

STAT 641
Statistical Data Analytics Case Study

Monthly Extent of North Pole Sea Ice Flow from 1979 to 2017

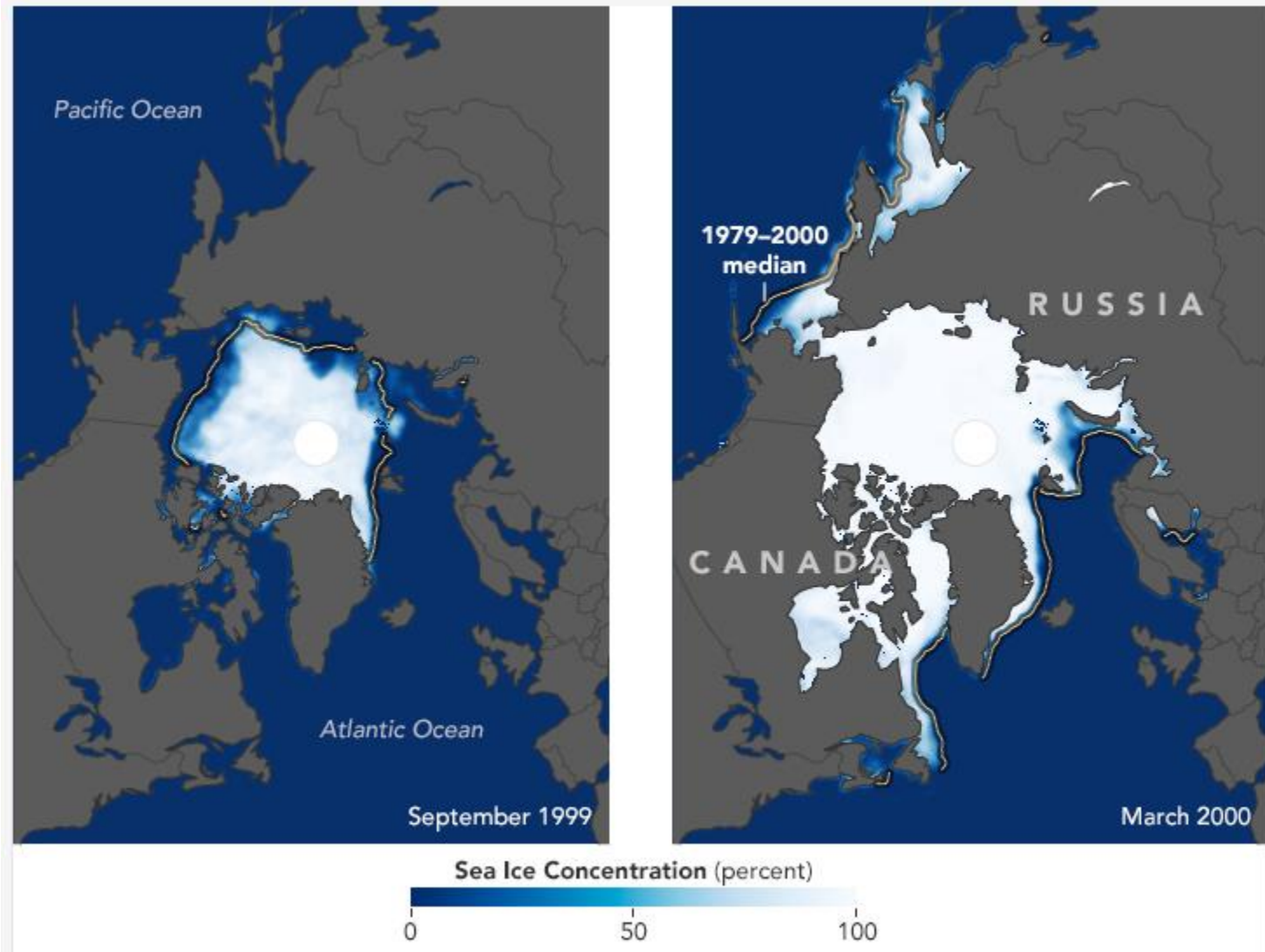
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Statistics Program
University of Delaware



Arctic Sea Ice



Aim : to analyze whether there is evidence of shrinkage of north sea ice over time

About the data

- combined provided data
- eliminate extraneous data
- fill in missing data

	A	B	C	D	E	F
1	year	mo	data-ty	region	extent	area
10	1987	1	Godde	N	14.97	11.9
11	1988	1	-9999	N	-9999	-9999
49	1987	2	Godde	N	16.05	13.02
50	1988	2	Godde	N	15.58	13.57
88	1987	3	Godde	N	15.82	12.83
89	1988	3	Godde	N	15.96	13.9
127	1987	4	Godde	N	15.21	12.35
128	1988	4	Godde	N	15.12	13.18
166	1987	5	Godde	N	13.74	10.97
167	1988	5	Godde	N	13.56	11.41
205	1987	6	Godde	N	12.49	9.39
206	1988	6	Godde	N	11.94	9.68
244	1987	7	Godde	N	10.33	6.55
245	1988	7	Godde	N	9.81	7.01
283	1987	8	Godde	N	7.63	-9999
284	1988	8	Godde	N	7.89	5.42
322	1987	9	Godde	N	7.28	5.64
323	1988	9	Godde	N	7.37	5.36
361	1987	10	Godde	N	9.05	7.49
362	1988	10	Godde	N	9.13	7.52
391	1978	11	Godde	N	11.65	9.04
400	1987	11	Godde	N	11.22	9.73
401	1988	11	Godde	N	11.33	9.91
430	1978	12	Godde	N	13.67	10.9
439	1987	12	-9999	N	-9999	-9999
440	1988	12	Godde	N	13.63	11.99
469						

Regression Model:

$$\text{extent} = b1 * \text{year} + b2 * \text{month} + b0$$

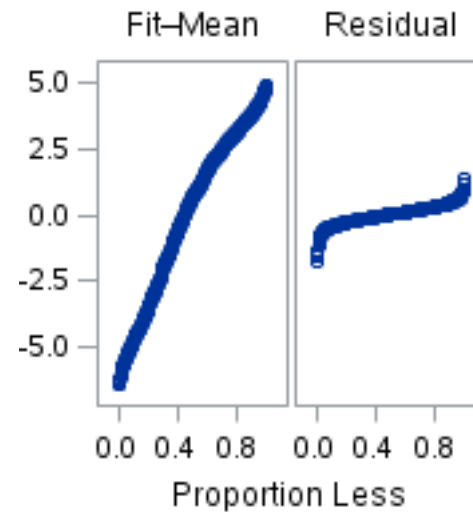
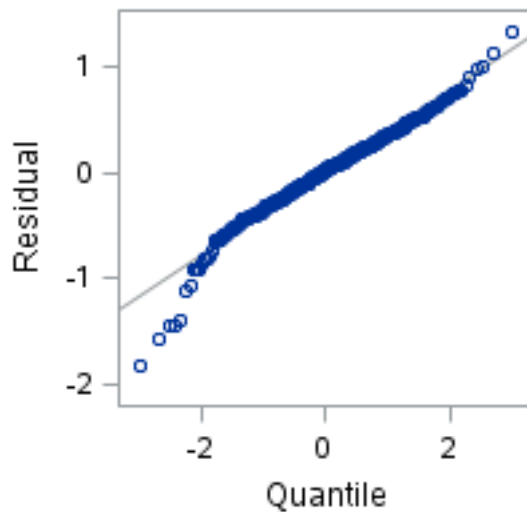
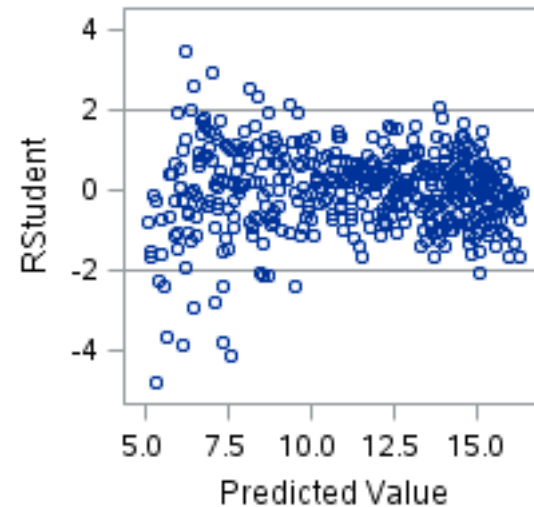
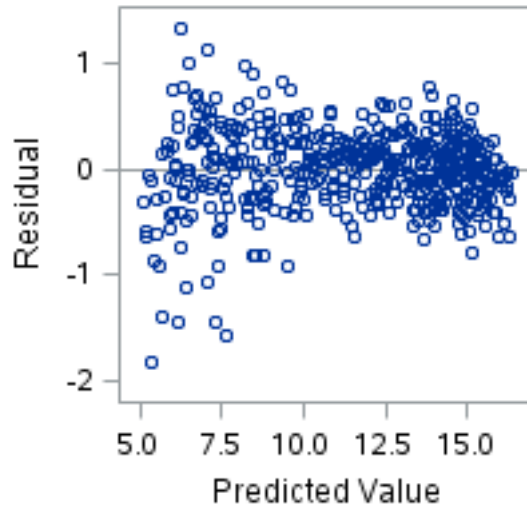
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	4732.401831	394.366819	2581.47	<.0001
Error	454	69.356692	0.152768		
Corrected Total	466	4801.758522			

Parameter Estimates				
Parameter	DF	Estimate	Standard Error	t Value
Intercept	1	122.432006	3.216502	38.06
year	1	-0.054915	0.001610	-34.10
month 1	1	1.581581	0.088526	17.87
month 2	1	2.464915	0.088526	27.84
month 3	1	2.615427	0.088526	29.54
month 4	1	1.903633	0.088526	21.50
month 5	1	0.482351	0.088526	5.45
month 6	1	-1.085855	0.088526	-12.27
month 7	1	-3.474573	0.088526	-39.25
month 8	1	-5.772521	0.088526	-65.21
month 9	1	-6.568675	0.088526	-74.20
month 10	1	-4.623926	0.089095	-51.90
month 11	1	-2.186154	0.088511	-24.70
month 12	0	0	.	.

Root MSE	0.39086
Dependent Mean	11.50923
R-Square	0.9856
Adj R-Sq	0.9852
AIC	-395.60011
AICC	-394.67091
SBC	-810.69783

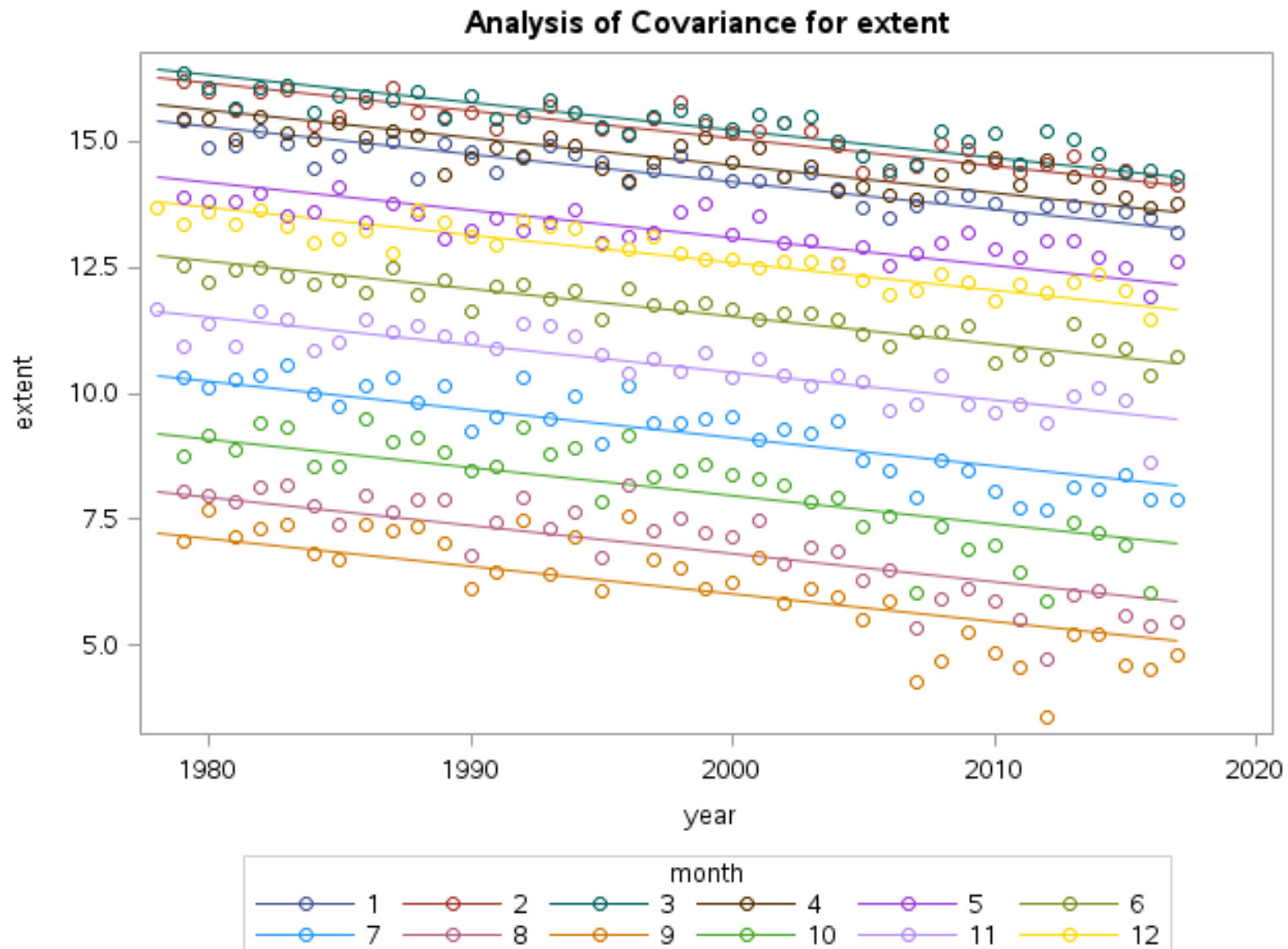
Regression Model:

$$\text{extent} = b1 \cdot \text{year} + b2 \cdot \text{month} + b0$$

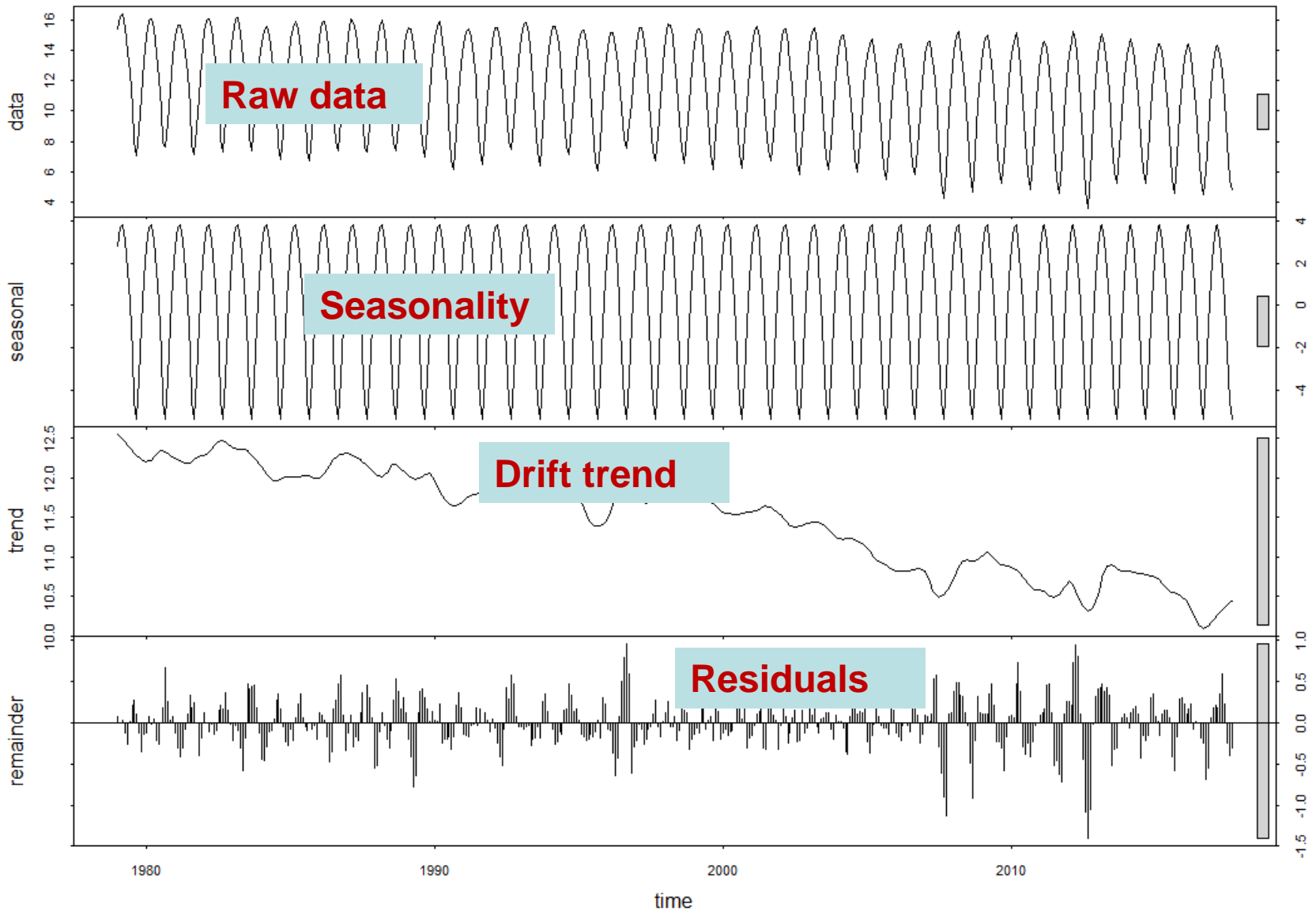


Regression Model:

$$\text{extent} = b1 * \text{year} + b2 * \text{month} + b0$$



ARIMA Model



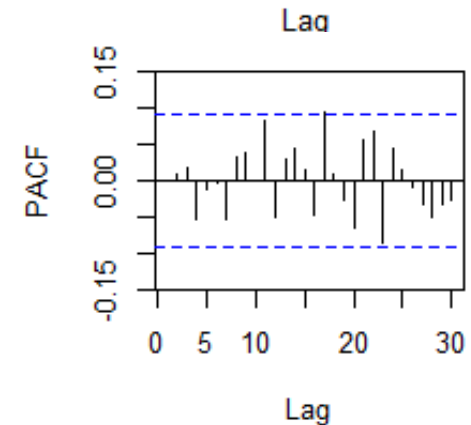
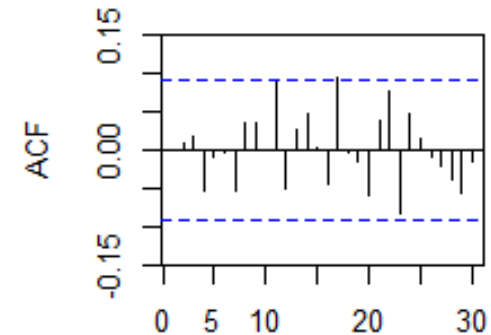
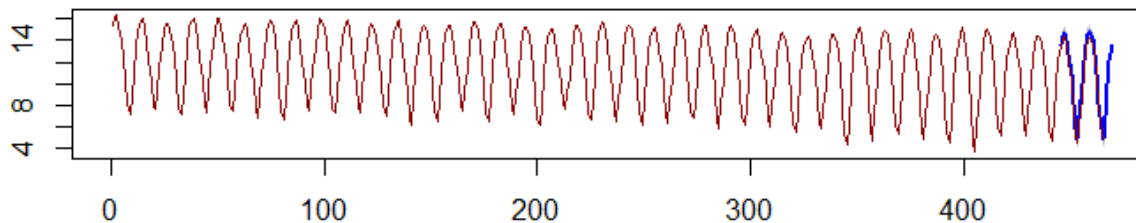
ARIMA(1,0,1)(0,1,1)[12] with drift

Coefficients:

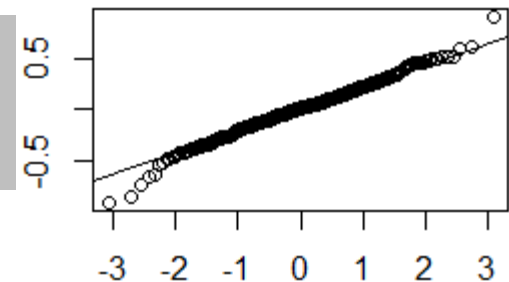
	ar1	ma1	sma1	drift
	0.5954	0.3337	-0.8114	-0.0045
s.e.	0.0492	0.0586	0.0295	0.0006

AIC=-7.76 AICc=-7.62 BIC=12.82

Prediction for next 20 years



Normal Q-Q Plot



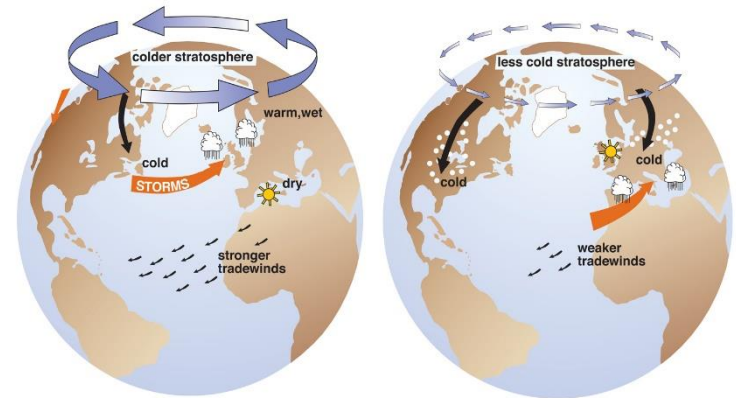
✓ **Conclusion : there is evidence of shrinkage of north sea ice over time**

Why is the North Ice Sea Shrinking?

- Natural variability



- Arctic oscillation cause the ice transport



- Melting the sea ice



- Global warming



Conclusion

- **Regression and ARIMA are both suitable models to analyze the data set**
- **There is evidence of shrinkage of north sea ice over time based on our analysis of the extend of North Ice sea from 1979 to 2017**
- **Reasons for the shrinkage of north ice sear include: natural variability, sea ice melting, global warming, and arctic oscillation**

Sources

https://earthobservatory.nasa.gov/Features/WorldOfChange/sea_ice.php

paragraph 6

<https://earthobservatory.nasa.gov/Features/SeaIce/page3.php>

paragraph 9

<https://nsidc.org/cryosphere/quickfacts/seaice.html>

2nd to last bullet point near the bottom

Thank you!