Early Child Development Mapping (ECMap) Project Alberta

The 14 decimal places (default) in EDI's Norm II cut-off values: They do it, but do they increase accuracy?

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The EDI's developmental scores range between 0 and 10 and are calculated as a mean score of all valid responses. Higher scores indicate a higher level of development for each area. Children who score below the 10th percentile of the Canadian Norm II cut-off values for an individual developmental area are categorized as *children experiencing great difficulty* (EGD) for that particular developmental area (see Tables 1A & 1B).[1]

Table 1A: Description of how the scores are classified

Experiencing Great Difficulty (EGD)	• Experiencing Great Difficulty in 1+ areas (EGD1+) • Experiencing Great Difficulty in 2+ areas (EGD2+)	Children who score below the 10th percentile, adopting Offord Centre's percentile boundaries and cut-off values specified for each area.
Experiencing Difficulty (ED)		Children who score between 10th and 25th percentiles, adopting Offord Centre's percentile boundaries and cut-off values specified for each area.
Developing Appropriately (DA)		Children who score above the 25th percentile, adopting Offord Centre's percentile boundaries and cut-off values specified for each area.

Table 1B: National Norm II cut-off values*

	EGD	ED	DA
Physical health & well-being (P)	P<=7.0833	7.0833<P<=8.0769	P>8.0769
Social competence (S)	S<=5.5769	5.5769<S<=7.3077	S>7.3077
Emotional maturity (E)	E<=6.0000	6.0000<E<=7.1667	E>7.1667
Language & thinking skills (L)	L<=5.7692	5.7692<L<=7.6923	L>7.6923
Communication & general knowledge (C)	C<=4.375	4.375<C<=5.6250	C>5.6250

*For one or more areas of development.

Significant digits in cut-off values, 5 vs. 15

Take the physical health & well-being area cut-off values, as given by the Offord's updated Norm II.

EGD: p<=7.0833; ED: 7.0834<=p<=8.0769; DA: p>=8.0770

Here, all cut-off values have **4 decimals** and **5 significant digits**.

Please note that when the zero has a non-zero digit anywhere to its left, then the zero can be considered significant, otherwise it is not. That means 5 digits make sense in terms of measurement accuracy because the number of decimal places has nothing to do with accuracy, but only precision.

Now take a look at the same physical health & well-being area cut-offs by inputting 14 decimals (default) as:
EGD: p<=7.08330000000000 (14 decimals)
ED: 7.08330000000001<=p<=8.07690000000000 (14 decimals)
DA: p>=8.07690000000001 (14 decimals)
Here, all numbers have **15 significant digits**.

Which of the two can be more accurate, 4 or 14 decimals? To uniquely represent a four decimal, you need 18 decimal places (14 inputted plus extra 4) but not all 18 decimal numbers map to 4 decimals. In simple terms, the back-and-forth conversion can be accurate if you have extra decimals than what is the default. Mathematically, this is to ensure conversion back and forth in order to yield the same number. Just because you have 14 decimals it does not mean the developmental area can represent all values to that precision. If the zeros from 5th place to 14th place **are not the result of measurement** or that the value has 7 ones, 0 tenths, 8 hundredths, 3 thousandths, and 3 ten thousandths as in EGD, then it should not be written with so many decimal places. In other words, the mathematical value of 7.0833 with 10 more zeros after it is coincidental and it is only a lucky guess that a child has this score. It only makes people in believing that accuracy is greater than it really is by having more **significant** digits. Using too much precision, as in the case of 14 decimal places can mislead the measurements to approach the actual value when we know that accuracy is more important than precision.

What is the best option? Rounding is needed to get an approximate answer to ensure the level of accuracy. It is a good practice to have in our mind what the approximate value should be for a developmental area mean score. So round the number before calculation. In short, the best practice is to round to four decimals to produce values closer to or equal to the cut-off values given to us.

Digging deeper into the data

In reality, when 14 decimals were inputted for the cut-off values, Merger #4 produced the following discrepancies in results, as compared to four decimal places. Of course, the rounding was done before calculations in the case of four decimal places.

The physical health & well-being area overestimated the DA category by taking 148 cases from EGD and 8,758 cases from ED (almost by 12.69%). The social competence area overestimated the ED category by taking 734 from EGD. The language & thinking skills area overestimated the DA category by taking 1161 from EGD and 1917 from ED.

The syntax for rounding values to 4 decimals

```
* Rounding values to 4 decimals*
COMPUTE phys=RND(phys,0.0001).
EXECUTE.
COMPUTE soc=RND(soc,0.0001).
EXECUTE.
COMPUTE emot=RND(emot,0.0001).
EXECUTE.
COMPUTE langcog=RND(langcog,0.0001).
EXECUTE.
COMPUTE comgen=RND(comgen,0.0001).
EXECUTE.
```

The syntax for classification into EGD, ED, & DA

```
* Updated NormII *
RECODE phys (Lowest thru 7.0833=1) (7.0834 thru 8.0769=2) (8.0770 thru Highest=3) INTO phys.N2.3.
EXECUTE.
RECODE soc (Lowest thru 5.5769=1) (5.5770 thru 7.3077=2) (7.3078 thru Highest=3) INTO soc.N2.3.
EXECUTE.
RECODE emot (Lowest thru 6.0000=1) (6.0001 thru 7.1667=2) (7.1668 thru Highest=3) INTO emot.N2.3.
EXECUTE.
RECODE langcog (Lowest thru 5.7692=1) (5.7693 thru 7.6923=2) (7.6924 thru Highest=3) INTO lang.N2.3.
EXECUTE.
```

```
RECODE comgen (Lowest thru 4.3750=1) (4.3751 thru 5.6250=2) (5.6251 thru Highest=3) INTO comm.N2.3.
EXECUTE.
VALUE LABELS phys.N2.3 to comm.N2.3
1 'EGD'
2 'ED'
3 'DA'.
USE ALL.
FILTER BY ECMAP_P_Valid.
EXECUTE.
```

Endnote

[1] The Normative II 10th percentile cut-off values were based on a national sample of 174,799 children.

Reference

Krishnan, V., Wang, H., Babenko, O., & Lynch, S. (2011). Alberta's children in their early years of development: An analysis of the Early Development Instrument (EDI), 2010. ECMap, Community-University Partnership (CUP), Faculty of Extension, University of Alberta, Edmonton, Alberta, Canada.