Pi treatment for the constituent rectangles of the superscribed square in the study of exact area of the inscribed circle and its value of Pi (SV University Method*).

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Abstract: Pi value equal to 3.14159265358... is derived from the Exhaustion method of Archimedes (240 BC) of Syracuse, Greece. It is the only one geometrical method available even now. The second method to compute 3.14159265358... is the infinite series. These are available in larger numbers. The infinite series which are of different nature are so complex, they can be understood and used to obtain trillion of decimals to 3.14159265358... with the use of super computers only. One unfortunate thing about this value is, it is still an approximate value. In the present study, the exact π value is obtained. It is \[ \frac{14 - \sqrt{2}}{4} = 3.14644660942... \]

A different approach is followed here by the blessings of the God. The areas of constituent rectangles of the superscribed square, are estimated both arithmetically, and in terms of π of the inscribed circle. And π value thus derived from this study of correct relationship among superscribed square, inscribed circle and constituent rectangles of the square, is exact.

Keywords: Circle, diagonal, diameter, area, radius, side, square

I. Introduction

Square is an algebraic geometrical entity. It has four sides and two diagonals which are straight lines. A circle can be inscribed in the square. The side of the square and the diameter of the inscribed circle are same. This similarity between diameter and side, has made possible to find out the exact length of the circumference and the exact extent of the area of the circle, when this interrelationship between circle and its superscribed square, are understood in their right perspective. The difficulty is, the inscribed circle is a curvature, though, its diameter/ radius is a straight line as in the case of side, diagonal of the square. When we say a different approach is adopted, it means, these are entirely new to the literature of mathematics. The universal acceptance to the new principles observed in the following method is a tough job and takes time. However, as the following reasoning ways are cent percent in accordance with the known principles, understanding of the idea is easy.

To study the different dimensions, such as, circumference and area of circle, π constant is inevitable. Similarly, to understand perimeter and area of the square, 4a and a² are adopted and hence, no constant similar to circle is necessary in square. In the present study, the area of the square is divided into five rectangles. The areas of rectangles are calculated in two ways: they are: 1. Arithmetical way and 2. In terms of π of the inscribed circle. Finally, the arithmetical values are equated to formulas having π, and the value of π is derived ultimately, which is exact.

II. Procedure

Draw a square and its two diagonals. Inscribe a circle in the square.

1. Square = ABCD, AB = Side = a
2. Diagonals = AC = BD = \( \sqrt{2}a \)
3. ‘O’ Centre, EF = diameter = side = a
4. The circumference of the circle intersects two diagonals of four points: E, H, F and G. Draw a parallel line IJ to the sides DC, passing through G and F.
5. OG = OF = radius = a/2
6. Triangle GOF: GF = hypotenuse = \( \frac{OG \times \sqrt{2}}{2} = \frac{a}{2} \times \sqrt{2} = \frac{\sqrt{2}a}{2} = GF \)

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7. \(IJ = \text{side} = a\)

8. \(DI = IG = FJ = JC = \frac{\text{Side} - \text{hypotenuse}}{2} = \frac{IJ - GF}{2}\)

\[= \left( a - \frac{\sqrt{2}a}{2} \right) \times \frac{1}{2} = \left( \frac{2 - \sqrt{2}}{4} \right) a = JC\]

9. \(JC = \left( \frac{2 - \sqrt{2}}{4} \right) a\), \(CB = \text{side} = a\)

\(JB = CB - CJ = a - \left( \frac{2 - \sqrt{2}}{4} \right) a = \left( \frac{2 + \sqrt{2}}{4} \right) a\)

10. Bisect \(JB\) twice of \(CB\) side of Fig-2

\(JB \rightarrow JL + LB \rightarrow JK + KL + LM + MB\)

\[= \left( \frac{2 + \sqrt{2}}{4} \right) a \rightarrow \left( \frac{2 + \sqrt{2}}{8} \right) a \rightarrow \left( \frac{2 + \sqrt{2}}{16} \right) a\]

11. Similarly, bisect \(IA\) twice, of \(AD\) side of Fig-2

\(IA \rightarrow IP + PA \rightarrow IQ + QP + PN + NA\)

12. Join \(QK, PL, \) and \(NM\).

13. Finally, the \(ABCD\) square is divided into five rectangles.

\(DJJC, IQKJ, QPLK, PNML\) and \(NABM\)

Out of the five rectangles, the uppermost rectangle \(DJJC\) is of different dimension from the other four bottomed rectangles.

14. Area of \(DJJC\) rectangle

\[= DI \times IJ = \left( \frac{2 - \sqrt{2}}{4} \right) a \times a = \left( \frac{2 - \sqrt{2}}{4} \right) a^2\]

15. The lower four rectangles are of same area. For example one rectangle

\[= IQKJ = IQ \times QK = \left( \frac{2 + \sqrt{2}}{16} \right) a \times a = \left( \frac{2 + \sqrt{2}}{16} \right) a^2\]

16. Area of 4 rectangles
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\[ = IQKJ + QPLK + PNML + NABM = 4 \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = \left( \frac{2 + \sqrt{2}}{4} \right) a^2 \]

17. Area of the square ABCD
\[ = DJJC + 4 \text{ bottomed rectangles} = a^2 \]
\[ = \left( \frac{2 - \sqrt{2}}{4} \right) a^2 + 4 \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = a^2 \]

**Part-II**

18. Let us repeat that
Area of the ABCD square = \( a^2 \)
Area of the inscribed circle = \( \pi d^2 = \frac{\pi a^2}{4} \); where diameter = side = \( a \)

19. When side = diameter = \( a = 1 \)
Area of the ABCD square = \( a^2 = 1 \times 1 = 1 \)
Area of the inscribed circle = \( \pi d^2 = \frac{\pi a^2}{4} = \frac{\pi \times 1 \times 1}{4} = \frac{\pi}{4} \)

20. Corner area in the square (of Figs 1, 2, and 3)
\[ = \text{Square area} - \text{circle area} \]
\[ = 1 - \frac{\pi}{4} = \frac{4 - \pi}{4} \]

21. It is true that any bottomed 4 rectangles, is equal to the corner area of the square of Figs 1, 2 and 3. Thus,
\[ \text{bottomed rectangle} = \text{corner area} \]
\[ \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = \left( \frac{2 + \sqrt{2}}{16} \right) \times 1 \times 1 = \frac{2 + \sqrt{2}}{16} \]

**Part-III**

22. Let us prove it i.e. S. No. 21

23. The inscribed circle is equal to the sum of the areas of upper most rectangle DJJC = \( \frac{2 - \sqrt{2}}{4} a^2 \) of S.No. 14 and next lower 3 rectangles IQJK, QPLK and PNML, and each is equal to \( \frac{2 + \sqrt{2}}{16} a^2 \) of S.No. 15
\[ \left( \frac{2 - \sqrt{2}}{4} \right) a^2 + 3 \left( \frac{2 + \sqrt{2}}{16} \right) a^2 = \left( \frac{14 - \sqrt{2}}{16} \right) a^2 = \frac{\pi a^2}{4} \]

24. Area of the inscribed circle = \( \frac{\pi a^2}{4} = \frac{\pi}{4} \); where \( a = 1 \)

Area of the corner region = \( \frac{4 - \pi}{4} \) (S.No. 20)
Area of the inscribed circle + corner area = square area
\[ \frac{\pi}{4} + \frac{4 - \pi}{4} = 1 \]

25. The sum of the areas of 4 bottomed rectangles
\[ = \text{Square area} - \text{Uppermost rectangle DJJC} \]
= a² - \left( \frac{2 - \sqrt{2}}{4} \right) a² = \left( \frac{2 + \sqrt{2}}{4} \right) a² and

S. No. 14 this is equal to S.No. 16

26. As the area of the corner region is equal to any one of the 4 bottomed rectangles,
then it is = \left( \frac{4 - \pi}{4} \right) a² (S.No. 20 & 21)

27. Then the sum of the areas of 4 bottomed rectangles
= 4 \left( \frac{4 - \pi}{4} \right) a² = (4 - \pi) a²

28. Finally,
Area of the uppermost rectangle DIJC
= Square area – 4 bottomed rectangles
= a² - (4 - \pi) a² = (\pi - 3) a²

29. CJ length = (\pi - 3) a
Side = AB = IJ = a
Area of the upper most rectangle DIJC
= CJ x IJ = (\pi - 3) a

10. Area of the upper most rectangle DIJC
= S. No. 21

31. Thus, the areas of five rectangles which are interpreted in terms of \(\pi\) above, are
▷ Uppermost rectangle DIJC = (\pi - 3) a²
▷ 4 bottomed rectangles = (4 - \pi) a²
▷ Area of the ABCD square
▷ Uppermost rectangle + 4 bottomed rectangles
= (\pi - 3) a² + (4 - \pi) a² = a²
▷ Area of the inscribed circle
= Uppermost rectangle DIJC + 3 bottomed rectangles
= (\pi - 3) a² + 3 \left( \frac{4 - \pi}{4} \right) a² = \frac{\pi}{4} a²

This is the end of the process of proof.

32. As the corner area is equal to

1. Arithmetically = \left( \frac{2 + \sqrt{2}}{16} \right) a² = \left( \frac{2 + \sqrt{2}}{16} \right) S. No. 21 where a = 1

and 2. in terms of \(\pi\) = \frac{4 - \pi}{4} S. No. 20

then \(\frac{4 - \pi}{4} = \frac{2 + \sqrt{2}}{16}\)

∴ \(\pi = \frac{14 - \sqrt{2}}{4}\)

III. Conclusion

It is well known, that \(a²\) is the formula to find out area of a square or a rectangle. In this paper besides \(a²\), formulae, in terms of \(\pi\), of the inscribed circle in a square, are obtained, and equated to the classical arithmetical values of \(a²\). One has to admire the Nature, that a circle’s area can also be represented exactly equal, by the areas of rectangles, thus, the arithmetical values of these rectangles, are equated to that of a circle, which thus give rise to new \(\pi\) value \(\frac{14 - \sqrt{2}}{4} = 3.14644660942\ldots\) This author stands and bow down and
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dedicates this work to the Nature. The Nature is the visible speck of the infinite Cosmos. The Creator exists in the invisible Energy form of this infinite Cosmos. We call this Creator as GOD and this author offers himself, surrenders himself totally and prays to THE LORD of the Cosmos of His/ Hers/ It’s infinite goodness, as an infinitesimally, a small living moving body, as a mark of humble gratitude to THE LORD.

References


