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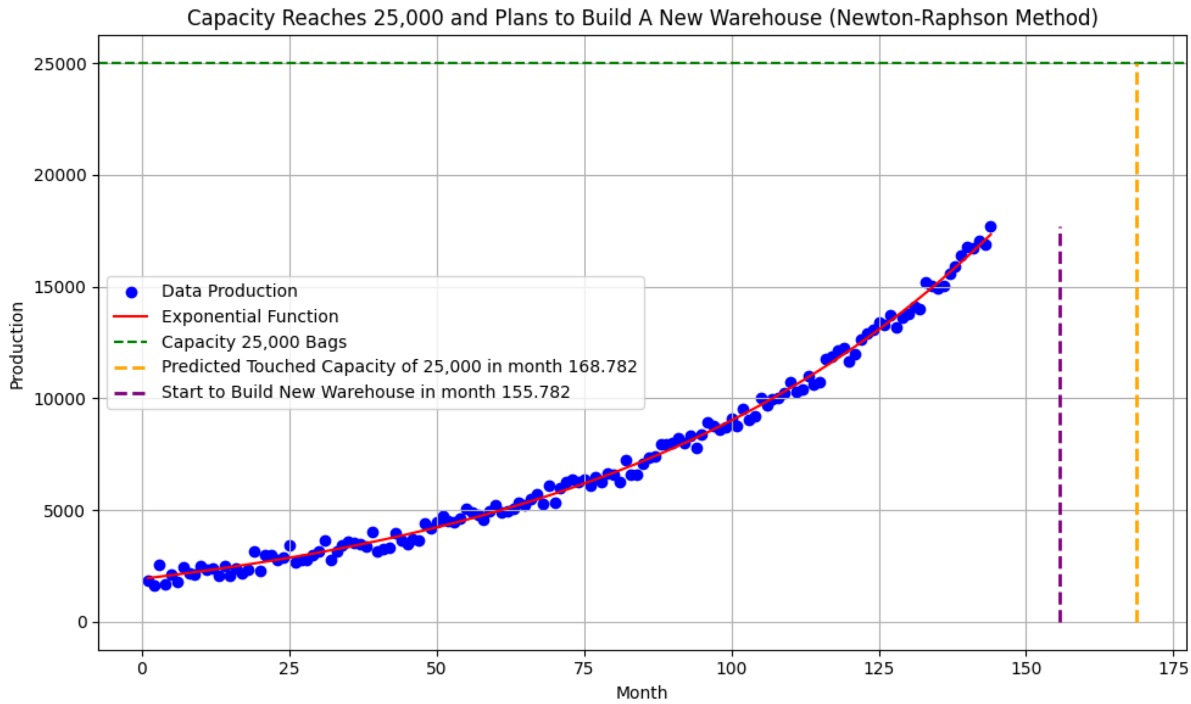
To provide a prediction when do EGIER need to build a new warehouse based on the trend that I have acquired in problem #2 this can be approached as a root of equation problem. So, I use Newton-Raphson Method.

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Exponential function parameters: a= 2139.452, b= 0.015, c=-220.005
Exponential approximation = 2139.452 * e^(0.015 * x) + -220.005
EGIER is expected to reach a capacity of 25,000 bags in month 168.782
EGIER needs to start building a new warehouse around month  155.782
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First, we must know when the capacity of the EGIER's warehouse reaches 25,000 (twenty-five thousand) bags. Here I use one of the methods of solving the root of equation problem, namely the Newton-Raphson Method. By using the Newton-Raphson Method, we know that EGIER is expected to reach a capacity of 25,000 bags in month 168.782 and if rounded up it becomes the 169th month.

Next, as mentioned in the question that to build a new warehouse, it is estimated that they will need at least 13 months. So, to find out when EGIER started building their new warehouse, we just need to subtract the time when EGIER's warehouse capacity reaches 25,000 (which we get using the Newton-Raphson Method) by 13.

168.782 – 13 = 155.782

So the result is that EGIER needs to start building a new warehouse in month 155.782 and if rounded up it becomes the 156th month.

The reasons I choose the Newton-Raphson method are:

1. One of the fastest convergences to the root

   The Newton-Raphson method is known for its rapid convergence to the root, especially when the initial guess is close to the actual root. This is due to its quadratic convergence property, meaning the error term decreases quadratically as the iterations proceed, resulting in a fast approach to the exact root.

2. Computational Efficiency

   In many cases, the Newton-Raphson method requires fewer iterations to reach convergence than other methods, which means less use of computational resources and faster run times.

3. Converges on the root quadratically

   The convergence rate of the Newton-Raphson method is quadratic, which means that the number of correct digits approximately doubles with each iteration once it is sufficiently close to the root. This makes the method highly efficient compared to other methods with linear or sub-linear convergence rates.

4. Easy to convert to multiple dimensions

   The Newton-Raphson method can be extended to functions of multiple variables, making it a versatile tool in higher-dimensional root-finding problems. This is done by using the Jacobian matrix in place of the derivative, allowing the method to handle systems of nonlinear equations.

5. Can be used to “polish” a root found by other methods

This emphasizes that the method is useful for improving the accuracy of roots initially approximated by other numerical techniques. This dual application enhances the robustness and effectiveness of the Newton-Raphson method.

6. High Accuracy
   With its quadratic convergence properties, the Newton-Raphson method can achieve very high levels of accuracy quickly. This is especially important in applications where the precision of the results is crucial, such as in prediction or planning.

Overall, these advantages make the Newton-Raphson method a powerful tool in numerical analysis for solving equations efficiently and accurately.

Reference:

Mishra, A. (2023). Newton Raphson Method in Machine Learning. https://ai.plainenglish.io/newton-raphson-method-in-machine-learning-9ff2f81b4c59