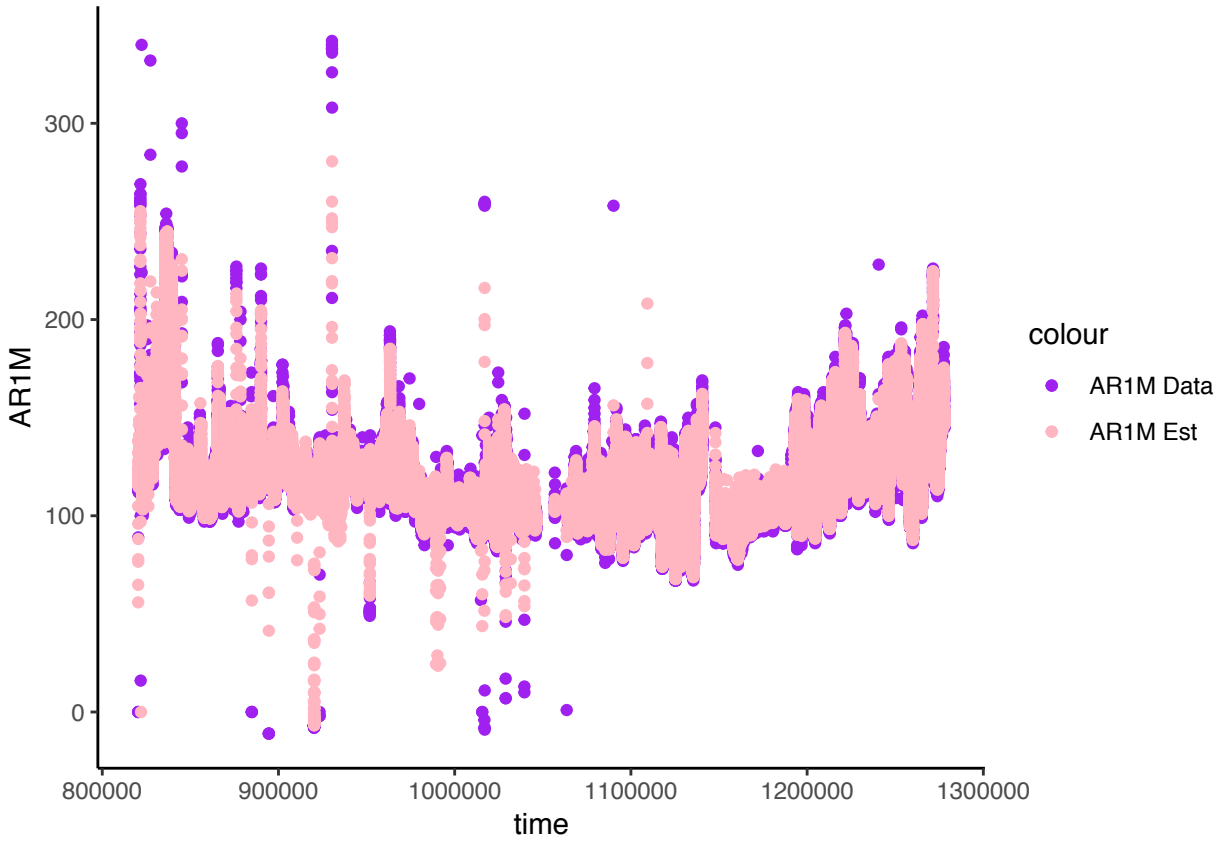
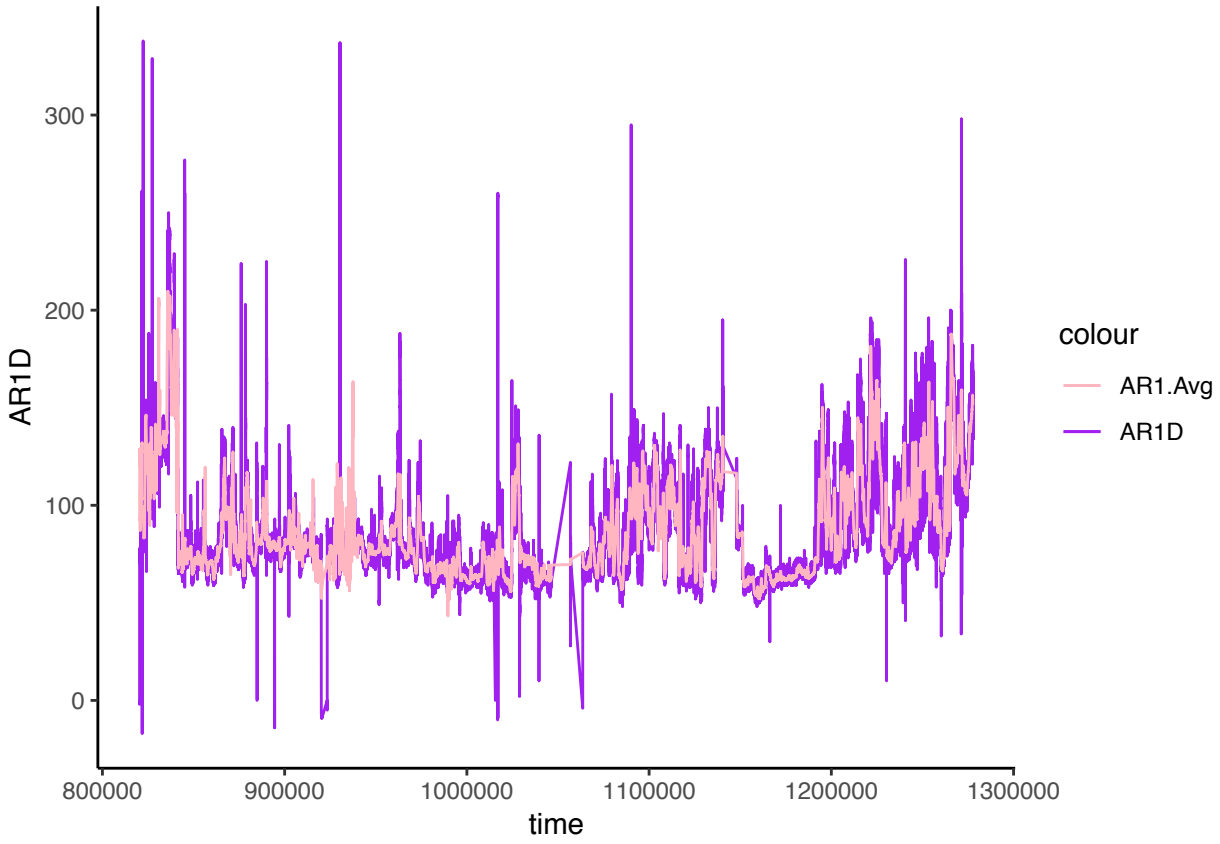


Time Averaging

Unweighted time averaging prediction

```
p21.clean$avg <- ma(p21.clean$AR1D,order=100)
ggplot()+geom_line(data=p21.clean, aes(x=time, y=AR1D, colour="AR1D"))+
  geom_line(data=p21.clean, aes(x=time, y=avg,color="AR1.Avg"))+
  scale_color_manual(values = c('AR1D' = 'purple', 'AR1.Avg' = 'light pink')) +
  theme_classic()
```

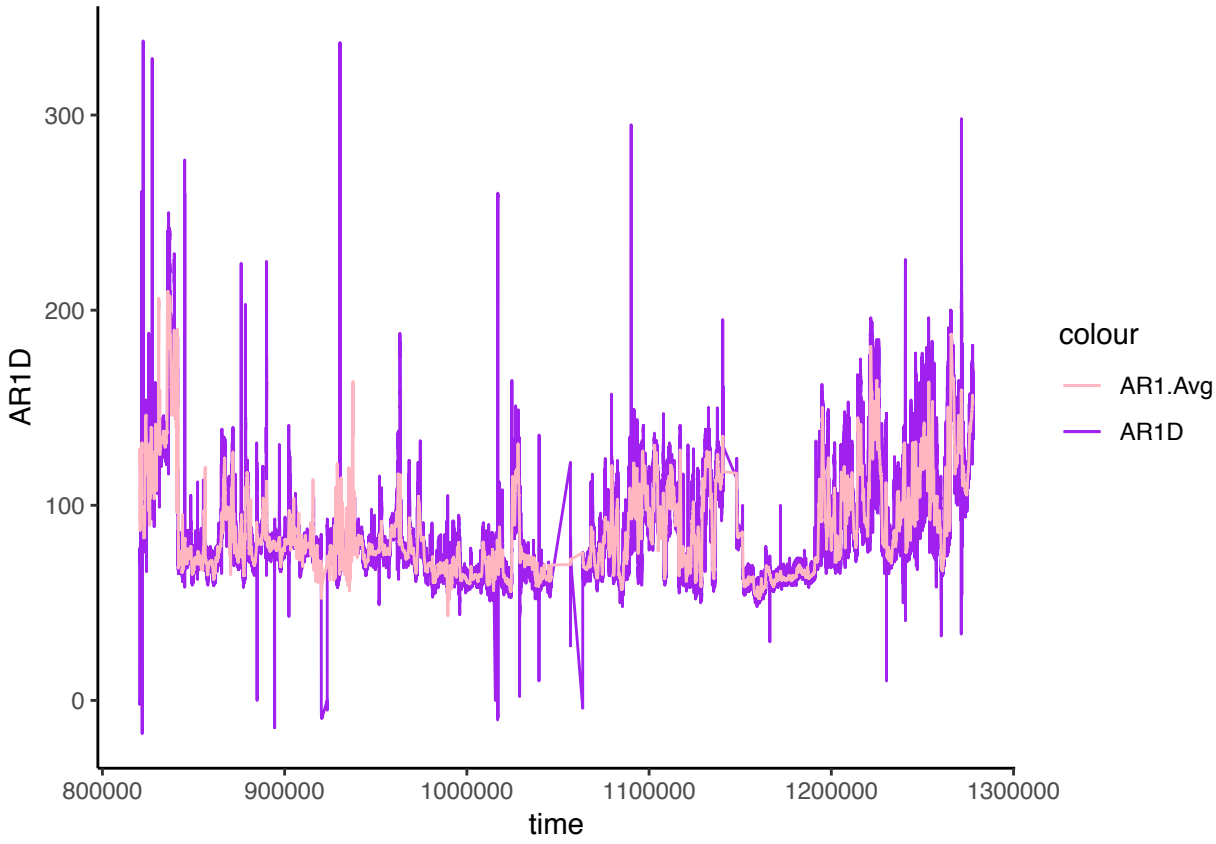
```
## Warning: Removed 50 rows containing missing values (geom_path).
```



Weighted time averaging prediction

```
p21.clean$avg.weighted <- ma(p21.clean$AR1D,order=100,centre=TRUE)
ggplot()+geom_line(data=p21.clean, aes(x=time, y=AR1D, colour="AR1D"))+
  geom_line(data=p21.clean, aes(x=time, y=avg.weighted,color="AR1.Avg"))+
  scale_color_manual(values = c('AR1D' = 'purple', 'AR1.Avg' = 'light pink')) +
  theme_classic()
```

```
## Warning: Removed 50 rows containing missing values (geom_path).
```



Alarm reduced comparison

First we summarize the median of the patient's AR1D and AR1M, use it as the "normal level".

```
summary(p21.clean$AR1D)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -17.00   68.00   78.00   86.83   99.00  338.00
```

```
summary(p21.clean$AR1M)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   -11.0   103.0   115.0   117.6   127.0   342.0
```

Now we set the normal level for patient's AR1D as 78, and normal level for patient's AR1M as 115.

We set alarms when it exceeds the 1st and 3rd quantile of the patients, which are (68, 99) for AR1D, and (103, 127) for AR1M. These numbers are purely for comparison and based on no pratical research.

Now we assess the alarm situation for **AR1D**.

Before

```
sum(p21.clean$AR1D >= 99 | p21.clean$AR1D <= 68) / nrow(p21.clean)
```

```
## [1] 0.5233755
```

After applying Kalman Filter.

```
sum(est.AR1D$est >= 99 | est.AR1D$est <= 68) / nrow(est.AR1D)
```

```
## [1] 0.5003344
```

After applying two variable's Kalman Filter

```
sum(est.AR1$est1 >= 99| est.AR1$est1 <= 68) / nrow(est.AR1)
```

```
## [1] 0.5003344
```

After applying time averaging.

```
sum(na.omit(p21.clean$avg) >= 99 | na.omit(p21.clean$avg) <= 68) / nrow(p21.clean)
```

```
## [1] 0.4798508
```

After applying weighted time averaging.

```
sum(na.omit(p21.clean$avg.weighted) >= 99 | na.omit(p21.clean$avg.weighted) <= 68) / nrow(p21.clean)
```

```
## [1] 0.4798508
```

Now we assess the alarm situation for **AR1M**.

Before

```
sum(p21.clean$AR1M >= 127 | p21.clean$AR1M <= 103) / nrow(p21.clean)
```

```
## [1] 0.5326787
```

After applying Kalman Filter.

```
sum(est.AR1M$est >= 127 | est.AR1M$est <= 103) / nrow(est.AR1M)
```

```
## [1] 0.5011556
```

After applying two variable's Kalman Filter

```
sum(est.AR1$est2 >= 127| est.AR1$est2 <= 103) / nrow(est.AR1)
```

```
## [1] 0.5011556
```