Annotated Bibliography

Nate Lant

Microsimulation

Buzz words: multi-agent, microsimulation model, on-demand, agent-based, carpooling, travel demand/supply estimation, taxi fleets, demand-responsive transportation, case study,

Autonomous Taxicabs in Berlin – A Spatiotemporal Analysis of Service Performance

Bischoff J, Maciejewski M (2016). "Autonomous Taxicabs in Berlin, â€“ A Spatiotemporal Analysis of Service Performance.", *Transportation Research Procedia*, *19*, 176-186. ISSN 23521465„ doi: 10.1016/j.trpro.2016.12.078 (URL:, https://doi.org/10.1016/j.trpro.2016.12.078), <URL:, www.sciencedirect.com, https://linkinghub.elsevier.com/retrieve/pii/S235214651630864X>.

Abstract

Notes

They tested the effect on traffic from empty cars and demand shift as people switch from public transit.

They show how they scale from the 100% base scenario to the 10% without describing how they scaled down trip rates and network capacity (maybe described in previous paper).

Helpful graphics include the passenger waiting times during time of day, the productivity of the vehicles during time of day, and spatial distribution of waiting times and empty rides.

They found 10% of transit riders switched to autonomous taxis (only measured on the city center model, no outskirts). No explanation was given.

Simulation of city-wide replacement of private cars with autonomous taxis in Berlin

Bischoff J, Maciejewski M (2016). "ScienceDirect Simulation of, city-wide replacement of private cars with autonomous taxis in, Berlin." *Procedia Computer Science*, *83*, 237-244. doi:, 10.1016/j.procs.2016.04.121 (URL:, https://doi.org/10.1016/j.procs.2016.04.121), <URL:, www.sciencedirect.com>.

Abstract

Notes

Goal is to find optimum number of autonomous taxis (ATs) to service the city of Berlin, by replacing the private cars. They came up with 100,000 (not sure how exactly)

Details include the dispatching strategy using the demand-supply balancing strategy, *undersupply* and *oversupply*.

I think the dispatch algorithm should include a buffer distance around the request. The model should be seen from the customer's perspective.

Data not supported... - The split of car and public transit. - Section 3.2, certain adaptations pertaining to shortest path search... - What are taxi ranks (section 4) - 4.2, the graphs all look the same, and they don't talk about why 100,000 vehicles were chosen. "It was a good compromise..." - 4.3 the Replacement ratio... is it 1:10 or 1:12? - 4.3.2 where did they get the 40 min utilization of CDVs? - Conclusion, total drive time? what is it?

Simulating a rich ride-share mobility service using agent-based models

Segui-Gasco P, Ballis H, Parisi V, Kelsall DG, North RJ, Busquets, D (2019). "Simulating a rich ride-share mobility service using, agent-based models." *Transportation*. ISSN 0049-4488, doi:, 10.1007/s11116-019-10012-y (URL:, https://doi.org/10.1007/s11116-019-10012-y).

Abstract

In the UK, and using the National Trip End Model (NTEM), they produced a set of O-D matrices and then integrated them into MATSim. MATSim was used to predict the changes in travel behavior (specifically mode shift) and predict the effect on traffic conditions due to new AMoD services for the year 2025. As part of their agent-based framework, the Value of Time changes depending on the purpose of each trips and the income of the traveler.

MATSim is used to calculate the service demand, however, neither the occupancy of each vehicle and waiting/detour time were known. Average values were used and held constant (IMSim could have precisely calculated those values, but it would have taken a lot of time. . .).

MATSim informs the IMSim about the network conditions (travel times) and origins and destinations. With this input, IMSims calculates the optimum routes for the AMoD fleet, while simultaneously tracking the waiting and detour times that each agent experiences. "This information" (not exactly sure what is included here) is reported back to MATSim which updates the perception score of the agents and the Passenger Car Unit factor.

Then they calibrate it to the MERGE Greenwich case study in London.

Notes

In London, using MATSim (demand simulation model) coupled with IMSim (Intelligent mobility simulator)

Includes a literature review that describes several authors' efforts.

OD trips had to be disaggregated? What does that mean? Each trip was assigned information regarding the purpose, departure time, and initial mode of transport before the introduction of AV ride-sharing. The Value of Time (VoT) for each trip was also included together with demographic characteristics.

the original transport demand derives from a trip-based model, no information can be extracted regarding the sequence of activities (trip-chaining). Instead, all plans were expressed as two activities: one at the origin and one at the destination, linked by an intermediate trip.

Microsimulation of Demand and Supply of Autonomous Mobility On Demand

Azevedo CL, Marczuk K, Raveau S, Soh H, Adnan M, Basak K,, Loganathan H, Deshmunkh N, Lee DH, Frazzoli E, Ben-Akiva M (2016)., "Microsimulation of demand and supply of autonomous mobility on, demand." *Transportation Research Record, 2564*, 21-30. ISSN, 03611981, doi: 10.3141/2564-03 (URL:, https://doi.org/10.3141/2564-03).

Abstract

Using SimMobility, they integrate mobility sensitive behavioral models in a multiple time-scale structure. They look at three simulation levels a) long-term, b) a midterm level, and c) a short-term level.

Notes

Professors from the MIT-Singapore alliance.

TaxiSim: A Multiagent Simulation Platform for Evaluating Taxi Fleet Operations

Cheng S, Nguyen TD (2011). "TaxiSim: A Multiagent Simulation, Platform for Evaluating Taxi Fleet Operations." In *2011, IEEE/WIC/ACM International Conferences on Web Intelligence and, Intelligent Agent Technology*, 14-21. ISBN 978-1-4577-1373-6, doi:, 10.1109/WI-IAT.2011.138 (URL:, https://doi.org/10.1109/WI-IAT.2011.138), <URL:, http://ieeexplore.ieee.org/document/6040748/>.

Abstract

They *build* a multi-agent-base simulation platform, TaxiSim.

Notes

"Despite all these efforts in building computer simulations for a wide range of studies, to the best of our knowledge, we cannot find any simulation platform that is capable of modeling realistic taxi fleet operations. Taxi fleet operation is special and cannot be modeled straightforwardly by using existing technologies for the following reasons: [Taxi drivers make decisions "selfishly" and taxi drivers act unpredictably after they drop off a customer.]"

Output variability caused by random seeds in a multi-agent transport simulation model

Paulsen M, Rasmussen TK, Nielsen OA (2018). "Output variability, caused by random seeds in a multi-agent transport simulation, model." In *Procedia Computer Science*, volume 130, 850-857. doi:, 10.1016/j.procs.2018.04.078 (URL:, https://doi.org/10.1016/j.procs.2018.04.078).

Abstract

In this study they analyse the output variability caused by random seeds of a multi-agent transport simulator (MATSim) when applied to a case study of Santiago, Chile.

Notes

A Critical Analysis of Travel Demand Estimation for New One-Way Carsharing Systems

Abstract

This paper discusses the methods, paradigms, toolkits and platforms used by other researchers for the demand estimation of one-way carsharing systems. It is a collection of information.

Notes

Probably more helpful to learn from than to cite.

Includes an informative table with summary of studies on travel demand estimation for one-way carsharing systems (includes Axhausen, Ciari, Balac, Fagnant, and Horl - all using MATSim)

An Assignment-Based Approach to Efficient Real-Time City-Scale Taxi Dispatching

Maciejewski M, Bischoff J, Nagel K (2016). "An Assignment-Based, Approach to Efficient Real-Time City-Scale Taxi Dispatching.", *IEEE Intelligent Systems*, *31*(1), 68-77. ISSN 15411672, doi:, 10.1109/MIS.2016.2 (URL: https://doi.org/10.1109/MIS.2016.2).

Abstract

Notes

They evaluate dispatching strategies in detail in the city of Berlin and the neighboring region of Brandenburg using the microscopic large-scale MATSim simulator.

Carsharing demand estimation Zurich, Switzerland, area case study

Abstract

Notes

The Philippines: Agent-Based Transport Simulation Model for Disaster Response Vehicles

Yaneza EB (2016). "The Philippines: Agent-Based Transport, Simulation Model for Disaster Response Vehicles." In *The, Multi-Agent Transport Simulation MATSim*, 461-468. Ubiquity Press., doi: 10.5334/baw.78 (URL: https://doi.org/10.5334/baw.78), <URL:, http://www.ubiquitypress.com/site/chapters/10.5334/baw.78/>.

Abstract

Notes

USING PASSIVE DATA TO BUILD AN AGILE TOUR-BASED MODEL: A CASE STUDY IN ASHEVILLE

Abstract

Notes

Validating and calibrating agent-based models: A case study

Bianchi C, Cirillo P, Gallegati M, Vagliasindi PA (2007)., "Validating and calibrating agent-based models: A case study.", *Computational Economics*, *30*(3), 245-264. ISSN 09277099, doi:, 10.1007/s10614-007-9097-z (URL:, https://doi.org/10.1007/s10614-007-9097-z).

Abstract

Notes

What are ad hoc perameter values?

Uses the complex adaptive trivial system (CATS) model - this means

Italian professors (various universities). There are some grammatical errors.

Multi-agent simulation for planning and designing new shared mobility services

Inturri G, Le Pira M, Giuffrida N, Ignaccolo M, Pluchino A,, Rapisarda A, D'Angelo R (2019). "Multi-agent simulation for, planning and designing new shared mobility services." *Research in, Transportation Economics*, *73*, 34-44. ISSN 07398859, doi:, 10.1016/j.retrec.2018.11.009 (URL:, https://doi.org/10.1016/j.retrec.2018.11.009).

Abstract

They use an agent-based model to explore different system configurations of flexible transit (a specific demand responsive shared transport service) to estimate demand and supply in the city of Ragusa, Italy. They aim to use GIS based demand and road network models, explore dispatching strategies, find indicators to monitor efficiency. They identify an optimal range of operational vehicles.

Notes

Agent-based simulation testbed for on-demand mobility services

Certick'y M, Jakob M, P'ibil R, Moler Z (2014). "Agent-based, simulation testbed for on-demand mobility services." In *Procedia, Computer Science*, volume 32, 808-815. doi:, 10.1016/j.procs.2014.05.495 (URL:, https://doi.org/10.1016/j.procs.2014.05.495).

Abstract

Notes

The simulation testbed is built on the versatile transport simulation framework AgentPolis.

Effects of scaling down the population for agent-based traffic simulations

Llorca C, Moeckel R (2019). "Effects of scaling down the, population for agent-based traffic simulations." *Procedia, Computer Science*, *151*, 782-787. ISSN 18770509, doi:, 10.1016/j.procs.2019.04.106 (URL:, https://doi.org/10.1016/j.procs.2019.04.106).

Abstract

Scaling down large populations is required because of runtime. In Munich 5% of agents and 50 iterations produced similar travel time distributions to the 100% of agents and 500 iterations (but 50 times faster). The researchers compared runtime, average travel time, and travel time distribution.

Notes

Using MATSim and carried out in the Munich metropolitan area.

Heterogeneous tolls and values of time in multi-agent transport simulation

Nagel K, Kickhöfer B, Joubert JW (2014). "Heterogeneous tolls and, values of time in multi-agent transport simulation." In *Procedia, Computer Science*, volume 32, 762-768. doi:, 10.1016/j.procs.2014.05.488 (URL:, https://doi.org/10.1016/j.procs.2014.05.488).

Abstract

Notes

Simulating ad-hoc demand-responsive transportation: a comparison of three approaches

Ronald N, Thompson R, Winter S (2017). "Simulating ad-hoc, demand-responsive transportation: a comparison of three, approaches." *Transportation Planning and Technology*, *40*(3)„ 340-358. ISSN 10290354, doi: 10.1080/03081060.2017.1283159 (URL:, https://doi.org/10.1080/03081060.2017.1283159).

Abstract

The three approaches are 1) a simple custom-developed package, 2) traffic microsimulation, and 3) agent-based simulation. Each approach is used to analyze the advantages and disadvantages in evaluating for demand-responsive transportation.

Notes

Researchers from University of Melbourne

DYNAMIC RIDE-SHARING AND FLEET SIZING FOR A SYSTEM OF SHARED 1 AUTONOMOUS VEHICLES IN AUSTIN, TEXAS 2 3 4

Abstract

Notes

Simulating Demand-responsive Transportation: A Review of Agent-based Approaches

Ronald N, Thompson R, Winter S (2015). "Simulating, Demand-responsive Transportation: A Review of Agent-based, Approaches." *Transport Reviews*, *35*(4), 404-421. ISSN 14645327,, doi: 10.1080/01441647.2015.1017749 (URL:, https://doi.org/10.1080/01441647.2015.1017749).

Abstract

Notes

A Conceptual Design of an Agent-based Interaction Model for the Carpooling Application

Cho S, Yasar AUH, Knapen L, Bellemans T, Janssens D, Wets G, (2012). "A Conceptual Design of an Agent-based Interaction Model, for the Carpooling Application." In *Procedia Computer Science*,, volume 10, 801-807. doi: 10.1016/j.procs.2012.06.103 (URL:, https://doi.org/10.1016/j.procs.2012.06.103).

Abstract

Notes

(PDF is linked to a dial-a-ride paper by Fu)

Simulation model of carpooling with the Janus Multiagent platform

Galland S, Gaud N, Yasar AUH, Knapen L, Janssens D, Lamotte O, (2013). "Simulation model of carpooling with the Janus Multiagent, platform." In *Procedia Computer Science*, volume 19, 860-866., doi: 10.1016/j.procs.2013.06.115 (URL:, https://doi.org/10.1016/j.procs.2013.06.115).

Abstract

Notes

A modeling system for simulation of dial-a-ride services

Häll CH, Högberg M, Lundgren JT (2012). "A modeling system for, simulation of dial-a-ride services." *Public Transport*, *4*(1),, 17-37. ISSN 1866749X, doi: 10.1007/s12469-012-0052-6 (URL:, https://doi.org/10.1007/s12469-012-0052-6).

Abstract

Notes

Estimating Activity and Health Impacts of First and Last Mile Transit Access Programs for Work and

Shopping Trips Using Sharing Mobility Services in the Metropolitan Area Center for Transportation,

Environment, and Community Health Final Report

Abstract

Notes

Dynamic Transport Services

Axhausen K, Nagel K, Horni A (eds.) (2016). *Multi-Agent Transport, Simulation MATSim.* Ubiquity Press, London. ISBN, 978-1-909188-75-4, 978-1-909188-76-1, 978-1-909188-77-8„ 978-1-909188-78-5, doi: 10.5334/baw (URL:, https://doi.org/10.5334/baw).

Abstract

Notes

Large-scale agent-based transport simulation in shanghai, china

Zhang L, Yang W, Wang J, Rao Q (2013). "Large-scale agent-based, transport simulation in shanghai, china." *Transportation Research, Record*, 34-43. ISSN 03611981, doi: 10.3141/2399-04 (URL:, https://doi.org/10.3141/2399-04).

Abstract

Notes

The MATSim Open Berlin Scenario: A multimodal agent-based transport simulation scenario based on

synthetic demand modeling and open data

Ziemke D, Kaddoura I, Nagel K (2019). "The MATSim Open Berlin, Scenario: A multimodal agent-based transport simulation scenario, based on synthetic demand modeling and open data." *Procedia, Computer Science*, *151*, 870-877. ISSN 18770509, doi:, 10.1016/j.procs.2019.04.120 (URL:, https://doi.org/10.1016/j.procs.2019.04.120).

Abstract

Notes

Mobility for the Disabled

Buzz words:

TNCs and Disbled Access - SFMTA

California SB 1376

Abstract

In September of 2018, the State of California filed SB 1376 which "requires the Public Utilities Commission, by January 1, 2019, to begin conducting workshops with stakeholders in order to determine community WAV demand and WAV supply and to develop and provide recommendations regarding specified topics for programs for on-demand services and partnerships. The bill would require each TNC, by July 1, 2019, to pay on a quarterly basis to the commission an amount equivalent to, at a minimum, $0.05 for each TNC trip completed. The bill would require moneys collected by the commission to be deposited in the TNC Access for All Fund, which the bill would create, and would continuously appropriate moneys deposited in the fund to the commission for purposes of the program. The bill would require the commission to distribute funds from the TNC Access for All Fund on a competitive basis to access providers that establish on-demand transportation programs or partnerships to meet the needs of persons with disabilities."

New York State Transportation Newtork Company Accessibility Task Force

Notes

In 2018, the Taxi and Limousine Commission (TLC) in New York City issued a mandate requiring Uber, Lyft and Via to make wheelchair accessible service a growing part of their operations. While this particular mandate was not adopted, a settlement was reached in the New York State Supreme Court. The NYC TLC retained the mandate that would require ... TNCs to meet a wait-time requirement. The wait time requirement states that, by 2021, TNCs must either service at least 80 percent of requests for wheelchair-accessible vehicles in under 10 minutes and 90 percent in under 15 minutes, or associate with a company that has the capacity to meet those requirements ().

Travel Patterns of American Adults with Disabilities

Abstract

This paper briefly covers employment, vehicle ownership, trip purpose, mode choice, trip distance, travel times, trip substitutes,

Notes

The NHTS asks respondents if they have "a temporary or permanent condition or handicap that makes it difficult to travel outside of the home." If they respond yes, the NHTS asks followup questions about the mobility devices they use, such as canes or wheelchairs. It also asks follow-up questions about how the condition affects their travel—for example, by limiting their driving to daytime. Some respondents have disabilities that might not limit travel, but the NHTS asks only about "travel- limiting disabilities."

Over half (57.8 percent) of all respondents with disabilities use one or more medical devices:

Walking canes (36.7 percent) Walkers (22.9 percent) Wheelchairs (11.6 percent) Motorized scooters (4.4 percent) Motorized wheelchairs (3.9 percent) Crutches (2.6 percent) White canes for visual impairments (1.3 percent) Seeing-eye dogs (1.1 percent)

Over one-third (36.5 percent) of people with disabilities who made zero trips say that they stayed home because they have disabilities or are housebound.

Most ride-hailing services use applications on smartphones or tablets. People with disabilities use these devices less often than people without disabilities. Over four-fifths (86.5 percent) of people without disabilities use a smartphone daily versus 66.5 percent for people with disabilities.

The impacts of limited transportation access on persons with disabilities' social participation

Bascom GW, Christensen KM (2017). "The impacts of limited, transportation access on persons with disabilities' social, participation." *Journal of Transport & Health*, *7*, 227-234., ISSN 2214-1405, doi: 10.1016/J.JTH.2017.10.002 (URL:, https://doi.org/10.1016/J.JTH.2017.10.002), <URL:, https://www.sciencedirect.com/science/article/pii/S2214140517300075>.

Abstract

Notes

(Graydon W. Bascom, Keith M. Christensen) The overall goal of the research was to see how social life was impacted by limited transportation because of a disability. They looked at the strength of the social network of each individual. They also looked at what modes were being used and if modes were associated with age, gender, race, income, employment, type of disability, and education.

Nearly 70% of individuals with disabilities reported that their social life was hindered by transportation needs. And social networks affected mode choice.

Demographics

Results seem slightly different from the NHTS research that I did. According to their survey (they also included 2014 census data) less than 28.4% made less than $15,000 per year, over 47.6% of respondents were employed (very different from the 2017 NHTS).

Mode

They show mode distribution by disability type (including taxi and paratransit) and compare the distribution to the 2003 BTS survey. In the one-way ANOVA test they found that income and disability type were significantly associated with mode choice and that race, age, education and employment were not. About 32% of people with disabilities utilize a private vehicle (about half of the number reported by the 2003 BTS). Public transportation and paratransit use were also reported higher than in the 2003 BTS survey results.

Paratransit demand of disabled people

Bearse P, Gurmu S, Rapaport C, Stern S (2004). "Paratransit demand, of disabled people." *Transportation Research Part B:, Methodological*, *38*(9), 809-831. ISSN 01912615, doi:, 10.1016/j.trb.2003.10.004 (URL:, https://doi.org/10.1016/j.trb.2003.10.004).

Abstract

This paper shows how demand for paratransit ridership has increased over time. The main goal is to take the JAUNT administrative records and calculate the demand growth per passenger. They found that the mean number of trips per month of those eligible for the service was 3.11 trips. That number includes a lot of people that took zero trips, so including only those who took at least one trip in the month, the mean number of trips was 10.64

Notes

This paper is limited by the data collected in the early 1990s and by the Virginia region. Data was primarily taken from the JAUNT paratransit system in Virginia. This service is similar to the service in Salt Lake City in that the riders have to be eligible for the service and request a ride at least 24 hours in advance.

This image shows the distribution of users and how many trips they take."For example, 53% of trips are taken by people who take 20 trips or fewer per month. This figure implies that 47% of JAUNT trips are taken by 7% of the users."

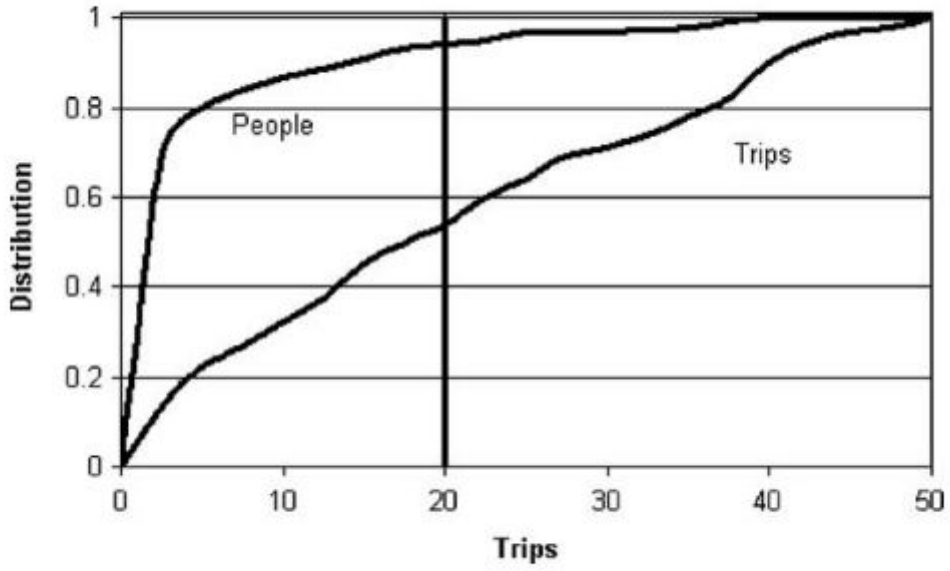

Fig. 1. Distribution of people and trips for average month.

Figure 1: Distribution of users and number of trips.

The Charlottesvill Transit System manages the eligibility process for Charlottesville users of JAUNT. The figure below shows the growth since 1984 by number of eligible JAUNT users.

Mobility as a Service and the transition to driverless systems

Abstract

From Joschka Bischoff's dissertation, chapter 6 covers wheelchair accessible taxis.

Assumptions

The current paratransit system will be almost completely replaced. WAV taxis are subsidized instead of using the Special Transit Service (SFD) in Berlin. 700 daily rides (from the SFD and 10% WAV) + 300 daily rides (from tourists, suburban areas, or temporarily disabled individuals) = 1000 assumed daily rides. "Trips of persons using wheelchairs are generally similar to non-work trips of persons without disability."

Methodology

10/100 non-work trips are marked with "wheelchair-friendly service". This is added to the demand in Berlin and matched with taxi/supply model. Certain vehicles are marked WAV (500-100) aiming to achieve an average wait time of 15 minutes. The "nearest vehicle" with the WAV requirement is dispatched but not prioritized.

Conclusions

With 250 WAV vehicles (well below 5% of the city's active vehicle fleet) an estimated wait time of 12:22 minues is acheived.

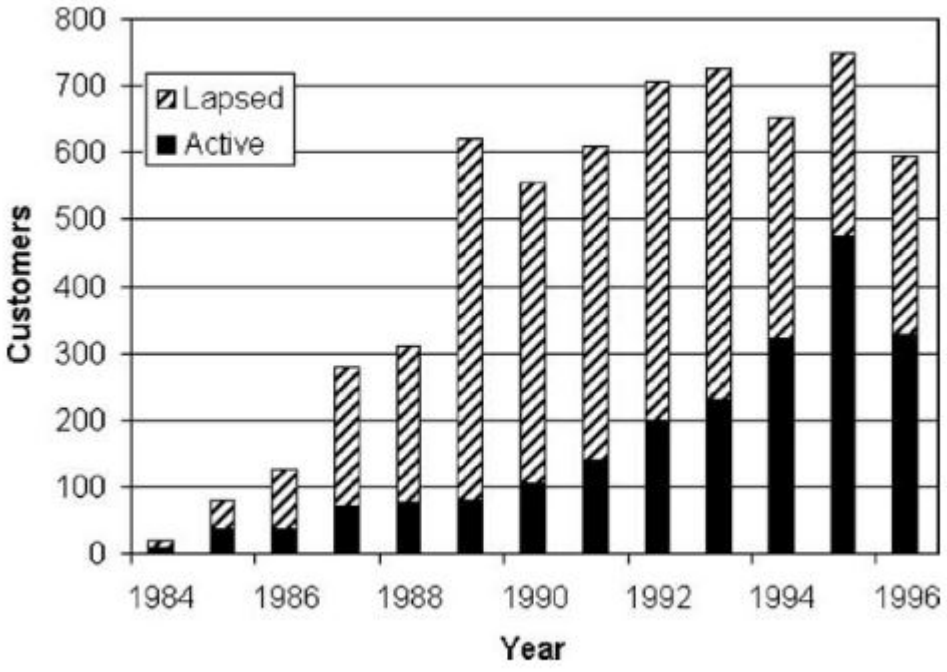

Fig. 2. Distribution of issue dates.

Figure 2: Growth of eligibile users.