

# Covid 19 Confirmed Cases 90 Day Forecast

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In this project we use a model to predict how Covid 19 confirmed cases will look for next 3 months in the US. According to the Centers for Disease Control and Prevention (CDC) , a confirmed case “is an individual who had a confirmatory viral test performed by was of throat swab, nose swab or saliva and that specimen tested positive for SARS-CoV-2, which is the virus that causes COVID-19”. We explore different R packages including: covid19.analytics, dplyr, prophet, lubridate, ggplot and more packages to forecast how the curve will look.

**Dataset:** We will be working with live data from reported covid19 cases specifically the confirmed cases, the data is collected by John Hopkins University. The dataset can be found in the “covid19.analytics” package.

Load required R packages:

```
library(covid19.analytics)
library(dplyr)
library(prophet)
library(lubridate)
library(ggplot2)
library(sna)
library(openair)
library(kableExtra)
```

Read data

```
tsc <- covid19.data(case = 'ts-confirmed')
```

```
dl <- tail(tsc[,1:10])
```

```
kable(dl)%>%
```

```
kable_styling(bootstrap_options = "striped", font_size = 15)
```

	Province.State	Country.Region	Lat	Long	2020-01-22	2020-01-23	2020-01-24	2020-01-25	2020-01-26	2020-01-27
267		Venezuela	6.42380	-66.58970	0	0	0	0	0	0
268		Vietnam	14.05832	108.27720	0	2	2	2	2	2
269		West Bank and Gaza	31.95220	35.23320	0	0	0	0	0	0
270		Yemen	15.55273	48.51639	0	0	0	0	0	0
271		Zambia	-13.13390	27.84933	0	0	0	0	0	0
272		Zimbabwe	-19.01544	29.15486	0	0	0	0	0	0

```
tsc <- tsc %>% filter(Country.Region == 'US')
```

Transpose, bind columns, rename headers and remove first 4 rows - they do not contain useful data

```
tsc <- data.frame(t(tsc)) # to transpose the data
tsc <- cbind(rownames(tsc), data.frame(tsc, row.names = NULL))
colnames(tsc) <- c('Date', 'Confirmed')
tsc <- tsc[-c(1:4),] # remove first 4 rows

dh <- head(tsc)
kable(dh)%>%
  kable_styling(bootstrap_options = "striped", font_size = 15)
```

	Date	Confirmed
5	2020-01-22	1
6	2020-01-23	1
7	2020-01-24	2
8	2020-01-25	2
9	2020-01-26	5
10	2020-01-27	5

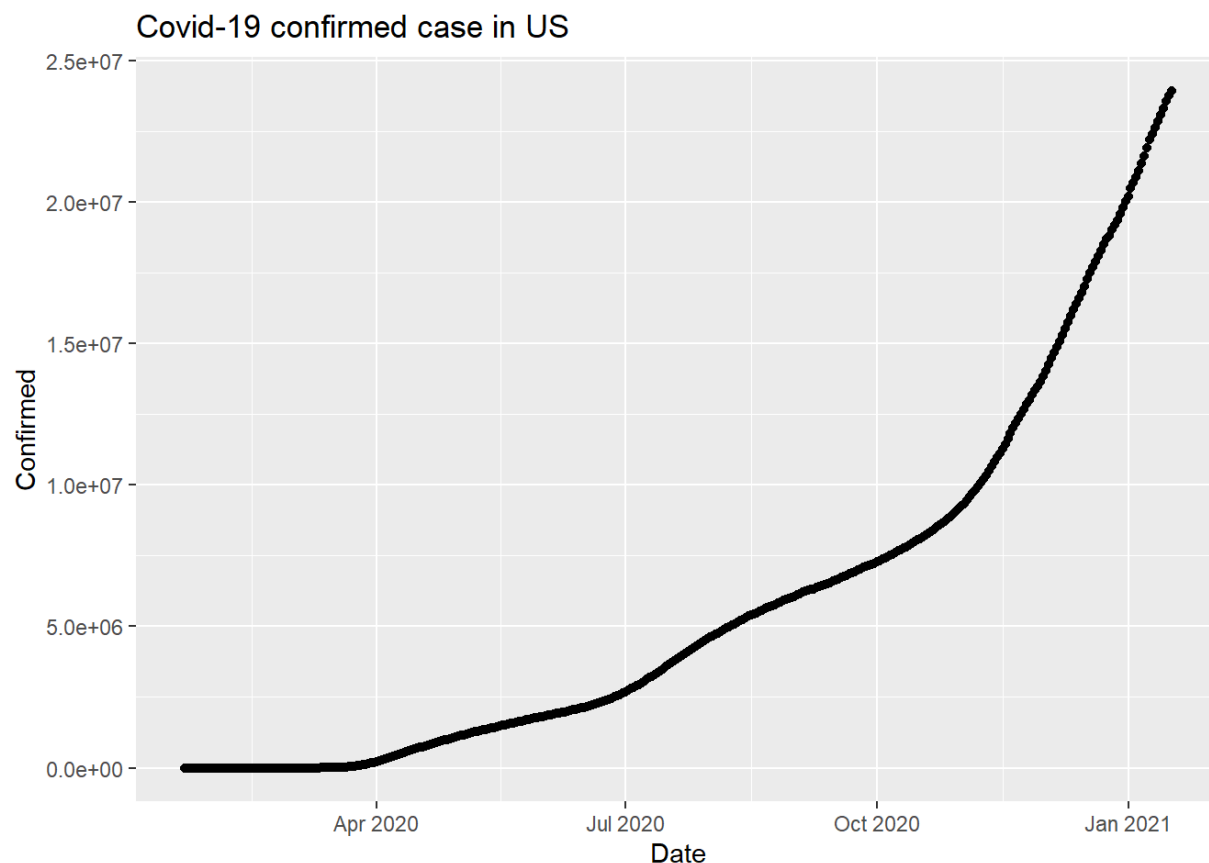
In order to convert a factor to numeric, convert to character first

```
tsc$Confirmed <- as.numeric(as.character(tsc$Confirmed))
tsc$Date <- ymd(tsc$Date) #ensure date is in correct format
str(tsc)
```

```
## 'data.frame':   362 obs. of  2 variables:
## $ Date       : Date, format: "2020-01-22" "2020-01-23" ...
## $ Confirmed: num  1 1 2 2 5 5 5 6 6 8 ...
```

Plot line graph showing confirmed cases, the y-axis are cumulative

```
qplot(Date, Confirmed, data = tsc,
      main = 'Covid-19 confirmed case in US')
```



Prepare for forecasting: store dates in `ds`, cases confirmed in `y` and make a date frame with both

```
ds <- tsc$Date
y <- tsc$Confirmed
df <- data.frame(ds, y)
```

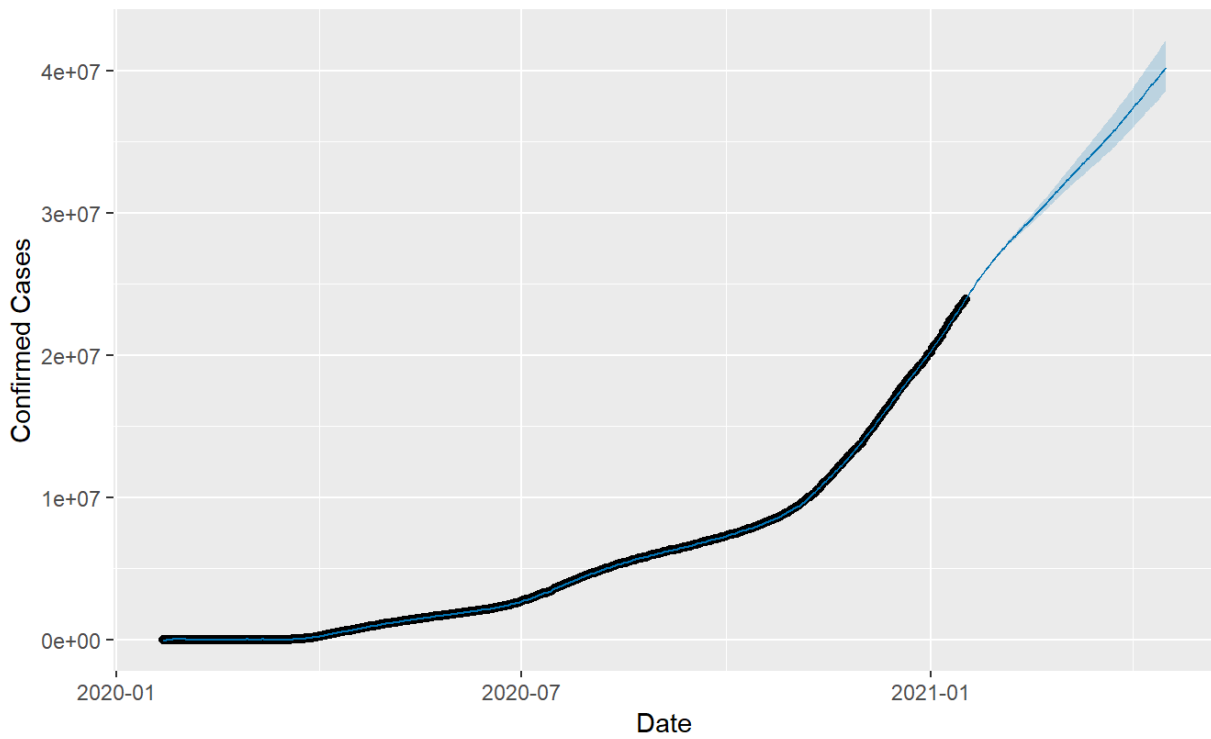
Use function `prophet` to forecast and make a new data frame that spans 3 months into the future. Make new variable with predictions and plot. The shaded blue around the line shows the confidence interval, if nothing changes confirmed cases should lie in between the interval. With vaccine in action we should expect to see the curve flatten steadily.

```
# Forecasting
m <- prophet(df, yearly.seasonality = TRUE)

# Prediction
future <- make_future_dataframe(m, periods = 90) #for future dates

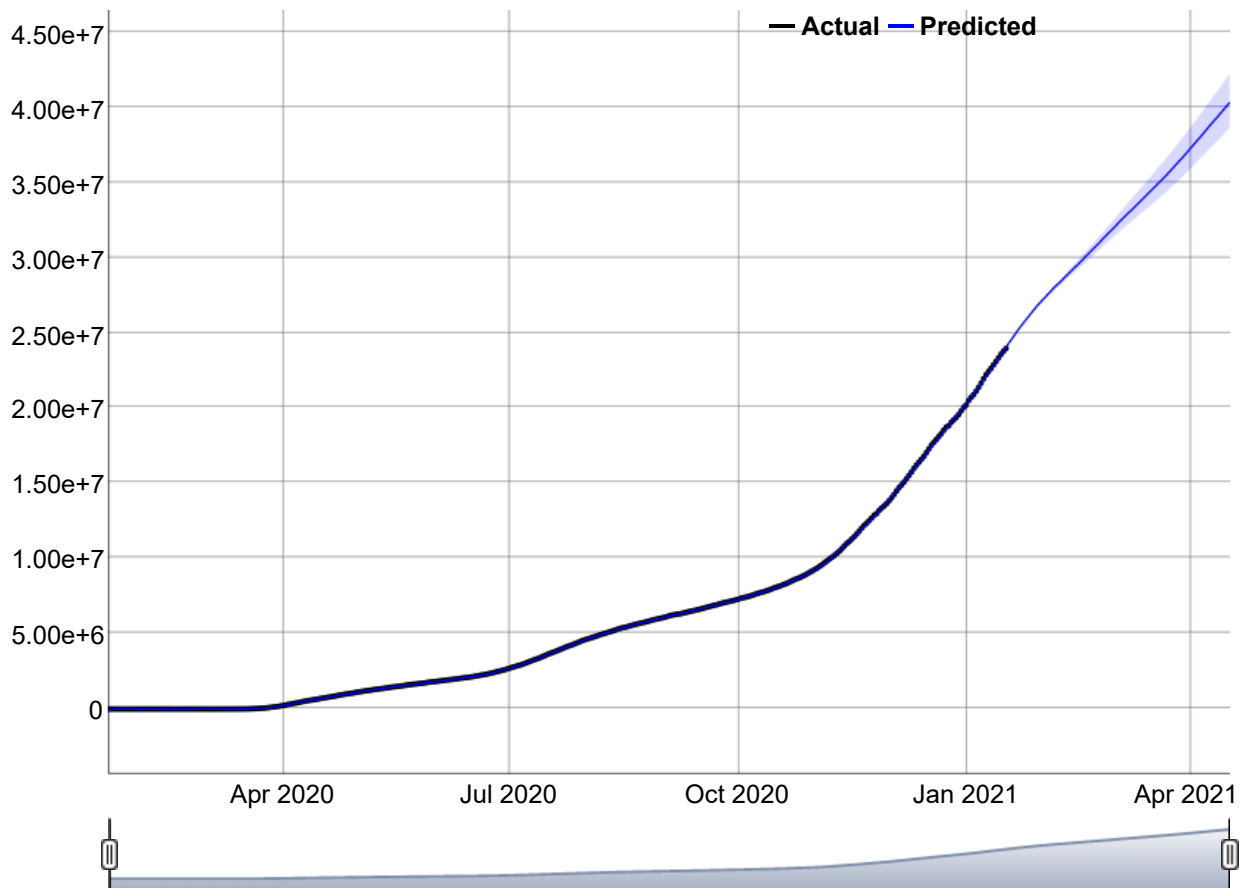
forecast <- predict(m, future)

plot(m, forecast,
     xlab = "Date",
     ylab = 'Confirmed Cases')
```

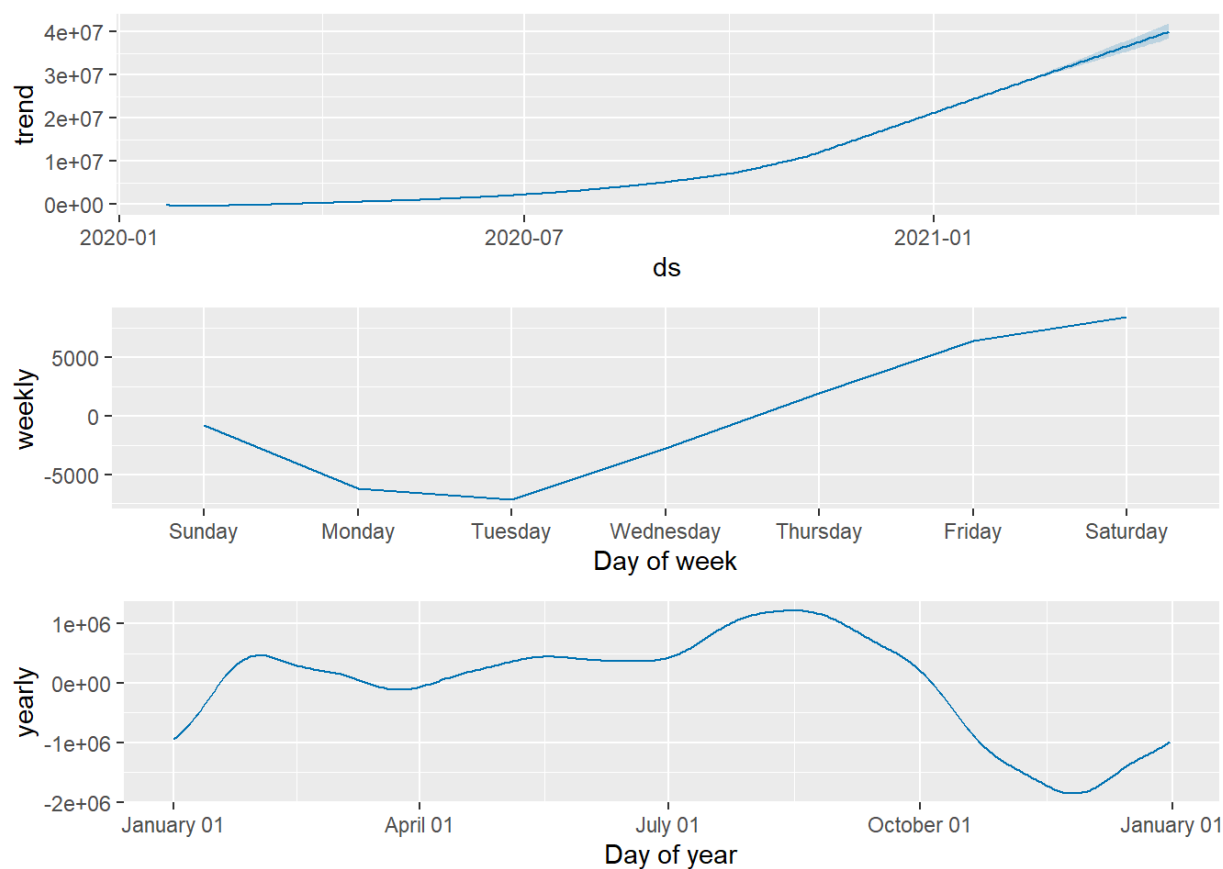


For interactive plot. Predictions show we can reach as high as 4 million cases in April.

```
dyplot.prophet(m, forecast)
```



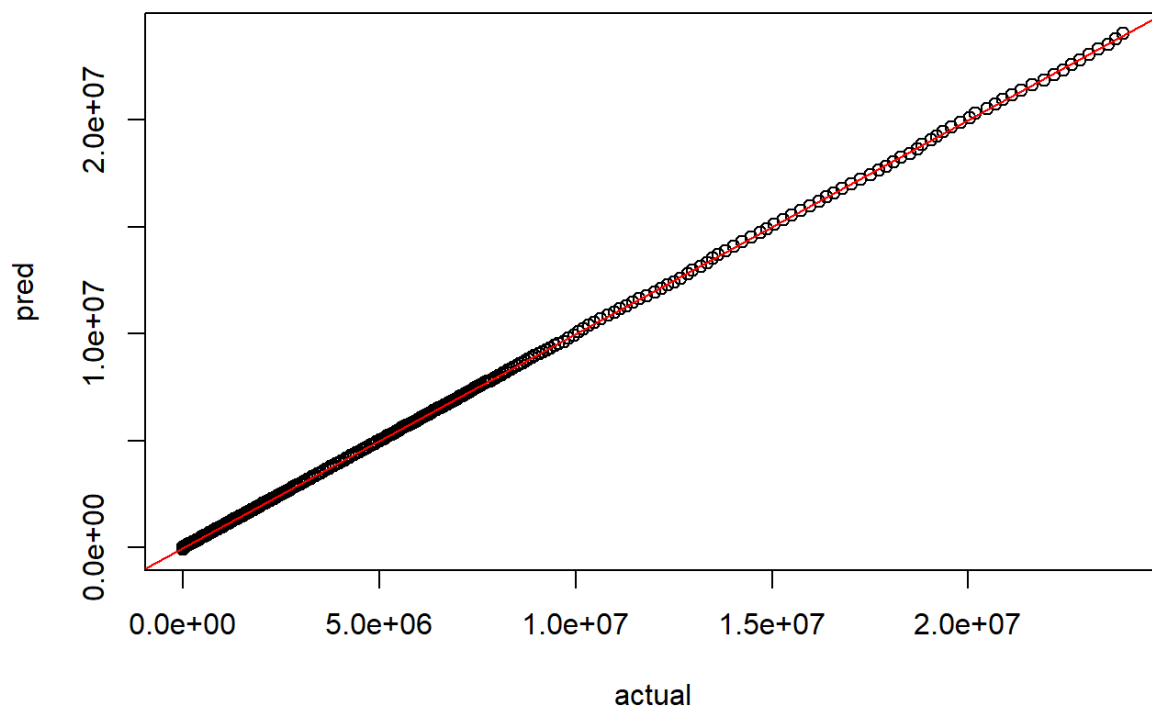
```
prophet_plot_components(m, forecast)
```



Next evaluate the accuracy of model.

```
pred <- forecast$yhat[1:362]
actual <- m$history$y
plot(actual, pred)
model1 <- lm(pred ~ actual)

abline(lm(model1), col= 'red')
```



R is squared equal to 1 and p-value is very small thus we have high confidence that the model is statistically significant.

```
summary(model1)
```

```
##
## Call:
## lm(formula = pred ~ actual)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -93546  -6682      49    7435 107607
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.124e+02  1.827e+03   0.062   0.951
## actual       1.000e+00  2.148e-04 4654.822 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 25410 on 360 degrees of freedom
## Multiple R-squared:  1, Adjusted R-squared:  1
## F-statistic: 2.167e+07 on 1 and 360 DF, p-value: < 2.2e-16
```