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USE OF CHATGPT-4 TO SET THE PROJECT'S RESERVE BUDGET

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Purpose: To present the results of a study on the potential of ChatGPT-4 (GPT-4) in determining the reserve budget of a project, based on its financial risk assessment performed using the Monte Carlo (MC) simulation method.
Design/methodology/approach: To determine the potential of GPT-4 in determining the size of a project's reserve budget, in Phase 1 of the research this budget was determined using data on the selected project, the knowledge of the authors of the publication, the MC method, and a Microsoft Excel spreadsheet tool. In phase 2 of the study, the reserve budget was determined using the same data, the MC method and GPT-4. The results obtained were subjected to comparative analysis and discussion.
Findings: GPT-4 correctly assessed the financial risk of the project using MC simulation in 83.33% of the experiments (50 out of 60), and on this basis determined the reserve budget and explained the significance of the results obtained.
Research limitations/implications: The undertaken problem of assessing the financial risk of projects relates only to exceeding their budget, which is a relatively easier issue than the question of not achieving the expected financial results. Therefore, it would be interesting for further research to see how GPT-4 deals with the assessment of the risk of not achieving financial outcomes, carried out using MC.
Practical implications: GPT-4 can be considered as a decision-support tool for the size of a project's reserve budget. Given the misinterpretation of data in 10 experiments (16.66% of the study sample), caution and a critical look at the results of GPT-4 calculations and their verification should be recommended.
Social implications: As part of the training of project managers, it is worth convincing them to use AI in project risk assessment, as this influences more rational decision-making.
Originality/value: Conducting experiments with GPT-4, including its testing and validation, to ascertain whether it can provide information to support decision-making about the size of a project's reserve budget.
Keywords: project financial risk assessment, reserve budget, Monte Carlo, ChatGPT-4.
Category of the paper: Research paper, Case study.

1. Introduction

Project implementation is constantly accompanied by risk. This is due to their specific nature, which is largely defined by uncertainty determined by unpredictable events or conditions, defined as parameters that can affect the achievement of project objectives. It is emphasised that the precise definition of these parameters is a real challenge (Borgonovo, 2016; Baraldi et al., 2009; Aven, Nøkland, 2010).

In considering project risk, the way in which uncertainty is understood is important and is discussed (Flage, 2014). In general, it can be assumed that uncertainty determines the level of risk, but in order to assess it, uncertainty needs to be expressed by a specific measure. Among the many measures, probability is considered the most widely used (Aven, 2016). Concepts of project risk quantification based on this measure mostly assume a probabilistic description of the uncertainty of specific parameters. This is the basis for the use of Monte Carlo (MC) simulation, which is one of the rather precise probabilistic-statistical methods of risk assessment.

MC is not a new method and its origins and development should be linked primarily to N.C. Metropolis, E. Fermi, J. von Neumann, S.M. Ulam and A. Turkevich (Metropolis, 1987). Although the benefits of its use in risk assessment and advances in information technology have made MC increasingly popular, it can be argued that even today its use in business practice is low (Ryan P.A., Ryan G.P., 2002, Wiśniewski, 2004; Wieteska, 2021). This is thought to be mainly due to a lack of skills to carry it out, a lack of understanding, a sense of discomfort or reluctance to use advanced statistical methods (Avlijas, 2019). For this reason, there are increasing hopes for the use of artificial intelligence (AI) for project risk assessment (Avlijas, 2019; Taboada et al., 2023). Thus, the Project Management Institute (PMI) (PMI. AI @ Work, 2019), in presenting considerations relating to the needs and possibilities of using AI in the seven main domains of project management effectiveness, points precisely to uncertainty and risk. The expectations of AI relating to project risk assessment are also confirmed by the results of a survey of 81 experts (Fridgeirsson et al., 2021), and academic publications emphasise that AI is desirable especially because of the complexity of projects and its relationship to uncertainty and risk (Dao et al., 2016; Floricel et al., 2016; Padalkar, Gopinath, 2016; Dunović et al., 2014; Qazi et al., 2016). AI is believed to be able to process large datasets quickly and accurately, supporting more informed decision-making, and can learn and make adjustments based on new data, enabling more accurate, up-to-date risk assessments, using various methods such as Machine Learning (ML) (Zhang, 2020), Neural Networks (NN) (Yegnanarayana, 2005), Natural Language Processing (NLP) (Chowdhury, 2023) or fuzzy logic (FL) commonly using expert systems (Król-Smetak, Zając, 2012), among others. It is worth noting that the AI methods indicated have been used to develop a number of models relating to various aspects of project risk. For example, using ML, models have been developed to manage the risk of

construction projects by case-based reasoning (Poh et al., 2018), to predict task risk in software projects (Choetkiertikul et al, 2015), or to predict the stability of construction projects (Fourie et al., 2018). Using NN, a system for predicting project outcomes based on critical success factors was developed, which classifies risk levels based on the experience of project managers (Costantino et al., 2015). Using NLP, a model for safety risk management and accident prediction in construction projects was developed (Di Giuda et al., 2020), and using FL, solutions for digitised risk management of construction projects were presented (Xu, Lin, 2016). The potential of hybrid AI methods for risk assessment of construction projects has also been indicated (Afzal et al., 2021).

Thus, it can be concluded that there is a steadily growing interest in the use of AI for project risk assessment. However, a systematic review of the literature (Taboada et al., 2023) shows that this does not apply to the assessment of their financial risk, although it is very important, especially in the planning and implementation phases of a project.

The financial risk of projects refers to two main issues.

The first issue relates to the failure to achieve the expected financial results from the project. The results of the financial risk assessment in this case should inform decisions on whether to proceed with the project or whether to introduce measures to reduce the risk or whether to wait for market conditions to change or whether to reject the project. Here, the possibilities of using AI for some elements related to financial risk assessment are presented, mainly relating to cash flow forecasting (Cheng et al., 2015; Cheng et al., 2020) or the development of project implementation scenarios (Hajdasz, 2014). However, AI-based solutions that make a holistic assessment of the risk of not achieving the expected financial outcomes have not been presented.

The second issue concerns project budget overruns. The assessment of financial risk in this case supports decision-making on the size of the managerial reserve. This reserve, referred to in practice as a reserve budget, is one of the basic tools of project risk management. The reserve budget is the amount of money that should be designated to cover costs resulting from the occurrence of changes in uncertain project parameters. Due to the dynamics of changes in these parameters, the setting of a reserve budget is now recommended, among others, in project management standards (A Guide to the Project Management, 2019; Dałkowski et al., 2009). It is emphasised that the size of the reserve budget should depend on the degree of uncertainty in the parameters of the project in question. This means, in the decision-making process concerning this size, an assessment of the financial risk of the project should be taken into account (the higher the risk, the higher the budget should be).

This publication focuses on the issue of budget overruns. Based on the interviews and the literature review, it was assumed that managers are interested in using the results of the risk assessment in deciding on the size of the reserve budget. At the same time, it was noted that, due to the problems identified earlier relating to MC, it is usually not applied in practice and the managerial reserve is assumed to be 10% of the base project budget (Trocki, 2015).

Such a solution can be considered problematic, as in the case of low risk it leads to an unjustified freezing of financial capital (which is important especially in projects with a high base budget), and in the case of high risk it reduces the ability to respond to emerging risks or opportunities.

The current capabilities of AI make it worthwhile to use it to assess the financial risk of MC projects, to support decision-making on the size of the reserve budget. At the same time, there is a realisation that it would be most beneficial to add AI to personalised decision support systems, allowing them to become even more effective. Among other things, AI could help automate the collection and analysis of uncertain parameters for MC, as well as perform the necessary calculations, thus reducing the time needed for decision-making. However, it should be noted that such a solution is costly. Other AI-based solutions, such as the popular ChatGPT (GPT-4 - OpenAI), which is not costly to use, offer new opportunities for a wide range of businesses. However, the question must be asked - will ChatGPT do the calculations well and obtain reliable information?

The authors of the publication assumed the hypothesis that ChatGPT-4 can correctly assess the financial risk of a project on the basis of MC simulations and, on this basis, determine the reserve budget. In order to verify it, a study was carried out, the purpose, the course of research, as well as the data and methods used, are presented in the next section of the publication.

2. Purpose, course of research, data and methods

The purpose of the research was to determine the potential of GPT-4 in determining the reserve budget of a project, based on its financial risk assessment made using MC.

To achieve this purpose, experiments were conducted with ChatGPT-4 (GPT-4). These included checking the way the calculations were made and the results obtained, to make sure it could work as expected and provide information to support decision-making on the size of the project's reserve budget.

Experiments were conducted on a selected investment project planned by a certain company. The base budget for this project is PLN 1,000,000.00. In the course of a management workshop at this enterprise, the 7 most significant uncertain parameters (6 threats and 1 opportunity) affecting the achievement of the project objectives were identified. For these parameters, the probabilities and consequences of their occurrence were determined.

The experiments were conducted in two phases. In Phase I, a reserve budget was determined based on data received from the company, the knowledge of the authors of the publication, the MC method, and a Microsoft Excel spreadsheet tool. In phase II, the reserve budget was determined on the basis of data obtained from the company, the knowledge of the authors of the publication, the MC method, and the GPT-4 tool. The results obtained were subjected to comparative analysis and discussion.

3. Findings

It was assumed that on the basis of the data received - the identified parameters (6 threats and 1 opportunity), the probabilities and consequences of their occurrence, with the help of the MC method, the project reserve budget should be determined for the three selected confidence levels, i.e. 0.5, 0.8 and 0.9. It was assumed that 10,000 iterations should be carried out within the MC framework.

3.1. Conducting MC using Excel

As previously mentioned, MC is not a new method, and its formal basis has been presented in many papers (e.g. Jäckel, 2002; Mitrenga, 2014), hence a theoretical description of it is omitted in this publication, focusing on practical application.

In Phase I of the research, an Excel model (Table 1) was prepared to carry out the MC. The first column in this table contains the identified parameters, the second the probability of their occurrence and the third the effect of their occurrence. For each parameter, the expected value of the effect was calculated by multiplying the probability and the effect. The sum of the expected values of the effect of each parameter determined the expected value of the effect of their occurrence on the achievement of the project objectives. This value was 64,500.00 PLN. The fifth column introduced the formula =LOS(), which acted as a pseudo-random number generator, for each parameter. The cell with this formula returned a value between 0 and 1 right-open, meaning that a value of 0 could occur and a value of 1 would never be generated as a result of the formula. The sixth column contained the logical function =IF(), which checked whether the value from the previous column was less than the probability. If it was, the value from column three was rewritten to column six. The sum of the effects for each parameter gave the effect value for one iteration, i.e. for one scenario in MC.

Table 1.
Excel model to run MC

Parameter	Probability	Effect, PLN	Expected value of effect, PLN	Pseudorandom number generator, - "LOS()"	The value of the effect in the iteration, - "IF()", PLN
1	2	3	4	5	6
Danger no 1	0.10	200,000.00	20,000.00	0.0820	200,000.00
Danger no 2	0.01	300,000.00	3,000.00	0.7396	
Danger no 3	0.10	50,000.00	5,000.00	0.0976	50,000.00
Danger no 4	0.50	10,000.00	5,000.00	0.9735	
Danger no 5	0.20	20,000.00	4,000.00	0.5276	
Danger no 6	0.30	100,000.00	30,000.00	0.0159	100,000.00
Chance no. 1	0.05	-50,000.00	-2,500.00	0.4906	
∑			64,500.00		350 ,000.00

Source: own elaboration.

10,000 iterations were carried out, i.e. 10,000 possible scenarios of changes in the development of the project parameters were obtained, defined by the result being the value of the sum of the consequences of their occurrence. Subsequently, a statistical analysis of the obtained results was carried out (44, 45, 46), based on risk assessment indicators, which include: expected value (μ), standard deviation (σ), coefficient of variation (cv). Thus, for the analysed project, the expected value of the reserve budget is 64,469.70 PLN, the standard deviation is 83,869.02 PLN and the coefficient of variation is 1.30.

Then, in order to determine the expected value of the reserve budget for the adopted confidence levels, the cumulative distribution of the normal distribution was plotted (Figure 1). The values corresponding to the adopted confidence levels are indicated on the distribution. The first, equal to 0.5 (the median of the distribution), determines the expected value of the reserve budget, which (as indicated above) is μ = 64,469.70 PLN. This is a value that secures the project with 50% certainty that costs arising from changes in project parameters will be covered. The second and third confidence levels indicate reserve budget values with 80% certainty, at 137,500.00 PLN and 90% certainty, at 172,500.00 PLN.

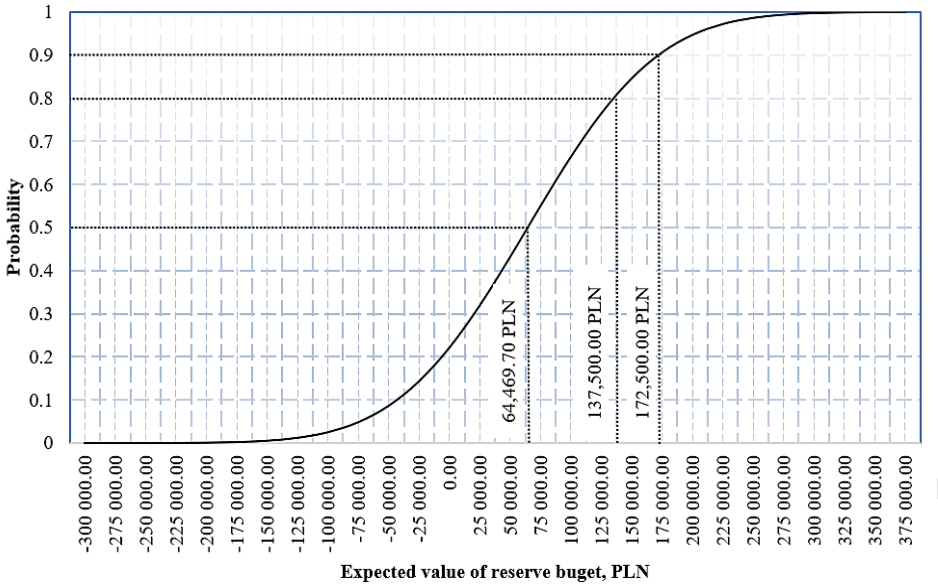


Figure 1. Cumulative distribution of the normal distribution of the value of the project reserve budget. Source: own elaboration.

3.2. Performance of MC by GPT-4

In Phase II of the study, for the determination of the reserve budget using GPT-4, the following command was formulated:

"From now on, act as a business analyst in investment projects. You will be instructed to assess the risk of the investment project using the Monte Carlo method. The total expenditure for the implementation of the investment project is PLN 1,000,000. Using the Monte Carlo method (only 10,000 calculation cycles), calculate:

1. Expected value of the project reserve budget.

2. Standard deviation of the project reserve budget.

3. Variability index of the project reserve budget.

Then:

4. Draw the distribution function of the normal risk distribution (cumulative Gaussian plot). On this basis, determine the value of the reserve budget for the investment for the confidence levels: 0.5, 0.8 and 0.9.

Draw conclusions about the level of risk of the investment project.

Below is data on the possibility of occurrence of risk factors for the implementation of the investment:

Risk factor probability, effect, PLN

Danger #1: 0.10 200000.00

Danger #2: 0.01 300000.00

Danger #3: 0.10 50000.00

Danger #4: 0.50 10000.00

Danger #5: 0.20 20000.00

Danger #6: 0.30 100000.00

Chance No. 1: 0.05 -50000.00"

In response to the given command, GPT-4 calculated the expected values of the reserve budget, standard deviation and coefficient of variation, as well as the expected values of the reserve budget for confidence levels 0.5, 0.8, 0.9. He also presented his interpretation of the obtained results of the financial risk assessment. The command was asked 30 times to check the repeatability of the calculation results. The obtained results of the calculations are presented in Table 2. During the execution of the experiments, it was noticed that Chat 4 times made calculations using the percentiles of the distribution of simulated incremental costs resulting from possible risks in the project, rather than on the basis of the cumulative distribution of the normal distribution, and that the results of 2 experiments differed significantly from the others. The results of these calculations are referred to in Section 4.

Table 2.
Expected values of reserve budget, standard deviation and coefficient of variation indicated by GPT-4

Index	Expected value of budget	Standard deviation of budget	Risk variability index	The value of the reserve budget for the investment project for the confidence level			Distribution function of the normal distribution
				0.5	0.8	0.9	
	PLN	PLN		PLN	PLN	PLN	
Experiment 1	65.728	84.566	1.287	65.728	136.901	174.105	yes
Experiment 2	64.856	83.304	1.284	64.856	134.966	171.614	yes
Experiment 3	63.862	82.265	1.288	63.862	133.098	169.289	yes
Experiment 4	64.578	83.562	1.294	64.578	134.905	171.667	yes
Experiment 5	64.571	82.889	1.284	64.571	134.332	170.797	yes
Experiment 6	64.619	84.187	1.303	64.619	135.473	172.509	yes
Experiment 7	64.309	82.806	1.288	64.309	134.001	170.430	yes
Experiment 8	**65.827**	**85.751**	**1.303**	**20.00**	**110.00**	**200.00**	no
Experiment 9	**64.887**	**83.584**	**1.288**	**64.887**	**135.233**	**172.004**	yes
Experiment 10	**64.432**	**83.73349**	**1.300**	**20.00**	**110.00**	**200.00**	no

Cont. table 2.

Experiment 11	**64.309**	**82.806**	**1.288**	**64.309**	**134.001**	**170.430**	yes
Experiment 12	**1 063.978**	**83.320**	**0.078**	**20.00**	**110.00**	**200.00**	no
Experiment 13	**1 064.309**	**82.806**	**0.078**	**1064.309**	**70.000**	**106.000**	no
Experiment 14	64.856	83.304	1.284	64.856	134.966	171.614	yes
Experiment 15	64.619	84.187	1.303	64.619	135.473	172.509	yes
Experiment 16	**64.715**	**83.012**	**1.283**	**20.00**	**110.00**	**200.00**	no
Experiment 17	64.856	83.304	1.284	64.856	134.966	171.614	yes
Experiment 18	65.126	85.346	1.310	65.126	136.955	174.501	yes
Experiment 19	65.423	85.236	1.303	65.423	137.160	174.658	yes
Experiment 20	64.733	83.716	1.293	64.733	135.190	172.019	yes
Experiment 21	64.619	84.187	1.303	64.619	135.473	172.509	yes
Experiment 22	**65.622**	**84.187**	**1.283**	**20.00**	**110.00**	**200.00**	no
Experiment 23	65.728	84.567	1.287	65.728	136.901	174.105	yes
Experiment 24	64.619	84.187	1.303	64.619	135.473	172.509	yes
Experiment 25	64.856	83.304	1.284	64.856	134.966	171.614	yes
Experiment 26	64.503	83.768	1.299	64.503	135.004	171.856	yes
Experiment 27	65.728	84.567	1.287	65.728	136.901	174.105	yes
Experiment 28	64.620	83.482	1.292	64.620	126.962	158.131	yes
Experiment 29	64.619	84.187	1.303	64.619	135.473	172.509	yes
Experiment 30	64.419	83.644	1.298	64.419	134.815	171.613	yes

Source: own elaboration.

4. Analysis of results and discussion

A comparative analysis of the results obtained using the knowledge of the authors of the publication and the Excel and GPT-4 software was carried out in relation to the compliance of the indicators of the project financial risk assessment, i.e. the expected value of the reserve budget (μ), standard deviation (σ), coefficient of variation (cv), and the value of the project reserve budget (μ) at the confidence levels of 0.5, 0.8 and 0.9.

The value of μ calculated in Phase I of the study, using the model in Microsoft Excel spreadsheet, was 64,469.70 PLN. In Phase II, the results of the calculations performed by GPT-4 on μ varied from experiment to experiment, oscillating between PLN 63,862.00 and PLN 1,064,309.00 (Table 2). However, it is worth noting the values of μ indicated by GPT-4 in Experiments 12 and 13, which differ markedly from the values of μ in the other experiments. The results of these two experiments were assumed to be incorrect and should therefore not be considered for further inference. Excluding experiments 12 and 13, the results of the calculations performed by GPT-4 in 28 experiments oscillate between 63,862.00 PLN and 65,728.00 PLN (Table 2). Taking into account the specificity of MC, in which randomisation (random selection) of the magnitude of uncertain parameters plays an important role, it can be concluded that the results obtained in phases I. and II. are consistent. This allows us to conclude that the results of the calculations performed by GPT-4 are reliable in 28 out of 30 experiments.

The value of σ calculated in Phase I. was 83,869.02. In Phase II, the calculation results for μ vary from experiment to experiment, oscillating between 82,265.00 PLN and 85,346.00 PLN. It can therefore be concluded that the results obtained in phases I. and II. are relatively consistent.

The value of cv calculated in Phase I. was 1.30. In Phase II. the results of cv calculations vary from experiment to experiment, oscillating between 1.28 and 1.31. It can therefore be concluded that the results obtained in Phases I. and II. are relatively consistent.

The value of the project reserve budget at the confidence levels 0.5, 0.8 and 0.9 in Phase I. of the study was 64,469.70 PLN, 137,500.00 PLN, 172,500.00 PLN, respectively.

In phase II. the values of the reserve budget are quite different. After elimination of experiments 12 and 13, at the 0.5 confidence level μ are in the range from 20,000.00 PLN to 65,728.00 PLN, at the 0.8 confidence level - in the range from 110,000.00 PLN to 136,901.00 PLN, at the 0.9 confidence level - in the range from 158,131.00 PLN to 200,000.00 PLN.

The analysis of the calculations carried out by GPT-4 allows us to conclude that in the case of 24 experiments (1, 2, 3, 4, 5, 6, 7, 9, 11, 14, 15, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30), in accordance with the order, the normal distribution distributor was used in the calculations (Figure 2). The results obtained from these 24 experiments at a confidence level of 0.5 are the same as for the calculation of the previously indicated μ values, which is due to the properties of the normal distribution. It can therefore be concluded that these results are consistent with the results of Phase I, and that the calculations carried out by GPT-4 are correct.

In the case of 4 experiments (8, 10, 16, 22), the calculations were realised on the basis of the percentiles of the distribution of simulated incremental costs (Figure 3). The obtained results of these 4 experiments are consistent, but definitely differ from the results of the 24 experiments indicated above.

As part of the discussion of the results obtained, it is worth addressing the research question posed: can GPT-4 correctly assess the financial risk of a project using MC simulations and, on this basis, determine the reserve budget?

On the basis of a comparative analysis of the 30 results obtained, it can be concluded that in 24 experiments (80% of the study sample), GPT-4 correctly and as instructed, carried out the MC, as well as calculated the risk assessment indicators and determined the value of the project reserve budget for the adopted confidence levels. Furthermore, it correctly interpreted the results obtained. The fact that there are discrepancies in the results (in these experiments and in relation to the calculations in the Microsoft Excel model) has to do with the nature of the MC simulation. It is primarily about the generation of pseudo-random numbers to simulate the values of unpredictable design parameters. Changes in the so-called random seed (the starting point of the sequence of pseudo-random numbers) can lead to different sets of simulation results even with identical parameters, as well as the number of iterations. At this point, it is worth emphasising that a sufficiently large number of iterations must be carried out, preferably calculated from a suitable formula (Wodarski, 2009).

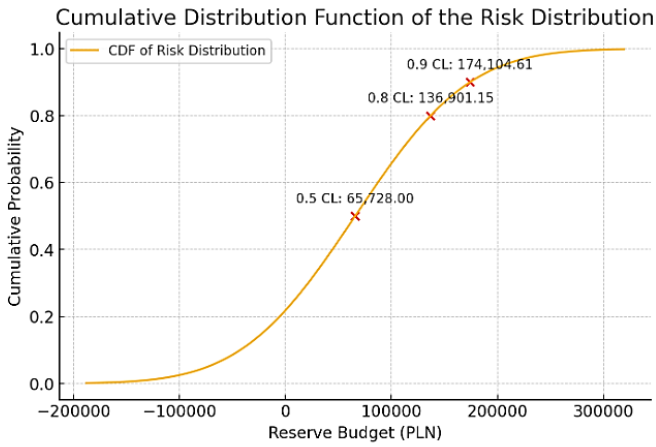
ChatGPT 4

Based on the Monte Carlo simulation of 10,000 cycles for the investment project, we have the following results:

1. **Expected Value of the Project Reserve Budget:** PLN 65,728.00
2. **Standard Deviation of the Project Reserve Budget:** PLN 84,566.72
3. **Variability Index of the Project Reserve Budget:** 1.29

Next, I'll plot the cumulative distribution function (CDF) of the risk distribution to find the values of the reserve budget at different confidence levels (0.5, 0.8, and 0.9). This will also provide visual insights into the risk spread of the project.

Cumulative Distribution Function Of The Risk Distribution



The Cumulative Distribution Function (CDF) plot for the risk distribution of the investment project gives us the following reserve budget values at different confidence levels:

- **50% Confidence Level:** PLN 65,728.00
- **80% Confidence Level:** PLN 136,901.15
- **90% Confidence Level:** PLN 174,104.61

Conclusions about the Level of Risk of the Investment Project:

- The **expected reserve budget** of PLN 65,728 represents the typical amount you might expect to need beyond the planned expenditure due to risk factors.
- The **variability index** of 1.29 indicates a high degree of uncertainty relative to the expected value. This high variability index suggests that the risk distribution is quite spread out, indicating substantial unpredictability in potential additional costs.
- Reserve budgets for higher confidence levels are significantly greater than the expected value, indicating that if the project requires a higher assurance against overrunning costs, substantially more reserve budget is necessary.
- The large difference between the reserve budgets at the 50% and 90% confidence levels (over PLN 100,000) emphasizes the potential volatility and unpredictability associated with the project's risks.

Considering these factors, the investment project carries a high level of financial risk. Depending on the risk appetite and the criticality of sticking to the budget for stakeholders, adequate precautions and possibly a higher reserve budget allocation might be recommended to mitigate potential overruns and ensure project feasibility.

Figure 2. Results of GPT-4 calculations based on the distributions of the normal distribution, for selected - 1 experiment.

Source: GPT-4.

ChatGPT 4

Monte Carlo Simulation Results for Investment Project

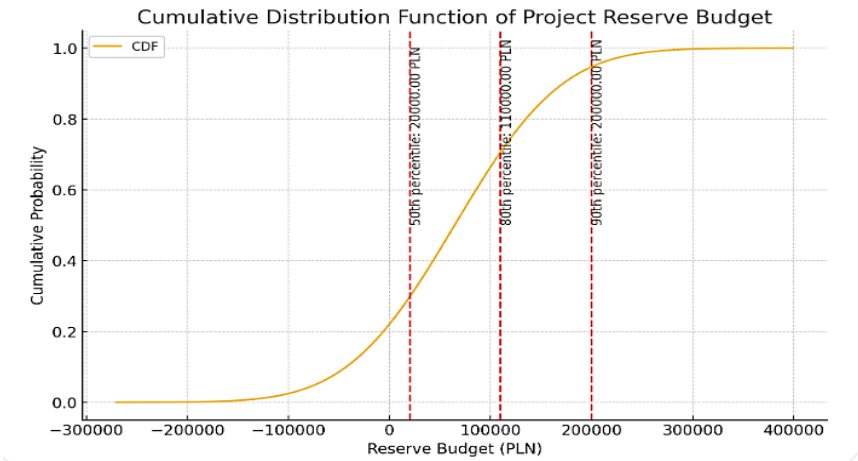
1. **Expected Value of the Project Reserve Budget**: PLN 64,432
2. **Standard Deviation of the Project Reserve Budget**: PLN 83,733.49
3. **Variability Index of the Project Reserve Budget**: 1.30

These results indicate the following:

- The expected reserve budget, which is the mean additional amount needed due to risks, is PLN 64,432.
- The high standard deviation relative to the expected value shows significant variability and uncertainty in the reserve budget.
- The variability index, greater than 1, suggests a high level of risk as the potential variation around the expected reserve budget is quite large.

Next, let's plot the distribution function of the normal risk distribution to further analyze the reserve budget at different confidence levels.

Cumulative Distribution Function Of Project Reserve Bu...



Analysis of Reserve Budget at Different Confidence Levels

The plot displays the cumulative distribution function of the project reserve budget, derived from the Monte Carlo simulation. Here are the reserve budgets required at various confidence levels:

- **50% Confidence Level**: PLN 20,000
- **80% Confidence Level**: PLN 110,000
- **90% Confidence Level**: PLN 200,000

Conclusions on the Level of Risk

- **Low Confidence (50%)**: At the median level, a relatively low reserve budget of PLN 20,000 is sufficient. This suggests that in half of the cases, the risk impacts are minimal.
- **Moderate Confidence (80%)**: As we increase our confidence to 80%, the required reserve jumps significantly to PLN 110,000, indicating that higher risk impacts are quite probable.
- **High Confidence (90%)**: At a high confidence level, the reserve requirement further escalates to PLN 200,000, which is substantial relative to the total project expenditure of PLN 1,000,000.

Overall Risk Evaluation: The variability index of 1.30 along with the steep increase in reserve requirements at higher confidence levels points to a high-risk profile for the investment project. Effective risk management and possibly increasing the initial reserve budget are recommended to mitigate potential financial overruns. The decision to proceed should carefully weigh these risks against the projected benefits of the project.

Figure 3. Results of GPT-4 calculations based on percentiles, for selected - 10 experiment

Source: GPT-4.

It is worth noting the methodological differences in the performance of MC by GPT-4. Calculations in 4 experiments (13.33% of the study sample), which were performed on the basis of percentiles, resulted in significant differences in results with respect to calculations based on the cumulative distribution of the normal distribution. It is also important to note the miscalculations in 2 experiments (6.66% of the study sample).

To clarify whether such a situation would recur and, if so, what was the source of the problem, a further 30 experiments were run with GPT-4, on the same input data and with the same command, adding only that it should make calculations 'solely' based on the cumulative distribution of the normal distribution.

In the 32nd experiment, GPT-4 again miscalculated μ. It was therefore asked a question aimed at explaining the source of the error. It turned out that it was an incorrect interpretation of the data and the addition of the value of the basic project budget to the reserve budget. It is worth noting that in the course of the conversation GPT-4 stated: *"You are correct, my error in interpreting the data may indeed have caused confusion in understanding the results. I apologise for the mistake'.* He then made the correct calculations.

In the 34th experiment, GPT-4 re-determined the reserve budget for different confidence levels (0.5, 0.8 and 0.9) using the percentiles of the distribution of simulated incremental costs resulting from possible risks in the project. He was then asked the question *"Why, despite being explicitly instructed that the reserve budgets were to be determined on the basis of the distribution of the normal distribution, were percentiles used?".* GPT-4 replied: *"You are correct that values from the normal distribution distributions were to be used. The explanation is due to my interpretive error in the data analysis process. In the Monte Carlo simulation that generated the results of the distribution of incremental costs, I actually applied the percentiles directly on the simulation results and not on the fitted normal distribution. I apologise for this misunderstanding. I will now correct this by using the values from the normal distribution function (CDF) for the specified confidence levels."* He then made the correct calculations.

In a further 26 experiments, GP-4 made 24 correct calculations and correctly interpreted the results, while in 2 it again added the value of the project's base budget to the reserve budget. This means that GPT-4 does not learn from its mistakes or experiences, which is not a unique finding (ChatGPT is generally not taught from current data).

To summarise the analysis of the results and discussion, based on the 60 experiments carried out, it can be concluded that the accepted research hypothesis has been confirmed to a very high degree. Therefore, it can be assumed that ChatGPT-4 is able to assess the financial risk of a project using MC simulations and, based on this, determine the reserve budget, but the authors of the publication recommend caution and verification of its calculations. It is important to look at how the results are obtained.

5. Conclusions

The results of the calculations presented in this publication allow us to conclude that GPT-4 has correctly assessed the financial risk of the project using MC simulations in 83.33% of the experiments (in 50 out of 60), and has determined the reserve budget on this basis. Furthermore, it adequately explained the significance of the results obtained. This means that the research hypothesis set out in the introduction has been largely confirmed. GPT-4 can therefore be recommended for use in practice, but given the misinterpretation of data in 10 experiments (16.66% of the study sample), caution and a critical look at the GPT-4 calculation results and their verification should be recommended.

Based on the results of the experiments, it is assumed that, in practice, GPT-4 can be a tool to support decision-making about the size of a project's reserve budget, but taking into account the recommendations indicated. The authors of the publication believe that GPT-4 has potential in this regard and is an alternative to managers performing MC based on their own knowledge, or to more sophisticated AI tools, such as those added to decision support systems. With regard to the considerations in the publication regarding, on the one hand, managers' lack of MC skills and, on the other hand, the adoption of a reserve budget of 10% of a project's base budget without assessing its risks, it is worth emphasising that GPT-4 addresses these problems and can contribute to more informed, rational decision-making. This does not change the fact that GPT is worth developing further. In addition, managers should be made aware of the need to develop their competencies in financial risk assessment and MC, which are necessary to interpret and verify the results given by GPT-4. Furthermore, it should be standard practice in the training of project managers to convince them to use AI in project risk assessment, as this influences more rational decision-making.

It is worth emphasising that the problem of assessing the financial risk of projects addressed in the publication relates only to exceeding their budget, which is a relatively easier issue than the question of not achieving the expected financial effects. For this reason, it would be interesting to see how GPT-4 deals with the assessment of the risk of not achieving financial outcomes, carried out using MC simulations. This sets a further direction for research, the results of which may be of relevance for supporting managerial decisions about the implementation of projects, especially those of a strategic nature requiring significant financial expenditure.

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