

Forecasting von Sales Zahlen

Beispiel: Eine Kategorie, 14 Modelle

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Im folgenden werden Forecasts von Saleszahlen erzeugt. Das entsprechende R script wird exportiert und kann dann weiterverwendet werden.

1 Setup

```
[1] "English_United_States.1252"
```

```
##Aufbereitung und Filterung der Daten
```

Namen werden für die Standardisierung vereinheitlicht:

1. date
2. category
3. value

1.1 Forecasting

Übergabe aus ist tsbl. 000 Zielsetzung: Bestimmung eines Modells, u.a. für die Verwendung in M Query.

Folgende 14 Modelle sind in diesem Beispiel implementiert:

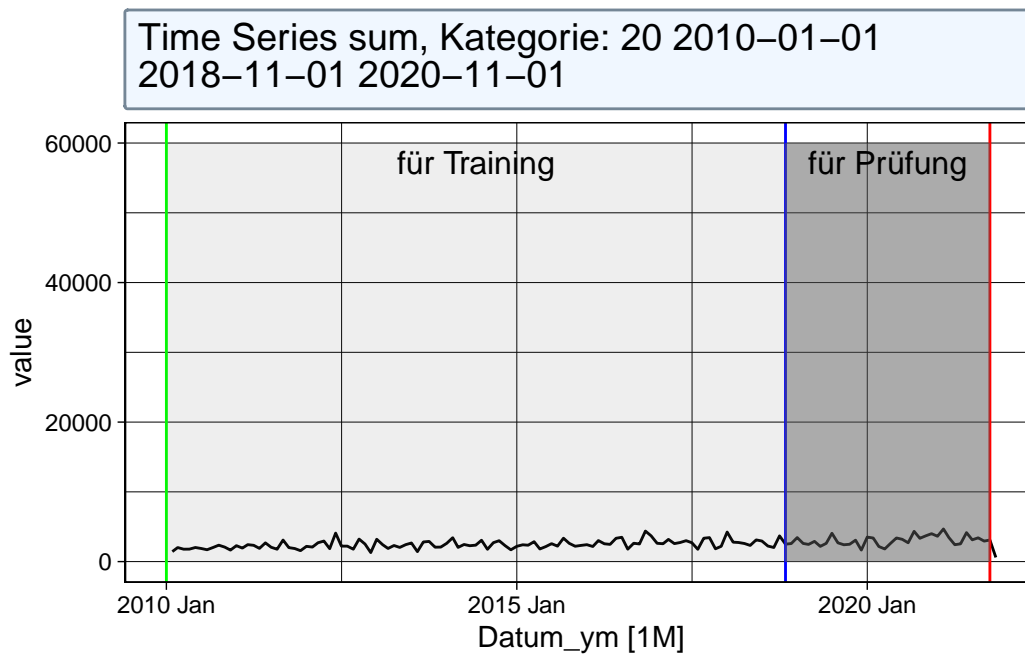
- Naive" = NAIVE(value),
- Mean" = MEAN(value),
- Seasonal naive" = SNAIVE(value),
- Arima" = ARIMA(log(value)),
- Arima stepwise" = ARIMA(value),
- Arima search" = ARIMA(value, stepwise = FALSE),
- Drift" = NAIVE(value ~ drift()),
- ETS" = ETS(value ~ error("A") + trend("N") + season("N")),
- Holt's Method" = ETS(value ~ error("A") + trend("A") + season("N")),
- Damped Holt's Method" = ETS(value ~ error("A") + trend("Ad", phi = 0.9) + season("N")),
- Holt-Winter add" = ETS(value ~ error("A") + trend("A") + season("A")),
- Holt-Winter mul" = ETS(value ~ error("M") + trend("A") + season("M")),
- Holt-Winter damp" = ETS(value ~ error("M") + trend("Ad") + season("M")),

- NNETAR” = NNETAR(sqrt(value)),

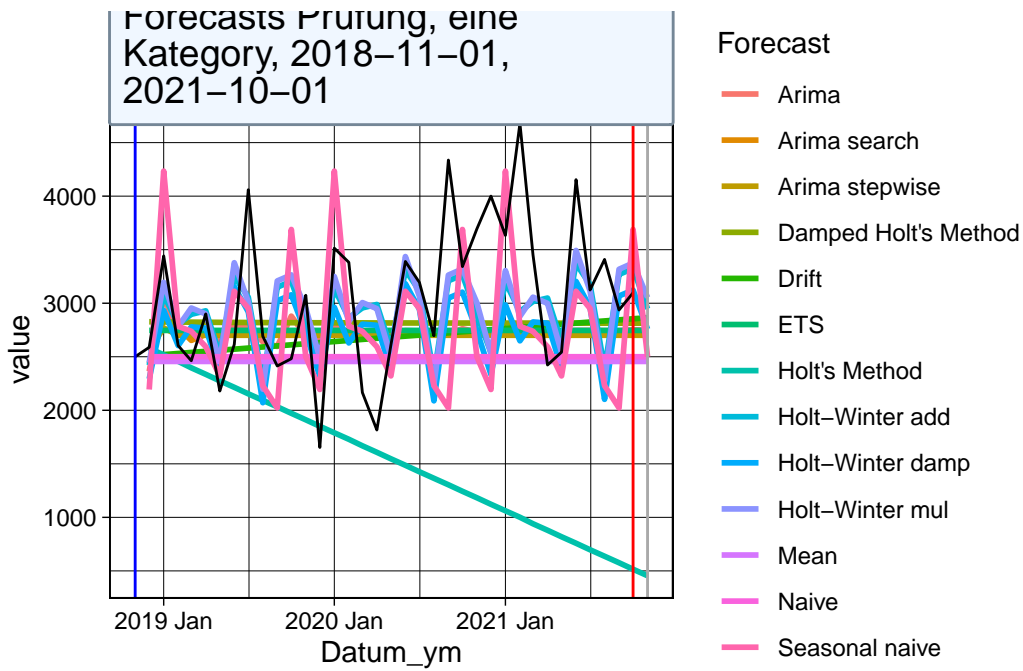
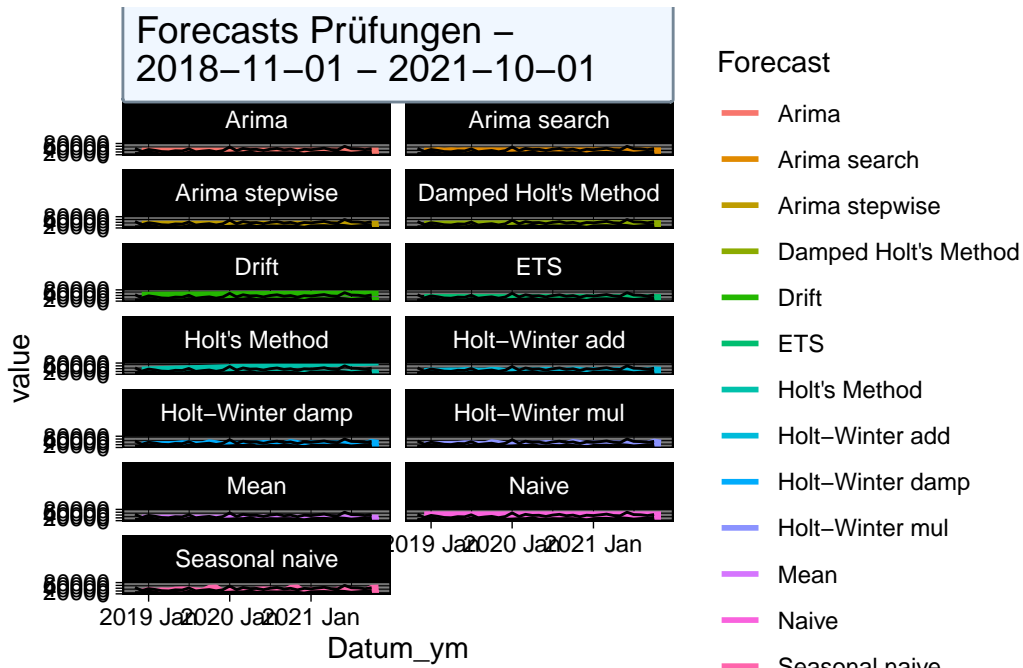
Für jede Kategorie werden alle 14 Modelle trainiert und geprüft.

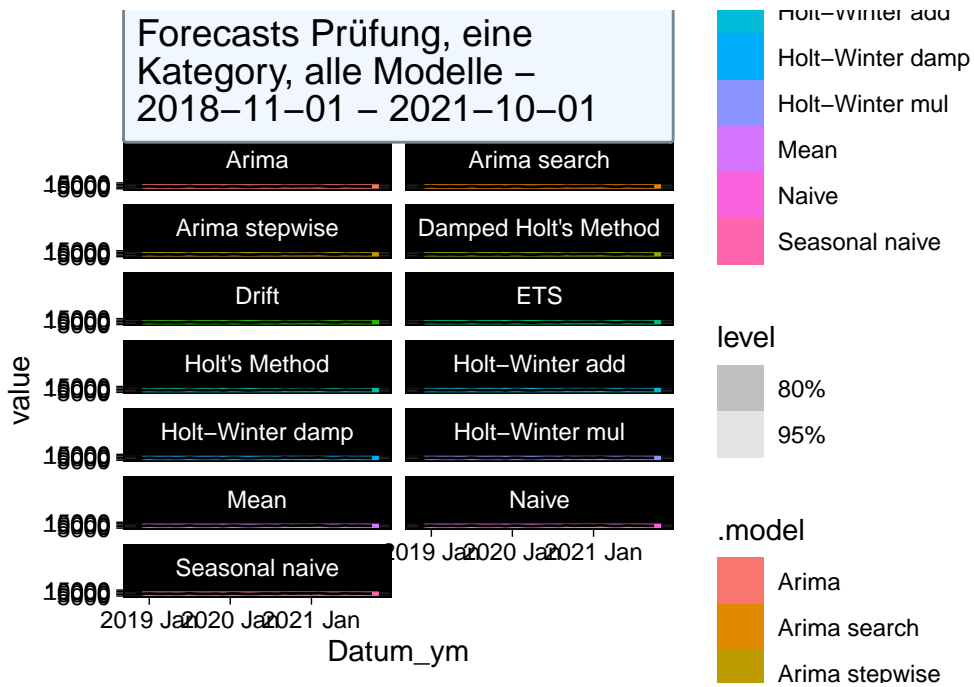
2 Training

Die vorliegenden Daten werden in die Bereiche Training und Prüfung aufgeteilt:



Weitere Darstellungen





3 Genauigkeit

Für die Bewertung der Berechnungen gibt es diverse Ansätze. Hier wird der kleinste Wert des Mean Average Percentage Error (MAPE) gesucht, wobei andere Ansätze möglich und implementiert werden können.

Tabelle 3.1: Accuracy Training.

category	.model	.type	RMSE	MAE	MAPE	MASE	RMSSE
10	Arima	Test	11161.39	8819.45	30.63	1.67	1.51
10	Arima search	Test	10603.42	8586.25	31.63	1.63	1.44
10	Arima stepwise	Test	11121.69	8818.31	30.78	1.67	1.51
10	Damped Holt's Method	Test	9800.20	7535.10	30.25	1.43	1.33
10	Drift	Test	19293.91	17348.78	71.99	3.28	2.62
10	ETS	Test	11297.16	8937.77	30.74	1.69	1.53
10	Holt's Method	Test	27607.87	23991.63	94.67	4.54	3.75
10	Holt-Winter add	Test	11175.10	8861.66	31.13	1.68	1.52
10	Holt-Winter damp	Test	11943.42	9561.87	33.17	1.81	1.62
10	Holt-Winter mul	Test	11588.87	9150.40	32.99	1.73	1.57
10	Mean	Test	16193.32	13581.01	38.71	2.57	2.20
10	Naive	Test	15234.38	12643.64	55.09	2.39	2.07
10	Seasonal naive	Test	15068.32	12323.61	45.96	2.33	2.04
20	Arima	Test	823.32	635.23	28.29	1.17	1.14
20	Arima search	Test	838.93	648.29	28.50	1.19	1.16
20	Arima stepwise	Test	843.56	647.72	28.32	1.19	1.17
20	Damped Holt's Method	Test	814.69	640.15	29.24	1.18	1.13
20	Drift	Test	840.83	633.26	28.35	1.16	1.16
20	ETS	Test	831.33	646.88	28.76	1.19	1.15
20	Holt's Method	Test	1827.02	1481.72	44.97	2.72	2.53
20	Holt-Winter add	Test	777.24	587.25	28.58	1.08	1.08
20	Holt-Winter damp	Test	822.66	636.01	28.60	1.17	1.14
20	Holt-Winter mul	Test	791.30	583.17	28.94	1.07	1.10
20	Mean	Test	954.91	744.90	29.40	1.37	1.32
20	Naive	Test	931.58	721.28	28.96	1.32	1.29
20	Seasonal naive	Test	900.54	718.92	29.80	1.32	1.25
30	Arima	Test	622.37	502.55	33.63	0.67	0.62
30	Arima search	Test	747.86	589.85	32.70	0.79	0.75

category	.model	.type	RMSE	MAE	MAPE	MASE	RMSSE
30	Arima stepwise	Test	636.81	509.00	32.67	0.68	0.64
30	Damped Holt's Method	Test	606.90	502.50	35.65	0.67	0.61
30	Drift	Test	728.31	563.56	31.27	0.75	0.73
30	ETS	Test	633.96	507.40	32.76	0.68	0.63
30	Holt's Method	Test	816.44	633.99	32.46	0.84	0.81
30	Holt-Winter add	Test	858.57	707.62	36.16	0.94	0.86
30	Holt-Winter damp	Test	670.74	548.89	33.49	0.73	0.67
30	Holt-Winter mul	Test	708.16	547.99	30.41	0.73	0.71
30	Mean	Test	639.50	534.25	41.27	0.71	0.64
30	Naive	Test	679.28	534.69	32.05	0.71	0.68
30	Seasonal naive	Test	760.17	641.25	38.24	0.85	0.76
40	Arima	Test	1360.20	1027.19	29.50	0.66	0.67
40	Arima search	Test	1433.65	1074.37	28.53	0.69	0.70
40	Arima stepwise	Test	1433.65	1074.37	28.53	0.69	0.70
40	Damped Holt's Method	Test	1451.85	1089.45	28.55	0.70	0.71
40	Drift	Test	1573.97	1381.80	47.96	0.89	0.77
40	ETS	Test	1383.59	1050.84	29.38	0.68	0.68
40	Holt's Method	Test	1332.97	1006.53	31.30	0.65	0.65
40	Holt-Winter add	Test	1416.63	1119.35	35.34	0.72	0.69
40	Holt-Winter damp	Test	1589.46	1273.85	41.94	0.82	0.78
40	Holt-Winter mul	Test	1476.31	1134.67	33.34	0.73	0.72
40	Mean	Test	1450.44	1088.58	28.56	0.70	0.71
40	Naive	Test	1440.78	1214.50	40.32	0.78	0.71
40	Seasonal naive	Test	2148.98	1724.47	50.91	1.11	1.05
50	Arima	Test	1859.82	1533.93	62.96	1.25	0.79
50	Arima search	Test	1683.20	1409.64	57.35	1.15	0.72
50	Arima stepwise	Test	1724.88	1449.11	53.99	1.18	0.74
50	Damped Holt's Method	Test	1798.59	1559.30	61.27	1.27	0.77
50	Drift	Test	1677.67	1374.46	49.28	1.12	0.72
50	ETS	Test	1721.65	1378.64	47.31	1.12	0.74
50	Holt's Method	Test	1796.82	1524.76	60.93	1.24	0.77
50	Holt-Winter add	Test	1673.72	1258.38	47.27	1.02	0.71
50	Holt-Winter damp	Test	2081.37	1520.02	54.56	1.24	0.89
50	Holt-Winter mul	Test	2191.36	1470.62	57.66	1.20	0.94
50	Mean	Test	2173.26	1520.92	36.12	1.24	0.93
50	Naive	Test	1739.88	1339.42	43.02	1.09	0.74
50	Seasonal naive	Test	2087.81	1401.06	43.48	1.14	0.89
60	Arima	Test	498.32	373.46	51.99	2.06	1.41
60	Arima search	Test	423.88	303.13	42.53	1.67	1.20
60	Arima stepwise	Test	423.88	303.13	42.53	1.67	1.20

Header text

category	.model	.type	RMSE	MAE	MAPE	MASE	RMSSE
60	Damped Holt's Method	Test	415.94	277.52	34.15	1.53	1.18
60	Drift	Test	417.58	275.55	32.34	1.52	1.18
60	ETS	Test	412.48	274.74	33.55	1.51	1.17
60	Holt's Method	Test	476.50	322.34	33.83	1.77	1.35
60	Holt-Winter add	Test	428.87	305.35	41.84	1.68	1.21
60	Holt-Winter damp	Test	458.59	312.40	38.43	1.72	1.30
60	Holt-Winter mul	Test	494.06	333.20	42.66	1.83	1.40
60	Mean	Test	540.12	400.96	37.38	2.21	1.53
60	Naive	Test	455.04	309.67	32.21	1.71	1.29
60	Seasonal naive	Test	422.74	283.17	32.14	1.56	1.19
70	Arima	Test	4875.65	3919.87	79.34	1.77	1.61
70	Arima search	Test	4969.81	3901.54	84.43	1.76	1.64
70	Arima stepwise	Test	5037.22	3914.14	83.62	1.77	1.66
70	Damped Holt's Method	Test	4800.17	3865.56	79.25	1.75	1.58
70	Drift	Test	6073.86	5074.24	69.44	2.29	2.00
70	ETS	Test	5135.78	4108.54	75.28	1.86	1.69
70	Holt's Method	Test	4639.71	3674.27	77.83	1.66	1.53
70	Holt-Winter add	Test	4669.40	3394.13	83.60	1.53	1.54
70	Holt-Winter damp	Test	4851.09	3551.87	79.58	1.61	1.60
70	Holt-Winter mul	Test	4996.81	3766.61	86.13	1.70	1.65
70	Mean	Test	6978.56	5931.09	70.43	2.68	2.30
70	Naive	Test	6500.59	5471.53	70.66	2.47	2.14
70	Seasonal naive	Test	5338.98	3878.36	94.55	1.75	1.76

Ausgewählte Modelle
Auswahl per kleinstem MAPE

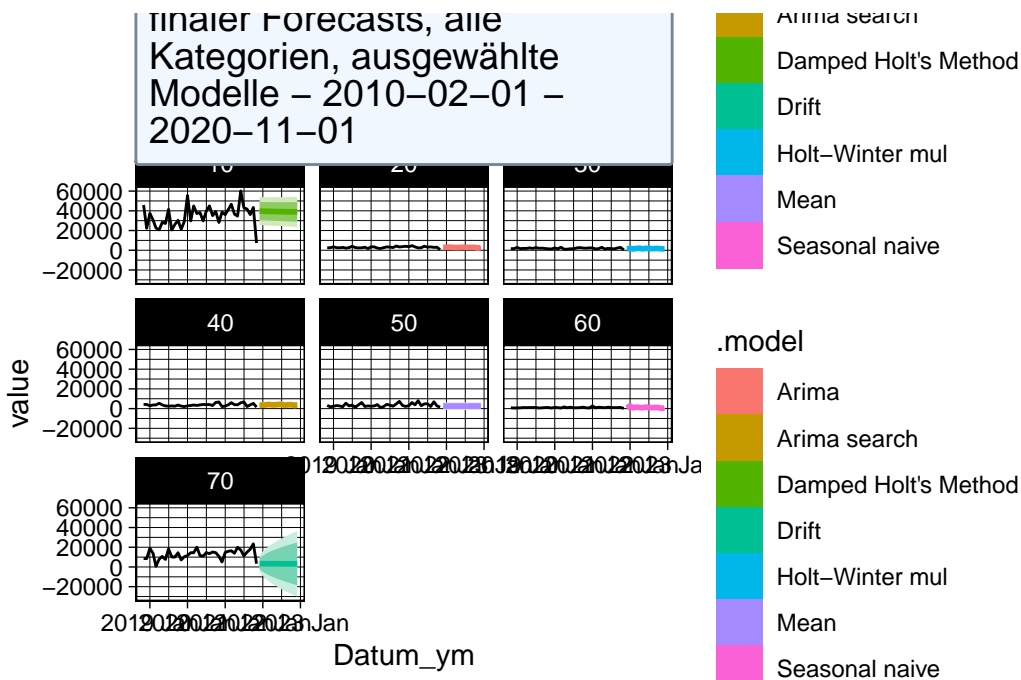
category	.model	.type	Kriterien				
			RMSE	MAE	MAPE	MASE	RMSSE
10	Damped Holt's Method	Test	9,800.20	7,535.10	30.25%	1.43	1.33
20	Arima	Test	823.32	635.23	28.29%	1.17	1.14
30	Holt-Winter mul	Test	708.16	547.99	30.41%	0.73	0.71
40	Arima search	Test	1,433.65	1,074.37	28.53%	0.69	0.70
50	Mean	Test	2,173.26	1,520.92	36.12%	1.24	0.93
60	Seasonal naive	Test	422.74	283.17	32.14%	1.56	1.19
70	Drift	Test	6,073.86	5,074.24	69.44%	2.29	2.00

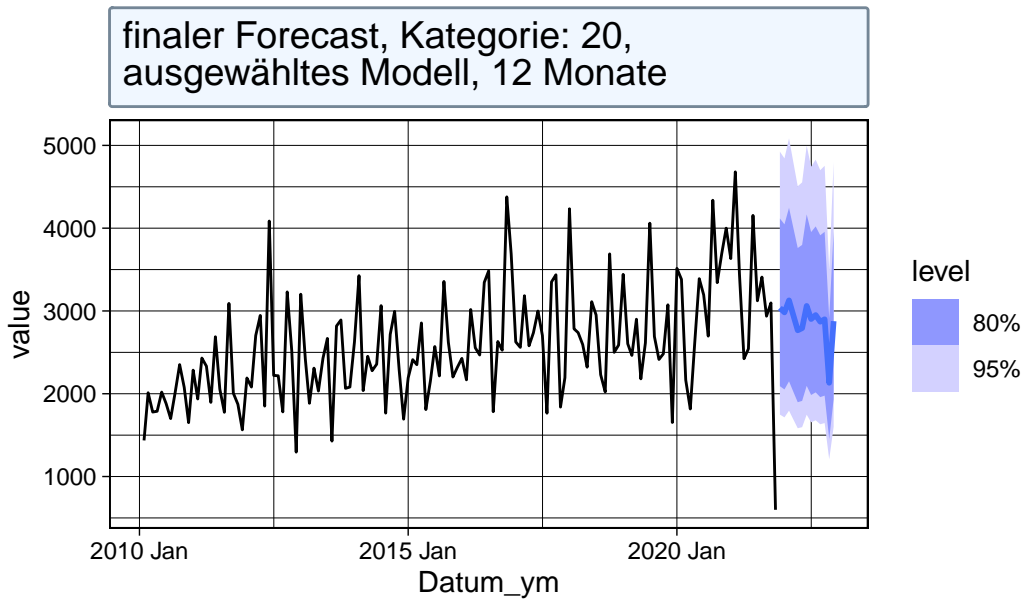
Tabelle 3.2: fit_accuracy, alle MAPE-Werte

category	Naive	Mean	Seasonal maive	Arima stepwise	Arima search	Drift	Holt's ETS	Damped Holt's Method	Holt- Winter add	Holt- Winter mul	Holt- Winter damp		
10	26.87	23.57	22.70	17.25	17.59	16.47	26.99	17.92	20.45	18.34	16.92	17.55	16.96
20	25.99	20.06	21.57	15.38	16.30	15.98	26.07	16.83	18.68	16.59	14.78	14.98	13.31
30	36.23	29.18	29.08	27.47	29.95	27.80	36.16	30.33	28.04	29.19	25.52	26.34	25.54
40	63.28	49.15	56.00	40.44	48.01	48.01	63.56	45.52	48.57	48.00	45.30	43.72	44.50
50	71.07	44.50	48.95	30.25	45.16	43.69	71.43	40.37	46.99	44.57	46.49	42.74	42.03
60	43.83	33.23	33.42	17.62	24.96	24.96	44.04	29.53	31.25	29.00	20.51	22.46	22.54
70	37.77	35.46	25.98	21.85	21.53	21.25	37.72	33.75	25.64	23.38	22.48	22.25	21.74

4 Forecast

```
# A tsibble: 1,183 x 7 [1M]
# Key:   category, .model [91]
  category .model Datum_ym      value .mean      `80%`
  <dbl> <chr>   <mtm>      <dist> <dbl>      <hilo>
1      10 Naive  2021 Dec N(7345, 9.3e+07) 7345 [ -5015.333, 19705.33]80
2      10 Naive  2022 Jan N(7345, 1.9e+08) 7345 [-10135.151, 24825.15]80
3      10 Naive  2022 Feb N(7345, 2.8e+08) 7345 [-14063.725, 28753.73]80
4      10 Naive  2022 Mar N(7345, 3.7e+08) 7345 [-17375.667, 32065.67]80
5      10 Naive  2022 Apr N(7345, 4.7e+08) 7345 [-20293.546, 34983.55]80
6      10 Naive  2022 May N(7345, 5.6e+08) 7345 [-22931.510, 37621.51]80
7      10 Naive  2022 Jun N(7345, 6.5e+08) 7345 [-25357.368, 40047.37]80
8      10 Naive  2022 Jul N(7345, 7.4e+08) 7345 [-27615.302, 42305.30]80
9      10 Naive  2022 Aug N(7345, 8.4e+08) 7345 [-29736.000, 44426.00]80
10     10 Naive  2022 Sep N(7345, 9.3e+08) 7345 [-31741.806, 46431.81]80
# i 1,173 more rows
# i 1 more variable: `95%` <hilo>
```





5 Vergleich der Jahressummen

Jahressumme

-

category	Jahr							.m
	2016	2017	2018	2019	2020	2021	2022	
10	283,039.00	295,891.00	353,212.00	335,876.00	461,236.00	427,514.00	470,420.28	Da
20	34,470.00	31,974.00	33,763.00	32,579.00	38,141.00	34,048.00	34,317.30	Ar
30	27,444.00	18,674.00	20,807.00	23,839.00	23,776.00	20,122.00	20,259.28	Ho
40	39,489.00	43,764.00	46,321.00	38,067.00	47,156.00	45,781.00	46,130.59	Ar
50	29,264.00	36,978.00	42,858.00	38,070.00	40,004.00	46,878.00	30,379.77	Me
60	9,390.00	13,007.00	11,684.00	11,036.00	12,507.00	12,948.00	13,546.00	Se
70	108,913.00	116,704.00	141,101.00	130,070.00	156,409.00	169,346.00	38,851.66	Dr

6 Export

Die generierten Daten werden exportiert.

Möglichkeiten:

- lokales file
- Speichern in SQL Server