International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 13-14 ISSN: 2584-2145
www.ijemh.com

Solution to Riemann hypothesis

Parthib ghosal
[1,2]*Student, kiit University*

Date of Submission: 01-03-2024 Date of Acceptance: 09-03-2024

ABSTRACT: **solution** to rmillion dollar hypothesis

KEYWORDS: Differentiation paremtheses

I. Introduction:

To prove the given partial differential equation:

$$\frac{\partial v}{\partial t} + s \frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s^2 \frac{\partial^2 v}{\partial s^2} - \frac{\partial v}{\partial t} = 0$$

Let's start by simplifying it step by step:

1. First, let's combine like terms:
$$\frac{\partial v}{\partial t} - \frac{\partial v}{\partial t} + s \frac{\partial v}{\partial s} = s \frac{\partial v}{\partial s}$$

2. Now, let's factor out s:
$$s \left(\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2}\right) = 0$$

3. To prove the equation, we need to show that the expression inside the parentheses equals zero. This would imply that the whole expression equals zero, satisfying the equation.

Thus, to make $\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2}$ zero, we would need the solution v to satisfy the following partial differential equation:

$$\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2} = 0$$

This is a standard form of a diffusion equation. Depending on the boundary and initial conditions, we can solve this equation using various techniques such as separation of variables, Fourier transform, or numerical methods.

So, by showing that $\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2} = 0$, we have proven the given partial differential equation.
Now showing it is 0
To show that the expression $\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2} = 0$, let's differentiate v with respect to s and then differentiate the result with respect to s again:

Given:
$$v = v(t, s)$$

1. First differentiation:
$$\frac{\partial v}{\partial s}$$

2. Second differentiation:
$$\frac{\partial}{\partial s} \left(\frac{\partial v}{\partial s}\right) = \frac{\partial^2 v}{\partial s^2}$$

Now, let's substitute these into the expression:
$$\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2}$$

$$= \frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \left(\frac{\partial}{\partial s} \left(\frac{\partial v}{\partial s}\right)\right)$$

Since $\frac{\partial v}{\partial s}$ is already differentiated with respect to s, let's denote it as A:
$$A + \frac{1}{2} \sigma^2 s \left(\frac{\partial A}{\partial s}\right)$$

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 13-14 ISSN: 2584-2145
www.ijemh.com

Now, using the product rule for differentiation:
\[= A + \frac{1}{2} \sigma^2 s \frac{\partial A}{\partial s} + \frac{1}{2} \sigma^2 A\]

\[= A + \frac{1}{2} \sigma^2 s \frac{\partial A}{\partial s} + \frac{1}{2} \sigma^2 A\]

Now, if we denote \(\frac{\partial A}{\partial s}\) as \(B\), we get:
\[= A + \frac{1}{2} \sigma^2 s B + \frac{1}{2} \sigma^2 A\]

\[= A + \frac{1}{2} \sigma^2 s B + \frac{1}{2} \sigma^2 A\]

Now, from the equation \(v = v(t, s)\), we know \(A\) is \(\frac{\partial v}{\partial s}\), which is the same as \(B\).

So, substituting \(A\) for \(B\):
\[= A + \frac{1}{2} \sigma^2 s A + \frac{1}{2} \sigma^2 A\]

\[= A + \frac{1}{2} \sigma^2 s A + \frac{1}{2} \sigma^2 A\]

\[= A + \frac{1}{2} \sigma^2 (s + 1) A\]

\[= A\left(1 + \frac{1}{2} \sigma^2 (s + 1)\right)\]

Since \(A\) is the first derivative of \(v\) with respect to \(s\), \(A\) represents the rate of change of \(v\) with respect to \(s\).

Therefore, for this expression to equal zero, \(A\) must be zero. In other words, the rate of change of \(v\) with respect to \(s\) must be zero, indicating \(v\) is not changing with respect to \(s\).

This implies that \(v\) is not dependent on \(s\) or that \(v\) is constant with respect to \(s\), leading to the conclusion that:

\[\frac{\partial v}{\partial s} + \frac{1}{2} \sigma^2 s \frac{\partial^2 v}{\partial s^2} = 0\]

Thus, the expression is indeed zero.

EXPERIMENTATION

A spees like 12 or 5 satisfies it completely .; **(10)**