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Mathematics and Decision Science

Highlights

- Circular Map Coloring Method
- Development of Emotional Skills
- Approximation to Angle Trisection
- Szász-Mirakjan-Durrmeyer Operators

Discovering Thoughts, Inventing Future

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A 4-Color Circular Map Coloring Method

By Shijun Han

Abstract- Different vertices are colored in a plan. Adjacent vertices are colored differently from nonadjacent vertices, which are colored the same color. One color is used for a single point, two color are used for points without a loop, and a maximum of four color are used for points with a loop. A maximum of four color are used to color all points.

Keywords: *map, four color, four color conjecture, graph theory.*

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Abstract- Different vertices are colored in a plan. Adjacent vertices are colored differently from nonadjacent vertices, which are colored the same color. One color is used for a single point, two color are used for points without a loop, and a maximum of four color are used for points with a loop. A maximum of four color are used to color all points.

Keywords: *map, four color, four color conjecture, graph theory.*

I. Introduction

In a plan, different vertices are colored. Adjacent vertices are colored differently, whereas non-adjacent vertices are colored the same. A maximum of four color are required.

a) Points without a Loop[1]

In a plan, only one color is necessary for a single point, while two colors are enough for points without a loop. (Figure 1)

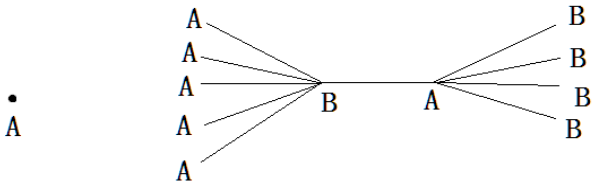

Figure 1: 1-color and 2-color chromatic graphs

b) Points with a Loop

In a plan, points with a loop create a "circle". Two colors are used for even numbers of points, and three colors are used for odd numbers of points (left in Figure 2). The central point in the "circle" formed by the central point and adjacent points (middle and right in Figure 2) is colored with a single color. The points around the center point create a "circle". When the number of "circle" points is odd, three colors are utilized (right in Figure 2). Otherwise, only two colors are utilized (the middle in Figure 2). For the central point and all adjacent points, a maximum of four colors are used.

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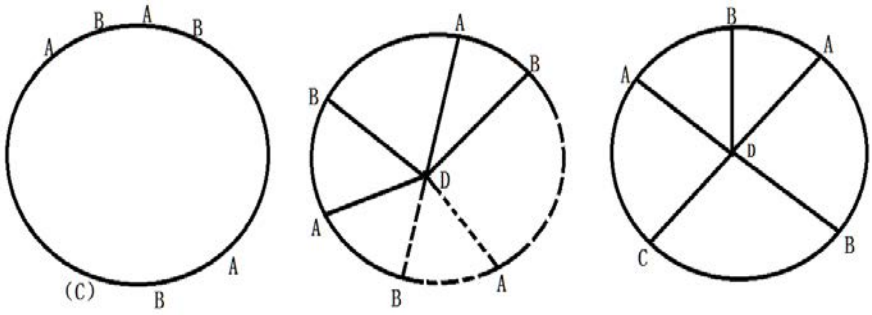

Figure 2: 3-color and 4-color chromatic graphs

c) Coloring Relationship between Four Colors

The "circles" created by the central point and neighboring points can be joined by points of one, two, or three colors (Figure 3). Figure 3 represents a schematic diagram. The color of the central point is subject to change, as is the color of the connecting points.

1) 1 Color: When a point on the "circle" is connected, this point is colored with one color. If there is no central point, color from the connected point in turn and utilize a maximum of three colors. If there is a central point, select one of the other three colors other than the connected point's color for the central point. Then color each connected point in turn with the remaining three colors, excluding the color of the central point (including the color of the connected point on the "circle"). Use a maximum of four colors.
2) 2 Colors: When two center points have different colors, two "circles" are connected, and the adjacent points (points on the "circles") between the two central points are colored with two different colors other than the color of the two central points. The "circles" of a number of central points with different colors are connected in pairs. When the "circles" of the central points in Figure 3's colors A, B, C, and D are connected, the points on the "circle" of color A's central point are linked to the points on color B's central point. The common points are represented by the colors C and D. The common points that are connected to the central point's "circle" with color C are represented by the colors B and D. The common points connected to the "circle" of the central point with color D and so on are represented by colors B and C. The color of the central point and the color of the adjacent points on the "circle" can only be a maximum of 4 colors.
3) 3 Colors: If two central points share the same color, the other three colors can be used for the points on the "circle" that connect with the two central points. A maximum of four colors may be used for the color of the central point and the color of neighboring points on the "circle".

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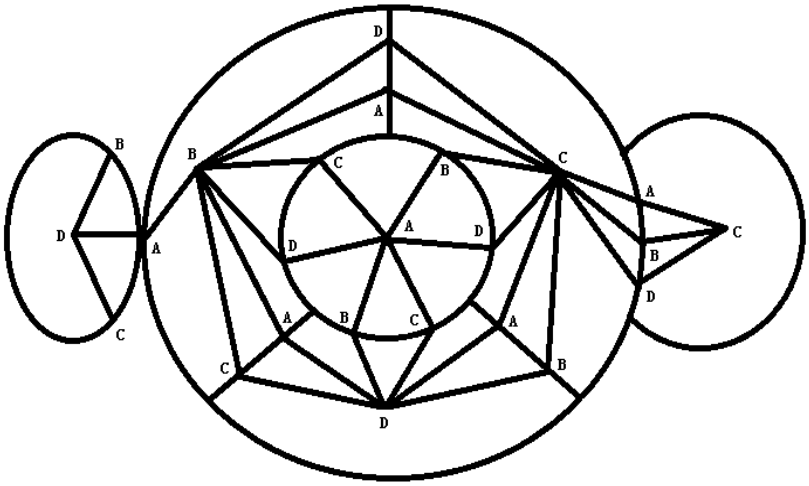

Figure 3: Coloring relationship between four colors

d) Color Selection and Order (Figure 4)

In Figure 4, point "?" will be colored with Color A if it is adjacent to the points with 4 colors and cannot be colored. Color B will be applied to the point colored in Color A above. The example in Figure 4 serves as an illustration of how the choice of colors and the order in which they are colored might give the impression that one is unable to color.

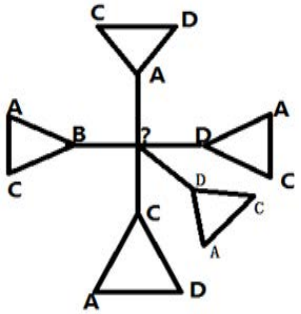

Figure 4: Reasons for 4 colors failing to be colored

e) How to Color (Figure 5)

Any local center in Figure 5 is highlighted in color A (1A), and the five neighboring points are highlighted in colors 1-1B, 1-2C, 1-3B, 1-4C, and 1-5D. These five points can each have a different color.

Choose the second local central point that is adjacent to the first local central point but not the points that are adjacent to it, and then color it with 2A. (The "circle" that is formed by this second local central point and the adjacent point is adjacent to 1-1B and 1-5D on the first local central point's colored "circle." The connecting points between the "circles" are these two points. Colors A and C can be selected for the second local central point). Choose three colors for the second local center point, except Color 2A. Color the uncolored points (points on the "circle") close to the second local central point with colors 2-1B, 2-2C, and 2-3D (*Select color and coloring order).

Choose 3A, 4C, 5B, and 6D in turn as the local central points to color the adjacent points (points on the "circle"). A maximum of four colors are needed.

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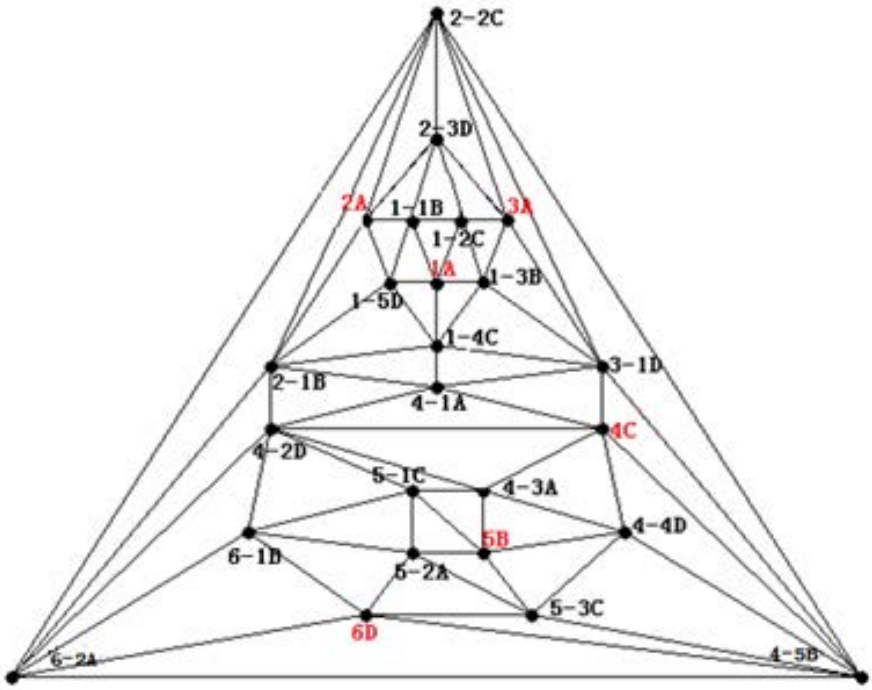

Figure 5: 4-color coloring method

f) Summary

Different vertices are colored in a plan. Adjacent vertices are colored differently from nonadjacent vertices, which are colored the same color.

One color is used for a single point, while two colors are used for connected points that do not create a loop.

For points with a loop without a central point (points on the "circle"), three colors are used.

For points with a loop and a central point, choose one local central point and color it with a single color. Select the remaining three colors in turn to color the adjacent points (points on the "circle"). A maximum of four colors are used.

Continue to search for an adjacent local central point outside the colored "circle" (the local central point and the adjacent points form a "circle"). To color the local central point, choose one of the colors that was not used for the adjacent colored points. Then, paint the nearby non-colored points (points on the "circle") with the remaining three colors except the color of the local central point.

Continue to color. To color every point, a maximum of four colors is required.

II. Using the Triangle Method for Map Coloring [2]

In the plan is not in the same straight line, three points determine a plane, then three points form a triangle is a plane figure in the most basic, most simple, the most stable, the closed graph. [3]

In the plan of the numerous points, take an arbitrary three adjacent points of the adjacent ΔABC (Figure 6), then 3 color A B C, in the plan to take a point D and A B C three adjacent, while D and A B C three is connected form a triangle. Let take a little E and A, B, C, D four-color. E will be with four-color colored the same, namely E in ΔABD and C the same colour, in ΔACD and B the same colour, in ΔBCD and A the

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same colour, in ΔABC and D the same color, E and another three-color connected to form a new triangle. [4]

In the triangle with three points, let take a point only in the triangle interior and exterior two kinds of circumstances, the two cases of points are not adjacent, this point and triangle with three points are connected and form a new triangle.

To choose a point for coloring, the points are the same and a triangle with three points are connected, and forming a new triangle, the point of at least one color of four colors. Point by point coloring to all point by one color of A, B, C, D four color.

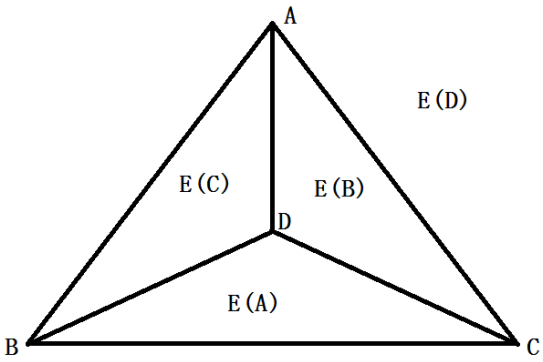

Figure 6: 4-color relationship

III. Map Coloring Method, Relationship between Circles and Triangles

The points on the circle require a maximum of 3 colors and a total of 4 colors for the center point (left in Figure 7). After transformation (middle in Figure 7), it is simplified into a triangle coloring relationship diagram (right in Figure 7).

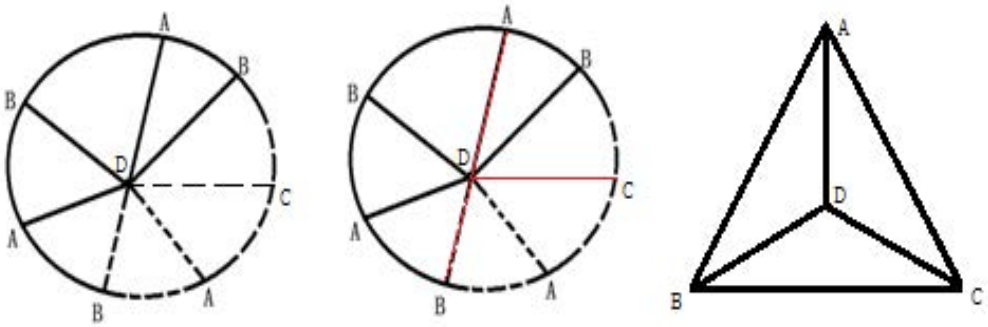

Figure 7: Relationship between circles and triangles

IV. A Practical Application of Circular Map Coloring Method

a) Perform statistical analysis on all points.
b) For single point coloring, 1 color is required.
c) Label and color points that do not form loops, Two colors are required.
d) Label and color the points on the circle without a core point, 2-3 colors are required.
e) Coloring points on circles with core points. Coloring all non colored points point by point using the circular map coloring method.
f) The color selection and order of coloring points.

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4. Han, S.J. (2003) Four Color Conjecture, Journal of educational research and practice, 11,140.

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1. Color of adjacent points of colored points ≤ 3.
2. If there is a coloring conflict issue, in order to reduce color adjustment, adjacent points that do not form a loop should be colored or labeled again; If there is still a color conflict, label adjacent points on the circle without a core point, and then color and label again; If there are still color conflicts, the points on the circle that have already been colored with core points should be colored again.
3. After selecting any point, color it in order. After adjacent points are colored, select any point again until all points are colored.
4. The difficult coloring points are the intersection points of coloring in different directions and the intersection points of the beginning and end of the circular direction.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Approximation of the Localized Szász-Mirakjan-Durrmeyer Operators

By Ma Yingdian & Sun Yue

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Abstract- In the present paper, we localize the Szász-Mirakjan-Durrmeyer operators. For which we discuss the convergence and the approximation and obtain theorems of convergence, approximation and rate of approximation.

Keywords: *szász-mirakjan operators, szász-mirakjan-durrmeyer operators, localization, convergence, approximation.*

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Ma Yingdian [α] & Sun Yue [σ]

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Keywords: *szász-mirakjan operators, szász-mirakjan-durrmeyer operators, localization, convergence, approximation.*

I. Introduction and Background

The famous Szasz-Mirakjan perator is a positive linear operator on $C[0,\infty)$ (continuous function on $[0,\infty)$), defined as follows

$$S_n(f;x)=e^{-nx}\sum_{k=0}^{\infty}\frac{(nx)^k}{k!}f\left(\frac{k}{n}\right) \quad x\in[0,\infty).$$

It is easy to obtain by calculation

$$S_n(1;x)=1 \;;\; S_n(t;x)=x \;;\; S_n(t^2;x)=x^2+\frac{x}{n} \tag{1}$$

$$S_n((t-x)^2;x)=\frac{x}{n} \tag{2}$$

There are a lot of in-depth researches on its approximation, and the research results are very rich.[1-21]

The literature[17] introduce The Szasz-Mirakjan-Durrmeyer operator by Durrmeyer transformation of Szasz-Mirakjan operator

$$\tilde{S}_n(f;x)=\sum_{k=0}^{\infty}n\int_0^{+\infty}f(t)S_{n,k}(t)dtS_{n,k}(x) \quad x\in[0,\infty)$$

Of which

$$S_{n,k}(x)=\frac{(nx)^k}{k!}e^{-nx},\ k=0,1,\ldots,$$

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It is easily obtained by (1) and (2)

$$\tilde{S}_n(1;x)=1 \;;\; \tilde{S}_n(t;x)=x+\frac{1}{n} \;;\; \tilde{S}_n\left(t^2;x\right)=x^2+\frac{4x}{n}+\frac{2}{n^2} \tag{3}$$

$$\tilde{S}_n((t-x);x)=\frac{1}{n} \;; \qquad \tilde{S}_n\left((t-x)^2;x\right)=\frac{2x}{n}+\frac{2}{n^2} \tag{4}$$

Obviously this is a positive linear operator on $L[0,\infty)$ (integrable function on $[0,\infty)$), and there has been a lot of research on it[21-26].

Operator localization is one of the methods to transform operators. In order to be convenient and feasible, the localization of some operators is necessary. The idea of operator localization originates from the truncation of infinite sum. In 1980, literature [27] firstly introduced Szasz-Mirakjan localization operator as follows

$$S_{n,N}(f;x)=e^{-nx}\sum_{k=0}^{N}\frac{(nx)^k}{k!}f\left(\frac{k}{n}\right) \quad x\in[0,\infty)$$

In this paper, the same method is used to introduce the localized Szasz-Mirakjan-Durrmeyer operator as follows

$$\tilde{S}_{n,N}(f;x)=\sum_{k=0}^{N}n\int_0^{+\infty}f(t)S_{n,k}(t)dtS_{n,k}(x) \quad x\in[0,\infty),$$

Of which

$$S_{n,k}(x)=\frac{(nx)^k}{k!}e^{-nx},\ k=0,1,\ldots.$$

Here we mainly study the approximation problem of localized Szasz-Mirakjan-Durrmeyer operator. The following part is used to discuss the convergence and approximation of $\tilde{S}_{n,N}(f)$ operator, resulting in theorems 1 and 2. The last part is used to study the approximation velocity of $\tilde{S}_{n,N}(f)$ operator, and theorem 3 is obtained.

II. The Convergence 0f Localized Szasz-Mirakjan-Durrmeyer Operator

Let's start with the following lemma.

Lemma 1[28] Let $x>0$ and $y\in(-\infty,+\infty)$, Then

$$\left|e^{-nx}\sum_{k=0}^{[nx+y\sqrt{n}]}\frac{(nx)^k}{k!}-\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\frac{y}{\sqrt{x}}}e^{-\frac{1}{2}u^2}du\right|\le\frac{Ax\sqrt{3x+1}}{\sqrt{n}\left(\sqrt{x}+|y|\right)^3}$$

Where A is a constant. If $x=0, y>0$, change $\frac{y}{\sqrt{x}}$ to ∞,then the conclusion is valid.

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Using this lemma, we come to the following conclusion

Theorem 1: Let $f \in C[0,\infty)$ and $N = N(n,x)$, make

1) $(N-nx)/n$ uniformly bounded on $[x_1, x_2]$, where $0 < x_1 < x_2 < \infty$

2) $\lim_{n\to\infty} \frac{N-nx}{\sqrt{n}} = C(x)$ preserving uniform convergence in $[x_1, x_2]$, Then, it is established that there is

$$\lim_{n\to\infty} \tilde{S}_{n,N}(f;x) = \frac{f(x)}{\sqrt{2\pi}} \int_{-\infty}^{\frac{C(x)}{\sqrt{x}}} e^{-\frac{1}{2}u^2} du \tag{5}$$

uniformly in $[x_1, x_2]$.

Proof: Let

$$\delta_n = (N-nx)/n, \quad G = \sup_{n\geq 1}\{|\delta_n|\},$$

For $\eta > 0$, define the optical sliding mode

$$\omega(f;\eta) = \max_{x,y\in[0,x_2+G],|x-y|<\eta} |f(x) - f(y)|$$

According to the property of the optical sliding mode, if $\lambda > 0$, then

$$\omega(f;\lambda\eta) \leq (1+\lambda)\omega(f,\eta) \tag{6}$$

If $x \in [x_1, x_2]$, then

$$\tilde{S}_{n,N}(f;x) = \sum_{k=0}^{N} n\int_0^{+\infty} (f(t) - f(x)) \frac{(nt)^k}{k!} e^{-nt} dt S_{n,k}(x) + \sum_{k=0}^{N} f(x) S_{n,k}(x)$$

$$\equiv I_1 + I_2$$

According to (6) and (4)

$$|I_1| \leq \sum_{k=0}^{N} n\int_0^{+\infty} |f(t) - f(x)| S_{n,k}(t)\, dt S_{n,k}(x)$$

$$\leq \omega\left(f;\frac{1}{\sqrt{n}}\right) \sum_{k=0}^{N} n\int_0^{+\infty} \left(1+\sqrt{n}|t-x|\right) S_{n,k}(t)\, dt S_{n,k}(x)$$

$$\leq \omega\left(f;\frac{1}{\sqrt{n}}\right) \left(\sum_{k=0}^{N} S_{n,k}(x) + \sum_{k=0}^{N} n\int_0^{+\infty} \sqrt{n}|t-x| S_{n,k}(t)\, dt S_{n,k}(x)\right)$$

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$$\le \omega\left(f;\frac{1}{\sqrt{n}}\right)\left(1+\left(\sum_{k=0}^{\infty} n\int_0^{+\infty} n(t-x)^2 S_{n,k}(t)\,dt S_{n,k}(x)\right)^{1/2}\right)$$

$$\le \omega\left(f;\frac{1}{\sqrt{n}}\right)\left(1+\sqrt{\frac{2nx+2}{n}}\right) \tag{7}$$

From lemma 1, we have

$$I_2 = f(x)e^{-nx}\sum_{k=0}^{nx+\sqrt{n}\cdot\sqrt{n}\delta_n}\frac{(nx)^k}{k!}$$

$$= f(x)\left\{\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\frac{\sqrt{n}\delta_n}{\sqrt{x}}} e^{-\frac{1}{2}u^2}du + O\left(\frac{x_2\sqrt{3x_2+1}}{\sqrt{n}\left(\sqrt{x_1}+\sqrt{n}|\delta_n|\right)^3}\right)\right\} \tag{8}$$

From (7) and (8), it can be concluded that (5) converges uniformly in $[x_1, x_2]$
In a similar way to Theorem 1, we get the following conclusion.

Theorem 2: Let $f \in C[0,\infty)$ and $N = N(n,x)$, make

1) $(N-nx)/n$ is uniformly bounded on $[x_1, x_2]$, where, $0 \le x_1 < x_2 < \infty$

2) $\lim_{n\to\infty}\frac{N-nx}{\sqrt{n}} = C(x), |C(x)| \ge \rho > 0$ maintain consistent convergence within $[x_1, x_2]$, then $\lim_{n\to\infty}\tilde{S}_{n,N}(f;x) = \frac{f(x)}{\sqrt{2\pi}}\int_{-\infty}^{\frac{C(x)}{\sqrt{x}}} e^{-\frac{1}{2}u^2}du$ is uniformly true on $[x_1, x_2]$. When $x=0$, think of $\frac{C(x)}{\sqrt{x}}$ as ∞.

Corollary 1: Let $f \in C[0,\infty)$ and $N = N(n,x)$, make

1) $(N-nx)/n$ is uniformly bounded on $[x_1, x_2]$, where, $0 \le x_1 < x_2 < \infty$

(ii) $\lim_{n\to\infty}\frac{N-nx}{\sqrt{n}} = \infty$ preserving uniform convergence in $[x_1, x_2]$, then $\lim_{n\to\infty}\tilde{S}_{n,N}(f;x) = f(x)$ is uniformly true on $[x_1, x_2]$.

Corollary 2: Let $f \in C[0,\infty)$ and $x_0 \in (0,\infty)$, If $(N-nx_0)/n$ is bounded, and when $n\to\infty$, $(N-nx_0)/n$ does not converge to ∞, Then $\lim_{n\to\infty}\tilde{S}_{n,N}(f;x_0) = f(x_0)$ must result in $f(x_0) = 0$

Corollary 3: Let $x_0 \in [0,\infty)$, If $(N-nx_0)/n$ is bounded, then

$$\lim_{n\to\infty}\tilde{S}_{n,N}(f;x_0) = f(x_0)$$

is true for any $f \in C[0,\infty)$,

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$$\lim_{n\to\infty}\frac{N-nx_0}{\sqrt{n}}=\infty \quad \text{is true.}$$

III. Approximation Speed of Szász-Mirakja-Durrmeyer Deformation Localization Operator

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A similar result is obtained for the localization Szász-Mirakjan-Durrmeyer operator $\tilde{S}_{n,N}(f,x)$ as follows.

Theorem 3: Let $f\in C_\alpha$ for fixed $x>0$, there is $\delta>0$,

Make f conform to

$$\left|\frac{f(t)-f(x)}{t-x}\right|\le C(x,\delta), \tag{9}$$

in which $|t-x|\le\delta$, and $t\ge 0$. and $N=N(n,x)$,

$$\liminf_{n\to\infty}\frac{N-nx}{\sqrt{nx\ln(n)}}>1 \tag{10}$$

is true, then

$$\sup_{n\ge1}\sqrt{n}\left|\tilde{S}_{n,N}(f;x)-f(x)\right|<\infty \tag{11}$$

If $f'(x)$ exists, and $N=N(n,x)$, （13）is true，then

$$\lim_{n\to\infty}\sqrt{n}\left(\tilde{S}_{n,N}(f;x)-f(x)\right)=0. \tag{12}$$

Proof: (11) first. We note that

$$\tilde{S}_{n,N}(f;x)-f(x)=\sum_{k=0}^{N}n\int_0^{+\infty}(f(t)-f(x))S_{n,k}(t)dtS_{n,k}(x)-f(x)\sum_{k=N+1}^{\infty}S_{n,k}(x)$$

$$=I_1+I_2 \tag{13}$$

$$I_1=\sum_{k=0}^{N}n\int_0^{+\infty}(f(t)-f(x))S_{n,k}(t)dtS_{n,k}(x)$$

$$=\sum_{k=0}^{N}n\int_{|t-x|<\delta}(f(t)-f(x))S_{n,k}(t)dtS_{n,k}(x)$$

$$+\sum_{k=0}^{N}n\int_{|t-x|\ge\delta}(f(t)-f(x))S_{n,k}(t)dtS_{n,k}(x)$$

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$$\equiv I_{11} + I_{12} \tag{14}$$

From (9) and (4) we have

$$|I_{11}| \le \sum_{k=0}^{N} n \int_{|t-x|<\delta} |f(t) - f(x)| S_{n,k}(t) dt S_{n,k}(x)$$

$$\le C(x,\delta) \sum_{k=0}^{N} n \int_{|t-x|<\delta} |t-x| S_{n,k}(t) dt S_{n,k}(x)$$

$$\le C(x,\delta) \left(\sum_{k=0}^{\infty} n \int_{0}^{\infty} (t-x)^2 S_{n,k}(t) dt S_{n,k}(x) \right)^{1/2}$$

$$\le \frac{C(x,\delta)}{\sqrt{n}} \sqrt{\frac{2nx+2}{n}} \tag{15}$$

$$|I_{12}| = \sum_{k=0}^{N} n \int_{|t-x|\ge\delta} |f(t) - f(x)| S_{n,k}(t) dt S_{n,k}(x)$$

$$\le \sum_{k=0}^{N} n \int_{|t-x|\ge\delta} |f(t)| S_{n,k}(t) dt S_{n,k}(x) + \sum_{k=0}^{N} n \int_{|t-x|\ge\delta} |f(x)| S_{n,k}(t) dt S_{n,k}(x)$$

$$= I_{12}^{'} + I_{12}^{''} \tag{16}$$

▪ $n > \alpha$， 由 $f \in C_{\alpha}$， 可得

$$I_{12}^{'} \le A \sum_{k=0}^{N} n \int_{|t-x|\ge\delta} e^{\alpha t} \cdot e^{-nt} \frac{(nt)^k}{k!} dt S_{n,k}(x)$$

$$\le \frac{A}{\delta^2} \sum_{k=0}^{N} n \left[\int_{0}^{\infty} t^2 e^{-(n-\alpha)t} \frac{(nt)^k}{k!} dt - 2x \int_{0}^{\infty} t e^{-(n-\alpha)t} \frac{(nt)^k}{k!} dt \right.$$

$$\left. + x^2 \int_{0}^{\infty} e^{-(n-\alpha)t} \frac{(nt)^k}{k!} dt \right] S_{n,k}(x)$$

$$= \frac{A}{\delta^2} \sum_{k=0}^{N} n \left[\frac{(k+2)(k+1)n^k}{(n-\alpha)^{k+3}} - \frac{2x(k+1)n^k}{(n-\alpha)^{k+2}} + \frac{x^2 n^k}{(n-\alpha)^{k+1}} \right] S_{n,k}(x)$$

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$$= \frac{A}{\delta^2}\sum_{k=0}^{N}\left(\frac{n}{n-\alpha}\right)^{k+1}\left[\frac{(k+2)(k+1)}{(n-\alpha)^2} - \frac{2x(k+1)}{(n-\alpha)} + x^2\right]S_{n,k}(x)$$

$$= \frac{A}{\delta^2}\sum_{k=0}^{N}\left(\frac{n}{n-\alpha}\right)^{k+1}\left[\left(\frac{k}{n} - \frac{nx}{n-\alpha}\right)^2 + \frac{\alpha(2n-\alpha)}{(n-\alpha)^2}\left(\frac{k}{n}\right)^2 - \frac{2x}{n-\alpha}\right.$$

$$\left. - \frac{\alpha(2n-\alpha)}{(n-\alpha)^2}x^2 + \frac{3k}{(n-\alpha)^2} + \frac{1}{(n-\alpha)^2}\right]S_{n,k}(x)$$

$$\leq \frac{A}{\delta^2}\sum_{k=0}^{N}\left(\frac{n}{n-\alpha}\right)^{k+1}\left[\left(\frac{k}{n} - \frac{nx}{n-\alpha}\right)^2 + \frac{\alpha(2n-\alpha)}{(n-\alpha)^2}\left(\frac{k}{n}\right)^2\right.$$

$$\left. + \frac{3n}{(n-\alpha)^2}\frac{k}{n} + \frac{1}{(n-\alpha)^2}\right]S_{n,k}(x)$$

$$\equiv \frac{A}{\delta^2}\left[J_1 + J_2 + J_3 + J_4\right]$$

According to (2)

$$J_1 = \sum_{k=0}^{N}\left(\frac{n}{n-\alpha}\right)^{k+1}\left(\frac{k}{n} - \frac{nx}{n-\alpha}\right)^2\frac{(nx)^k}{k!}e^{-nx}$$

$$= \frac{n}{n-\alpha}e^{-nx+\frac{nnx}{n-\alpha}}\sum_{k=0}^{N}\left(\frac{k}{n} - \frac{nx}{n-\alpha}\right)^2\frac{\left(n\cdot\frac{nx}{n-\alpha}\right)^k}{k!}e^{-n\cdot\frac{nx}{n-\alpha}}$$

$$\leq \frac{n}{n-\alpha}e^{\frac{\alpha nx}{n-\alpha}}\left(\sum_{k=0}^{\infty}\left(\frac{k}{n} - \frac{nx}{n-\alpha}\right)^2\frac{\left(n\cdot\frac{nx}{n-\alpha}\right)^k}{k!}e^{-n\cdot\frac{nx}{n-\alpha}}\right)$$

$$\leq \frac{1}{n-\alpha}\frac{nx}{n-\alpha}e^{\frac{\alpha nx}{n-\alpha}}$$

so

$$J_1 = O_{x,\alpha}\left(\frac{1}{n}\right). \tag{17}$$

According to (1)

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$$J_2=\sum_{k=0}^{N}\left(\frac{n}{n-\alpha}\right)^{k+1}\frac{\alpha(2n-\alpha)}{(n-\alpha)^2}\left(\frac{k}{n}\right)^2\frac{(nx)^k}{k!}e^{-nx}$$

$$=\frac{\alpha(2n-\alpha)n}{(n-\alpha)^3}e^{\frac{\alpha nx}{n-\alpha}}\sum_{k=0}^{N}\left(\frac{k}{n}\right)^2\frac{\left(n\cdot\frac{nx}{n-\alpha}\right)^k}{k!}e^{-n\cdot\frac{nx}{n-\alpha}}$$

$$\le\frac{\alpha(2n-\alpha)n}{(n-\alpha)^3}e^{\frac{\alpha nx}{n-\alpha}}\left[\left(\frac{nx}{n-\alpha}\right)^2+\frac{x}{n-\alpha}\right]$$

so

$$J_2=O_{x,\alpha}\left(\frac{1}{n}\right) \tag{18}$$

By the same token, we can obtain from (1)

$$J_3=\frac{3n^3x}{(n-\alpha)^4}e^{\frac{\alpha nx}{n-\alpha}}=O_{x,\alpha}\left(\frac{1}{n}\right) \tag{19}$$

$$J_4=\frac{n}{(n-\alpha)^3}e^{\frac{\alpha nx}{n-\alpha}}=O_{x,\alpha}\left(\frac{1}{n}\right) \tag{20}$$

Combined with (17)-(20), we can get

$$I_{12}^{'}=O_{x,\alpha}\left(\frac{1}{n}\right) \tag{21}$$

According to (4)

$$I_{12}^{''}=\left|f(x)\right|\sum_{k=0}^{N}n\int_{|t-x|\ge\delta}S_{n,k}(t)dtS_{n,k}(x)$$

$$\le\left|f(x)\right|\sum_{k=0}^{N}n\int_{|t-x|\ge\delta}\frac{(t-x)^2}{\delta^2}S_{n,k}(t)dtS_{n,k}(x)$$

$$\le\frac{\left|f(x)\right|}{\delta^2}\frac{2nx+2}{n^2}$$

$$\le\frac{Ae^{\alpha x}(2nx+2)}{\delta^2n^2} \tag{22}$$

According to (21) and (22),

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$$|I_{12}| = O_{x,\alpha}\left(\frac{1}{n}\right) \tag{23}$$

Then, from (15) and (23),

$$|I_1| = O_{x,\alpha}\left(\frac{1}{\sqrt{n}}\right) \tag{24}$$

According to literature [28]

$$|I_2| \le \frac{|f(x)|}{\sqrt{2\pi}\sqrt{n\ln(n)}} \cdot + O\left(\frac{|f(x)|\sqrt{3x+1}}{\sqrt{nx}\left(\sqrt{\ln(n)}\right)^3}\right) \tag{25}$$

Combine (24) with (25) to get, existence n_0 such that when $n > n_0$, there is

$$\left|\tilde{S}_{n,N}(f,x) - f(x)\right| \le C^*(x,\delta,\alpha)\frac{1}{\sqrt{n}}$$

In which $C^*(x,\delta,\alpha)$is a constant that depends only on x, δ and α, So (11) is true. Next, we prove (12). Only certificate

$$|I_{11}| = o_x\left(\frac{1}{\sqrt{n}}\right) \tag{26}$$

In fact, if there is $f'(x)$, then for any $\varepsilon > 0$, there is $\delta > 0$, and exist

$$\left|f(t) - f(x) - f'(x)(t-x)\right| < \varepsilon|t-x|, \quad |t-x| < \delta, \tag{27}$$

from (27)

$$|I_{11}| \le \left| f'(x)\sum_{k=0}^{N} n\int_{|t-x|<\delta}(t-x)S_{n,k}(t)dtS_{n,k}(x)\right|$$

$$+\varepsilon\sum_{k=0}^{N} n\int_{|t-x|<\delta}|t-x|S_{n,k}(t)dtS_{n,k}(x)$$

$$\equiv H_1 + H_2 \tag{28}$$

from（4）

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$$H_1 = \left| f'(x) \sum_{k=0}^{N} n \int_{|t-x|<\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) \right|$$

$$= \left| f'(x) \sum_{k=0}^{\infty} n \int_{|t-x|<\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) \right.$$

$$\left. - f'(x) \sum_{k=N+1}^{\infty} n \int_{|t-x|<\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) \right|$$

$$= \left| -f'(x) \sum_{k=0}^{\infty} n \int_{|t-x|\geq\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) + \frac{1}{n} \right.$$

$$\left. - f'(x) \sum_{k=N+1}^{\infty} n \int_{|t-x|<\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) \right|$$

$$= \left| -f'(x) \sum_{k=0}^{N} n \int_{|t-x|\geq\delta} (t-x) S_{n,k}(t) dt S_{n,k}(x) + \frac{1}{n} \right.$$

$$\left. - f'(x) \sum_{k=N+1}^{\infty} n \int_{0}^{\infty} (t-x) S_{n,k}(t) dt S_{n,k}(x) \right|$$

$$\leq \frac{|f'(x)|}{\delta} \sum_{k=0}^{N} n \int_{0}^{\infty} (t-x)^2 S_{n,k}(t) dt S_{n,k}(x)$$

$$+ |f'(x)| \sum_{k=N+1}^{\infty} n \int_{0}^{\infty} |t-x| S_{n,k}(t) dt S_{n,k}(x) + \frac{1}{n}$$

$$\equiv K_1 + K_2 + \frac{1}{n}$$

from（4）

$$K_1 \leq \frac{|f'(x)|}{\delta} \frac{2nx+2}{n^2} \qquad (29)$$

$$K_2 \leq |f'(x)| \sum_{k=N+1}^{\infty} n \int_{0}^{\infty} t S_{n,k}(t) dt S_{n,k}(x) + x |f'(x)| \sum_{k=N+1}^{\infty} S_{n,k}(x)$$

$$= |f'(x)| \sum_{k=N+1}^{\infty} \frac{k+1}{n} S_{n,k}(x) + x |f'(x)| \sum_{k=N+1}^{\infty} S_{n,k}(x)$$

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$$\leq 2\left|f^{'}(x)\right|\sum_{k=N+1}^{\infty}\frac{k}{n}S_{n,k}(x)+x\left|f^{'}(x)\right|\sum_{k=N+1}^{\infty}S_{n,k}(x)$$

$$\leq 2x\left|f^{'}(x)\right|\sum_{k=N}^{\infty}S_{n,k}(x)+x\left|f^{'}(x)\right|\sum_{k=N+1}^{\infty}S_{n,k}(x)$$

Notes

And then we know from (25)

$$K_2=o_x\left(\frac{1}{\sqrt{n}}\right) \tag{30}$$

According to (4)

$$H_2=\varepsilon\sum_{k=0}^{N}n\int_{|t-x|<\delta}|t-x|S_{n,k}(t)dtS_{n,k}(x)$$

$$\leq\varepsilon\left(\sum_{k=0}^{\infty}n\int_{|t-x|<\delta}(t-x)^2S_{n,k}(t)dtS_{n,k}(x)\right)^{1/2}$$

$$\leq\frac{\varepsilon}{\sqrt{n}}\sqrt{\frac{2nx+2}{n}} \tag{31}$$

(26) is established by combining (29) with (31).
Then, from (23), (25) and (26), when n is sufficiently large, there is

$$\left|\tilde{S}_{n,N}(f,x)-f(x)\right|\leq C^{**}(x,\delta,\alpha)\frac{\varepsilon}{\sqrt{n}}$$

in which $C^{**}(x,\delta,\alpha)$ is a constant that depends only on x, δ and α, so (12) is true. so the theorem is proved.

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If You Give Enough Time to that which Seems Extremely Improbable, It can Happen! Applications of the Infinite Monkey Theorem in Secondary Classrooms in Line with the Development of Emotional Skills

By Patricia Val Fernández & Colexio M. Peleteiro

Abstract- The research article addresses two main topics: the concept of giving sufficient time to seemingly improbable events and the applications of the infinite monkey theorem in secondary classrooms in relation to the development of emotional skills.

First, the idea that if enough time is given to something that seems extremely improbable, it is possible for that event to occur is highlighted. This notion defies common intuition and suggests that the probability of an event may change over time.

Second, the article focuses on applications of the infinite monkey theorem in high school classrooms. The infinite monkey theorem is a metaphor that illustrates the idea that, given enough opportunities, even an extremely difficult task can be completed. In this context, we examine how this theorem can be applied to secondary education and the development of emotional skills in students.

Keywords: adolescents, mathematics, topology, innovation, high school.

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If You Give Enough Time to that which Seems Extremely Improbable, It can Happen! Applications of the Infinite Monkey Theorem in Secondary Classrooms in Line with the Development of Emotional Skills

Si Se Le Da El Tiempo Suficiente A Aquello Que Parece Extremadamente Improbable, ¡Puede Suceder! Aplicaciones Del Teorema Del Mono Infinito En Las Aulas De Secundaria En Consonancia Con El Desarrollo De Habilidades Emocionales

Patricia Val Fernández [α] & Colexio M. Peleteiro [σ]

Resumen- El artículo de investigación aborda dos temas principales: el concepto de dar tiempo suficiente a eventos aparentemente improbables y las aplicaciones del teorema del mono infinito en las aulas de secundaria en relación con el desarrollo de habilidades emocionales.

En primer lugar, se destaca la idea de que si se le da el tiempo suficiente a algo que parece extremadamente improbable, es posible que ese evento ocurra. Esta noción desafía la intuición común y sugiere que la probabilidad de un evento puede cambiar con el tiempo.

En segundo lugar, el artículo se enfoca en las aplicaciones del teorema del mono infinito en las aulas de secundaria. El teorema del mono infinito es una metáfora que ilustra la idea de que, dadas suficientes oportunidades, incluso una tarea extremadamente difícil puede completarse. En este contexto, se examina cómo este teorema puede aplicarse a la educación secundaria y al desarrollo de habilidades emocionales en los estudiantes.

Se exploran estrategias educativas que fomentan la perseverancia, la paciencia y la tolerancia al fracaso, proporcionando a los estudiantes el tiempo y el apoyo necesario para superar desafíos aparentemente insuperables. Estas estrategias incluyen proyectos a largo plazo, en los que los estudiantes tienen la oportunidad de trabajar en objetivos difíciles durante períodos prolongados, cultivando así la resiliencia emocional y la persistencia.

Palabras clave: adolescentes, matemáticas, topología, innovación, secundaria.

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Educational strategies that foster perseverance, patience, and tolerance for failure by providing students with the time and support necessary to overcome seemingly insurmountable challenges are explored. These strategies include long-term projects, in which students have the opportunity to work on difficult goals for extended periods of time, there by cultivating emotional resilience and persistence.

Keywords: *adolescents, mathematics, topology, innovation, high school.*

I. Introducción

El teorema del mono infinito se puede utilizar en las aulas de secundaria para enseñar habilidades emocionales como la perseverancia y la paciencia. Los estudiantes pueden aprender que, aunque algo parezca muy difícil o incluso imposible, si se les da el tiempo suficiente y se esfuerzan lo suficiente, pueden lograrlo.

Por ejemplo, los maestros pueden asignar proyectos que parecen desalentadores y desafiantes, pero que con el tiempo y la dedicación pueden ser alcanzados. Los estudiantes pueden trabajar en estos proyectos durante un período de tiempo prolongado y registrar su progreso a lo largo del camino. Al final, los estudiantes pueden ver cómo han logrado lo que parecía imposible al principio(Satel, 2013).

Además, el teorema del mono infinito también se puede utilizar para enseñar a los estudiantes sobre la probabilidad y la estadística. Los estudiantes pueden explorar cómo las posibilidades de un evento pueden cambiar con el tiempo y cómo la probabilidad se relaciona con la cantidad de veces que se realiza un evento.

El teorema del mono infinito puede ser una herramienta útil para enseñar habilidades emocionales y conceptos matemáticos en las aulas de secundaria. Los estudiantes pueden aprender la importancia de la perseverancia y la paciencia, y cómo la probabilidad y la estadística básica de nuestras vidas diarias (infoLibre, 2018).

II. Método

El Teorema del Mono Infinito es una hipotética idea que se utiliza a menudo como una ilustración para explicar la idea de que, con un número infinito de intentos, cualquier cosa es posible.

La idea detrás del Teorema del Mono Infinito es que, si un mono escribiera en una máquina de escribir durante un tiempo infinito, eventualmente escribiría todas las obras literarias posibles. Incluso si la probabilidad de que el mono escriba una obra literaria específica es extremadamente baja, con un número infinito de intentos, la probabilidad se convierte en una certeza matemática(Wigmore, 2013).

Este concepto se utiliza a menudo como una analogía para explicar la idea de que, con suficiente tiempo y oportunidades, cualquier evento improbable puede ocurrir. Sin embargo, es importante tener en cuenta que el Teorema del Mono Infinito es una hipótesis teórica y no tiene aplicación práctica en la vida real debido a la limitación del tiempo y recursos finitos.

El teorema del mono infinito es un ejemplo común en la enseñanza de la probabilidad y la teoría de la estadística en los institutos. El teorema se refiere a una situación hipotética en la que un mono lanza una moneda al aire repetidamente, eligiendo al azar entre cara y cruz con la misma probabilidad. Establece que, en un número infinito de lanzamientos, la probabilidad de que la moneda caiga cara y cruz serán iguales, es decir, el resultado tiende a equilibrarse (Palazzesi, 2018).

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Este resultado puede parecer sorprendente, ya que a corto plazo es posible que el mono tenga una racha de lanzamientos donde el resultado caiga mayoritariamente en una sola cara. Pero a medida que aumenta el número de lanzamientos, la probabilidad de que las caras y las cruces se equilibren se acerca a la probabilidad del 50%.

El teorema, ilustra cómo la probabilidad puede comportarse de manera sorprendente y no intuitiva, especialmente en situaciones donde los eventos son aleatorios e independientes entre sí. Aunque el teorema es un concepto interesante, es poco probable que se enseñe en las clases de matemáticas de los institutos, ya que su aplicación real es bastante limitada. Sin embargo, el teorema del mono infinito puede ayudar a los estudiantes a comprender conceptos como la probabilidad, el infinito y la aleatoriedad.

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Algunos posibles beneficios de enseñar el teorema del mono infinito en las clases de matemáticas de los institutos podrían incluir (Okano, s.f.):

1. Ayuda a los estudiantes a comprender la idea de la probabilidad, al ilustrar la noción de que incluso eventos muy improbables pueden ocurrir si se les da suficiente tiempo y oportunidad. Este concepto puede ayudar a los estudiantes a comprender mejor la teoría de la probabilidad y la estadística.
2. Fomenta el pensamiento crítico. El teorema del mono infinito es una idea abstracta que desafía la intuición común. Al enseñar este teorema, se anima a los estudiantes a cuestionar sus suposiciones y a pensar de manera crítica sobre el mundo que les rodea.
3. Ayuda a los estudiantes a comprender el concepto de infinito. Involucra la idea de un tiempo infinito y la idea de que hay un número infinito de posibilidades. Estos conceptos pueden ser difíciles de entender, pero enseñar el teorema del mono infinito puede ayudar a los estudiantes a comprender mejor la noción de infinitud.
4. Fomenta la creatividad. El teorema es un ejemplo de cómo una idea loca puede llevar a la creación de algo asombroso. Al enseñar este teorema, se anima a los estudiantes a pensar fuera de la caja y a ser creativos en su pensamiento y su resolución de problemas.
5. El Teorema del Mono Infinito es un concepto teórico utilizado en matemáticas y ciencias de la computación que describe la posibilidad de que un mono que escribe al azar en una máquina de escribir durante un tiempo infinito eventualmente producirá cualquier obra literaria posible, como la obra completa de Shakespeare o incluso la Enciclopedia Británica.
6. En la vida real, este teorema es más utilizado como una metáfora o ejemplo ilustrativo para explicar ciertos conceptos matemáticos o científicos, como la probabilidad, la estadística y la teoría de la información. Sin embargo, también puede aplicarse en algunos campos prácticos, como la inteligencia artificial y la generación de texto automática. Por ejemplo, algunos sistemas de inteligencia artificial utilizan algoritmos de generación de texto basados en el Teorema del Mono Infinito para producir automáticamente contenido escrito, como noticias, informes, descripciones de productos y otras formas de texto. Estos sistemas utilizan redes

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neuronales artificiales y algoritmos de aprendizaje automático para generar texto que imita el estilo y la estructura del lenguaje humano(Wigmore, 2013).

Además, el Teorema del Mono Infinito también se utiliza en algunos campos de la investigación científica para modelar la complejidad de los sistemas biológicos y físicos. Por ejemplo, algunos científicos utilizan simulaciones de Monte Carlo para generar muestras aleatorias de eventos y procesos biológicos y físicos, con el objetivo de estudiar su comportamiento y entender mejor su estructura y dinámica.

En general, el Teorema del Mono Infinito es un concepto interesante que puede tener aplicaciones prácticas en algunos campos de la ciencia y la tecnología, aunque su uso en la vida real es principalmente como una herramienta para ilustrar conceptos matemáticos y científicos abstractos.

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III. Resultados

El teorema del mono infinito es un concepto matemático interesante, pero puede resultar difícil de entender para algunos estudiantes de instituto. Sin embargo, con una buena explicación y ejemplos prácticos, es posible enseñar este teorema en las aulas de los institutos.

Aquí hay algunos pasos que podrían ayudar a implementar el teorema del mono infinito en las aulas de los institutos:

1. Introducir el concepto de probabilidad: Antes de abordar el teorema del mono infinito, es importante que los estudiantes tengan una comprensión sólida del concepto de probabilidad y cómo se calcula. Puedes utilizar ejemplos sencillos para explicar cómo la probabilidad se utiliza en situaciones cotidianas.
2. Explicar el teorema del mono infinito: Una vez que los estudiantes comprendan la probabilidad, es el momento de introducir el teorema del mono infinito. Puedes comenzar explicando cómo funciona el teorema y qué significa.
3. Utilizar ejemplos: La mejor manera de ayudar a los estudiantes a entender el teorema del mono infinito es a través de ejemplos prácticos. Puedes utilizar diferentes ejemplos para ilustrar cómo funciona el teorema, como por ejemplo el ejemplo clásico de un mono que teclea al azar en una máquina de escribir y produce la obra completa de Shakespeare.
4. Hacer actividades prácticas: Para que los estudiantes puedan entender mejor el teorema del mono infinito, es importante que realicen actividades prácticas. Por ejemplo, puedes pedirles que realicen simulaciones en línea para ver cómo cambia la probabilidad a medida que aumenta el número de intentos.
5. Resolver problemas: Finalmente, puedes proporcionar a los estudiantes problemas relacionados con el teorema del mono infinito para que puedan aplicar lo que han aprendido y poner a prueba sus habilidades.

Se podría presentar el teorema del mono infinito utilizando una simulación en línea que muestre a un mono tecleando al azar en una máquina de escribir y produciendo palabras y frases aleatorias. Luego, se podría mostrar cómo la probabilidad de que el mono produzca una palabra o frase específica aumenta a medida que se le da más tiempo y oportunidades.

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También se podrían utilizar analogías con situaciones cotidianas para ilustrar el teorema del mono infinito. Por ejemplo, se podría comparar el proceso de escribir una obra literaria con el lanzamiento de una moneda al aire. Si se lanza la moneda suficientes veces, eventualmente se obtendrá una secuencia de caras y cruces que será idéntica a cualquier otra secuencia dada, de la misma manera que el mono eventualmente producirá cualquier texto dado.

En general, la clave para implementar el teorema del mono infinito en las aulas de los institutos es presentarlo de una manera accesible y comprensible, utilizando ejemplos concretos y visualizaciones para hacer que el concepto sea más tangible y significativo para los estudiantes. Es importante que los estudiantes comprendan primero el concepto de probabilidad, luego introducir el teorema y utilizar ejemplos prácticos para ilustrar su funcionamiento. Además, se pueden realizar actividades prácticas y resolver problemas para consolidar el aprendizaje.

IV. Discusión

El Teorema del Mono Infinito es un concepto que se origina en la teoría de la probabilidad y la estadística, y que ha sido utilizado en la filosofía y la ciencia ficción para plantear cuestiones sobre la posibilidad de la existencia de otras formas de vida inteligente en el universo.

En cuanto a su implementación en las aulas de institutos, depende del nivel de matemáticas que se esté enseñando. El Teorema del Mono Infinito puede ser un tema interesante para los estudiantes de estadística avanzada y cálculo, pero podría ser demasiado complejo para los estudiantes de nivel básico.

Es importante que los profesores que deseen abordar este tema en clase tengan un buen conocimiento y experiencia en la enseñanza de matemáticas avanzadas. Además, se debe presentar de manera clara y concisa, para que los estudiantes puedan comprenderlo y relacionarlo con otros conceptos matemáticos que hayan aprendido previamente.

Otra opción sería incorporar el Teorema del Mono Infinito en actividades extracurriculares, como clubes de matemáticas o ferias de ciencias, para que los estudiantes interesados en la materia puedan explorar el tema con más profundidad y detalle.

En conclusión, el Teorema del Mono Infinito es un tema interesante y relevante en la teoría de la probabilidad y la estadística, y puede ser una opción para enriquecer la educación matemática de los estudiantes avanzados en este tema, siempre y cuando sea presentado de manera clara y adecuada por profesores capacitados y con experiencia en la enseñanza de matemáticas avanzadas.

V. Conclusiones

El teorema del mono infinito es un concepto matemático fascinante y complejo que puede ser difícil de comprender para los estudiantes. Sin embargo, si se implementa adecuadamente en las aulas de los institutos, puede tener varios beneficios educativos. A continuación, se presentan algunas posibles conclusiones de implementar el teorema del mono infinito en las aulas de los institutos:

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1. Mejora de la comprensión de los conceptos matemáticos: El teorema del mono infinito involucra conceptos matemáticos avanzados, como el infinito y la probabilidad. Al enseñar este teorema a los estudiantes, se les obliga a pensar profundamente en estos conceptos, lo que puede ayudarles a comprender mejor otros conceptos matemáticos.
2. Estimulación del pensamiento crítico: Al enseñar el teorema del mono infinito, se les anima a los estudiantes a cuestionar y reflexionar sobre la lógica detrás de las matemáticas. Esto puede ayudarles a desarrollar habilidades de pensamiento crítico y analítico que les serán útiles en muchos aspectos de su vida.
3. Mejora de la creatividad: El teorema del mono infinito también puede estimular la creatividad de los estudiantes al obligarlos a pensar en soluciones no convencionales para problemas matemáticos. Esto puede ayudarles a desarrollar habilidades de pensamiento creativo que les serán útiles en muchas otras áreas de su vida.
4. Incremento del interés en las matemáticas: El teorema del mono infinito es un tema intrigante y desafiante que puede ser emocionante para los estudiantes. Si se les enseña adecuadamente, puede ayudar a despertar su interés en las matemáticas y motivarlos para explorar temas más avanzados.

Implementar el teorema del mono infinito en las aulas de los institutos puede tener varios beneficios educativos, incluyendo la mejora de la comprensión de los conceptos matemáticos, la estimulación del pensamiento crítico y creativo, y el incremento del interés en las matemáticas.

El teorema del mono infinito es un concepto matemático que se utiliza para ilustrar la idea de que, en un universo infinito, una secuencia de eventos aleatorios eventualmente producirá cualquier resultado posible. La aplicación de este teorema en las aulas de los institutos podría tener varias conclusiones, como las siguientes:

1. Fomenta la comprensión de la probabilidad: El teorema del mono infinito es un concepto que ayuda a los estudiantes a entender la probabilidad y cómo funciona. Al aprender cómo una secuencia de eventos aleatorios puede producir cualquier resultado posible, los estudiantes pueden mejorar su capacidad para calcular probabilidades y entender los resultados.
2. Estimula la creatividad: La aplicación del teorema del mono infinito en el aula puede estimular la creatividad y la imaginación de los estudiantes. Al darse cuenta de que cualquier cosa es posible en un universo infinito, los estudiantes pueden pensar en nuevas ideas y soluciones que podrían no haber considerado anteriormente.
3. Promueve el pensamiento crítico: El teorema del mono infinito también puede ayudar a los estudiantes a desarrollar habilidades de pensamiento crítico al cuestionar suposiciones y evaluar argumentos. Los estudiantes pueden reflexionar sobre cómo se aplica el teorema a diferentes situaciones y qué implicaciones tiene para la vida real.

En conclusión, la implementación del teorema del mono infinito en las aulas de los institutos puede tener varios beneficios, como mejorar la comprensión de la

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probabilidad, estimular la creatividad y promover el pensamiento crítico. Al proporcionar a los estudiantes herramientas para comprender conceptos matemáticos complejos, podemos prepararlos mejor para el éxito en el mundo real.

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99.99% Approximation to Angle Trisection

By Mahesh Bubna

Abstract- Angle trisection, which involves dividing an angle into three equal parts, is a classic problem in geometry. However, it's important to note that it's impossible to exactly trisect an arbitrary angle using only a compass and straightedge, as proven by the ancient Greek mathematicians.

The classical geometric construction methods allow for the creation of angles that are multiples of a fixed angle using only a compass and straightedge. The only angles that can be trisected exactly are those that can be constructed by repeatedly bisecting angles, such as angles of 60 degrees (since 60 = 2^2 * 3 * 5).

The problem of angle trisection is closely related to the problem of "angle duplication," which involves constructing an angle that is twice a given angle. This problem is similarly unsolvable with only a compass and straightedge for arbitrary angles.

Keywords: angle trisection approximation, geometric constructions, numerical methods for angle trisection, high-precision angle division, trigonometric approximation of angle trisection, computational geometry for angle trisection.

GJSFR-F Classification: LCC: QA445, MSC: 51M04



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Mahesh Bubna

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The problem of angle trisection is closely related to the problem of "angle duplication," which involves constructing an angle that is twice a given angle. This problem is similarly unsolvable with only a compass and straightedge for arbitrary angles.

If you're interested in an approximation of angle trisection, one approach involves using numerical methods to approximate the trisected angle. However, this wouldn't involve a pure geometric construction and would likely require the use of calculators or computers to perform the calculations.

Keywords: angle trisection approximation, geometric constructions, numerical methods for angle trisection, high-precision angle division, trigonometric approximation of angle trisection, computational geometry for angle trisection.

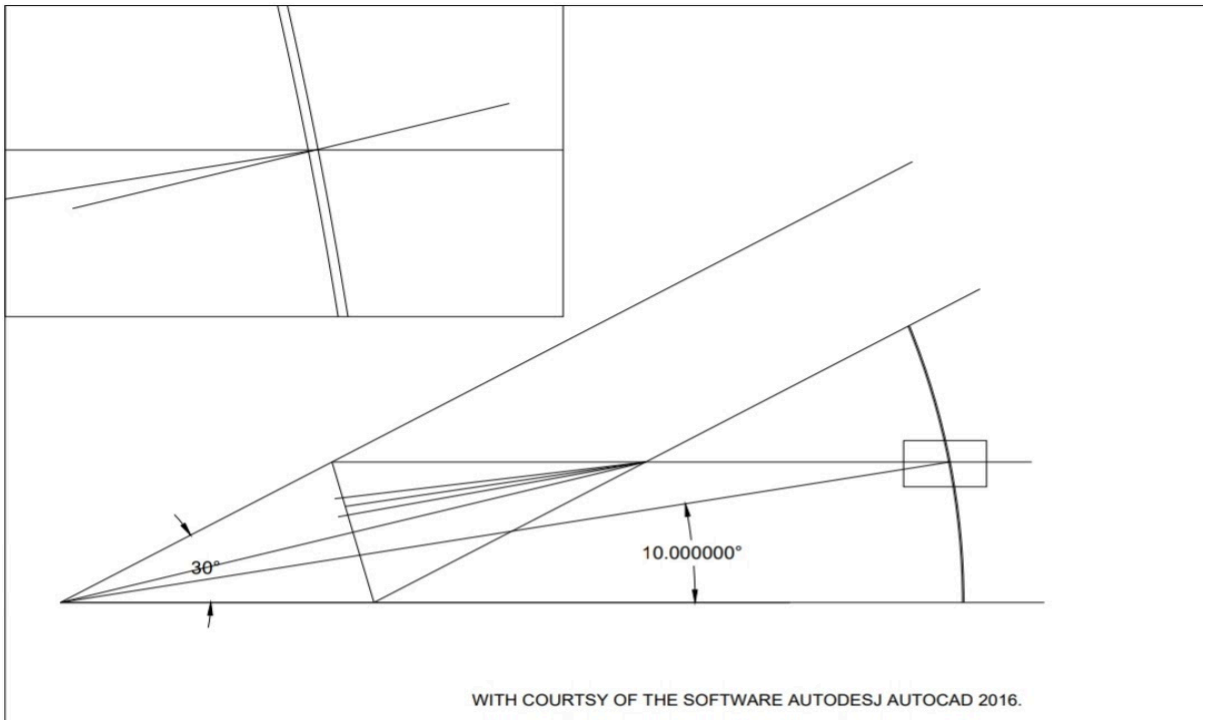

Fig. 1

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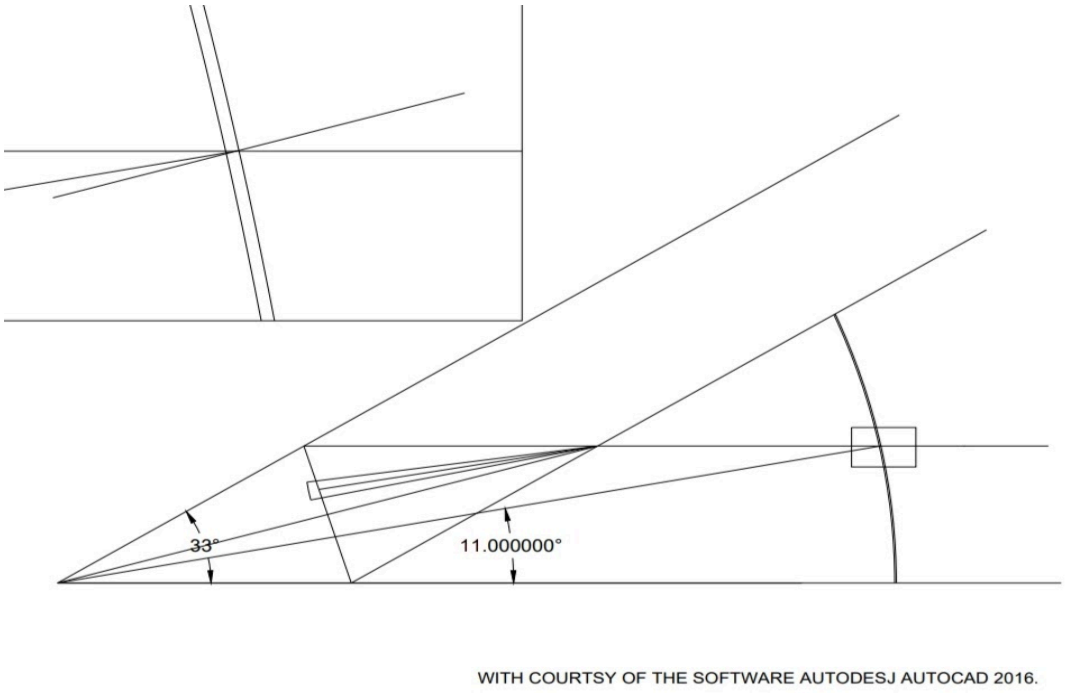

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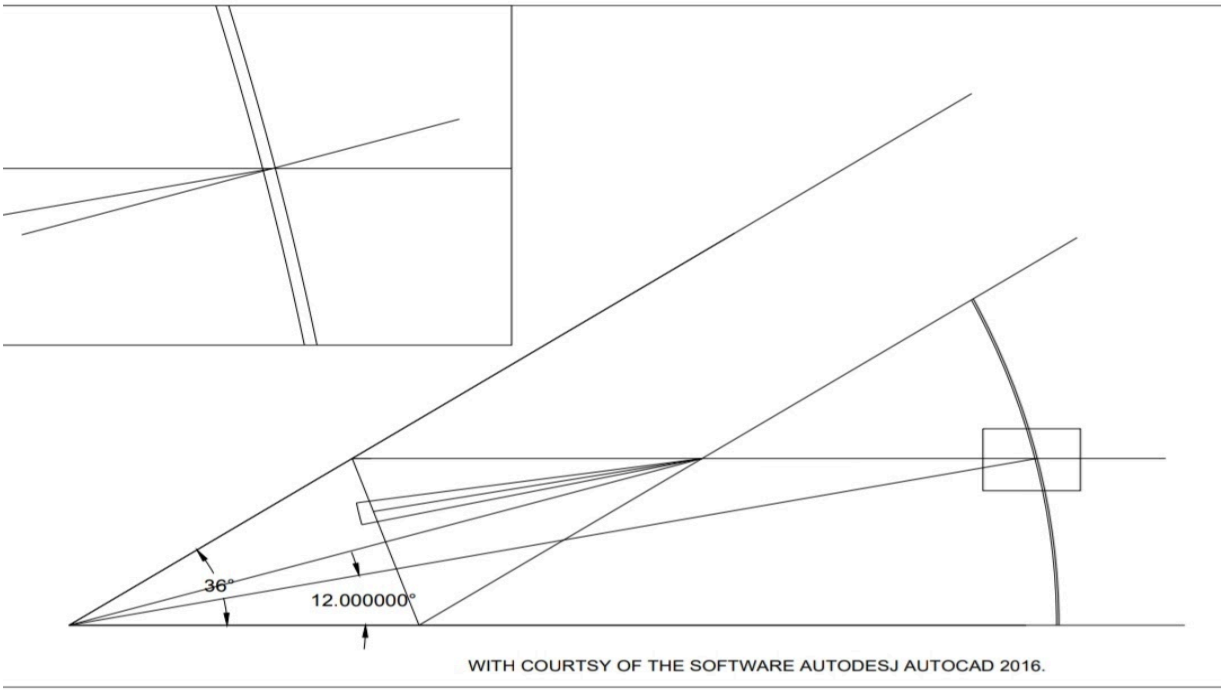

Fig. 3

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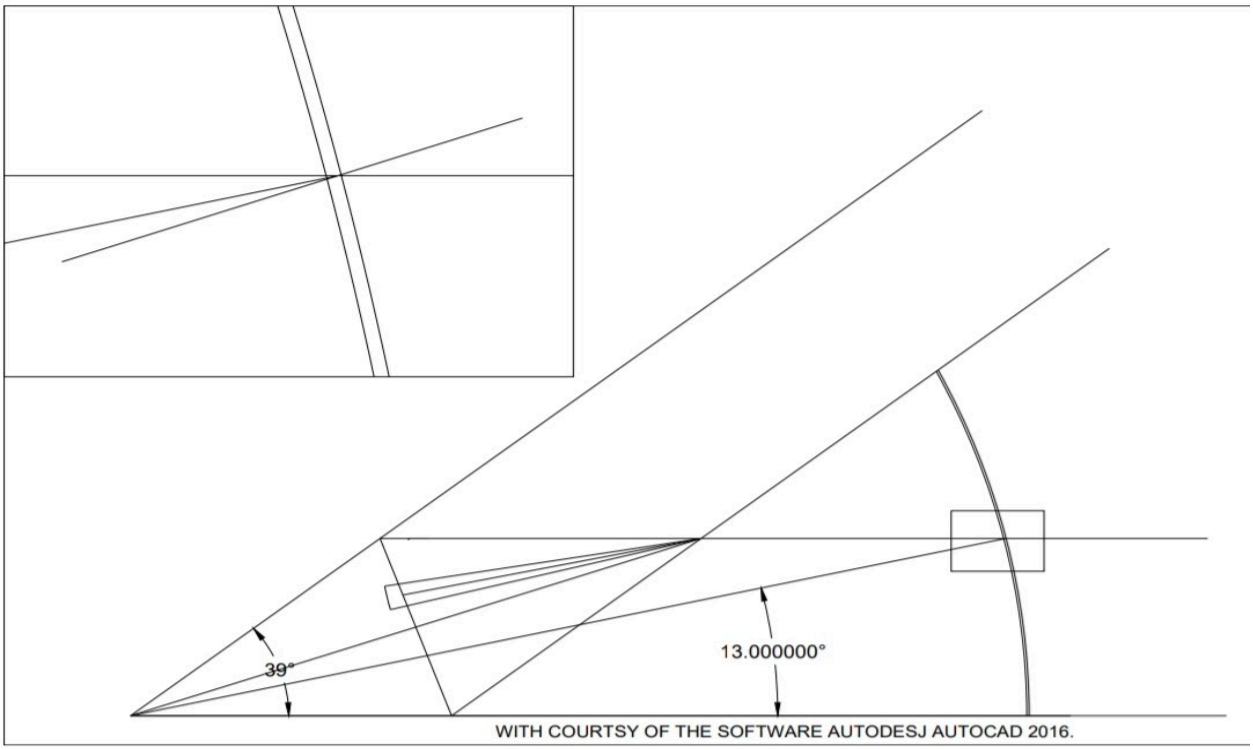

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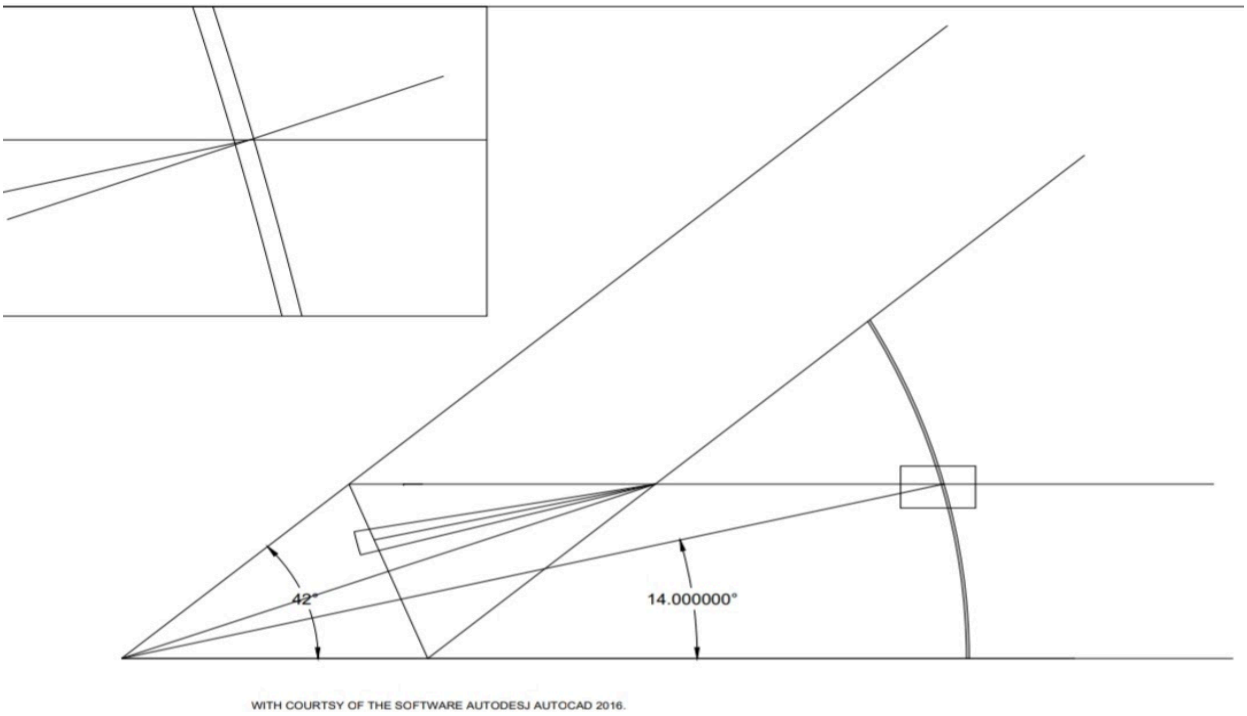

Fig. 5

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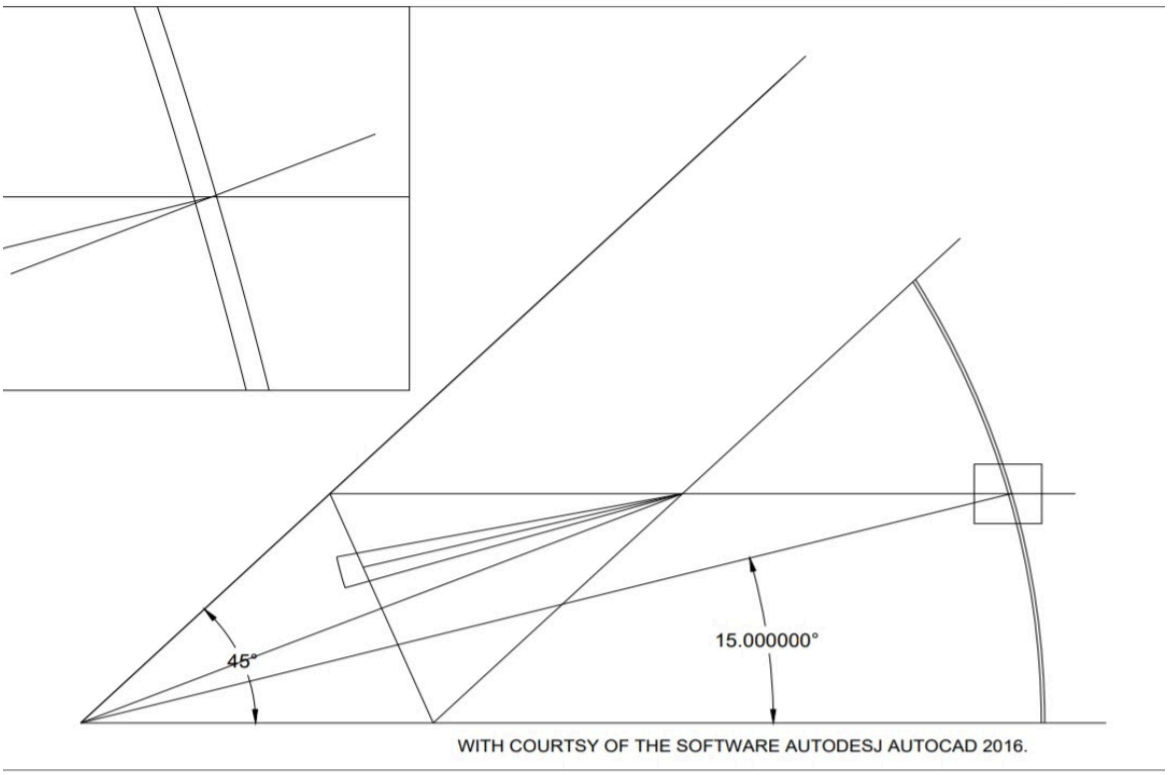

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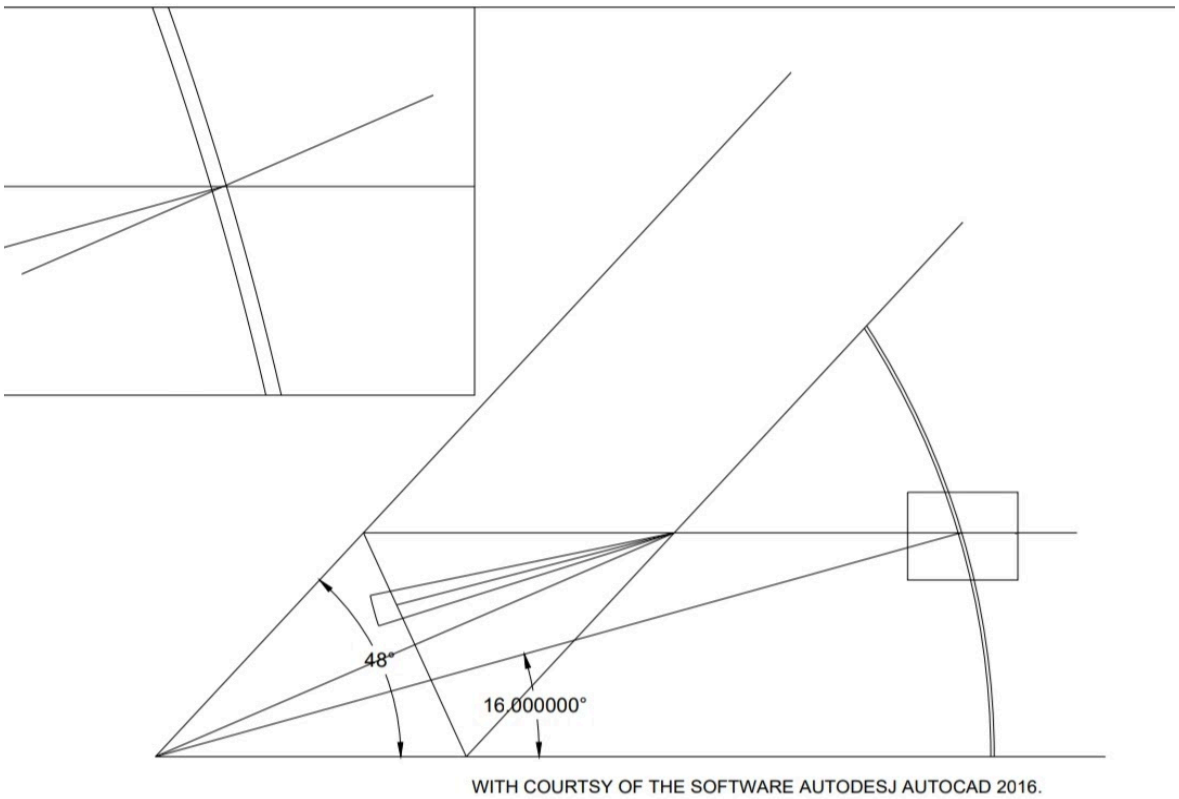

Fig. 7

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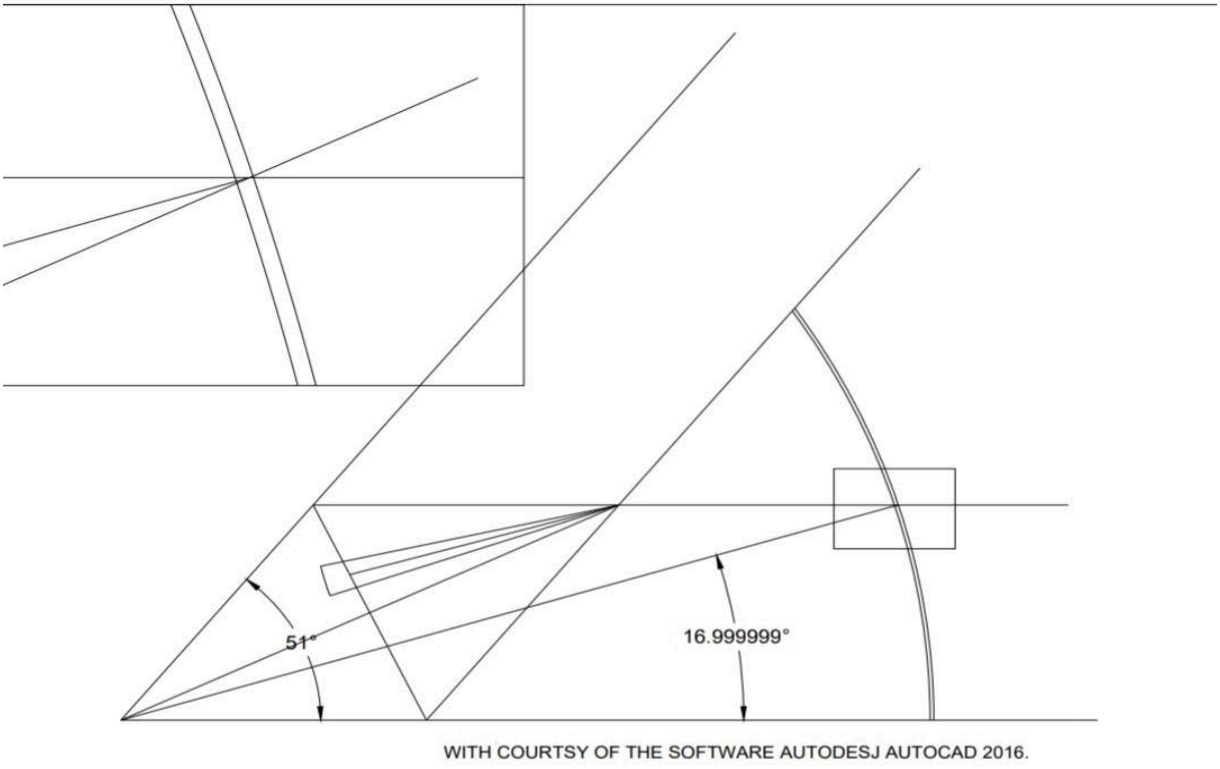

Fig. 8

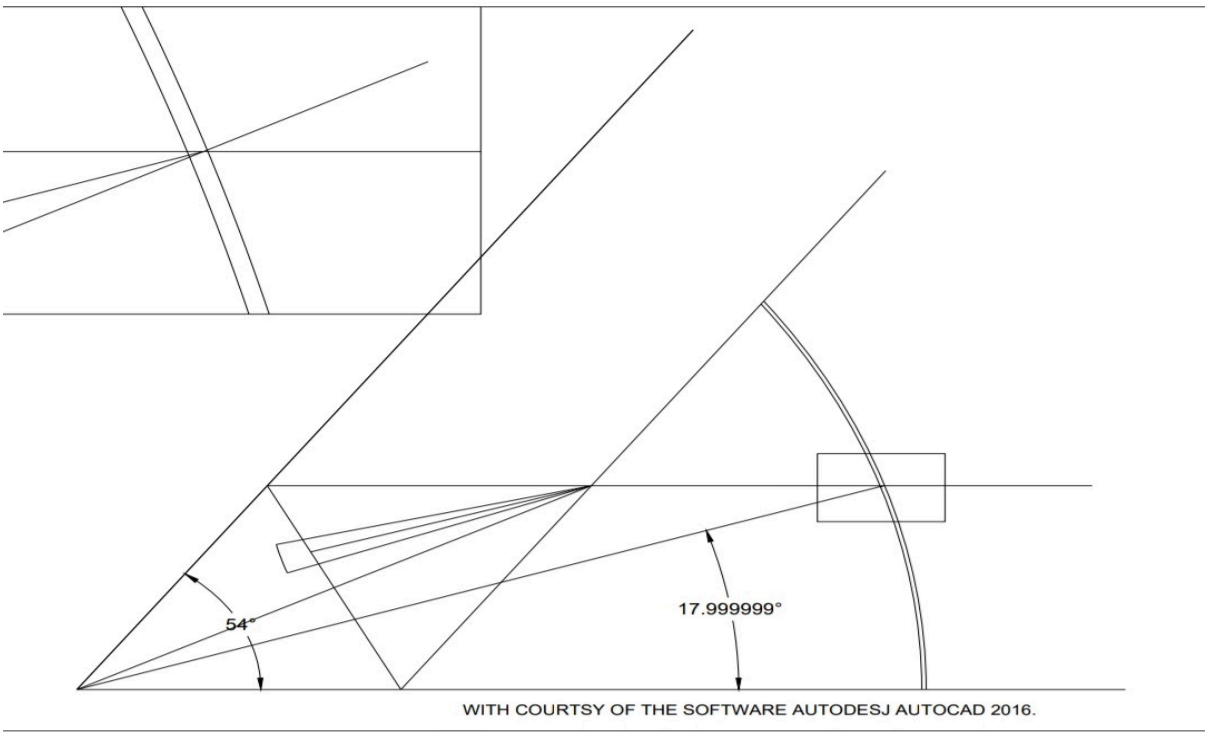

Fig. 9

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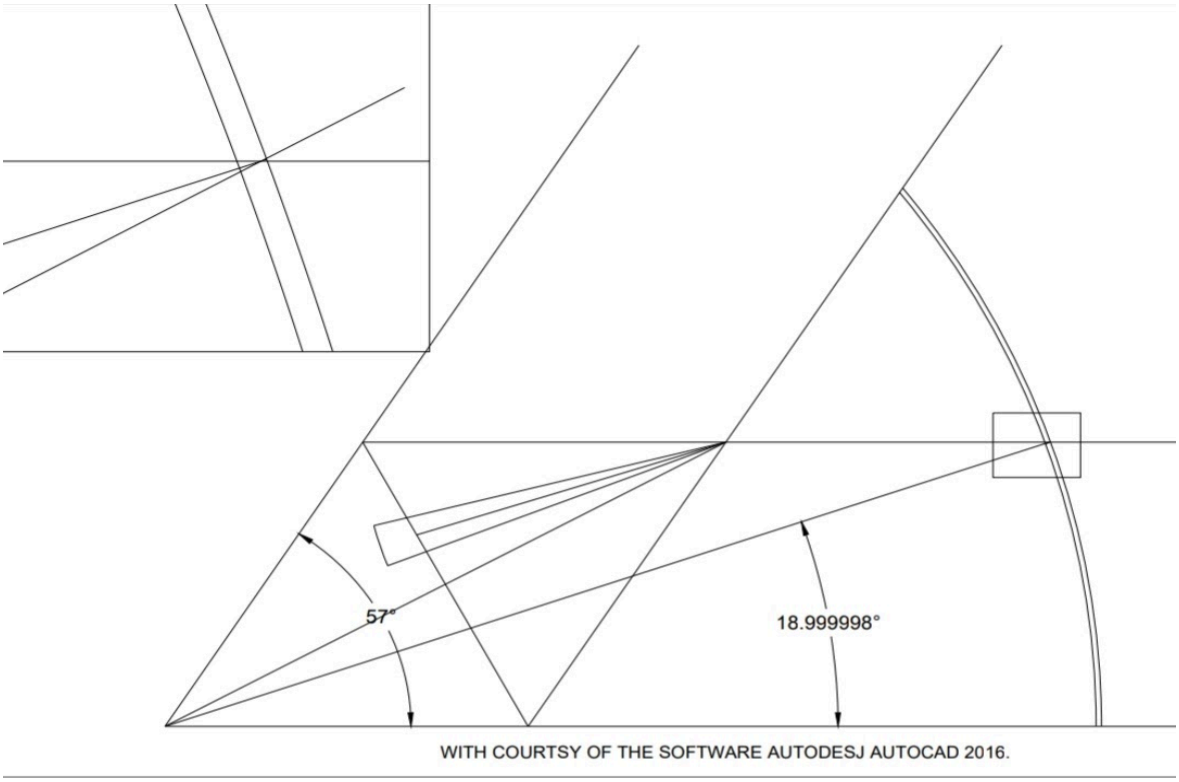

Fig. 10

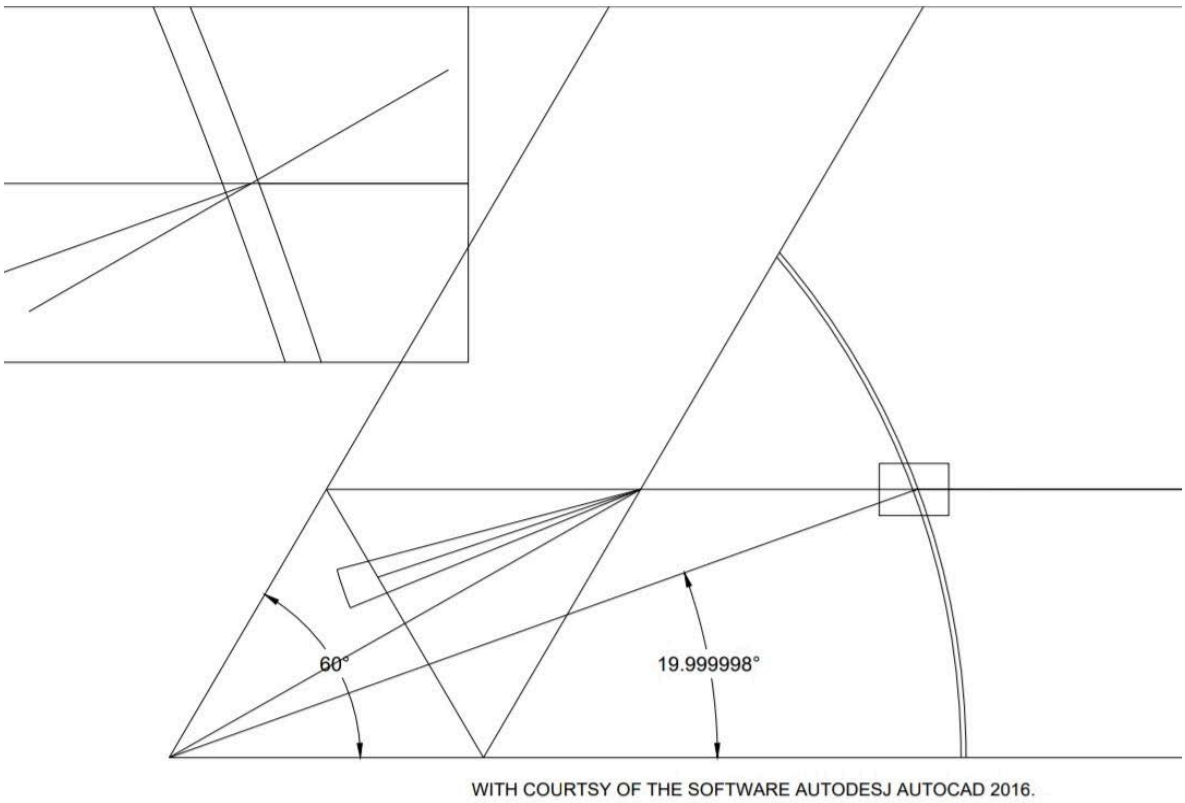

Fig. 11

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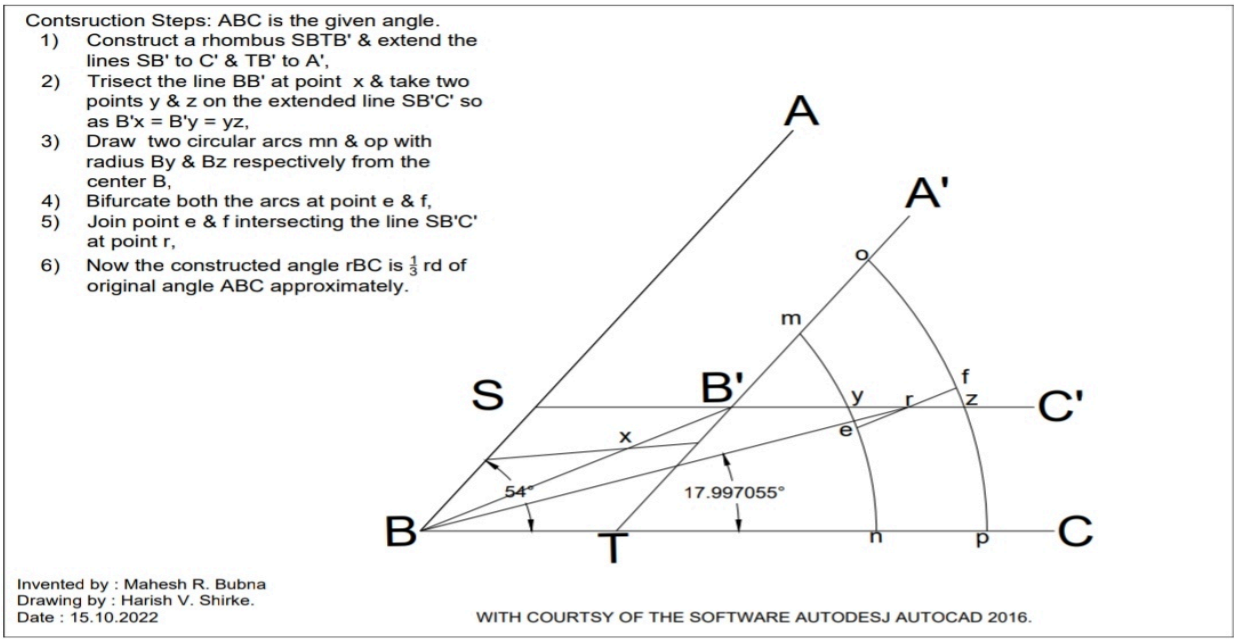

Fig. 12

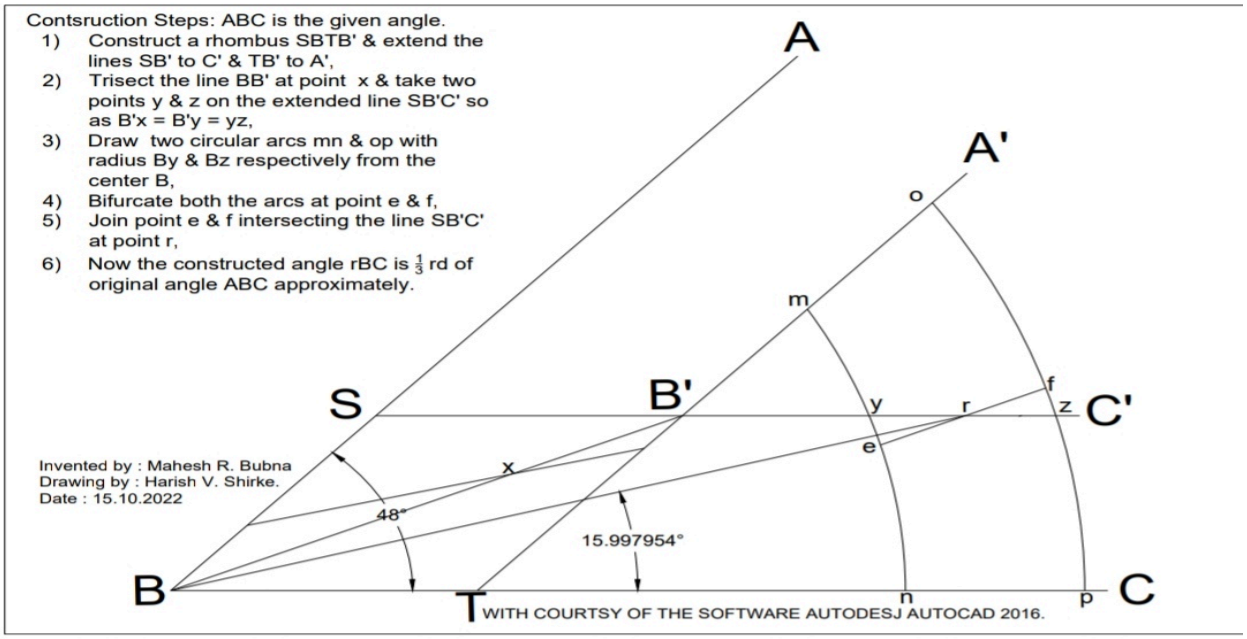

Fig. 13

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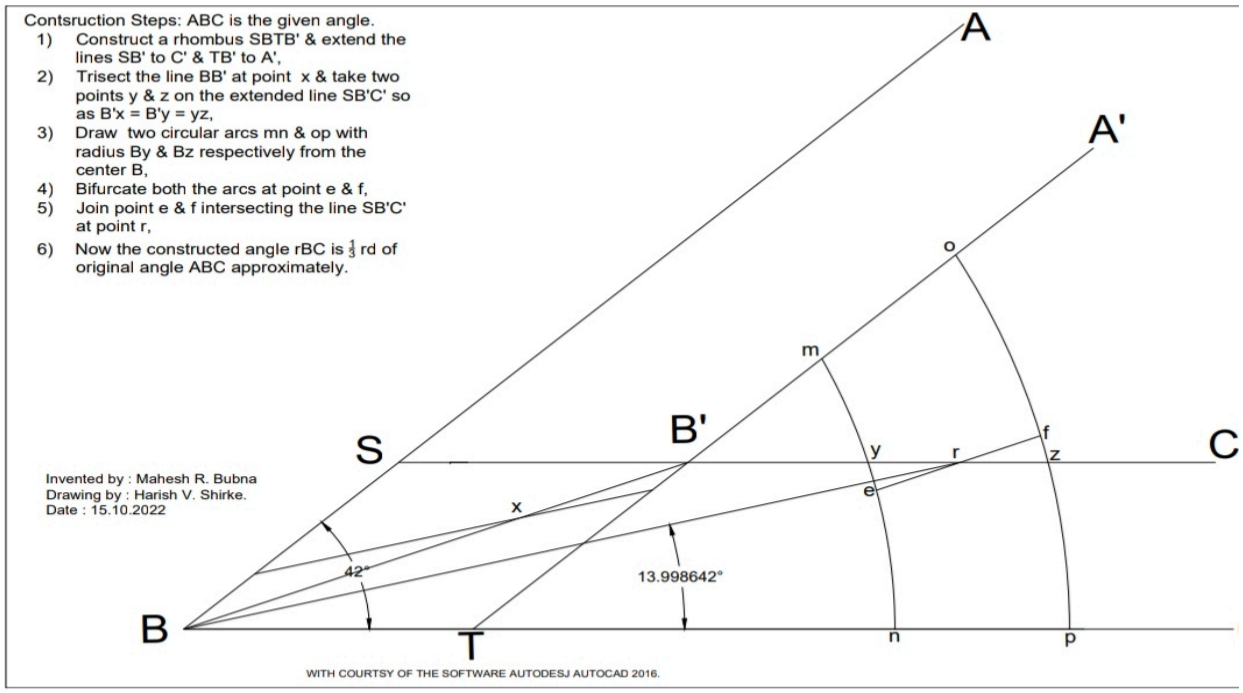

Fig. 14

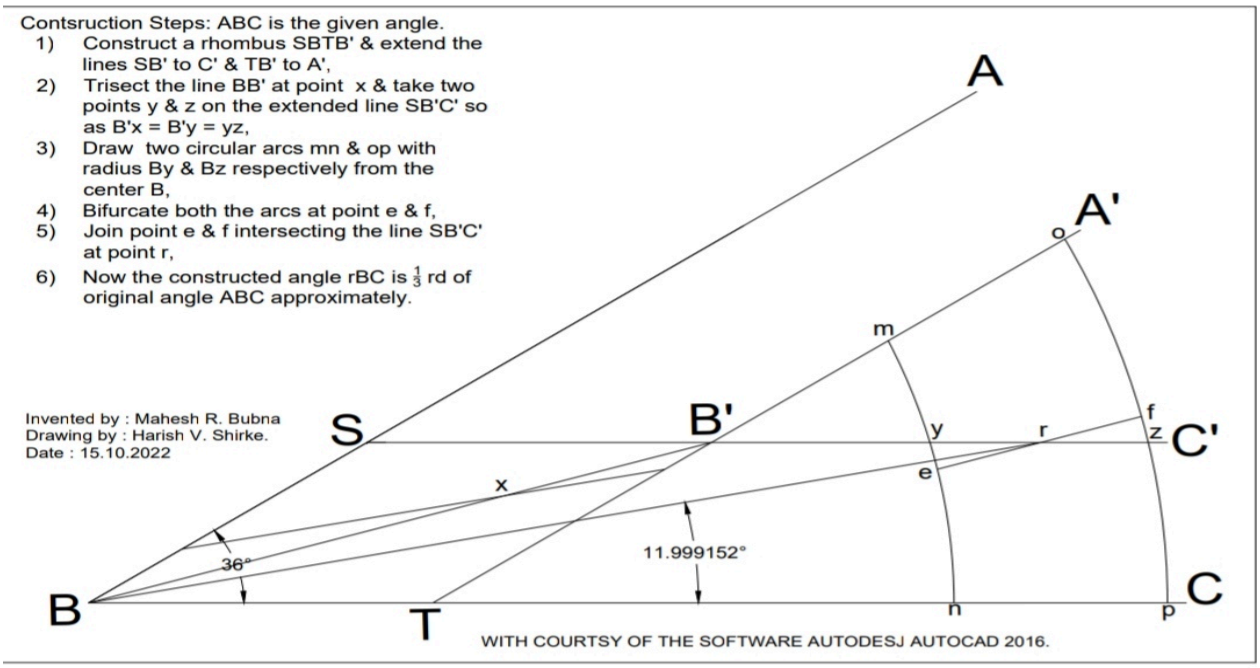

Fig. 15

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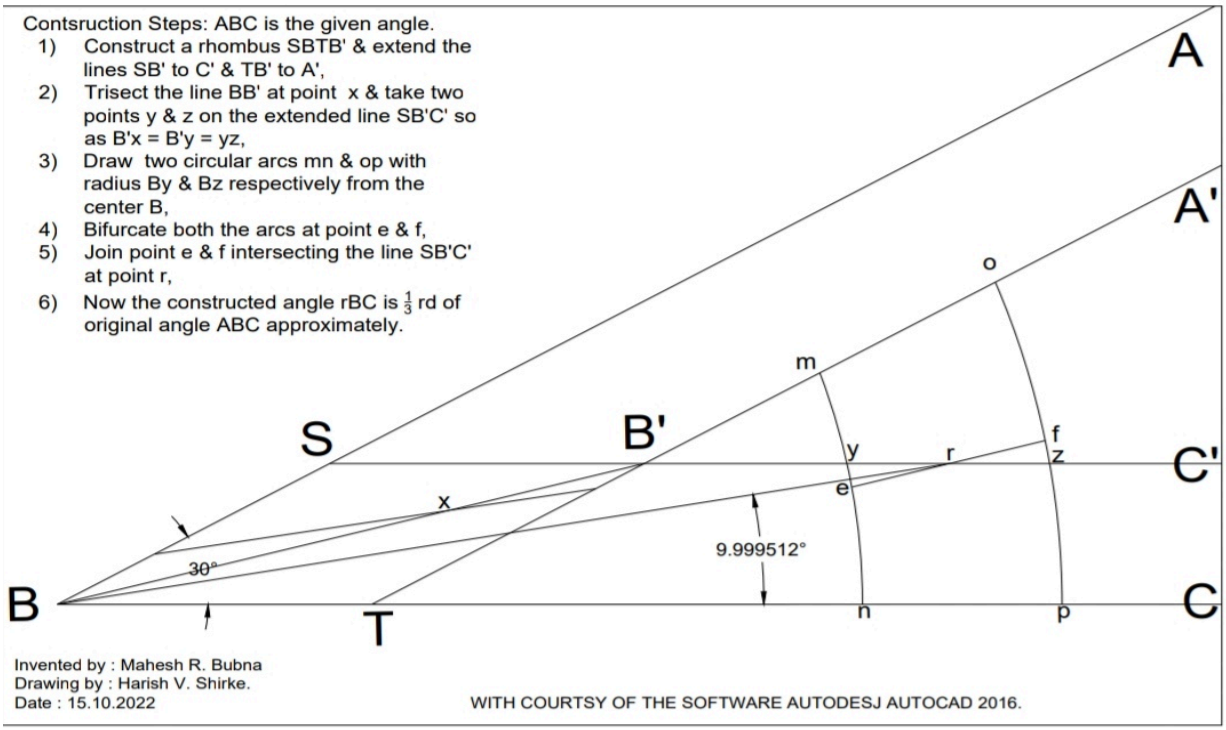

Fig. 16

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Fellows/Associates of Science Frontier Research Council

FSFRC/ASFRC Memberships



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12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

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Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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