Bell's theorem refuted mathematically for Professor X.

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Bringing an elementary knowledge of sums and averages to Bell (1964), we refute Bell's theorem.

1 Introduction

1.1. (i) From Bell (2004:65), this is Bell's famous theorem (BT): If a theory is local it will not agree with QM; and if it agrees with QM it will not be local. (ii) However, in our draft essay (19pp)—in the midst of delivering a local QM theory (WM): without reference to quantum theory—Watson 2017d:(40) shows BT to be absurd. (iii) So now, in this stand-alone note (3pp)—improving that part of Watson (2017d)—we again show that BT is absurd. (iv) But this time we use more conventional mathematics—ie, we use elementary sums and averages—in conjunction with Bell's (1964) method.

1.2. (i) Reserving P for probability, $E(x,y)$ denotes Bell's expectation $P(\vec{x},\vec{y})$. (ii). [#] denotes Bell 1964:(#) and [14a]-[14c] denote the formulas atop p.198. (iii) Given Bell's indifference—ie, his parameters $\boldsymbol{\lambda}$ may be continuous or discrete (p.195)—we use $A_i = A(a,\boldsymbol{\lambda}_i) = \pm 1$, etc; as in (10) [which (in passing) Watson 2017d:(24) derives without quantum theory].

1.3. (i) Here we rely on the crux of BT—see Bell's comments around [3]—ie, (10) is impossible [sic]. (ii) We represent this in the form of BT (11). (iii) In this form, BT is thus: (10) should be true; but it is not [sic]. (iv) Then, contra Bell but on his terms: we prove that (10) is true. (v) So BT is refuted again—and again mathematically; but in a simpler, more direct way—hence the title of this note.

1.4. (i) To see this—taking math to be the best logic—we may let it flow for several lines before we comment. (ii) By absurd (▲) we mean math-false. (iii) Its contrary here is QM-true (■): QM being the gold-standard for our results. (iv) WM denotes our theory (wholistic mechanics) since 1989.

2 Analysis

$$[14a] = E(a,b) - E(a,c) \Leftrightarrow E(a,b) = \frac{1}{n}\sum_{i=1}^{n} A_iB_i; E(a,c) = \frac{1}{m}\sum_{j=1}^{m} A_jB_j. \tag{1}$$

$$= \frac{1}{n}\sum_{i=1}^{n} A_iB_i - E(a,c) \Leftrightarrow \text{We do not require } A_i = A_j, \text{ but see ¶3.2.} \tag{2}$$

$$= \frac{1}{n}\sum_{i=1}^{n} A_iB_i\,[1 - A_iB_i \cdot E(a,c)]. \Leftrightarrow A_iB_iA_iB_i = 1; \frac{1}{n}\sum_{i=1}^{n} 1 = 1. \tag{3}$$

$$\leq \frac{1}{n}\sum_{i=1}^{n} 1\,[1 - A_iB_i \cdot E(a,c)] \Leftrightarrow \frac{1}{n}\sum_{i=1}^{n} A_iB_i \leq \frac{1}{n}\sum_{i=1}^{n} 1. \tag{4}$$

$$\leq 1 - E(a,b)E(a,c); \text{ our QM-true result.} \blacksquare \tag{5}$$

$$\text{For, from (5)}: 0 \geq E(a,b) - E(a,c) + E(a,b)E(a,c) - 1 \equiv \text{WM-inequality.} \blacksquare \tag{6}$$

$$\text{Confirmed by}: 0 \geq a\cdot c - a\cdot b - 1 + (a\cdot b)(a\cdot c) \Leftrightarrow \text{testing (6) with QM-true (10).} \blacksquare \tag{7}$$

$$\text{But from [15]}: 0 \geq |E(a,b) - E(a,c)| - E(b,c) - 1 \equiv \text{Bell's inequality} \blacktriangle. \tag{8}$$

$$\text{For}: \tfrac{1}{2} \geq |a\cdot c - a\cdot b| + (b\cdot c) - 1 \Leftrightarrow \text{testing (8) with QM-true (10).} \blacksquare \tag{9}$$

$$-a\cdot b = E(a,b) = [2] = [3] = [14] = \frac{1}{n}\sum_{i=1}^{n} A_iB_i \equiv \text{WM-theorem.} \blacksquare \tag{10}$$

$$\therefore -a\cdot b \neq E(a,b) = [2] = [3] = [14] \equiv \text{Bell's theorem [¶1.1(i)]} \blacktriangle\text{: and refuted.} \blacksquare \tag{11}$$

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3 Discussion

1. (1): is the common start-point [14a]: for Bell [us]; en route to his [our] inequality (8)▲ [(6)■].
2. (2): results may be paired: $A_i = 1,\ A_j = 1$; etc. Then we have different method, same results.
3. (3): in passing (though not required here): $\frac{1}{n}\sum_{i=1}^{n}\frac{1}{m}\sum_{j=1}^{m} A_j B_j = E(a, b)$.
4. (4): the help-note shows how (4) follows from (3).
5. (5): a decisive result against Bell's manipulations that deliver his math-false [15].
6. (6): is (5) reformatted.
7. (7): shows (6) tested—and passing—under QM-true (12).
8. (8): is [15]—Bell's 1964 inequality; the source of BT—reformatted. It is absurd, see next.
9. (9): shows (8) tested—and failing—under QM-true (12): (8)'s upper bound is $\frac{1}{2}$; not 0.
10. (10): QM-true; tested via (7) & (9); independently derived, per Watson 2017d:(24). QED.
11. (11): absurd, like its source (8): (10)—which is QM-true—refutes them both. QED.

4 Conclusions

4.1 (i) Beginning with [14a] at LHS (1)—using the most basic definition of an expectation; a conventional arithmetic mean—we move via elementary sums and QM-true tests to (11): Bell's theorem refuted. (ii) Bell's error—not developed here; but see Watson 2017d:(37)—is this: [14b] $\neq$ [14b] under EPRB, the experiment on which Bell (1964) is based.

4.2. Our comments next highlight our departure from Bell's theorem and beliefs, perhaps best summarized by these facts. From (1)-(11): by observation, locality is not breached; by our QM-true results, our math is nowhere corrupted; by Bell's 'use of [1]' at [14b], look at the consequences (in Bell's terms).

1. Bell (1964:199): 'The QM expectation $-a \cdot b$ cannot [sic] be represented in the form of [2].'
2. The contrary: see (10)■.
3. Bell, line below [3]: '(11)▲ is true [sic], so (10)■ is not [sic] possible.'
4. The contrary: (10)■ is true, so (11)▲ is not possible.
5. Bell (1964:195): 'any theory producing (10)■—the QM predictions—must be nonlocal [sic].'
6. The contrary: our theory, producing (10)■—the QM predictions—is local (by observation).
7. Bell generally: since the QM predictions are well-founded, locality must be abandoned [sic].
8. The contrary: since QM and locality are well-founded, false inferences must be avoided.
9. Thus, from Bell (1990:13): 'I step back from asserting that there is action-at-a-distance (AAD) and I say only that you cannot [sic] get away with locality. You cannot [sic] explain things by events in their neighbourhood.
10. The contrary: negating AAD, we here explain things locally; ie, by events in their neighbourhood. Our true locality allows that 'direct causes (and effects) of events are nearby, and even the indirect causes (and effects) are no further away than permitted by the velocity of light,' Bell (1990a:105).

4.3. (i) Using Bell's technique—avoiding pitfalls via our QM-true (6)■, (10)■, etc—we refute Bell's inequality (8)▲ and Bell's theorem (11)▲ mathematically and (hence) quantum mechanically. This adds to our findings elsewhere; eg, Watson (2017d): using sound mathematics and avoiding false inferences, (8)▲ & (11)▲ may be refuted without reference to quantum theory.

4.4. In closing, in Bell's words:

> 'This action-at-a-distance business will pass. If we're lucky it will be to some big new development like the theory of relativity. Maybe someone will just point out that we were being rather silly. But anyway, I believe the questions will be resolved,' after Bell (1990:9). 'Nobody knows where the boundary between the classical and quantum domain is situated. More plausible is that we'll find that there is no boundary,' after Bell (2004:29-30).

4.5. In short, agreeing with Bell, we deliver via WM: for our theory combines true locality (after Einstein) and true realism (after Bohr) with QM-true mathematics (and not being silly). QED.

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6 References

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