

УДК 51-78

**СКРЫТАЯ МАТЕМАТИКА В ФЛАГЕ РЕСПУБЛИКИ АНГОЛА****Казимиру Эринелту да Фонсека Жозефа,**Почетный доктор математических наук, PhD in Economics, ассоциированный профессор  
Департамента инженерии и технологий Высшего политехнического института технологий  
и наук.

Авенида Луанда Сул, улица S10 Талатона – Ангола

[herinelto.casimiro@isptec.co.ao](mailto:herinelto.casimiro@isptec.co.ao)**Аннотация**

Целью данной работы является прояснение математики, скрытой в флаге Республики Ангола, посредством четкой демонстрации используемых пропорций и расположения содержащихся в нем символов. Работа ссылается на деятельность великих художников древности, которые подтвердили важность золотого сечения как существенного фактора в определении красоты своих произведений.

**Ключевые слова:** золотое сечение, флаг Республики Ангола, совершенный прямоугольник.

**THE MATH HIDDEN IN THE FLAG OF REPUBLIC OF ANGOLA****Herinelto Da Fonseca Josefa Casimiro**Doctor, HC in Mathematical Sciences, PhD in Economics, Associate Professor of Department of  
Engineering and Technology of the Higher Polytechnic Institute of Technology and Sciences.

Av. Luanda Sul, Rua Lateral Via S10 Talatona – Angola

[herinelto.casimiro@isptec.co.ao](mailto:herinelto.casimiro@isptec.co.ao)**ABSTRACT**

The present work aims to clarify the mathematics hidden in the flag of the Republic of Angola, through clear demonstrations of the proportion used and the positioning of the symbols contained in it. The work makes reference to activity of the great artists of antiquity, who

confirmed the importance of the golden proportion as an essential factor in defining the beauty of their works.

---

**Keywords:** golden ratio, flag of the Republic of Angola, perfect rectangle.

---

### **Introduction.**

Modern mathematicians, observing logical patterns hidden in various human works, have come to the conclusion that they involve deep mathematical logics, which follow a rigorous and strictly rational process. In many cases, these patterns are presented as major introductions into the world of mathematical science.

We live in a very complex world that expresses itself through laws, which with the help of which mathematical expressions are developed as factors that guarantee the sustainability of their description.

The great Renaissance painters affirmed that mathematics is one of the essential elements for defining the beauty of their works, being the result of the search for the ideal of perfection. Therefore, mathematics arises naturally as men's thoughts are transformed into artistic works, reflecting purely mathematical rational congruences.

Strictly analyzing the flag of the Republic of Angola, which was adapted in 1975, in the vision clarified by the logic of the colors contained in it, in which: red-red, which means the blood shed by Angolans during colonial oppression, the national liberation struggle and the defense of the Homeland, Black – the color of the African continent; it comes to the conclusion that there is a mathematical logic obeyed.

It is known that the geometric design of the national flag of the Republic of Angola is quite obvious, as it has a rectangular shape and is composed of two rectangles, of the same size, in a horizontal position. The upper one is red and the lower one black. In the center of the flag, there is a cogwheel and a machete (agricultural work tool) yellow crosses. There is also a five-pointed yellow star in the center [1].

The big question that arises is the positioning of the symbols, which show a proportion between width and length, whose value is very close to the so-called golden number or golden proportion. This proportion is precisely  $2/3$ , which leads us to ask the following obvious questions:

1. What led to the choice of this proportion?
2. What is the reason for the positioning of the star, machete and sprocket?

The answers to these questions remind us of I. Kepler's famous phrase:

*"The two great discoveries in geometry: one is the famous Pythagorean theorem and the second is precisely, the golden ratio or mean ratio, or even golden ratio - one thing, we can compare with gold, and other things, as a precious stone".*

### **Fundamental part.**

The flag of the Republic of Angola has hidden mathematical principles. The questions asked above, in particular, lead us to the demonstrations and explanations of the history of the golden proportion.

It is known that the golden ratio was widely used in art, in works such as the Birth of Venus, a painting by Botticelli, in which Aphrodite is in the golden ratio. The reasons for the presence of proportion in these works are explained by the reason that the author represents the perfection of

beauty. Leonardo da Vinci himself, in his great work *Mona Lisa*, used the golden proportion in the relationships between the trunk and the head, as well as in the elements of the face, but this is an inherent characteristic of the human being and such proportions can be found in most of paintings in which anatomy has been respected [2]. The figure below shows the measurements taken by computer, where *Mona Lisa*'s eyes are situated in golden subdivisions of the screen.

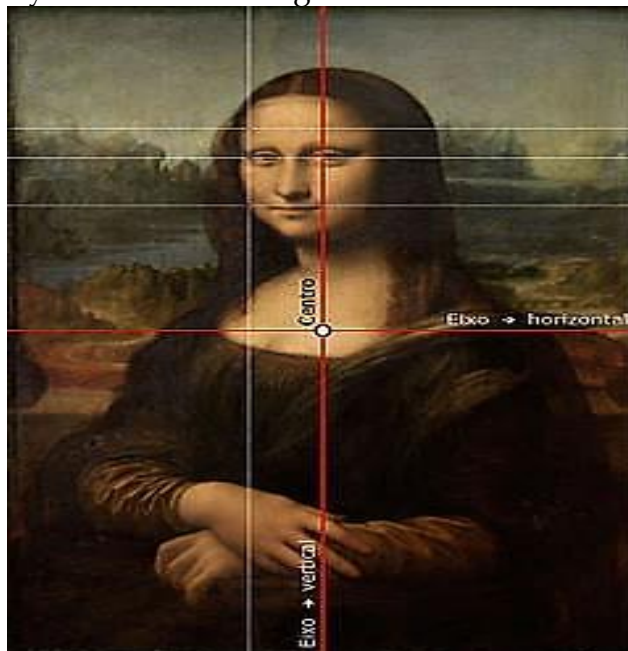


Figure 1. *Mona Lisa* – work by Leonardo da Vinci [2]

This work proves that the artists' paintings would not have a good appreciation and beauty if the drawn object were in the center of the painting. The big question is: where should it be drawn? And in which position concretely? Examples on the golden ratio are well presented and explained in the work [3].

Many years ago, scientists considered the best rectangle to be one with width  $a$  and length  $b$ , which satisfy the condition:

$$\frac{a}{b} = \frac{b-a}{a} \tag{1}$$

From there, we will have the following:

$$\frac{a}{b} = \frac{b}{a} - \frac{a}{a} = \frac{b}{a} - 1 \tag{2}$$

Let us replace  $\frac{a}{b} = x$ , where  $0 < x \leq 1$ , in this case, we will get the following:

$$x = \frac{1}{x} - 1 \rightarrow x^2 + x - 1 = 0;$$

$$\Delta = 1^2 + 4 \times 1 \times 1 = 5.$$

The equation has two roots:

$$x_1 = \frac{-1 + \sqrt{5}}{2} \text{ e } x_2 = \frac{-1 - \sqrt{5}}{2}.$$

As per condition:  $0 < x \leq 1$ , logo  $x_1$  is the desired solution.

In this way:

$$\frac{a}{b} = \frac{-1 + \sqrt{5}}{2} \approx 0,618.$$

This constant is called the gold ratio.

Now let us analyze fraction values  $\frac{2}{3}, \frac{1}{2}, \frac{3}{4}$ , where the first is what is on the flag of the Republic of Angola.

We will have the following:

$$\frac{2}{3} \approx 0,667; \frac{1}{2} = 0,5; \frac{3}{4} = 0,75.$$

We will notice that the number 0.667 is closer to the number 0.618, with a deviation of less than 5%, that is, if we draw a rectangle of size 2/3, we will obtain an almost perfect rectangle. Thus, the flag of the Republic of Angola was built and its explanation is shown in figure 2.

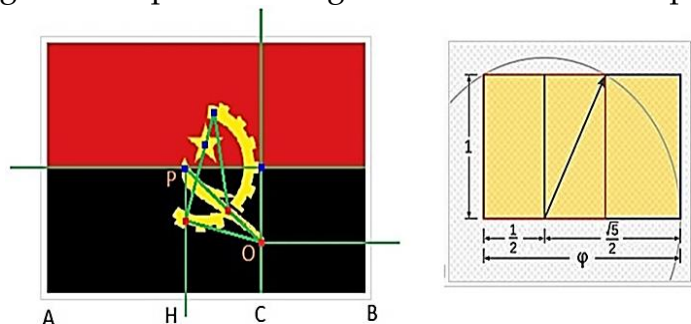
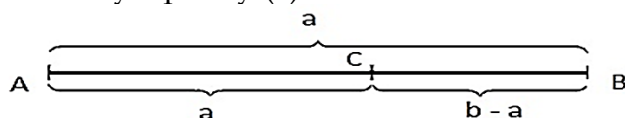


Figure 2. Flag of the Republic of Angola represented with projection points

If we show the foundation of figure 2 on line AB, the projection of a man on AB is point C, which must satisfy equality (1):



If we look closely at our flag, we will see that the points of the projections P and O are the points H and C, and the proportions will be:

$$\frac{AH}{AC}, \frac{AC}{AB}, \frac{HP}{HB}, \frac{HC}{BC}$$

approximately to the number of the proportion of gold.

If we designate the points of intersection between the machete and the sprocket with Q, then this point divides the length of the machete and the sprocket by the proportion also approximated by the number of the golden proportion.

We will also notice that the star divides the distance from the cogwheel by the proportion also approximated to the number of proportion of gold. In this case, the rectangle of our flag is almost perfect, as well as the position of the star symbol, the machete and the gear are in an almost perfect position.

The proportion of gold is reflected in the Fibonacci sequence. More information can be found in the source [4]. It is even found in modern company logos – for example, Pepsi and Twitter, as well as in nature, where flowers and stems, shells and even hurricanes are created as if with the help of divine proportions [5]. It is this mathematical phenomenon that many associate the attractiveness of these art and design objects.

### Conclusion.

The principle of beauty in works shows the presence of a classical mathematics, which in many cases is unknown by the authors themselves. However, these authors, in our view, are guided by the logical reasoning that is the foundation of mathematics.

The flag of the Republic of Angola has a hidden mathematics, proven by the positioning of the symbols contained therein. In the presentations, it was concluded that the value of the proportion used is very close to the value of the golden proportion, with an error that classifies the rectangle almost perfect. For better conclusions about the reason for the positioning of the symbols, it is necessary to carry out a study in the historical aspect, in order to survey the veracity of the authors' intention. But, the principles of classical geometry were all taken into account, which leads us to have a clear view of the beauty of our flag.

#### Список литературы.

1. Website oficial da Sua Pesquisa [Recurso electrónico]. Regime de acesso: <https://www.suapesquisa.com/paises/angola/bandeira.htm>
2. Mandarino, D. A divisão áurea por detrás do olhar de Mona Lisa. Portal Alô Artista. São Paulo. 2012
3. Carvalho, V. A proporção áurea está em tudo! Na natureza, na vida e em você [Recurso electrónico]. Regime de acesso:
4. <https://www.hypeness.com.br/2014/02/a-proporcao-aurea-esta-em-tudo-na-natureza-na-vida-e-em-voce/>
5. Casimiro, H. Matemática. No Mundo dos Números (NMN). Casa editorial «Belgorod». Belgorod. 2015.
6. Золотое сечение в дизайне и жизни [электронный ресурс]. Режим доступа: [https://www.canva.com/ru\\_ru/obuchenie/zolotoe-sechenie-matematika-kotoraya-izmenit-vash-dizajn/](https://www.canva.com/ru_ru/obuchenie/zolotoe-sechenie-matematika-kotoraya-izmenit-vash-dizajn/)

#### References.

1. Official Website of Your Research [Electronic Resource]. access regime: <https://www.suapesquisa.com/paises/angola/bandeira.htm> (In portuguese)
2. Mandarino, D. The golden division behind Mona Lisa's gaze. Hello Artist Portal. São Paulo. 2012 (In portuguese)
3. Carvalho, V. The golden ratio is in everything! In nature, in life and in you [Recurso electrónico]. Regime de acesso:
4. <https://www.hypeness.com.br/2014/02/a-proporcao-aurea-esta-em-tudo-na-natureza-na-vida-e-em-voce/> (In portuguese)
5. Casimiro, H. Math. In the World of Numbers (NMN). Publishing house «Belgorod». Belgorod. 2015 (In portuguese)
6. Golden ratio in design and life. [Electronic resource]. Access regime: [https://www.canva.com/ru\\_ru/obuchenie/zolotoe-sechenie-matematika-kotoraya-izmenit-vash-dizajn/](https://www.canva.com/ru_ru/obuchenie/zolotoe-sechenie-matematika-kotoraya-izmenit-vash-dizajn/) (In Russian)