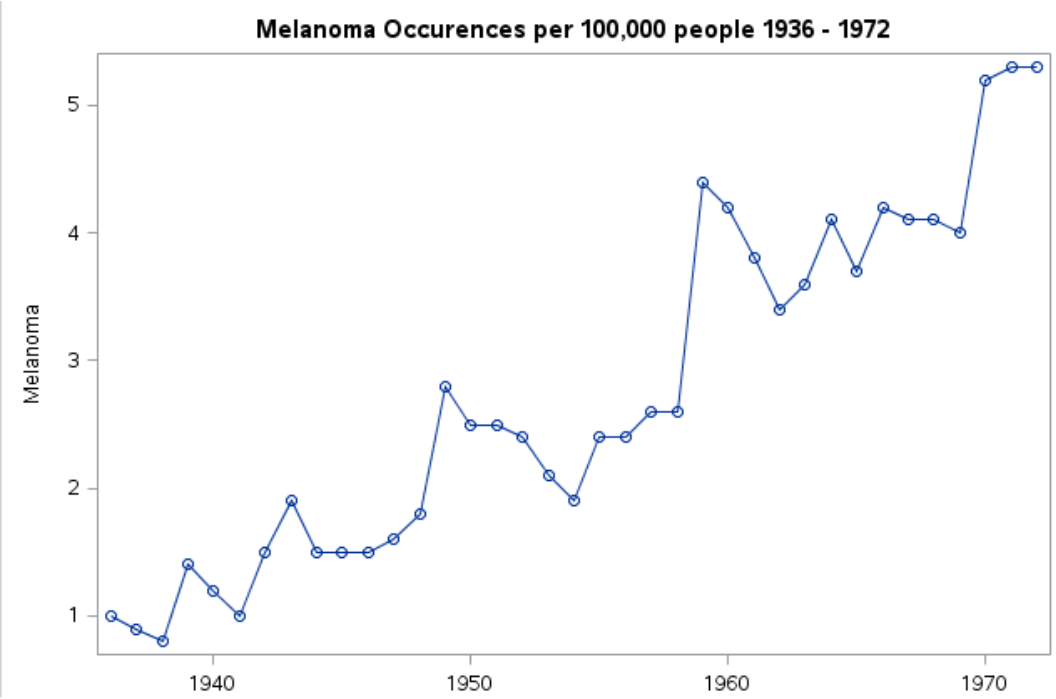
UNIT 4 HOMEWORK!!!

Below is a data set that has the year, the average number of melanomas per 100,000 people and the number of sunspots that year. We will first analyze just the melanoma data. ***Please include your code for all questions.***

```
data mel;
input Year    Melanoma      Sunspot;
datalines;
1936   1      40
1937   0.9    115
1938   0.8    100
1939   1.4    80
1940   1.2    60
1941   1      40
1942   1.5    23
1943   1.9    10
1944   1.5    10
1945   1.5    25
1946   1.5    75
1947   1.6    145
1948   1.8    130
1949   2.8    130
1950   2.5    80
1951   2.5    65
1952   2.4    20
1953   2.1    10
1954   1.9    5
1955   2.4    10
1956   2.4    60
1957   2.6    190
1958   2.6    180
1959   4.4    175
1960   4.2    120
1961   3.8    50
1962   3.4    35
1963   3.6    20
1964   4.1    10
1965   3.7    15
1966   4.2    30
1967   4.1    60
1968   4.1    105
1969   4      105
1970   5.2    105
1971   5.3    80
1972   5.3    65
;
```

1. We always want to plot the data first. Please plot the data with time on the x axis and melanoma per 100,000 people on the y axis. First of all, does it look like the mean of the rate of melanoma is increasing over time? What could be causing this … time or something possibly something else? This second question is just for thought … there are of course many possible answers.

```
proc sgplot data = mel;
scatter x = Year y = Melanoma;
series x = Year y = Melanoma;
title 'Melanoma Occurences per 100,000 people 1936 - 1972';
run;
```

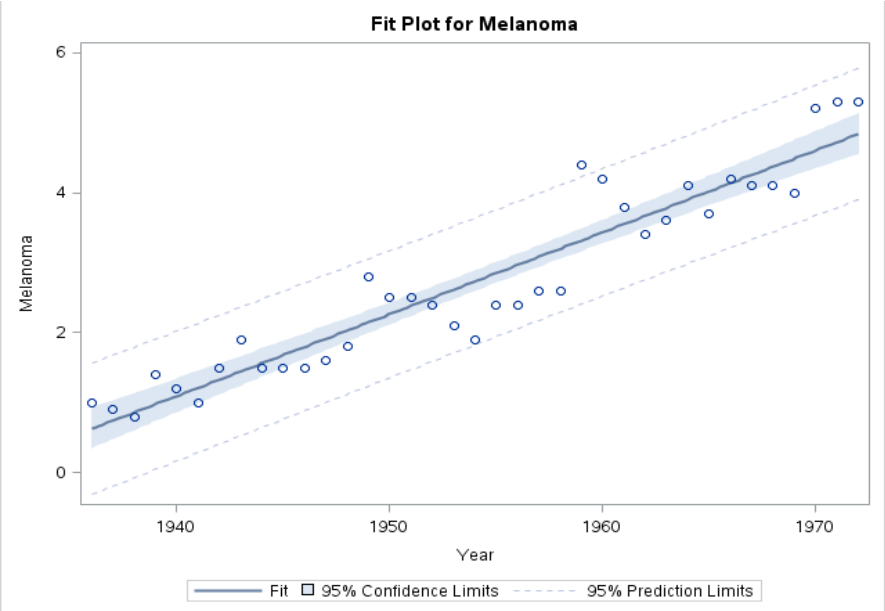


The mean of melanoma is increasing over time

2. Use proc glm to fit a simple linear regression model: $\widehat{melanoma} = \hat{\beta}_0 + \hat{\beta}_1 year$. Cut and paste the parameter estimate table and plot of the data with the regression line superimposed (default output from proc glm). Make sure that the plot has "year" on the x-axis. Note in your mind the estimates and standard errors of the intercept and slope (you don't need to write anything down for this.) In addition, please answer this question in writing: "Does it appear that the series is going on extended "runs" in which the rate of melanomas tends to be above or below the mean for an extended amount of time (suggesting correlated residuals with time (serially correlated residuals))?

```
proc glm data = mel plots = all;
model Melanoma = Year;
output out = resids r = residsOLS;
run;
```

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	-225.9264106	13.26374038	-17.03	<.0001
Year	0.1170223	0.00678789	17.24	<.0001



The runs look like they alternate around the mean over time, with staying below for a few years then going back across for a few.

3. Now use proc autoreg to plot the same line as above (same model). Do not account for any serial correlation here. (a) Does the parameter estimate table look different than the one from the OLS model you found from proc glm above? (b) Make sure and use the "dwprob" option to get the Durbin-Watson test statistic. Does it suggest AR(1) serial correlation? Discuss in a sentence or two including the test statistic and pvalue. (c) Cut and paste the PACF and comment on any evidence it may provide into serial correlated residuals.

proc autoreg data = mel;
model Melanoma = Year / dwprob;
run;

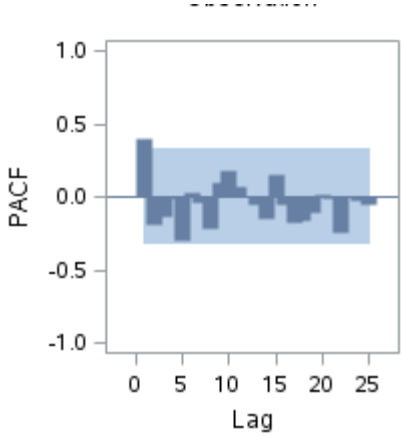
Durbin-Watson Statistics			
Order	DW	Pr < DW	Pr > DW
1	1.1550	0.0018	0.9982

NOTE: Pr<DW is the p-value for testing positive autocorrelation, and Pr>DW is the p-value for testing negative autocorrelation.

Parameter Estimates					
Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	-225.9264	13.2637	-17.03	<.0001
Year	1	0.1170	0.006788	17.24	<.0001

a) It has the same exact values

b) It shows that there is evidence that the variable year has positive autocorrelation.



c) **The PACF starts as positive which suggests that this should be an AR1 model and the blue area suggests that these autocorrelations are zero.**

4. Now use proc autoreg to fit a model that accounts for an AR(1) correlation structure in the residuals. (a) Cut and paste the Yule-Walker parameter estimate table and compare and contrast in a few sentences the slope and intercept estimates and their standard errors with the OLS estimates from above. (b) Report the estimate of the first serial correlation coefficient. (c) Make sure and use the "dwprob" option again to get the Durbin-Watson test statistic. Does it suggest any remaining serial correlation in the series? Discuss in a sentence or two including the test statistic and pvalue. (d) Cut and paste the PACF and comment on any evidence it may provide into any remaining serial correlation. (e) Compare the MSE from the OLS and Yule Walker models. (f) Compare the AIC from the OLS and Yule Walker models. Which one does the AIC favor?

proc autoreg data = mel;

model Melanoma = Year / nlag = 1 dwprob;

output out = Forecast p = yhat pm = ytrend lcl = lower ucl = upper;

run;

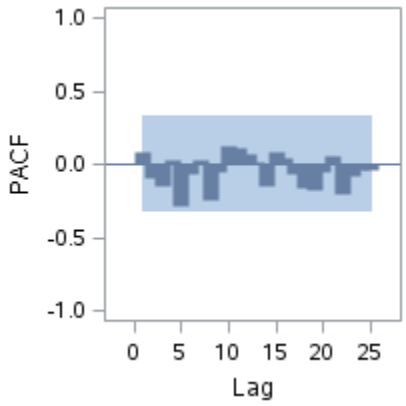
The AUTOREG Procedure

Yule-Walker Estimates			
SSE	5.67279475	DFE	34
MSE	0.16685	Root MSE	0.40847
SBC	46.621896	AIC	41.7891422
MAE	0.3042134	AICC	42.516415
MAPE	12.7399723	HQC	43.4929143
Durbin-Watson	1.8024	Transformed Regression R-Square	0.8050
		Total R-Square	0.9121

a)

Durbin-Watson Statistics			
Order	DW	Pr < DW	Pr > DW
1	1.8024	0.2460	0.7540

b) **The PACF starts as positive which suggests that this should be an AR1 model and the blue area suggests that these autocorrelations are zero/statistically insignificant which leads more to an AR2 model**



c) **OSL MSE is 0.19435 & YULE MSE is 0.16685**

d) **OSL AIC IS 46.3551818 & YULE AIC is 41.7891422, so sas likes the AR(2) model better since it has lower numbers**

5. Use your model to predict the number of melanomas from 1973 - 1975. Include the prediction with 95% confidence limits as well as a plot of the series and the predictions.

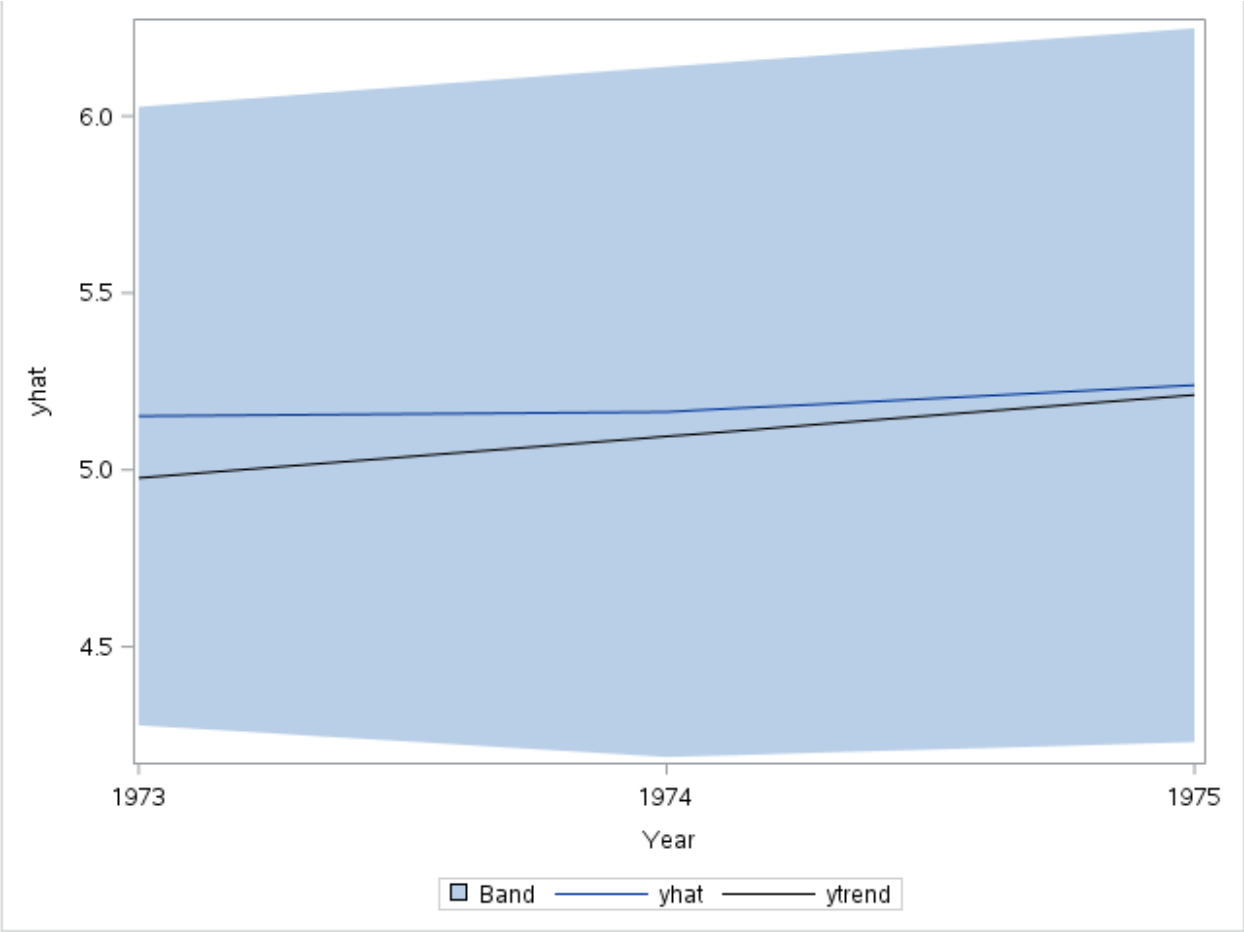
```
data mel2;
Melanoma=.;
do Year = 1973 to 1975; output;
end;
run;

data mel3;
merge mel mel2;
by year;
run;

proc autoreg data=mel3 all plots(unpack);
  model Melanoma= Year / nlag=1;
  output out=Forecast p=yhat  pm=ytrend
          lcl=lcl ucl=ucl;
run;

proc print data=Forecast;
run;

proc sgplot data = Forecast;
where Year > 1972;
band x = Year ucl = upper lower = lcl;
scatter x = Year y = Melanoma;
series x = Year y = yhat;
series x = Year y = ytrend / lineattrs = (color = black);
run;
```



BONUS:

(Up to 5 pts) Looking back at the series in question 1, scientists back in the 70's surmised that melanomas may be related to sunspots. Is there any evidence that melanoma incidence is related to sunspot activity in the same year, or to sunspot activity in the previous one or even two years? Useful Hint: Check Example 1 of this function:
http://support.sas.com/documentation/cdl/en/lrdict/64316/HTML/default/viewer.htm#a000212547.htm