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Mathematizing Mathematics in Holy Writ

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Abstract

Studies have unraveled and given exposition on mathematics inherent in Holy Writ, the Bible. This study provides further evidence of more implicit and explicit mathematics in its words, verses and chapters. These are furnished through document analysis and purposeful mathematizing and explication of a selected host of Biblical texts and contexts to demonstrate their mathematical nature and worth. It reveals mathematics, some amenable to formulation, are embedded in the texts and underlie the contexts of scripture. It further reveals, among others, that internal logic, coherence and fact-validation, and diversity of content areas that match 21st century curriculum characterize mathematics in the Bible. Recommendations were made for faith-based Christian schools to incorporate mathematics in biblical context into their curriculum and for this study to be replicated with other religious texts.

Keywords: Biblical patriarchs, characteristics of mathematics in the Bible, Years of human existence on Earth

Introduction

Mathematics is pervasive and underlies all human activities. It is used "to explain and interpret phenomena and experiences" (NaCCA, 2019, p.v). Its power lies in the use of formulations to understand, control and predict reality. Scientists agree with Pythagoras and Galileo that the universe is written in language of mathematics and governed by its principles (Brown & Porter, 2017; Tegmark, 2008; 2014). D'Ambrosio (2001) explains mathematics as an accumulated discovered knowledge; *"a wonderful mosaic of cultural contributions" (p. 311).* The pervasiveness of mathematics presupposes that Holy Writ, the Bible, has mathematical value that require exploration. As non-traditional source of mathematics, there is low expectation of the sophistry of mathematics it embeds. Studies have unraveled and given exposition on mathematics in the Bible (Adejumo, 2018; Christensen, n.d.; Matiki, 2014; Price, 2012; Shalman, 2009). Further evidence is required of yet–to-be-unraveled mathematics ideas in the Bible for better appreciation or evaluation of its mathematical nature and worth.

Literature Review

To 'mathematize' or 'mathematicize' is to reason mathematically; perform mathematical calculations or adopt mathematical approach; consider or treat mathematically; reduce to mathematical term or form or subject to mathematical treatment (Merriam-Webster, n.d.; Oxford English Dictionary, 2023). To mathematize implies coming up with the mathematical element in something or make a context/situation amenable to mathematical formulation and treatment. Tout (2014) describes it, based on Organization for Economic Cooperation and Development [OECD] model, as involving identifying mathematics in context, formulating, interpreting, evaluating the outcome and reflecting on it application and fit with real world situations. To characterize is to identify peculiar features of something. Characterizing mathematics in the Bible amounts to unravelling its peculiar mathematical nature.

Studies have highlighted mathematics in biblical texts (Adejumo, 2018; Baker, 2016; Christensen, n.d.; Matiki, 2014; Price, 2012; Shalman, 2009). Much effort had focused on unravelling mathematics related to the ages of biblical patriarchs in Genesis 5 and 11 with the aim to explicate their long ages and resolve literal/symbolic interpretation controversy (Kvasnica, 2005). Matiki (2014) unveiled 10 mathematical ideas/concepts in "words and passages from the Bible which have a mathematical character infused in them" (p.2055). He interpreted contentment as balance; amen as an axiom; "as far as the East is from the West" as infinity; the word of God as wheel and knot with no ends and formulated books with common biblical themes as: f (book) = n + k22, where n is the numerical position of the book in the Bible and k, a whole number constant. He unveiled GOLGOTTA as deriving from cryptographic mathematics, explicated the spiritual significance of 2,3, 4 and 12; illustrated the relation between Jesus and God as a set with two different names, the word of God as Boolean dichotomous logic rather than fuzzy logic, algebraic transitivity and the idea of exponential increase. Adejumo (2018) formulated Leviticus 26:8 to provide proportional equations that demonstrate the exponential effect of group performance.
The already unveiled mathematics ideas are pointers to the effect that more careful and thorough efforts would yield more.

Statement of the Problem

This study's premise is that mathematics is pervasive, thus in the Bible. Primary evidences exist. Mathematics instantly conjures up numbers. 'Numbers' entitles the Bible's fourth book; a Greek translation of its Hebrew title "Bemidbar" meaning, "wilderness" (Editorial Safeliz, 2015, p.114). This translation seemed informed by the "**census [**enumeration**]**…according to the ***number***" of males "***twenty years and above****"* in the wilderness of Sinai "on the ***first day*** *of the* ***second month****, in the* ***second year*** [emphases mine] after they had come out of Egypt" (Numbers 1:1-3). The emphasized words are numbers and mathematical. The creation account (Genesis 1:1-2:3) furnishes ordinal numbers, thus, cardinal numbers (1-7) implying counting, ordering and number base (seven).

Revelation 13:18 reads: "*Here is* ***wisdom****. Let him who has* ***understanding calculate*** *the* ***number*** *of the beast, for it is a* ***number of a man***: *His number is* ***666*** [emphasis mine]". 'Calculate', 'number' and '666', a palindrome, are explicitly mathematical. The "***number of his name****"* (verse 17) denotes cardinal number, connotes nominal number and implies the alphanumeric nature of the Greco-Roman and Hebrew numerals. Perceptively, it objectivizes "number" as "wisdom" and those able to calculate as having "understanding". Coincidentally, developing 'number sense' is a goal pursued in school mathematics (Greeno, 1991; McKinney, 2023; Park & Brannon, 2014).

Literature reveals a beautiful Bible-based mathematical idea. The ratio of letters to words in each of two creation verses, Genesis 1:1 and John 1:1, in their original languages, Hebrew and Greek, results in two constants π (Pi) and e (The base of natural logarithm) respectively and in Euler's identity, $e^{i\pi} + 1 = 0$; considered "the most beautiful theorem in mathematics" (Barker, 2016). Studies that explored mathematical ideas in the Bible are few (Adejumo, 2018; Baker, 2016; Christensen, n.d.; Matiki, 2014; Price, 2012; Shalman, 2009) and are in no wise exhaustive. Much more effort is required to add to the existing unraveled ones for better appreciation and evaluation of the mathematical nature and worth of the Bible. As well mathematics in the Bible needs some characterization to afford the appreciation of its relatedness to mathematics in the 21st century.

This study therefore further mathematizes the holy Writ for mathematical elements in its texts and contexts.

Research Purpose/questions

This study's traction is to unravel more mathematical ideas in the Bible and characterize them. The Bible was subjected to document analysis, mathematized and characterized to address two research questions as follows:

1. What unexplored implicit and explicit mathematics ideas, concepts, or principles are embedded in texts and underlie contexts of Holy Writ?
2. What characterizes mathematized mathematics in Holy Writ?

Holy Writ in context

Holy Writ designates the Bible or any writing or utterance with unquestionable authority (Merriam-Webster, n.d.). World religions have sacred books that provide historical accounts, expositions on object of worship and principles guiding expression of beliefs and practices. These are read for insight, revelation, fulfilment, hope, comfort, prosperity, and enlightenment and progress. In Christianity, the Bible serves these purposes. It is a conglomeration of Jewish religious canon, the Tanakh (White, 2021) and later derivative canons by the apostles of Jesus Christ under inspiration (The Best Schools, 2021). It has 66 books. The King James Version (AD 1611) is regarded as the closely translated version of the original texts and "the most printed book in the history of the world" (Fairchild, 2018). The Bible, also referred to as scripture, in the past served as curriculum for religious and moral instruction and considered divine truth, the blue-print for judging scientific and intellectual discoveries (White, 2000; O'Connor & Robertson, 2002; Pace, 1909).

Methodology

This is a documentary research informed by the interpretivist paradigm that views reality as a construction of the human mind and knowledge and meaning as deriving from interpretation (Schwandt, 1994). Revealed or inspired, the Bible reflects the minds of the writers, thus subject to analysis and interpretations. The Bible is a historical as well as a sacred document. Its authenticity is presumed in this study thus no attempt was made to validate it as a researchable document. The New King James® Version (NKJV), copyrighted by Thomas Nelson International in 1982 was used. It was chosen for its clarity of language and retention of units of measures in the original texts.

This study employed document analysis. This refers to an in-depth reading of a document and analyzing the texts therein to achieve the research intention (Bowen, 2009). In this study, the document analysis involved intense reading, re-reading and interpretation as well as mathematizing- formulating and explicating mathematical ideas embedded in the text and context of the Bible. Thus, the Bible was perused and spotted texts and contexts with implicit and explicit mathematical ideas were highlighted, read carefully, re-read and interpreted. These were then formulated, expressed and explicated through textual, symbolic or diagrammatic representations (tables) or a combination of these. The unraveled ideas were then characterized. In reporting, portions of the Bible, current geographical statistics, and created examples were drawn on.

Results and Discussion

In this section, the unraveled mathematical ideas and their characteristics are presented, explicated and discussed. This study neither exhausts the mathematical ideas in the Bible. What is derivable is a function of the technical expertise, reading depth, speed and duration among others. The results are presented in accordance with the research questions and discussed.

Results

Mathematical ideas and concepts in Holy Writ

1. Genesis 5:1-32; 11:1--32: These furnish data of the ages of Adam and his descendants for statistics. Measures of central tendency, dispersion and relative position are calculable. Lifespan across eras, contemporaneousness of the biblical patriarchs and years of human existence on Earth are inferable from the data pattern. It beckons conjecture God intended Adam to live to 1000 years to be immortalized (see Isaiah 60:22; 65:20; Titus 1:2; 2 Peter 3:8; Revelation 20: 4, 5). Adam lived 930 years; 70 years short of this conjectured time. The antediluvian lifespan was pegged at 120 years due to inappropriate marriages (Genesis 6: 2, 3). By David's time it reduced to 80 years [70+10 years] (Psalm 90:10). Interestingly, subtracting the verse from the chapter gives 80! Data from Genesis 5 is presented in Table 1.

Table 1: Data from Genesis 5

	Adam	**Seth**	**Enosh**	**Cainan**	**Ma'lel**	**Jared**	**Enoch**	**Methu'**	**Lamech**	**Noah**
AB*	130	105	90	70	65	162	65	187	182	500
YB*	800	807	815	840	838	800	300	782	595	450
Lifespan	930	912	905	910	895	962	365#	969	777	950

AB= Age at Birth; YB= Years after Birth * …of first son [or one under consideration]; # Enoch was translated.

There are palindrome, pronounced "pal-un-drohm" (Buffington, 1985, p.67), ages (838, 595, 969 and 777) and outlived patriarchs are determinable from Table 1. Methuselah outlived Lamech (782yrs -777yrs) = 5 yrs. Also Human Existence (HE) on Earth (up to a named patriarch) is formulable as:

$$\sum AB_{PRE} + LS_{PER}$$

AB_{PRE} is age at birth of preceding patriarch(s) and LS_{PER} is the lifespan of patriarch under consideration.

Thus, if life had ended with Noah, Human Existence (HE) would have been only 2006 literal years.

2. Genesis 11: Data in Genesis 11 also furnish palindrome, 464 (Eber's lifespan). Shem outlived Aphaxad 62 years, Eber outlived Preleg 191 years and Sureg outlived Nahor 52 years. Estimating Jacob's age when he gave birth to Joseph as 97 years (see Tables 3 and 4) and applying the HE formula yields 757 years, a palindrome (i.e. if life started with Shem and ended with Joseph). Data from Genesis 11 and those scattered in the same Book are displayed in Tables 2 and 3.

Table 2: Data from Genesis 11

	Shem	A'xad	Salah	Eber	Preleg	Reu	Serug	Nahor	Terah	Abram
AB*	100	35	30	34	30	32	30	29	70	100$
YB*	500@	403	403	430@	209	207	200@	119	135#	75#$
Lifespan	600	438@	433	464	239@	239	230	148@	205	175$

AB= Age at Birth; YB= Years after Birth * …of first son [or one under consideration] Out-lived by parents: YB > Lifespan of son (consecutive @); #: Derived; $=Not in Genesis 11.

Table 3: Scattered Data in Genesis

	Isaac	Jacob	Joseph
AB*	60	97$	30
YB*	120#	50#	80#
Lifespan	180	147	110

AB= Age at Birth; YB= Years after Birth * …of first son [or one under consideration]; $ =Estimated; # = Derived

The genealogies reveal diminishing mean lifespan across the eras. These are: Adam to Noah (10 generations, if Enoch had attained 1000): 921; Adam to Noah (10 generations; with Enoch translated): 857.50 2dp; Shem to Abraham (10 generations): 317.10 2dp; Shem to Joseph (13 generations): 277.54 2dp; Isaac to Joseph (3 generations): 145.67 2dp]. Applying the HE formula ($\sum AB_{PRE} + LS_{PER}$) to the eras yields 2,313 years (If life stated with Adam and ended with Joseph) and this is verifiable arithmetically [(2,006-450) + 757 = 2,313 years; 450 being years Noah and Shem were contemporaneous].

3. Determining when a forbearer patriarch died (FPD) relative to a named patriarch is formulable as:

$$[YB_{FP} - [\sum AB_{PRO}]$$

YB_{FP} is years after birth of forbearer patriarch and $\sum AB_{PRO}$ is the sum of ages at birth of proceeding patriarchs up to a named patriarch.

For interpretation, a positive value is "years after" and a negative one "years before" the named patriarch's son' birth. Thus, Methuselah died when Shem was 100 years and the very day Aphaxad was born: 782−(182 + 500 + 100) = 782−782= 0 or 100−100 = 0. Adam died when Lamech was 56 years old or 126 years to the birth of Noah: 800−(105 +90 +70 + 65 + 162 + 65 + 187 + 182) = 800−926 = − 126 + 182=56 or 182− 56 = 126 and Shem died when Jacob was 50 years old or 47 years to birth of Joseph: 500−547= −47+ 97= 50 or 97−50 = 47.

4. Estimation of Jacob's age at birth of Joseph has embedded mathematics. It involves estimation, subtraction, addition, coordinates {(0, 97), (30, 127), (33, 130), (50, 147)} and linear equation: $y = x + 97$. The estimate is presented in Table 4.

Table 4: Estimate of Jacob's Age at Birth of Joseph

Event	Birth of Joseph	*Before Pharaoh*	*Both before Pharaoh*	Death of Jacob	Death of Joseph
Jacob's age (y)	97#	127#	***130**** (Genesis 47:9)	*147**	
Joseph's age (x)	0#	***30**** (Genesis 41:46)	33#	50#	*110*#

[Subtract Joseph's 33, age he stood before pharaoh (Genesis 41:46) plus third year of famine (Genesis 45:6), from Jacobs' 130, when both were before Pharaoh (Genesis 47:7-9). *Provided in the Bible; # Derived.

Thus, Reuben was at least 6 years older than Joseph [Both were born within 20 years Jacob lived with Laban and Leah gave birth to Reuben after 14 years of marriage] or at most 35 years (97yrs-62yrs) older than Joseph. Jacob gave birth to Reuben, at least, age 62 [His twin brother married at 40 plus 21 years of service to Laban]. There were ten births between Reuben and Joseph plus periods before seed taking] (Genesis 26:34; 27:1; 29:15-32).

5. Genesis 16:16; 17:17, 24-25; 21:5; 23:1-3; 25:20: These enable verifying Abraham's age at different times relative to the ages of his wife and children and spotting seeming discrepancies. Ishmael's age at death of Sarah is determinable. It suggests setting up an equations but sequencing allows for various inferences at a go as shown in Table 5.

Table 5: Sequence of Abraham's Age Relative to His Family Members

Event/ Person's Age	At circumcision	Isaac born	Sara died	Isaac married	Abram died	Ishmael died	Isaac died
Abraham's Age	99*	100*	137#	140#	175*		
Sarah' Age	90! [89]	90*	127*				
`Ishmael' Age	13*	14#	51#	54#	89#	137*	
Isaac's Age		0	37#	40*	75#	123#	180*

* Provided in the Bible; # Derived. ! Source of error; [ ] Should be for accuracy

There is a margin of error of 1 year between Abram's self-stated age (Gen. 17:17) and narrated age (Gen. 17: 1, 24).

6. Genesis 18: Abrahams' intercession for Lot with God yields number pattern: 50, 45, 40, 30, 20, 10 in realistic context. The nth term is determinable. Treating 45 as 'outlier' furnishes: 10(5), 10(4), 10(3), 10(2), 10(1) with a common difference of -10 and nth term: $10(6-n)$. Properly interpreted, $\{1 \leq n \leq 5\}$ fits the realistic context though theoretically can assume any integral value. The sum to the nth term is $\frac{n}{2}(110-10n)$. The *45,* is between the 1st and 2nd term thus formulable as: $10\left[6-\frac{1}{2}(n_1+n_2)\right]$. Thus, beyond plea and bargaining, Abram and God had discourse on mathematical sequence.

7. Exodus 16; 18: Exodus 16:16-21 reveal explicitly the trilogy of mathematics relations-equal to [=], less than [<] or more than [>] an omer of manna and "*twice as much*" [2 omers of manna]. In Exodus 18, Jethro's advice to Moses yields a number pattern: $1000, 100, [50], 10$. Eliminating the 'outlier', 50, furnishes geometric sequence: $10^3\ 10^2\ 10^1$ with common ratio 10^{-1} and nth term 10^{4-n}. In realistic context, $\{n: n < 4\}$ though n can theoretically assume any integral values. The sun to the nth term is $\sum 10^{4-(n!)}$ or $\frac{1000[1-10^{-n}]}{0.9}$.

The sum to infinity leads to conjecturing a theological interpretation for 10000/9 = 1111.1111… as a refutation of self-centeredness, the "I" syndrome. The reason Jethro counselled Moses to devolve power and function. The twin exquisite sequences [6 and 7] converge, involve 'outliers' and negative reciprocals (additive and multiplicative) as common difference and ratios respectively. Both have distractors and require mathematical audacity, knowledge of mathematical patterns, indicial laws and ability to generalize. While Genesis 18 furnishes an arithmetic sequence and Exodus 18, a geometric sequence. The formulating 'outliers' and the sums to infinity reveals their nuanced differences.

8. Exodus 25-28: The earthly sanctuary embed mathematics. The shapes, positioning and crafting of equipment and furnishings embrace mathematics of design and construction engineering. It involves measurements- mass, weight, length (perimeter), area, volume and angles; requires mathematical skills and processes such as visualization, drawing, calculating, measuring and mathematical dispositions (in constructing). The sanctuary demonstrates relatedness and dependence of quantity on quality (see 1 Chronicles 28:16-19). Difference in quality results in categories thus nominal data; ordering these results in ordinal data and calibrating, yields interval and ratio data.

9. Leviticus 24:5-6: This relates: "*bake twelve cakes" from fine flour. "…Two-tenths of an ephah shall be in each cake*" (vs 5). Fraction as operator and multiplication are evident. One ephah makes 5 cakes i.e. $5 \times \frac{2}{10} = 1$. Two (2) ephahs yields 10 cakes and $2\frac{2}{5}$ ephahs, 12 cakes (ie. $12 \times \frac{2}{10} = 2\frac{2}{5}$) . An ephah is 22 liters (of dry goods) (Editorial Safeliz, p1130). This also means $22 \times 2\frac{2}{5} = 52\frac{4}{5}$ liters (dry goods). The cake are set "in two rows, six in a row'' on a table. This models multiplication 2 x 6 =12. The 2, multiplier; 6 , multiplicand and 12, product.

10. Deuteronomy 3:11; Revelation 21:7; Judges 20:10: The size of Og, "*remnant of the giants*" and King of Bashan's bed, suggest the stature of antediluvian men or mankind at creation: "Nine cubits in length and four cubits" [4.5m] (Deuteronomy 3:11). Comparing his height to that of an angel: "…one hundred and forty-four cubits [72m] (Revelation 21:7) yields a ratio of 9:72 = 1:16. The proportional equation: $\frac{10}{100} = \frac{100}{1000} = \frac{1000}{10000}$ in Judges 20:10 yields a ratio of 1:10.

11. I Kings 18:18-19, 22: Number, numerals and ratio in "*the four hundred and fifty prophets of Baal, and the four hundred prophets of Asherah*"; implies arithmetic operations and inequality. Ratio of Baal to Asherah prophets was 45:40 or 9:8. Types of ratios are demonstrable. The Baal prophets were 9/8 of Asherah's and Asherah's, 8/9 of Baal's [Part-part ratios]. Likewise, Baal and Asherah prophets were 8/17 and 9/17 respectively of the total number of prophets (950) [Part-whole ratios].

12. 2 Kings 20:1, 8-11: Ten degrees angle is mathematical. Shadow formation, angular rotation, relative movement between the Earth and the Sun and 'sundial of Ahaz' (vs 11) imply Mathematical Physics. A sundial is a device that tells time using the position of the Sun (Rohr, 2012). In its rustic form, it was a pole and calibrated flat ground. Shadows cast by the positioned pole tells the time. Dependent on Sun, it accounted for part or the whole 12 hours of day. The narrative is mathematically drenched though meant to prove divine power through cosmic disturbance.

The shadow going 'down' [forward], moving from east to west, and 'backward', moving from west to east, imply anti-clockwise and clockwise rotations respectively relative to the base of the pole for a viewer located between the pole and the rising Sun from the east. As the Sun appears on the horizon, the pole's shadow lengthens (magnifies). It shortens and turns in an anti-clockwise direction as the Sun rises. When directly overhead, the pole's shadow shortens disappearing under its foot. So, as the Sun sets, moves in the anti-clockwise direction, the shadow also moves in the anti-clockwise direction. A further fall of ten degrees in same direction will appear normal however a rise (clockwise rotation) is obviously abnormal; an indication of apparent reversal of the Sun. This accounts for Hezekiah argument: "*It is an easy thing for the shadow* [of pole] *to go down ten degrees*; *no, but let the shadow [of pole] go backward ten degrees.*" (vs10). Ten degrees in verse ten! The shadow indexes the Sun's apparent movement.

Unintended information is supplied- Ahaz, an inventor and Hezekiah knew sundial-related mathematics (vs 11) and ten degrees turn as sign of supernatural occurrence (see Isaiah 38:22). Sundials accounted for the 12 hours of day and watches, 24 hours of night. Watches were manned by sentinels [watchmen] who run four three-hour shifts. Thus in the Bible we have first watch [6pm-9pm], second watch [9pm-12pm], third watch [12am-3am] and fourth watch [3am-6am]. In the "*fourth watch*" [3am-6am], Jesus walked on the sea (Matthew 14:25). Thus, sundials and watches calibrated the 24 hours. Modern watches (time devices) derived their origin and names from these phenomena! (see Psalm 63:6; 119:148; Lamentation 2:19).

13. Ezra 6:17; 7:9 8:35: These texts present pie-chart tasks. Ezra 7:9 presents calculation of time duration and time conversions. Ezra's travel time from Babylon to Jerusalem: "*first day of first month*" to "*first day of fifth month*" gives estimate of travel time via horse between two ancient cities as 120 days or 4 months [using 30 days per month, not average of $29\frac{1}{2}$ on Jewish calendar]. This could be compared to travel time by air and road in modern times.

14. Ezekiel 48:30-35: The sketch of a map from the description of the division of the land of Israel amongst the tribes of Israel. This passage require visualization, reading ability, geometric reasoning, and drawing skills. It involves the four compass points-North, South, East and West of a square city called "THE LORD IS THERE" with length 4500 cubits. A fitting starting point for ideas of relative positions and bearings. The perimeter, "*All the way round*" (vs 35), is 4(4500) =18000 cubits. The area is $4500 \times 4500 = 20{,}250{,}000$ square cubits. The city with three gates on each side models a multiplication sentence ($4 \times 3 = 12$) and affords labelling of parts- '4' multiplier; '3'multiplicand and '12' product.

15. Zachariah 1:7; 2:1; 5:2: These furnishes three ordinal numbers, a mathematical instrument, measuring line [measuring tape/rule] "*to measure Jerusalem*", a city with 'width' and 'length'. (Zachariah 2:1, 2). Also, an area problem of a rectangular sheet (scroll) with dimensions 20 cubits

by 10 cubits [thickness negligible] (Zachariah 5:2) requiring identification of dimensions and calculation as: $10m \times 5m = 50m^2$.

16. Matthew 20: This reveals ancient working hours as 12 hours per day (dawn to dusk) which roughly coincides with 6am (1st hour) to 6pm (12th hour) respectively. Thus, 12 hours of day and equivalent 12 hours of night validates the 24 hours in a day concept of time. This concept underlies invention of sundials; confirms days as literal in Genesis account of creation and the idea of night preceding day-they worked from rest, not rest from work. In this, Christ's death and resurrection 'in three days' finds meaning and validation. His death straddled three days-three hours of Friday [3pm-6pm] (Mark 15:34); 24 hours of Sabbath [6pm-6pm] (Mark 15:42; 16:1) and 12 hours of Sunday, very "early in the morning on the first day of the week" [6am] (Mark 16:2). Spectacular events occurred-the Sun's refusal to shine from 12 noon to 3pm, temple veil ripping and a Roman soldier exclamation "*truly this man was the son of God*" (Mark 15: 33-39).

17. Mark 12:41-44: Jesus "*sat*" vertically opposite and "*saw*" possible trajectory of "how" money got into the treasury-transversal line, parabola or hyperbola? It presents a fraction puzzle. Mathematically, the old widowed woman gave all [relative to herself], a whole, "*whole livelihood*" but the Pharisees [relative to themselves] gave a fraction "*out of their abundance*"; part of their whole possessions. Thus, $1 > a/b\,, \{a < b, b \neq 0, a, b \in Z^+\}$. If "a quadrans" ["farthing"] is interpreted as one-quarter, she had given one-fourth of the currency unit. If 2mites = 1quarter, then, 2mites X 4 = 1quarter X 4=1unit. Therefore, 8mites = 1 unit. If it were US Dollar, then she gave 0.125 USD. Fraction is a relative concept, more especially when decontextualized.

18. Mark 14:1-8; Matthew 20: This presents present-value costing and valuation problem. The woman poured "*more than three hundred denarii*" (Mark 14:5) spikenard oil from an alabaster flask on Jesus. Mathew 20:2 supplies information. The daily wage was 1 denarius (singular) for approximately 12 hours of work in then Jewish economy. Thus, 300 denarii imply 300days. Adding up 52 days she kept the Sabbath (52 weeks in a year) yields 352 days, almost a year's (less 8 days) wage. Ben-David (2021) reports:

> The minimum wage in Israel stands at a monthly NIS 5,300 ($1,500), or NIS 29 ($9.2) an hour. It will rise to NIS 5,400 by April 2022, and increase every year until 2025 when it will hit NIS 6,000 by December, according to the announcement

Based on the 2021 hourly rate, the value of the gift to Jesus comes to 12 X 9.2 X 300 = $33,120. The oil cost more- "more than". The flask adds value to her gift. Alabaster flask is made from a soft stone thus, required tact, delicateness, intense concentration and time to produce.

19. John 3:16; I Timothy 3:16; Mark. 16:19-20: John 3:16 provides explicit logical tools and implicit symbols. Negation, conditionality, and implication statements are derivable.

Portions of John 3:16	Description	Elaboration
For God so loved the world	Given statement $[l]$	Major premise/Simple statement
That He gave His only begotten Son	Implied statement$[l \rightarrow g]$, $\sim (g \rightarrow l)$ [NIMP]	Minor premise 1 /Compound statement
That whosoever believe in Him	Conditional statement $[b]$	Minor premise 2 Conditional/Compound statement
Should not perish (Negation of perish p)	Final implication $[b \rightarrow \sim p]$ and $[\sim p \rightarrow b]$	Conclusion $[\sim p]$
But have everlasting life	Negation$[\sim p = e]$, thus, $[p = \sim e]$	Conclusion $[e]$

1 Timothy 3:16 provides a logical puzzle- "*mystery of godliness*". God was: a. Manifested in the Flesh b. Justified in the Spirit c. Seen by Angels d. Preached among the Gentiles e. Believed on in the world and f. Received up in Glory. These require re-ordering as: b, c, a, e, f and d to make logical sense. Mark 16:19-20 confirms a, e, f and d implying rendering in the former as a list of mystery characteristics than a logical ordering. The verses and chapter numerical rhyme: 3:16; 3:16 and 16.

20. Revelation 1-15: Conjecturing, equivalence and matching is involved in the seven churches/angels (Rev.1:20), seven lamps of fire/spirits (Rev.4:5), seven horns/seven eyes of God (Rev.5:6), seven seals (Rev. 6-7), seven trumpets (8-9; 13:15-19) and seven plaques (Rev. 15:1.6, 8; 16). This repetition leads to conjecturing of seven as symbolizing completeness/perfection thus, a unique denominator. Division of single-digit natural numbers by 7 leads to a beautiful conclusion. The digits after the decimal point do not repeat same numbers and excludes 3, 6 and 9. Aside 5, 7 is the only number with no factor or multiple among the set of ten single-digit Hindu-Arabic numerals. Its divisibility rule is relatively complex-continuous subtraction of twice the last digit from the rest of the digits till zero or seven (positive or negative) or its multiple is obtained.

21. Revelation 6:6 [Compare 2 Kings 7:1, 18]: "*A quart of wheat for a denarius, three quarts of barley for a denarius…*" Rendering "quart" as quarter, imply fractions: $\frac{1}{4}$ and $\frac{3}{4}$ and their multiplicative relationship: $3 \times \frac{1}{4} = \frac{3}{4}$ and additive relationship: $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$. The ratio of wheat to barley for the same amount of money is 1:3. How many quarts of equal quantities of wheat and barley can 108 denarius buy? (4D × Qty) + ($\frac{4}{3}$ D × Qty) = 108D. Qty × $5\frac{1}{3}$ = 108= 20.25 (units each). How much is needed for a household for one week if their daily intake is 2 quarts of wheat and 2 quarts of barley? 7[(2 × 1) D + (2× $\frac{1}{3}$) D] = 18.67D 2dp. It involves fraction arithmetic operations, ratio, and equations and provides context-based mathematics problem.

22. Revelation 12:3, 4: These texts state: "*His tail drew a third of stars of heaven [angels] and threw them to the earth*". This embraces unit fraction, fraction as a set and as an operator [one-third of] and presents an estimation problem- determining the **minimum** number of angels

created by God. Revelation 5:11 renders it "*ten thousand times ten thousand, and thousands of thousands" of angels*. This is estimable as: [10,000 × (10,000 + (1,000 × 1,000)] =10,000 × (10,000 + 1,000,000) = 10,000 × 1,010,000= 10,100,000,000. [Ten billion and one hundred million]. Also estimable as: (10,000 × 10,000) + (1000 × 1000) = 100,000,000 + 1,000,000 = 101,000,000 [One hundred and one million]. This figure seems probable as Daniel 7:10 renders it: "*A thousand thousand ministered; Ten thousand times ten thousand stood before Him*". [(1000 × 1000) + (10000 × 10000)] = [1,000,000 + 100,000,000] = 101,000,000. This constituted two-thirds of angelic host. One-half of this yields 50,500,000 [Fifty million and five hundred thousand]; giving a ratio of unfallen to fallen angels as 2:1. In sum, the **minimum** number of angels comes to 151,500,000 [One hundred and fifty one million and five hundred thousand]. Based on UN estimates, this figure is between the 2023 population figures for Bangladesh, 172,954,319 and Russia, 144,444,359 (Worldometer, 2023).

23. Revelation 21: Geometric properties of descending cube "*city of God*", with same dimensions and perimeter "*twelve thousand furlongs*" measured with a "*reed*" [rod] and viewed from an angled position-"*a great and high mountain*". Its wall, 144 cubits high. The city has length 3000 furlongs [fl.]; area, 90,000,000 sq. fl. and volume, 27,000,000,000 cubic fl. Conversion reveals its modern-era reality. A furlong, from "furrow-long," is 201.1680 meters (m) or one-eighths of a mile (mi) (Britannica.com, n.d.). The perimeter of the city is 1500 mi [i.e.12000/8]. It has length 375 mi [i.e.1500/4]; area, (375 × 375) sq. miles [**140, 625 mi^2**] and volume, (375 × 375 × 375) cubic miles **[52, 734, 375 mi^3].** The height of 375 mi (603504 m) is **727** (nearest whole; a palindrome) times taller than Burj Khalipha, the tallest building in the world (829.8m). The area is about 3000 **mi^2** bigger than Germany and 4000 **mi^2** smaller than Japan. This text embraces measurement, 3-D geometry and visualization.

These 23 itemized texts or combinations of texts reveal that mathematics, some amenable to formulation, are embedded in the texts and underlie the contexts of scripture. Their characteristics follow.

Characteristics of Mathematics in the Bible

The texts and contexts reveal mathematics in the Bible is characterized by principles, elements, operations, problems and process skills; logic, internal logic, coherence and fact validation; equipment and diversity of content areas. Evidence of these are provided.

1. Principles: These include equivalence, ordering, proportionality and dimensionality. Equivalence is in equations (HE and FPD formulas); inequality/ordering, in non-equivalence contexts (Mark 12:41-44; Genesis 5; 11); proportionality, in equated equivalent ratios (Judges 20:10) and dimensionality in points, line (length), area (length and breadth) and volume (length, breadth and height) with possible extension to the fourth dimension, "strength", an attribute of God (Rev. 5: 12).

2. Elements: These are specific mathematical ideas or concepts; not members of a set. Numbers as ordinal and cardinal, number bases (seven and ten) and palindromes; numeration system thus counting and calculation (see Genesis 5; 11; Revelation 13:18); arithmetic and geometric sequences/series (Genesis 18; Exodus 18) and logic, logical pattern and puzzle (John 3:16; I Timothy 3:16). Also, mathematical formulas (implicit) (Genesis 5, 11; Exodus 18; Leviticus

26:14-28); statistical data-calculations, representation and interpretation (Genesis 5, 11; Exodus 18); chance (I Samuel 6:9); fractions, ratio, proportion, percentage, equations and inequalities (Mark 12:41-44; Judges 20:10); measurements and measuring units; 1, 2 and 3-dimesional geometrical shapes and ideas; angles in angular rotation (Revelation 21; 2 Kings 20:1-11); costing and evaluation (Mathew 20; Mark 14:1-8].

3. Operations: Explicit operations such as addition, ["add"] (Rev 22: 18); subtraction, ["take away"] (Revelation 22: 19); multiplication, "multiply" (Leviticus 26:9); division, ["divide"] (Exodus 21: 25); fraction as operator, ["a third of"] (Rev. 12:3) and implicit exponential operation (squaring) (Leviticus 26:14-28) and number [verb, implying count] (Exodus 1:18).

4. Problems and Process Skills: Explicit mathematical problems- calculating for 666 (Revelation 13:18); Fraction and measurement in baking (Leviticus 24:5-6); sundials/mathematics physics (2 Kings 20:1, 8-10) and costing of spikenard oil (Mark 14:1-8) and many implicit ones (see Genesis 18; Exodus 18) are in the Bible. Problems require human solution thus invoke deployment of mathematical processes (used by people to solve problems). An auto-ethnographic reflection on the mathematizing involved in this study indicates process skills such as conjecturing, visualizing, formulating, generalizing, symbolizing, calculating, estimating and tabulating among others.

5. **Logic, Internal Logic and Fact-Validation:** Logic, in terms of tools, symbols (implied) and games [John 3:16; 1 Timothy 3:16 and Mark 16:19-20], internal logic [Gen 5, 11], mathematical coherence [Genesis 18 and Exodus 18; Ephesians 3:18 and Revelation 21] and fact-validation [Daniel 7:10 and Rev. 12; Mathew 20 and 2 Kings 20:1, 8-10; [Genesis 5 and 11].

6. Equipment and Devices: Mathematical equipment/devices include measuring rods/reed (Revelation 11:1; 21:15, 16), scale for quarts/measures (Revelation 6:6) and sundials [time, angles and shadow formation] (2 Kings 20:1). Isaiah 40:12 gives a list of such instruments.

7. Diverse Content Areas: Content areas include number (and numeration), algebra, geometry and measurement and data and chance and engineering mathematics/mathematical physics and logical puzzles. These are shown in Tables 6-10.

Table 6: Number and Numeration

Bible Texts	Ideas/Principles/ Strategies/Concepts
Genesis 14:20	A "tithe", 'a tenth'; symbolized 1/10 or 0.10 or 10%. Decimal expressions-ten as base for Hindu-Arabic numeration
Genesis 15:13-16	Division problem (A generation approximately100 years) and terms-dividend, divisor and quotient.
Genesis 41:34	Joseph's formula: $\frac{1}{5} \times 7 = \frac{7}{5} = 1\frac{2}{5}$
Genesis 47:24	Fraction addition and concept of one whole: $\frac{1}{5} + \frac{4}{5} = \frac{5}{5} = 1$
Exodus 30:23-24	Ratio for four components of anointing oil 2:1:1:2 (myrrh: cinnamon: cane: cassia)
Leviticus 22:14; 23:12	$\frac{1}{5}$ and $\frac{2}{10}$ respectively; equivalent fractions
Leviticus 25:8,10	$7\times 7 = 49$; Jubilee: 49+1=50. Thus $7\times 7 + 1 = 50$

Leviticus 27	Demographic-based valuation: Ratio, fractions and percentages (60%; 50%; 66.$\dot{6}$%; 20%). g: s =20:1 h: s =1:50, g:h=? ; $\frac{1}{10}+\frac{1}{10}\left(\frac{1}{5}\right)=\frac{1}{10}+\frac{1}{50}=\frac{3}{25}$.
Numbers 1-4; 11:21; 15: 4-10 [28; 29]; 16: 31:5.	Estimation of number of Israelites; Unit and non-unit fractions [FOWL-RB fractions] and ordering: $\frac{1}{10},\frac{2}{10},\frac{3}{10}$ and $\frac{1}{4},\frac{1}{3},\frac{1}{2}$; 50+250+14700=15000; 1000 × 12= 12000
Daniel 8:14; 9:20-27	Integer operation on real number line with applications in date calculations.
Acts 19: 19	Present value of magical books burnt-Fifty thousand pieces of silver.

Source: Field Data, 2023

Table 7: Algebra

Bible Texts	**Ideas/Principles/ Strategies/Concepts**
Exodus 30:23-24	Expression "half as much…" as one-half of reference quantity [$\frac{1}{2}x$=y] and an operator
Leviticus 26:8-9; 14-28	Chaos analysis (puzzle) and algebraic exponential sequence; 'multiply' imply exponential increase (vs9) ; Sinning to obstinacy [$7^{(n-1)} \rightarrow 7^n$]
Isaiah 46:5, 9	**M**athematical 'trilogy' $=, <$ and $>$ inferred. Idolaters presume: Idols $>$ God or Idols=God and summarized as Idol $\geq$God. God declares: God>Idols [Exodus 18:11]
Matthew 26:69-75	Patterns: DDDC…; ADADADC…; DCDDC…
Mark 10:8-12	1+1=2, "joined" to form a new 'product' (×), "flesh" thus, 1 × 1=1
Romans 3:23	$GG - HG = x$ (Effect of sin)

Source: Field Data, 2023

Table 8: Geometry and Measurement

Bible Texts	**Ideas/Principles/ Strategies/Concepts**
Exodus 30:1-2	Altar of incense (cubits) in modern units
Ezekiel 45:10-14	Measures: Basic-ephah/bath: homer = 1:10; garah: shekel: maneh (mina) =1: 20: 1200 and bath: homer: cor (Kor) =1:10:100
Isaiah 40:12, 22; 44:13; 43:5, 6	Terms-measure, weigh, span, scales, circle, compass and compass points-North, South East and West. Israel as point of intersection or reference
2 Corinthians 3:18 [1 Corinthians 15:35-58]	Reflection of object in/as image. Holy Spirit, mirror/ line of reflection, facilitating change from real (bodily) to virtual (Image of God-spirit beings).
Ephesians 3:18	"Comprehend", spatial sense and reasoning, the height (high), width (wide), length (long) and depth (deep) of love, an

	abstract geometric entity in space (physically, New Jerusalem). Embraces collinearity, perpendicularity, parallelism and co-planarity.
Revelation 4:1- 6; 5:6, 11-14.	Problem solving- geometrical drawing and geometric transformation

Source: Field Data, 2023

Table 9: Data and Chance

Bible Texts	**Ideas/Principles/ Strategies/Concepts**
Genesis 35:23-26	Conditional probability: Picking two- a child each of Leah and Rachel = $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$; Leah or Rachel $\frac{1}{2} + \frac{1}{6} = \frac{2}{3}$
Numbers 31:25-54	Sharing of booty- Calculation and representing (graphing-Pie-chart).
I Samuel 6:9	The concept of chance (uncertainty)
Ezra 1	Data, statistics, graphing
Nehemiah 7	Data, statistics, graphing
Isaiah 60:17	Nominal and ordinal data [Gold=1 (1st); Silver=2 (2nd); bronze=3(3rd) and stone =4(4th)]. [Iron, tin & lead added (Numbers 31:22)]
Mark 3:20-30	Statistical error: Type II Error
Matthew 27:35	Casting lots: chance and outcomes. With a coin, 2 outcomes (Head or Tail)

Source: Field Data, 2023

Table 10: Mathematical Physics and Engineering/Puzzle

Bible References	**Ideas/Principles/ Strategies/Concepts**
Ezekiel 48	City and land planning-locating and measurements
Revelation 22:1,2[Ezekiel 47:12];18-19	The puzzle of the tree of life in the middle of a street yet on either sides of the river. “add” (+) and “take away”(−).

Source: Field Data, 2023

The diversity of content areas revealed in Tables 6 to 9 match 21st century K-12 Mathematics Curriculum in Ghana (MOE, 2019). There are elements beyond this levels (i.e. Sundial-related mathematical physics; nth terms and sum to infinity of arithmetic and geometric sequences; statistical error, types of quantitative data).

Mathematics in the Bible has characteristics- *P*rinciples, *E*lements, *O*perations, *P*roblems ***and*** *P*rocess Skills, *L*ogic, logical coherence and fact-validation; *E*quipment (devices) and *D*iversity of content areas. These form an acrostic: ‘PEO*P*LED’. Problem solving requires people (humans) to deploy mathematical process skills, thus, **P**rocesses used by **P**eople to solve mathematical **P**roblems (P-P-P). Mathematicians play this role, thus, are the People in the mist of the PEO***P***LED who use mathematical processes to solve problems. The italicized P in the mist indicates the centrality (mean and median) of the human factor in mathematical exploration and applications.

When P-P-P is used, it expands to PEOP-P-PLED, the human-related factor retains its central status.

Discussion

Literally, the findings reveal formulations that address contemporaneousness of the Biblical patriarchs and Human Existence (HE) on Earth. Thus, based on biblical records, Human Existence (H.E.) on Earth is one-digit multiples of a thousand years and not 315,000 years or theoretical millions of years (see Howard, 2023). The patriarch's ages have been explored, tabulated and formulated (see Christensen, n.d.; Price, 2012; Shalman, 2009) but these did not derive these generalized formulas and Reuben's age relative to Joseph's. The use of scientific phenomena to demonstrate God's power to heal and deliver a dying King gives mathematical credence to the Bible's existential dimension. The derived formulas (HE, FPD; nth and sum to nth terms of AP and GP series) and explicated mathematical ideas indicate, at least, that mathematics in the Bible is not unsophisticated. In 'Elements of mathematics', Stillwell (2016) cites elements in mathematics as arithmetic, computation, algebra, geometry, calculus, combinatorics, probability, and logic. Thus, the use of 'elements' to designate specific mathematical ideas or concepts is thus justified.

That the acrostic "PEOPLED" characterizes mathematics in the Bible is insightful and intriguing. Could it be a prompt that mathematics derived from **'peopled'** groups and meant for the '***people***' (masses) but not a privileged few? The highlight of the centrality of the human factor in problem solving through application of processes is also intriguing. The emergence of process skills such as estimating, calculating, conjecturing and visualizing in this study confirms problem solving as key characteristic of Bible mathematics. Ghana's K-12 curriculum (MOE, 2019) cites observing, communicating, designing, measuring, interpreting and deriving conclusions etcetera as process skills leaners must acquire through contextualized situations and these have reflected in this study.

That mathematics in the Bible matches the contents for instruction in 21st century K-12 Ghanaian Basic School Curriculum (MOE, 2019) with some elements applicable at the tertiary level attests to the pervasiveness of mathematics, its embeddedness in context and its modern-era mathematical relevance. The Bible provides contextualized mathematics deemed ideal for developing proficiency and capacity for transfer to real-life situations (Tout, 2014; Van den Heuvel-Panhuizen, 2000). As already revealed in literature (Adejumo, 2018; Baker, 2016; Christensen, n.d.; Matiki, 2014) and confirmed in this study, exquisite mathematics implicitly and explicitly embed the Bible texts and contexts.

Stillwell (2016) has explicated how arithmetic, computation, algebra, geometry, calculus, combinatorics, probability, and logic interplay into more advanced mathematical topics required for building up mathematics as a whole. Bishop (1988) also alludes to counting, locating (in space), measuring, designing, playing and explaining as six universal practices that generate mathematics in all cultures. The diverse mathematical contents and elements indicate that the Bible has nearly all that is required for building up mathematics. Had the Bible been embraced and studied as an authoritative document, it would have activated the discovery of todays' level of mathematics disciplinary knowledge. Representing or symbolizing of these ideas, the first step in mathematizing, could have triggered it.

This study presents a mathematical context and perspective to the Bible that deepens the religious and spiritual insights gleaned from the texts and points to the fact that mathematics is intricately interwoven with spiritual and religious phenomena. The appreciation of the mathematical elements in the texts of the Bible points to the pervasiveness of mathematics and supports the argument that every aspect of life has mathematical interpretation. The Bible thus has academic or educational value that can be harnessed to enrich curriculum and instruction.

Conclusion

Rich and cognitively challenging formulable or explicable mathematics elements, ideas and concepts, are in the texts and underlie contexts of the Bible. It includes mathematics related to existential issues and scientific phenomena. Specifically, there are among others, formulable statistical data for estimating existence on earth and age of a patriarch relative to another; formulable twin geometric and arithmetic sequences and estimates for minimum number of created angels and the size of New Jerusalem. John 3:16, interpreted mathematically, is a logical statement, and mathematics in the Bible, based on the selected texts, is characterized by principles, elements, operations, problems and process skills, logic, logical coherence and fact validation, equipment (devices) and diversity of content areas. These form an acrostic: PEO*P*LED. The Bible thus has mathematical worth. It looks plausible more mathematics are in the Bible awaiting unravelling.

Recommendations

The following are recommended:

1. First, mathematics is better studied in and from contexts. Faith-based schools can incorporate the unraveled mathematics in biblical context into their curriculum and the teachers can use it to self-train on mathematizing from context.
2. A study by mathematics teacher educators and researchers that translates the mathematical contents and ideas captured in this study into mathematical problems in real classroom is needed to validate the practicality.
3. A study can be commissioned by universities and Christian missions to unravel mathematics inherent in the entire book of the Bible to better appreciate its mathematical worth and explore ways of incorporating it into the existing curriculum to enrich it for faith-based education.
4. The mathematical processes involved in mathematizing mathematics in the Bible require unravelling. This would enhance the mathematical value of the Bible.
5. The Bible is the religious text used in this study; it can be replicated with other religious texts and compared.

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