

Successful Examples: Problem 2.6 from ControlBench

Human Input:

A system has a characteristic equation given by $s^3 + Ks^2 + (K + 1)s + 6 = 0$. Determine the range of K for a stable system. You can use Routh-Hurwitz Stability Criteria.

GPT-4:

To determine the range of K for a stable system using the Routh-Hurwitz Stability Criteria, we start with the given characteristic equation:

$$s^3 + Ks^2 + (K + 1)s + 6 = 0$$

We construct the Routh array as follows ...

Solving the second inequality, we find the solution to be $K < -3$ or $K > 2$.

However, since $K > 0$ is required for stability, we ignore the solution $K < -3$. Hence, for the system to be stable, the range of K is $K > 2$.



Claude-3 Opus:

Step 1: Write the characteristic equation in the standard form:

$$a_0s^3 + a_1s^2 + a_2s + a_3 = 0.$$

Step 2: Apply the Routh-Hurwitz stability ... the following condition must be satisfied:

$$a_1a_2 > a_0a_3.$$

Step 3: Check the positivity of the coefficients ... we get: $K > 0$...

Step 4: Check the condition $a_1a_2 > a_0a_3$... Solving the quadratic inequality $K < -3$ and $K > 2$.

Step 5: Combine the conditions for K .

From steps 3 and 4, we have:

$K > 0$ and $K > 2$. Therefore, the range of K for a stable system is $K > 2$.



Gemini 1.0 Ultra:

Routh-Hurwitz Stability Criterion: The Routh array is:

| | | |
|-------|-------------------|-----|
| s^3 | 1 | K |
| s^2 | K | 6 |
| s^1 | $(K^2 + K - 6)/K$ | K |
| s^0 | 6 | 0 |

Conditions for Stability: $K > 0$, $K^2 + K - 6 > 0$, $6 > 0$ (always true)

Range of K for stability: $K > 2$.



Comment: For the above stability problem, all three LLMs follow roughly the same reasoning path and reach to the correct answer eventually.