Model for Analysis of Energy Demand (MAED)

Hands-on 8: MAED-EL Input Data Preparation

Learning outcomes

By the end of this exercise you will be able to:

1) Account for demand growth within your base year

2) Calculate the seasonal coefficients for each week

3) Calculate the daily coefficients for each day of each week

4) Calculate the hourly coefficients for each day of each season

Activity 1: Seasonal coefficients

To calculate the modulating coefficients, you need hourly electricity demand data for the base year. For this hands-on session, we have provided a Microsoft Excel file with sample hourly demand data named *Base year load data.xlsx*. You can prepare your input data for MAED-el in the software of your choice, we have just chosen Excel for its simplicity and universality.

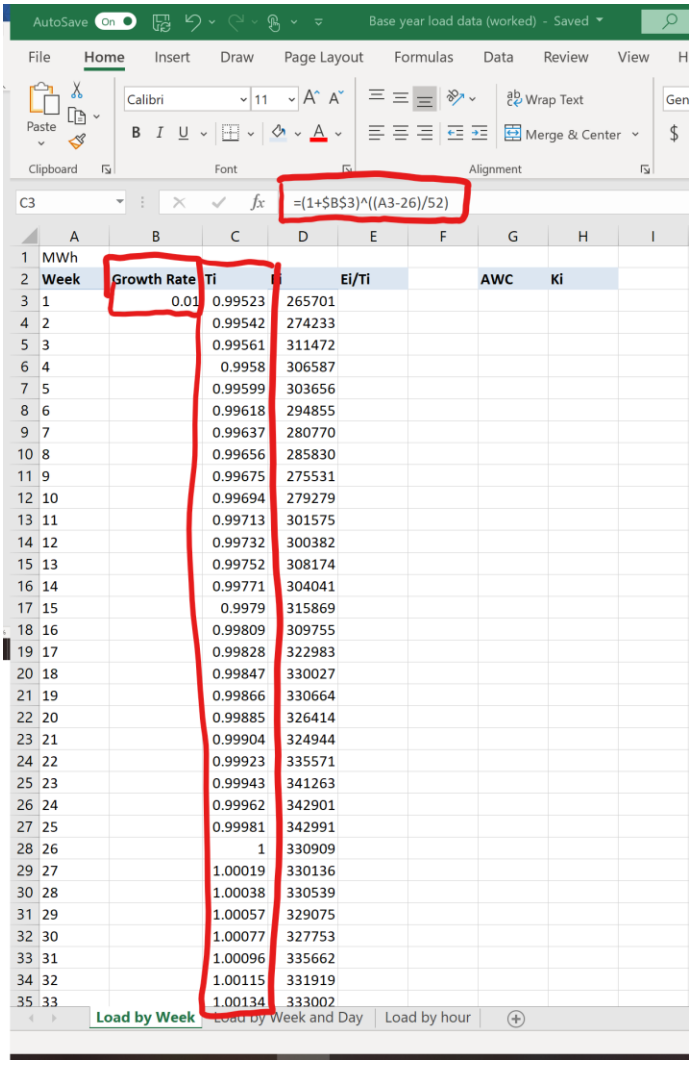
Follow this link to access the data file: https://zenodo.org/records/11242025

To calculate the seasonal coefficients, it is necessary to know the electricity demand growth rate, r, between the base year and the preceding year. Once this value is known, it is possible to calculate the growth trend deflator T for each week of the year, using the equation following equation:

$$T_i = (1 + \frac{r}{100})^{\frac{i-26}{52}}$$

Let us assume that the growth rate is 1%. In the "Load by Week" tab of the workbook, input this value in the growth rate column.

Then, use the equation above to calculate the growth trend deflator for each week in the column labelled T_i. Be sure to put a dollar sign in the formula before the row number of the growth rate r, so that the same value is used for the calculation in each row.

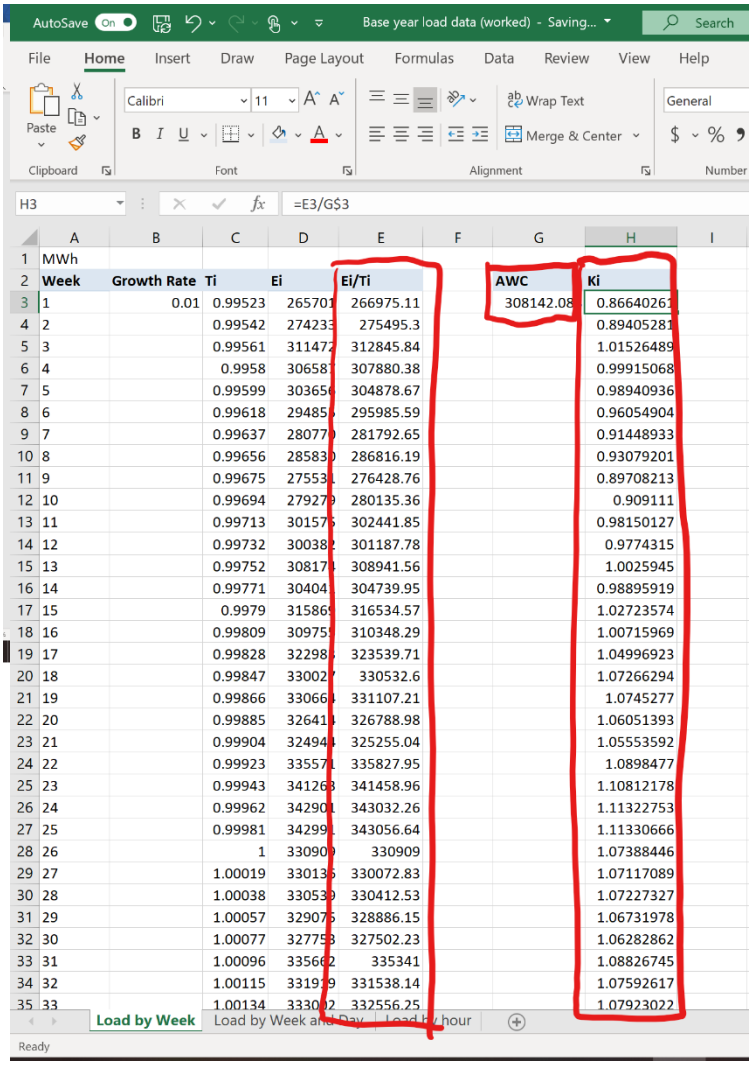


	A	B	C	D	E	F	G	H	I
1	MWh								
2	Week	Growth Rate	Ti	Ei	Ei/Ti		AWC	Ki	
3	1	0.01	0.99523	265701					
4	2		0.99542	274233					
5	3		0.99561	311472					
6	4		0.9958	306587					
7	5		0.99599	303656					
8	6		0.99618	294855					
9	7		0.99637	280770					
10	8		0.99656	285830					
11	9		0.99675	275531					
12	10		0.99694	279279					
13	11		0.99713	301575					
14	12		0.99732	300382					
15	13		0.99752	308174					
16	14		0.99771	304041					
17	15		0.9979	315869					
18	16		0.99809	309755					
19	17		0.99828	322983					
20	18		0.99847	330027					
21	19		0.99866	330664					
22	20		0.99885	326414					
23	21		0.99904	324944					
24	22		0.99923	335571					
25	23		0.99943	341263					
26	24		0.99962	342901					
27	25		0.99981	342991					
28	26		1	330909					
29	27		1.00019	330136					
30	28		1.00038	330539					
31	29		1.00057	329075					
32	30		1.00077	327753					
33	31		1.00096	335662					
34	32		1.00115	331919					
35	33		1.00134	333002					

The second step is to calculate the seasonal coefficients. To do so, the electricity demand for each week "Ei" should be divided by the corresponding growth trend deflator Ti.

Then find the average weekly consumption (AWC). This is the sum of all the new values for weekly electricity demand "Ei/Ti", divided by 53, the total number of weeks in the study.

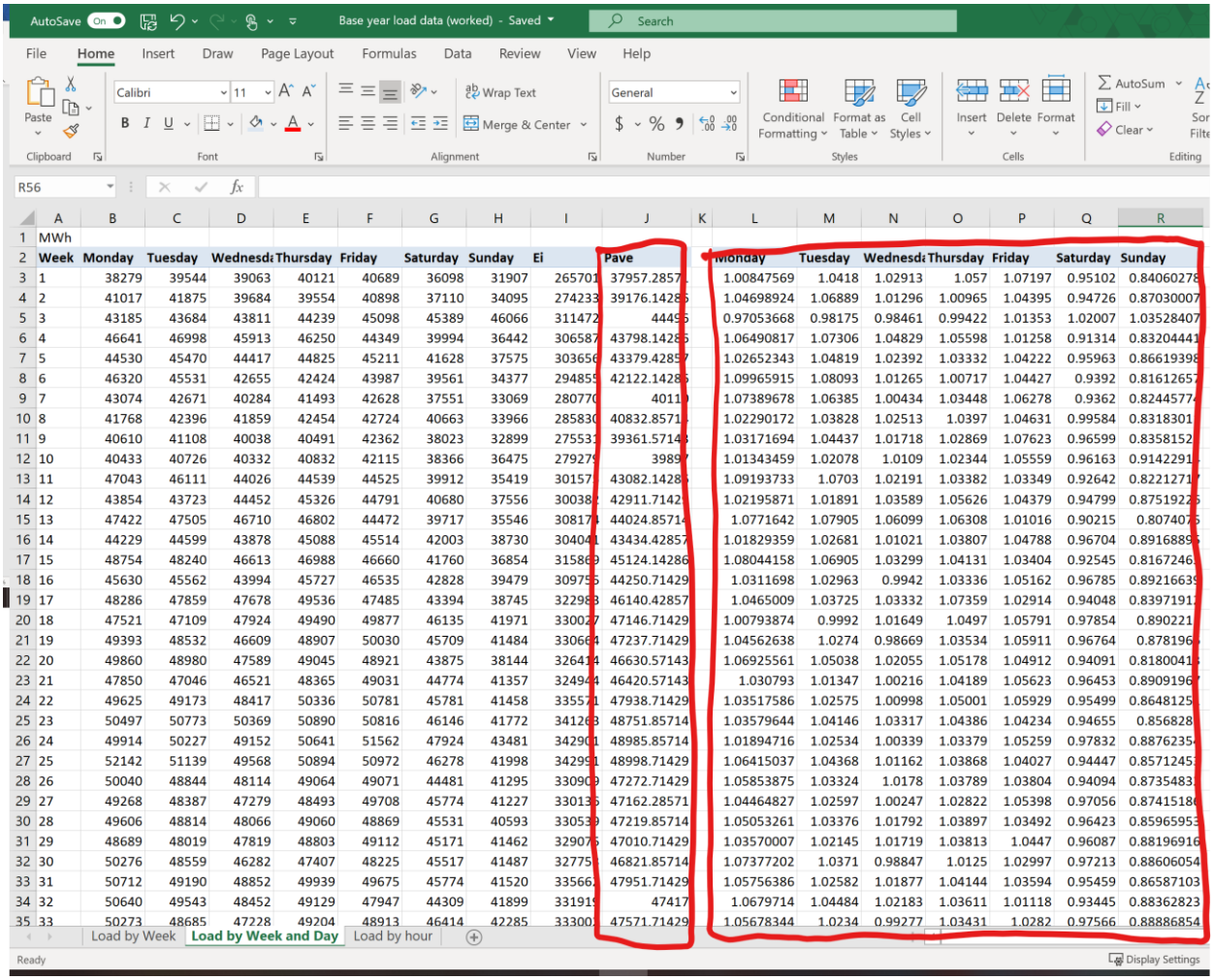
Next, calculate the seasonal coefficients “Ki” as the weekly electricity demand without the growth trend “Ei/Ti”, divided by the average weekly consumption “AWC”. You should calculate 53 values.



Activity 2: Daily coefficients

Now go to the “Load by Week and Day” tab of the workbook. First, calculate the average daily consumption in each week, “Pave”, as the sum of the electricity consumption in the week, given in the column “Ei”, divided by 7, the number of days in a week.

The daily coefficients are obtained by dividing the electricity consumption for each day by the average daily consumption for the corresponding week.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	MWh																	
2	Week	Monday	Tuesday	Wednesda	Thursday	Friday	Saturday	Sunday	Ei	Pave		Monday	Tuesday	Wednesda	Thursday	Friday	Saturday	Sunday
3	1	38279	39544	39063	40121	40689	36098	31907	265701	37957.2857		1.00847569	1.0418	1.02913	1.057	1.07197	0.95102	0.84060278
4	2	41017	41875	39684	39554	40898	37110	34095	274233	39176.1428		1.04698924	1.06889	1.01296	1.00965	1.04395	0.94726	0.87030007
5	3	43185	43684	43811	44239	45098	45389	46066	311472	44496		0.97053668	0.98175	0.98461	0.99422	1.01353	1.02007	1.03528407
6	4	46641	46998	45913	46250	44349	39994	36442	306587	43798.1428		1.06490817	1.07306	1.04829	1.05598	1.01258	0.91314	0.83204441
7	5	44530	45470	44417	44825	45211	41628	37575	303656	43379.4285		1.02652343	1.04819	1.02392	1.03332	1.04222	0.95963	0.86619398
8	6	46320	45531	42655	42424	43987	39561	34377	294855	42122.1428		1.09965915	1.08093	1.01265	1.00717	1.04427	0.9392	0.81612657
9	7	43074	42671	40284	41493	42628	37551	33069	280770	40110		1.07389678	1.06385	1.00434	1.03448	1.06278	0.9362	0.82445774
10	8	41768	42396	41859	42454	42724	40663	33966	285830	40832.8571		1.02290172	1.03828	1.02513	1.0397	1.04631	0.99584	0.8318301
11	9	40610	41108	40038	40491	42362	38023	32899	275531	39361.5714		1.03171694	1.04437	1.01718	1.02869	1.07623	0.96599	0.83581525
12	10	40433	40726	40332	40832	42115	38366	36475	279279	39897		1.01343459	1.02078	1.0109	1.02344	1.05559	0.96163	0.91422915
13	11	47043	46111	44026	44539	44525	39912	35419	30157	43082.1428		1.09193733	1.0703	1.02191	1.03382	1.03349	0.92642	0.82212717
14	12	43854	43723	44452	45326	44791	40680	37556	300382	42911.7142		1.02195871	1.01891	1.03589	1.05626	1.04379	0.94799	0.87519226
15	13	47422	47505	46710	46802	44472	39717	35546	308171	44024.8571		1.0771642	1.07905	1.06099	1.06308	1.01016	0.90215	0.8074076
16	14	44229	44599	43878	45088	45514	42003	38730	304041	43434.4285		1.01829359	1.02681	1.01021	1.03807	1.04788	0.96704	0.89168895
17	15	48754	48240	46613	46988	46660	41760	36854	315869	45124.1428		1.08044158	1.06905	1.03299	1.04131	1.03404	0.92545	0.81672461
18	16	45630	45562	43994	45727	46535	42828	39479	309755	44250.7142		1.0311698	1.02963	0.9942	1.03336	1.05162	0.96785	0.89216639
19	17	48286	47859	47678	49536	47485	43394	38745	322983	46140.4285		1.0465009	1.03725	1.03332	1.07359	1.02914	0.94048	0.83971917
20	18	47521	47109	47924	49490	49877	46135	41971	330027	47146.7142		1.00793874	0.9992	1.01649	1.0497	1.05791	0.97854	0.890221
21	19	49393	48532	46609	48907	50030	45709	41484	330664	47237.7142		1.04562638	1.0274	0.98669	1.03534	1.05911	0.96764	0.87819648
22	20	49860	48980	47589	49045	48921	43875	38144	326414	46630.5714		1.06925561	1.05038	1.02055	1.05178	1.04912	0.94091	0.81800413
23	21	47850	47046	46521	48365	49031	44774	41357	324944	46420.5714		1.030793	1.01347	1.00216	1.04189	1.05623	0.96453	0.89091967
24	22	49625	49173	48417	50336	50781	45781	41458	335571	47938.7142		1.03517586	1.02575	1.00998	1.05001	1.05929	0.95499	0.86481257
25	23	50497	50773	50369	50890	50816	46146	41772	341268	48751.8571		1.03579644	1.04146	1.03317	1.04386	1.04234	0.94655	0.8568287
26	24	49914	50227	49152	50641	51562	47924	43481	342901	48985.8571		1.01894716	1.02534	1.00339	1.03379	1.05259	0.97832	0.88762354
27	25	52142	51139	49568	50894	50972	46278	41998	342991	48998.7142		1.06415037	1.04368	1.01162	1.03868	1.04027	0.94447	0.85712451
28	26	50040	48844	48114	49064	49071	44481	41295	330909	47272.7142		1.05853875	1.03324	1.0178	1.03789	1.03804	0.94094	0.87354833
29	27	49268	48387	47279	48493	49708	45774	41227	330136	47162.2857		1.04464827	1.02597	1.00247	1.02822	1.05398	0.97056	0.87415186
30	28	49606	48814	48066	49060	48869	45531	40593	330539	47219.8571		1.05053261	1.03376	1.01792	1.03897	1.03492	0.96423	0.85965953
31	29	48689	48019	47819	48803	49112	45171	41462	329076	47010.7142		1.03570007	1.02145	1.01719	1.03813	1.0447	0.96087	0.88196916
32	30	50276	48559	46282	47407	48225	45517	41487	327751	46821.8571		1.07377202	1.0371	0.98847	1.0125	1.02997	0.97213	0.88606054
33	31	50712	49190	48852	49939	49675	45774	41520	335662	47951.7142		1.05756386	1.02582	1.01877	1.04144	1.03594	0.95459	0.86587103
34	32	50640	49543	48452	49129	47947	44309	41899	331919	47417		1.0679714	1.04484	1.02183	1.03611	1.01118	0.93445	0.88362823
35	33	50273	48685	47228	49204	48913	46414	42285	333001	47571.7142		1.05678344	1.0234	0.99277	1.03431	1.0282	0.97566	0.88886854

Activity 3: Hourly coefficients

The hourly coefficients are calculated for each type of day (e.g. Monday, Tuesday) in each season for each sector or client, if available. For example, let us assume that we have identified the following three seasons using monthly consumption data:

- Season 1: From January 1st to March 30th

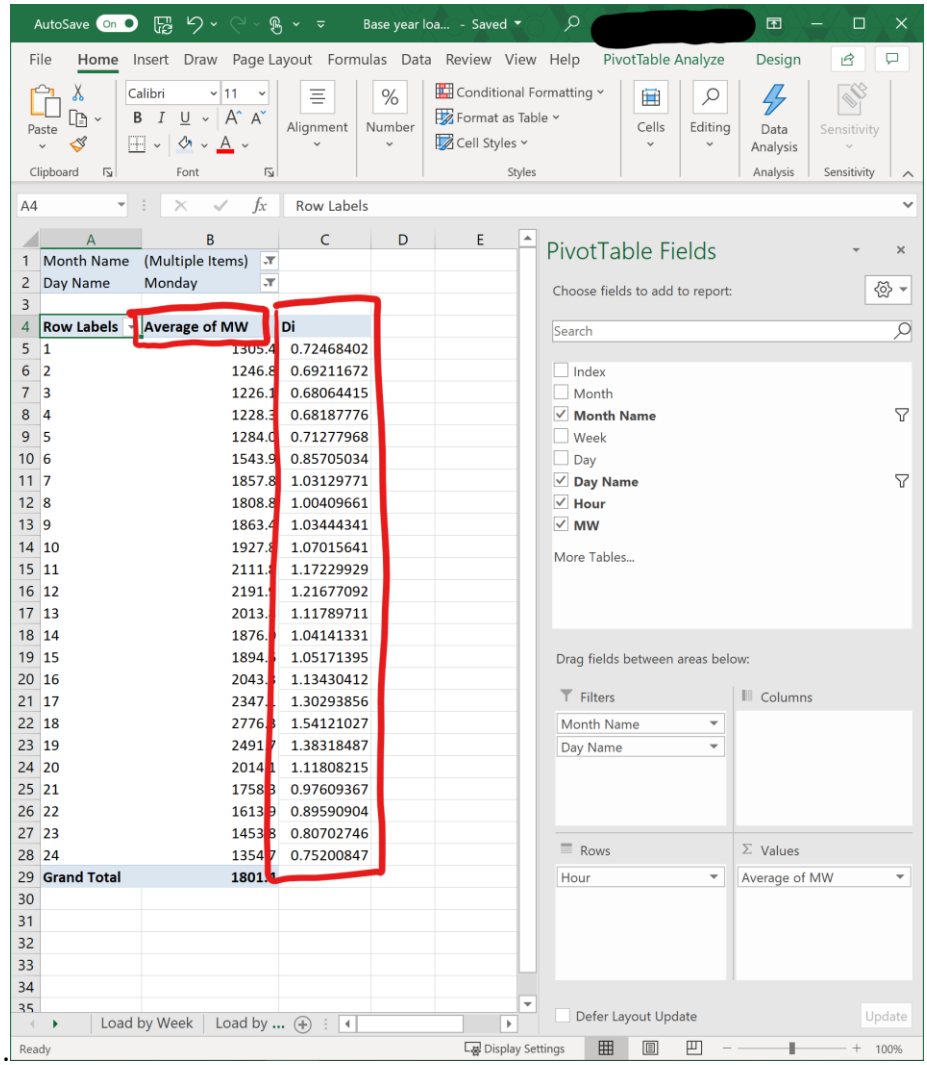
- Season 2: From April 1st to October 31st
- Season 3: From November 1st to December 31st

Let us focus on Mondays in Season 3, during November and December. We assume that the hourly demand in the "Load by hour" tab of the workbook is the demand of a hypothetical sector without any clients, so the whole sector is modelled as a single client.

To calculate the hourly coefficients for Mondays, we first find the average demand for each hour over the season. Using the pivot table feature in the "Insert" tab of Excel, we can use the data in the "Load by hour" tab to create a table with the average electricity demand for each of the 24 hours in every Monday in November and December.

We also need to calculate the average hourly demand as the sum of all electricity demand for each Monday divided by 24, the total number of hours in a day. Conveniently, this value appears in the bottom of the pivot table in the row labelled "Grand Total."

To find the hourly coefficients for each hour, we divide the average demand for that hour by the average demand for all hours in that day in that season, which is in the "Grand Total" row. This technique is used to calculate the hourly coefficients for each hour of Monday in Season 3.



To calculate the input data for MAED-EL, these steps would have to be repeated for each day of the week in every season, for each client in each sector. Thus, you need data on the hourly demand for at least each sector you wish to model in the base year and the reference years of the study period. Because typically reference years have not happened yet, these data represent your scenario assumptions.