kettler analysis

intro code

```python
import os
import sys
import pandas as pd
from pathlib import Path
from textwrap import wrap
import plotly.express as px
import datetime as dt
import warnings
import requests

exec(
    requests.get(
        "https://gist.githubusercontent.com/smeisegeier/4944b9a88b7a90cb1b2acc6da0dd906f/raw/"
    ).text
)

# * get plotting mods
exec(requests.get(
    'https://gist.githubusercontent.com/smeisegeier/2a3c931c987dbfaa23ff0ca6e9955829/raw/'
    ).text)

# * get src directory which *must* be parent
dir_src = Path(os.getcwd()).parent.parent

# # * add to path
# if dir_src.as_posix() not in sys.path:
#     sys.path.append(dir_src.as_posix())

# * display / style settings
pd.options.display.max_rows = 100
pd.options.display.max_colwidth = 160
pd.options.display.precision = 2
pd.options.mode.chained_assignment = None


# * theme settings
# THEME = "light"
THEME = "light"
os.environ["THEME"] = THEME

if THEME == "dark":
    THEME_PLOTLY = "plotly_dark"
else:
    THEME_PLOTLY = "plotly"

print(f"last run: {dt.datetime.now()}")
```

```
last run: 2024-01-27 22:29:01.626659
```

load data

```python
df_training=pd.read_parquet('data/trainings.pq')
df_records=pd.read_parquet('data/records.pq')
```

analysis

```python
describe_df(df_training.iloc[:,1:], 'training', use_columns=False, use_plot=False)
```

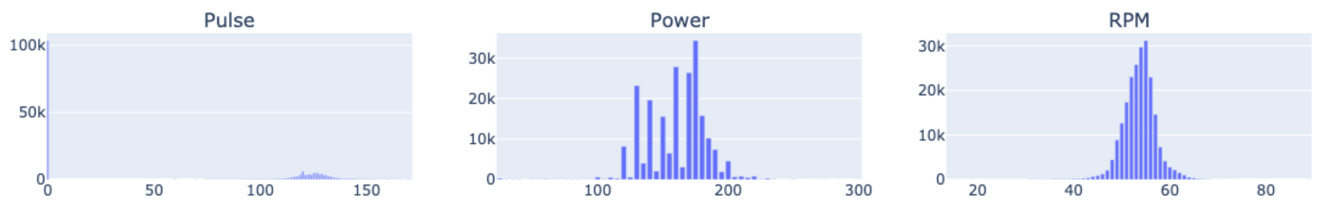
```
🔵 *** df: training ***
🟣 shape: (1_125, 13) columns: ['Device', 'Calibration', 'Software', 'Date', 'Time', 'RecordIntervall', 'Transmission', 'Energy',
'TrainingDateTime', 'FileName', 'CreatedAt', 'Duration_minutes', 'Streak_days']
🟣 duplicates: 0
🟣 missings: {'Device': 0, 'Calibration': 0, 'Software': 0, 'Date': 0, 'Time': 0, 'RecordIntervall': 0, 'Transmission': 0, 'Energy': 0,
'TrainingDateTime': 0, 'FileName': 0, 'CreatedAt': 0, 'Duration_minutes': 0, 'Streak_days': 0}
--- column uniques (all)
🟠 Device(1|object)
🟠 Calibration(1|object)
🟠 Software(1|object)
🟠 Date(1_121|object)
🟠 Time(1_107|object)
🟠 RecordIntervall(1|object)
🟠 Transmission(1|object)
🟠 Energy(1|object)
🟠 TrainingDateTime(1_124|object)
🟠 FileName(1_125|object)
🟠 CreatedAt(45|datetime64[ns])
🟠 Duration_minutes(114|float64)
🟠 Streak_days(13|int64)
--- column stats (numeric)
🟠 Duration_minutes(114|float64) min: 0.667 | max: 73.833 | median: 30.0 | mean: 32.322 | std: 6.591 | cv: 0.204 | sum: 36_361.833 | skew: 2.579 |
kurto: 11.013
🟠 Streak_days(13|int64) min: 0 | max: 23 | median: 1.0 | mean: 0.996 | std: 1.689 | cv: 1.696 | sum: 1_120 | skew: 5.519 | kurto: 52.156
```

	Device	Calibration	Software	Date	Time	RecordIntervall	Transmission	Energy	TrainingDateTime	FileName	CreatedAt	Duration_minutes	Streak_days
0	SJ10X SKYLON 5	07655-350-2007	3367	11.01.2014	20:09:26	10	9.5	6.0	2014-01-11T20:09:26+01:00	Training 11.01.2014 20h09m26s.xml	2021-01-07 23:58:46.053121	53.17	0
1	SJ10X SKYLON 5	07655-350-2007	3367	12.01.2014	18:49:44	10	9.5	6.0	2014-01-12T18:49:44+01:00	Training 12.01.2014 18h49m44s.xml	2021-01-07 23:58:46.053121	56.67	0
2	SJ10X SKYLON 5	07655-350-2007	3367	13.01.2014	21:56:13	10	9.5	6.0	2014-01-13T21:56:13+01:00	Training 13.01.2014 21h56m13s.xml	2021-01-07 23:58:46.053121	59.17	0

```python
describe_df(df_records.iloc[:,1:], 'records', use_columns=False, fig_offset=-4)
```

```
🔵 *** df: records ***
🟣 shape: (218_171, 7) columns: ['Pulse', 'Power', 'RPM', 'TimePassed_minutes', 'TimePassed_percent', 'Score_10sec', 'TrainingId']
🟣 duplicates: 0
🟣 missings: {'Pulse': 0, 'Power': 0, 'RPM': 0, 'TimePassed_minutes': 0, 'TimePassed_percent': 0, 'Score_10sec': 0, 'TrainingId': 0}
--- column uniques (all)
🟠 Pulse(182|int64)
🟠 Power(52|int64)
🟠 RPM(61|int64)
🟠 TimePassed_minutes(443|float64)
🟠 TimePassed_percent(23_272|float64)
🟠 Score_10sec(1_029|float64)
🟠 TrainingId(1_125|int64)
--- column stats (numeric)
🟠 Pulse(182|int64) min: 0 | max: 220 | median: 78.0 | mean: 65.203 | std: 64.223 | cv: 0.985 | sum: 14_225_458 | skew: 0.096 | kurto: -1.735
🟠 Power(52|int64) min: 25 | max: 300 | median: 160.0 | mean: 160.233 | std: 23.28 | cv: 0.145 | sum: 34_958_190 | skew: -0.643 | kurto: 2.316
🟠 RPM(61|int64) min: 14 | max: 89 | median: 54.0 | mean: 53.633 | std: 3.557 | cv: 0.066 | sum: 11_701_072 | skew: -0.818 | kurto: 6.298
🟠 TimePassed_minutes(443|float64) min: 0.167 | max: 73.833 | median: 16.333 | mean: 16.916 | std: 10.766 | cv: 0.636 | sum: 3_690_485.0 | skew:
0.693 | kurto: 0.854
🟠 TimePassed_percent(23_272|float64) min: 0.002 | max: 1.0 | median: 0.503 | mean: 0.503 | std: 0.289 | cv: 0.574 | sum: 109_648.0 | skew: -0.0 |
kurto: -1.2
🟠 Score_10sec(1_029|float64) min: 0.0 | max: 0.018 | median: 0.008 | mean: 0.007 | std: 0.001 | cv: 0.186 | sum: 1_610.97 | skew: -0.127 | kurto:
1.514
🟠 TrainingId(1_125|int64) min: 1 | max: 1_128 | median: 521.0 | mean: 531.252 | std: 336.07 | cv: 0.633 | sum: 115_903_885 | skew: 0.088 | kurto:
-1.243
```

	Pulse	Power	RPM	TimePassed_minutes	TimePassed_percent	Score_10sec	TrainingId
0	0	50	46	0.17	3.13e-03	1.97e-03	1
1	0	150	45	36.17	6.80e-01	5.77e-03	1
2	0	150	49	36.00	6.77e-01	6.28e-03	1



enhance tables

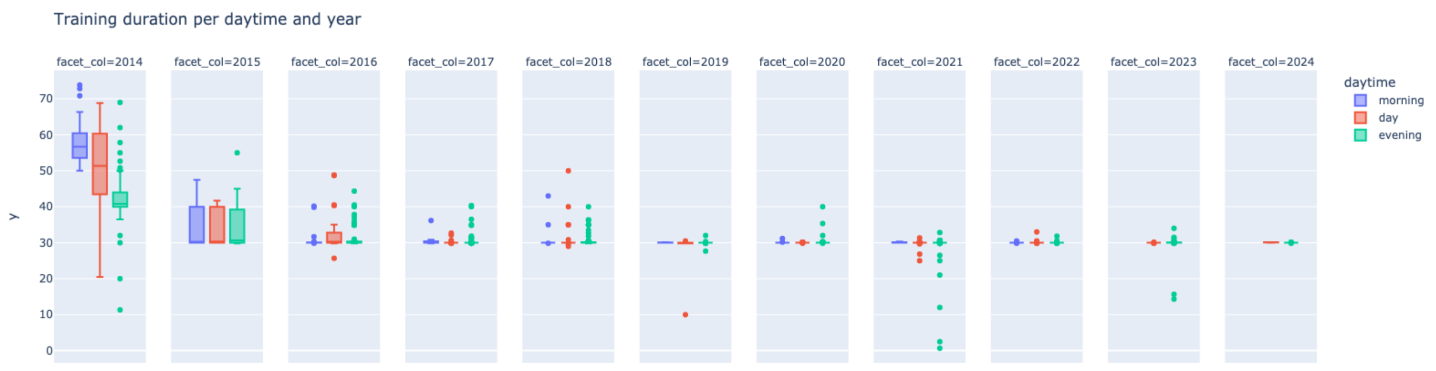
```python
#
# * tailor and join both tables

# * id col is new index
if "Id" in df_training.columns:
    df_training.set_index("Id", inplace=True, drop=True)
if "Id" in df_records.columns:
    df_records.set_index("Id", inplace=True, drop=True)

# * convert to proper datetime (remove 'T')
df_training.TrainingDateTime = pd.to_datetime(
    df_training.TrainingDateTime, errors="coerce"
)

# * add daytime (3 cats: morning, day, evening)
df_training["daytime"] = df_training.TrainingDateTime.dt.hour.map(
    lambda x: "morning" if x < 13 else "day" if x < 18 else "evening"
)

# * add day_of_week
df_training["day_of_week"] = df_training.TrainingDateTime.dt.strftime("%A")

# * add date
df_training["training_date"] = df_training.TrainingDateTime.dt.date.astype("datetime64")

# * join both tables on records level
df = df_records.join(df_training, on="TrainingId")

# * drop unneeded columns: filename, createdat, TrainingId
cols_drop = [col for col in df if len(df[col].unique()) == 1]
print(f"remove these one-item columns:{cols_drop}")

cols_drop += ["Date", "Time", "FileName", "CreatedAt", "TrainingId"]

df.drop(
    # * subtract columns to make the statement idempotent
    columns=set(df.columns) & set(cols_drop),
    inplace=True,
)
df[:3]
```

```
remove these one-item columns:['Device', 'Calibration', 'Software', 'RecordIntervall', 'Transmission', 'Energy']
```

	Pulse	Power	RPM	TimePassed_minutes	TimePassed_percent	Score_10sec	TrainingDateTime	Duration_minutes	Streak_days	daytime	day_of_week	training_date
Id												
1	0	50	46	0.17	3.13e-03	1.97e-03	2014-01-11 20:09:26+01:00	53.17	0	evening	Saturday	2014-01-11
2	0	150	45	36.17	6.80e-01	5.77e-03	2014-01-11 20:09:26+01:00	53.17	0	evening	Saturday	2014-01-11
3	0	150	49	36.00	6.77e-01	6.28e-03	2014-01-11 20:09:26+01:00	53.17	0	evening	Saturday	2014-01-11

duration

```
_df = df_training.copy()
# * add aux cols for sorting
_df['_daytime'] = pd.Categorical(_df.daytime, ["morning", "day", "evening"])
_df['_year'] = _df.TrainingDateTime.dt.year

_fig = px.box(
    _df.sort_values(by=["_year","_daytime"]),
    y=_df.Duration_minutes,
    template=THEME_PLOTLY,
    color='daytime',
    points="outliers",
    # points=False,
    facet_col=_df.TrainingDateTime.dt.year,
    # height=300,
    width=1600,
    title="Training duration per daytime and year",
    )
_fig.show('png')
```



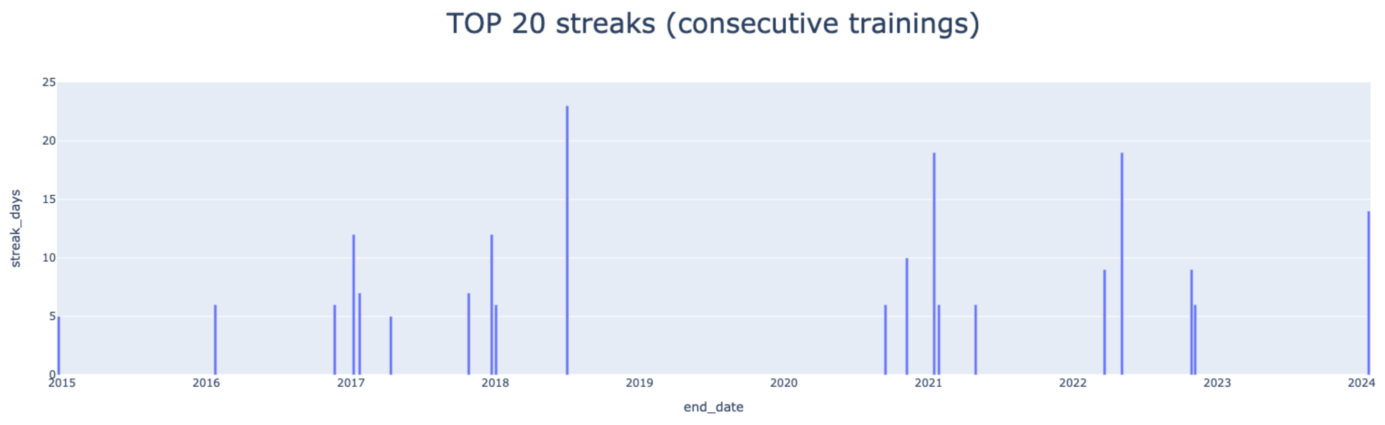
streaks

```
#
# * copy table, must be sorted by TrainingDateTime
_df = (
    df_training.sort_values("TrainingDateTime")
    .reset_index()
    [["Id", "training_date"]]
    .copy()
)

# * add bool for "is a sequence", check if delta to previous training is 1
_df['sequence'] = (_df['training_date'] - _df.shift(1)['training_date']).dt.days.astype('Int16').fillna(1) == 1
# _df['no_interruption_days'] = (_df['training_date'] - _df['training_date'].shift(1)).dt.days.fillna(1).ne(1).cumsum()

# * add section number. cumsum increases on a certain condition (when sequence is False, streak has ended)
_df['section'] = (~_df.sequence).cumsum()

# * fix edge case: very first section has no predessesor and belongs to first streak
_df.loc[1, 'section'] = 0

display(_df[:3])

# * calculate streak
df_training_streak=(_df.groupby(
    'section',
    as_index=False,     # only relevant for series output
    observed=False,     # speeds up processing for large data
    )
    .agg({
        'section':'count',
        'training_date':['min','max'],
        })
    .droplevel(axis=1, level=0)
    .rename(columns={'count':'streak_days', 'min':'start_date', 'max':'end_date'})
    .sort_values(by='streak_days', ascending=False)
    )
df_training_streak[:3]
```

	Id	training_date	sequence	section
0	1	2014-01-11	True	False
1	2	2014-01-12	True	0
2	3	2014-01-13	True	0

	streak_days	start_date	end_date
280	23	2018-06-10	2018-07-02
485	19	2022-04-17	2022-05-05
395	19	2020-12-28	2021-01-15

```
_df = df_training_streak.copy()[:20]
_fig = px.bar(
    _df,
    y="streak_days",
    x=_df['end_date'].astype(str),
    # text='streak_days',
    width=1600,
    labels={"x": "end_date"},
    title="TOP 20 streaks (consecutive trainings)",
    template=THEME_PLOTLY,

)
_fig.update_layout(
    title={
        'x': 0.5,
        'y': 0.95,
        'xanchor': 'center',
        'yanchor': 'top',
        'font': {'size': 30, }
    },
    yaxis_range=[0, 25],
)
_fig.show('png')
_fig.write_image('img/top20streaks.png')
```



aggregations

```
df=(df_training
    .merge(
        df_records,
        left_on='Id',
        right_on='TrainingId',
    )
)
df['year']=df['TrainingDateTime'].dt.year
```

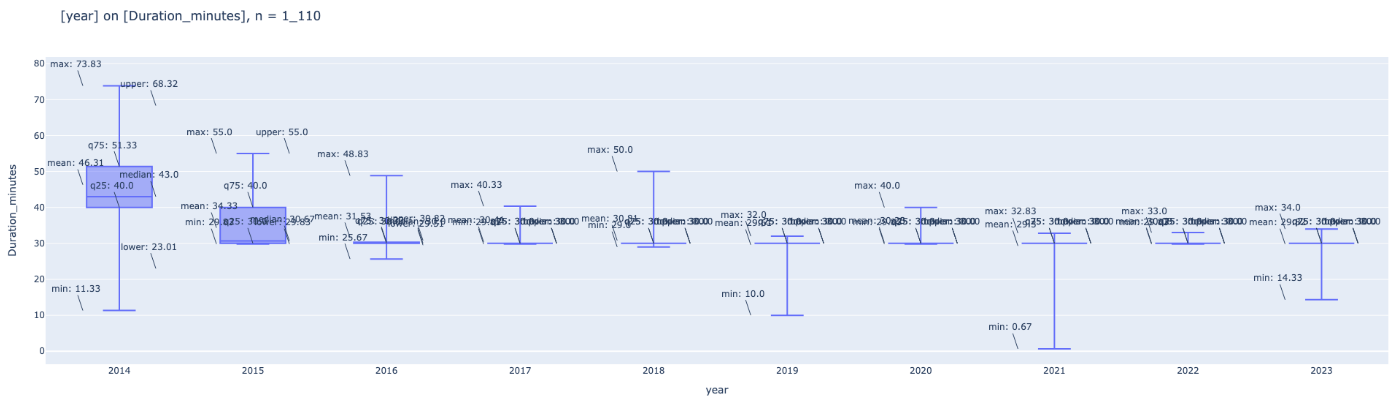
```
df.groupby(
    'year',
    # as_index=False,
    ).agg({
        'training_date':['min', 'max','nunique'],
        'Duration_minutes':['min', 'max', 'mean'],
        'Power':['max', 'mean'],
        }
    )
```

	training_date			Duration_minutes			Power	
	min	max	nunique	min	max	mean	max	mean
year								
2014	2014-01-11	2014-12-24	119	11.33	73.83	48.52	275	132.13
2015	2015-01-03	2015-12-31	95	29.83	55.00	35.15	230	138.07
2016	2016-01-02	2016-12-31	131	25.67	48.83	31.96	250	144.49
2017	2017-01-01	2017-12-31	134	29.83	40.33	30.49	250	164.50
2018	2018-01-01	2018-12-31	132	29.00	50.00	31.04	300	178.17
2019	2019-01-01	2019-12-22	53	10.00	32.00	29.87	240	177.40
2020	2020-04-07	2020-12-31	90	29.83	40.00	30.28	235	162.25
2021	2021-01-01	2021-12-31	130	0.67	32.83	29.83	230	176.16
2022	2022-01-03	2022-12-31	113	29.83	33.00	30.09	200	173.47
2023	2023-01-02	2023-12-04	109	14.33	34.00	29.96	250	177.60
2024	2024-01-03	2024-01-19	15	29.83	30.17	30.03	175	174.19

numerics

```
df=df_training.iloc[:,[8,11]]
df['year']=df['TrainingDateTime'].dt.year.astype(str)
_df1=df[df['year']<'2022'].iloc[:,[2,1]]
_df2=df.iloc[:,[2,1]]
```

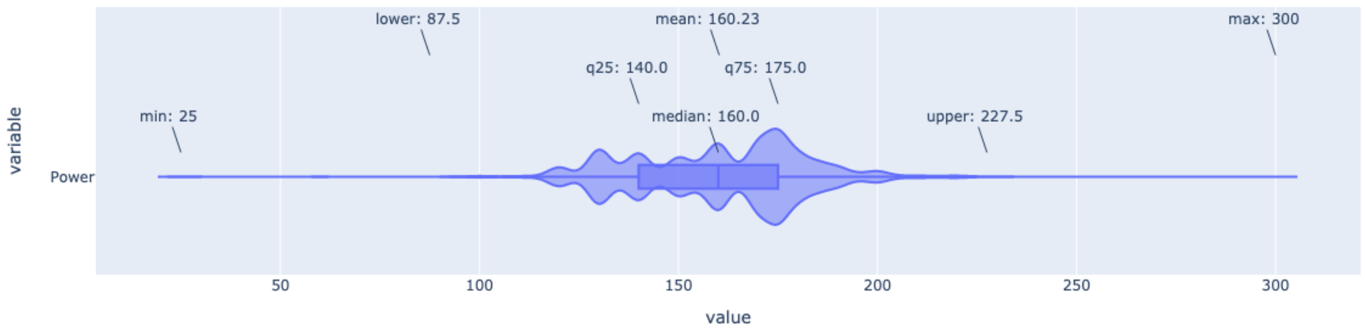
```
_df1=df[df['year']<'2024'].iloc[:,[2,1]]
plot_boxes(_df1,annotations=True, width=2000)
```



```
# lol = px.data.iris()[["species", "sepal_width"]]
# plot_boxes(lol, "sepia", width=800, )
```

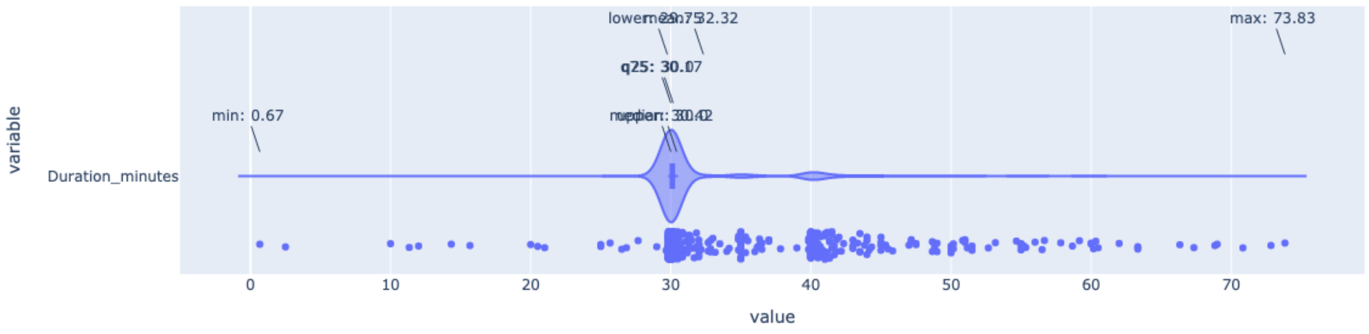
```
plot_box(df_records['Power'], height=400, violin=True, caption='kettler')
```

#️⃣kettler, [Power], n = 218_171



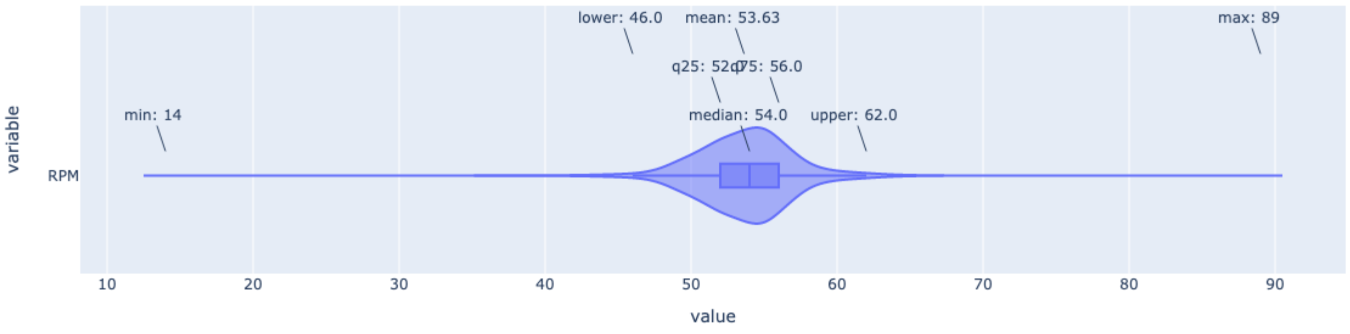
```
plot_box(df_training['Duration_minutes'], height=400, violin=True, caption='kettler', points='all')
```

#️⃣kettler, [Duration_minutes], n = 1_125



```
plot_box(df_records['RPM'], height=400, violin=True, caption='kettler')
```

#️⃣kettler, [RPM], n = 218_171


lower: 46.0
mean: 53.63
max: 89
q25: 52.0
q75: 56.0
min: 14
median: 54.0
upper: 62.0
variable
RPM
value