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Application of Motorcycle Service Queuing Models and Simulations in Aur Kuning

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Abstract

Queue simulation is important for analyzing and optimizing service processes in various fields such as bank counter queue services, gas station vehicle queues, vehicle queues in parking lots including motorcycle repair shop service queues. In this case, the research objective is to propose the application of queuing simulation to identify and improve service efficiency in motorcycle maintenance workshops. With the right simulation model, we can analyze various aspects of motorcycle workshop operations, from customer waiting time to efficient resource utilization. This research investigates the use of queuing simulation in motorcycle repair shops, focusing on identifying and addressing potential bottlenecks in the service process. By collecting sample data from 30 incoming vehicles split over three days, we created a representative simulation model for a motorcycle repair shop. With the results of this simulation can help workshop owners in overcoming or getting a solution to the problem of motorcycle queues, this case study will contribute so that there is a change to the effectiveness of motorcycle workshops in the queue by developing the results of this article, keyword model, simulation, queue, motorcycle.

Abstrak

Simulasi antrian penting untuk menganalisis dan mengoptimalkan proses pelayanan di berbagai bidang seperti layanan antrian loket bank, antrian kendaraan SPBU, antrian kendaraan di tempat parkir termasuk antrian layanan bengkel sepeda motor. Dalam hal ini tujuan penelitian adalah mengusulkan penerapan simulasi antrian untuk mengidentifikasi dan meningkatkan efisiensi pelayanan di bengkel perawatan motor. Dengan model simulasi yang tepat, kita dapat menganalisis berbagai aspek operasional bengkel sepeda motor, mulai dari waktu tunggu pelanggan hingga pemanfaatan sumber daya yang efisien. Penelitian ini menyelidiki penggunaan simulasi antrian di bengkel sepeda motor, dengan fokus untuk mengidentifikasi dan mengatasi potensi kemacetan dalam proses pelayanan. Dengan mengumpulkan data sampel dari kendaraan yang masuk sebanyak 30 yang kami bagi dalam tiga hari, kami membuat model simulasi yang representatif untuk bengkel sepeda motor. Dengan Hasil simulasi ini dapat membantu pemilik bengkel dalam mengatasi atau mendapatkan solusi mengenai permasalahan akan antrian sepeda motor, studi kasus ini akan berkontribusi sehingga terdapat perubahan ke efektivisan bengkel sepeda motor dalam antrian dengan mengembangkan hasil dari artikel ini, kata kunci model, simulasi, antrian ,sepeda motor.

INTRODUCTION (Tahoma 10, Bold, Line Spacing 1**.**15)

A good company is a company that always maintains its quality. Company quality can be measured in various ways. Service can be used as a measure of the quality of a company or agency. In the service process there will be a queue. If a company has a poor queuing system, it will cause fewer customers, a bad company image, reduced revenue, and others.

In today's world, where mobility has become an integral part of daily life, motorcycle repair services play an important role in ensuring that your vehicle continues to operate in optimal

condition. With the increase in electric vehicles, especially motorcycles, motorcycle repair shops are at the forefront of ensuring the smooth operation of vehicles and the safety of road users. One of the biggest challenges that motorcycle repair shops face is managing customer queues. Long waiting times can lead to customer dissatisfaction and affect the operational efficiency of the workplace.

Motorcycle workshop services are one of the companies in the field of repair services that are in great demand today, especially for motorized vehicle users who are engaged in maintaining their motorized vehicles. The motorcycle repair service business is now increasingly competing due to the wider need for motorcycle repair services. Motorcycle repair services for various brands often face challenges in the form of customer complaints regarding the average duration of service by mechanics. This can lead to long queues and is a major concern in maintaining customer satisfaction.

To maintain customer satisfaction, motorcycle service workshops must ensure that they can provide the best service to customers, as well as timely and best service results, the convenience of customers bringing motorbikes to the workshop to picking up motorbikes. According to Saraswati & Hendikawati (in Yanti, Rila Fitri. 2023: 2). Fast service really helps retain customers which of course increases workshop profits in the long run. As stated by Faizal (2005), 'Queues that are very long and too long are of course detrimental to those who need service, because a lot of time is wasted while waiting. In addition, the service provider indirectly also suffers losses, because it will reduce work efficiency, little profit, and will even create an unfavorable image to its customers. One of the reasons that causes long queues in this workshop is the queue that occurs when the customer's motorbike is being serviced. The influx of many customers causes a long queue time and causes the queuing time to be long.

Simulation comes from the word simulate which means to pretend or do as if. As a teaching method, simulation can be interpreted as a way of presenting learning experiences by using artificial situations to understand certain concepts, principles, or skills. Simulation has an important role in modeling and in analyzing activities, because it allows quantitative estimates and can affect the design process on system performance (Mojca Indihar Stemberger, 2001). Simulation is a useful tool for analyzing complex systems where we cannot use standard methods in operational research (Tomas Domonkos, 2010). Simulation is a computer program (soware) that functions to mimic the behavior of certain real systems (reality). The purpose of simulation is training, study of system behavior, entertainment or games. Modeling and simulation is one of the tools often used by management in studying or analyzing the work behavior of a system or process.

Service in the Big Indonesian Dictionary is an activity that helps prepare or take care of what others will need. Service is also an activity or sequence of activities that are invisible or invisible that occur with the relationship between customers and business owners or workers in a company provided by the company in helping or serving customers and solving problems from customer desires.

Queuing is an activity of waiting for your turn to be served. Queuing activities arise because the number of service facilities is less than the number of people who need the service concerned. People are forced to queue to fulfill their needs. Queuing is an activity where several people line up or wait at a service facility then are served, and finally leave the facility after being served to fulfill something they want. Queues occur when a group of people, components, or machines must wait in a certain order to get service. This condition arises when the available service capacity is unable to meet existing service needs. Queuing occurs when the processing time is greater than the time between arrivals. Queuing is also an activity that we always encounter every day in everyday life, the queuing system includes customers who come with a fixed and varied speed in order to get the service needed.

Service is an action or decision to be offered by a party to another party who needs the service, which is basically invisible and does not result in ownership and its production may or may not be associated with a physical product. Queuing systems include customers who come at a constant or variable rate to get service at a service facility. If an incoming customer can enter the service facility, the customer can be served immediately. (Antono, in Aji and boadrastuti).

This article discusses the model and simulation of queues at one of the motorcycle services. Here we explain how the basic concepts of queuing and the benefits of using simulation models in improving the performance of motorcycle vehicle inspection and maintenance services. First we need to know the basic concepts of queuing so that we can minimize the risk of errors that will occur when we process data obtained directly or real-time using the queue simulation method.

The results of this article have the aim of finding alternative solutions to queuing problems at motorcycle workshops, and it is hoped that readers will understand the importance of modeling and simulating motorcycle maintenance queues. With this, it can also improve service management in motorcycle maintenance queues so that it has a significant impact so that customers get satisfaction in visiting this motorcycle workshop.

METHODS

This research was conducted at one of the motorcycle service workshops located in Aur Kuning. The object of the research is workshop customers who queue to get motorcycle service services, which greatly affects customer satisfaction and the quality of service provided by the workshop.

Data collection is done by making observations to the workshop in groups. The data we take or obtain is the time the customer is served, the service time of the service and the time the customer is served, and the equipment used is a cellphone to calculate the length of the queue and documentation.

The subjects observed were customers of the workshop who were queuing for motorcycle services. The data sample taken in this study amounted to 30 motorcycles. Then the data is processed manually using a queue simulation model that is done in groups.

Limitations and assumptions in this study:

1. The data obtained is motorcycle maintenance queue data
2. Observations were made for 3 days due to time constraints
3. Assumption that no customers cancel the queue

RESULT AND DISCUSSION

RESULT

The queue data in table 1.1 is obtained on Friday, May 17, 2024 based on recording the time distance of the arrival of the first and second motorcycles, then the second and third motorcycles and so on until the arrival of the 11th motorcycle.

Table 1.1 Queuing data (Friday)

Motor ke	Plate	Arrival Time	Arrival Distance
1	BA 5489 LA	14.13 - 14.35	13 menit
2	BA 2348 ND	14.18 - 14.25	5 menit
3	BM 3125 DAB	14.24 - 14.39	6 menit
4	BA 3628 LG	14.30 - 15.00	6 menit
5	BA 4781 LP	14.35 - 15.55	5 menit
6	BA 4765 LI	14.39 – 16.16	4 menit

7	BA 4469 CA	14.40 - 14.54	1 menit
8	BA 2267 EL	14.41 - 15.19	1 menit
9	D 3397 TB	14.45 - 15.03	4 menit
10	BA 3447 XA	14.50- 15.06	5 menit
11	BA 3391 LI	15.06-15.38	16 menit

By summing up the total arrival distance on Friday, the result is 66 which is then divided by the number of samples, which results in 6 which is the formula for finding the IAT value by entering into the formula -x ln (Ri), namely -6 ln (Ri).

The queue data in table 1.2 is obtained on Saturday, May 18, 2024 based on recording the time distance of the arrival of the first and second motorbikes, then the second and third motorbikes and so on until the arrival of the 10th motorbike.

Table 1.2 Queuing data (Saturday)

Motor ke	Plate	Arrival Time	Arrival Distance
12	BA 2869 LO	13.30-16.03	30
13	BA 3128 XC	13.36-15.16	6
14	BA 2874 LE	13.38-14.30	2
15	BA 6402 BJ	14.12-15.05	25
16	BA 3700 LE	14.20-15.34	8
17	BA 4778 LAB	14.46-15.43	26
18	BA 3212 LU	15.07-15.26	23
19	BA 6504 TZ	15.17-16.41	10
20	BA 6147 AAT	15.31-15.39	19
21	BA 2959 XA	15.42-16.46	18

By summing up the total arrival distance on Friday, the result is 167 which is then divided by the number of samples, which results in 16.7 which is the formula for finding the IAT value by entering into the formula -x ln (Ri), namely -16.7 ln (Ri).

The queue data in table 1.3 is obtained on Thursday, May 23, 2024 based on recording the time distance of the arrival of the first and second motorbikes, then the second and third motorbikes and so on until the arrival of the 9th motorbike.

Table 1.3 Queuing data (Thursday)

Motor ke	Plate	Arrival Time	Arrival Distance
22	Ba 3081 lw	11.05 - 12.24	5
23	Ba 2901 HB	11.07- 12.20	2
24	Ba 6002 AV	11.15- 12.45	8
25	Ba 2564 LA	11.27- 11.49	12
26	Ba 5505 LN	11.30- 12.32	3
27	Ba 3248 TU	11.32-12.45	2
28	Ba 2459 LJ	11.35- 12.25	3
29	Bm 4231 YN	11.50- 13.10	15
30	Ba 6026 NA	12.30- 13.45	40

By summing up the total arrival distance on Friday, the result is 90 which is then divided by the number of samples, which results in 10 which is the formula for finding the IAT value by entering into the formula -x ln (Ri), namely -10 ln (Ri).

Service data in table 2.1 is obtained on Friday, May 17, 2024 through the length of time waiting for the service time contained in the queue table, how to calculate it is by subtracting from the time the motorcycle arrives until the motorcycle leaves.

Table 2.1 Service duration data (Friday)

Motor ke	Plate	Duration of Service (minutes)
1	BA 5489 LA	22 menit
2	BA 2348 ND	7 menit
3	BM 3125 DAB	15 menit
4	BA 3628 LG	30 menit
5	BA 4781 LP	90 menit
6	BA 4765 LI	95 menit
7	BA 4469 CA	14 menit
8	BA 2267 EL	40 menit
9	D 3397 TB	18 menit
10	BA 3447 XA	16 menit
11	BA 3391 LI	27 menit

By summing up the total arrival distance on Friday, the result is 374 which is then divided by the number of samples, which results in 34 which is the formula for finding the IAT value by entering into the formula -x ln(Ri), namely -34 ln(Ri).

Service data in table 2.2 is obtained on Saturday, May 18, 2024 through the length of time waiting for the service time contained in the queue table, how to calculate it is by subtracting from the time the motorcycle arrives until the motorcycle leaves.

Table 2.2 Service duration data (Saturday)

Motor ke	Plate	Duration of Service (minutes)
12	BA 2869 LO	183 menit
13	BA 3128 XC	122 menit
14	BA 2874 LE	68 menit
15	BA 6402 BJ	57 menit
16	BA 3700 LE	74 menit
17	BA 4778 LAB	59 menit
18	BA 3212 LU	19 menit
19	BA 6504 TZ	78 menit
20	BA 6147 AAT	8 menit
21	BA 2959 XA	63 menit

By summing up the total arrival distance on Friday, the result is 731 which is then divided by the number of samples, which results in 73.1 which is the formula for finding the IAT value by entering into the formula -x ln(Ri), namely -73.1 ln(Ri).

This Service data was obtained on Thursday, May 23, 2024 through the length of time waiting for the service time contained in the queue table, how to calculate it is by subtracting from the time the motorcycle arrives until the motorcycle leaves.

Table 2.3 Service duration data (Thursday)

Motor Ke	Plat	Duration of Service (minutes)
22	Ba 3081 lw	89 menit
23	Ba 2901 HB	87 menit
24	Ba 6002 AV	90 menit
25	Ba 2564 LA	31 menit
26	Ba 5505 LN	62 menit
27	Ba 3248 TU	77 menit
28	Ba 2459 LJ	50 menit
29	Bm 4231 YN	60 menit
30	Ba 6026 NA	75 menit

By summing up the total arrival distance on Friday, the result is 621 which is then divided by the number of samples, which results in 69 which is the formula for finding the IAT value by entering into the formula -x ln(Ri), namely -69 ln(Ri).

Based on the queue data table and the service length table, we can use it to find a calculation table using a random number obtained using the multiplicative RNG formula with the equation z0 = 12357 a = 43 and modulo m = 1237 which results in an RNG value according to table 3.1.

Tabel 3.1 Random Number Generator

NO	Ri
1	R1 = 0,5481
2	R2 = 0,5683
3	R3 = 0,4373
4	R4 = 0,8059
5	R5 = 0,6572
6	R6 = 0,2611
7	R7 = 0,2279
8	R8 = 0,8027
9	R9 = 0,5181
10	R10 = 0,2821
11	R11 = 0,1317
12	R12 = 0,6661
13	R13 = 0,6434

14	R14 = 0,6741
15	R15 = 0,8172
16	R16 = 0,1438
17	R17 = 0,1875
18	R18 = 0,0646
19	R19 = 0,7809
20	R20 = 0,5796
21	R21 = 0,9240
22	R22 = 0,7324
23	R23 = 0,4939
24	R24 = 0,2392
25	R25 = 0,2894
26	R26 = 0,4446
27	R27 = 0,1188
28	R28 = 0,1095
29	R29 = 0,7275
30	R30 = 0,2853

Here the author will explain the parts contained in the data calculation table or table 3 as follows:

1. Intern Arival Time (IAT)

Is the time between the arrival of the first motor with the second and so on. To get the IAT results we need the value of ln (Ri) which is in the queue data table with the random number that has been obtained.

2. Arival Time (AT)

In the queue simulation model refers to the time at which each entity arrives or enters the queue. By calculating the sum between the initial arrival and the next one until completion.

3. Service Time (ST)

Is the duration of time required to serve or respond to a vehicle from the start time to the finish time. By calculating the ln(Ri) value in the service length data table with the random number that has been obtained.

4. Intro Time Service (ITS)

In the simulation model the queue is the time interval between the arrival of two consecutive customers. In finding the ITS value using the method, for the first ITS value the first row AT value plus the first row ST value. For the second ITS value the first ITS value plus the second line ST value and so on.

5. Queueing Time(QT)

Refers to the period of time spent by customers in the queue before being served. To get the QT value for the first value is 0 because the customer is served first, for the second QT value by means of the first row ITS value minus the second row AT value.

6. SP Idle Time (IT)

Refers to the period of time when workers have free time because there is no demand to be served. The IT value is searched by looking at QT if the value contains it means that the IT time is 0 while the QT time is 0 then IT is worth the value of the first line AT.

7. System Time (St)

Refers to the simulation time that continues to run and is used to organize various events in the simulation. The St value is searched by the first row ITS value minus the first row AT value resulting in the first St value, the second row ITS value minus the second row AT value resulting in the second St value and so on.

For the calculation value of the queuing system, the author will explain the following parts:

1. Avarage Queueing Time = Rata- rata waktu dalam antrean (AQT)

Average Queueing Time (AQT) is a value that indicates how long, on average, a data or item spends in the queue.

2. Average Sistem Process Time = Rata- rata waktu proses (Ws)

Average time in system is a value that shows how long, on average, a data or item spends in the system, including time in queue and service time.

3. Average Queue Length = Rata- rata Panjang antrian

Average Queue Length is a value that indicates how many items or data are, on average, in the queue at any given time.

4. Average Number in The System = Rata- rata jumlah unit dalam sistem

Average number of units in a system is a value that indicates how many units or items are, on average, in the system at any given time.

5. Service Point Idle Time = Lama istirahat

Rest time or idle time refers to the period during which a service is inactive or unused. To calculate the percentage of this idle time, it is used.

DISCUSSION

Here we show the results of the calculation of queue data that we have processed the previous data in the table below.

Table 4.1 Queuing data calculation (Friday)

arrival no	intern arrival time	arrival time	service time	intro time service	queueing time	SP idle time	system time
1	3.6077	3.6077	20.4441	24.0518	0	3.6077	20.4441
2	3.3906	6.9983	19.2135	43.2653	17.0535	0	36.267
3	4.9655	11.9638	28.1226	71.3879	31.3015	0	59.4241
4	1.2947	13.2585	7.337	78.7249	58.1294	0	65.4664
5	2.5186	15.7771	14.272	92.9969	62.9478	0	77.2198
6	8.0571	23.8342	45.6569	138.6538	69.1627	0	114.8196
7	8.873	32.7072	50.2808	188.9346	105.9466	0	156.2274

8	1.3186	34.0258	7.4723	196.4069	154.9088	0	162.3811
9	3.9455	37.9713	22.3579	218.7648	158.4356	0	180.7935
10	7.5929	45.5642	43.0267	261.7915	173.2006	0	216.2273
11	12.1633	57.7275	68.9257	330.7172	204.064	0	272.9897

The calculation of this queuing system will be estimated with the following results:

a. Average Queueing Time = Rata- rata waktu dalam antrean (AQT)
   AQT = (Quenty Time) / (Banyak Data) = 1035.15 / (11) = 94,1046 minute
b. Average Sistem Process Time = Rata- rata waktu proses (Ws)
   Ws = (Total Sytem Time) / (Banyak Data) = (1362.26) / (11) = 123,842 minute
c. Average Queue Length = Rata- rata Panjang antrian
   Lq = (Total Queueing Time) / (Total Time) = (1035.35) / (330.717) = 3,13002 minute
d. Average Number in The System = Rata- rata jumlah unit dalam sistem
   Lq = (Sytem Time) / (Total Time) = (1362.26) / (330.717) = 4,11911 minute
e. Service Point Idle Time = Lama istirahat
   R.I.T = (Total SP Idle) / (Total Time) = (3,6077) / (330.717) = 0,01091 minute

From the results of the above calculations on Friday, it is obtained that the average time in the queue is 94.10 minutes or about ± 1.5 hours and the process time is around 123.8 or about ± 2 hours and a break time of 0.01 minutes.

Table 4.2 Queuing data calculation (Saturday)

Arrival no	IAT	arrival time	service time	intro time service	queueing time	SP idle time	system time
1	6.7854	6.7854	29.7016	36.487	0	6.7854	29.7016
2	7.3645	14.1499	32.2362	68.7232	22.3371	0	54.5733
3	6.586	20.7359	28.2889	97.0121	47.9873	0	76.2762
4	3.3714	24.1073	14.7568	111.7689	72.9048	0	87.6616
5	32.3868	56.4941	141.7651	253.534	55.2748	0	197.0399
6	27.9554	84.4495	122.3676	375.9016	169.0845	0	291.4521
7	45.7503	130.1998	200.2604	576.162	245.7018	0	445.9622
8	4.13	134.3298	18.0782	594.2402	441.8322	0	459.9104
9	9.1084	143.4382	39.8699	634.1101	450.802	0	490.6719
10	1.32	144.7582	5.778	639.8881	489.3519	0	495.1299

The calculation of this queuing system will be estimated with the following results:

a. Average Queueing Time = Rata- rata waktu dalam antrean (AQT)
   AQT = (Quenty Time) / (Banyak Data) = (1995.28) / (10) = 199,528 minute
b. Average Sistem Process Time = Rata- rata waktu proses (Ws)
   Ws = (Total Sytem Time) / (Banyak Data) = (2628.38) / (10) = 262,838 minute
c. Average Queue Length = Rata- rata Panjang antrian
   Lq = (Total Queueing Time) / (Total Time) = (1995.28) / (639.888) = 3,11816 minute
d. Average Number in The System = Rata- rata jumlah unit dalam sistem
   Lq = (Sytem Time) / (Total Time) = (2628,38) / (639.888) = 4,10756 minute
e. Service Point Idle Time = Lama istirahat

R.I.T = (Total SP Idle) / (Total Time) = (6.7854) / (639.888) = 0,0106 minute

Based on the above calculations, it is concluded that on Saturdays the average length of time in the queue is 199.53 minutes or about ± 3.3 hours and the average length of process time is 262.84 minutes ± or about 4.3 hours and the rest time is 0.01 minutes.

Table 4.3 P Queuing data calculation (Thursday)

arrival no	IAT	arrival time	service time	intro time service	queueing time	SP idle time	system time
1	3.1142	3.1142	21.4885	24.6027	0	3.1142	21.4885
2	7.0542	10.1684	48.6741	73.2768	14.4343	0	63.1084
3	14.3045	24.4729	98.7014	171.9782	48.8039	0	147.5053
4	12.3994	36.8723	85.5562	257.5344	135.1059	0	220.6621
5	8.1058	44.9781	55.93	313.4644	212.5563	0	268.4863
6	21.3031	66.2812	146.9916	460.456	247.1832	0	394.1748
7	22.1183	88.3995	152.6163	613.0723	372.0565	0	524.6728
8	3.1814	91.5809	21.9517	635.024	521.4914	0	543.4431
9	12.5421	104.123	86.5407	721.5647	530.901	0	617.4417

The calculation of this queuing system will be estimated with the following results:

a. Average Queueing Time = Rata- rata waktu dalam antrean (AQT)
   AQT = (Quenty Time) / (Banyak Data) = (2082.53) / (9) = 231,393 minute
b. Average Sistem Process Time = Rata- rata waktu proses (Ws)
   Ws = (Total Sytem Time) / (Banyak Data) = (2800.98) / (9) = 311,22 minute
c. Average Queue Length = Rata- rata Panjang antrian
   Lq = (Total Queueing Time) / (Total Time) = (2082.53) / (721.565) = 2,88613 minute
d. Average Number in The System = Rata- rata jumlah unit dalam system
   Lq = (Sytem Time) / (Total Time) = (2800.98) / (721.565) = 3,88182 minute
e. Service Point Idle Time = Lama istirahat
   R.I.T = (Total SP Idle) / (Total Time) = (5) / (626) = 0,00432 minute

Based on the above calculations, it is concluded that on Saturday the average length of time in the queue is 231.39 minutes or about ± 3.8 hours and the average length of process time is 311.22 minutes ± or about 5.1 hours and the rest time is 0.004 minutes.

KESIMPULAN

The results of the analysis from using this queue simulation can be seen the length of the queue in motorcycle service, our suggestions for improvement might be done by adding mechanics in the service or imposing queue limits in a day of work. In this simulation we made observations to one of the motorcycle services in Aur kuning to get sample data. We also took documentation as evidence of direct observation of the field which we started on 17-18 and continued on May 23. In completing this research we used the queue data table, we manipulated and calculated to get the results of the calculation table.

Based on the author's calculations in observations made in three days at different times and the number of different vehicle samples, the longest time in this motor vehicle service activity was on Thursday, May 23, 2024 with a queue time of about ± 3.8 hours and a service process time of about ± 5.1 hours in one sampling observation.

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