SAS Code

```
*Importing monthly Soybean prices;
proc import datafile = 'C:\Users\sgirada\Desktop\Python\Soybean.csv'
   out = work.Soybean
   dbms = CSV;
   run;
quit;
```

```
ods pdf file="C:\Users\sgirada\Desktop\Python\report.pdf" style = minimal;
ods listing gpath='C:\Users\sgirada\Desktop\Python\';
ods graphics / imagename="test" imagefmt=jpg;
```

```
*Generating price plots;
proc sgplot data=Soybean;
   SERIES X= Date Y= L_P_Soy ;
   YAXIS LABEL = 'Closing Prices in $ per bushel';
   TITLE 'Soybean Active Continuation Prices';
run;
quit;
```

```
*Computing the log returns;
```

```
data work.Soybean;
    set Soybean;
    Prev_L_P_Soy=lag(L_P_Soy);
    return_L_P=log(L_P_Soy/Prev_L_P_Soy);
    if FIRST.L_P_Soy then return_L_P =.;
    time=_n_-1;
run;
```

```
ods listing gpath='C:\Users\sgirada\Desktop\Python\';
ods graphics / imagename="Returns" imagefmt=jpg;
```

```
*Plotting the log returns;
proc sgplot data=Soybean;
    SERIES X= Date Y= return_L_P;
    YAXIS LABEL = 'Log Returns in %';
    TITLE 'Log Returns Month over Month';
run;
quit;
```

```
title "ARMA model for log returns";
*Fitting regular ARIMA model;
proc arima data=work.Soybean;
    identify var=return_L_P stationarity=(adf=0)nlag=36;
    run;
    estimate p=(2,3) q=(9) noconstant;
    run;
    forecast out=res2;
```

```
quit;
```

```
*Calculating squared residuals;
data work.Res2;
    set Res2;
    res_sq=RESIDUAL**2;
    run;
quit;
```

```
title "ARMA model for squared residuals";
*Fitting squared residuals;
    proc arima data = work.Res2;
    identify var=res_sq nlag=36;
    run;
    estimate p=(2) q=(0);
    run;
quit;
```

```
*Generating time periods for forecasts;
data b;
    return_L_P=.;
    do time = 238 to 260;
    output;
    end;
run;
```

```
data b; merge Soybean b; by time; run;
```

```
title "GARCH model for squared residuals";

*Fitting GARCH model to log returns;

proc autoreg data=b;

    model return_L_P = / nlag=(3 9)garch=(q=(2))noint archtest method=ml;

    output out =p p=yhat pm=ytrend lcl=lcl ucl=ucl;

run;
```

```
title "Forecasting Autocorrelated Time Series";

*Plotting forecasts with above fitted model;

proc sgplot data=p;

    band x=time lower=lcl upper=ucl;

    scatter x=time y=return_L_P;

    series x=time y=yhat;

refline  238 /axis=x label="Last Data Point" lineattrs=(color=red);

run;
```

```
ods pdf close;
```