Ranking index for leadership in the world

Bennour Mohamed Hsin

Introduction

In this report we will be treating the data of the GLOBE initiative, on National Culture, Societal Effectiveness and Desirable Leadership Attributes, to create an index that ranks the countries. Many factors of culture, affect the leadership in a country, in the GLOBE study, various decompositions have been made in order to treat these factors. Using different categories of traits we have :

Charismatic/Value-Based Leadership:

Reflects the ability to inspire, motivate, and expect high performance outcomes from others based on firmly held core values. It includes the following six primary leadership dimensions: (a) visionary, (b) inspirational, (c) self-sacrifice, (d) integrity, (e) decisive and (f) performance oriented.

Team-Oriented Leadership:

Emphasizes effective team building and implementation of a common purpose or goal among team members. It includes the following five primary leadership dimensions: (a) collaborative team orientation, (b) team integrator, (c) diplomatic, (d) malevolent (reverse scored), and (e) administratively competent.

Participative Leadership:

Reflects the degree to which managers involve others in making and implementing decisions. It includes two primary leadership dimensions labeled (a) nonparticipative and (b) autocratic (both reverse scored).

Humane-Oriented Leadership:

Reflects supportive and considerate leadership and includes compassion and generosity. This leadership dimension includes two primary leadership dimensions labeled (a) modesty and (b) humane orientation.

Autonomous Leadership:

Refers to independent and individualistic leadership attributes. It is measured by a single primary leadership dimension labeled autonomous leadership, consisting of individualistic, independence, autonomous, and unique attributes.

Self-Protective Leadership:

Focuses on ensuring the safety and security of the individual and group through status enhancement and face saving. It includes five primary leadership dimensions labeled (a) self-centered, (b) status conscious, (c) conflict inducer, (d) face saver, and (e) procedural.

Source

Data Source

Data

After some preprocessing and cleaning, we ended up with table(see below) with some specific attributes. We have chosen these attributes precisely to validate the mutual utility independance between each subattribute. The Idea can be seen in the table below

country	vision_1	inspiration_1	self_sacrifice_1	collaboration_2	integration_2	competence_2
England	0.8457447	0.8490566	0.4577114	0.5449102	0.8841202	0.4338624
Costa Rica	0.7659574	0.6666667	0.8407960	0.7904192	0.8369099	0.7037037
Italy	0.8617021	0.6918239	0.6069652	0.6646707	0.8755365	0.6137566
India	0.7446809	0.5597484	0.7313433	0.6526946	0.7424893	0.7671958
Namibia	0.8191489	0.7672956	0.4029851	0.6227545	0.8369099	0.6825397
Czech Republic	0.6861702	0.6226415	0.8656716	0.5988024	0.6609442	0.8518519

participation_3	autocracy_3	autonomy_4	self_centered_5	conflict_inducer_5
0.7371429	0.3350254	0.6932773	0.2096774	0.1718750
0.6514286	0.2893401	0.5000000	0.2204301	0.5625000
0.6742857	0.3807107	0.5672269	0.2473118	0.3020833
0.3885714	0.6142132	0.6638655	0.5806452	0.5989583
0.6514286	0.3502538	0.6302521	0.3118280	0.3854167
0.7714286	0.0761421	1.0000000	0.3763441	0.6822917

As specified in the introduction, the study provides groups of attributes that describe the cultural, societal, and efficiency of political leadership around the world.

Our whoice was as follows :

Attribute 1 : Charisma

- Vision of leadership: charismatic_1_visionary
- Inspirational leadership: charismatic_2_inspirational
- Self sacrificing leeadership: charismatic_3_self_sacrifice

Attribute 2 : Team player

- Collaboration oriented leadershib: eam_1_collaborative_team_orientation
- Integrating leadership: team_2_team_integrator
- Compentent leadership: administratively_competent

Attribute 3 : Participation

- Participative leadership: participative
- Autocratic leadership: autocratic

Attribute 4 : Protection

- Self centered and narrowed leadership: self_centred
- Conflict inducing leadership: internally_competitive_originally_labeled_conflict_inducer

Attribute 5 : Autonomy(no subattributes)

- Autonomous independent leadership: autonomous

Again, as we have chosen this attribute and sub attributes, many others have been discarded because of the mutual utility independace to be validated. Moreover as the assyption is validated, we can use the multiplactive form of the multi attribute utility function.

SAUFs

Validating the MUI, is not enough to create the multi-attribute utility function, in fact, we will need to proceed with the Keeny and Raiffa 5 points. The idea is to determine the values of the attributes from the signle attribute utility function, when the latter is equal to 0, 0.25, 0.5, 0.75, and 1.

This is done by determining the x from which we are indifferent between uncertain lottery, containing the extreem values of the attribute i, and a certain lottery containing the infamous x.

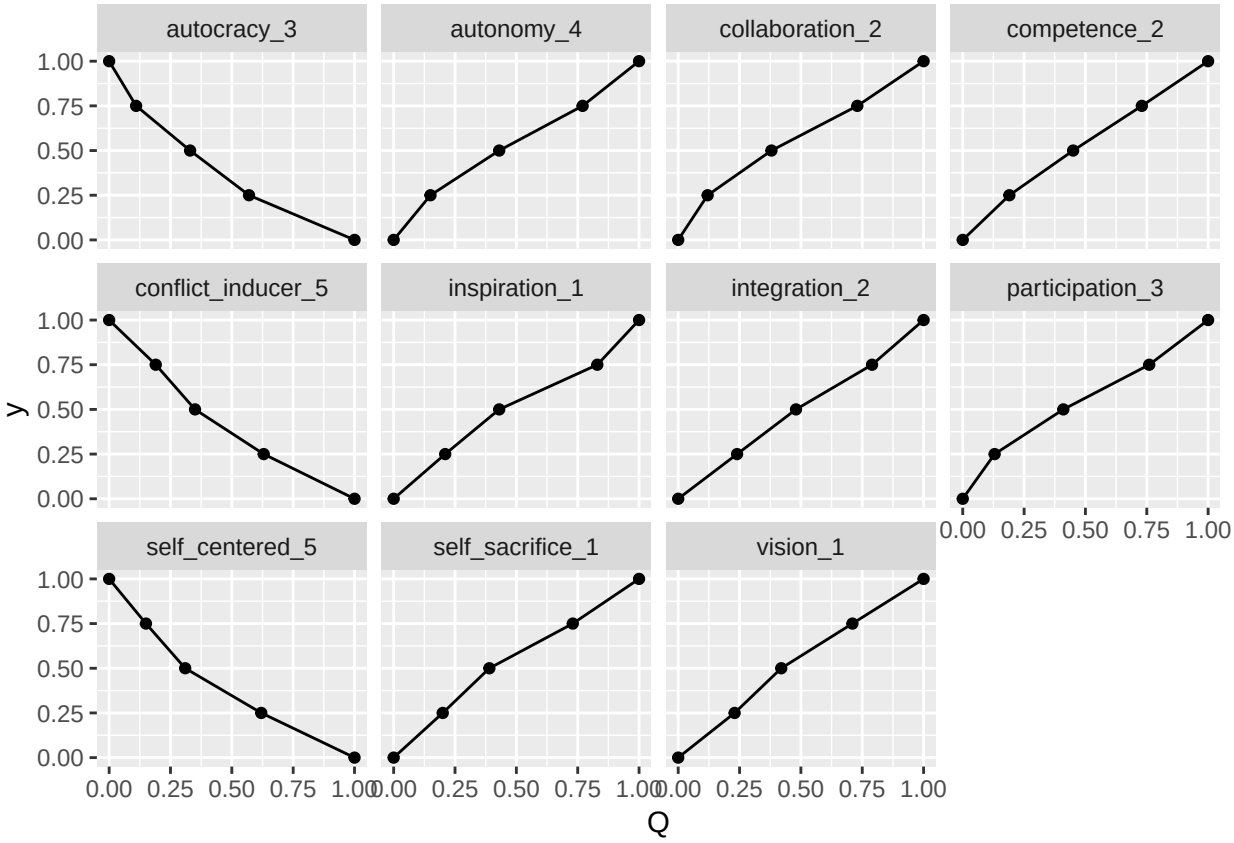
In few iterations we could come up with this table:

Q	vision_1	inspiration_1	self_sacrifice_1	collaboration_2	integration_2	competence_2
min	0.00	0.00	0.00	0.00	0.00	0.00
q25	0.23	0.21	0.20	0.12	0.24	0.19
q50	0.42	0.43	0.39	0.38	0.48	0.45
q75	0.71	0.83	0.73	0.73	0.79	0.73
max	1.00	1.00	1.00	1.00	1.00	1.00

competence_2	participation_3	autonomy_4	self_centered_5	autocracy_3	conflict_inducer_5
0.00	0.00	0.00	1.00	1.00	1.00
0.19	0.13	0.15	0.62	0.57	0.63
0.45	0.41	0.43	0.31	0.33	0.35
0.73	0.76	0.77	0.15	0.11	0.19
1.00	1.00	1.00	0.00	0.00	0.00

These Points will give us an idea on the way our SAUFs are going to be fitted, after using LMFIT with python, the following equation satisfied a minimum fitting error, you can also observe the plots:

Notice that we haven't smouthed the connection between the points, however, this has no lin to the fitted curves



It is to note that :

- Not all attributes are of preference to the decision maker.
- For example a DM would prefer a country with a participative leadership, than one with autocratic leadership.
- An immigrant would appreciate attributes of team playing and integration.

To fit these points, we have chosen to optimize this equation form, and it turned out it gives us a minimal fitting error and it keep up with linear relations, this was the result of various iteration of trial and error.

$$U_i = a + bx + ce^{dx+e}$$

In this table we can summarize the output of the optimization process and outlay the parameters.

X1	vision_1	inspiration_1	self_sacrifice_1	collaboration_2	integration_2	competence_2
a	0.0276038	151.665064	185.014144	233.3021194	38.3187141	104.4807591
b	1.0008394	8.346792	12.158480	14.0815772	2.3360482	7.3898526
c	92.4743082	-13.672052	-10.667467	-18.5071970	-6.8218747	-11.3906459
d	1.3174223	0.047670	0.058673	0.0548395	0.0348372	0.0595541
e	-93.5814657	2.406223	2.853197	2.5339807	1.7256398	2.2160867

participation_3	autonomy_4	self_centered_5	autocracy_3	conflict_inducer_5
197.5518122	166.4858378	-263.2930473	-221.8082449	-106.4172782
11.2335123	9.4016068	-20.4594048	-19.3455724	-12.3382087
-15.9474366	-14.5144419	15.8734446	14.5914416	10.2058881
0.0508475	0.0495829	0.0711283	0.0792685	0.1003118
2.5164822	2.4395564	2.8123589	2.7257456	2.3538045

vision_1:

$$U_{11}(x) = 0.0276038 + 1.0008394x + 92.4743082e^{1.3174223x - 93.5874657}$$

inspiration_1:

$$U_{12} = 151.665064 + 8.346792x - 13.672053e^{0.047670x + 2.406223}$$

self_sacrifice_1:

$$U_{13} = 185.014144 + 12.158480x - 10.667467e^{0.058673x + 2.853197}$$

collaboration_2:

$$U_{21} = 233.302119 + 14.081577x - 18.507197e^{0.054840x + 2.533981}$$

integration_2:

$$U_{22} = 38.318714 + 2.336048x - 6.821875e^{0.034837x + 1.725640}$$

competnec_2:

$$U_{23} = 104.480759 + 7.389853x - 11.390646e^{0.059554x + 2.216087}$$

participation_3:

$$U_{31} = 197.551812 + 11.233512x - 15.947437e^{0.050848x + 2.516482}$$

autocracy_3:

$$U_{32} = -221.808245 - 19.345572x + 14.591442e^{0.079268x + 2.725746}$$

autonomy_4:

$$U_4 = 166.485838 + 9.401607x - 14.514442e^{0.049583 + 2.439556}$$

self_centered_5:

$$U_{51} = -263.293047 - 20.459405x + 15.873445e^{0.071128x+2.812359}$$

conflict_inducer_5:

$$U_{52} = -106.417278 - 12.338209x + 10.205888e^{0.100312x+2.353804}$$

In a seperate folder, I will be uploading the graphs of the given fitted curves with the parameters presentd above, plus R and Python code that has been used to generate all of this.

Multi-Attribute Utility functions

Now we have our SAUFs, the parameters, and basically all the ingridiant to get our attributes utility function. In addition to that it is to note that as specified in the paragraph regarding the data, our cleaning and feature selection depended on the validation of The MUI, which would allow us to use the multiplacative form of the utility function.

The form of the multiplicative form is known as :

To get the final function we need to define the scaling constants k_{1i}, i denoting the subattribute $i \in [1..3]$, and to do that we need to review the meaning behind these constants.

In fact, enven though they are named constants they actually denote the probability for which a decision maker is indifferent between the uncertain lottery containing extreem values of the sub-attributes $(x^*_{11}, x^*_{12}, x^*_{13}) and (x^0_{11}, x^0_{12}*, x^0_{13}*)$, and the certain lottery in which we have the sub-attribute in regard in it's best value, while the rest of the sub-attributes are in the worst value possible in their domain $(x^*_{11}, x^0_{12}, x^0_{13})$.

This process is rpeated for each sub-attribute in each group, untill we have all of the k_i for each attribute.

We can summarize this work in the following table:

sub-attributes	ks
vision_1	0.42
inspiration_1	0.53
self_sacrifice_1	0.52
collaboration_2	0.67
integration_2	0.71
competence_2	0.87
participation_3	0.86
autonomy_4	1.00
self_centered_5	0.48
autocracy_3	0.22
conflict_inducer_5	0.39

Note that autonomy_4 is assigne 1 as it's scaling constant, that is because this attribute has no subattribute

MAUF (*eg:charisma*)

We will propose the case of the charisma attribute as an example, as the work is a repetitive task which we will automatise with a program.

The subattributes are :

- vision_1 (x_{11} for simplicity)
- inspiration_1 (x_{12} for simplicity)
- self_sacrifice_1 (x_{13} for simplicity)

To form it we need to define the following function based on the multiplicative form:

$$kU_1(x_{11}, x_{12}, x_{13}) + 1 = (kk_{11}U(x_{11}) + 1)(kk_{12}U(x_{12}) + 1)(kk_{13}U(x_{13}) + 1)$$

After running the program and doing all calculations this is the results we found: *Notice we did not add the autonomy attribute as it is involved in a later stage, and not concerned by this one*

sub_att	K
charisma	-0.745
team-orientation	-0.985
participation	-0.422
protection	0.694

Now that we ahve everything inplace, here we will provide the equations of each attribute, we need to proceed with determining the quadratic form for each attribute with the given order.

MAUF of charisma:

$$U_1(x_{11}, x_{12}, x_{13}) = -1.3422(-0.3129U(x_{11}) + 1)(-0.394U(x_{12}) + 1)(-0.3874U(x_{13}) + 1) + 1.3422$$

MAUF of team-orientation

$$U_2(x_{21}, x_{22}, x_{23}) = -1.01522(-0.65995U_{21}(x_{21}) + 1)(-0.6993U_{22}(x_{22}) + 1)(0.8569U_{23}(x_{23}) + 1) + 1.01522$$

MAUF of participation

$$U_3(x_{31}, x_{32}) = -2.3696(-0.36291U_{31}(x_{31}) + 1)(-0.0928U_{32}(x_{32}) + 1) + 2.3696$$

MAUF of protection

$$U_5(x_{51}, x_{52}) = 1.44092((0.3331U_{51}(x_{51}) + 1)(0.27066U_{32}(x_{32}) + 1) - 1)$$

The Big finale: creating the final index.

After determining the SAUF, and MUAF, we now need to combine the previous steps by creating the index we'd like to use later to classify the original data set. to do this we need to find the k_i and K that satisfy this relation with the same manner proceeded previously :

$$KI(U_1, U_2, U_3, U_4, U_5) + 1 = (Kk_1U_1(.) + 1)(Kk_2U_2(.) + 1)(Kk_3U_3(.) + 1)(Kk_4U_4(.) + 1)(Kk_5U_5(.) + 1)$$

We review that in this case, k_i is the probabilty that a decision maker is indifferent between certain and certain lotteries. for example, k_1 is the probability that a DM is indifferent between the lottery $(U^*_{1..5})$

with probability = p, ($U^0_{1..5}$) with probability 1-p, nad the certain lottery ($U^*_1, U^0_{2..5}$). following the same proceedure we ended up with these results:

attributes	ki
vision	0.31
team-oriented	0.60
participation	0.74
autonomy	0.58
protection	0.63

We now can solve the scaling equation where we can find the big K and derive the full equation and apply it later on.

$$K + 1 = (0.31K + 1)(0.6K + 1)(0.74K + 1)(0.58K + 1)(0.63K + 1)$$

This equation yields a value of K as folows : 0.323666 *This is a numerical approximation with the least complex extention, further rremedies can be applied.* therefore:

$$I(U_1, U_2, U_3, U_4, U_5) = 3.0896((01003U_1(.)+1)(0.1941U(.)_2+1)(0.23950U_3(.)+1)(0.1877U_4(.)+1)(0.2039U_5(.)+1)-1)$$

Backprobagation:

Now we will apply the SAUFs, the MAUFs, and the index itself, the *bigshot*, using the SAUFs for our data yielded this table:

vision_1	inspiration_1	self_sacrifice_1	collaboration_2	integration_2
0.8740584	0.8378844	0.5361593	0.6428939	0.8732471
0.7942042	0.6825515	0.8739759	0.8424272	0.8278906
0.8900292	0.7046826	0.6793121	0.7457061	0.8650084
0.7729097	0.5859857	0.7873806	0.7358933	0.7368577
0.8474403	0.7697225	0.4800116	0.7109052	0.8278906
0.7143500	0.6432804	0.8925406	0.6904463	0.6578960

competence_2	participation_3	autocracy_3	autonomy_4	self_centered_5	conflict_inducer_5
0.4846573	0.7807983	0.4852159	0.7316455	0.6673619	0.7526912
0.7420693	0.7096700	0.5420369	0.5575696	0.6526102	0.3005616
0.6593690	0.7290174	0.4313952	0.6199027	0.6164183	0.5830081
0.7985649	0.4674335	0.2035725	0.7061726	0.2499310	0.2671623
0.7228910	0.7096700	0.4669418	0.6766127	0.5335732	0.4843090
0.8714593	0.8081599	0.8465541	0.9753590	0.4564183	0.1965597

Afterwards we get this table for the multi-attribute utility functions:

charisma	team_or	participation	protection	autonomy
0.8018403	0.6700436	4.072725	0.1723518	0.6932773
0.8348335	0.6884336	3.613136	0.3412822	0.5000000
0.7967799	0.6734684	3.725760	0.2462200	0.5672269
0.7671260	0.5504416	2.186724	0.5574659	0.6638655
0.7545071	0.6173968	3.605913	0.3155934	0.6302521

charisma	team_or	participation	protection	autonomy
0.8135120	0.4397358	4.305569	0.4800849	1.0000000

This table will allow us to get the scores of the *bigshot* index by combining the attributes in a single table with respect to the formula deducted above. Here is the frist few observations with the final index, in a separate RMD file we will present the full table, and the ranking in sorted manner.

PS: *I could not mention that the trickiest part here is that sometimes when we try to solve the scaling equation, we can not find any real root beside zero even when we change the probabilities, this is basically what caused the frustration in the final result, however, a simple normalization will make sense of it.*

country	Index
England	0.7022304
Costa Rica	0.6225027
Italy	0.6276532
India	0.4117575
Namibia	0.6206302
Czech Republic	0.8502792
Venezuela	0.1983429
Taiwan	0.1223214
Singapore	0.4984574
Hong Kong	0.3909311

Conclusion

Even though this work is a time consuming effort, we can basically automate some of it by using modulare codes just like what we did in here, a misture of R, Python and their libraries. The multiattribute utility function is very useful when we are dealing with ranking problems on human behaviour or that concern human preferences, however more work is needed to promote it properly and discuss the limitations of it's proceedure.

END.