

## ✓ Prediction Of Covid Cases Using FbProphet

```
!pip install pystan
!pip install fbprophet
```

```
Requirement already satisfied: pystan in /usr/local/lib/python3.7/dist-packages (2.19.1.1)
Requirement already satisfied: Cython!=0.25.1,>=0.22 in /usr/local/lib/python3.7/dist-packages (from pystan) (0.29.23)
Requirement already satisfied: numpy>=1.7 in /usr/local/lib/python3.7/dist-packages (from pystan) (1.19.5)
Requirement already satisfied: fbprophet in /usr/local/lib/python3.7/dist-packages (0.7.1)
Requirement already satisfied: Cython>=0.22 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (0.29.23)
Requirement already satisfied: cmdstanpy==0.9.5 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (0.9.5)
Requirement already satisfied: pystan>=2.14 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (2.19.1.1)
Requirement already satisfied: numpy>=1.15.4 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (1.19.5)
Requirement already satisfied: pandas>=1.0.4 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (1.1.5)
Requirement already satisfied: matplotlib>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (3.2.2)
Requirement already satisfied: LunarCalendar>=0.0.9 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (0.0.9)
Requirement already satisfied: convertdate>=2.1.2 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (2.3.2)
Requirement already satisfied: holidays>=0.10.2 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (0.10.5.2)
Requirement already satisfied: setuptools-git>=1.2 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (1.2)
Requirement already satisfied: python-dateutil>=2.8.0 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (2.8.1)
Requirement already satisfied: tqdm>=4.36.1 in /usr/local/lib/python3.7/dist-packages (from fbprophet) (4.41.1)
Requirement already satisfied: pymeeus<1,>=0.3.13 in /usr/local/lib/python3.7/dist-packages (from convertdate>=2.1.2->fbprophet) (0.5.11)
Requirement already satisfied: pytz>=2014.10 in /usr/local/lib/python3.7/dist-packages (from convertdate>=2.1.2->fbprophet) (2018.9)
Requirement already satisfied: hijri-converter in /usr/local/lib/python3.7/dist-packages (from holidays>=0.10.2->fbprophet) (2.1.3)
Requirement already satisfied: korean-lunar-calendar in /usr/local/lib/python3.7/dist-packages (from holidays>=0.10.2->fbprophet) (0.2.1)
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from holidays>=0.10.2->fbprophet) (1.15.0)
Requirement already satisfied: ephemer>=3.7.5.3 in /usr/local/lib/python3.7/dist-packages (from LunarCalendar>=0.0.9->fbprophet) (4.0.0.2)
Requirement already satisfied: cyclical>=0.10 in /usr/local/lib/python3.7/dist-packages (from matplotlib>=2.0.0->fbprophet) (0.10.0)
Requirement already satisfied: pyparsing!=2.0.4,!2.1.2,!2.1.6,>=2.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib>=2.0.0->fbprophet) (2.4.7)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib>=2.0.0->fbprophet) (1.3.1)
```

```
import fbprophet
```

```
from fbprophet import Prophet
```

```
import pandas as pd
```

```
df=pd.read_csv('/content/covid_19_clean_complete.csv')
```

```
df.head()
```

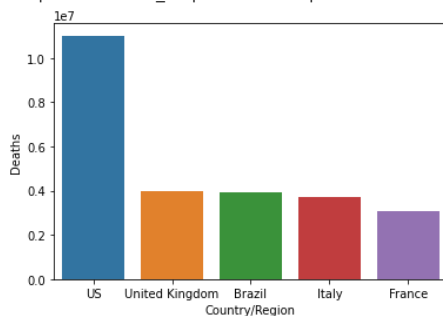
```
Province/State Country/Region Lat Long Date Confirmed Deaths Recovered Active WHO Region
0 NaN Afghanistan 33.93911 67.709953 2020-01-22 0 0 0 0 Eastern Mediterranean
1 NaN Albania 41.15330 20.168300 2020-01-22 0 0 0 0 Europe
2 NaN Algeria 28.03390 1.659600 2020-01-22 0 0 0 0 Africa
3 NaN Andorra 42.50630 1.521800 2020-01-22 0 0 0 0 Europe
4 NaN Angola -11.20270 17.873900 2020-01-22 0 0 0 0 Africa
```

```
import matplotlib.pyplot as plt
import seaborn as sns
```

## ✓ Top 5 Countries ranked by Covid Deaths

```
total_deaths=df.groupby(['Country/Region'])['Deaths'].sum().reset_index()
total_deaths.sort_values('Deaths',ascending=False,inplace=True)
total_deaths = total_deaths.head()
sns.barplot(x=total_deaths['Country/Region'],y=total_deaths['Deaths'])
```

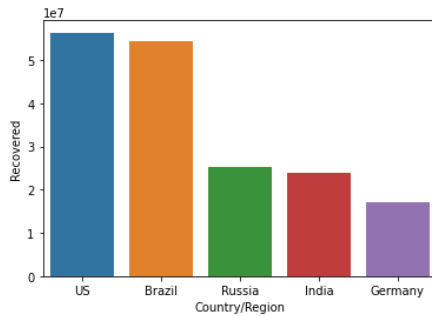
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f300b5f90d0>
```



## ✓ Top 5 Countries ranked by Recovered Covid Cases

```
total_Recovered=df.groupby(['Country/Region'])['Recovered'].sum().reset_index()
total_Recovered.sort_values('Recovered',ascending=False,inplace=True)
total_Recovered = total_Recovered.head()
sns.barplot(x=total_Recovered['Country/Region'],y=total_Recovered['Recovered'])
```

↳ <matplotlib.axes.\_subplots.AxesSubplot at 0x7f300b4721d0>



df.shape

↳ (49068, 10)

df.dtypes

↳

|                |         |
|----------------|---------|
| Province/State | object  |
| Country/Region | object  |
| Lat            | float64 |
| Long           | float64 |
| Date           | object  |
| Confirmed      | int64   |
| Deaths         | int64   |
| Recovered      | int64   |
| Active         | int64   |
| WHO Region     | object  |
| dtype:         | object  |

df['Date']=pd.to\_datetime(df['Date'])

df.dtypes

↳

|                |                |
|----------------|----------------|
| Province/State | object         |
| Country/Region | object         |
| Lat            | float64        |
| Long           | float64        |
| Date           | datetime64[ns] |
| Confirmed      | int64          |
| Deaths         | int64          |
| Recovered      | int64          |
| Active         | int64          |
| WHO Region     | object         |
| dtype:         | object         |

df.isnull().sum()

↳

|                |       |
|----------------|-------|
| Province/State | 34404 |
| Country/Region | 0     |
| Lat            | 0     |
| Long           | 0     |
| Date           | 0     |
| Confirmed      | 0     |
| Deaths         | 0     |
| Recovered      | 0     |
| Active         | 0     |
| WHO Region     | 0     |
| dtype:         | int64 |

df['Date'].nunique()

↳ 188

total=df.groupby(['Date'])['Confirmed','Deaths','Recovered','Active'].sum().reset\_index()

↳ /usr/local/lib/python3.7/dist-packages/ipykernel\_launcher.py:1: FutureWarning:

Indexing with multiple keys (implicitly converted to a tuple of keys) will be deprecated, use a list instead.

total.head()



|   | Date       | Confirmed | Deaths | Recovered | Active |
|---|------------|-----------|--------|-----------|--------|
| 0 | 2020-01-22 | 555       | 17     | 28        | 510    |
| 1 | 2020-01-23 | 654       | 18     | 30        | 606    |
| 2 | 2020-01-24 | 941       | 26     | 36        | 879    |
| 3 | 2020-01-25 | 1434      | 42     | 39        | 1353   |
| 4 | 2020-01-26 | 2118      | 56     | 52        | 2010   |

```
df_prophet=total.rename(columns={'Date':'ds','Confirmed':'y'})
```

```
df_prophet.head()
```



|   | ds         | y    | Deaths | Recovered | Active |
|---|------------|------|--------|-----------|--------|
| 0 | 2020-01-22 | 555  | 17     | 28        | 510    |
| 1 | 2020-01-23 | 654  | 18     | 30        | 606    |
| 2 | 2020-01-24 | 941  | 26     | 36        | 879    |
| 3 | 2020-01-25 | 1434 | 42     | 39        | 1353   |
| 4 | 2020-01-26 | 2118 | 56     | 52        | 2010   |

```
m=Prophet(daily_seasonality=True,yearly_seasonality=True)
```

```
model=m.fit(df_prophet)
```

```
model.seasonalities
```



```
OrderedDict([('yearly',
  {'condition_name': None,
   'fourier_order': 10,
   'mode': 'additive',
   'period': 365.25,
   'prior_scale': 10.0}),
 ('weekly',
  {'condition_name': None,
   'fourier_order': 3,
   'mode': 'additive',
   'period': 7,
   'prior_scale': 10.0}),
 ('daily',
  {'condition_name': None,
   'fourier_order': 4,
   'mode': 'additive',
   'period': 1,
   'prior_scale': 10.0})])
```

```
### now I am going to do forecasting so to do forecasting I need some Future Days
future_global=model.make_future_dataframe(periods=30,freq='D')
```

```
future_global.head()
```



|   | ds         |
|---|------------|
| 0 | 2020-01-22 |
| 1 | 2020-01-23 |
| 2 | 2020-01-24 |
| 3 | 2020-01-25 |
| 4 | 2020-01-26 |

```
df_prophet.shape
```



```
(188, 5)
```

```
future_global.shape
```



```
(218, 1)
```

```
df_prophet['ds'].tail()
```



```
183  2020-07-23
184  2020-07-24
185  2020-07-25
186  2020-07-26
187  2020-07-27
Name: ds, dtype: datetime64[ns]
```

```
future_global.tail()
```



|     | ds         |
|-----|------------|
| 213 | 2020-08-22 |
| 214 | 2020-08-23 |
| 215 | 2020-08-24 |
| 216 | 2020-08-25 |
| 217 | 2020-08-26 |

```
### now do Prediction on future_global
prediction=model.predict(future_global)
prediction
```



|     | ds         | trend         | yhat_lower    | yhat_upper   | trend_lower   | trend_upper   | additive_terms | additive_terms_lower | additive_terms_upper | daily         |
|-----|------------|---------------|---------------|--------------|---------------|---------------|----------------|----------------------|----------------------|---------------|
| 0   | 2020-01-22 | -6.632025e+05 | -1.769075e+04 | 5.508184e+03 | -6.632025e+05 | -6.632025e+05 | 6.577998e+05   | 6.577998e+05         | 6.577998e+05         | -2.658267e+06 |
| 1   | 2020-01-23 | -5.790479e+05 | -9.762946e+03 | 1.296022e+04 | -5.790479e+05 | -5.790479e+05 | 5.804456e+05   | 5.804456e+05         | 5.804456e+05         | -2.658267e+06 |
| 2   | 2020-01-24 | -4.948933e+05 | -2.603031e+03 | 2.008124e+04 | -4.948933e+05 | -4.948933e+05 | 5.034426e+05   | 5.034426e+05         | 5.034426e+05         | -2.658267e+06 |
| 3   | 2020-01-25 | -4.107387e+05 | 1.478308e+02  | 2.324234e+04 | -4.107387e+05 | -4.107387e+05 | 4.218376e+05   | 4.218376e+05         | 4.218376e+05         | -2.658267e+06 |
| 4   | 2020-01-26 | -3.265841e+05 | -7.382512e+03 | 1.490967e+04 | -3.265841e+05 | -3.265841e+05 | 3.303953e+05   | 3.303953e+05         | 3.303953e+05         | -2.658267e+06 |
| ... | ...        | ...           | ...           | ...          | ...           | ...           | ...            | ...                  | ...                  | ...           |
| 213 | 2020-08-22 | 1.767950e+07  | 1.316994e+07  | 1.329888e+07 | 1.761012e+07  | 1.774071e+07  | -4.441315e+06  | -4.441315e+06        | -4.441315e+06        | -2.658267e+06 |
| 214 | 2020-08-23 | 1.776681e+07  | 1.254658e+07  | 1.268838e+07 | 1.769254e+07  | 1.783295e+07  | -5.146193e+06  | -5.146193e+06        | -5.146193e+06        | -2.658267e+06 |
| 215 | 2020-08-24 | 1.785412e+07  | 1.191691e+07  | 1.207013e+07 | 1.777481e+07  | 1.792513e+07  | -5.857683e+06  | -5.857683e+06        | -5.857683e+06        | -2.658267e+06 |
| 216 | 2020-08-25 | 1.794143e+07  | 1.130430e+07  | 1.146296e+07 | 1.785929e+07  | 1.801610e+07  | -6.553639e+06  | -6.553639e+06        | -6.553639e+06        | -2.658267e+06 |
| 217 | 2020-08-26 | 1.802874e+07  | 1.071181e+07  | 1.087892e+07 | 1.794227e+07  | 1.810635e+07  | -7.229602e+06  | -7.229602e+06        | -7.229602e+06        | -2.658267e+06 |

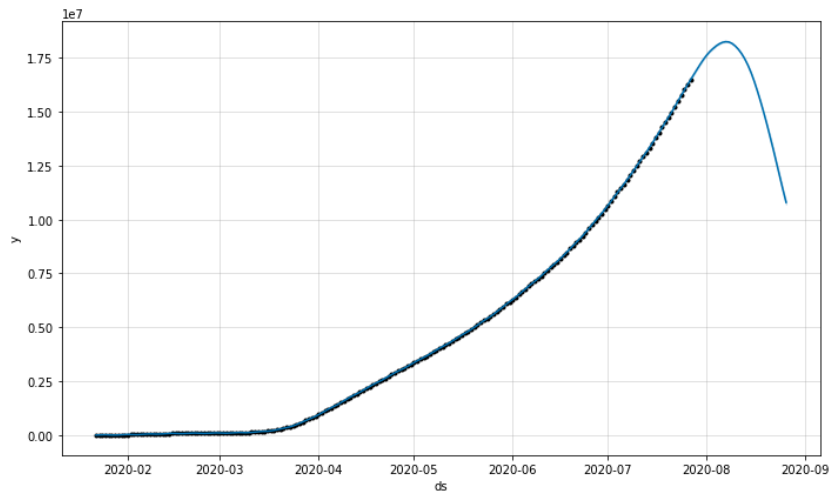
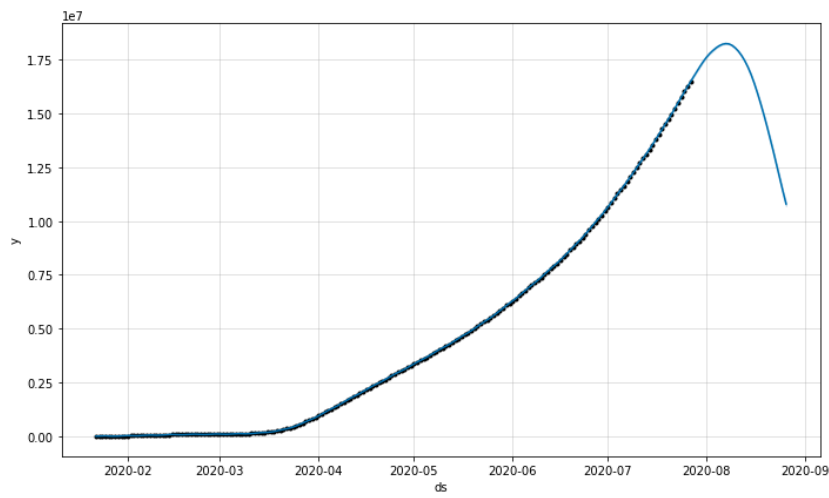
218 rows × 22 columns

```
prediction[['ds', 'yhat', 'yhat_lower', 'yhat_upper']].tail()
```

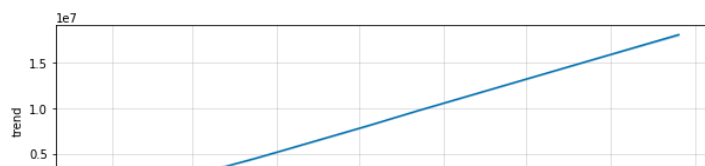
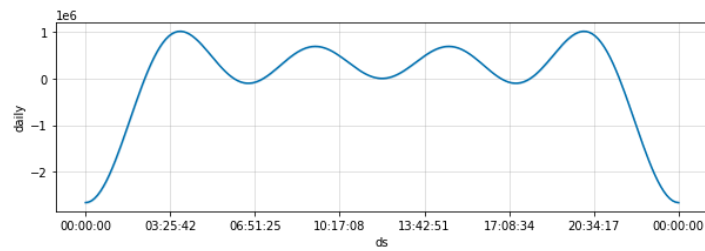
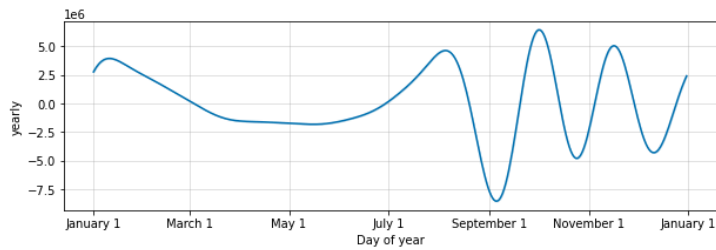
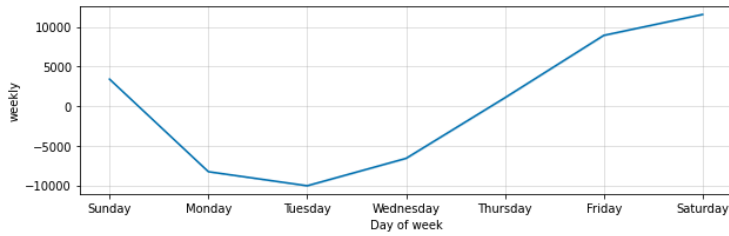
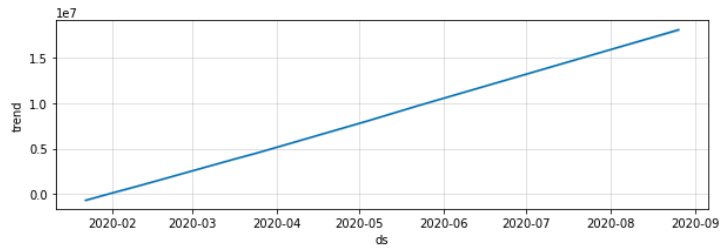


|     | ds         | yhat         | yhat_lower   | yhat_upper   |
|-----|------------|--------------|--------------|--------------|
| 213 | 2020-08-22 | 1.323818e+07 | 1.316994e+07 | 1.329888e+07 |
| 214 | 2020-08-23 | 1.262061e+07 | 1.254658e+07 | 1.268838e+07 |
| 215 | 2020-08-24 | 1.199643e+07 | 1.191691e+07 | 1.207013e+07 |
| 216 | 2020-08-25 | 1.138779e+07 | 1.130430e+07 | 1.146296e+07 |
| 217 | 2020-08-26 | 1.079914e+07 | 1.071181e+07 | 1.087892e+07 |

```
#### plot the predictions u will see these are with respect to yhat
model.plot(prediction)
```



```
##### Visualize Each Components[Trends,Weekly]  
model.plot_components(prediction)
```

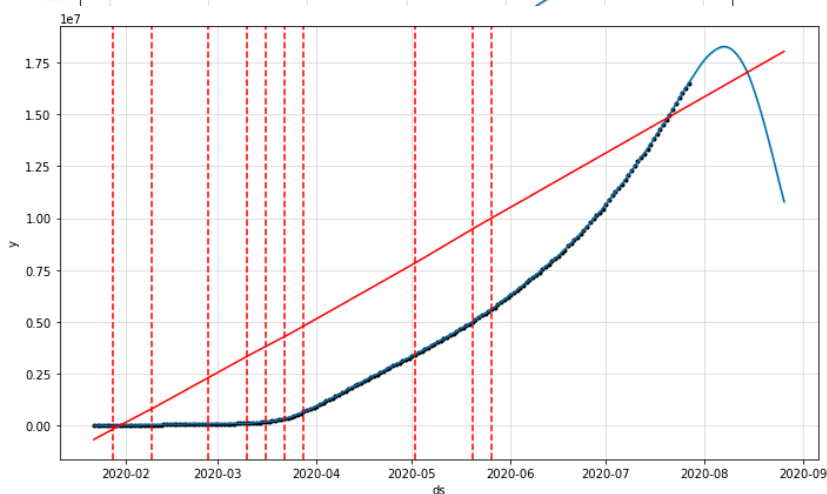


#### The prophet model identifies points at which the trend changes and those can be plotted.  
from fbprophet.plot import add\_changepoints\_to\_plot

rk

fig=model.plot(prediction)

a=add\_changepoints\_to\_plot(fig.gca(),model,prediction)



from fbprophet.diagnostics import cross\_validation

-2

```
df_cv=cross_validation(model,horizon='30 days',period='15 days',initial='90 days')
## horizon='365 days'--> for how many days we have to cross validate=====

## Computes forecasts from historical cutoff points Beginning from..

## (end - horizon) it means it is going to take that date that is (end - horizon) bcz on these date we have to just
## cross-validate for the new dataset that we have to find out

## period=180 as from documentation of func as period=0.5*365=180 or {period=1/2*horizon value}
## initial -How many total no. of days we actually want-- 3*365 from documentation of function or {initial=3*horizon}

INFO:fbprophet:Making 5 forecasts with cutoffs between 2020-04-28 00:00:00 and 2020-06-27 00:00:00
WARNING:fbprophet:Seasonality has period of 365.25 days which is larger than initial window. Consider increasing initial.
100% 5/5 [05:42<00:00, 68.49s/it]
```

```
df_cv.head()
```

```

ds          yhat    yhat_lower  yhat_upper    y    cutoff
0  2020-04-29  3.180573e+06  3.176463e+06  3.184844e+06  3185195  2020-04-28
1  2020-04-30  3.253741e+06  3.249592e+06  3.257822e+06  3268876  2020-04-28
2  2020-05-01  3.322668e+06  3.318113e+06  3.327013e+06  3355922  2020-04-28
3  2020-05-02  3.384776e+06  3.379953e+06  3.389192e+06  3437608  2020-04-28
4  2020-05-03  3.442155e+06  3.436753e+06  3.447013e+06  3515244  2020-04-28

```

```
df_cv.shape
```

```
(150, 6)
```

## Obtaining the Performance Metrics

We use the `performance_metrics` utility to compute the Mean Squared Error(MSE), Root Mean Squared Error(RMSE), Mean Absolute Error(MAE), Mean Absolute Percentage Error(MAPE), Mean Absolute Scaled Error(MASPE), and Coverage.

```
from fbprophet.diagnostics import performance_metrics
```

```
df_performance=performance_metrics(df_cv)
df_performance.head()
```

```

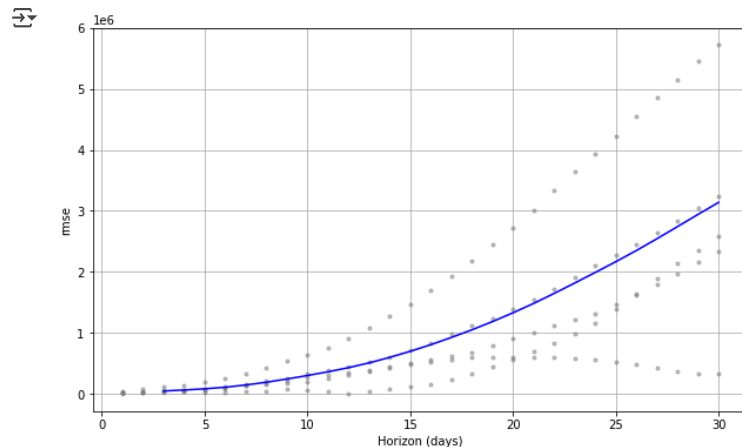
horizon    mse          rmse          mae    mape    mdape  coverage
0    3 days  2.053921e+09  45320.207202  35985.526753  0.006067  0.004630      0.0
1    4 days  3.718658e+09  60980.796159  51807.187823  0.008959  0.006297      0.0
2    5 days  6.528630e+09  80799.939672  67866.334668  0.011986  0.010393      0.0
3    6 days  1.136875e+10  106624.317175  87360.691703  0.015567  0.015369      0.0
4    7 days  2.062456e+10  143612.527529  117876.111294  0.020688  0.020792      0.0

```

Start coding or [generate](#) with AI.

```
from fbprophet.plot import plot_cross_validation_metric
```

```
df_performance=plot_cross_validation_metric(df_cv,metric='rmse')
```



```
df_performance=plot_cross_validation_metric(df_cv,metric='mse')
```



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