LAB. METEOROLOGICAL DATA ANALYSIS ..... FOURTH STAGE

(The second Semester)

Department of Atmospheric Sciences

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((Sixh Lecture))

T-test:

It is a statistical test that enables us to compare the arithmetic mean of the sample and the population.

$$t = \frac{\overline{x} - \mu_o}{s/\sqrt{n}}$$

Where: $\bar{x}$ = The arithmetic mean of the sample.

μo =the arithmetic mean of the population.

s = $standard\ deviation$.

Note: When the number of samples is less than 30, we use a test t .

For example: A sales company sells $100 transactions. They wanted to increase sales, so share 25 people in development courses, which increased the percentage of sales 130 $ What is the reason for the increase and standard deviation is 15 and error rate =5% .

Solue:

1-we extract values of **t** Calculated from the equation below:

$$t = \frac{\overline{x} - \mu_o}{s/\sqrt{n}}$$

=(130-100)-(15/SQRT(25)) = **The value of t calculated**

2-Calculate the value of t in the statistical table:

* From the table we determine the value vertical Which represents the error percentage given, 5%(0.05).

* From the table we determine the value horizontal Which **represents degree of freedom** which is equal to (n-1) If the number of samples In the example 25 The degree of freedom is 24.

* find the value of t Tabular by finding the location of the value (1.711).

*- We compare the value of each (t) tabular and (t) calculated If the calculation is greater than Tabular, ***We reject the null hypothesis and accept the alternative hypothesis.***

	P						
one-tail	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	0.2	0.1	0.05	0.02	0.01	0.002	0.001
DF							
1	3.078	6.314	12.706	31.821	63.656	318.289	636.578
2	1.886	2.92	4.303	6.965	9.925	22.328	31.6
3	1.638	2.353	3.182	4.541	5.841	10.214	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.61
5	1.476	2.015	2.571	3.365	4.032	5.894	6.869
6	1.44	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.86	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.25	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.93	4.318
13	1.35	1.771	2.16	2.65	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.14
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.12	2.583	2.921	3.686	4.015
17	1.333	1.74	2.11	2.567	2.898	3.646	3.965
18	1.33	1.734	2.101	2.552	2.878	3.61	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.85
21	1.323	1.721	2.08	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.5	2.807	3.485	3.768
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.06	2.485	2.787	3.45	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.689
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.66
30	1.31	1.697	2.042	2.457	2.75	3.385	3.646
60	1.296	1.671	2	2.39	2.66	3.232	3.46
120	1.289	1.658	1.98	2.358	2.617	3.16	3.373
1000	1.282	1.646	1.962	2.33	2.581	3.098	3.3
Inf	1.282	1.645	1.96	2.326	2.576	3.091	3.291

H.W

Q1\ If the average increase in the wages of workers in one of the institutions in 2015 was 36 thousand dinars, and in 2017, a sample was taken from 64 individuals working in this institution, it was found that the arithmetic mean of the increase in their wages is 40 thousand dinars and the standard deviation 8 thousand . Does this indicate that The average increase in wages for employees of the establishment in 2017 differed from the average increase in wages in 2015, at a significant level of 0.05.

Q2\The director of a statistical studies company believes that the average monthly expenditure on food in the homes of an area is equal to 290 thousand dinars. If a random sample of 10 houses is taken, it turns out that its arithmetic mean is 296 thousand and its standard deviation is 5 thousand dinars. Is it possible to rely on this sample to confirm what he assumed. Use the 95% accuracy level.

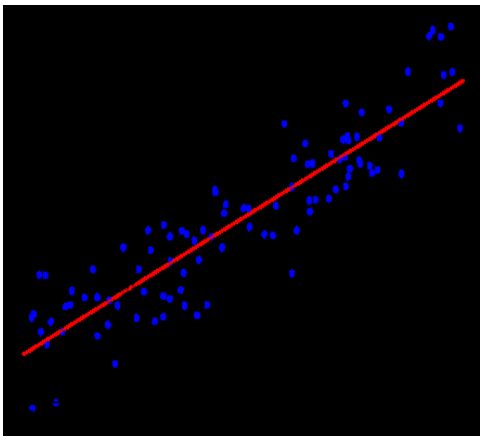
Time Series

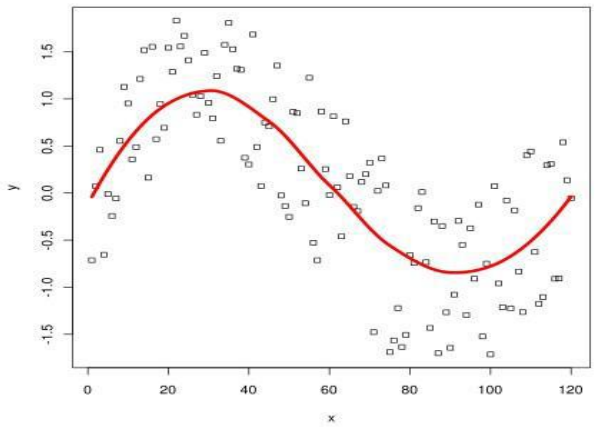
The time series for any phenomenon is a set of numbers resulting from tracking that phenomenon for a relatively long period of time. Then recording observations or data at regular intervals. The series depends on two variables, one independent and the other dependent.

Time series components

The four categories of the components of time series are:

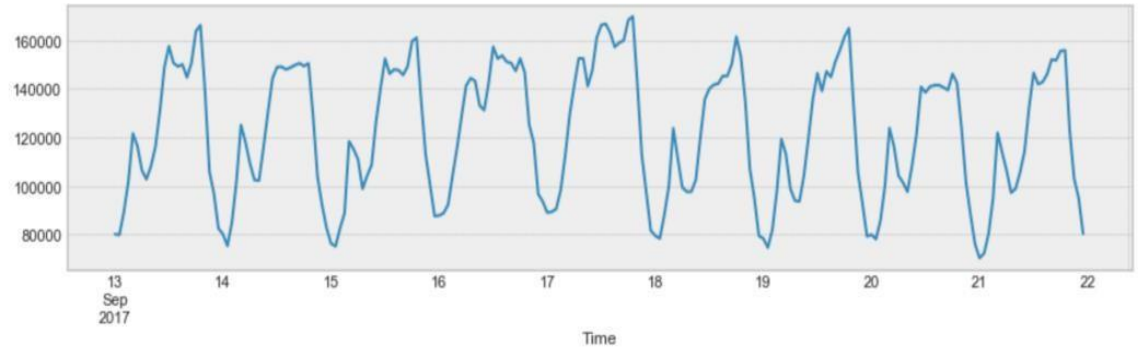
1-Trend*:* The general trend depends on long-term changes in time series, which are Reflect the amount of growth and development where the general trend line is positive, or reflect the amount of decrease, so it is the general trend line is negative. Rainfall, drought, the population, agricultural production, number of births and deaths, number of schools or colleges are some of its example showing some kind of tendencies of movement. The general trend can be in the form of a straight line (linear) or on the Curved shape (non-linear). It is preferable to study the general trend that the time series be large.





2- Seasonal Variations: These are the regular changes that affect the phenomenon during a period A maximum period of one year (12 months), For example Production of crops depends on seasons. the most important factors that cause these changes:
1- Climate and weather conditions.

2- Social customs and traditions.



3- Cyclic Variations: they are periodic movements around the general trend and they are not short-term changes. This oscillatory movement has a period of oscillation of more than a year. One complete period is a cycle. The cycles are not of fixed length – some last 8 or 9 years and others last longer than 10 years.

4- Random or Irregular Movements: these changes do not repeat regularly as in the seasonal and cyclical changes. These fluctuations are unforeseen, uncontrollable, unpredictable, and are erratic. These forces are earthquakes, wars, flood, and any other disasters.

Modeling time series:

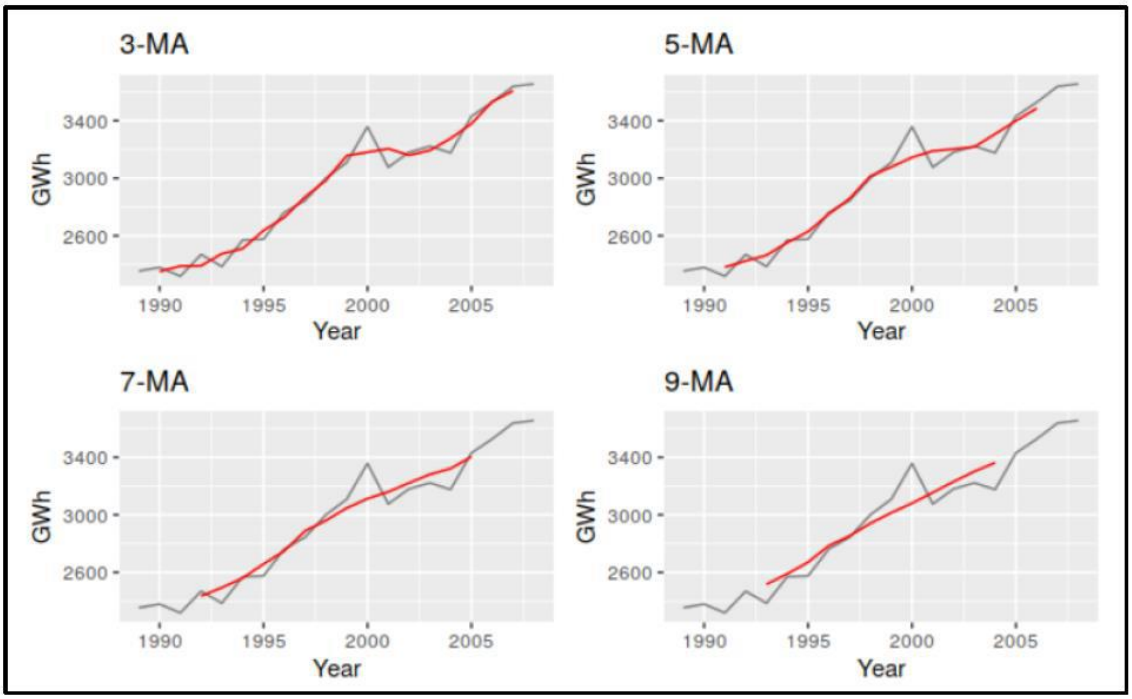
There are several methods of time series modeling to make forecasts:

1- Moving Average
2 – Exponential Smoothing
3 – ARIM

1-Moving Average Model:

A moving average is a model used to get a general idea of trends in a data set; That is, it is the average of any subset of numbers. A moving average is very useful for predicting long-term trends. It can also be calculated for any time period.

The mean value of a group of numbers is exactly the same moving average, but the average is computed multiple times for multiple subsets of data. For example, if you wanted a two-year moving average for a data set of 2000, 2001, 2002, and 2003, you would find averages for the 2000/2001, 2001/2002, and 2002/2003 subgroups. Moving averages are usually plotted and are better visualized.



Residential electricity sales represented by (the black line) with different moving averages applied to the data represented by (Red line).

For example // Calculate the five-year moving average for the data set given in the table below:

year	Rain (mm)
2003	40
2004	60
2005	50
2006	80
2007	90
2008	50
2009	40
2010	30
2011	70
2012	80

.

- First average: $= \frac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$

Moving Average(2003 – 2007) = $\frac{(40+60+50+80+90)}{5}$ = 64 *mm*

- Second average: $= \frac{X_2 + X_3 + X_4 + X_5 + X_6}{5}$

Moving Average(2004 – 2008) = $\frac{(60+50+80+90+50)}{5}$ = 66 *mm*

Moving Average(2005 – 2009) = $\frac{(50+80+90+50+40)}{5}$ = 62 *mm*

year	Rain (mm)	Moving Average
2003	40	
2004	60	
2005	50	64
2006	80	66
2007	90	62
2008	50	58
2009	40	56
2010	30	54
2011	70	
2012	80	

For example // Calculate the two-year moving average for the data set given in the table below:

year	T (C^O)
2005	5
2006	7
2007	12
2008	15
2009	21

H.W// Draw the general trend of the series and extract its annual average every 3 years.

year	1988	1989	1990	1991	1992	1993	1994
Rain (mm)	20	30	32	23	34	39	32