Praktikum Pemodelan Statistika terapan

Peramalan Deret Waktu

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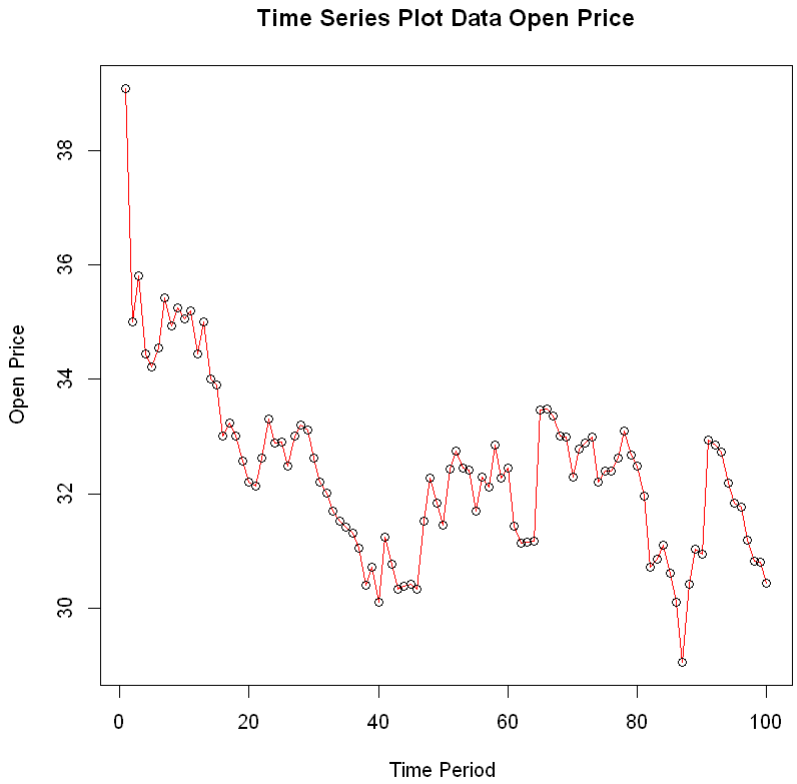
Percobaan ke-1: Studi Kasus 1

In [ ]:
```
library("forecast")
library("TTR")
```

In [ ]:
```
data = read.csv("AABA_06sd18.csv", header = TRUE)
data.ts = data$Open[10:109]
data.ts
```

39.09 · 35.01 · 35.82 · 34.44 · 34.22 · 34.55 · 35.43 · 34.94 · 35.26 · 35.06 · 35.2 · 34.45 · 35.01 · 34 · 33.9 · 33.01 · 33.24 · 33.01 · 32.58 · 32.21 · 32.14 · 32.62 · 33.3 · 32.88 · 32.9 · 32.49 · 33.01 · 33.2 · 33.11 · 32.63 · 32.21 · 32.01 · 31.7 · 31.53 · 31.42 · 31.31 · 31.05 · 30.4 · 30.72 · 30.1 · 31.25 · 30.77 · 30.34 · 30.38 · 30.42 · 30.33 · 31.52 · 32.28 · 31.84 · 31.45 · 32.44 · 32.75 · 32.45 · 32.41 · 31.69 · 32.3 · 32.12 · 32.85 · 32.28 · 32.45 · 31.44 · 31.14 · 31.16 · 31.17 · 33.47 · 33.48 · 33.36 · 33.01 · 32.99 · 32.3 · 32.79 · 32.88 · 32.99 · 32.2 · 32.4 · 32.4 · 32.63 · 33.09 · 32.68 · 32.48 · 31.96 · 30.71 · 30.85 · 31.1 · 30.61 · 30.1 · 29.05 · 30.42 · 31.04 · 30.95 · 32.94 · 32.86 · 32.73 · 32.19 · 31.83 · 31.77 · 31.19 · 30.83 · 30.8 · 30.43

In [ ]:
```
ts.plot(data.ts, xlab="Time Period ", ylab="Open Price", main= "Time Series Plot
points(data.ts)
```



In [ ]:
```
data.sma = SMA(data.ts, n=4)
data.sma
```

<NA> · <NA> · <NA> · 36.09 · 34.8725 · 34.7575 · 34.66 · 34.785 · 35.045 · 35.1725 · 35.115 · 34.9925 · 34.93 · 34.665 · 34.34 · 33.98 · 33.5375 · 33.29 · 32.96 · 32.76 · 32.485 · 32.3875 · 32.5675 · 32.735 · 32.925 · 32.8925 · 32.82 · 32.9 · 32.9525 · 32.9875 · 32.7875 · 32.49 · 32.1375 · 31.8625 · 31.665 · 31.49 · 31.3275 · 31.045 · 30.87 · 30.5675 · 30.6175 · 30.71 · 30.615 · 30.685 · 30.4775 · 30.3675 · 30.6625 · 31.1375 · 31.4925 · 31.7725 · 32.0025 · 32.12 · 32.2725 · 32.5125 · 32.325 · 32.2125 · 32.13 · 32.24 · 32.3875 · 32.425 · 32.255 · 31.8275 · 31.5475 · 31.2275 · 31.735 · 32.32 · 32.87 · 33.33 · 33.21 · 32.915 · 32.7725 · 32.74 · 32.74 · 32.715 · 32.6175 · 32.4975 · 32.4075 · 32.63 · 32.7 · 32.72 · 32.5525 · 31.9575 · 31.5 · 31.155 · 30.8175 · 30.665 · 30.215 · 30.045 · 30.1525 · 30.365 · 31.3375 · 31.9475 · 32.37 · 32.68 · 32.4025 · 32.13 · 31.745 · 31.405 · 31.1475 · 30.8125

🖋 **Analisis :** menampilkan SMA(Simple moving Average) dengan rata-rata 4 jeda baris elemen secara berurutan.

In [ ]:
```
data.peramalan = c(NA,data.sma)
data.peramalan
```

<NA> · <NA> · <NA> · <NA> · 36.09 · 34.8725 · 34.7575 · 34.66 · 34.785 · 35.045 · 35.1725 · 35.115 · 34.9925 · 34.93 · 34.665 · 34.34 · 33.98 · 33.5375 · 33.29 · 32.96 · 32.76 · 32.485 · 32.3875 · 32.5675 · 32.735 · 32.925 · 32.8925 · 32.82 · 32.9 · 32.9525 · 32.9875 · 32.7875 · 32.49 · 32.1375 · 31.8625 · 31.665 · 31.49 · 31.3275 · 31.045 · 30.87 · 30.5675 · 30.6175 · 30.71 · 30.615 · 30.685 · 30.4775 · 30.3675 · 30.6625 · 31.1375 · 31.4925 · 31.7725 · 32.0025 · 32.12 · 32.2725 · 32.5125 · 32.325 · 32.2125 · 32.13 · 32.24 · 32.3875 · 32.425 · 32.255 · 31.8275 · 31.5475 · 31.2275 · 31.735 · 32.32 · 32.87 · 33.33 · 33.21 · 32.915 · 32.7725 · 32.74 · 32.74 · 32.715 · 32.6175 · 32.4975 · 32.4075 · 32.63 · 32.7 · 32.72 · 32.5525 · 31.9575 · 31.5 · 31.155 · 30.8175 · 30.665 · 30.215 · 30.045 · 30.1525 · 30.365 · 31.3375 · 31.9475 · 32.37 · 32.68 · 32.4025 · 32.13 · 31.745 · 31.405 · 31.1475 · 30.8125

🖋 **Analisis :** Kali ini untuk teknik time seriesnya menambahkan nilai NA untuk memperluas data deret waktu dengan nilai prediksi Simple moving average tadi.

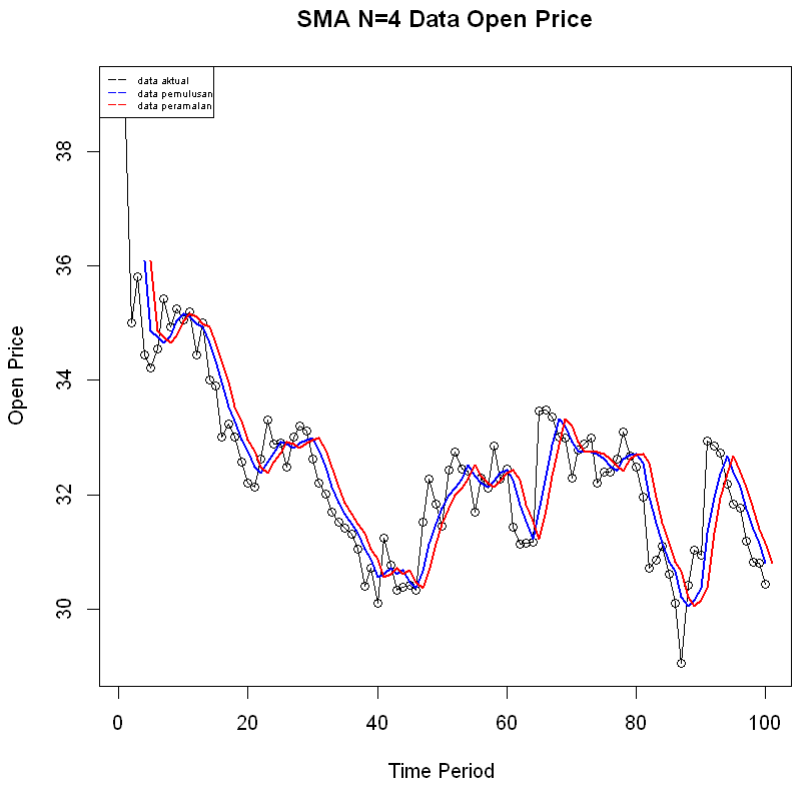
In [ ]:
```
dataku <- cbind(aktual=c(data.ts,rep(NA,5)),pemulusan=c(data.sma,rep(NA,5)) ,ram
dataku
```

A matrix: 105 × 3 of type dbl

aktual	pemulusan	ramalan
39.09	NA	NA
35.01	NA	NA
35.82	NA	NA
34.44	36.0900	NA
34.22	34.8725	36.0900
34.55	34.7575	34.8725
35.43	34.6600	34.7575
34.94	34.7850	34.6600
35.26	35.0450	34.7850
35.06	35.1725	35.0450
35.20	35.1150	35.1725
34.45	34.9925	35.1150
35.01	34.9300	34.9925
34.00	34.6650	34.9300
33.90	34.3400	34.6650
33.01	33.9800	34.3400
33.24	33.5375	33.9800
33.01	33.2900	33.5375
32.58	32.9600	33.2900
32.21	32.7600	32.9600
32.14	32.4850	32.7600
32.62	32.3875	32.4850
33.30	32.5675	32.3875
32.88	32.7350	32.5675
32.90	32.9250	32.7350
32.49	32.8925	32.9250
33.01	32.8200	32.8925
33.20	32.9000	32.8200
33.11	32.9525	32.9000
32.63	32.9875	32.9525
⋮	⋮	⋮
32.40	32.4975	32.6175

aktual	pemulusan	ramalan
32.63	32.4075	32.4975
33.09	32.6300	32.4075
32.68	32.7000	32.6300
32.48	32.7200	32.7000
31.96	32.5525	32.7200
30.71	31.9575	32.5525
30.85	31.5000	31.9575
31.10	31.1550	31.5000
30.61	30.8175	31.1550
30.10	30.6650	30.8175
29.05	30.2150	30.6650
30.42	30.0450	30.2150
31.04	30.1525	30.0450
30.95	30.3650	30.1525
32.94	31.3375	30.3650
32.86	31.9475	31.3375
32.73	32.3700	31.9475
32.19	32.6800	32.3700
31.83	32.4025	32.6800
31.77	32.1300	32.4025
31.19	31.7450	32.1300
30.83	31.4050	31.7450
30.80	31.1475	31.4050
30.43	30.8125	31.1475
NA	NA	30.8125
NA	NA	30.8125
NA	NA	30.8125
NA	NA	30.8125
NA	NA	30.8125

In [ ]:
```
ts.plot(data.ts, xlab="Time Period ", ylab="Open Price", main= "SMA N=4 Data Ope
points(data.ts)
lines(data.sma,col="blue",lwd=2)
lines(data.peramalan,col="red",lwd=2)
legend("topleft",c("data aktual","data pemulusan","data peramalan"), lty=5, col=
```



🖌 **Analisis :** Dataset di atas merupakan hasil analisa dari peramalan deret waktu. Hasil plot di atas merupaakan hasil visualisasi dari 3 data yaitu data aktual, data smoothing dan data forecasting yang ketiganya memiliki pergerakan yang hampir mirip

In [ ]:
```
error=data.ts-data.peramalan[1:length(data.ts)]
SSE=sum(error[5:length(data.ts)]^2)
SSE
```

61.3459624999998

In [ ]:
```
MSE=mean(error[5:length(data.ts)]^2)
MSE
```

0.639020442708332

In [ ]:
```
MAPE=mean(abs((error[5:length(data.ts)]/data.ts[5:length(data.ts)])*100))
MAPE
```

1.94089892445136

🖌 **Analisis :** Disini untuk 3 teknik yang dipakai untuk evaluasi model yaitu melakukan perhitungan error, MSE, dan MSE. Nilai-nilai tersebut menunjukkan bahwa model cukup akurat.

Percobaan ke-2: Studi Kasus 2

In [ ]:
```
AirPassengers
```

A Time Series: 12 × 12

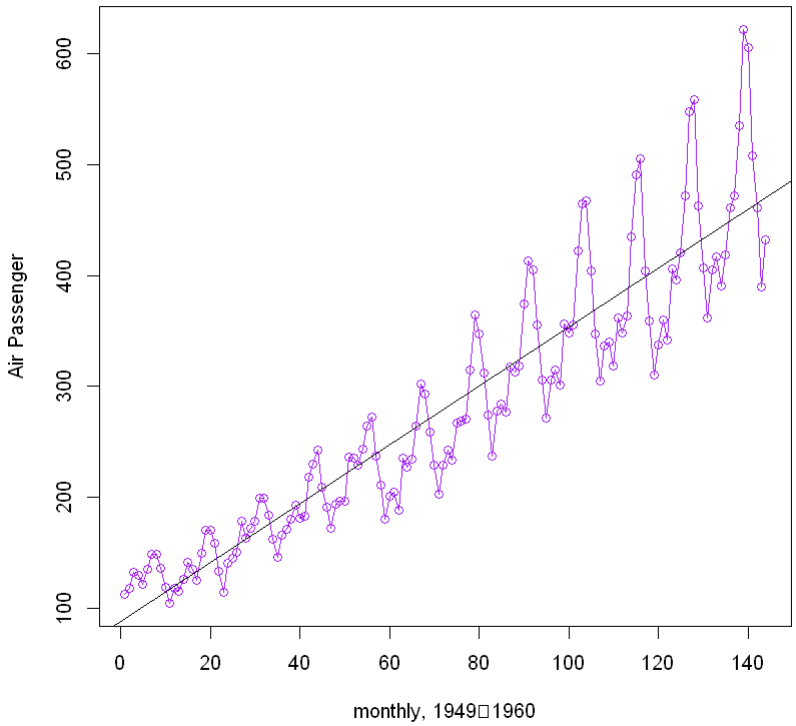
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1949	112	118	132	129	121	135	148	148	136	119	104	118
1950	115	126	141	135	125	149	170	170	158	133	114	140
1951	145	150	178	163	172	178	199	199	184	162	146	166
1952	171	180	193	181	183	218	230	242	209	191	172	194
1953	196	196	236	235	229	243	264	272	237	211	180	201
1954	204	188	235	227	234	264	302	293	259	229	203	229
1955	242	233	267	269	270	315	364	347	312	274	237	278
1956	284	277	317	313	318	374	413	405	355	306	271	306
1957	315	301	356	348	355	422	465	467	404	347	305	336
1958	340	318	362	348	363	435	491	505	404	359	310	337
1959	360	342	406	396	420	472	548	559	463	407	362	405
1960	417	391	419	461	472	535	622	606	508	461	390	432

In [ ]:
```
t=1:length(AirPassengers)
y=AirPassengers
trend_analysis = lm(y~t)
summary(trend_analysis)
```

```
Call:
lm(formula = y ~ t)

Residuals:
    Min      1Q  Median      3Q     Max
-93.858 -30.727  -5.757  24.489 164.999

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 87.65278    7.71635   11.36   <2e-16 ***
t            2.65718    0.09233   28.78   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 46.06 on 142 degrees of freedom
Multiple R-squared:  0.8536,    Adjusted R-squared:  0.8526
F-statistic: 828.2 on 1 and 142 DF,  p-value: < 2.2e-16
```

In [ ]:
```
plot(t,y,type="o", xlab="monthly, 1949-1960", ylab="Air Passenger",col="purple")
plot
abline(trend_analysis)
```

```
function (x, y, ...)
UseMethod("plot")
```



🖌️ **Analisis :** Dataset AirPassengers berisi data jumlah penumpang pesawat internasional bulanan dari tahun 1949 hingga 1960. Berdasarkan summary trend analysis, dapat disimpulkan bahwa parameter intercept dan t signifikan secara statistik karena nilai p-value nya di bawah 0.05. Selain itu, nilai Multiple R-squared dan Adjusted R-squared cukup besar, yaitu masing-masing 0.8536 dan 0.8526, menunjukkan bahwa model memiliki kemampuan yang baik dalam menjelaskan variasi data. Plot yang dihasilkan menunjukkan garis trand positif tiap bulan hingga beberapa puluhan tahun ke depan.

Percobaan ke-3: Studi Kasus 3

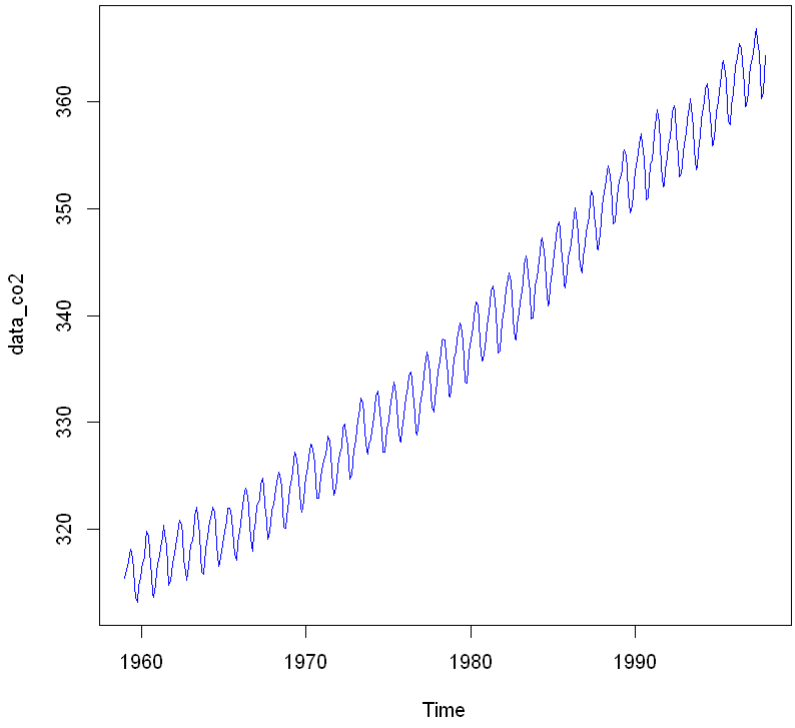
In [ ]:
```
data_co2 = co2
data_co2
```

A Time Series: 39 × 12

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	No
1959	315.42	316.31	316.50	317.56	318.13	318.00	316.39	314.65	313.68	313.18	314.6
1960	316.27	316.81	317.42	318.87	319.87	319.43	318.01	315.74	314.00	313.68	314.8
1961	316.73	317.54	318.38	319.31	320.42	319.61	318.42	316.63	314.83	315.16	315.9
1962	317.78	318.40	319.53	320.42	320.85	320.45	319.45	317.25	316.11	315.27	316.5
1963	318.58	318.92	319.70	321.22	322.08	321.31	319.58	317.61	316.05	315.83	316.9
1964	319.41	320.07	320.74	321.40	322.06	321.73	320.27	318.54	316.54	316.71	317.5
1965	319.27	320.28	320.73	321.97	322.00	321.71	321.05	318.71	317.66	317.14	318.7
1966	320.46	321.43	322.23	323.54	323.91	323.59	322.24	320.20	318.48	317.94	319.6
1967	322.17	322.34	322.88	324.25	324.83	323.93	322.38	320.76	319.10	319.24	320.5
1968	322.40	322.99	323.73	324.86	325.40	325.20	323.98	321.95	320.18	320.09	321.1
1969	323.83	324.26	325.47	326.50	327.21	326.54	325.72	323.50	322.22	321.62	322.6
1970	324.89	325.82	326.77	327.97	327.91	327.50	326.18	324.53	322.93	322.90	323.8
1971	326.01	326.51	327.01	327.62	328.76	328.40	327.20	325.27	323.20	323.40	324.6
1972	326.60	327.47	327.58	329.56	329.90	328.92	327.88	326.16	324.68	325.04	326.3
1973	328.37	329.40	330.14	331.33	332.31	331.90	330.70	329.15	327.35	327.02	327.9
1974	329.18	330.55	331.32	332.48	332.92	332.08	331.01	329.23	327.27	327.21	328.2
1975	330.23	331.25	331.87	333.14	333.80	333.43	331.73	329.90	328.40	328.17	329.3
1976	331.58	332.39	333.33	334.41	334.71	334.17	332.89	330.77	329.14	328.78	330.1
1977	332.75	333.24	334.53	335.90	336.57	336.10	334.76	332.59	331.42	330.98	332.2
1978	334.80	335.22	336.47	337.59	337.84	337.72	336.37	334.51	332.60	332.38	333.7
1979	336.05	336.59	337.79	338.71	339.30	339.12	337.56	335.92	333.75	333.70	335.1
1980	337.84	338.19	339.91	340.60	341.29	341.00	339.39	337.43	335.72	335.84	336.9
1981	339.06	340.30	341.21	342.33	342.74	342.08	340.32	338.26	336.52	336.68	338.1
1982	340.57	341.44	342.53	343.39	343.96	343.18	341.88	339.65	337.81	337.69	339.0
1983	341.20	342.35	342.93	344.77	345.58	345.14	343.81	342.21	339.69	339.82	340.9
1984	343.52	344.33	345.11	346.88	347.25	346.62	345.22	343.11	340.90	341.18	342.8
1985	344.79	345.82	347.25	348.17	348.74	348.07	346.38	344.51	342.92	342.62	344.0
1986	346.11	346.78	347.68	349.37	350.03	349.37	347.76	345.73	344.68	343.99	345.4
1987	347.84	348.29	349.23	350.80	351.66	351.07	349.33	347.92	346.27	346.18	347.6
1988	350.25	351.54	352.05	353.41	354.04	353.62	352.22	350.27	348.55	348.72	349.9
1989	352.60	352.92	353.53	355.26	355.52	354.97	353.75	351.52	349.64	349.83	351.1
1990	353.50	354.55	355.23	356.04	357.00	356.07	354.67	352.76	350.82	351.04	352.6

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	No
1991	354.59	355.63	357.03	358.48	359.22	358.12	356.06	353.92	352.05	352.11	353.6
1992	355.88	356.63	357.72	359.07	359.58	359.17	356.94	354.92	352.94	353.23	354.0
1993	356.63	357.10	358.32	359.41	360.23	359.55	357.53	355.48	353.67	353.95	355.3
1994	358.34	358.89	359.95	361.25	361.67	360.94	359.55	357.49	355.84	356.00	357.5
1995	359.98	361.03	361.66	363.48	363.82	363.30	361.94	359.50	358.11	357.80	359.6
1996	362.09	363.29	364.06	364.76	365.45	365.01	363.70	361.54	359.51	359.65	360.8
1997	363.23	364.06	364.61	366.40	366.84	365.68	364.52	362.57	360.24	360.83	362.4

In [ ]:
```
plot(data_co2, col = "blue")
```



In [ ]:
```
model <- HoltWinters(data_co2)
model
```

```
Holt-Winters exponential smoothing with trend and additive seasonal component.

Call:
HoltWinters(x = data_co2)

Smoothing parameters:
 alpha: 0.5126484
 beta : 0.009497669
 gamma: 0.4728868

Coefficients:
           [,1]
a   364.7616237
b     0.1247438
s1    0.2215275
s2    0.9552801
s3    1.5984744
s4    2.8758029
s5    3.2820088
s6    2.4406990
s7    0.8969433
s8   -1.3796428
s9   -3.4112376
s10  -3.2570163
s11  -1.9134850
s12  -0.5844250
```

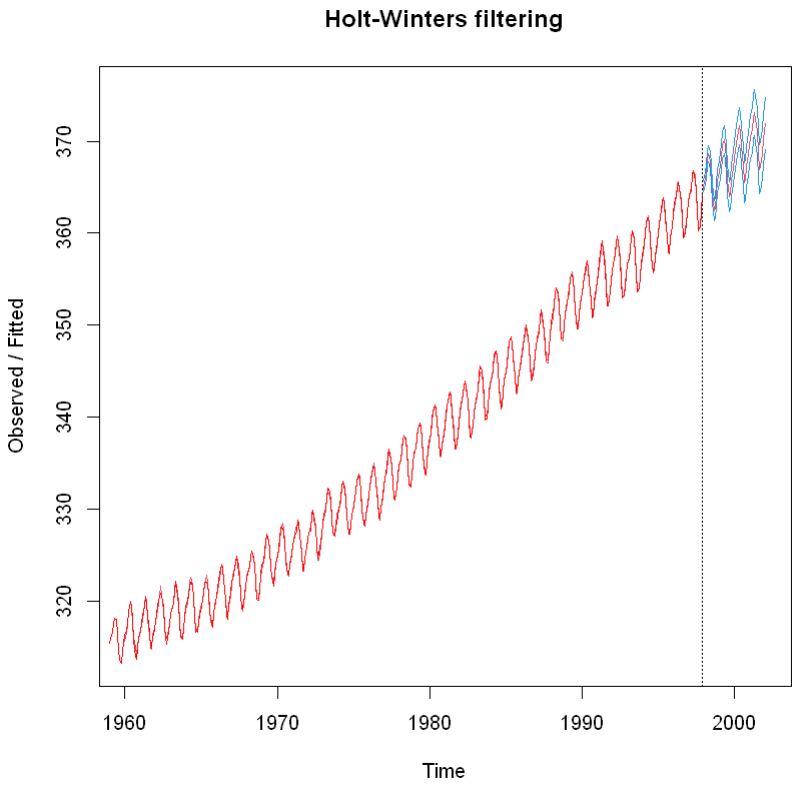
In [ ]:
```r
fore <- predict(model, 50, prediction.interval = TRUE)
fore
```

A Time Series: 50 × 3

	fit	upr	lwr
Jan 1998	365.1079	365.7105	364.5053
Feb 1998	365.9664	366.6449	365.2879
Mar 1998	366.7343	367.4823	365.9864
Apr 1998	368.1364	368.9490	367.3238
May 1998	368.6674	369.5410	367.7937
Jun 1998	367.9508	368.8824	367.0192
Jul 1998	366.5318	367.5189	365.5446
Aug 1998	364.3799	365.4206	363.3392
Sep 1998	362.4731	363.5656	361.3806
Oct 1998	362.7520	363.8948	361.6093
Nov 1998	364.2203	365.4121	363.0285
Dec 1998	365.6741	366.9138	364.4345
Jan 1999	366.6048	367.9353	365.2744
Feb 1999	367.4633	368.8383	366.0884
Mar 1999	368.2313	369.6500	366.8125
Apr 1999	369.6333	371.0954	368.1713
May 1999	370.1643	371.6690	368.6596
Jun 1999	369.4477	370.9946	367.9008
Jul 1999	368.0287	369.6173	366.4401
Aug 1999	365.8769	367.5068	364.2469
Sep 1999	363.9700	365.6409	362.2991
Oct 1999	364.2490	365.9604	362.5375
Nov 1999	365.7172	367.4690	363.9655
Dec 1999	367.1710	368.9628	365.3793
Jan 2000	368.1017	369.9669	366.2366
Feb 2000	368.9602	370.8642	367.0563
Mar 2000	369.7282	371.6707	367.7857
Apr 2000	371.1303	373.1111	369.1494
May 2000	371.6612	373.6803	369.6421
Jun 2000	370.9446	373.0018	368.8874
Jul 2000	369.5256	371.6208	367.4305
Aug 2000	367.3738	369.5067	365.2408

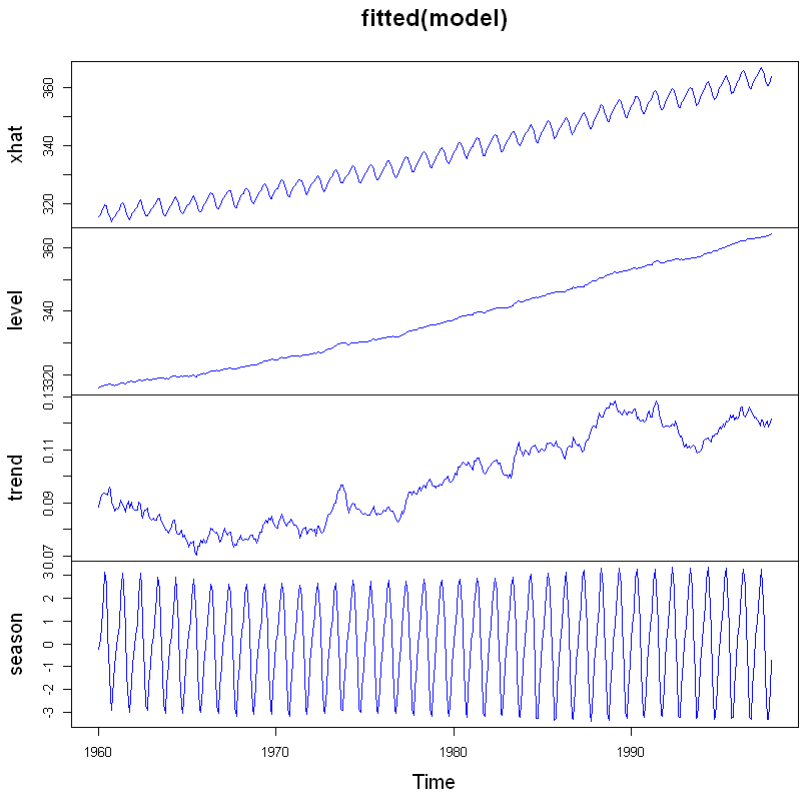
	fit	upr	lwr
Sep 2000	365.4669	367.6376	363.2963
Oct 2000	365.7459	367.9541	363.5376
Nov 2000	367.2142	369.4599	364.9684
Dec 2000	368.6680	370.9511	366.3848
Jan 2001	369.5987	371.9479	367.2494
Feb 2001	370.4572	372.8432	368.0711
Mar 2001	371.2251	373.6479	368.8023
Apr 2001	372.6272	375.0867	370.1677
May 2001	373.1581	375.6543	370.6619
Jun 2001	372.4416	374.9744	369.9087
Jul 2001	371.0226	373.5920	368.4531
Aug 2001	368.8707	371.4767	366.2647
Sep 2001	366.9639	369.6064	364.3213
Oct 2001	367.2428	369.9219	364.5637
Nov 2001	368.7111	371.4267	365.9955
Dec 2001	370.1649	372.9170	367.4128
Jan 2002	371.0956	373.9100	368.2812
Feb 2002	371.9541	374.8046	369.1036

In [ ]:
```
plot(model,fore,col="red")
```



🖌️ **Analisis :** Dataset merupakan pengukuran konsentrasi karbondioksida (CO2) di Mauna Loa, Hawai pada tahun 1959 hingga 1997. Hasil insight didapat pola trend dan seasonal dan terdapat kenaikan setiap tahunnya. Kemudian melakukan predict untuk model dengan interval 50 prediksi ke depan dengan menggunakan motode HoltWintres.

In [ ]:
```
plot(fitted(model),col="blue")
```



🖌️ **Analisis :** Model kemudian di fit kan. Dan dari hasil fitting model berhasil menangkap dan memvisualisasikan komponen-komponen penting dari data time series, yaitu level, trend, dan seasonality.

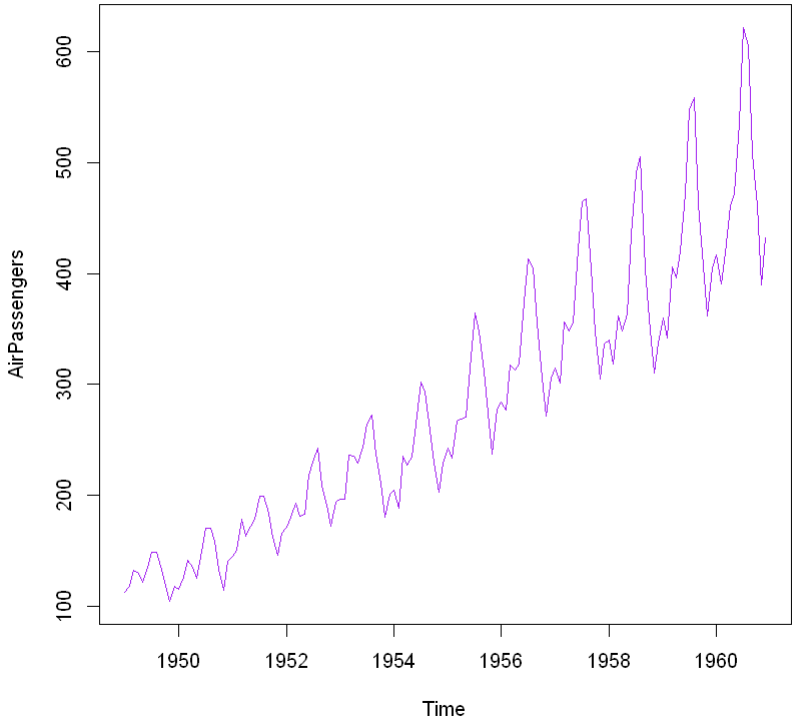
Percobaan ke-4: Studi Kasus 4

In [ ]:
```
AirPassengers
```

A Time Series: 12 × 12

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1949	112	118	132	129	121	135	148	148	136	119	104	118
1950	115	126	141	135	125	149	170	170	158	133	114	140
1951	145	150	178	163	172	178	199	199	184	162	146	166
1952	171	180	193	181	183	218	230	242	209	191	172	194
1953	196	196	236	235	229	243	264	272	237	211	180	201
1954	204	188	235	227	234	264	302	293	259	229	203	229
1955	242	233	267	269	270	315	364	347	312	274	237	278
1956	284	277	317	313	318	374	413	405	355	306	271	306
1957	315	301	356	348	355	422	465	467	404	347	305	336
1958	340	318	362	348	363	435	491	505	404	359	310	337
1959	360	342	406	396	420	472	548	559	463	407	362	405
1960	417	391	419	461	472	535	622	606	508	461	390	432

In [ ]:
```
plot(AirPassengers, col = "purple")
```



In [ ]:
```
model <- HoltWinters(AirPassengers, seasonal="mult")
model
```

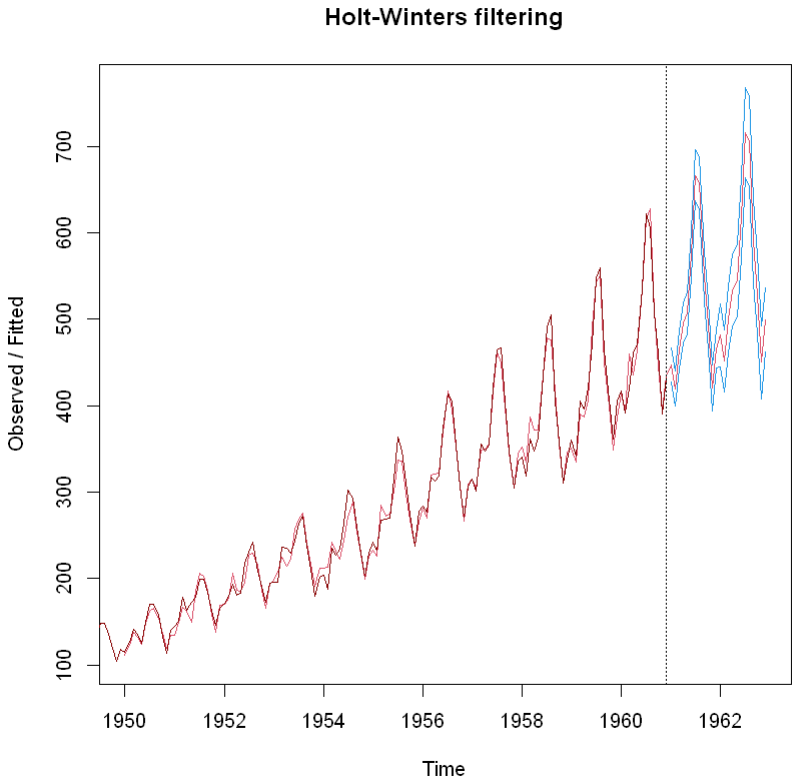
```
Holt-Winters exponential smoothing with trend and multiplicative seasonal compone
nt.

Call:
HoltWinters(x = AirPassengers, seasonal = "mult")

Smoothing parameters:
 alpha: 0.2755925
 beta : 0.03269295
 gamma: 0.8707292

Coefficients:
           [,1]
a   469.3232206
b     3.0215391
s1    0.9464611
s2    0.8829239
s3    0.9717369
s4    1.0304825
s5    1.0476884
s6    1.1805272
s7    1.3590778
s8    1.3331706
s9    1.1083381
s10   0.9868813
s11   0.8361333
s12   0.9209877
```

In [ ]:
```
fore <- predict(model, 24, prediction.interval = TRUE)
fore
```

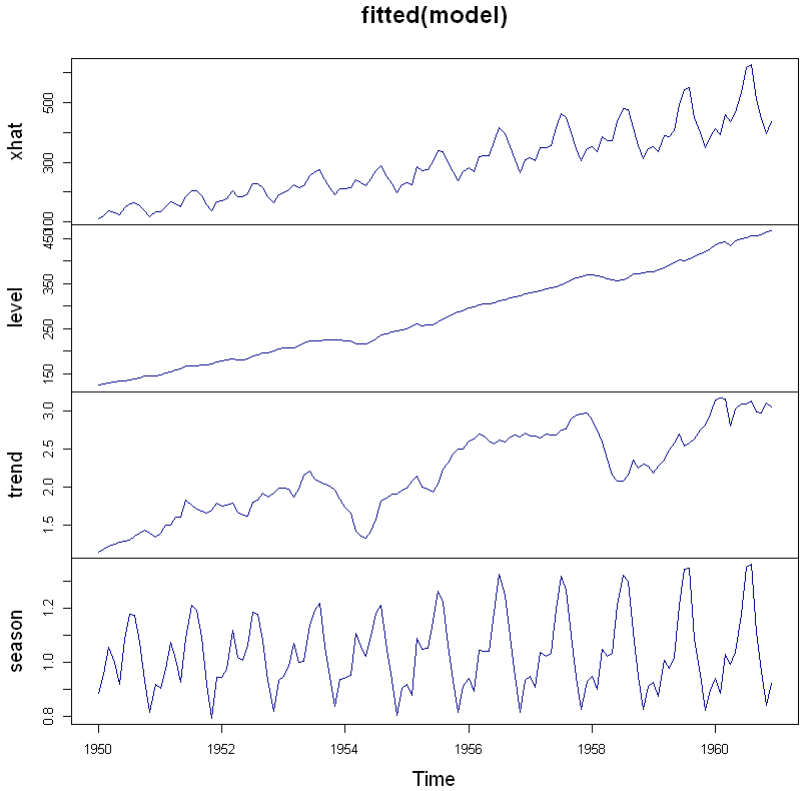
A Time Series: 24 × 3

	fit	upr	lwr
Jan 1961	447.0559	466.8057	427.3061
Feb 1961	419.7123	440.2920	399.1326
Mar 1961	464.8671	486.7712	442.9630
Apr 1961	496.0839	519.3350	472.8329
May 1961	507.5326	531.9278	483.1375
Jun 1961	575.4509	602.1935	548.7083
Jul 1961	666.5923	696.5558	636.6288
Aug 1961	657.9137	688.6454	627.1821
Sep 1961	550.3088	578.9777	521.6398
Oct 1961	492.9853	520.9553	465.0153
Nov 1961	420.2073	446.9458	393.4688
Dec 1961	465.6345	487.9686	443.3004
Jan 1962	481.3732	517.8126	444.9337
Feb 1962	451.7258	488.0308	415.4207
Mar 1962	500.1008	538.8928	461.3088
Apr 1962	533.4477	574.3831	492.5122
May 1962	545.5202	587.8399	503.2005
Jun 1962	618.2550	664.8185	571.6915
Jul 1962	715.8704	768.3289	663.4118
Aug 1962	706.2524	759.2423	653.2626
Sep 1962	590.4954	638.2882	542.7027
Oct 1962	528.7681	574.2084	483.3279
Nov 1962	450.5242	492.7194	408.3290
Dec 1962	499.0281	535.8450	462.2112

In [ ]:
```
plot(model,fore,col="darkred")
```



In [ ]:
```
plot(fitted(model),col="darkblue")
```



🖌️ **Analisis :** Sama seperti percobaan sebelumnya model menangkap dan memvisualisasikan komponen-komponen dengan sangat baik dari data time series,

yaitu level, trend, dan seasonality. Model yang telah di fit menunjukkan bahwa data atau nilai pada 24 periode berikutnya cenderung naik.