TERD 1.0 Instructions (as of February, the 22nd, 2018)

Data insertion

When opening the file, the user will see a set of coloured cells. Data need to be inserted in the pink cells:

	A	B	C	D	E	F	G	H	I	J
1	INPUT DATA									
2	Control subjects						Patients to be assessed			
3										
4			Max possible N of Errors							
5										
6	ID	Time (>0)	Number o	*Warnings*		Mahalanob	ID	Time (>	Number	*Warnings*
7	1						1			
8	2						2			
9	3						3			
10	4						4			
11	5						5			
12	6						6			
13	7						7			
14	8						8			
15	9						9			
16	10						10			
17	11						11			
18	12						12			

The first thing to do is to insert the **maximum possible number of errors** ("**MAX**") in the C5 cell – of course, a positive integer. This number will be used to compute the error rate, thus, if a subject made 13 errors out of a MAX of 50, the error rate considered in the computations will be 13/50 = 0.26.

As a second step, data from the normative sample are to be inserted in the pink cells of columns B and C, from row 7 downward. Scores from each single subject of the normative sample are needed and must be inserted, one row per subject. Time scores must be entered in column B, in whatever unit of measurement. These must be positive values – beware of using the decimal separator ("," or ".") that is appropriate according to the settings of the Excel version you are using. Error counts (not error rates) must be entered in column C and must be integers between zero and MAX. Thus in the example above, one needs to enter the number 13, and not the 0.26 error rate.

Please note that if the normative sample is **stratified** in age classes, or according to any relevant demographic variable, the best strategy is to save separate TERD 1.0 files, each one containing normative subjects from only one (e.g.) age class, in columns B-C. Else, if one wishes to use age-adjusted scores, some caveats are reported in a later Section ("Adjusted Scores"; see also Toraldo, submitted). Also be aware that the simulation studies performed to validate the statistical mathematics of the file had N=50 as the smallest sample, so normative samples (or age classes) with less than 50 subjects produce results that should be interpreted with caution. If N<20, TERD 1.0 does not give diagnostic solutions at all.

The third and last step is to insert the data for the subject(s) to be assessed. The format must be exactly the same, but the columns H-I (pink cells) are to be used this time. Data from up to 500 to-be-assessed subjects can be inserted simultaneously.

	A	B	C	D	E	F G	H	I	J
1	INPUT DATA								
2	Control subjects					Patients to be assessed			
3									
4			Max possible N of Errors						
5			40						
6	ID	Time (>0)	Number o	Warnings	Mahalanob	ID	Time (>	Number	Warnings
7	1	88	0		2.764077	1	156	5	
8	2	116	1		1.094	2	121	13	
9	3	123	5		0.973174	3	158	15	
10	4	116	0		1.464127	4			
11	5	113	2		0.412498	5			
12	6	111	0		1.012318	6			
13	7	120	6		0.801749	7			
14	8	111	4		0.580252	8			
15	9	117	7		1.169767	9			
16	10	110	3		0.416285	10			
17	11	121	3		1.074689	11			
18	12	121	8		1.355703	12			
19	13	104	3		1.225069	13			
20	14	127	9		1.655141	14			
21	15	118	7		1.119762	15			
22	16	116	9		1.978368	16			
23	17	118	3		0.669991	17			
24	18	128	8		1.53037	18			
25	19	120	5		0.661067	19			
26	20	118	4		0.470436	20			
27	21	118	3		0.669991	21			
28	22	109	2		0.440354	22			

To understand whether there are data insertion errors somewhere in the file, look at the red cells in the "GENERAL WARNINGS WITH DATA INSERTION" section further right on the sheet. If some warning is given there, search for the exact data that are wrong, by looking at the red columns D and J: these report warnings for specific subjects (rows).

				DIAGNOSIS (patients)				GENERAL WARNINGS WITH DATA INSERTION		
Patients to be assessed				Mahalanobis distance						
					Outlier detection					
					at the alpha level=					
					0.08					
ID	Time (>	Number	Warnings	Mahalanob	p-value	Diagnosis	Direction	Controls		Multiple patients
1	-1		Time must be>0	problem	########	#VALORE!	#VALORE!			Time must be>0
2	0		Time must be>0	problem	########	#VALORE!	#VALORE!			Out-of-range values
3		45	Out-of-range Error	problem	########	#VALORE!	#VALORE!			
4	f		Text not allowed	problem	########	#VALORE!	#VALORE!			Entered values must be numbers
5		f	Text not allowed	problem	########	#VALORE!	#VALORE!			

Adjusted scores

If the user has age-adjusted scores for Time and Error Count, these can be inserted in columns B-C, H-I, provided that:

(i) Adjusted scores are in the same format specified above for raw scores, i.e. positive time values and positive or null error counts; z-scores, percentiles, or any other standardized scores cannot be used;

(ii) If a raw error count is zero, the corresponding adjusted error count is also zero;

(iii) If a raw error count equals MAX, the corresponding adjusted count also equals MAX;

(iv) If an adjusted error count is negative, it is replaced by a zero count;

(v) If an adjusted error count exceeds MAX, it is replaced by MAX;

(vi) If an adjusted time score is negative, it must be omitted from the sample (anyway, negative adjusted times indicate that something is the matter with the adjustment procedure).

The reader should be aware that age-adjustment of Error Counts can be difficult to perform properly, due to the skewed and lower-bounded statistical distribution (see Tessari et al., 2015, for a way to adjust bounded scales, and Toraldo, submitted, for discussion; or, contact the author at alessio.toraldo@unipv.it, alessio.toraldo@gmail.com).

Results

ID	Time (>0	Number o	*Warnings*		Mahalanobi	p-value	Diagnosis	Direction
					DIAGNOSIS (patients)			
	Patients to be assessed				Mahalanobis distance			
							Outlier detection	
							at the alpha level=	
							0.08	
1	156	5			5.3156024	0.00000	DEFICIT	Slow
2	121	13			3.1093346	0.00795	DEFICIT	Inaccurate
3	158	15			4.4516288	0.00005	DEFICIT	Slow-inaccurate
4	114	4			0.2609057	0.96654	Normal	
5	65	2			6.2473453	0.00000	Super-normal	Fast

The section "DIAGNOSIS" reports results. Results regarding a given subject are reported on the same row as that where raw data were inserted. The first column (L) shows the Mahalanobis distance; the second (M) provides the p-value associated to it; the third column (N) shows a rough classification of subjects into three macro-categories: Normal, DEFICIT, Super-Normal. "Normal" is given when the p-value is higher than the chosen alpha value (which can be changed in the cell N5); this means that the bivariate performance of the subject is well within the cloud of bivariate performances of the normative sample. "DEFICIT" is given when the p-value is smaller than alpha, and the direction of the deviation from the bivariate sample indicates impairment. "Super-normal" is given when the p-value is smaller than alpha, but the direction of the deviation from the normative sample indicates superior performance. This can best be understood by clicking on the "Plot" sheet and looking at the bivariate distribution:
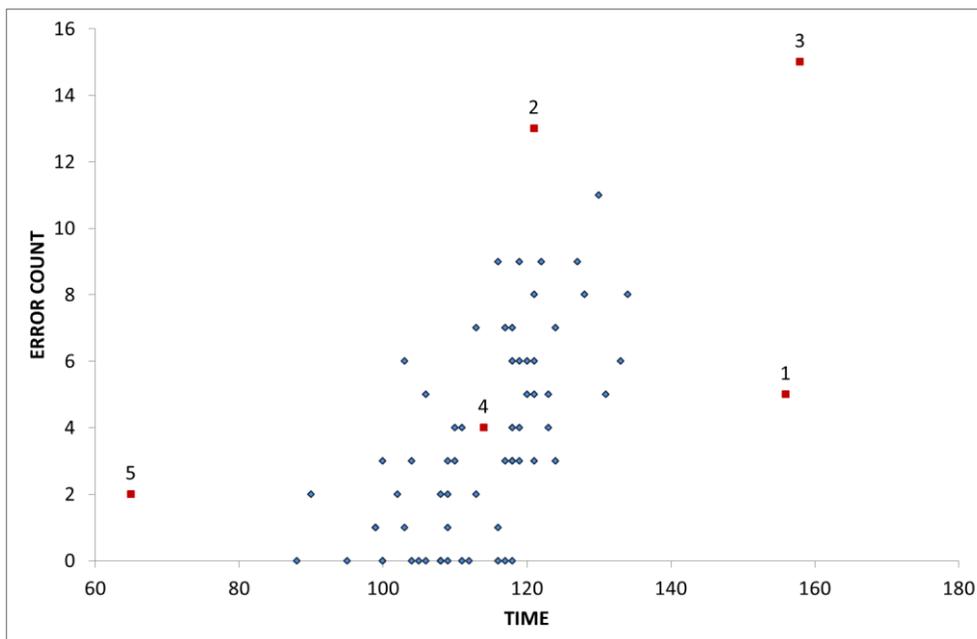
Blue dots show the bivariate performances of subjects from the normative sample; red dots show performances of to-be-assessed subjects, and are numbered according to the row they were inserted in (ID

of row is reported in column G). While subject 4's performance is normal, subjects 1-3's performances witness impairment, and subjects 5's one is "super-normal" as its time score is definitely shorter than normal.

Column O shows finer diagnostic categories. Thus, impaired patients 1, 2, and 3 are further classified as, respectively, "slow" (but normally accurate), "Inaccurate" (but with normal time), "slow and inaccurate".

Alpha value setting

It is important to learn that if one is *only* interested in diagnosing forms of impairment (and would like ignore supra-normal performances), the alpha value set in cell N5 must be 1.6 times higher than the desired false positive rate. For instance, if one wishes to diagnose impairment (and only impairment) with a 0.05 risk of false positives, s/he must compute perform the multiplication 0.05x1.6=0.08, and type its result, 0.08 in the N5 cell.

Else, if one is wishing to diagnose *any* kind of deviation from normality, both in the direction of impairment and in that of superior performance, the desired (overall) false positive rate (0.05 in the above example) must be typed directly in cell N5.

References

Tessari, A., Toraldo, A., Lunardelli, A., Zadini, A., & Rumiati, R.I. (2015). STIMA: a short screening test for ideo-motor apraxia, selective for action meaning and bodily district. *Neurological Sciences*, *36*, 977-984. DOI: 10.1007/s10072-015-2203-4

Toraldo A. (submitted). Diagnosis of dyslexia: a bivariate solution to a bivariate problem. *Psicologia Clinica dello Sviluppo*.