

ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON
RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 23-24-25, 2026 | Marrakech, Morocco



Quantifying the impact of immunotherapy response of breast cancer stages: a computational approach for mathematical model and numerical simulation

Communication Info

Authors:

Maryem EL KARCHANI¹
Nadia IDRISSE FATMI²

^{1,2} LaMDa, National School of
Applied Sciences of Khouribga,
Sultan Moulay Slimane
University, Morocco

Keywords:

- (1) Breast cancer
- (2) Immunotherapy
- (3) Stages of breast cancer
- (4) Dormancy
- (5) Mathematical model
- (6) Numerical simulations

Abstract

Breast cancer is a complicated disease that can be treated with a variety of approaches such as Chemotherapy, Immunotherapy, Targeted Therapy, and Hormonal Therapy. A type of cancer treatment known as Immunotherapy can assist the immune system in identifying and attacking cancer cells to combat them. This study investigates a system of differential equations that considers the stages of breast cancer as well as the influence of immunotherapy on patients who are in a dormant condition. We analysed the temporal dynamics of the model by examining the stability and behavior of its equilibrium point. To determine the equilibrium point's stability, we applied the Routh-Hurwitz Criterion, which allowed us to conclude that the equilibrium point is asymptotically stable. Numerical simulations that demonstrated the persistence of the stable equilibrium regardless of the initial conditions, without any further prerequisites, were run to validate our findings. These results suggest that after the five patient sub-populations converge to the equilibrium point, they will eventually reach a state of stability.

© ICRAMCS 2026 Proceedings ISSN: 2605-7700

References

- [1] El Karchani, M., Idrissi Fatmi, N., Mouden, K., Analysing the effect of trastuzumab treatment on breast cancer stages and cardiac function: A mathematical modeling and numerical simulation, *Commun Math Biol Neurosci*, 2023, Article ID 47, <https://doi.org/10.28919/cmbn/7970>.
- [2] El Karchani, M., Idrissi Fatmi, N., Mouden, K., Quantifying the impact of immunotherapy response of breast cancer stages: A computational approach for mathematical model and numerical simulation, *Commun Math Biol Neurosci*, 2023, Article ID 138, <https://doi.org/10.28919/cmbn/8341>.
- [3] Fathoni, M., Gunardi, G., Kusumo, F. A., Hutajulu, S. H., Mathematical model analysis of breast cancer stages with side effects on heart in chemotherapy patients, *AIP Conf Proc*, 2019; 2192:060007-1--060007-8, <https://doi.org/10.1063/1.5139153>.