```
proc import out=aep datafile="/home/u62176551/sasuser.v94/aep_monthly data.xlsx"
dbms=xlsx replace;
run;

proc sgplot data=aep;
    series x=date y=aep;
    title "Monthly Mean Energy Consumption(in MW)";
    xaxis label="Months";
    yaxis label="Mean Energy Consumption(in MW)";
run;/*possible trend,seasonal*/

proc timeseries data=aep plots=(acf pacf) out=_null_;
    var aep;
    corr acf/nlag=36;
run;/*confirms seasonal,no trend*/

/*WINTERS*/
/*Multiplicative winters*/
proc esm data=aep lead=24 back=24 outfor=outaep plot=forecasts out=_null_ print=all;
id date interval=month;
forecast aep/model=winters;
run;

proc sgplot data=outaep;
series x=date y=Actual;
series x=date y=Predict;
title "plot of actual versus forecasted";
run;

/*Additive winters*/
proc esm data=aep lead=24 back=24 outfor=outaep1 plot=forecasts out=_null_ print=all;
id date interval=month;
forecast aep/model=addwinters;
run;

proc sgplot data=outaep1;
series x=date y=Actual;
series x=date y=Predict;
title "Plot of actual versus forecasted";
run;

/* deseasonalising data*/

data aep1;
set aep;
t=_n_;
aep_new=aep;
if t>143 then aep_new =.;
run;

proc reg data=aep1 outest=aep11new;
model aep_new=t/AIC BIC;
output out=AEP11_out r=r_AEP11 p=p_AEP11;
```

```
run;

data AEP11_out;
set AEP11_out;
mape_fit=(abs(r_AEP11)/aep_new)*100;
if t>143 then mape_acc=(abs(aep-p_AEP11)/aep)*100;
run;

proc means data=AEP11_out mean;
var mape_fit mape_acc;
run;
/*mape_fit 7.5691252 and mape_acc 6.5155743*/

proc sgplot data=AEP11_out;
series x=date y=aep;
series x=date y=p_AEP11;
run;

/* Obtaining seasonally adjusted data */

proc timeseries data=aep1 outdecomp=sa_aep out=_null_;
decomp sa;
id date interval=MONTH;
var aep;
run;

data aep_combined;
merge sa_AEP aep1;
si=aep/sa;
run;

proc sgplot data=aep_combined;
series x=t y=aep;
series x=t y=sa;
run;

proc reg data=aep_combined outest=aep2new;
model sa=t/aic bic dwprob;
output out=sa_aepout r=r_sa p=p_sa;
run;

data sa_aepout;
set sa_aepout;
mape_fit2=(abs(r_sa)/sa)*100;
if t>143 then mape_acc2=(abs(sa-p_sa)/sa)*100;
aep_reseason=si*p_sa;
run;

proc means data=sa_aepout mean;
var mape_fit2 mape_acc2;
run;
/*mape_fit2 3.4407620 and mape_acc2 3.3896240*/

proc sgplot data=sa_aepout;
```

```
series x=date y=aep;
series x=date y=aep_reseason;
run;

/*X11 decomposition*/
data aep_x11;
    set aep;
    t=_n_;
    aep_new=aep;
    if t>143 then aep_new =.;
run;

proc x11 data=aep_x11 noprint outextrap;
    monthly date=date;
    var aep_new;
    arima forecast=4;
    output out=aep_out a1=original d10=sf d11=sa d12=tcc a15=forecast;
run;

data aep_x11_merge;
    merge aep_x11 aep_out;
run;

data aep_x11_merge;
    set aep_x11_merge;
    t=_n_;
    mape_fit=(abs(original-forecast)/original)*100;
    if t>143 then mape_acc=(abs(aep-forecast)/aep)*100;
run;

proc means data=aep_x11_merge mean;
    var mape_fit mape_acc;
run;

proc sgplot data=aep_out;
    series x=date y=original;
    series x=date y=forecast;
    series x=date y=sa;
    series x=date y=tcc;
run;

proc sgplot data=aep_out;
      series x=date y=original;
      series x=date y=forecast;
run;

/*Regression using dummy variables*/
data aep1;
    set aep;
    month=month(date);
    if month=1 then m1=1; else m1=0;
    if month=2 then m2=1; else m2=0;
    if month=3 then m3=1; else m3=0;
    if month=4 then m4=1; else m4=0;
```

```
    if month=5 then m5=1; else m5=0;
    if month=6 then m6=1; else m6=0;
    if month=7 then m7=1; else m7=0;
    if month=9 then m9=1; else m9=0;
    if month=10 then m10=1; else m10=0;
    if month=11 then m11=1; else m11=0;
    if month=12 then m12=1;else m12=0;
run;

proc reg data=aep1 outest=outaepreg;
    model aep=m1 m2 m3 m4 m5 m6 m7 m9 m10 m11 m12/aic bic adjrsq vif corrb;
    output out=aep1out p=aep_pred r=aep_res;
run;

data aep1out;
    set aep1out;
    mape=(abs(aep_res)/aep)*100;
run;

proc means data=aep1out mean;
    var mape;
run;
/*Classical Decomposition Method*/
proc timeseries data=aep plots=(tc sa cc tcc) outdecomp=aep1 printdetails;
      id date interval=month;
      var aep;
      decomp orig tc sc sa cc ic/mode=additive;
run;


/* Seasonal ARIMA */
proc arima data=aep;
    identify var=aep nlag=36 whitenoise=ignoremiss;
    estimate p=(1) q=(12) whitenoise=ignoremiss; /*ARIMA (8,0,0)(0,0,3)*/
    estimate p=(1)(12) q=(12) whitenoise=ignoremiss; /*ARIMA (8,0,0)(1,0,3)*/
    forecast id=date interval=month lead=24 out=out1;
run;


/*Moving averages*/
proc expand data=aep out=aep_ma_output1;
    id date;
    convert aep=moving_average12/transout=(movave 12);
    convert aep=moving_average3/transout=(movave 3);
run;

proc sgplot data=aep_ma_output1;
    series x=date y=aep;
    series x=date y=moving_average3;
    label moving_average3="MA3";
    title "Moving Average 3";
run;

proc sgplot data=aep_ma_output1;
```

```
    series x=date y=aep;
    series x=date y=moving_average12;
    label moving_average12="MA12";
    title "Moving Average 12";
run;

data aep_ma_output1;
    set aep_ma_output1;
    mape_MA3=(abs(aep-moving_average3)/aep)*100;
    mape_MA12=(abs(aep-moving_average12)/aep)*100;
run;

proc means data=aep_ma_output1 mean;
    var mape_MA3 mape_MA12;
run;/*MAPE 3 is 6.2185027 and MAPE 12 is 7.1552610*/

/*Simple exponential smoothing*/
proc esm data=aep print=all outfor=outaep back=24 lead=24 out=_null_ plot=forecasts;
    forecast aep/model=simple;
run;

/*Trying ARIMA with less order*/
proc arima data=aep;
    identify var=aep(1,12) nlag=36 whitenoise=ignoremiss;
    estimate p=3 q=(12) whitenoise=ignoremiss;/*ARIMA (3,1,0)(0,1,1)*/
    estimate p=2 q=(2)(12) whitenoise=ignoremiss;/*ARIMA (2,1,2)(0,1,1)*/
    *forecast id=date interval=month lead=24 out=out1;
```