Probabilistic time series forecasting with Facebook prophet

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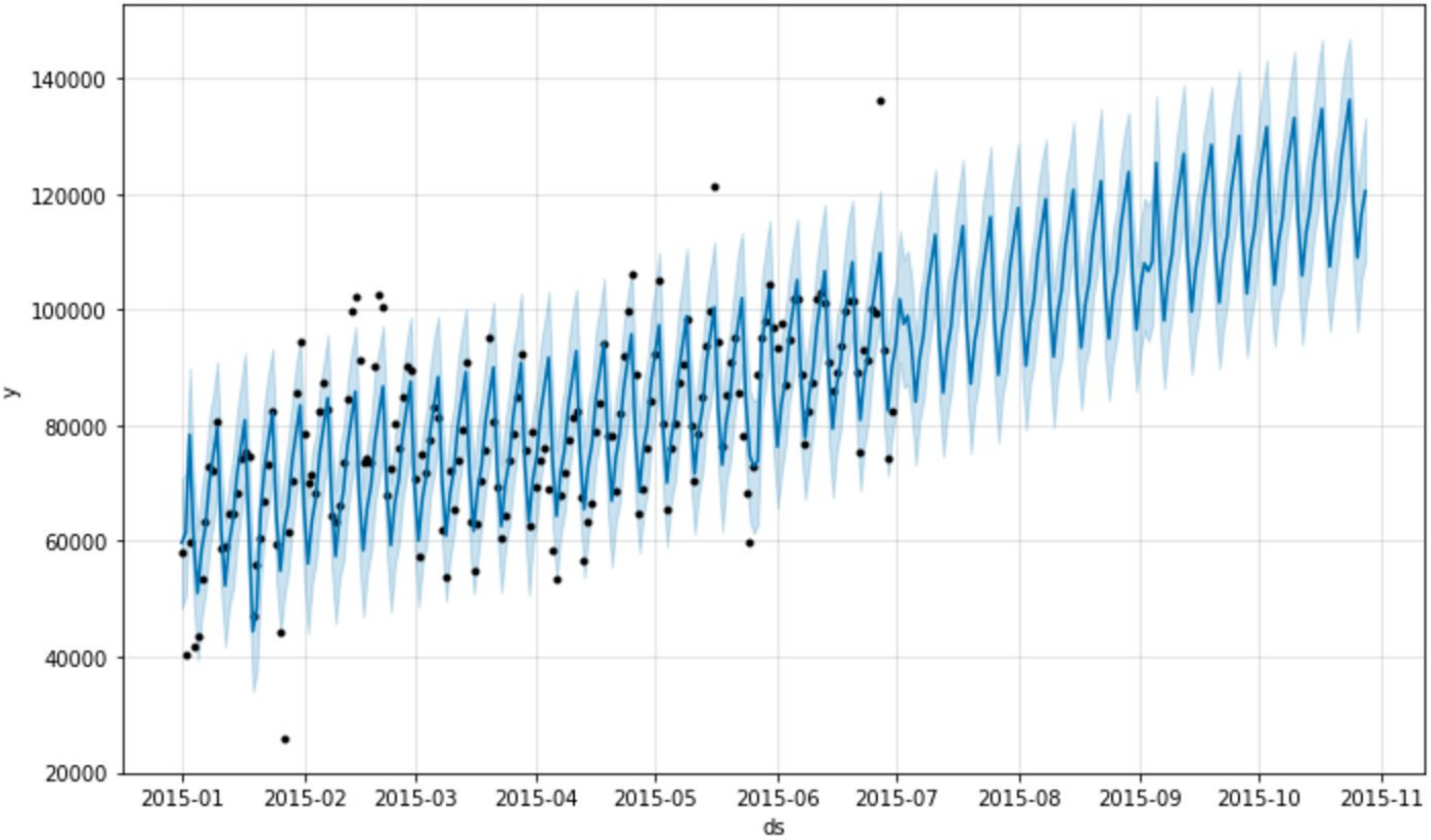
PyData London 2017 lightning talk

https://github.com/samuelleach/python-notebooks

Old problem

Something happened yesterday.

Will it happen tomorrow?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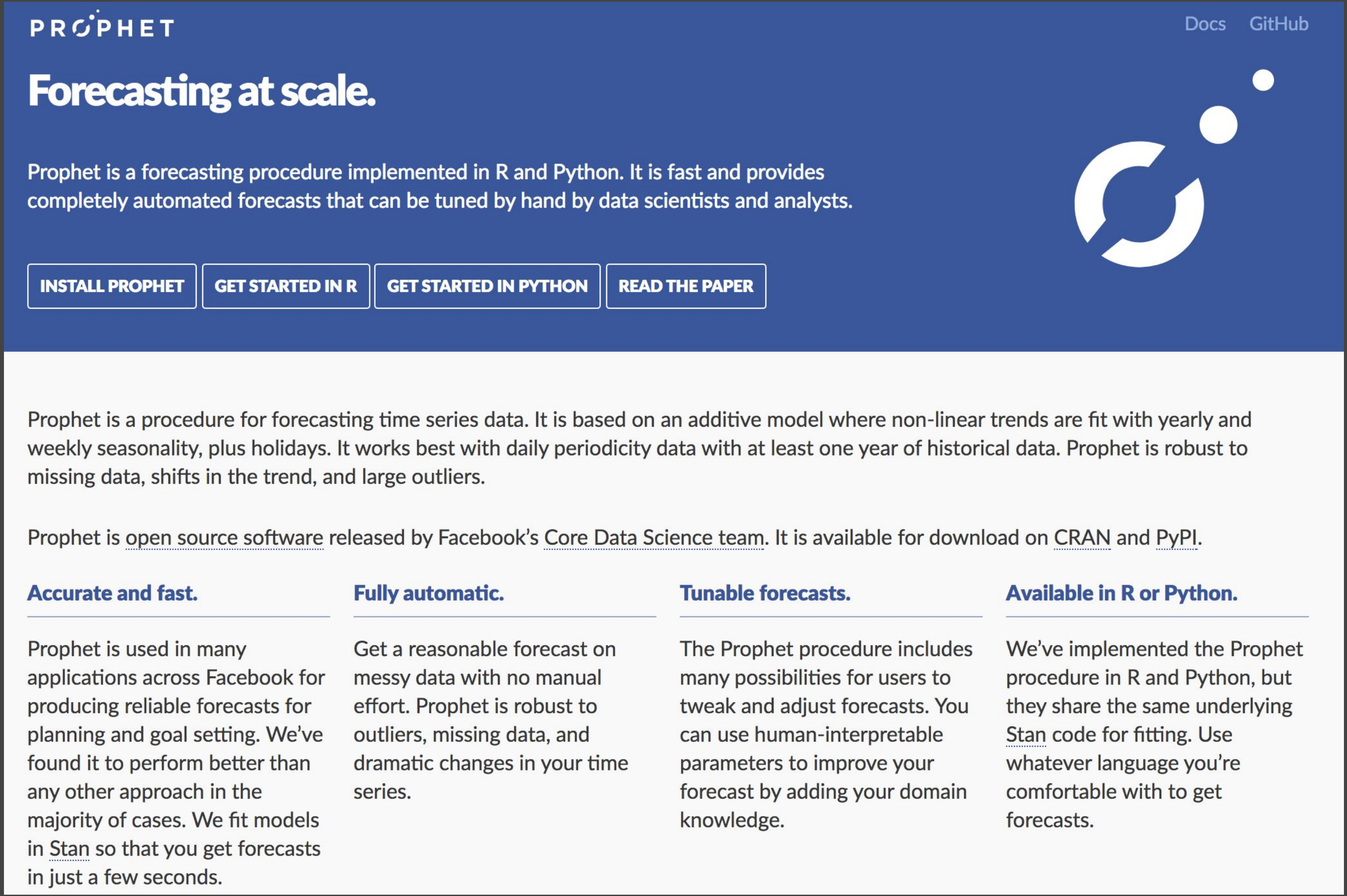


Forecasting at scale.

Prophet is a forecasting procedure implemented in R and Python. It is fast and provides completely automated forecasts that can be tuned by hand by data scientists and analysts.

Prophet is a procedure for forecasting time series data. It is based on an additive model where non-linear trends are fit with yearly and weekly seasonality, plus holidays. It works best with daily periodicity data with at least one year of historical data. Prophet is robust to missing data, shifts in the trend, and large outliers.

Prophet is open source software released by Facebook's Core Data Science team. It is available for download on CRAN and PyPI.

Accurate and fast.

Prophet is used in many applications across Facebook for producing reliable forecasts for planning and goal setting. We've found it to perform better than any other approach in the majority of cases. We fit models in Stan so that you get forecasts in just a few seconds.

Fully automatic.

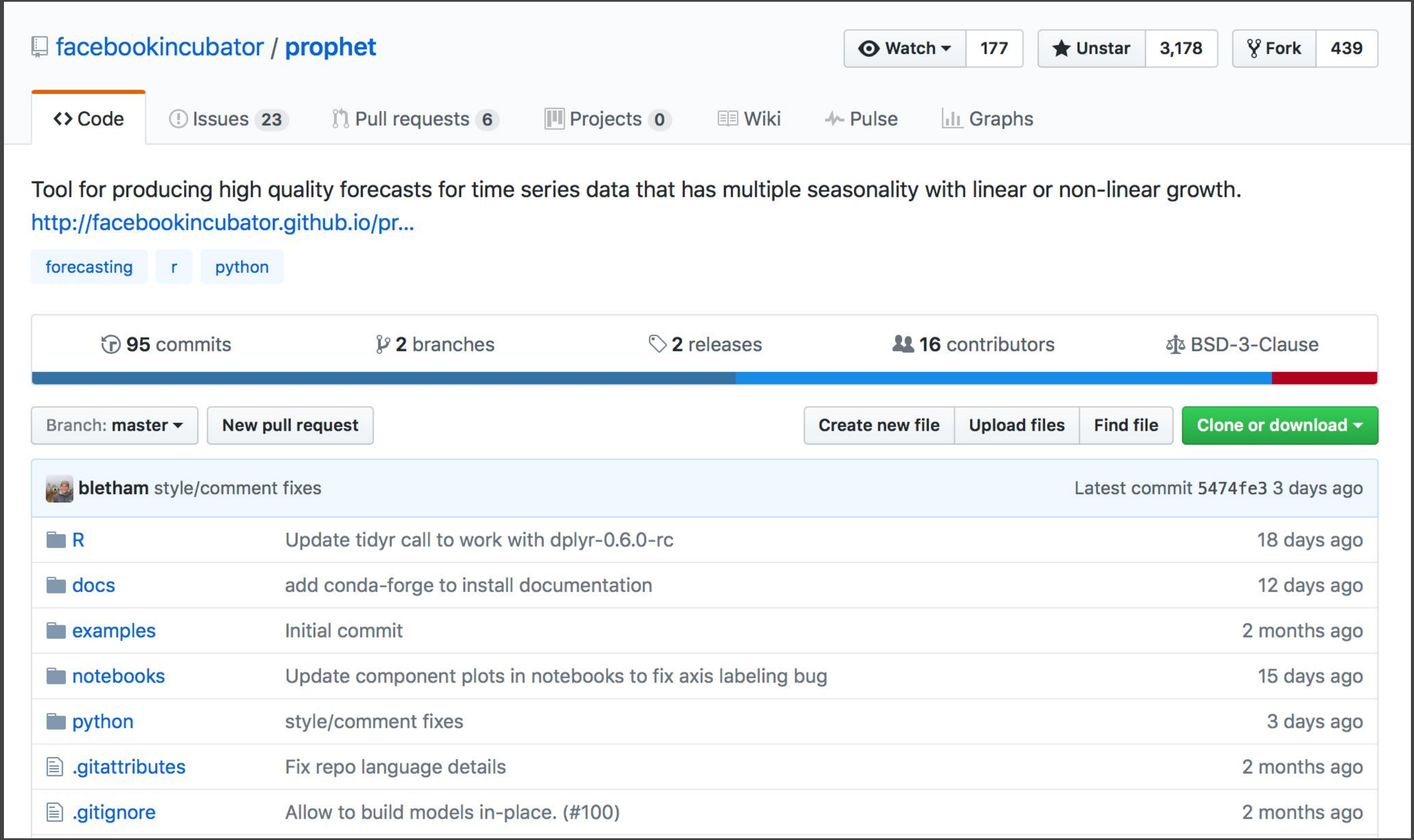
Get a reasonable forecast on messy data with no manual effort. Prophet is robust to outliers, missing data, and dramatic changes in your time series.

Tunable forecasts.

The Prophet procedure includes many possibilities for users to tweak and adjust forecasts. You can use human-interpretable parameters to improve your forecast by adding your domain knowledge.

Available in R or Python.

We've implemented the Prophet procedure in R and Python, but they share the same underlying Stan code for fitting. Use whatever language you're comfortable with to get forecasts.



Tool for producing high quality forecasts for time series data that has multiple seasonality with linear or non-linear growth. http://facebookincubator.github.io/pr...

bletham style/comment fixes Latest commit 5474fe3 3 days ago

R	Update tidyr call to work with dplyr-0.6.0-rc	18 days ago
docs	add conda-forge to install documentation	12 days ago
examples	Initial commit	2 months ago
notebooks	Update component plots in notebooks to fix axis labeling bug	15 days ago
python	style/comment fixes	3 days ago
.gitattributes	Fix repo language details	2 months ago
.gitignore	Allow to build models in-place. (#100)	2 months ago

What is Prophet?

- Time series forecasting library by Sean Taylor and Benjamin Letham at Facebook.
- Models a single time series with a daily timestamp.
- Scikit learn like fit / predict API.
- Uses stan under the hood to sample uncertainties of some model component parameters.

Time series model components

- Linear or non-linear growth with changepoint detection and specification.
- Weekly and yearly periodic / Fourier components.
- Specification of (multiple groups of) holiday events.

Inputs

- Pandas dataframe with a daily timestamp and time series to be modeled.
- Model parameters: changepoints, holidays.

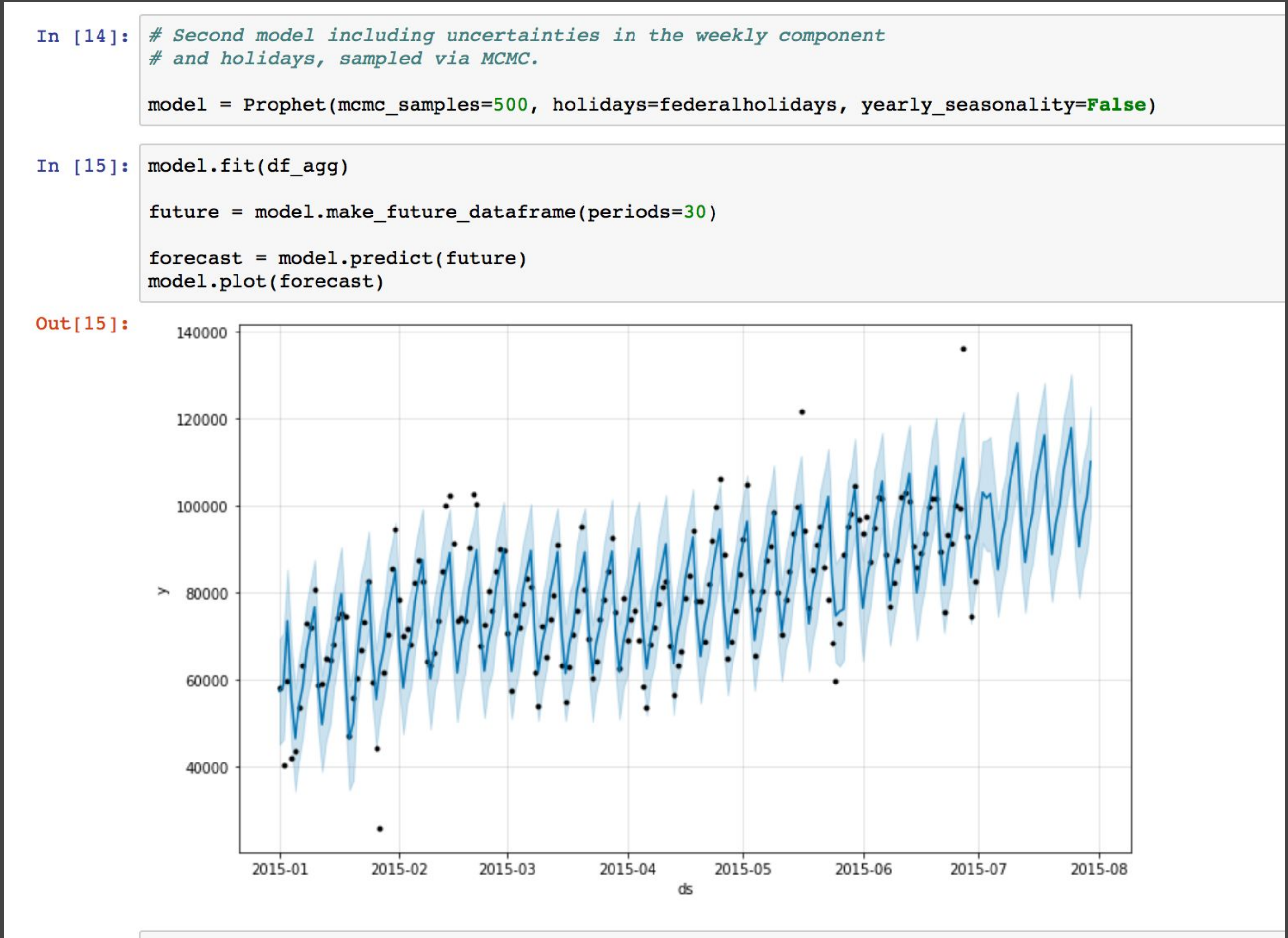
Outputs

- Dataframe with forecasts and uncertainties for some set of future timestamps.
- Model components and uncertainties.

Demo

Run prophet on 14 million Uber rides in New York, January - June 2015

Notebook: https://github.com/samuelleach/python-notebooks
Data: https://github.com/fivethirtyeight/uber-tlc-foil-response



In [14]:

```
# Second model including uncertainties in the weekly component
# and holidays, sampled via MCMC.

model = Prophet(mcmc_samples=500, holidays=federalholidays, yearly_seasonality=False)
```

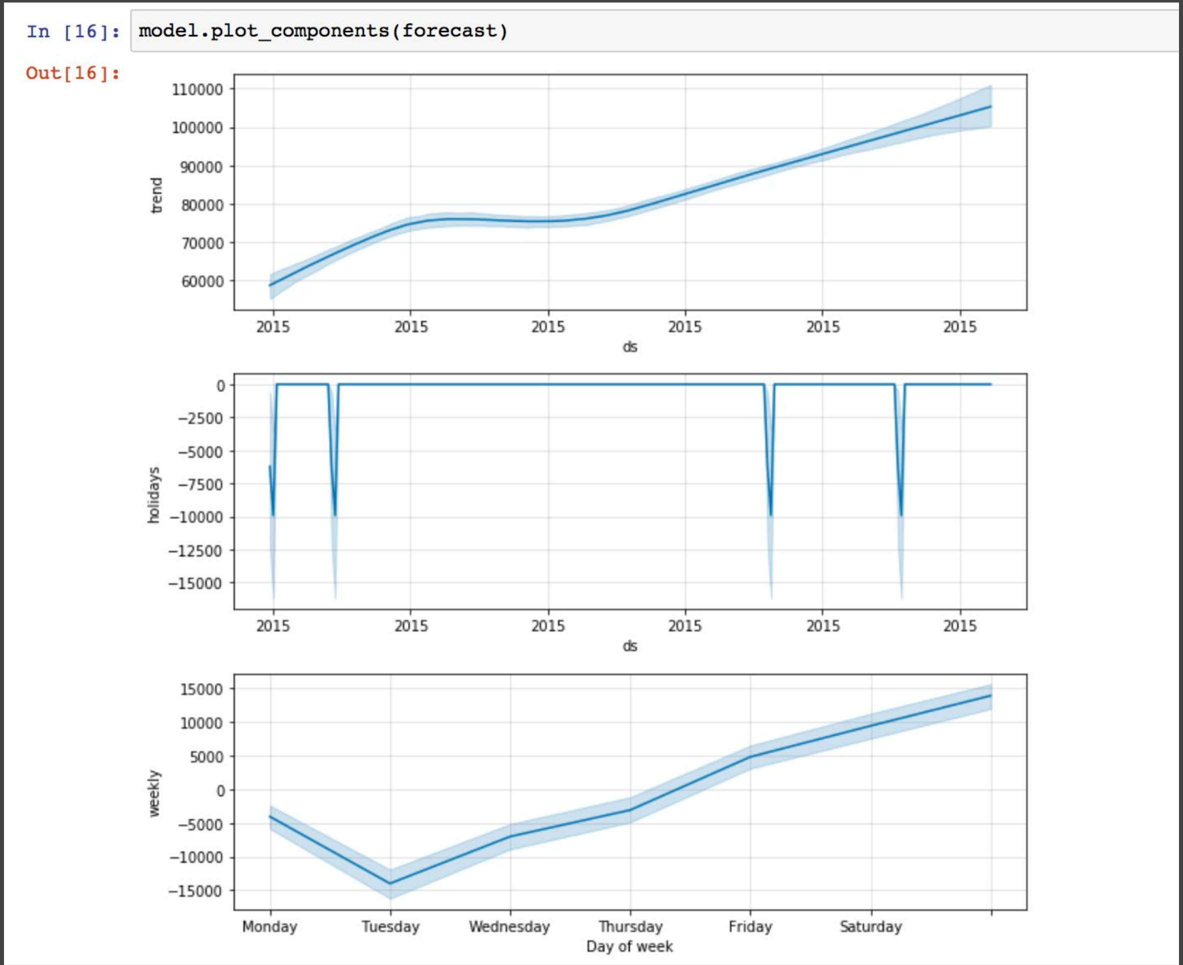
In [15]:

```
model.fit(df_agg)

future = model.make_future_dataframe(periods=30)

forecast = model.predict(future)
model.plot(forecast)
```

Out[15]:



```
In [16]: model.plot_components(forecast)
```

Out[16]:

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