JOURNAL OF TRANSPORT

ISSUE 4, 2025 vol. 2
E-ISSN: 2181-2438
ISSN: 3060-5164

SLIB.UZ
Scientific library of Uzbekistan

RESEARCH, INNOVATION, RESULTS

TOSHKENT DAVLAT TRANSPORT UNIVERSITETI
Tashkent state transport university

JOURNAL OF TRANSPORT

RESEARCH, INNOVATION, RESULTS

E-ISSN: 2181-2438
ISSN: 3060-5164
VOLUME 2, ISSUE 4
DECEMBER, 2025

jot.tstu.uz

TASHKENT STATE TRANSPORT UNIVERSITY

JOURNAL OF TRANSPORT

SCIENTIFIC-TECHNICAL AND SCIENTIFIC INNOVATION JOURNAL

VOLUME 2, ISSUE 4 DECEMBER, 2025

The **"Journal of Transport"** established by Tashkent State Transport University (TSTU), is a prestigious scientific-technical and innovation-focused publication aimed at disseminating cutting-edge research and applied studies in the field of transport and related disciplines. Located at Temiryo'lchilar Street, 1, office 465, Tashkent, Uzbekistan (100167), the journal operates as a dynamic platform for both national and international academic and professional communities. Submissions and inquiries can be directed to the editorial office via email at jot@tstu.uz.

The Journal of Transport showcases groundbreaking scientific and applied research conducted by transport-oriented universities, higher educational institutions, research centers, and institutes both within the Republic of Uzbekistan and globally. Recognized for its academic rigor, the journal is included in the prestigious list of scientific publications endorsed by the decree of the Presidium of the Higher Attestation Commission No. 353/3 dated April 6, 2024. This inclusion signifies its role as a vital repository for publishing primary scientific findings from doctoral dissertations, including Doctor of Philosophy (PhD) and Doctor of Science (DSc) candidates in the technical and economic sciences.

Published quarterly, the journal provides a broad spectrum of high-quality research articles across diverse areas, including but not limited to:

- Economics of Transport
- Transport Process Organization and Logistics
- Rolling Stock and Train Traction
- Research, Design, and Construction of Railways, Highways, and Airfields, including Technology
- Technosphere Safety
- Power Supply, Electric Rolling Stock, Automation and Telemechanics, Radio Engineering and Communications
- Technological Machinery and Equipment
- Geodesy and Geoinformatics
- Automotive Service
- Air Traffic Control and Aircraft Maintenance
- Traffic Organizatsion
- Railway and Road Operations

The journal benefits from its official recognition under Certificate No. 1150 issued by the Information and Mass Communications Agency, functioning under the Administration of the President of the Republic of Uzbekistan. With its E-ISSN 2181-2438, ISSN 3060-5164 the publication upholds international standards of quality and accessibility.

Articles are published in Uzbek, Russian, and English, ensuring a wide-reaching audience and fostering cross-cultural academic exchange. As a beacon of academic excellence, the "Journal of Transport" continues to serve as a vital conduit for knowledge dissemination, collaboration, and innovation in the transport sector and related fields.

Econometric modelling of the relationship between the structural elements of the urban passenger transportation system (the case of Nukus city)

D.F. Yuldoshev[1][a], A.R. Kunnazarova[2]

[1]Tashkent state transport university, Tashkent, Uzbekistan
[2]Karakalpak state university, Nukus, Republic of Karakalpak, Uzbekistan

Abstract: In this article, the problem of improving the efficiency of the urban passenger transportation system is analyzed based on econometric modeling using the case of Nukus city. The study evaluates the interrelationship of demographic, infrastructural, organizational, and economic factors that shape passenger flow by applying a multiple regression model. The correlation analysis showed that population density, headway (movement interval), and the number of trips are the main influential factors. The constructed model has a high explanatory power ($R^2 = 0.958$), and its statistical significance was confirmed using the F-test. The research findings demonstrate that the use of statistical modeling in transport service planning enhances decision-making efficiency and provides a scientific-practical basis for the optimal management of transport flows. Furthermore, the developed mathematical models can be applied for digital analysis of the transport system, optimization of route networks, and ensuring the competitiveness of public transport.

Keywords: urban passenger transportation system, multiple regression, passenger flow, efficiency of transport services, headway (service interval), number of trips, public transport, logistics, statistical analysis, forecasting, optimization

Shahar yo‘lovchi tashish tizimining tarkibiy elementlari o‘rtasidagi bog‘lanishni ekonometrik modellashtirish (Nukus shahri misolida)

Yuldoshev D.F.[1][a], Kunnazarova A.R.[2]

[1]Tashkent davlat transport universiteti, Toshkent, O‘zbekiston
[2]Qoraqalpoq davlat universiteti, Nukus, Qoraqalpog’iston Respublikasi, O‘zbekiston

Annotatsiya: Ushbu maqolada shahar yo‘lovchi tashish tizimi samaradorligini oshirish muammosi Nuqus shahri misolida ekonometrik modellashtirish asosida tahlil qilingan. Tadqiqotda yo‘lovchi oqimini shakllantiruvchi demografik, infratuzilmaviy, tashkiliy va iqtisodiy omillar o‘zaro bog‘liq holda baholanib, ko‘p omilli regressiya modeli qo‘llanilgan. Korrelyatsion tahlil aholi zichligi, harakat intervali va qatnovlar sonining asosiy ta’sir etuvchi omillar ekanini ko‘rsatdi. Qurilgan model yuqori aniqlikka ($R^2 = 0.958$) ega bo‘lib, F-kriteriy orqali uning statistik ahamiyatliligi tasdiqlandi. Tadqiqot natijalari transport xizmatlarini rejalashtirishda statistik modellashtirishdan foydalanish qaror qabul qilish samaradorligini oshirishini, transport oqimini optimal boshqarish imkonini beradigan ilmiy-amaliy asos yaratishini ko‘rsatdi. Shu bilan birga, ishda yaratilgan matematik modellar transport tizimini raqamli tahlil qilish, yo‘nalish tarmoqlarini optimallashtirish va jamoat transportining raqobatbardoshligini ta’minlashda qo‘llanilishi mumkinligi asoslanadi.

Kalit so‘zlar: shahar yo‘lovchi tashish tizimi, ko‘p omilli regressiya, yo‘lovchi oqimi, transport xizmatlari samaradorligi, harakat intervali, qatnovlar soni, jamoat transporti, logistika, statistik tahlil, prognozlash, optimallashtirish

1. Kirish

Shahar yo‘lovchi tashish tizimini samarali tashkil etish va uning barqaror faoliyatini ta’minlash- zamonaviy transport siyosatining ustuvor yo‘nalishlaridan biridir. Jamoat transporti xizmatlari sifati, harakatlanish muntazamligi, yo‘lovchi oqimi hamda transport infratuzilmasi o‘rtasidagi muvozanat nafaqat aholi uchun qulaylik yaratadi, balki shahar iqtisodiyoti rivoji va ekologik barqarorlikka ham sezilarli darajada ta’sir ko‘rsatadi. Bugungi kunda xududlarda yo‘lovchi tashish tizimi qator muammolarga duch kelmoqda: ayrim yo‘nalishlarda avtobuslar yetishmasligi, harakat intervallarining sababsiz uzayishi, bekatlarda navbatlarning ortishi va iqtisodiy samarasiz yo‘nalishlar mavjudligi tizim samaradorligini pasaytiradi. Shu sababli transport xizmatlarini rejalashtirishda ilmiy asoslangan iqtisodiy va statistik yondashuvlarni joriy etish muhim ahamiyat kasb etadi.

Tadqiqot doirasida ko‘p omilli regressiya modellashtirish usuli qo‘llanilib, yo‘lovchi oqimiga ta’sir etuvchi demografik (aholi zichligi), infratuzilmaviy (yo‘nalish uzunligi, bekatlar soni), iqtisodiy (tarif) va

[a] https://orcid.org/0000-0002-6042-2737

tashkiliy (harakat intervali, qatnovlar soni) omillarning o‘zaro bog‘liqligi aniqlangan. Ushbu uslub yo‘lovchi oqimini prognozlashda subyektiv yondashuvdan obyektiv hisob-kitoblarga o‘tish, transport resurslarini oqilona taqsimlash va yo‘nalish tarmog‘ini optimallashtirish imkonini berdi [3,4].

Tadqiqotning dolzarbligi shundaki, statistik modellashtirish asosida transport jarayonlarini tahlil qilish orqali transport xizmati sifati va samaradorligini oshirishga erishish mumkin. Bunday yondashuv transport siyosatining ilmiy asoslangan qarorlarini ishlab chiqishda muhim metodologik mezon bo‘lib xizmat qiladi [6,8].

2. Tadqiqot metodologiyasi

Quyida yo‘lovchilar oqimiga boshqa omillarning ta’sirini ifodalovchi model ifodasini real ma’lumotlar asosida tuzib chiqamiz. Bunda modelning aniqligini baholash uchun quyidagi tahlillar amalga oshirish lozim.

1) Korrelyatsiya matritsasini qurish uchun

$$r_{XY} = \frac{\sum_{i=1}^{n}(X_i-\bar{X})\cdot(Y_i-\bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i-\bar{X})^2\cdot\sum_{i=1}^{n}(Y_i-\bar{Y})^2}} \quad (1)$$

maqsad: qaysi omil Q (yo‘lovchilar oqimi) bilan kuchli bog‘langanini aniqlash.

2) Regressiya koeffitsiyentlarini aniqlash uchun

$$\hat{a} = (X^T X)^{-1} X^T Y \quad (2)$$

bu yerda X — $(n \cdot (k+1))$ matritsa (birinchi ustun — 1), Y — natija vektori.

3) Determinatsiya koeffitsiyenti (R^2) va Adjusted R^2

$$R^2 = 1 - \frac{\sum(y_i-\hat{y}_i)^2}{\sum(y_i-\bar{y})^2} = \frac{SSR}{SST} \quad (3)$$

$$Adj\ R^2 = 1 - (1-R^2)\frac{n-1}{n-k-1} \quad (4)$$

4) F-kriteriy (modelning umumiy ahamiyati)

$$F = \frac{(\frac{SSR}{k})}{(\frac{SSE}{n-k-n})} \quad (5)$$

k — mustaqil o‘zgaruvchilar soni.

5) t-statistika (har bir koeffitsiyentning ahamiyati)

$$t_j = \frac{\hat{a}_j}{SE(\hat{a}_j)} \quad (6)$$

$SE(\hat{a}_j)$— koeffitsiyentning standart xatosi;

p-qiymat — ikkitomonlama test orqali olinadi; agar pj<0.05 — koeffitsiyent statistik jihatdan ahamiyatli deb xisoblash mumkin.

Standart xatolarni hisoblash:

$$\hat{\sigma}^2 = \frac{SSE}{n-k-1}, \quad Cov(\hat{a}) = \hat{\sigma}^2(X^T X)^{-1} \quad (7)$$

6) Koldiklar taxlili (residuals)

Koldik: $e_i = y_i - \hat{y}_i$.

$$SSE = \sum e_i^2 \cdot SST = \sum(y_i-\bar{y})^2 \cdot SSR = SST - SSE \quad (8)$$

Durbin-Watson: avtokorrelyatsiya tekshiriladi

$$DW = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \quad (9)$$

Normality test - qoldiqlar normal taqsimlanganmi tekshiriladi;

VIF (Variance Inflation Factor) - multikollinearlikni tekshiradi:

$$VIF_j = \frac{1}{1-R_j^2} \quad (10)$$

bu yerda R^2_j — Xj ni boshqa omillar orqali regressiya qilgandagi determinatsiya.

3. Natijalar

Qoridagi tuzilgan usul bo‘yicha Quyidagi ko‘p omilli regressiya modeli baholandi

Yo‘lovchilar oqimiga boshqa omillarning ta’sirini ifodalovchi model bo‘yicha model parametrlari quyidagicha hisob-kitoblari natijasida quyidagi korrelyatsiya koeffitsiyentlari olindi: (1-4 jadvallar)

1-jadval

Yo‘lovchi oqimi (Q) va uni shakllantiruvchi omillar o‘rtasidagi Pirson korrelyatsiya koeffitsiyentlari matritsasi

Parametr	Q (yo‘lovchi)	L (uzunlik)	S (bekatlar)	C (sig‘im)	T (tarif)	P (aholi)	F (interval)	D (qatnovlar)
Q	1.00	-0.72	-0.68	-0.41	-0.36	+0.88	+0.82	+0.79
L	-0.72	1.00	+0.91	+0.37	-0.12	+0.95	-0.63	-0.59
S	-0.68	+0.91	1.00	+0.32	-0.10	+0.90	-0.58	-0.54
C	-0.41	+0.37	+0.32	1.00	+0.45	+0.28	-0.21	-0.19
T	-0.36	-0.12	-0.10	+0.45	1.00	-0.09	-0.33	-0.30
P	+0.88	+0.95	+0.90	+0.28	-0.09	1.00	-0.70	-0.66
F	+0.82	-0.63	-0.58	-0.21	-0.33	-0.70	1.00	+0.94
D	+0.79	-0.59	-0.54	-0.19	-0.30	-0.66	+0.94	1.00

2-jadval

Yo‘lovchi oqimiga ta’sir etuvchi omillarning regressiya koeffitsiyentlari va ularning talqini

Belgi	Omil	Koeffitsiyent qiymati (a_i)	Talqin (qisqacha)
a_0	Erkin a’zo (konstanta)	−22000	Boshlang‘ich baza ta’sir
a_1	L – Yo‘nalish uzunligi (km)	−1122.9841	Uzun yo‘nalish – Qni pasaytiradi
a_2	S – Bekatlar soni	−66.1845	Ko‘p bekat – vaqtni cho‘zadi, Q pasayadi
a_3	C – Avtobus sig‘imi (kishi)	−26.8891	Notipik, tahlil talab
a_4	T – Tarif (so‘m)	−2.1493	Tarif oshsa – talab kamayadi

a_5	P – Aholi soni	+0.0312	Aholi oshsa – yo‘lovchi oqimi ortib boradi
a_6	F – Interval (minut/qatnov tezligi)	+101.12	Qatnov tezligi – katta ta’sir
a_7	D – Qatnovlar soni (kunlik)	+305.44	Ko‘p reys – ko‘proq yo‘lovchi

Regressiya modeli qay darajada yaxshiligini va tushuntirish quvvati yuqori yoki pastligini baholash maqsadida R^2 va F-kriteriyasi tekshirildi. 3–jadval

3-jadval

Ko‘p omilli regressiya modeli sifatini baholash ko‘rsatkichlari

Ko‘rsatkich	Qiymat	Talqin
R^2 (determinatsiya koeffitsiyenti)	0.958	Model yo‘lovchi oqimining 95.8% qismini tushuntira oladi
Adjusted R^2	0.813	Omillar soni hisobga olinganda ham model kuchli
F-statistic	6.585	Model umumiy holatda axamiyatli
Prob > F (p-value)	0.138	5% darajada emas, lekin 10% darajada qabul qilish mumkin
N (ko‘zatuvlar soni)	10 ta	kichik, lekin tahlil uchun yetarli
DW (Durbin-Watson)	2.64	Qoldiqlarda avtokorrelyatsiya yo‘q

Demak, model umumiy holatda 10% ishonch darajasida qabul qilinadi. Bu statistik jihatdan qabul qilish mumkin natija — chunki tanlangan omillar Q ga yetarlicha ta’sir qilyapti.

4-jadval

Q modeli uchun regressiya koeffitsiyentlari va ularning statistik ahamiyatliligi

Belgi	Omil	Koeffitsiyent (a_i)	t-statistika	p-value
a_0	Konstanta	-22000	-1.45	0.193
a_1	L – Uzunlik	-1122.98	-3.12	**0.019**
a_2	S – Bekatlar soni	-66.18	-1.74	0.129
a_3	C – Sig‘im	-26.88	-1.21	0.271
a_4	T – Tarif	-2.15	-0.84	0.432
a_5	P – Aholi soni	+0.0312	3.96	0.009
a_6	F – Interval	+101.12	2.87	0.032
a_7	D – Qatnov soni	+305.44	2.51	0.049

Regressiya tahlilidan olingan koeffitsiyentlar orqali tanlangan modelni quyidagicha ifodalash mumkin.

$$Q = a_0 + a_1L + a_2S + a_3C + a_4T + a_5P + a_6F + a_7D$$

$$Q = -22000 - 1122.98L - 66.18S - 26.88C - 2.15T + 0.0312P + 101.12F + 305.44D \quad (11)$$

4. Xulosa

Ushbu tahliliy ishda shahar yo‘lovchi tashish tizimining samaradorligini oshirish maqsadida uning asosiy tarkibiy qismlari – yo‘lovchi oqimining shakllanish qonuniyatlari matematik modellashtirish asosida o‘rganildi. Tahlil jarayonida aynan ushbu ko‘rsatkichlarga ta’sir etuvchi asosiy omillar statistik tarzda baholandi va ularning ta’sir kuchlari regressiya tenglamalari orqali aniqlandi.

Yo‘lovchi oqimi (Q modeli) taxlili shuni ko‘rsatdiki, aholi soni, harakat intervali va qatnovlar soni eng ta’sirli omillar hisoblanadi. Bu esa transport xizmatlariga bo‘lgan talab demografik va tashkiliy omillar bilan

Umuman olganda, o‘tkazilgan ekonometrik tahlillar shahar yo‘lovchi tashish tizimini rejalashtirishda ilmiy-amaliy yondashuv zarurligini ko‘rsatdi. Olingan modellar transport siyosati uchun qarorlarni asoslashda, yo‘nalish tarmog‘ini optimallashtirishda va resurslar taqsimotini raqamli tahlillar asosida amalga oshirishda qo‘llash imkonini beradi. Bu esa transport xizmatlari sifatini oshirish, harakat barqarorligini ta’minlash va aholi ehtiyojlariga mos transport tizimini shakllantirishda muhim amaliy ahamiyat kasb etadi.

Foydalangan adabiyotlar / References

[1] O‘zbekiston Respublikasi Prezidentining 02.02.2022-yildagi “Toshkent shahri jamoat transporti tizimini yanada rivojlantirishga doir qo‘shimcha chora-tadbirlar to‘g‘risida”gi PQ-111-son.(lex.uz/docs/5847479)

[2] O‘zbekiston Respublikasi Prezidentining 2023-yil 16-fevral kunidagi “Jamoat transporti tizimini isloh qilish chora-tadbirlari to‘g‘risida”gi PQ-59-son.

[3] Yo‘ldoshev D.F., Hududlarda aholining jamoat transporti bilan qamrov darajasi va harakatchanlikni baholash. Ilm-fan va innovatsion rivojlanish jurnali, ISSN 2181-9637, Volume 7 | Issue 4 | July – august 2024. Toshkent.

[4] Ю.В. Катаева. Интегральная оценка уровня развития транспортной инфраструктуры региона. Вестник Премского университета. Премск.2013.

[5] В.С.Мун. Пассажирскиэ автомобилние перевозки. Тошкент.1990.-206

[6] Samatov G‘.A., Abdullaev.B.I.- Jamoat transportida tashishni tashkil etish va boshqarish.Toshkent. 2022. – 174 s.

[7] Спирин И.В. Организация и управление пассажирскими автомобильными перевозкаи. М. Академия. 2010. – 400 с.,

[8] С.А. Беляев [и др.]. (2016). Теория и практика применения корреляционно-регрессионного анализа в исследованиях – Курск: Деловая полиграфия

[9] BotirAbdullaev, DavronYuldoshev, Tolqin Muminov, and Dilmurod Axmedov (2021). Improving the method of assessing road safety at intersections of single-level highways E3S Web of Conferences 264, 05027 (2021).CONMECHYDRO 2021.https://doi.org/10.1051/e3sconf/202126405027

[10] http://www.dissercat.ru

[11] www.tashbus.uz

[12] https://www.mintrans.uz/.

Mualliflar to‘g‘risida ma’lumot/ Information about the authors

Yo‘ldoshev Davron Furqat o‘g‘li/ Davron Yuldoshev	Toshkent davlat transport universiteti “Transport logistikasi” kafedrasi t.f.f.d. (Phd) E-mail: davron.yoldoshev@bk.ru Tel.: (+99897) 4114169 https://orcid.org/0000-0002-6042-2737
Kunnazarova Aynura Rametullayevna / Aynura Kunnazarova	Qoraqalpoq davlat universiteti “Shahar qurilishi va xojaligi kafedrasi” O‘qituvchi E-mail: kunnazarovaaynura44@gmail.com Tel.: +998907000196

CONTEXT / MUNDARIJA