

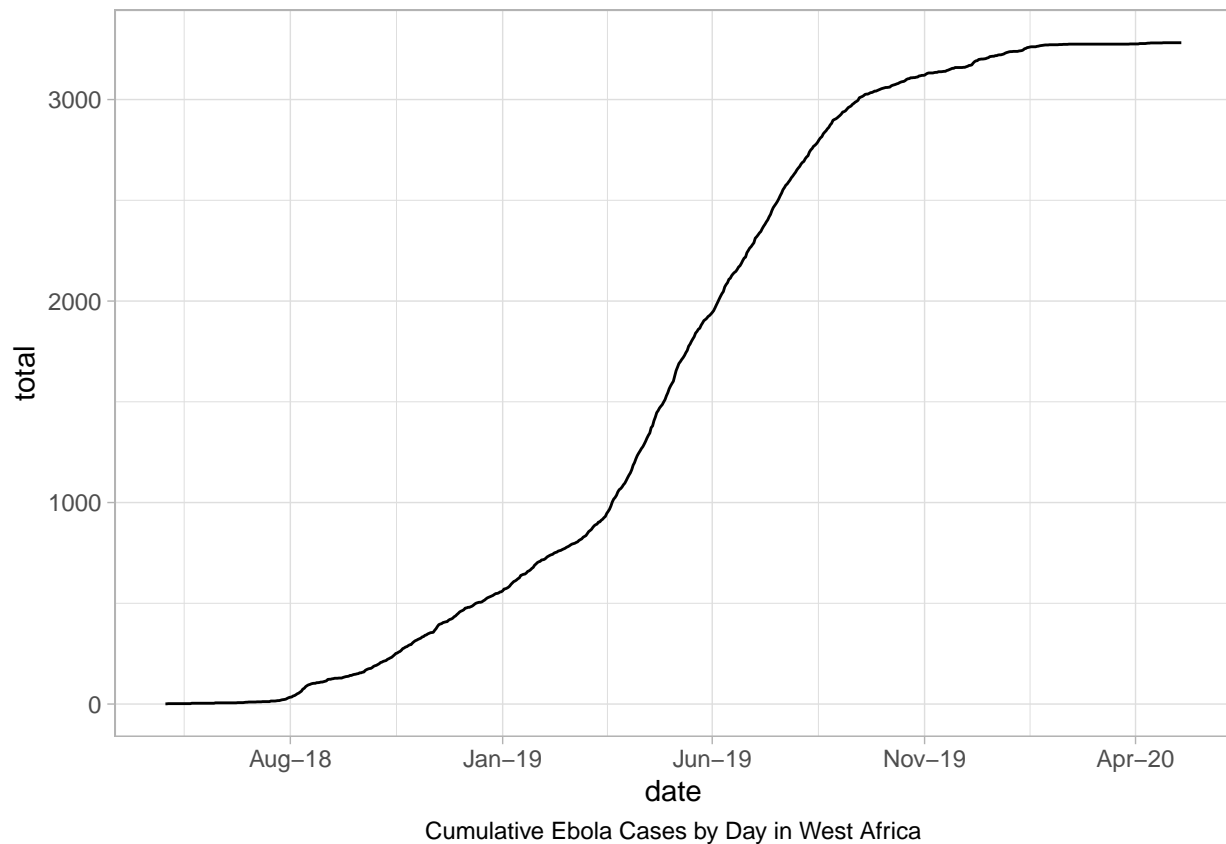
Ebola Forecasting - Residual Analysis

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9/11/2020

1 Full Outbreak

```
title <- paste0("Cumulative Ebola Cases by Day in West Africa")
overall <- ggplot(
  data = true,
  mapping = aes(x = date, y = total)) +
  geom_line() + theme_light() + labs(caption = title) +
  theme(plot.caption = element_text(hjust = 0.5)) +
  scale_x_date(date_breaks = "5 months", date_labels = "%b-%y")
overall #+ theme(panel.grid.minor = element_blank())
```



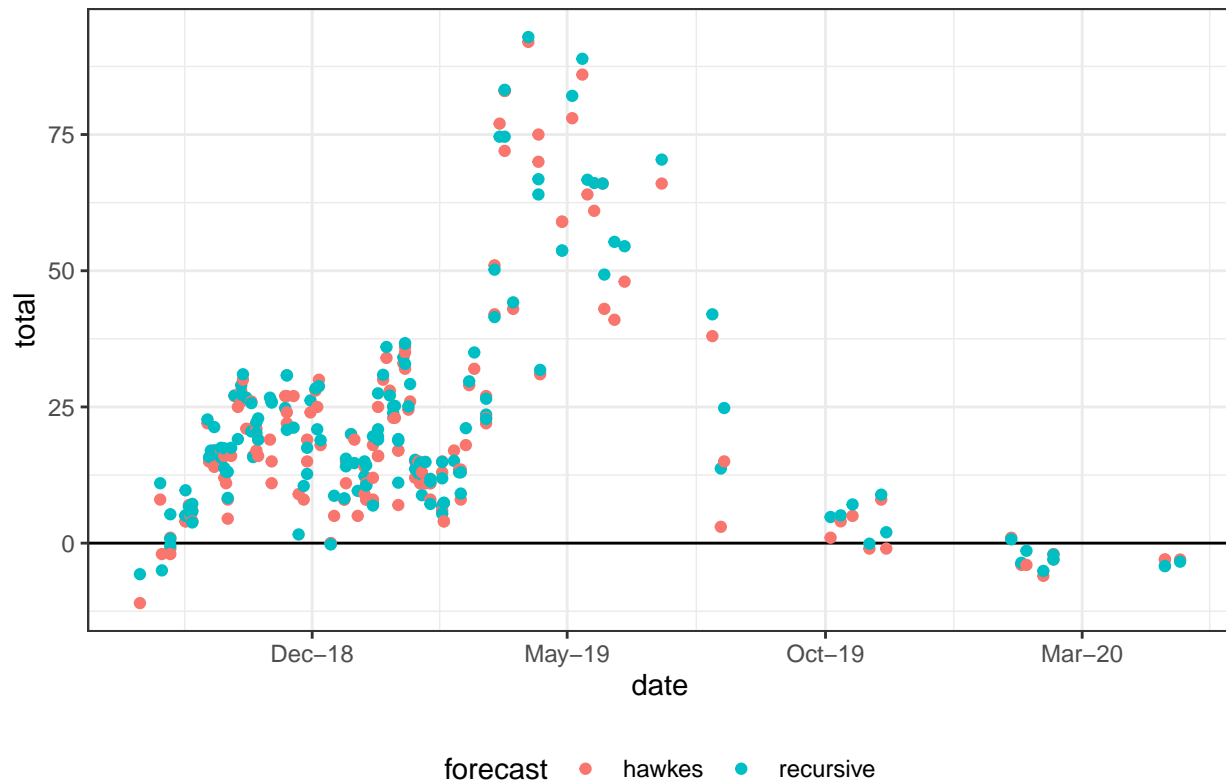
```
#ggsave("test.png",p,width = 6, height = 4, units="in")
```

2 Residual Analysis

2.1 Hawkes vs Recursive 7-Day

```
cap <- paste0("Residual plot of Hawkes and Recursive 7-day models")
h7 <- (single_forecast(hdates, hpreds, days = 7)$results)
r7 <- (single_forecast(rdates, rpreds, days = 7)$results)
df <- data.frame(
  date = h7$forecast.date,
  hawkes = h7$resids,
  recursive = r7$resids
)
df <- pivot_longer(df, cols = 2:3, names_to = "forecast", values_to = "resid")
p <- ggplot(
  data = df,
  mapping = aes(x = date, y = total)
) +
  theme_bw() +
  theme(plot.caption = element_text(hjust = 0.5), legend.position = "bottom") +
  scale_x_date(date_breaks = "5 months", date_labels = "%b-%y") +
  geom_hline(aes(yintercept=0))

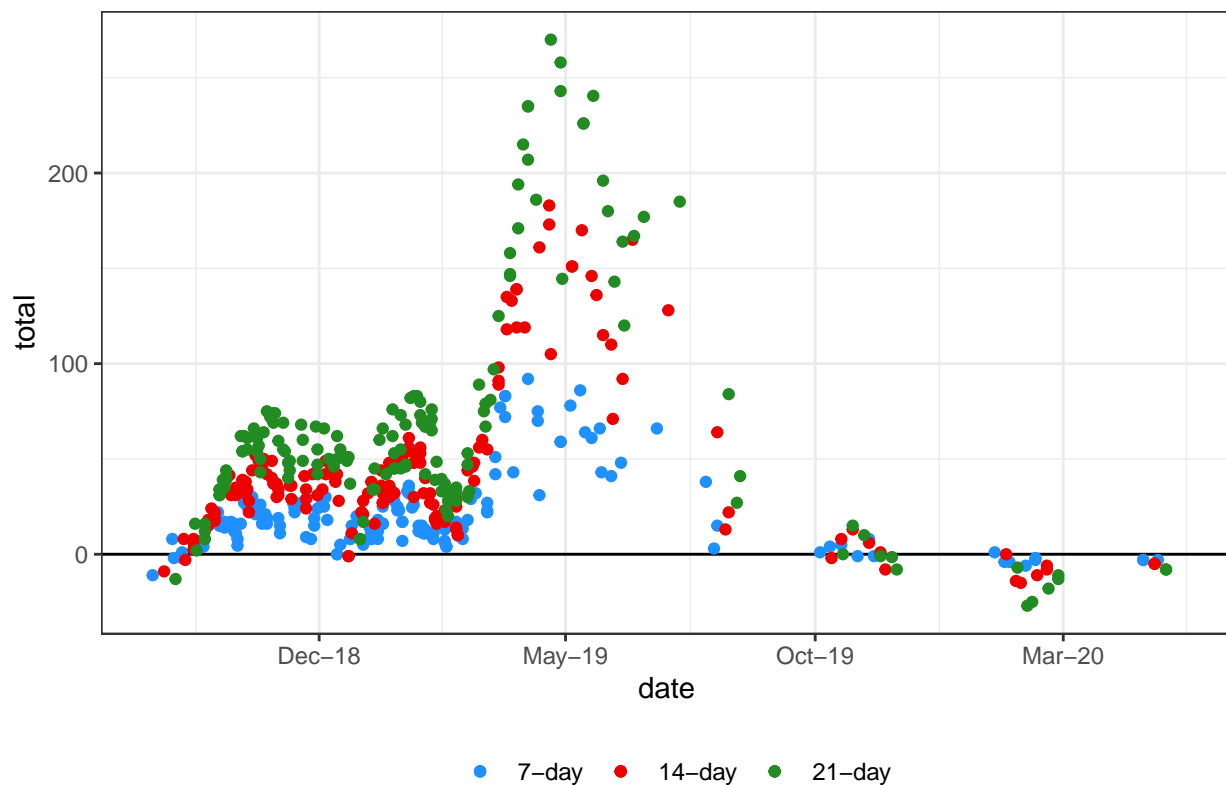
p + geom_point(
  data = df,
  mapping = aes(x = as.Date(date), y = resid, color = forecast)
) + labs(caption = cap)
```



2.2 Hawkes-Only Residual Plot

```
cap <- paste0("Residual plot of Hawkes 7-, 14-, and 21-day models")
# h7 already created
h14 <- (single_forecast(hdates, hpreds, days = 14)$results)
h21 <- (single_forecast(hdates, hpreds, days = 21)$results)

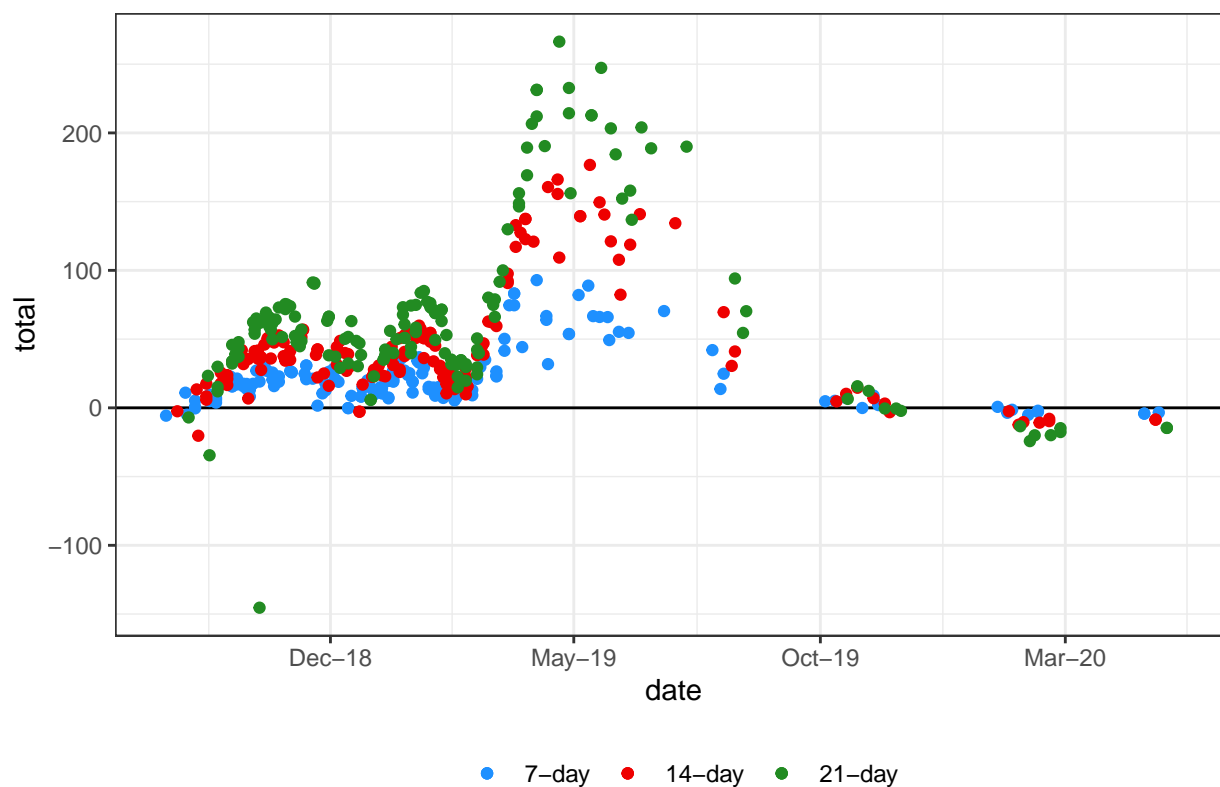
p + labs(caption = cap) +
  geom_point(
    data = h7,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "dodgerblue")
  ) +
  geom_point(
    data = h14,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "red2")
  ) +
  geom_point(
    data = h21,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "forestgreen")
  ) +
  scale_color_identity(
    name = "",
    breaks = c("dodgerblue", "red2", "forestgreen"),
    labels = c("7-day", "14-day", "21-day"),
    guide = "legend"
  )
)
```



2.3 Recursive-Only Residual Plot

```
cap <- paste0("Residual plot of Recursive 7-, 14-, and 21-day models")
# r7 already created
r14 <- (single_forecast(rdates, rpreds, days = 14)$results)
r21 <- (single_forecast(rdates, rpreds, days = 21)$results)

p + labs(caption = cap) +
  geom_point(
    data = r7,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "dodgerblue")
  ) +
  geom_point(
    data = r14,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "red2")
  ) +
  geom_point(
    data = r21,
    mapping = aes(x = as.Date(forecast.date), y = resids, col = "forestgreen")
  ) +
  scale_color_identity(
    name = "",
    breaks = c("dodgerblue", "red2", "forestgreen"),
    labels = c("7-day", "14-day", "21-day"),
    guide = "legend"
  )
)
```



Residual plot of Recursive 7-, 14-, and 21-day models

3 RMSE Calculation During Outbreak

3.1 Beginning of Outbreak