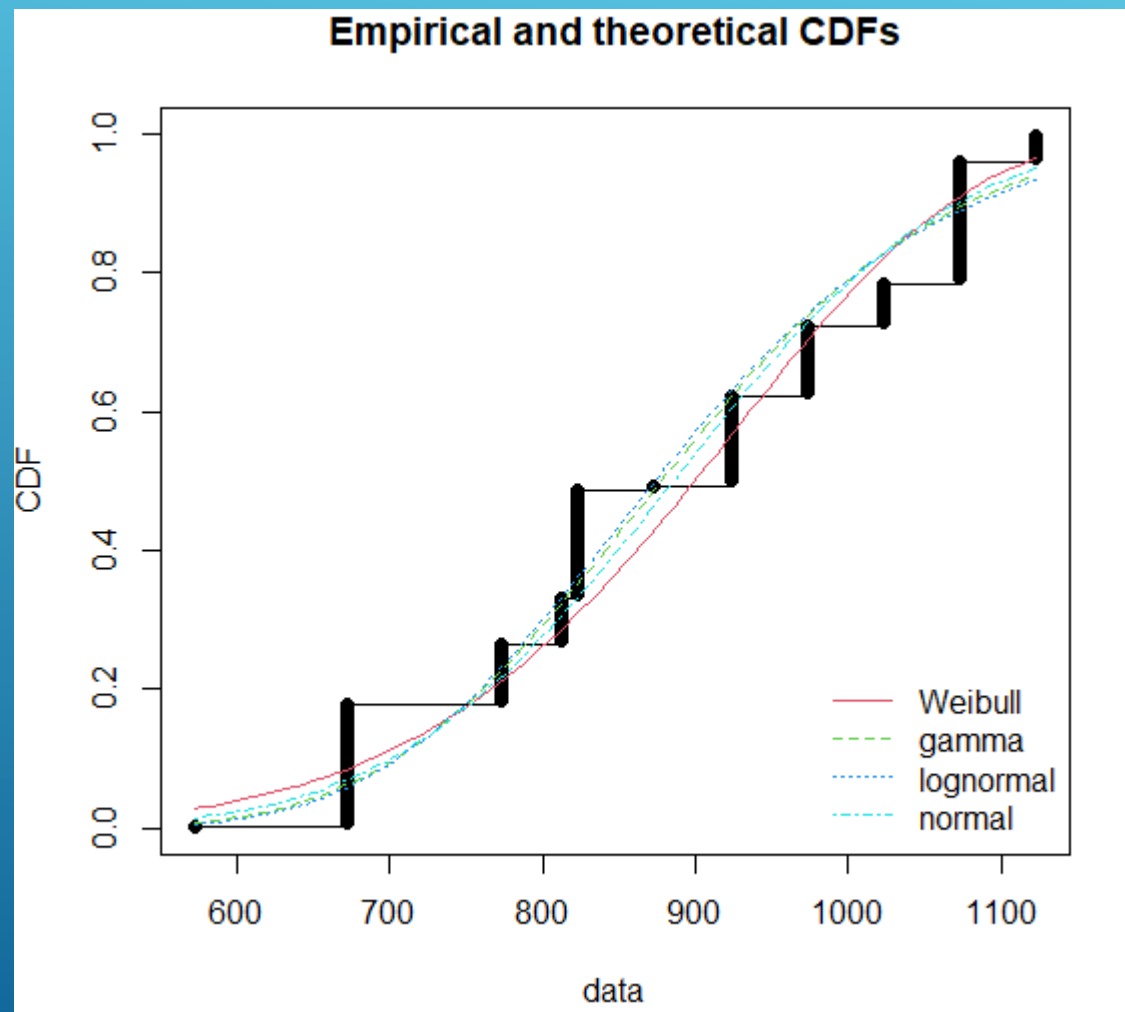
	weibull	gamma	lognormal	normal
Akaike's Information Criterion	1832.421	1899.292	1906.247	1886.367
Bayesian Information Criterion	1838.633	1905.504	1912.459	1892.579

```
Hartigans' dip test for unimodality / multimodality

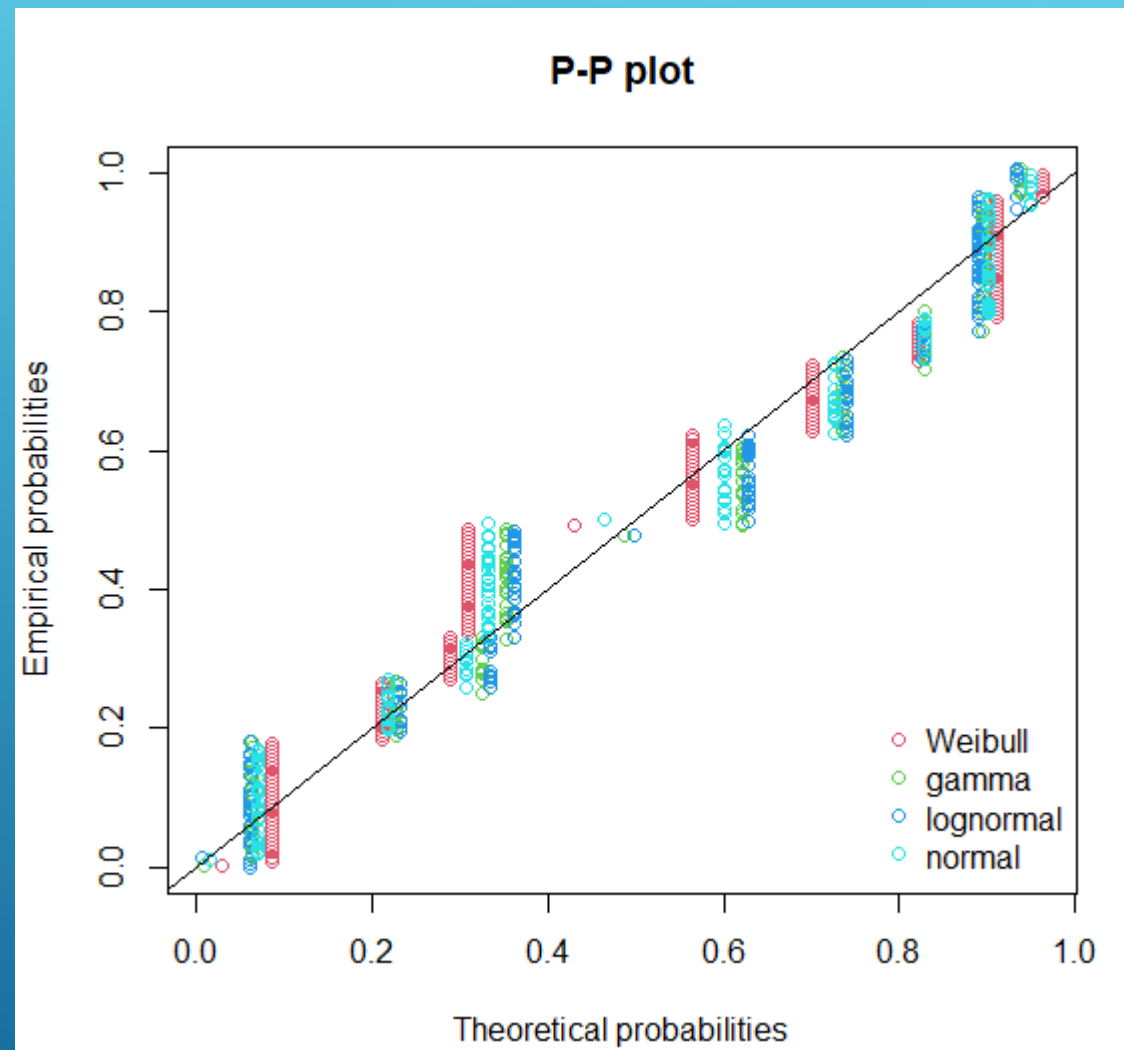
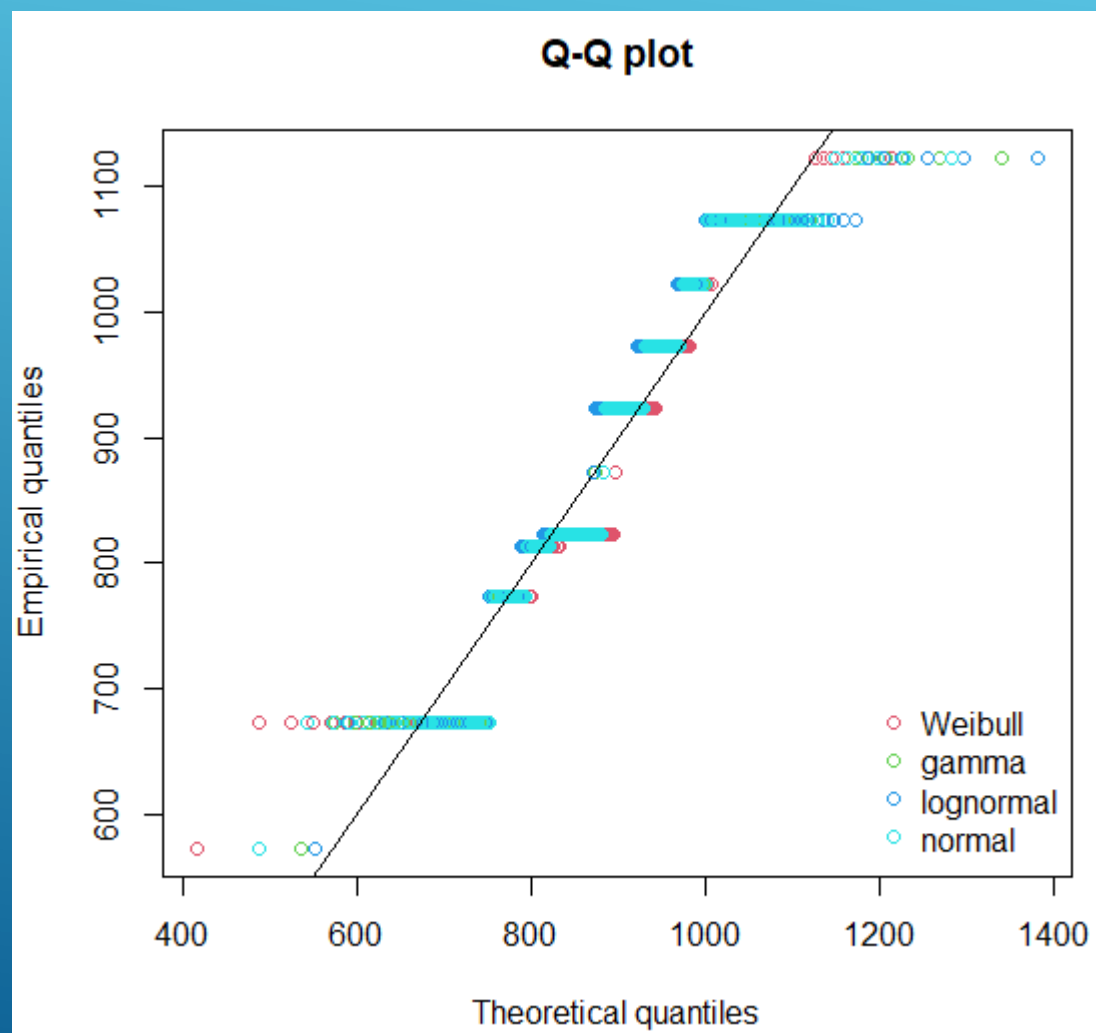
data: vari
D = 0.11515, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal

> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] TRUE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.6033031
> |
```

Temperatura de calcinação



Temperatura de calcinação



Temperatura de calcinação

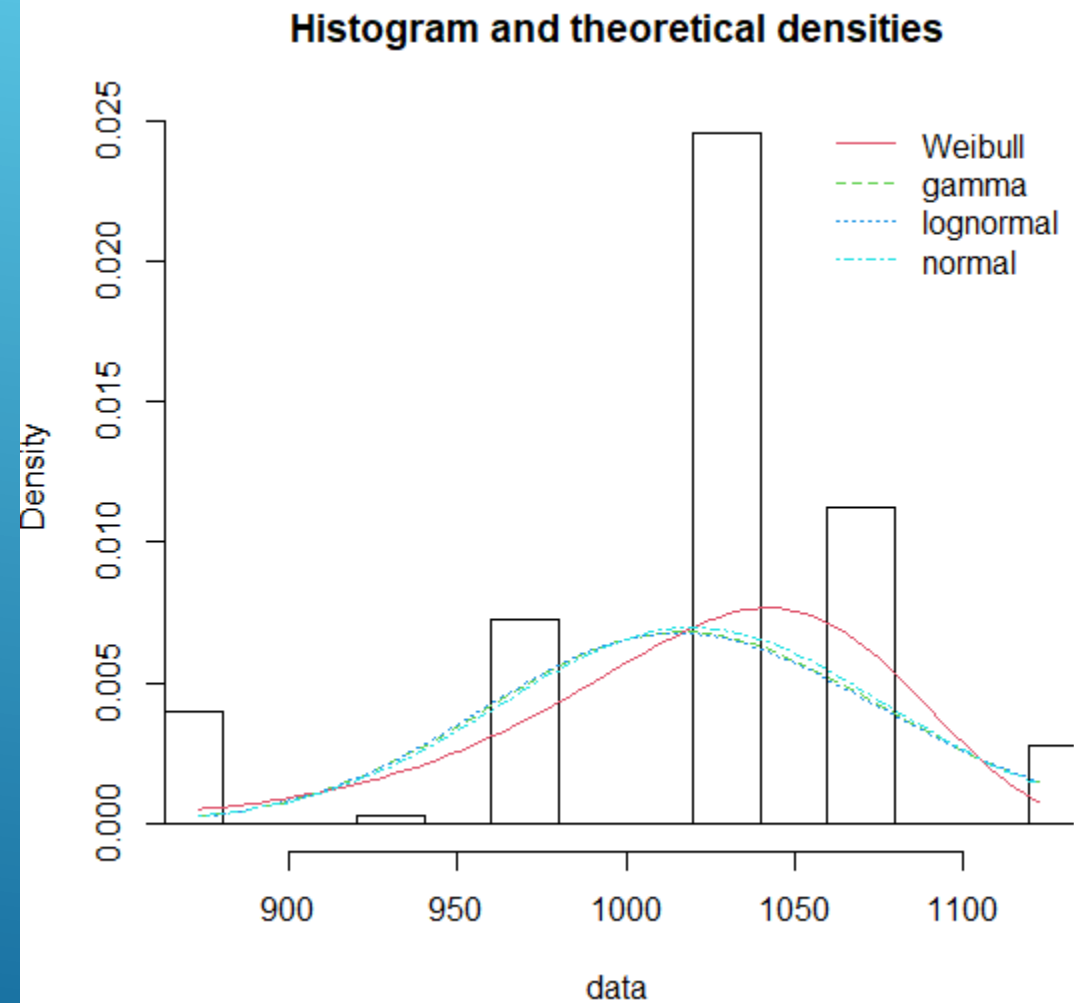
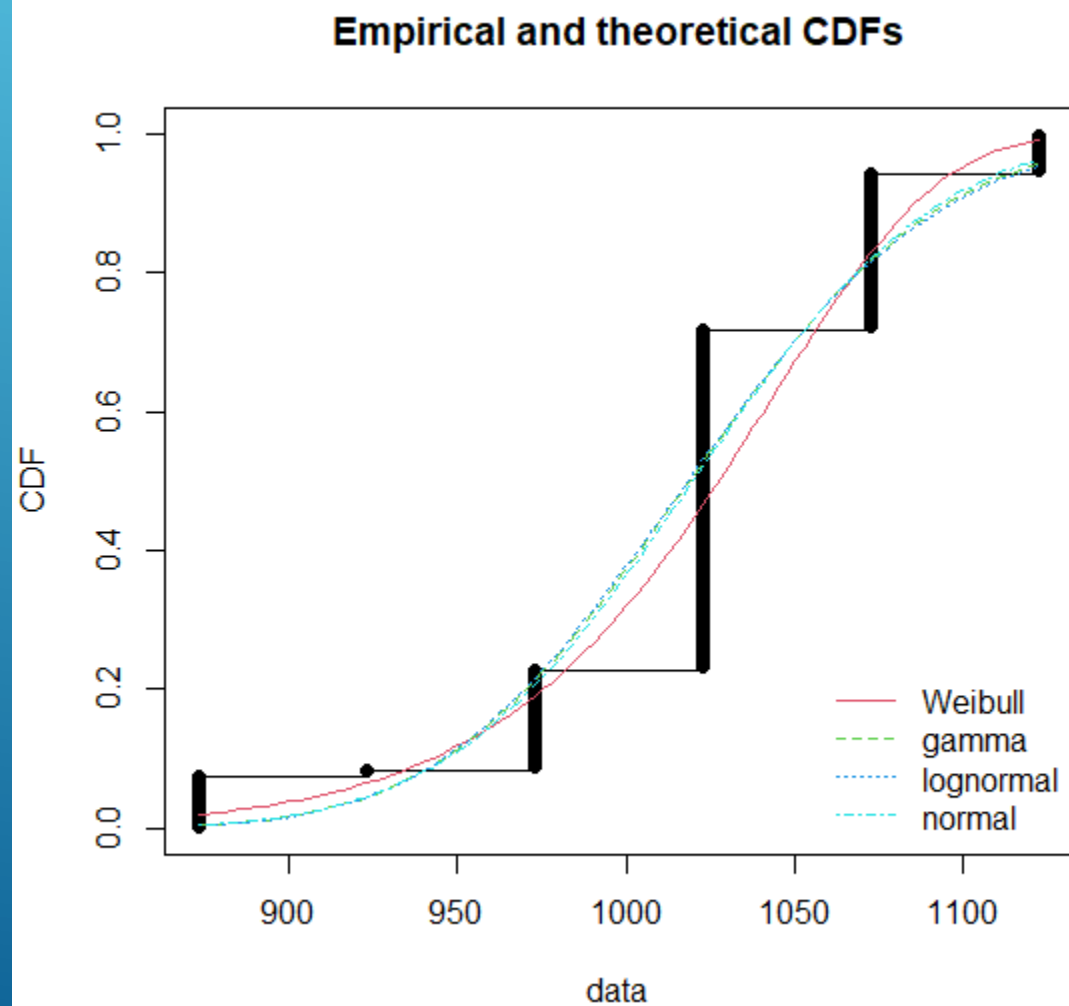
Goodness-of-fit statistics				
	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.1816432	0.1396689	0.1318943	0.1585255
Cramer-von Mises statistic	0.6370087	0.6024380	0.6160109	0.6039363
Anderson-Darling statistic	4.3169967	4.3985398	4.5575810	4.2742464
Goodness-of-fit criteria				
	weibull	gamma	lognormal	normal
Akaike's Information Criterion	2112.690	2115.217	2117.406	2113.690
Bayesian Information Criterion	2118.902	2121.429	2123.618	2119.902

```
Hartigans' dip test for unimodality / multimodality

data: vari
D = 0.091515, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal

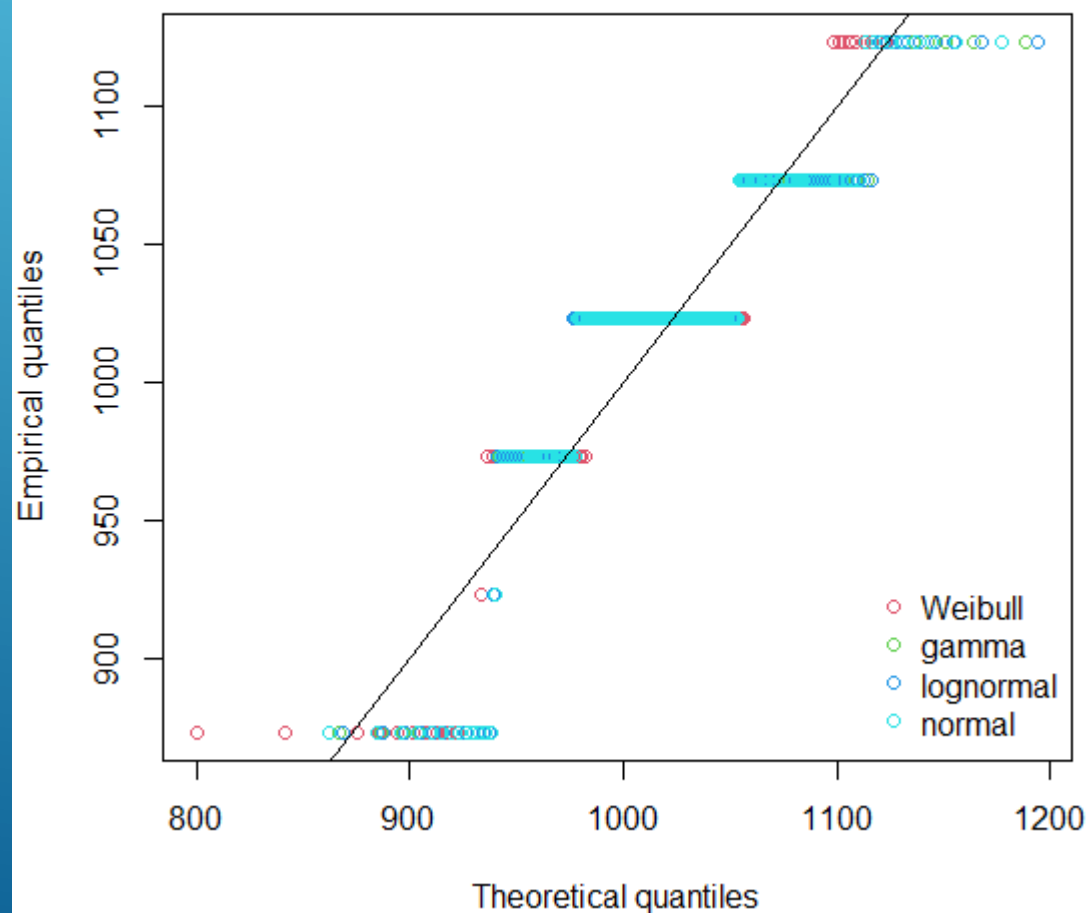
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.5356709
>
```

Temperatura de redução

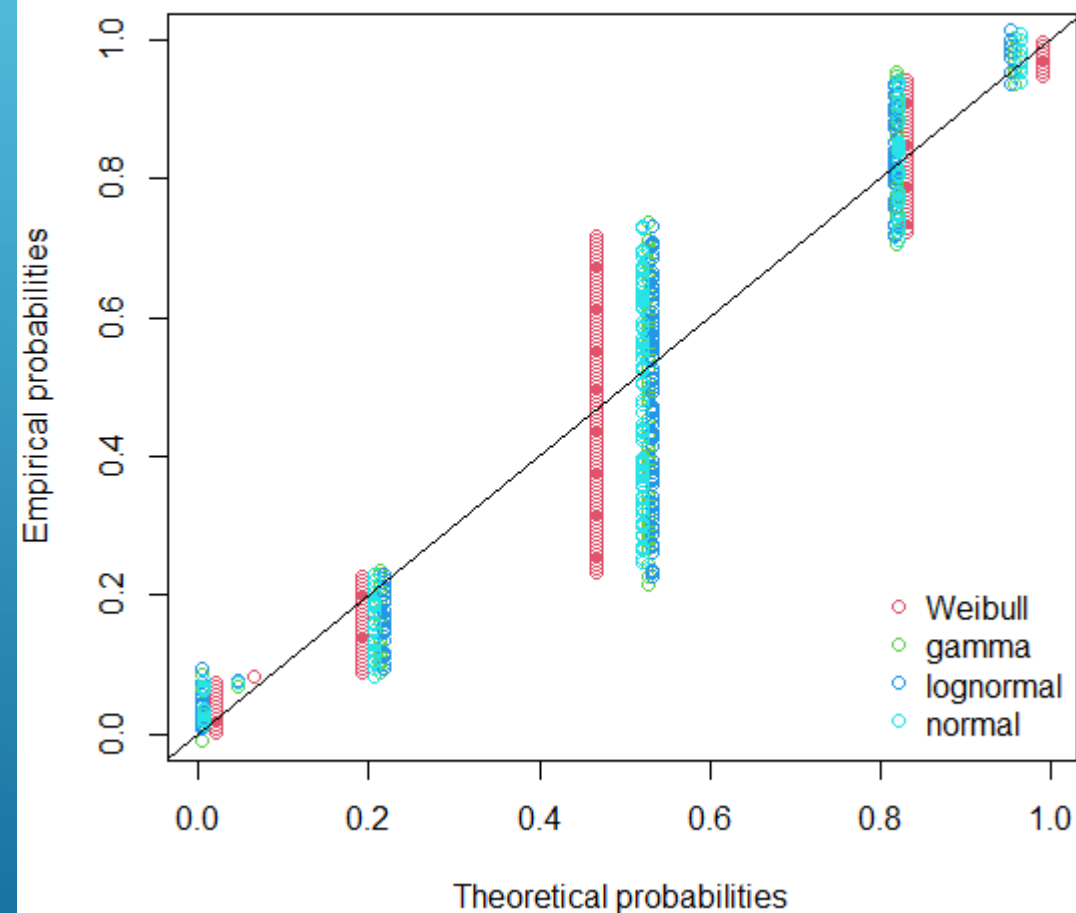


Temperatura de redução

Q-Q plot



P-P plot



Temperatura de redução

```
Goodness-of-fit statistics
      weibull      gamma lognormal      normal
Kolmogorov-Smirnov statistic 0.2542006 0.297872 0.3013743 0.2907514
Cramer-von Mises statistic  1.8746644 2.157766 2.2019311 2.0785752
Anderson-Darling statistic  9.1357013 11.349858 11.6510101 10.8023233

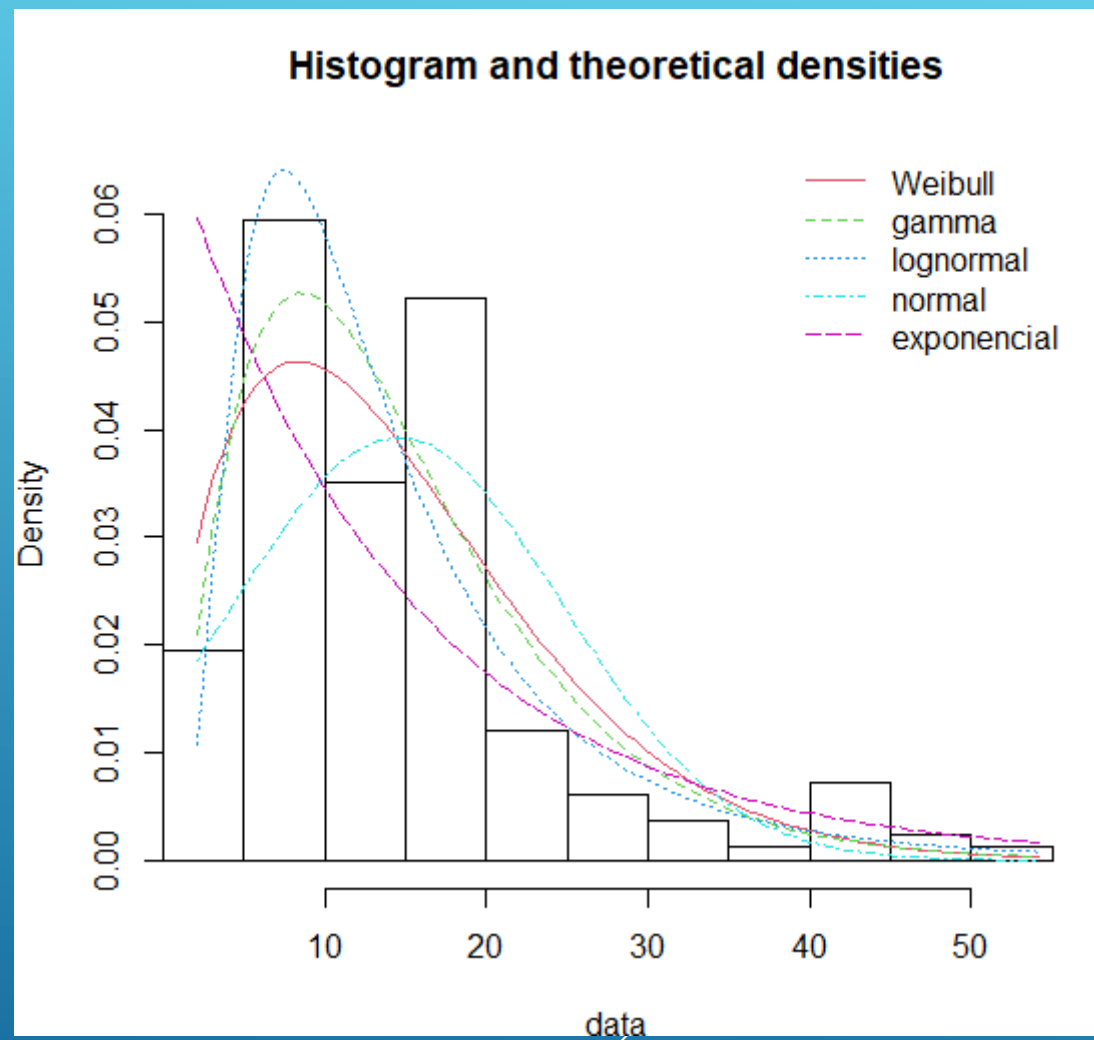
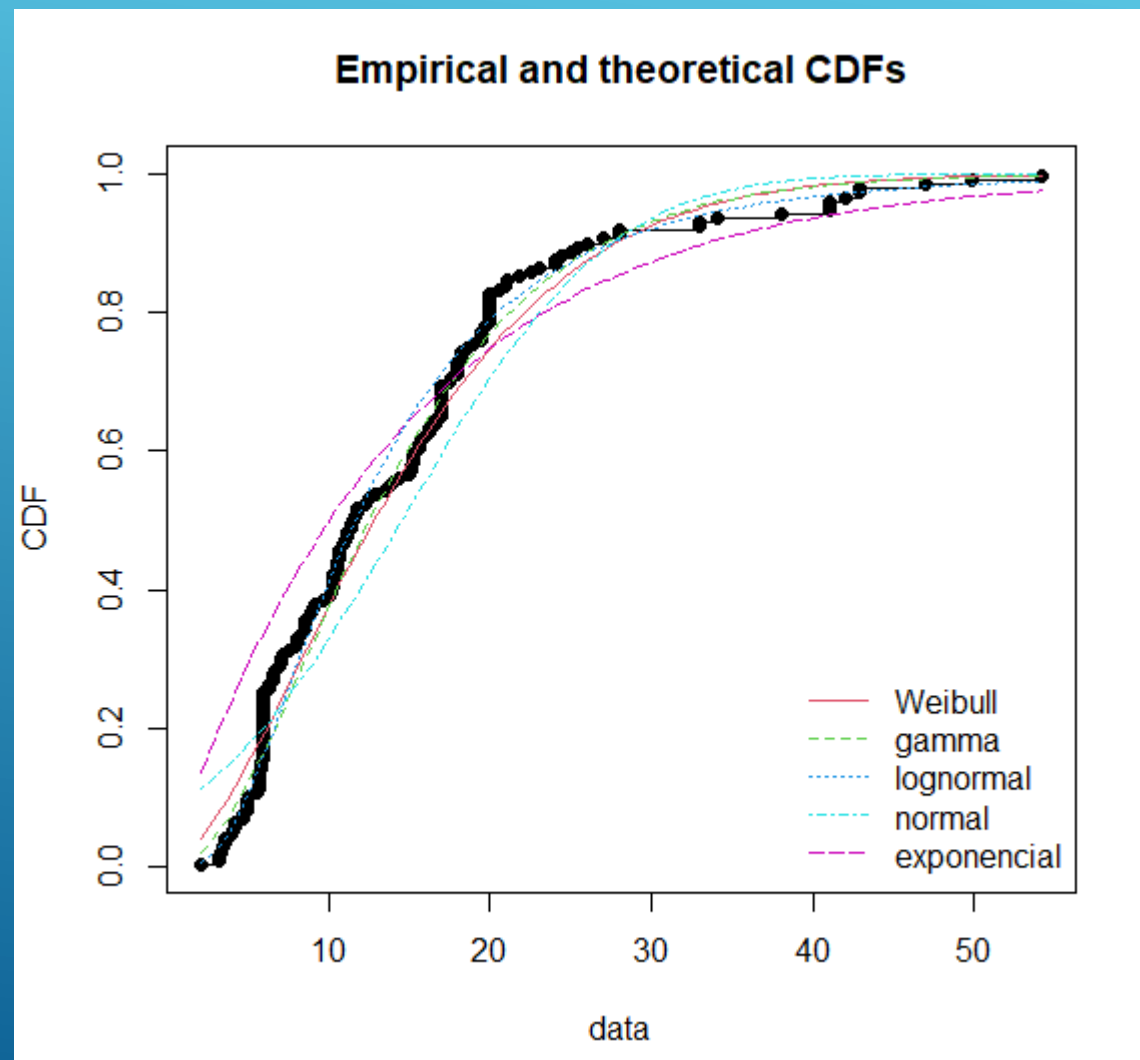
Goodness-of-fit criteria
      weibull      gamma lognormal      normal
Akaike's Information Criterion 1789.593 1815.145 1818.663 1808.719
Bayesian Information Criterion 1795.805 1821.357 1824.875 1814.931
```

Hartigans' dip test for unimodality / multimodality

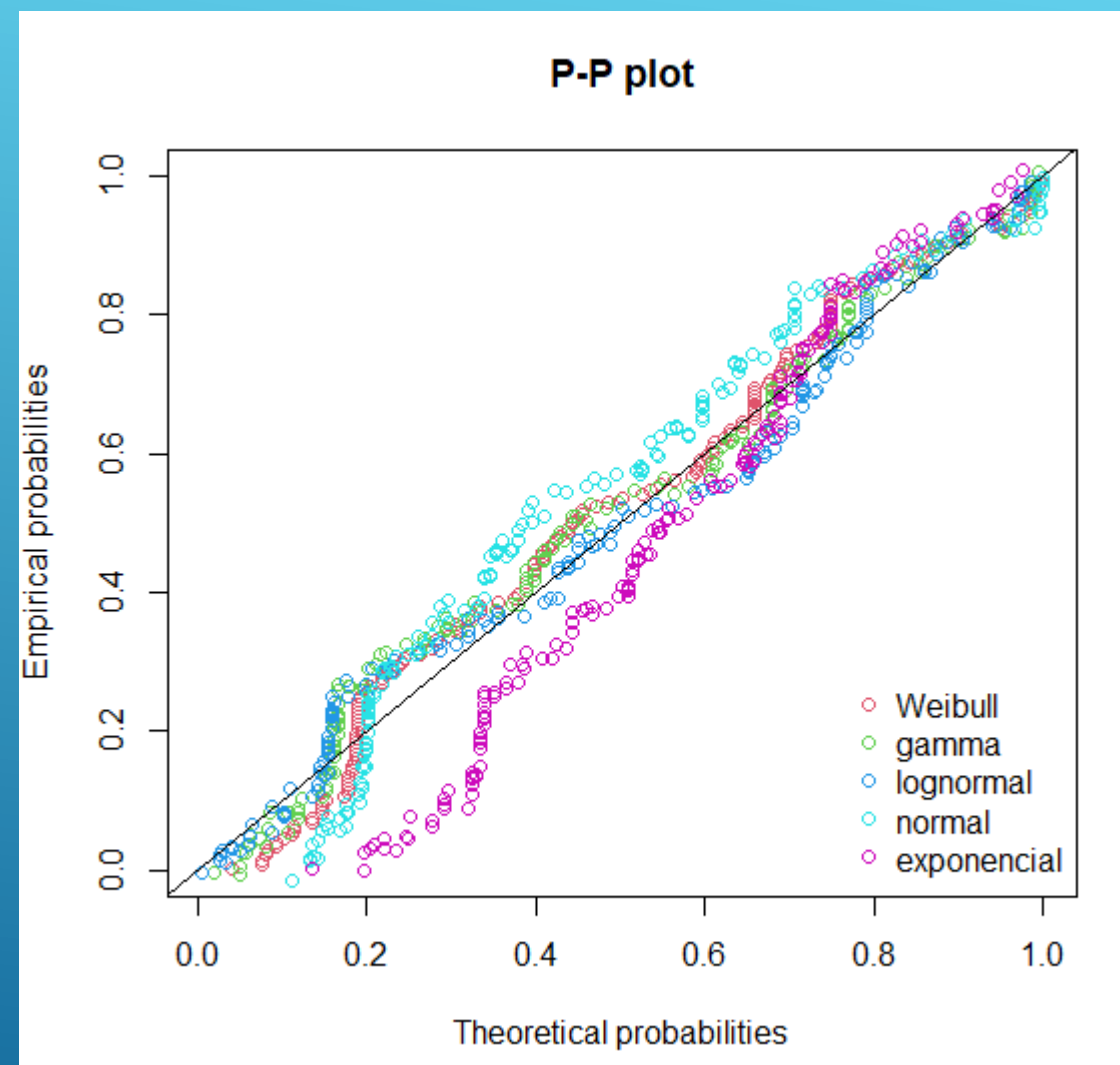
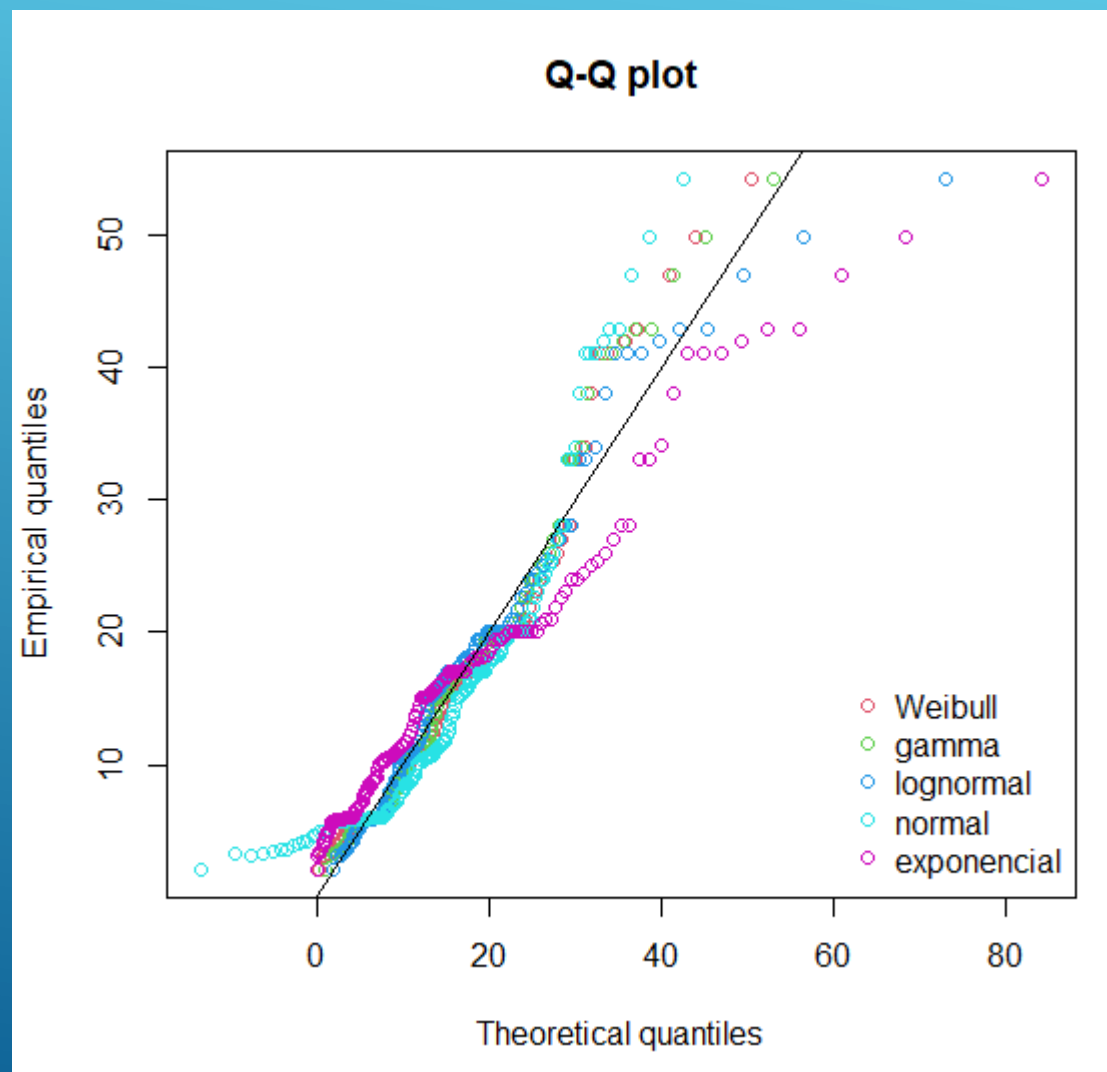
```
data: vari
D = 0.11212, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal

> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] TRUE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.4351551
```

Tamanho de cristalito da fase ativa



Tamanho de cristalito da fase ativa



Tamanho de cristalito da fase ativa

```
Goodness-of-fit statistics
      weibull      gamma lognormal      normal
Kolmogorov-Smirnov statistic 0.08220269 0.0885631 0.09369834 0.1268770
Cramer-von Mises statistic  0.28275520 0.2391011 0.22325618 0.9493994
Anderson-Darling statistic  2.27921868 1.7248426 1.29606106 6.5558608

      exponencial
Kolmogorov-Smirnov statistic  0.2164764
Cramer-von Mises statistic    1.7394098
Anderson-Darling statistic    10.4115742

Goodness-of-fit criteria
      weibull      gamma lognormal      normal
Akaike's Information Criterion 1170.206 1158.862 1149.435 1237.599
Bayesian Information Criterion 1176.418 1165.074 1155.647 1243.811

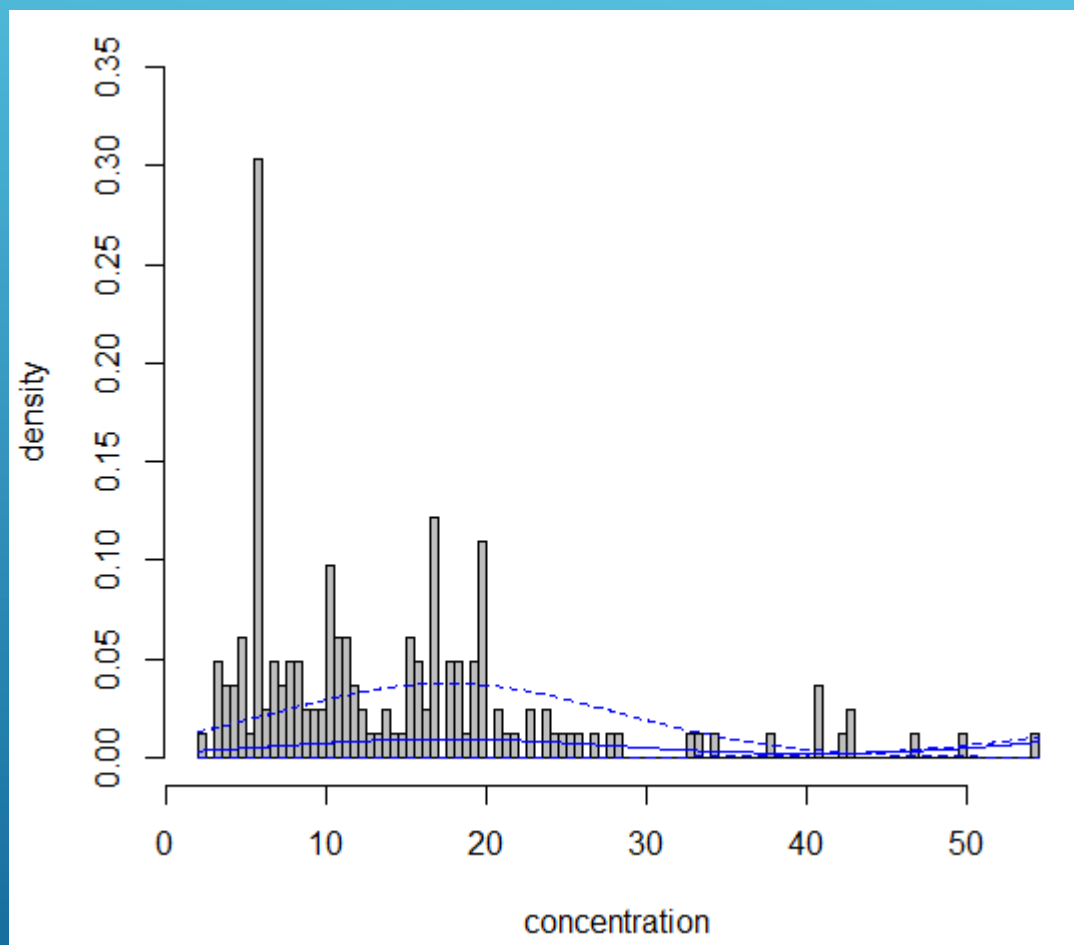
      exponencial
Akaike's Information Criterion  1214.765
Bayesian Information Criterion  1217.871
```

```
Hartigans' dip test for unimodality / multimodality

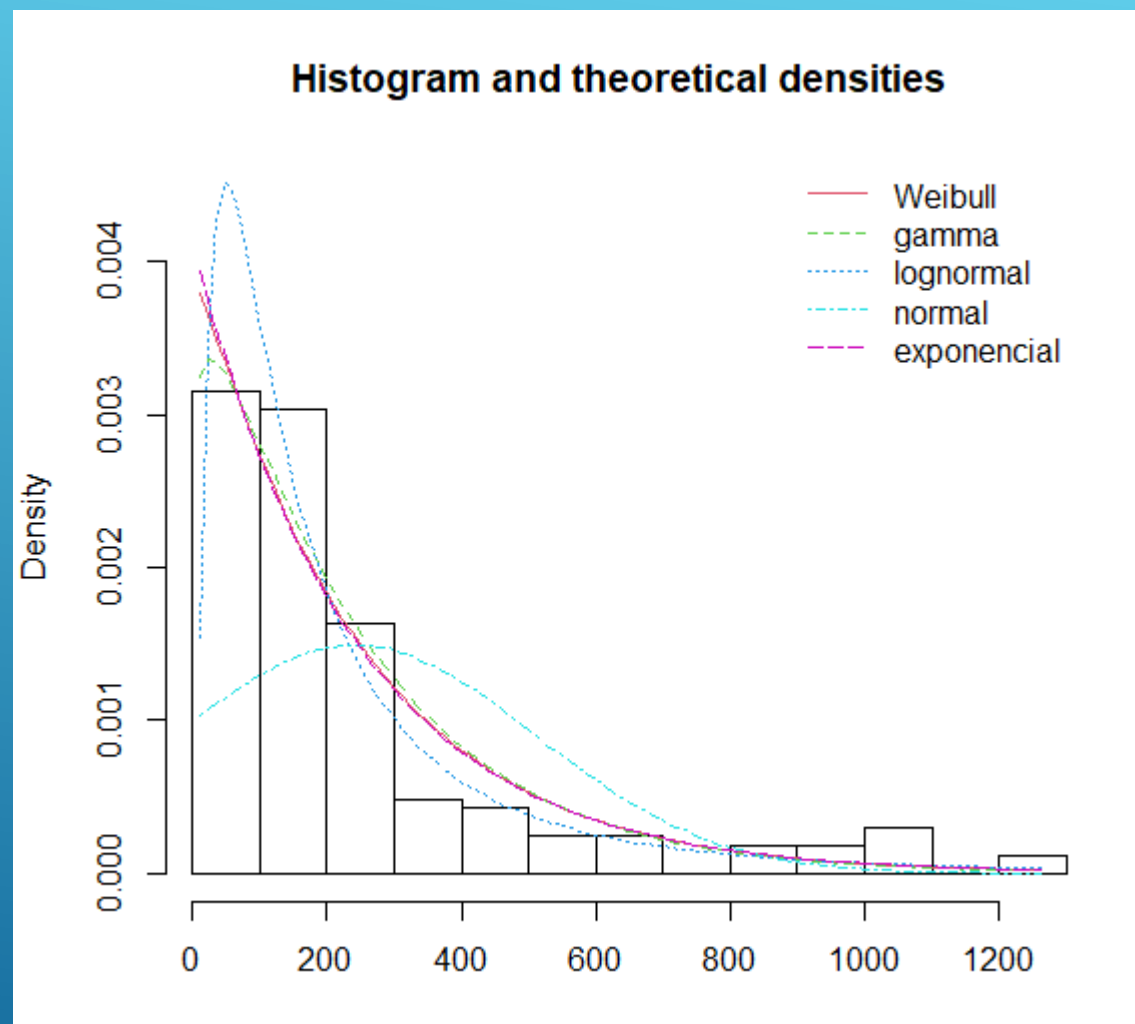
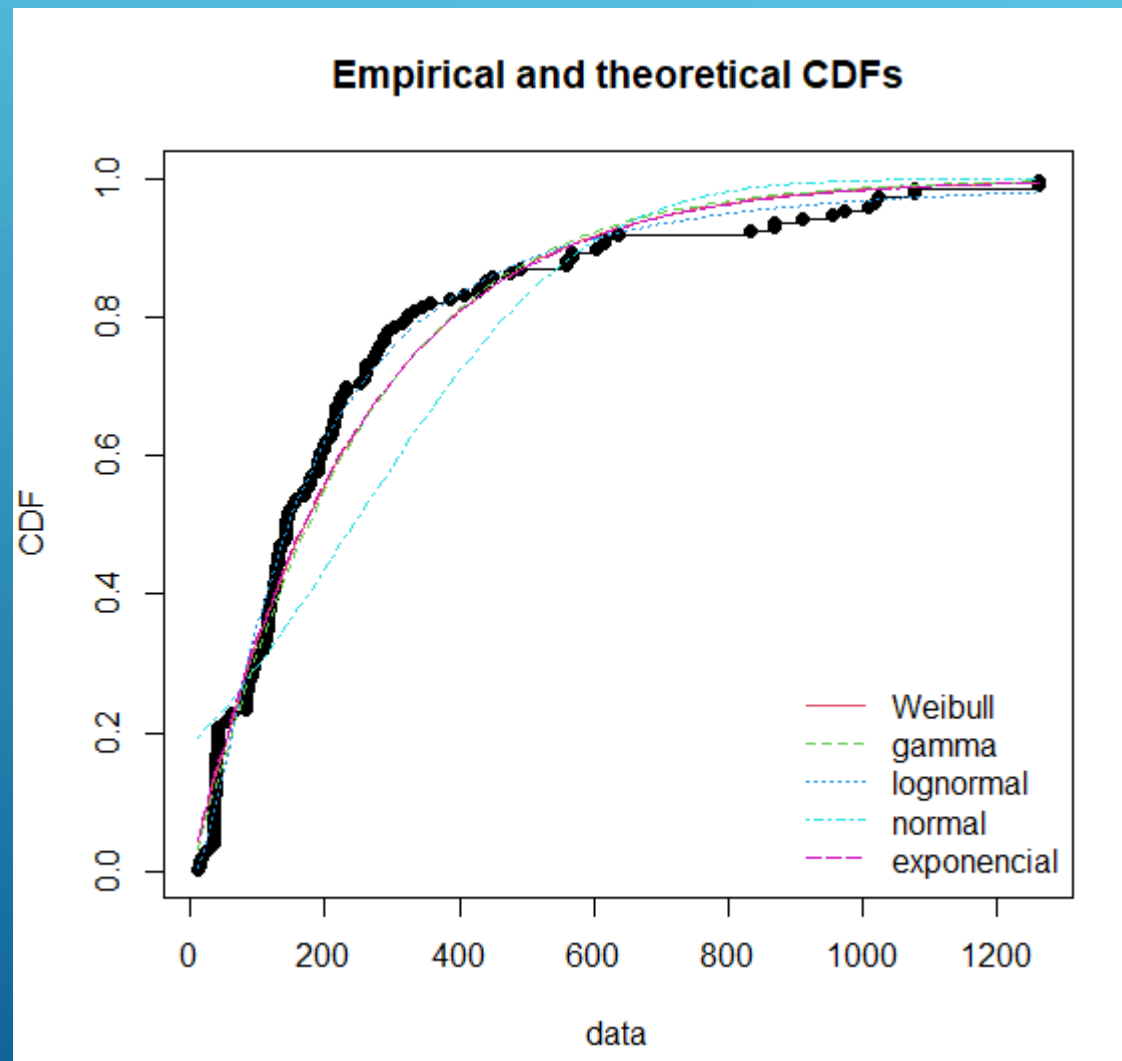
data: vari
D = 0.039098, p-value = 0.0692
alternative hypothesis: non-unimodal, i.e., at least bimodal

> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] TRUE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.6064561
```

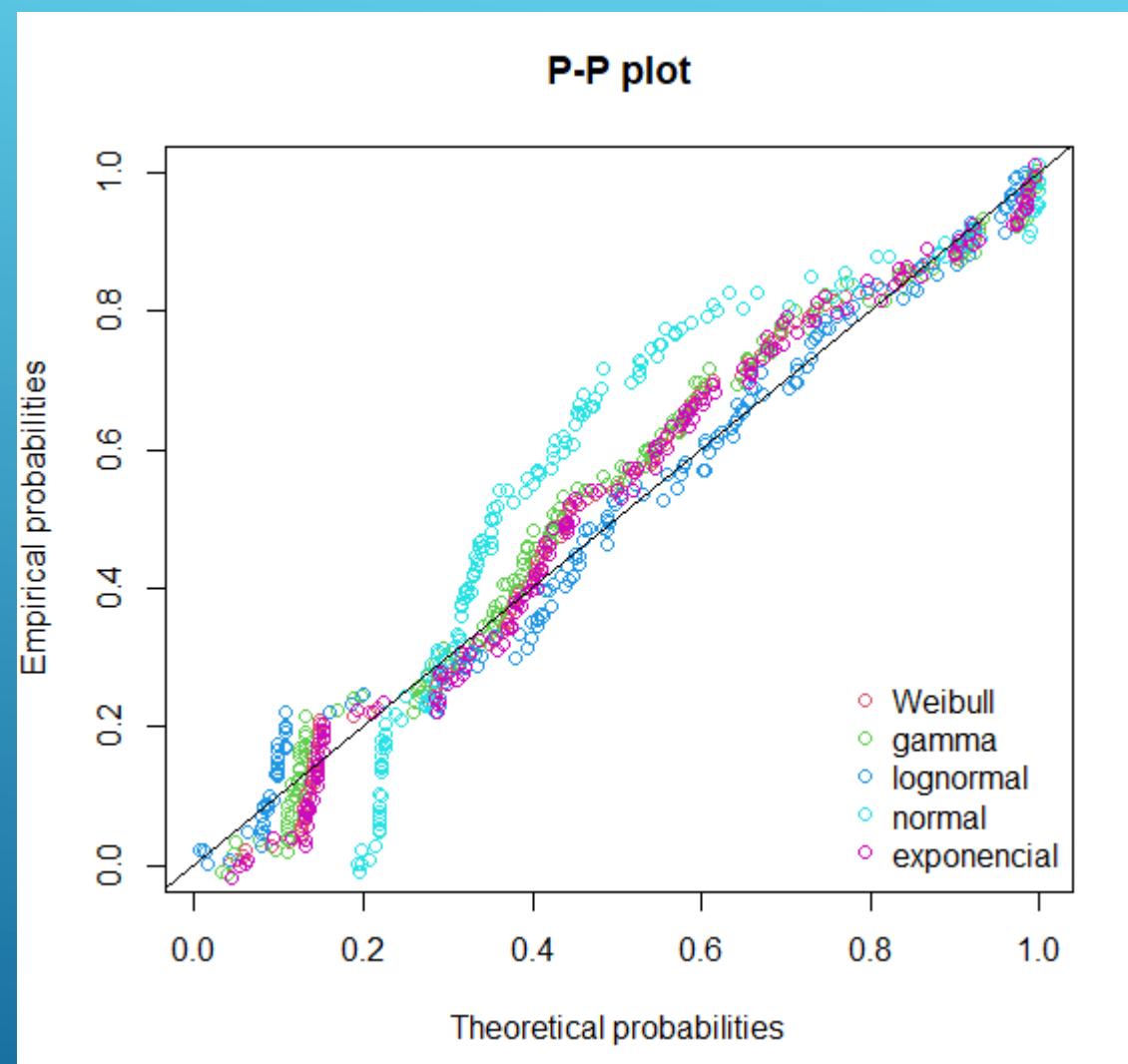
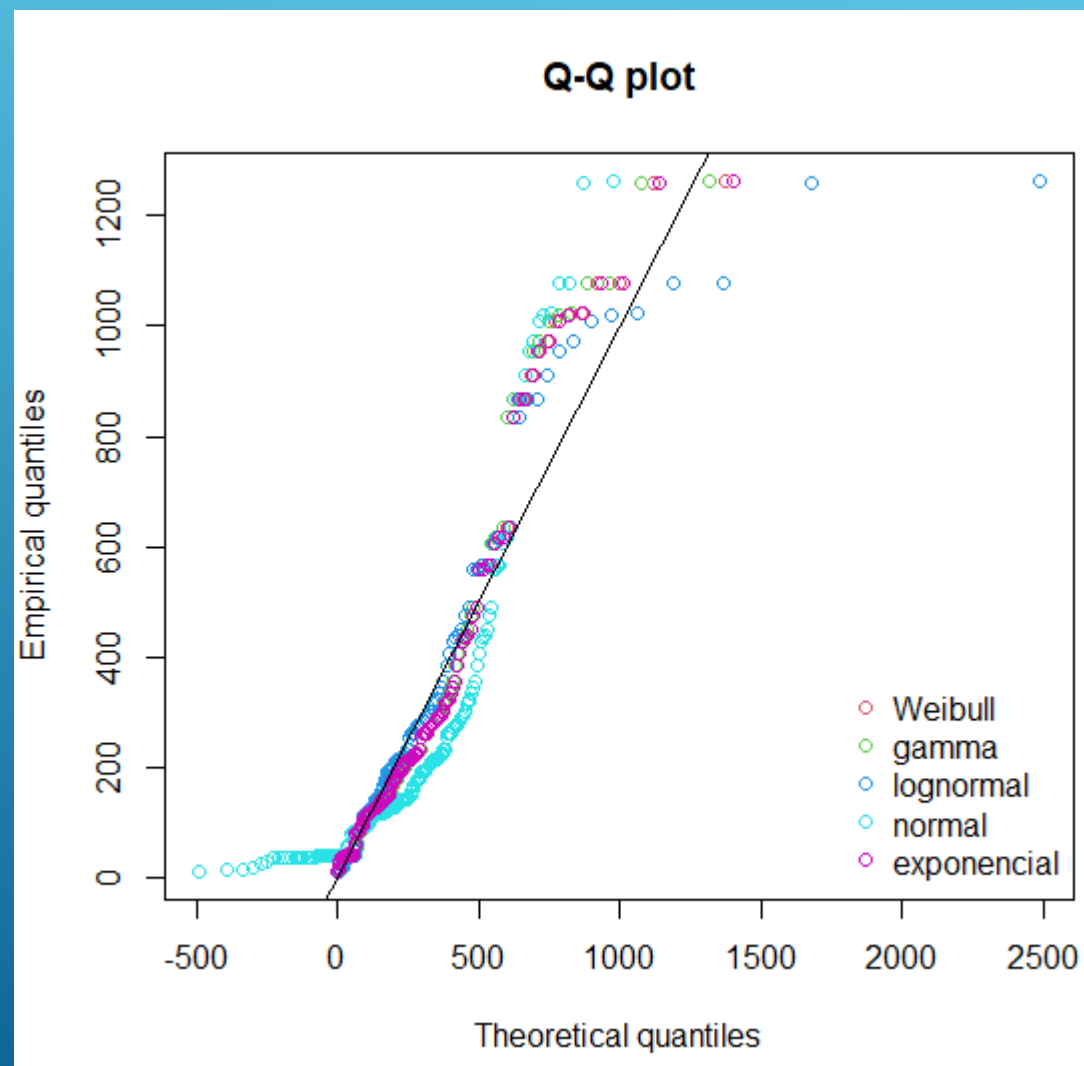
Tamanho de cristalito da fase ativa



Área específica do catalisador



Área específica do catalisador



Área específica do catalisador

```
Goodness-of-fit statistics
```

	weibull	gamma	lognormal	normal
Kolmogorov-Smirnov statistic	0.09079559	0.09501041	0.1046914	0.218273
Cramer-von Mises statistic	0.36126329	0.41116966	0.1648714	2.660561
Anderson-Darling statistic	2.52232203	2.70666737	1.2593924	14.948105

```
exponencial
```

Kolmogorov-Smirnov statistic	0.09532346
Cramer-von Mises statistic	0.34760846
Anderson-Darling statistic	2.47870550

```
Goodness-of-fit criteria
```

	weibull	gamma	lognormal	normal
Akaike's Information Criterion	2145.555	2144.300	2127.352	2316.050
Bayesian Information Criterion	2151.767	2150.512	2133.564	2322.262

```
exponencial
```

Akaike's Information Criterion	2143.628
Bayesian Information Criterion	2146.734

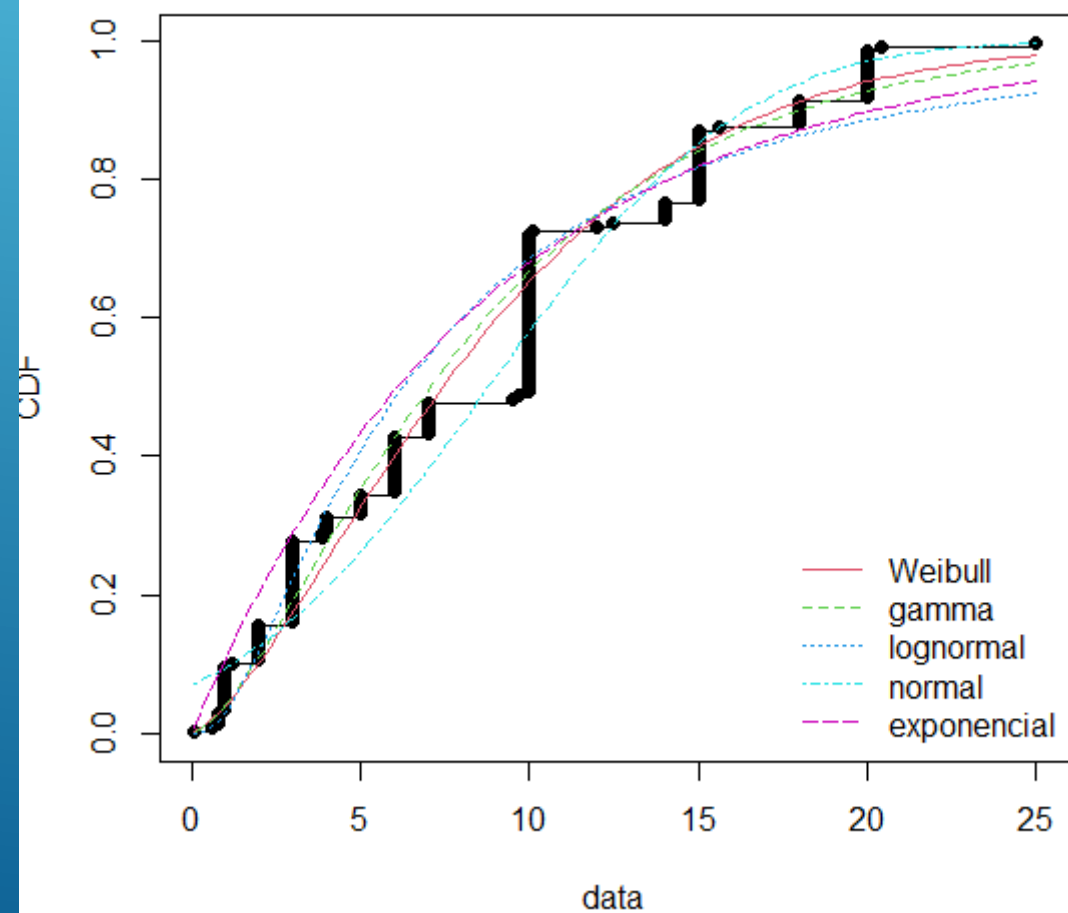
```
Hartigans' dip test for unimodality / multimodality

data: vari
D = 0.050895, p-value = 0.003203
alternative hypothesis: non-unimodal, i.e., at least bimodal

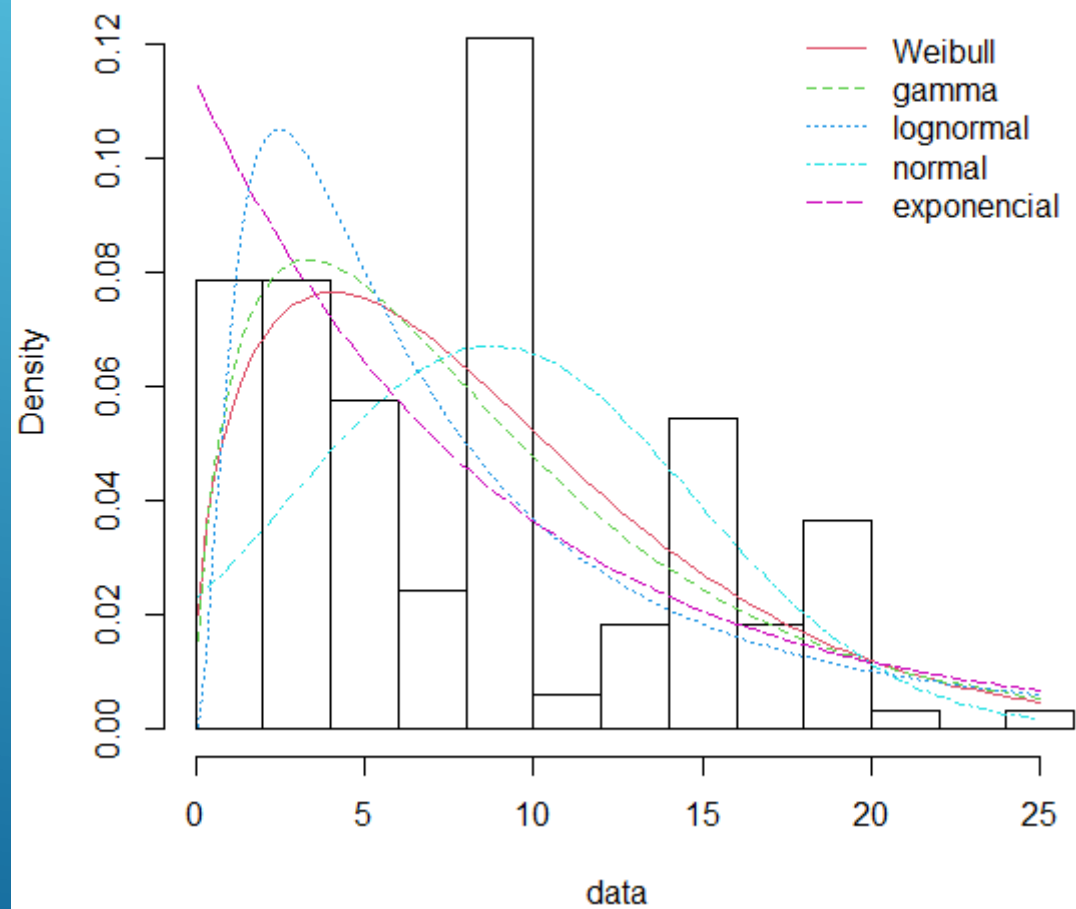
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] TRUE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.7576246
```


Teor total da fase ativa

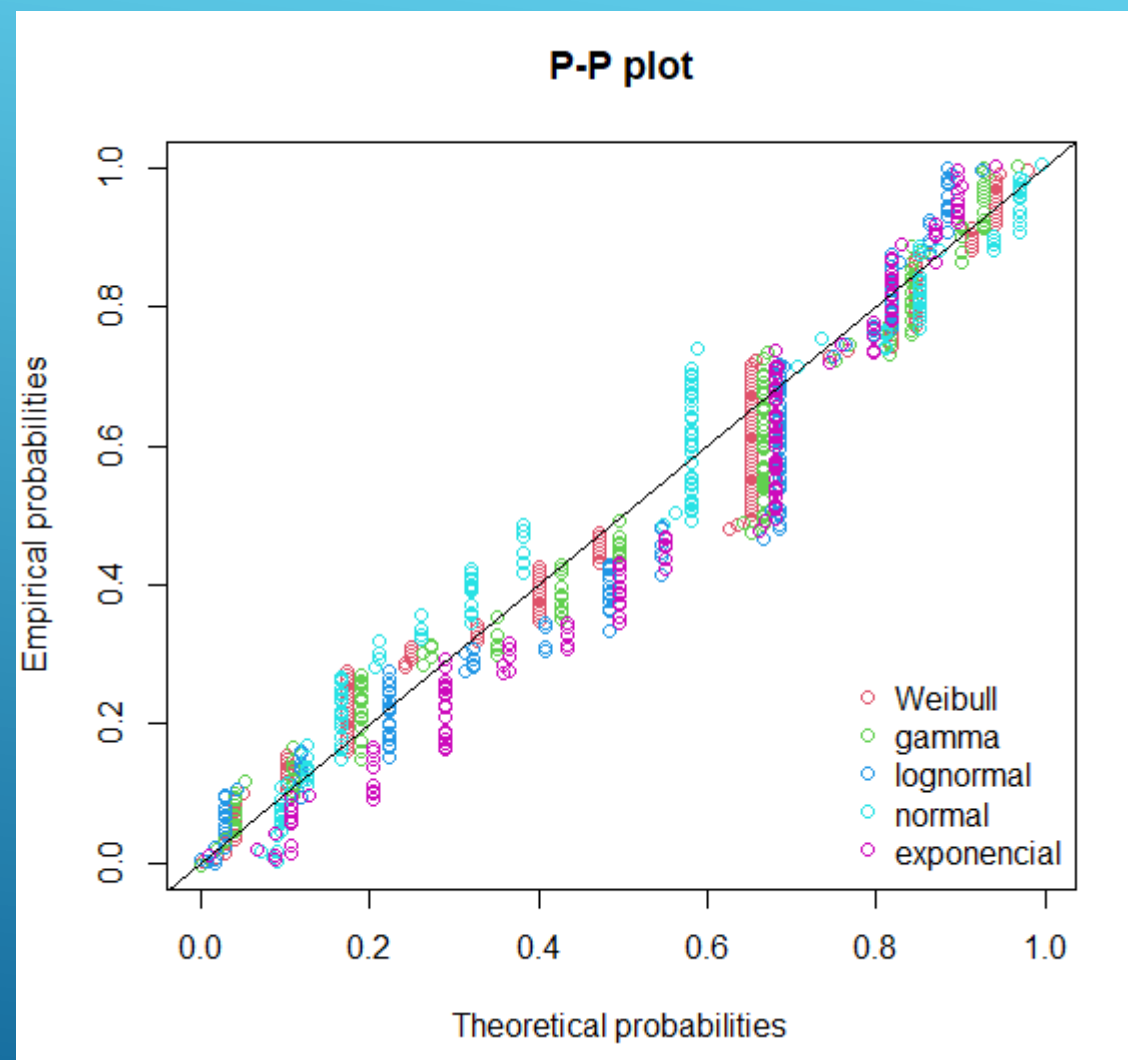
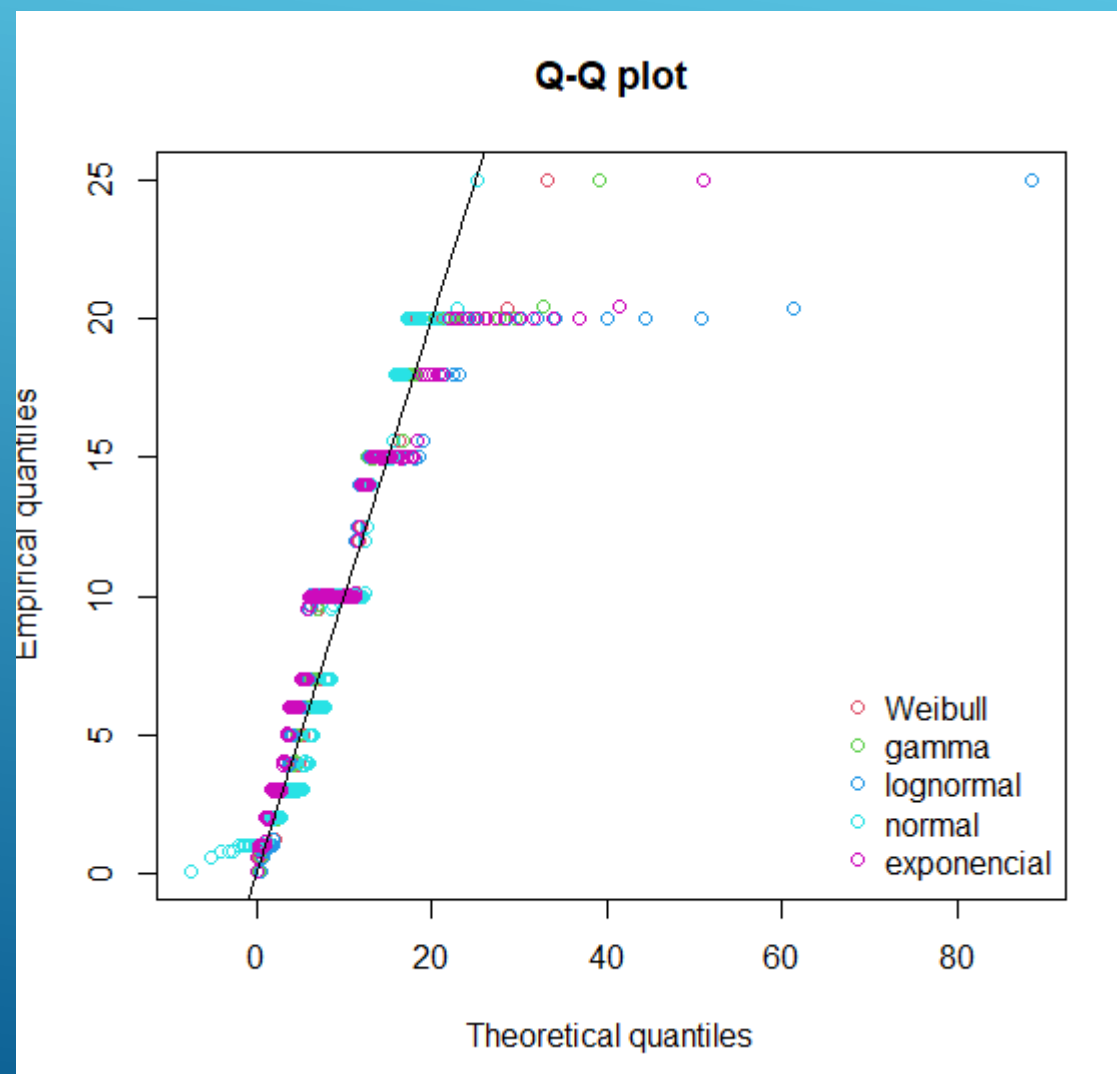
Empirical and theoretical CDFs



Histogram and theoretical densities



Teor total da fase ativa



Teor total da fase ativa

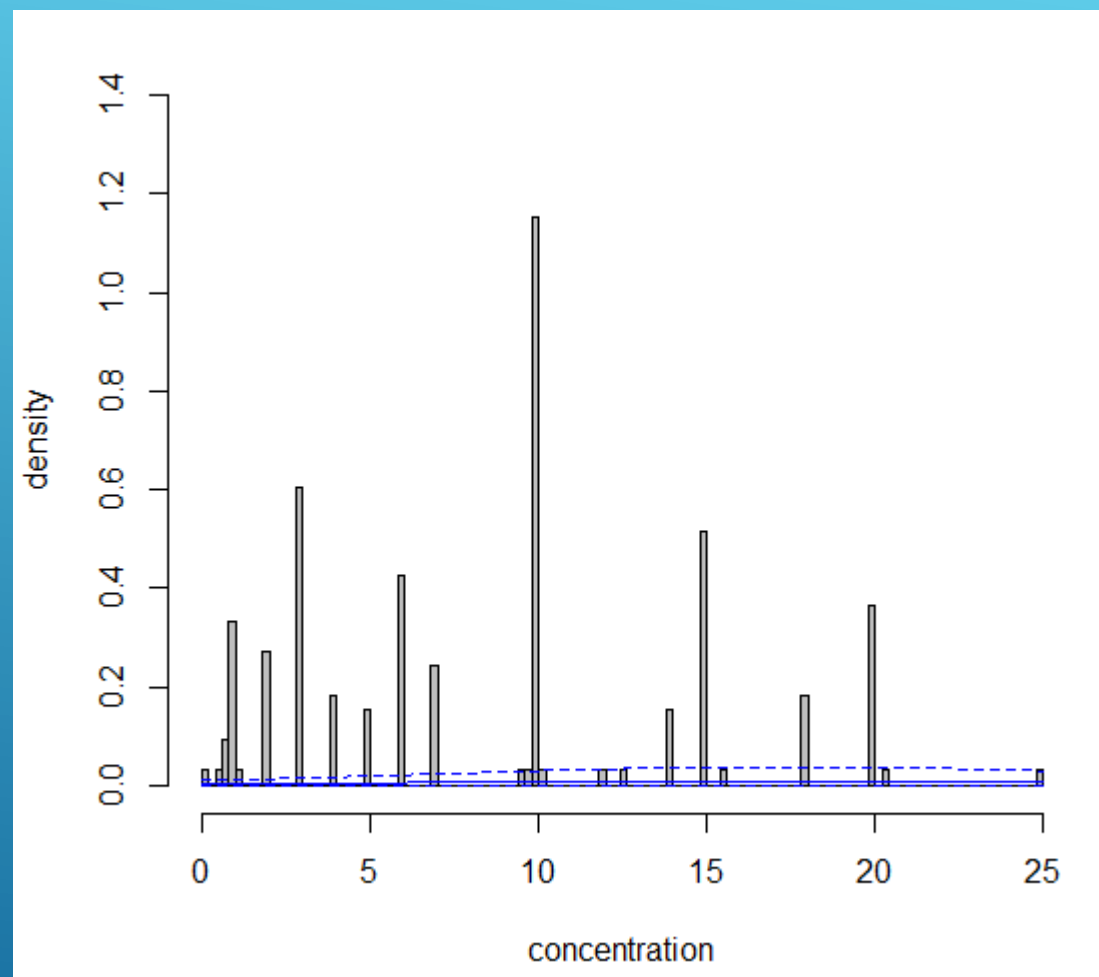
```
Goodness-of-fit statistics
      weibull      gamma lognormal      normal
Kolmogorov-Smirnov statistic 0.1611311 0.1756427 0.1955048 0.1403467
Cramer-von Mises statistic  0.4705444 0.5347664 0.8792033 0.6007862
Anderson-Darling statistic  2.7394829 2.9984722 5.0966753 3.8096452
      exponencial
Kolmogorov-Smirnov statistic  0.1886388
Cramer-von Mises statistic    1.0637486
Anderson-Darling statistic    5.9408758

Goodness-of-fit criteria
      weibull      gamma lognormal      normal
Akaike's Information Criterion 1025.247 1031.115 1065.772 1060.330
Bayesian Information Criterion 1031.459 1037.327 1071.984 1066.542
      exponencial
Akaike's Information Criterion    1049.187
Bayesian Information Criterion    1052.293
```

```
data: vari
D = 0.076087, p-value < 2.2e-16
alternative hypothesis: non-unimodal, i.e., at least bimodal

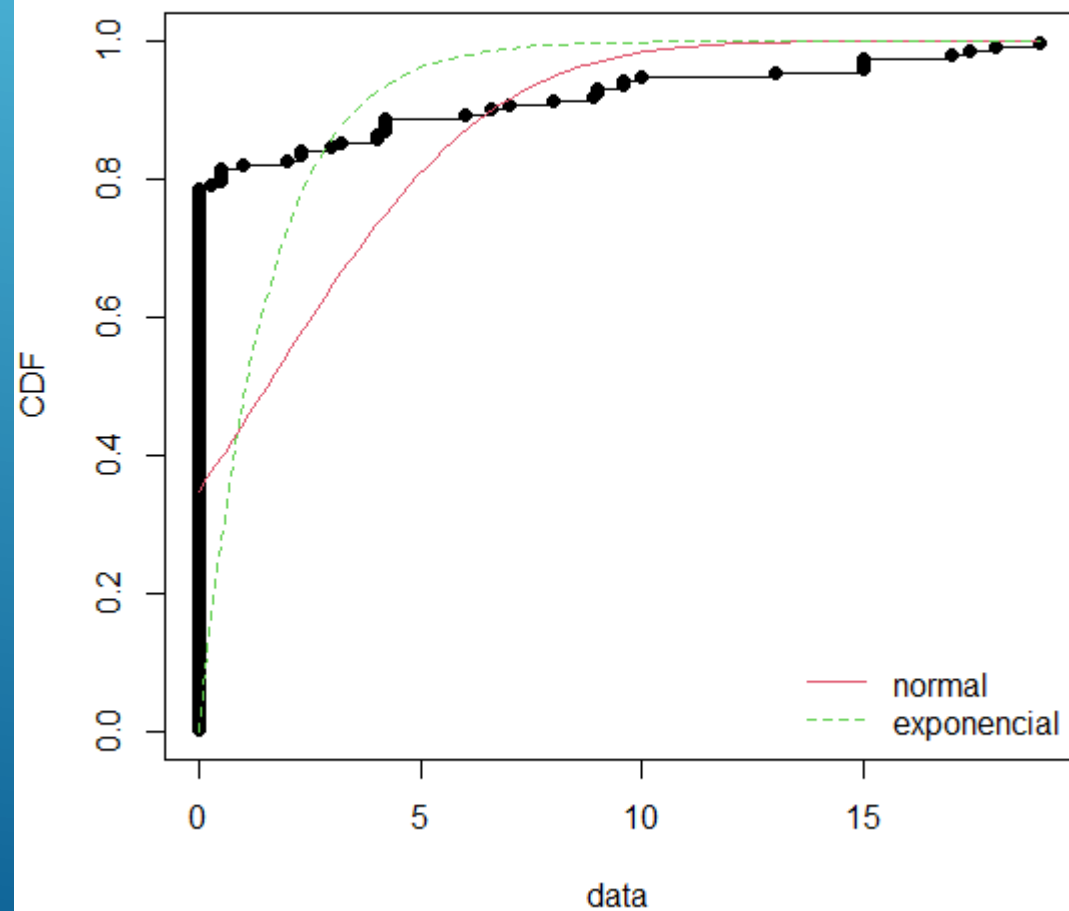
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] FALSE
> is.bimodal(vari)
[1] TRUE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.5268316
```

Teor total da fase ativa

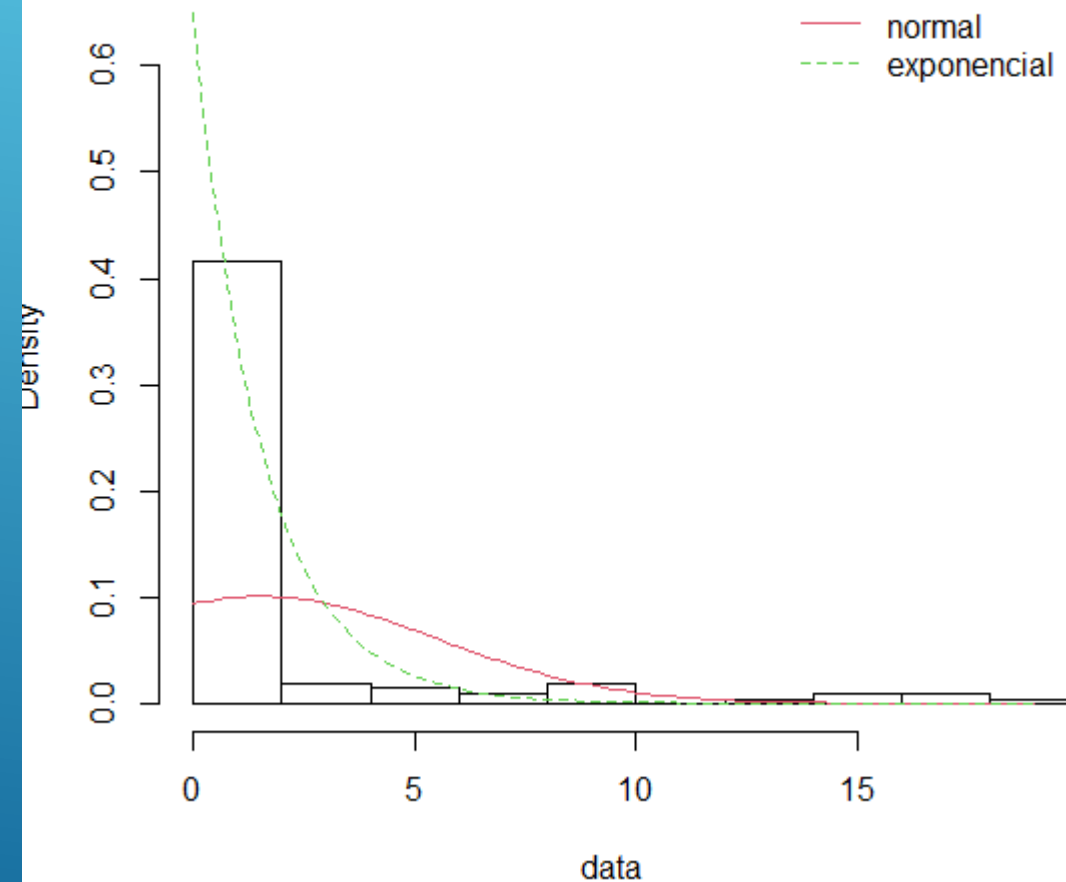


Concentração

Empirical and theoretical CDFs

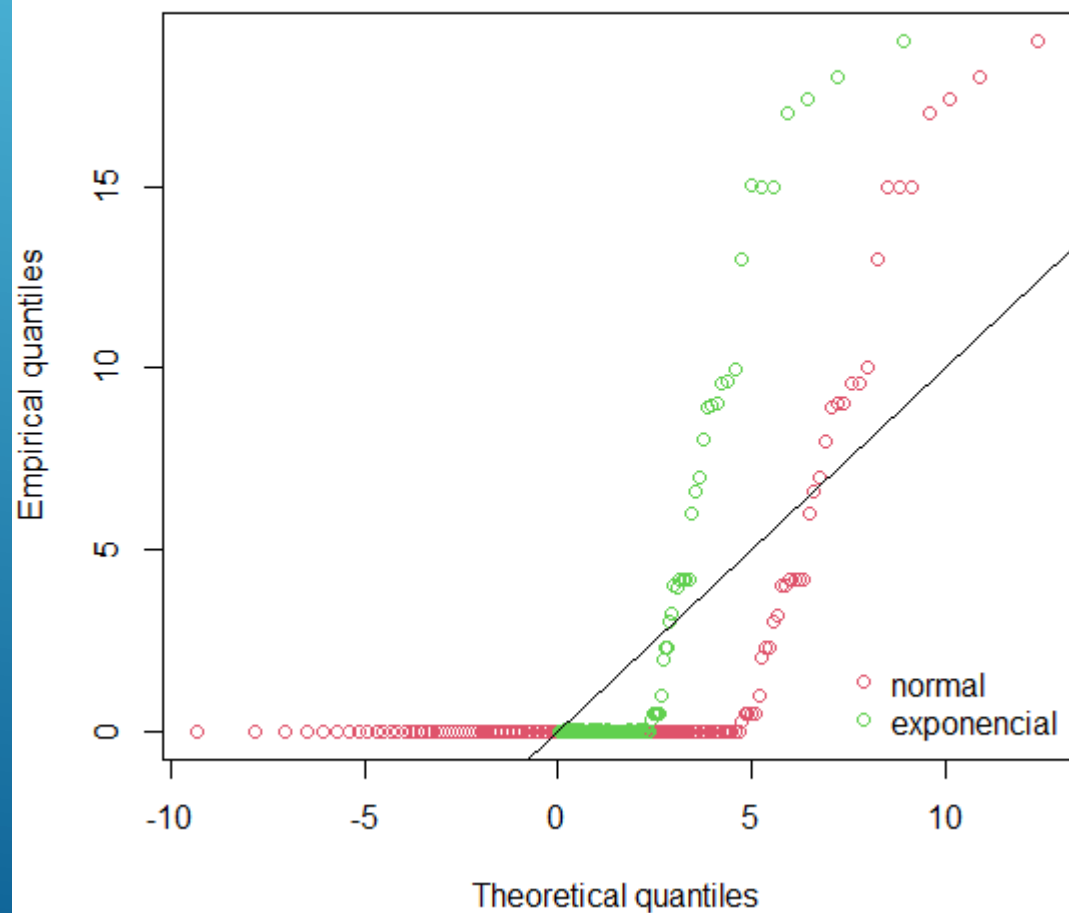


Histogram and theoretical densities

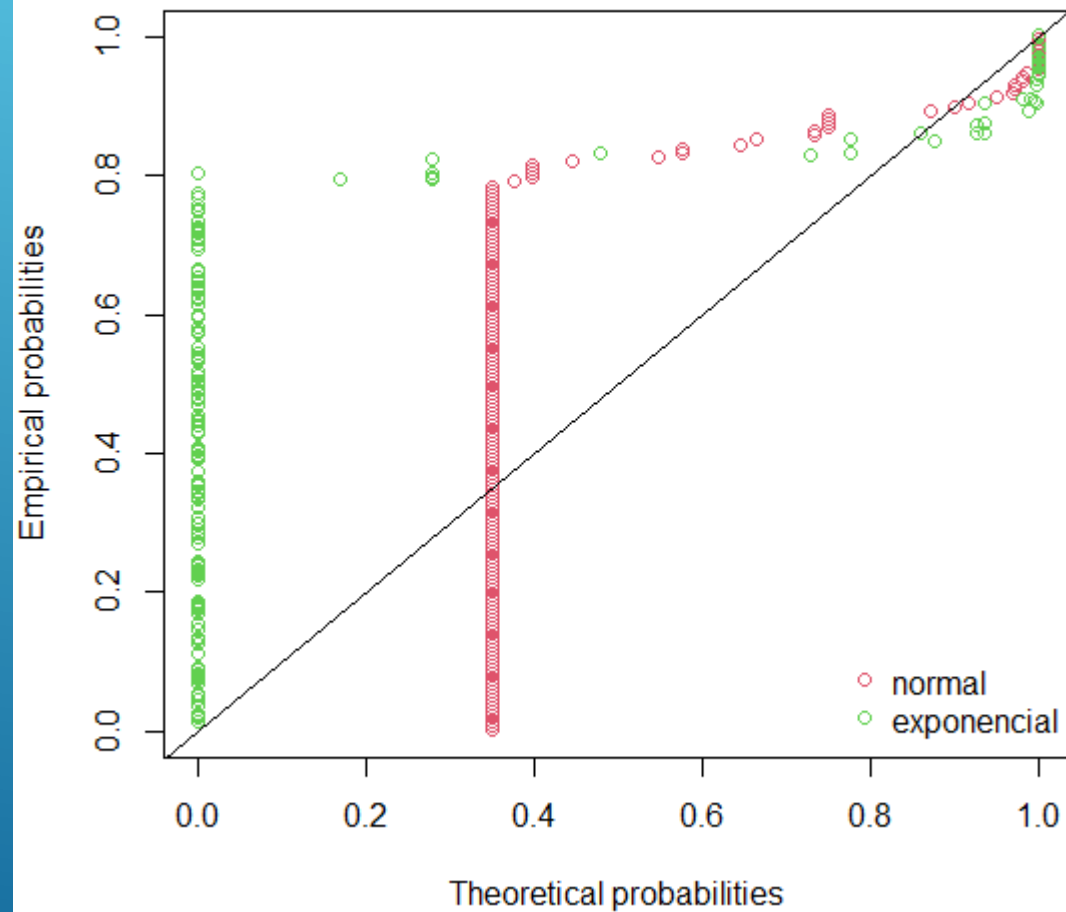


Concentração

Q-Q plot



P-P plot



Concentração

Goodness-of-fit statistics

	normal	exponencial
Kolmogorov-Smirnov statistic	0.439165	0.7878788
Cramer-von Mises statistic	8.384778	28.6223083
Anderson-Darling statistic	40.442942	Inf

Goodness-of-fit criteria

	normal	exponencial
Akaike's Information Criterion	926.3394	474.3379
Bayesian Information Criterion	932.5513	477.4438

Hartigans' dip test for unimodality / multimodality

data: vari
D = 0.016216, p-value = 0.9933
alternative hypothesis: non-unimodal, i.e., at least bimodal

```
> is.amodal(vari)
[1] FALSE
> is.unimodal(vari)
[1] TRUE
> is.bimodal(vari)
[1] FALSE
> is.trimodal(vari)
[1] FALSE
> is.iterquad(vari)
[1] FALSE
> bimodality_coefficient(vari)
[1] 0.8623796
```

	Melhor distribuição
Conversão	bimodal
Fator de estabilidade	unimodal
Razão molar inerte/metano	trimodal
WHSV	trimodal
Temperatura de reação	unimodal
Temperatura de Calcinação	
Temperatura de Redução	trimodal
Tamanho de cristalito da fase ativa	bimodal
Área específica do catalisador	unimodal
Teor total da fase ativa	bimodal
Concentração	unimodal

	Melhor distribuição
Conversão	Weibull
Fator de estabilidade	Normal
Razão molar inerte/metano	
WHSV	Exponencial
Temperatura de reação	Weibull
Temperatura de Calcinação	Normal
Temperatura de Redução	
Tamanho de cristalito da fase ativa	Lognormal
Área específica do catalisador	Lognormal
Teor total da fase ativa	Gamma
Concentração	