DEEPSEEK-V3 AND QWEN2.5-MAX IN SOLVING RESOURCE AND PROCESS OPTIMIZATION PROBLEMS

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Abstract. The digital world is invaded by a wide range of products that use Artificial Intelligence (AI) technology to provide services of various types. Developers come up with new products that always arouse both admiration and criticism. AI is gradually replacing repetitive and mechanical activities with automated and intelligent processes. This is achieved through sophisticated algorithms, machine learning, and other technologies that enable systems to make decisions, analyze data, and perform tasks that previously required human intervention. AI replaces repetitive and predictable activities, but cannot, at the current stage, completely replace creativity, empathy, or deep critical thinking. Collaboration between humans and machines in some areas is more effective than completely replacing human activity. A widely used AI product is chatbots, which are trained on a huge amount of data, which allows them to understand and generate natural language in a variety of contexts. They are useful for answering questions, performing translations, generating texts, recommendations, friendly conversations, and last but not least, they are learning assistants that can help users understand complex concepts or solve problems. The goal of the paper is to analyze the results provided by DeepSeek-V3 and Qwen2.5-Max models for complex academic problems in the field of Operational Research. The problems analyzed include activity planning, inventory management, and queuing systems analysis.

Keywords: artificial intelligence, activity planning, inventory management, analysis of queuing systems

JEL Classification: C02, C44, C50, C51, C65

INTRODUCTION

AI-based technologies have become an indispensable part of life in today's world. They are implemented in various fields to optimize repetitive processes, perform rapid data analysis, create presentations, process and create images, interior design, learn foreign languages, generate code, etc. The paper analyzes the products DeepSeek-V3 and Qwen2.5-Max. DeepSeek-V3 is a free Chinese start-up that shook the AI community at the end of January 2025, surpassing the popularity and performance of GPT chat. The position of technology players in the market has undergone changes, some of which have been marked by financial losses. DeepSeek developers managed to develop their AI technology at 1% of the usual cost. An efficient product with fewer development resources. An analysis of this product is conducted by Christian PERRY (Perry, *"DeepSeek Review: Is It the Right Tool for You?"*), ranked by Forbes as the best artificial intelligence detector in the world and responsible for the most advanced humanization technology on the market. The chatbot's developers claim that DeepSeek was trained on massive volumes of texts from various sources, has access to a large general knowledge base based on data available until October 2023, cannot search the internet or access sources in real time (*DeepSeek platform*).

Another free product used is Qwen2.5-Max, developed by the Chinese company Alibaba Cloud. Qwen2.5-Max generates text, images and videos, runs code, solves problems, etc. It is trained on data sources available until December 2024 and launched in the same period. It uses a transformer neural network optimized for text understanding and generation. It outperforms DeepSeek V3, GPT-4o, and Claude Sonnet on key performance criteria (Qwen Team, *"Qwen2.5-Max: Exploring the Intelligence of Large-scale MoE Model"*), such as: complex reasoning and coding, ability to adapt to recent information with unexpected data, code generation for technical tasks and practical programming, knowledge for professional and academic scenarios, and uncertainty management.

Previously, the solutions offered by GPT, Copilot and Gemini chat were analyzed for problems related to activity planning, inventory management and analysis of waiting systems, and were communicated during the sessions of the international conference "Competitiveness and Innovation in the Knowledge Economy", 28th Edition, September 2024. Since DeepSeek-V3 and Qwen2.5-Max are considered more efficient than the previously examined models, it is necessary to confirm or refute this hypothesis by analyzing the results generated by them for the same set of problems.

MAIN RESULTS

The source for testing the correctness of the results provided by the DeepSeek-V3 and Qwen2.5-Max chatbots served the examples from the manual: *"Operational Research, Volume II"* by Gametchi and Solomon (2015).

1. The problem of planning a complex of activities

Planning a set of activities is a complex problem in the optimization domain and project coordination, which involves the efficient organization and sequencing of interconnected tasks. The main objective is to achieve a well-defined goal within restrictive conditions, such as limited resources (time, personnel, budget) and operational constraints (fixed deadlines, dependencies between activities). To test the results provided by chatbots, the solved example from (Gametchi and Solomon 82) was used, for which it was required to build the network-graph, determine the critical activities, critical events and time parameters. Information about the project is presented in Table 1.

Table 1. Project characteristics and time parameters.

Activity	Next activity	Duration of activity	Time parameters			
			$T_{ij}^{s.min}$	$T_{ij}^{s.max}$	$T_{ij}^{e.min}$	$T_{ij}^{e.max}$
A	**B, C**	3	0	0	3	3
B	**D, E, F**	8	3	3	11	11
C	**G**	5	3	14	8	19
D	**G**	6	11	13	17	19
F	**-**	4	11	16	15	20
E	**H**	15	11	11	26	26
G	**-**	7	17	19	24	26
H	**-**	6	15	20	21	26

Source: *Made by the author based on Gametchi and Solomon, 82-92.*

According to the source (Gametchi and Solomon 82-92), the critical path has the value 26, critical events: x1, x2, x3, x6; critical activities: A, B and E; the total time reserve for activity C is 11 time units, D – 2, F – 5, G – 2, H – 5; the free time reserve for activity C is 9, H – 5; the independent time reserve alone for activity C is 9. The network-graph of the project, critical activities and critical

events are presented in figure 1. The critical path consists of activities A → B → E. Critical events and activities are highlighted in red on the graph. In (Gametchi and Solomon 82-92) the values of time parameters are also found – presented in Table 1.

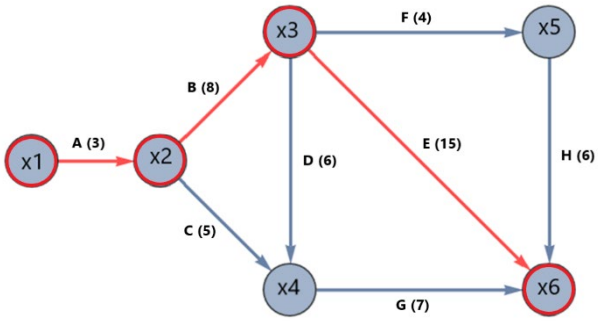
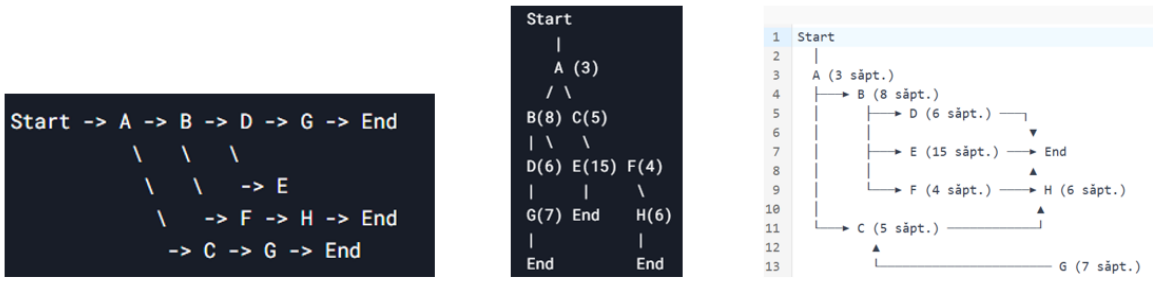


Figure 1. Network-graph, events and critical activities.
Source: *Adapted by the author based on the example in (Gametchi and Solomon 83).*

Initially, DeepSeek-V3 presented the definition of the network-graph, after analyzing the sequence of activities once again and proposing the result in Figure 2a.



(a) **(b)** **(c)**

Figure 2. Project's network-graph generated by DeepSeek-V3 and Qwen2.5-Max models.
Source: *The DeepSeek-V3 and Qwen2.5-Max chats.*

If Figure 2a is analyzed, it can be seen that the representation of the network-graph is not precise. It is not clear what comes after activity E. The given representation can be confusing in some situations of project analysis. The critical path with a duration of 26 weeks was established: A → B → E. The answer corresponds to the results of (Gametchi and Solomon 82-92). A clearer representation of the network-graph was insisted on and the answer in Figure 2b was obtained, more confusing than the previous one. In the second representation, the continuity between activities C and G, B and F is lost. For the time parameters, the chatbot provided the calculation formulas. Upon repeated request for presentation of numerical values, the results were presented that coincide with those in Table 1. Therefore, the model can be used in solving the planning and control problems per network if the graphical representation of activities and events is not important.

Qwen2.5-Max provides an answer to the proposed problem, starting with the analysis process. Several sources have been researched, the model "thinks", this activity may take some time. Then, the summary results for the network-graph, the critical path, the critical events and activities, and the time parameters are presented. The network-graph is exposed in a logical sequence that corresponds to Table 1. At the insistence of the presentation of the network-graph, the procedure for its construction is provided in detail after which the network-graph in Figure 2c is generated. As can be seen from the diagram presented in Figure 2c, the dependence of activities D and G is not reflected. However, if the procedure for constructing the network-graph is followed, taking into account the

detailed explanation, the representation in Figure 1 is obtained. The critical path and its value, as well as the time parameters, coincide with the result from (Gametchi and Solomon 82-92).

In the case of analyzing planning problems for a complex of activities, the tested models presented correct results, if the graphical representation aspect is not important, where there are still reserves. The results obtained are more accurate than those generated by the chatbots analyzed previously. Chat GPT provided the critical path and its value correctly, but 25% of the time parameters were incorrect. Copilot and Gemini generated the critical path and its value incorrectly, as well as the values for the time parameters - 43% and 37% incorrect, respectively. Now, the results of Chat GPT coincide with those generated by DeepSeek-V3, but this does not prove that the model has evolved. Based on previous interactions and user behavior, the model learned individual preferences and optimized the answers to be more accurate. For the accuracy of the experiment, the analyzed problem was proposed to the chat from a different account and the answer generated by it was incorrect.

2. Queuing systems with infinite queue

Another important problem is the analysis of queueing systems with infinite queue. The possibilities of chatbots were tested using the example from (Gametchi and Solomon 165): *„In a supermarket, three cash registers operate with the same productivity. It has been observed that during an hour an average of 40 buyers arrive and the average service time of a buyer is 3 minutes. Determine: the stationarity probability of the cash registers (P_0); the average tail length ($\bar{r}$); the average number of shoppers in the store ($\bar{k}$); the average time a shopper waits to be served ($\bar{t}_{wait}$); the average time the customer is in the store ($\bar{t}_{sist}$). Establish the conclusion about the effectiveness of the supermarket's activity.*"

The result in (Gametchi and Solomon 165) is: $P_0 \approx 0{,}11$; $\bar{r} = 0{,}88 \approx 1$ buyer; $\bar{k} = 2{,}88 \approx 3$ customers; $\bar{t}_{wait.} = 1{,}32$ min.; $\bar{t}_{sist.} = 4.32$ min. *Conclusion:* The activity of the supermarket must be considered efficient.

Both models, DeepSeek-V3 and Qwen2.5-Max, provide the calculation formulas for each characteristic of the waiting system and the actual calculations. The same results are generated (except for the conclusion) which roughly coincide with those in the source: $P_0 \approx 0{,}1111$; $\bar{r} = 0{,}88 \approx 1$ shopper; $\bar{k} = 2{,}89 \approx 3$ customers; $\bar{t}_{wait.} = 1{,}33$ min.; $\bar{t}_{sist.} = 4{,}33$ min. *Conclusion:* "the supermarket operates efficiently, with low waiting and serving times, and resources are used optimally" (*DeepSeek-V3*); "The supermarket operates with acceptable efficiency, with a low probability of stalls and relatively low waiting times. However, the intensive use of the stalls suggests that adding a fourth stall could reduce the queue and waiting time during peak periods" (*Qwen2.5-Max*).

Previously, Chat GPT generated correct results for the analyzed problem, but Copilot and Gemini – incorrect results.

3. Inventory management

Inventory management problems are common difficulties in the efficient management of an organization's material resources. Depending on the specifics of the domain of activity (e.g. production, retail, logistics), various management models and strategies are used to optimize processes. The possibilities of chats will be tested using the example from (Gametchi and Solomon 202), which reflects the optimal batch size for several types of products: *„A store sells items of two types. The demand during the period of T=30 days is respectively of $S_1 = 500$ units and $S_2 = 1000$ units of articles. The fixed costs of selling a lot is $c_2 = 60$ m.u., but the unit keeping cost $c_{11} = 0{,}1$*

m.u./day and respectively $c_{12} = 0{,}05$ *m.u./day. Determine the optimal number of lots* (n^*)*, the optimal lot size for each item type* (q_1^*, q_2^*)*, the optimal delivery interval* (τ^*)*.*"

The solution to the problem is: $q_1^* = 100$ units; $q_2^* = 200$ units; $\tau^* = 6$ days; $n^* = 5$ lots.

DeepSeek-V3 for the analyzed multi-product inventory management problem provided the following results: $q_1^* = 141{,}42$ units; $q_2^* = 282{,}84$ units; $\tau^* = 7{,}5$ days; $n^* = 4$ lots. It is obvious that the results obtained are incorrect. The reason is the formula used to calculate the optimal lot size: $q_i^* = \sqrt{\frac{2S_i c_2}{Tc_{1i}}}$. The formula for single-product inventory models was used. The calculation formula for multi-product inventory management is: $q_i^* = S_i \Big/ \sqrt{\frac{T\sum_{i=1}^{k} c_{1i} \cdot S_i}{2c_2}}$.

Qwen2.5-Max returned the following results: $q_1^* = 100$ units; $q_2^* = 200$ units; $\tau^* = 6$ days; $n^* = 5$ lots. The results coincide with those of (Gametchi and Solomon 202) when compared to the results proposed by DeepSeek-V3. The only disadvantage of the Qwen2.5-Max chatbot is the duration of the response return. Due to the analysis process, this takes time, depending on the complexity of the problem analyzed.

Chat GPT, Copilot, and Gemini generated incorrect results for the issue analyzed.

CONCLUSIONS

AI-powered chats are gaining popularity by providing quick answers to various questions. They are valuable due to the immediate accessibility of data, as AI systems can process information from multiple sources (articles, databases, documents) without the need to perform time-consuming manual searches or browse through extensive content. AI is a valuable tool for effective problem solving, rapid access to relevant information and informed decision-making based on data analysis.

The analyzed products can be used to solve resource and process optimization problems, with some inaccuracies in aspects related to graphical representations. The Qwen2.5-Max model proved to be more accurate than DeepSeek-V3. It provided correct answers to all analyzed problems. So, the developer's claims proved true. The product can be used with caution to avoid addiction.

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