

to choose

between the cost of protection and the economic benefit of preventing losses. The situation is further complicated by reputational risks: public disclosure of fraud incidents can negatively affect a company's image. Aggressive blocking of legitimate users, even in the absence of confirmed fraud, undermines trust in the service and damages its reputation [5].

Conclusion. The development of financial technologies directly contributes to the improvement of security methods and the increased reliability of transactions. Intelligent technologies detect suspicious operations with high accuracy, reducing the number of false alarms. Unlike rigid rule-based systems, machine learning algorithms are capable of identifying hidden patterns that previously remained undetected. Such systems adapt to changing conditions by continuously updating behavioral patterns. However, their implementation requires significant computational resources and high-quality data. Without these, their effectiveness decreases. By combining multiple approaches, banks enhance their resilience to attacks. As a result, users gain greater confidence in the security of their transactions.

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TRANSPORT MASALASINI YECHISHDA MS EXCEL DASTURINING IMKONIYATLARIDAN FOYDALANISH

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Annotatsiya: Ushbu maqolada transport masalasini yechishda Microsoft Excel dasturining imkoniyatlaridan foydalanish usullari ko'rib chiqilgan. Transport masalasining matematik modeli, uning chiziqli dasturlash bilan bog'liqligi hamda MS Excel dasturining "Solver" (Yechuvchi) qo'shimchasidan foydalanib masalani optimallashtirish bosqichlari batafsil yoritilgan. Tarmoq transport masalasiga doir amaliy misol keltirilgan va uning MS Excel muhitida qo'llanilishi ko'rsatilgan. Maqola natijalaridan matematika va informatika o'qituvchilari, logistika mutaxassislari va tadqiqotchilar foydalanishi mumkin.

Kalit so'zlar: transport masalasi, MS Excel, Solver qo'shimchasi, chiziqli dasturlash, optimallashtirish, matematik model, logistika, simplex usul, ta'minot, talab, minimal xarajat.

ИСПОЛЬЗОВАНИЕ ВОЗМОЖНОСТЕЙ ПРОГРАММЫ MS EXCEL ПРИ РЕШЕНИИ ТРАНСПОРТНОЙ ЗАДАЧИ

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Аннотация: В данной статье рассмотрены методы использования возможностей программы Microsoft Excel при решении транспортной задачи. Подробно освещены математическая модель транспортной задачи, её связь с линейным программированием, а также этапы оптимизации задачи с использованием надстройки «Solver» (Поиск решения) в MS Excel. Приведён практический пример сетевой транспортной задачи и показано его применение в среде MS Excel. Результаты статьи могут быть полезны преподавателям математики и информатики, специалистам в области логистики и исследователям.

Ключевые слова: транспортная задача, MS Excel, надстройка Solver, линейное программирование, оптимизация, математическая модель, логистика, симплекс-метод, предложение, спрос, минимальные затраты.

USING THE CAPABILITIES OF MS EXCEL IN SOLVING THE TRANSPORTATION PROBLEM

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Abstract: This article examines methods of using the capabilities of Microsoft Excel in solving the transportation problem. The mathematical model of the transportation problem, its relationship with linear programming, and the stages of optimization using the “Solver” add-in in MS Excel are described in detail. A practical example of a network transportation problem is provided, and its implementation in the MS Excel environment is demonstrated. The results of the study may be useful for teachers of mathematics and computer science, logistics specialists, and researchers.

Keywords: transportation problem, MS Excel, Solver add-in, linear programming, optimization, mathematical model, logistics, simplex method, supply, demand, minimum cost.

Hozirgi kunda zamonaviy iqtisodiyotning barcha sohalarida resurslardan oqilona foydalanish, xarajatlarni kamaytirish va foyda ko'rsatkichlarini oshirish muhim ahamiyat kasb etmoqda. Transport va logistika sohasi bu jihatdan alohida o'rin tutadi, chunki yuk tashish va tovarlarni yetkazib berish bo'yicha optimal marshrutlarni belgilash korxonalar faoliyatining samaradorligini bevosita belgilaydi.

Transport masalasi — bu chiziqli dasturlash nazariyasining muhim qo'llanilishi bo'lib, minimal transport xarajatlari bilan etkazib beruvchilardan istehmolchilarga yuk tashishni rejalashtirish masalasidir. Ushbu masalani samarali yechish zamonaviy axborot texnologiyalari, xususan MS Excel kabi keng qo'llaniladigan dasturlar yordamida amalga oshirish mumkin.

Microsoft Excel dasturi nafaqat oddiy hisob-kitoblar uchun, balki murakkab matematik optimizatsiya masalalarini yechish uchun ham kuchli vosita hisoblanadi. Uning “Solver” qo'shimchasi chiziqli va no chiziqli dasturlash masalalarini, shu jumladan transport masalasini avtomatik tarzda yechish imkonini beradi.

Transport masalasining klassik formulasi quyidagicha: m ta etkazib beruvchi (manba) va n ta

istehmolchi (qabul qiluvchi) mavjud bo'lsin. i -etkazib beruvchining zaxirasi a_i , j -istemolchining talabi b_j , i - yetkazib beruvchidan j -istehmolchiga bir birlik yuk tashish xarajati c_{ij} bilan belgilansin. Maqsad — jami transport xarajatlarini minimallashtirishdan iborat.

Maqsad funksiya:

$$Z = \sum \sum c_{ij} \cdot x_{ij} \rightarrow \min$$

Cheklovlar:

$$\begin{aligned} \sum_j x_{ij} &= a_i \text{ (ta'minot cheklovi), } i = 1, 2, \dots, m \\ \sum_i x_{ij} &= b_j \text{ (talab cheklovi), } j = 1, 2, \dots, n \\ x_{ij} &\geq 0 \end{aligned}$$

Bu yerda x_{ij} — i-manbadan j-istehmolchiga tashiladigan yuk miqdori bo'lib, manfiy bo'lmasligi kerak. Agar $\sum a_i = \sum b_j$ bo'lsa, masala muvozanatli, aks holda muvozanatsiz deyiladi.

Microsoft Excel dasturida transport masalasini yechish uchun "Solver" (Ma'lumotlar → Tahlil → Solver) qo'shimchasidan foydalaniladi. Solver — bu maqsad funksiyani optimallashtirishga mo'ljallangan vosita bo'lib, quyidagi imkoniyatlarni taqdim etadi:

- Chiziqli dasturlash masalalarini yechish (Simplex LP usuli);
- Nochiziqli masalalarni yechish (GRG Nonlinear usuli);
- Integer (butun son) cheklovlarni qo'llash;
- O'zgaruvchilarning manfiy bo'lmaslik shartini avtomatik qo'llash;

Solver qo'shimchasini faollashtirish uchun: Fayl → Parametrlar → Qo'shimchalar → Excel qo'shimchalari → Solver qo'shimchasi yoqiladi.

Quyidagi misolni ko'rib chiqamiz: 3 ta manba (A_1, A_2, A_3) va 4 ta istehmolchi (B_1, B_2, B_3, B_4) mavjud.

1-jadval. Transport masalasining ma'lumotlari

	A	B	C	D	E	F
1	Manba / Ombor	B ₁	B ₂	B ₃	B ₄	Zaxira
2	A ₁	2	3	1	4	120
3	A ₂	5	4	8	1	100
4	A ₃	3	6	2	5	80
5	Talab	70	90	60	80	300

MS Excel dasturida transport masalasini yechish 5 ta asosiy bosqichga bo'lingan:

1-bosqich: Ma'lumotlarni kiritish. Excel jadvalida transport xarajatlari matritsasi (C matritsasi) B2:E4 katakchalarga, zaxiralar F2:F4 ga, talablar B6:E6 ga kiritiladi. Qaror o'zgaruvchilar (x_{ij}) uchun B9:E11 diapazoni ajratiladi.

2-bosqich: Maqsad funksiyani kiritish. B13 katakchasiga =SUMPRODUCT(B2:E4, B9:E11) formulasi kiritiladi. Bu formula xarajatlar matritsasi va tashilgan miqdorlar ko'paytmasining yig'indisini hisoblaydi.

3-bosqich: Cheklovlarni kiritish. Ta'minot cheklovlari uchun G9:G11 = G2:G4 va talab cheklovlari uchun B12:E12 = B6:E6 tenglamalar Solver dialogiga kiritiladi. Barcha $x_{ij} \geq 0$ sharti ham qo'shiladi.

4-bosqich: Solver sozlamalari. Ma'lumotlar → Solver → Maqsad katak: B13 → Min → O'zgaruvchi kataklar: B9:E11 → Cheklovlar qo'shiladi → Simplex LP usuli tanlanadi → Solve tugmasi bosiladi.

5-bosqich: Natijani tahlil qilish. Solver optimal yechimni topib, x_{ij} qiymatlarini B9:E11 diapazoniga yozadi. Sensitivity Report (Sezgirlik hisoboti) yordamida yechimning barqarorligi tahlil qilinadi.

Simplex LP usulida barcha tengsizliklar qo'shimcha o'zgaruvchi kiritish xisobiga tenglamalarga keltiriladi. Ushbu tenglamalar uchun maqsad funksiyaning optimal (eng katta yoki eng kichik) qiymati uchun yechim topiladi.

MS Excel dasturining Solver qo'shimchasi transport masalasini yechishda samarali va qulay vosita hisoblanadi. Dastur yordamida: murakkab optimizatsiya masalalari tezda yechiladi; vizual interfeys orqali ma'lumotlar kiritish va natijalarni ko'rish osonlashadi; sezgirlik tahlili orqali optimal yechimning barqarorligi tekshiriladi; katta hajmdagi ma'lumotlar bilan ishlash imkoniyati mavjud.

Ushbu yondashuv matematika va informatika ta'limida, shuningdek logistika, transport va iqtisodiy sohalarda amaliy muammolarni hal qilishda keng qo'llanilishi mumkin. MS Excel — bu professional optimizatsiya dasturlariga (LINDO, CPLEX) munosib alternativa bo'lib, uning keng tarqalganligi va o'rganish qulayligi muhim ustunlik hisoblanadi.

Foydalanilgan adabiyotlar

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ISHLAB CHIQRARISH JARAYONLARNI AVTOMATLASH MASALASNI YECHISH ALGORTMI

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Annatatsiya: Ushbu maqolada texnologik jarayonlarni avtomatlashtirish masalasini chekli ayirmali usullardan foydalanib yechishning parallel hisoblash algoritmini ishlab chiqish masalasi qaralgan.

Kalit so'zlar: Texnologiya, kompyuter, avtomatlashtirish, filtratsion, dastur lash, protsessor, parallel, MATLAB, Matematik model, differensial, diskret.

АЛГОРИТМ РЕШЕНИЯ ЗАДАЧИ АВТОМАТИЗАЦИИ ПРОИЗВОДСТВЕННЫХ ПРОЦЕССОВ

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Аннотация: В данной статье рассматривается задача разработки алгоритма параллельных вычислений для решения задачи автоматизации технологических процессов с использованием методов конечных разностей.