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Supporting Evidences To the Exact π Value from the Works Of Hippocrates Of Chios, Alfred S. Posamentier And Ingmar Lehmann

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Abstract: *Till very recently we believed 3.1415926… was the final value of π.And no body thought exact π value would be seen in future. One drawback with 3.1415926…is, that it is* ***not*** *derived from any line-segment of the* ***circle****. In fact, 3.1415926… is derived from the line-segment of the inscribed/ circumscribed* ***polygon*** *in and about circle, respectively. Surprisingly, when any line-segment of the circle is involved two things happened: they are 1. Exact π value is derived and 2 that exact value differs from 3.1415926… from its 3rd decimal onwards, being 3.1464466… Two geometrical constructions of* ***Hippocrates of Chios,*** *Greece (450 B.C.) and* ***Prof. Alfred S. Posamentier*** *of New York, USA, and* ***Prof. Ingmar Lehmann*** *of Berlin, Germany, are the supporting evidences of the new π value. They are detailed below.*
Keywords: *π value, lune, triangle, area of curved regions*

I. Introduction

In the days of **Hippocrates**, π value 3 of the **Holy Bible** was followed in mathematical calculations. He did not evince interest in knowing the **correct** value of π. He wrote a book on Geometry. This was the **first book** on Geometry. This book became later, a guiding subject for **Euclid's Elements**. He is very famous for his squaring of lunes. **Prof. Alfred S. Posamentier** and **Prof. Ingmar Lehmann** wrote a **very fine** collaborative book on π. They have chosen two regions and have proved both the regions, though appear very different in their shapes, still both of them are **same** in their **areas**. These areas are represented by a formula $r^2\left(\frac{\pi}{2}-1\right)$. The symbol 'r' is radius. π, here must be, the **universally** accepted 3.1415926…

Every subject in Science is based on one important point. It would be its **soul**. In Geometry, the soul is a **line-segment**. The study of **right** relationship between two or more line-segments help us to find out areas, circumference of a circle, perimeters of a triangle, polygon etc. For example, we have **side** in the square, **base**, **altitude**in the triangle. The same concept is **extended** here, to show its inevitable importance in the study of two regions of Professors of USA and Germany. The lengths of the concerned line-segments have been arrived at and associated with $r^2\left(\frac{\pi}{2}-1\right)$. 3.1415926… **does not** agree with the value of line-segments of two regions. However, the new value 3.1464466… = $\frac{14-\sqrt{2}}{4}$ has agreed *in to-to* with the line-segments of the two regions of the Professors. This author does believe this argument involving interpretation of $r^2\left(\frac{\pi}{2}-1\right)$ with the line-segments, is acceptable to these great professors and the mathematics community. It is only a humble submission to the World of Mathematics. **Judgment is yours**. If this argument in associating line-segment with the formula looks **specious** or superficial, this author may **beexcused**.

II. Procedure

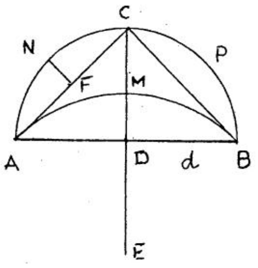
The two methods are as follows:

1. Hippocrates' Method of Squaring Lunes And Computation of The Exact π Value

"Archimedes's procedure for finding approximate numerical values of π (without, of course, referring to πas a number), by establishing narrower and narrower limits between which the value must lie, turned out to be the only practicable way of squaring the circle. But the Greeks also tried to square the circle exactly, that is they tried to find a method, employing only straight edge and compasses, by which one might construct a square equivalent to the given circle. All such attempts failed, though Hippocrates of Chios did succeed in squaring lunes.

Hippocrates begins by noting that the areas of similar segments of circles are proportional to the squares of the chords which subtend them

Consider a semi-circle ACB with diameter AB. Let us inscribe in this semi-circle an isosceles triangle ACB, and then draw the circular arc AMB which touches the lines CA and CB at A and B respectively. The segments ANC, CPB and AMB are similar. Their areas are therefore proportional to the squares of AC, CB and AB respectively, and from Pythagoras's theorem the greater segment is equivalent to the sum of the other two. Therefore the lune ACBMA is equivalent to the triangle ACB. It can therefore be squared".



The Circular arc AMB which touches the lines CA and CB at A and B respectively can be drawn by taking E as the centre and radius equal to EA or EB.

AB = diameter, d. DE = DC = radius, d/2; F = mid point of AC

N = mid point of arc AC

NF = $\frac{\sqrt{2}d-d}{2\sqrt{2}}$; DM = $\frac{\sqrt{2}d-d}{2}$; MC = $\frac{\sqrt{2}d-d}{\sqrt{2}}$

With the guidance of the formulae of earlier methods of the author where a Circle is inscribed with the Square, the formulae for the areas of ANC, CPB, ACM and BCM are devised.

1. Area of ANC = Area of CPB = $2\left\{\frac{d^2}{32}\left(1+\frac{\sqrt{2}-1}{2\sqrt{2}}\right)\right\}$

2. Area of AMB = Areas of ANC + CPB (Hippocrates)

3. Area of ACM = Area of BCM = $\dfrac{\frac{\left(\sqrt{2}d\right)^2}{16}}{8\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)}$

4. Area of ACB triangle = $\frac{1}{2}\times\frac{d}{2}\times d$

5. According to Hippocrates the area of the lune ACBMA is equivalent to the area of the triangle ACB

Lune ACBMA = triangle ACB

(ANC + ACM + BCM + CPB)

$$\text{i.e. } 4\left\{\frac{d^2}{32}\left(1+\frac{\sqrt{2}-1}{2\sqrt{2}}\right)\right\}+2\left\{\dfrac{\frac{\left(\sqrt{2}d\right)^2}{16}}{8\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)}\right\}=\frac{1}{2}\times\frac{d}{2}\times d$$

ANC + CPB ACM+BCM ACB

From the above equation it is clear that the devised formulae for the areas of different segments is **exactly** correct.

6. Area of AMB = Areas of ANC + CPB

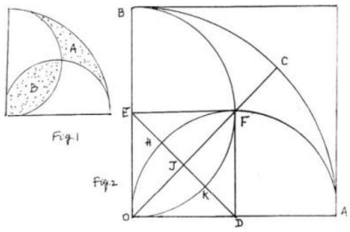
7. Area of the semicircle = $\frac{\pi d^2}{8}$ = Areas of ANC + CPB + ACM + BCM + AMB

8. $\pi = \frac{8\times \text{Area of the semicircle}}{d^2}$

$$= \frac{8}{d^2}\left[4\left\{\frac{d^2}{32}\left(1+\frac{\sqrt{2}-1}{2\sqrt{2}}\right)\right\}+2\left\{\dfrac{\frac{\left(\sqrt{2}d\right)^2}{16}}{8\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)}\right\}+4\left\{\frac{d^2}{32}\left(1+\frac{\sqrt{2}-1}{2\sqrt{2}}\right)\right\}\right] = \frac{14-\sqrt{2}}{4}$$

2. Alfred S. Posamentier's similarity of the two areas

and decimal similarity between an area and its line-segments

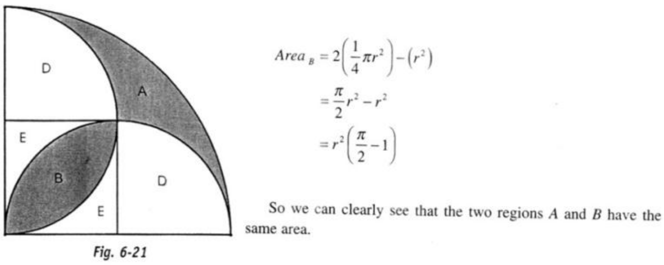


Prof. A.S. Posamentier has established that areas of A and B regions are equal. His formula is $r^2\left(\frac{\pi}{2}-1\right)$ for the above regions. This author is grateful to the professor of New York for the reason through his idea this author tries to show that his new π value equal to $\frac{1}{4}\left(14-\sqrt{2}\right)$ is **exactly** right.

1. Arc = BCA; O = Centre; OB = OA = OC = Radius = r
2. Semicircles : BFO = AFO; E and D = Centres; OD=DA = BE = OE= radius= $\frac{r}{2}$

   OF = $\frac{\sqrt{2}r}{2}$; FC = OC – OF = $r-\frac{\sqrt{2}r}{2}$ = $\frac{2r-\sqrt{2}r}{2}$
3. Petal = OKFH; EK = $\frac{r}{2}$; ED = $\frac{\sqrt{2}r}{2}$; EJ = $\frac{\sqrt{2}r}{4}$; JK = EK – EJ = $\frac{r}{2}-\frac{\sqrt{2}r}{4}=\frac{2r-\sqrt{2}r}{4}$;

   JK = JH, HK = JH + JK = $\frac{2r-\sqrt{2}r}{2}$
4. So, FC of region A = HK of region B = $\frac{2r-\sqrt{2}r}{2}$
5. BFAC = OKFH i.e. areas of A and B regions are equal (**A.S. Posamentier** and **I. Lehmann)**.



(By Courtesy: From their book)

Formula for A and B is $r^2\left(\frac{\pi}{2}-1\right)=\frac{r^2}{2}\left(\pi-2\right)$

Here r = radius = 1

From March 1998, there are two π values. The official π value is 3.1415926… and the new π value is $\frac{14-\sqrt{2}}{4}$ = 3.1464466… and which π value is exact and true ?

Let us substitute both the values in $\frac{r^2}{2}\left(\pi-2\right)$, then

Official πvalue $=\frac{r^2}{2}\left(3.1415926-2\right)$ = $\frac{r^2}{2}\left(1.1415926...\right)$

(It is universally accepted that 3.1415926… is approximate at its **last decimalplace** however astronomical it is in its magnitude.)

New π value = $\frac{r^2}{2}\left(3.\underline{1464466}-2\right)$ = $\frac{r^2}{2}\left(1.\underline{1464466}...\right)$

6. FC = HK (HJ + JK) line segments = $\frac{2r-\sqrt{2}r}{2}$
7. Half of HC and HK are same $\frac{FC}{2}=\frac{HK}{2}=\left(\frac{2r-\sqrt{2}r}{2}\right)\frac{1}{2}$ = $\frac{2r-\sqrt{2}r}{4}$ = **0.1464466…..**
8. Area of A/B region equal to 1.1464466… is similar in **decimal** value of half of FC/HK line segment i.e. 0.1464466…
9. Formulae a^2, 4a of square and ½ab of triangle are based on side of the square and altitude, base of triangle, respectively. In this construction, FC and HK are the line segments of A and B regions, respectively.

As the value 0.1464466… which is half of FC or HK is in **agreement** with the area value of A/B region equal to 1.1464466… in **decimal** part, it is argued that new π value equal to $\frac{1}{4}\left(14-\sqrt{2}\right)$ = 3.1464466… is **exactly** correct.

The decimals 0.1415926… of the official π value 3.1415926… does not tally beyond 3rd decimal with the half the lengths of HK and FC, whose value is 0.1464466, thus, the official π value is **partially** right. Whereas, FC & HK are **incompatible** with the areas of A & B calculated using official π value. **Then, which π is real, Sirs?**

III. Conclusion

3.1415926… agrees partially (upto two decimals only) with the line-segments of **curved** geometrical constructions. When these line-segments agree totally and play a significant role in these constructions a different π value, exact π value $\frac{14-\sqrt{2}}{4}$ = 3.1464466… invariably appears. Hence, $\frac{14-\sqrt{2}}{4}$ is the **true value**of π.

Acknowledgements

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