

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.

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.

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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.

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1	MWh	-	_			_				
2	Week	Growth	Rate Ti		E	i/Ti		AWC	кі	
3	1	9	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			_	0.99885	326414					
23			_	0.99904	324944					
24	22			0.99923	335571					
25	23			0.99943	341263					
	24		_	0.99962	342901					
	25			0.99981	342991					
	26		_	1	330909					
	27		_	1.00019	330136					
	28		_	1.00038	330539					
31	29			1.00057	329075					
			_	1.00077	327753					
	31		_	1.00096	335662					
	32			1.00115	331919					
	33) L	oad by W		1.00134	333002 Week and D		d hu hau	r (+)		

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.

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2	Week	Growth Rate	ті	Ei	Ei/Ti		AWC	кі		
3	1	0.01	0.99523	265701	266975.11		308142.08	0.866402	61	
4	2		0.99542	274233	275495.3			0.894052	81	
5	3		0.99561	311472	312845.84			1.015264	89	
6	4		0.9958	30658	307880.38			0.999150	68	
7	5		0.99599	30365	304878.67			0.989409	36	
8	6		0.99618	29485	295985.59			0.960549	04	
9	7		0.99637	28077	281792.65			0.914489	33	
10	8		0.99656	28583	286816.19			0.930792	01	
11	9		0.99675	27553	276428.76			0.897082	13	
12	10		0.99694	27927	280135.36			0.9091	.11	
13	11		0.99713	30157	302441.85			0.981501	.27	
14	12		0.99732	30038	301187.78			0.97743	15	
15	13		0.99752	30817	308941.56			1.00259	45	
16	14		0.99771	30404	304739.95			0.988959	19	
17	15		0.9979	31586	316534.57			1.027235	74	
18	16		0.99809	30975	310348.29			1.007159	69	
19	17		0.99828	32298	323539.71			1.049969	23	
20	18		0.99847	33002	330532.6			1.072662	.94	
21	19		0.99866	33066	331107.21			1.07452	77	
22	20		0.99885	32641	326788.98			1.060513	93	
23	21		0.99904	32494	325255.04			1.055535	92	
	22		0.99923	33557	335827.95			1.08984	77	
25			0.99943		341458.96			1.108121	.78	
26	24		0.99962	34290	343032.26			1.113227	53	
27	25		0.99981		343056.64			1.113306	66	
	26		1		330909			1.073884	46	
29	27		1.00019	33013	330072.83			1.071170	89	
30	28		1.00038	33053	330412.53			1.072273	27	
31	29		1.00057					1.067319		
	30		1.00077					1.062828	_	
33	31		1.00096	335662	335341			1.088267	45	

Activity 2: Daily coefficients

1.00134 33 Load by Week Load by Week

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35 33

Ready

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.

1.00115 3319:9 331538.14

332556.25

3330 2

1.07592617

1.07923022

+

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



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3 1		38279	39544	39063	40121	40689	36098	31907	265701			1.00847569	1.0418	1.02913	1.057	1.07197		
2		41017	41875	39684	39554		37110	34095	274233	-	-	1.04698924	1.06889	1.01296	1.00965	1.04395		
3		43185	43684	43811	44239		45389	46066				0.97053668	0.98175	0.98461	0.99422			
5		46641	46998	45913	46250		39994	36442		43798.1428		1.06490817	1.07306	1.04829	1.05598			
5		44530 46320	45470 45531	44417 42655	44825 42424		41628 39561	37575 34377	303656 294855	43379.4285		1.02652343 1.09965915	1.04819 1.08093	1.02392 1.01265	1.03332		0.95963	
7		48320	43531	42655	42424		37551	34377		42122.1428		1.07389678	1.06385	1.00283	1.03448			
) 8		41768	42396	41859	42454		40663	33966		40832.8571		1.02290172	1.03828	1.02513	1.03448	1.04631		
9		40610	41108	40038	40491		38023	32899		39361.5714		1.03171694	1.04437	1.01718	1.02869	1.07623		
1		40433	40726	40332	40832		38366	36475		3989		1.01343459	1.02078	1.0109	1.02344	1.05559		
3 1	11	47043	46111	44026	44539	44525	39912	35419	30157	43082.1428		1.09193733	1.0703	1.02191	1.03382	1.03349	0.92642	0.822127
1 1	12	43854	43723	44452	45326	44791	40680	37556	30038	42911.7142		1.02195871	1.01891	1.03589	1.05626	1.04379	0.94799	0.875192
5 1	13	47422	47505	46710	46802	44472	39717	35546	30817	44024.85714		1.0771642	1.07905	1.06099	1.06308	1.01016	0.90215	0.80740
5 1	14	44229	44599	43878	45088	45514	42003	38730	30404	43434.42857		1.01829359	1.02681	1.01021	1.03807	1.04788	0.96704	0.891688
1	15	48754	48240	46613	46988	46660	41760	36854	31586	9 45124.14286		1.08044158	1.06905	1.03299	1.04131	1.03404	0.92545	0.816724
3 1	16	45630	45562	43994	45727	46535	42828	39479	30975	5 44250.71429		1.0311698	1.02963	0.9942	1.03336	1.05162	0.96785	0.892166
9 1	17	48286	47859	47678	49536	47485	43394	38745	32298	3 46140.42857		1.0465009	1.03725	1.03332	1.07359	1.02914	0.94048	0.839719
) 1	18	47521	47109	47924	49490	49877	46135	41971	33002	47146.71429		1.00793874	0.9992	1.01649	1.0497	1.05791	0.97854	0.89022
1		49393	48532	46609	48907		45709	41484	33066			1.04562638	1.0274	0.98669	1.03534	1.05911		0.87819
2 2		49860	48980	47589	49045		43875	38144				1.06925561	1.05038	1.02055	1.05178			
32		47850	47046	46521	48365		44774	41357	32494			1.030793	1.01347	1.00216	1.04189			
12		49625	49173	48417	50336		45781	41458				1.03517586	1.02575	1.00998	1.05001	1.05929	0.95499	
5 2 5 2		50497 49914	50773 50227	50369 49152	50890 50641		46146 47924	41772 43481	34126 34290			1.03579644 1.01894716	1.04146 1.02534	1.03317 1.00339	1.04386	1.04234		0.85682
7 2		52142	50227	49152	50641		4/924 46278	43481		48985.85714 48998.71429		1.01894716	1.02534	1.00339	1.03379		0.97832	0.887623
3 2		52142	48844	49568	49064		46278	41998				1.05853875	1.03324	1.01162	1.03868	1.04027	0.94447	
2		49268	48387	47279	49004		44481	41293	33013	47162.28571		1.04464827	1.03524	1.00247	1.02822			
) 2		49606	48814	48066	49060		45531	40593		47219.85714		1.05053261	1.03376	1.01792	1.02822	1.03492		0.859659
2		48689	48019	47819	48803		45171	41462		47010.71429		1.03570007	1.02145	1.01719	1.03813	1.0447	0.96087	0.881969
3		50276	48559	46282	47407		45517	41487	32775	46821.85714		1.07377202	1.0371	0.98847	1.0125	1.02997	0.97213	
3 3		50712	49190	48852	49939		45774	41520		47951.71429		1.05756386	1.02582	1.01877	1.04144			
4 3	32	50640	49543	48452	49129	47947	44309	41899	33191	47417		1.0679714	1.04484	1.02183	1.03611	1.01118	0.93445	0.883628
5 3	33	50273	48685	47228	49204	48913	46414	42285	33300	47571.71429		1.05678344	1.0234	0.99277	1.03431	1.0282	0.97566	0.888868
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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.



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5 1	1305.4	0.72468402			
6 2	1246.8	0.69211672		Index	
7 3	1226.1	0.68064415		Month	5
8 4	1228.3	0.68187776		✓ Month Name	2
9 5 10 6	1284.0	0.71277968 0.85705034		Week	
10 6 11 7	1543.9 1857.8	1.03129771		Day	5
12 8	1808.8	1.00409661		 ✓ Day Name ✓ Hour 	
13 9	1863.4	1.03444341		✓ Hour ✓ MW	
14 10	1927.8	1.07015641			
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24 20	2014	1.11808215			
25 21	1758	0.97609367			
26 22	1613	0.89590904			
27 23	1453	0.80702746			
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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.