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Queuing Theory And immigration process at Kempe Gowda international airport

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Abstract - ***This paper study the immigration process at Kempe Gowda international airport and how we can use queueing model to make immigration process more comfortable in less time consuming.***

Keywords - Immigration, Queuing theory

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INTRODUCTION

Population-Population, particularly Indian population has aroused growing interest across the globe in recent year. The world population has started increasing rapidly in the twentieth century. If we keep on eye about India. India is a one on the developing country. The population count for 1867-1871 was 203.4 million it increased 9.4 % in 1889-1891 and in 1910 5.7%. India`s population

History of Air transport - Aviation History of India – The Early Beginnings – The great business of air transport was born in India on the 18th of February 1911 and first mail flight took place. The Indian aviation market is on high growth path. As per IATA (International Air Transport Association) the number of global departures during calendar year 2018 is projected at around 4.3 billion. India among the top seven aviation market with 187 million passengers. India is as one of the fastest growing economies of the world and is likely to become the fifth largest in 2019.

The Growth Driver- India growing Aviation Market-According to the international air transport association (IATA). India is the fastest growing aviation market currently. Bangalore is the aviation manufacturing hub in India. Today global air lines consist of more than 2000 airlines. That are operating 23,000 aircraft.

Queuing theory-Queuing theory had its beginning in the research work of a Danish engineer named A. K. Erlang in 1909 Erlang experimented with fluctuating demand in telephone traffic. There are many solutions we have made like for traffic jam we have widen road. If there is runway for airport, we have more runways but still there is problem.

So, in queueing system we solve this problem mathematically so we make model. Before This we will know the generic term.

THE INPUT PROCESSES

Balking- A customer may decide to wait no matter how long the queue becomes. if a customer decides not to enter the queue because of its huge length. he is said to have balked

Reneging- A customer may enter the queue, but after some time loses patience and decide to leave. this is called reneging

Joking - In the case when there are two or more parallel queues, the customer may move from one queue to another for his personnel economic gain it's called joking

The Queue Discipline

A rule according to which customers are selected for service when a queue formed. The most commonly used laws are

- FIFO - First in First Out: who comes earlier leaves earlier, FCFS - First Come First Served
- LIFO - Last Come First Out: who comes later leaves earlier, LCFS - Last Come

First Served Performance Measures of Queueing Systems To characterize a queueing system we have to identify the probabilistic properties of the incoming flow of requests, service times and service disciplines. The arrival process can be characterized by the distribution of the interarrival times of the customers, denoted by A(t), that is A(t) = P (interarrival time < t).

Immigration and custom- The Immigration an important process for security purpose. in the immigration inspection first is Documents review which includes passport, Visa, Immunization

certificate, Documentation, Letter of confirmation or support. Second- standard questions like what is the nature of visit? How long do you plan to stay in the country, third finger print and photos, Fourth- After Approval put an official stamp. Some passengers choose for second level inspection for more information

(i) “secure implementation in queueing problem” Katsuhiko Nishizaki

Theoretical Economics Letters, 2012, 2, 561-565 http://dx.doi.org/10.4236/tel.2012.25103 Published Online December 2012 (http://www.SciRP.org/journal/tel) Objective of this paper is to consider queueing problems of allocating position in a queue to agents each of whom has a constant unit waiting cost with monetary transfers. Result shows that it is difficult find such conditions that are reasonable in the economic sense.

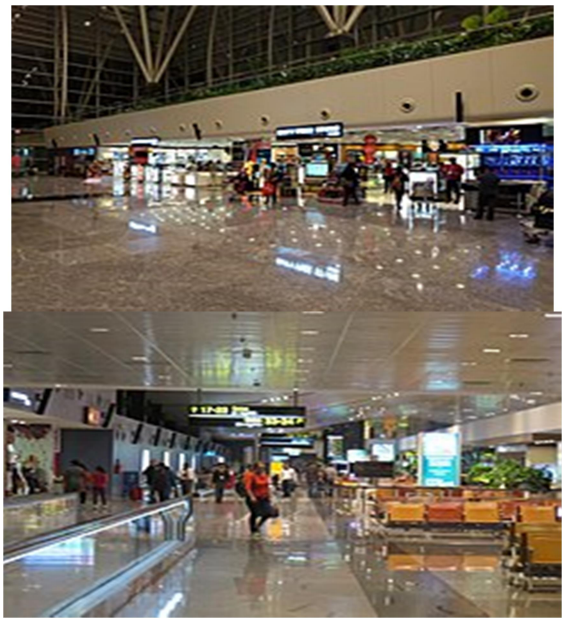
(ii) Approximate Analysis of an M/M/1 Markovian Queue Using Unit Step Function Dhanesh Garg Department of Mathematics, Maharishi Markandeshwar University, Ambala, India. In this article the incoming arrivals are Poisson stream; service time is exponentially distributed and the first-come first-served queueing discipline presented. the transient behaviour of the M/M/1 queue is very important for practical applications in this paper they obtained the analytic transient solution of M/M/1/N queuing system with a time-dependent arrival rate.

Kempe Gowda International Airport, Bangalore

Kempe Gowda International Airport (IATA: BLR, ICAO: VOBL) (commonly known as Bangalore Airport) is an international airport serving the Indian city of Bangalore. It is located at Devanahalli about 30 kilometres (19 mi) from the Bangalore City Railway Station and covers 4,700 acres (1,900 ha). (16)https:/www indiaairport.com

History

Before Kempe Gowda International Airport Opened in 2008, Bangalore had a smaller airport, Known as HAL Airport. The previous airport gets its name from the Hindustan Aeronautics Limited (HAL), a state -owned aerospace and defence company The airport was constructed in 1940 by the founder of HAL, who used the airport as a manufacturing and testing site for military aircraft By 2005, the airport was servicing multiple international carriers, such as Lufthansa, British Airways, and Air France. However, the airport only had a single runway and limited parking space, with only six aircraft aprons. Seeing the exponential rise of traffic at the single-runway HAL Airport, the government moved to begin construction on a new major airport for Bangalore in 2005. The new hub was originally named Bangalore International Airport, before being officially renamed to Kempe Gowda International Airport in 2013 to honour the Founder of the city. The new airport had a single terminal and runway, but with space to build one more, and could accommodate up to 25 million Passengers.



Quick Facts About Kempe Gowda International Airport1.

1. Architectural Wonder- Bangalore Airport Terminal 2A terminal in a garden, environmental and ecological stewardship and a celebration of Karnataka`s rich and culture are the pillars of A terminal in a garden, environmental and ecological stewardship and a celebration of Karnataka`s rich heritage and culture are the pillars of the project. With the use of 100% renewable energy, the airport has already set a standard.

2. Hanging Garden Terminal - Designed as a tribute to Bangalore's Garden city, Terminal 2 offers travellers a "walk in the garden" experience. Unique in its kind. It will be a sight to behold, unlike anything else in the world, for it will be both inside and out covered in greenery. Passengers will have access to nature through passageways located throughout the airport. Bells will dangle from the ceiling in the entrance, check-in, and security areas.

3. Celebration of Karnataka's Art and Culture - The goal is to give visitors a genuine understanding of our state and nation. As a passenger travels through Bangalore airport terminal 2, art has the incredible power to delight them and add a touch of enchantment to usual routine process of boarding a plane.

4. Statue of prosperity - On the premises of Bengaluru International Airport stands a 108-foot bronze statue of Bengaluru founder Nada Prabhu Kempe Gowda. The statue of prosperity is constructed as a tribute to Kempe Gowda`s contribution to the growth of the city.

5. Bangalore Airport Terminal 2 Features - 22 entry and exit gates, 5,932 gate lounge seating, 95 check-in bays, 17 security check lanes, Departure immigration – 30 conventionally manned, ten e-gates, Arrival immigration – 34 conventional, six e-gates, 20 visas on- arrival bays and Nine baggage claim belts. (104)

SERVICES & FACILITIES:

Bangalore International Airport Terminal Information & Facilities

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Bangalore International Airport Terminal Information & Facilities

Bangalore International Airport also termed Kempe Gowda International Airport is located about 30 kilometres north of the city near the suburb of Devanahalli in Karnataka. Operated and owned by BIAL (Bengaluru International Airport Limited) it is the 29th busiest airport in Asia.

Spread over an area of 4,000 acres, it is the 3rd-busiest airport by passenger traffic, air traffic movements, and domestic and total cargo handled in India after Mumbai and Delhi Airport.

Airport Facilities:

ATMs / Cash Machines : If you require some cash then don't worry there are plenty of options available at the airport.

Currency Exchange: there are currency exchange services available in the Arrivals Area, Departures Area, and Airside of both International and Domestic Departures.

Baby Care Facility: Families with the child can utilize the baby care room for breastfeeding and diaper-changing.

WIFI: Wi-Fi at Kempe Gowda International can only be accessed if you have an Indian cell phone number. You have to register and once you're registered,

Charging Stations: Power stations with eight outlets are located at every gate for the ease of travellers.

Food & Beverages: Food concessions are available throughout the airport operating at varying schedules. 24 hours open options are19) https:// fantasticfare.com

There are plenty of options such as Aubree, Barley & Grape Café, Belgian Fries Company, Cafe Coffee Day,

Domestic Terminal, Airside: Here you will find Fresh & Healthy, Krispy Kreme, Puro Gusto, and Tata Cha.

International Terminal, Airside:

Table 1: Kempe Gowda International Airport, Bangalore

Year	International Sector	Domestic Sector	Total	% Growth
2010	2.2	9.4	11.6	16.6
2011	2.4	10.3	12.7	9.6
2012	2.5	9.5	12.0	-5.5
2013	2.6	10.2	12.9	7.3

2014	2.9	12.5	15.4	19.7
2015	3.4	15.6	19.0	23.2
2016	3.6	19.3	22.9	20.6
2017	3.1	23	26	17
2018	3.3	22	25	16

Air lines	Flight no	Origin	Time	Terminal	Approximate Passengers
Jal Japan Airlines	JL 753	Tokyo	00:15	T1	182
Vistara	UK2075	Tokyo	00:15	T1	180
Sri Lankan Airlines	UL 3346	Tokyo	00:15	T1	303
Lufthansa	LH 754	Frankfurt	01:25	T1	364
Air Canada	AC9056	Frankfurt	01:25	T1	364
Air India	AI8754	Frankfurt	01:25	T1	145
SAS Scandinavian Airlines	SK 3234	Frankfurt	01:25	T1	306
Qatar Airways	QR572	Doha	02:25	T1	311
Indigo	6E1302	Doha	02:40	T1	186
Qatar Airways	QR4786	DOHA	02:40	T1	311
Emirates	EK568	Dubai	02:45	T1	489
Etihad Airways	EY216	Abu Dhabi	03:15	T1	174
Flynas	XY3216	Abu Dhabi	03:15	T1	198
Indigo	6E1486	Dubai	04:10	T1	186
Indigo	6E1006	Singapore	07:20	T1	186
Emirates	EK564	Dubai	08:55	T1	354
Indigo	6E1168	Colombo	16:05	T1	180
Indigo	6E1128	Male	18:15	T1	186
Emirates	EK566	Dubai	19:20	T1	361
Etihad Airways	Ey 238	Abu Dhabi	19:40	T1	174
Fly nas	XY3236	Abu Dhabi	19:40	T1	198
Singapore Air lines	SQ510	Singapore	21:50	T1	303
ANA All Nippon Airways	NH6280	Singapore	21:50	T1	303
Air New Zealand	NZ3208	Singapore	21:50	T1	200
Thai Air Asia	Fd137	Bangkok	22:40	T1	186
Thai Airways International	TG325	Bangkok	23:25	T1	321
ANA All Nippon Airways	Nh5957	Bangkok	23:25	T1	309
Air France	AF194	Paris	23:30	T1	223
Delta Airlines	DL8461	Paris	23:30	T1	129
KLM Royal Dutch Airlines	KL2288	Paris	23:30	T1	208
Milesians Airlines	MH192	Kuala Lumpur	23:40	T1	166
JAL JAPAN AIRLINES	JL7945	Kuala Lumpur	23:40	T1	256

Table shows Above Passengers data of Kempe Gowda international Airport Date 27/06/2023data collected by https://delhiairport.com. There are near about 50 international flights in a day on 27/06/2023 by this we can predict approximate flight per day at Indira Gandhi International Airport. Many international flights are connected with international Indira Gandhi Airport. Total passenger is 7944 Approx. If we divide a whole day in four parts of the day (i)00:00hr to 06:00hr passenger count is 3701. (ii)06:00hr to 12:00hr passenger count is 540(iii)12:00hr to 18:00hr passenger count is 180(iv) 18:00hr to 24:00hr passenger count is 3523It is observed that passenger count is different by this data we observe that in these four parts of the day there are differences between no of passengers.

4a Scenario for Immigration Process for Kempe Gowda international Airport

Time	Total Passengers	Passenger Arrival/minut	Average Arrival Rate(λ)	Average Service rate	Passenger Serve/6h (μ)	No of server	Server Utility (λ/μ)
00:00-06:00	3701	10.28	35.01	07m/p	51.4	17	0.62
06:00-12:00	540	1.5	240	07m/p	51.4	17	4.66
12:00-18:00	180	0.5	720	07m/p	51.4	17	14.00
18:00-24:00	3523	9.78	36.80	07m/p	51.4	17	0.71

4bProposed solutions for Immigration Process for Kempe Gowda International Airport.

Time	Total Passenger	Arrival Rate	Service rate	No of server required	Server Utilization	Queue Length in Line (L)	System Queue Length (q)	WaitTime in Line (Lq)	Wait time in line (lq)	Probability all server ideal	Efficiency
00:00-06:00	3701	10.281	51.4	02	0.62	0.202	0.019	0.002	0.00	0.818	0.100
06:00-12:00	540	1.5	51.4	02	4.66	0.029	0.019	6.21	4.24	0.97	0.01
12:00-1800	180	0.5	51.4	02	14.00	0.00	0.019	2.3	4.6	0.99	0.004
18:00-24:00	3523	9.78	51.4	02	0.71	0.192	0.019	0.001	0.00	0.82	0.095

CONCLUSION

We have developed the queueing model under Heavy traffic environment and made its intensive studies. The Immigration process in a country like India is complex process. One of the main reasons is heavy population load. Almost various performance measures obtained have been have been tabular form. We have made optimisation of indistinct queueing systems for its optimal number of servers with respect to minimization of time consumption of traveller. The entire process becomes faster.

A cost examination must be done in order to determine the cost practicability of increasing the number of servers during peak times.

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