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**SIMULATION OF SHIPPING SYSTEM OF
SHOPEE**

**SIMULATION MODELS IN INDUSTRIAL
ENGINEERING**

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Table of Contents

CHAPTER 1: INTRODUCTION	1
1.1 Problem Statement	1
1.2 Objectives	2
1.3 Scope and Limitations	3
CHAPTER 2: SIMULATION MODELING OF THE CURRENT SYSTEM	4
2.1 Conceptual model	4
2.2 Data collection and Input modeling	5
2.2.2 Fast and Economical delivery	6
2.2.3 Express delivery	11
2.3 ARENA model	13
CHAPTER 3: VALIDATION	24
3.1 Type II error	24
3.2 The hypothesis testing	24
3.3 Confidence interval testing	25
CHAPTER 4: OUTPUT ANALYSIS OF CURRENT SYSTEM PERFORMANCE	26
4.1 Point estimation	26
4.2 Confidence – Interval Estimation	26
CHAPTER 5: EXPERIMENTATION	27
5.1 Adjustment Shipper of Fast (or Economic) delivery	27
5.2 Adjustment Shipper of Express delivery	27
5.3 Suggestion scenario	28
CHAPTER 6: CONCLUSION	31
6.1 Conclusion	31
6.2 Recommendation	31
APPENDIX	33

CHAPTER 1: INTRODUCTION

1.1 Problem Statement

A simulation is the reflection of the movement of a process or system in the real world over time. Simulations need the application of models; the model performs the main features or styles of the chosen system or process, while the simulation changes the model over time. More practically, simulation can be used to forecast (predict) the future behavior of a system and find out what can do to affect that future behavior.

Hence, the purpose of this project indicates how we apply all the theories that we have learned to reality. And in our case, we demonstrate the operation of a delivery system whose name is Shopee. According to the application of simulation – Arena app, we simulate how the system operates based on the foundation of the processing time of purchase orders. In the results, we can give the conclusion about the situation of Shopee's delivery system and give improvements to bring the most benefits for the store.

To optimize the service, utilization of labor, and decrease waiting time, the improvements have been struggling for years. Many alternatives have been raised, but to reach the final decision, a simulated model needs to be run to test whether the given solution is going to return the expected result. In this report, we chose to simulate and solve the problem of domestic delivery systems in specific. We tried to suggest some possible alternatives to improve the service and work efficiency, optimizing labor usage. We built a conceptual model and also arena models for the accurate model and alternatives. To test whether the arena model is fit and built correctly, we used some tests to check the validation and verification. In addition to giving the conclusion, we also have some suggestions for Shopee to optimize the model.

1.2 Objectives

The primary objective of this project is to conduct an in-depth and rigorous assessment of Shopee's domestic delivery system, with the overarching goal of identifying and recommending strategies that can effectively minimize waiting time, enhance customer satisfaction, and optimize processing time. A critical challenge in this endeavor arises from the absence of precise information on the exact number of shippers available for the system. Consequently, to overcome this limitation and provide accurate recommendations, it becomes imperative to employ simulation modeling using the Arena software.

By leveraging the power of simulation, we can create a virtual representation of Shopee's domestic delivery system that closely resembles real-world operational dynamics. This allows us to simulate various scenarios and evaluate the impact of different factors on the system's performance. However, to ensure the fidelity of the simulation results, it becomes necessary to make reasonable assumptions regarding the number of resources, specifically the shippers, within the Arena model. These assumptions are carefully formulated based on industry standards, expert knowledge, and available data on the company's operations.

The estimation of the number of resources, such as shippers, is a critical aspect of this project. It necessitates a meticulous analysis of historical data, market trends, and operational requirements. By leveraging relevant statistical techniques and considering factors such as order volume, delivery locations, and peak demand periods, we aim to arrive at a resource estimation that closely approximates the actual number of shippers in the system. This estimation is crucial for ensuring the accuracy and reliability of the simulation results, as it allows us to optimize customer waiting time while maintaining operational efficiency.

Once the simulation model is appropriately calibrated with the estimated number of shippers, we can proceed with the comprehensive assessment of Shopee's domestic delivery system. This assessment involves analyzing the sequence of activities, evaluating the existing layout, and identifying potential areas for improvement. Through rigorous experimentation and sensitivity analysis, we can identify the most effective strategies to reduce waiting time, enhance customer satisfaction, and streamline processing time.

In conclusion, this project aims to provide valuable insights into Shopee's domestic delivery system by conducting a thorough evaluation and proposing optimal strategies. Despite the challenge posed by the unavailability of precise data on the number of shippers, we will employ simulation modeling and resource estimation techniques to optimize the waiting time of customers.

1.3 Scope and Limitations

This paper's scope is limited to 147 shipment orders of Shopee to evaluate their general delivery network between the sellers and the end customers. The simulation of this network will be conducted in 1 to 2 weeks to perform the sample size of Shopee delivery. Therefore, a determination of each factor such as arrival time, processing time, customer satisfaction, and the number of order dispositions will be considered to give evaluation and how to improve their system by changing at least 1 variable to see how significant that factor affects the total network. However, the limitation of this paper cannot give the most precise and accurate to match the practical case since the total network of Shopee is more complicated than the simulation model. The various obstacles are the policy of Shopee shipment, the unknown processing time of Shopee Hub, the biased sample size, etc so further research should be conducted to give a direct and practical view of the Shopee delivery system.

CHAPTER 2: SIMULATION MODELING OF THE CURRENT SYSTEM

2.1 Conceptual model

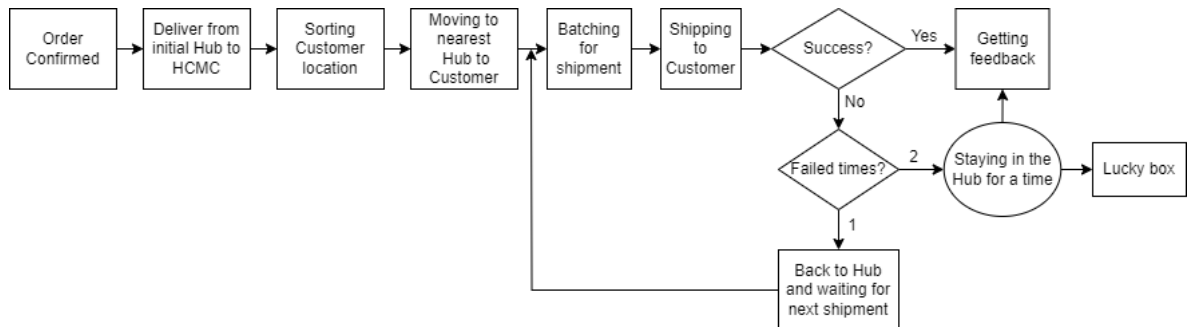


Figure 01: Fast and Economical Delivery

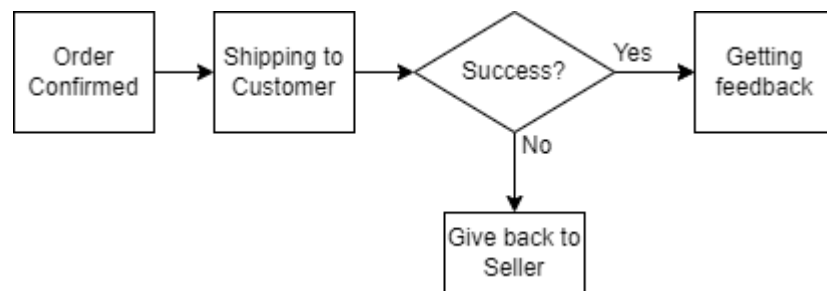


Figure 02: Express Delivery

The flow chart consists of 3 main parts: order confirmation, fast and economical delivery, and express delivery.

First, the order will be confirmed through the Shopee app or website, the information of the order will have consisted of the destination and type of delivery based on the need of the customer, especially for the instant delivery the customer and the seller have to be in the same city to fulfill the requirement of this delivery type. There are 3 types of Shopee delivery: fast, economical, and express delivery. Since the characteristics of fast and economical are the same, these two types of delivery share the same flow.

Second, for fast and economical delivery, the order will go from the initial Hub based on the region of the seller to the Hub at Ho Chi Minh City. After bringing the orders to the Hub, they will be sorted to each designated location based on their destination and these

orders will be moved to the Hub that is the closest to the customer's address. These orders will be batched into bigger sizes for shipment and wait for the shipper to come to fulfill these batched orders. If one order is completed, the order will get feedback. However, if the orders are not shipped to the customer for a certain reason for the first time, these orders will back to the Hub for the following shipment and it will be batched with later orders. But if these orders fail for the second time, they will be moved to the Hub for a while these second-times failed orders will get feedback for improvement as well as they will be in the lucky box (a Shopee policy of failed shipment)

Third, for express delivery, since its characteristics are instant receiving and a short amount of time, usually this kind of delivery can only be performed if the customer and the seller are situated in the same city. After the order of express delivery is confirmed, it will be shipped immediately to the customer and get feedback if successful, otherwise, it will be given back to the seller.

2.2 Data collection and Input modeling

2.2.1 Probability between two delivery configurations

To collect this data, we conducted a survey of friends and relatives about the delivery method they often choose when shopping through Shopee. The result is a total of 147 forms, of which 125 people choose the "Fast, economical" form and 22 people choose "Express". From there, we calculated the ratio between the two forms and applied it to the assumed number of orders in this project.

Method	Quantity	Proba
Fast and economic	125	85%
Super Fast	22	15%
Total quantity of order number	147	

Table 01: Probability between the two types of delivery

2.2.2 Fast and Economical delivery

2.2.2.1 Total delivery time

In our academic investigation, we conducted a search on Shopee's website to obtain information regarding their delivery times, specifically focusing on the aspect of “Fast, economical” method. Subsequently, we implemented a random approach to place 125 orders and documented the outcomes, which are presented in the following manner. Finally, the results were entered into the Input Analyzer to obtain the appropriate distribution.

Phương thức vận chuyển	Hỏa Tốc	Nhanh	Tiết Kiệm
Đơn vị vận chuyển	Shopee Xpress Instant GrabExpress beDelivery Ahamove	Shopee Xpress Viettel Post Giao Hàng Nhanh (GHN) J&T Express Ninja Van Best Express VNPost Nhanh	VNPost Tiết Kiệm Giao Hàng Nhanh (GHN) Ninja Van
Thời gian giao hàng (*)	1 - 2 giờ	1 - 4 ngày	2 - 6 ngày
Phí vận chuyển	Phụ thuộc vào khoảng cách vận chuyển	Phụ thuộc vào khoảng cách vận chuyển + khối lượng đơn hàng	

Figure 03: Related information of the two types of delivery

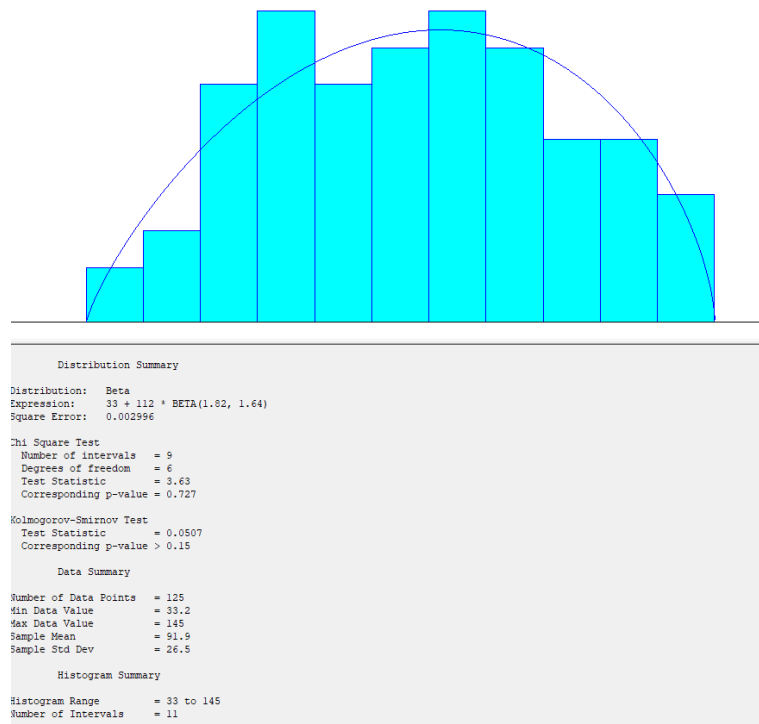


Figure 04: Distribution summary of total delivery time of Fast and Economical delivery

2.2.2.2 Number of sellers

Regarding the available data, our initial intention was to determine the number of sellers in all three regions based on the information provided by Shopee. Our plan was to apply the resulting ratio to our 125 orders, which would correspond to 125 sellers. Unfortunately, we were unable to obtain this specific information as it is considered confidential and not publicly accessible.

Subsequently, we considered exploring alternative approaches such as searching for the quantity or percentage of shopping activities in the three regions across the country. However, our attempts in this direction proved futile, yielding no promising results. Consequently, we resorted to utilizing an economic indicator, namely the Gross Regional Domestic Product (GRDP) index of the 63 provinces and cities in Vietnam, to establish the ratio of economic development among the North, Central, South, and Ho Chi Minh City (HCMC) regions. This decision was influenced by previous research indicating a correlation between robust economic development and increased online purchasing behavior. Based on the GRDP data, we extrapolated the percentage of Shopee sellers in the respective domestic regions as follows:

Location	Number of sellers	Proba
North	46	37%
Central	25	20%
South	42	34%
HCM City	12	10%
Total	125	100%

Table 02: Probability of sellers based on locations

2.2.2.3 Processing time of “The first hub”

The data presented here comprises precisely 125 orders that were acquired by our team on Shopee, spanning from 2019 up until the current period. Finally, the results in hours were entered into the Input Analyzer to obtain the appropriate distribution.

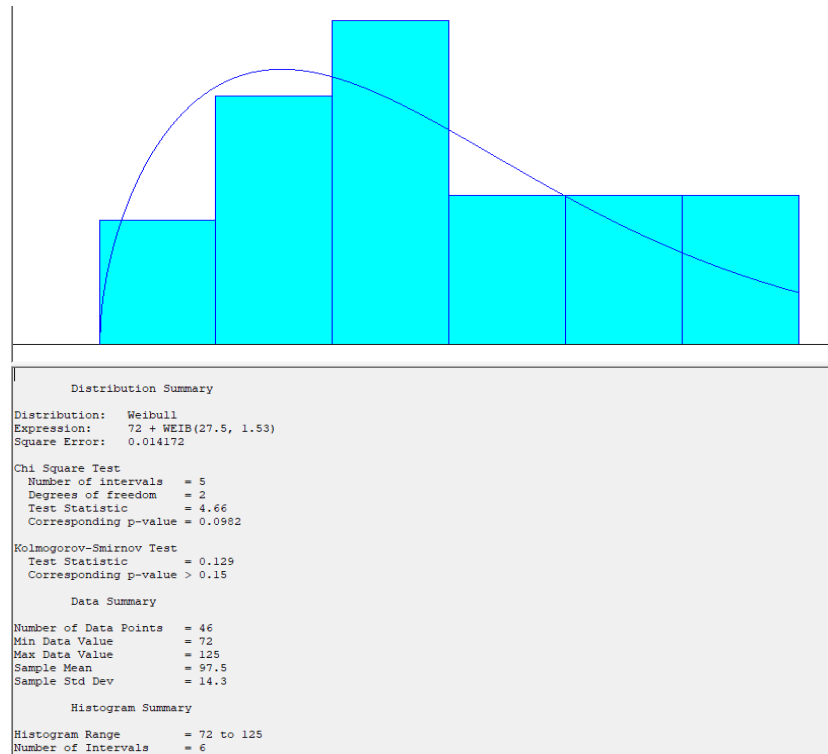


Figure 05: Distrbution summary of processing time in Northern Area

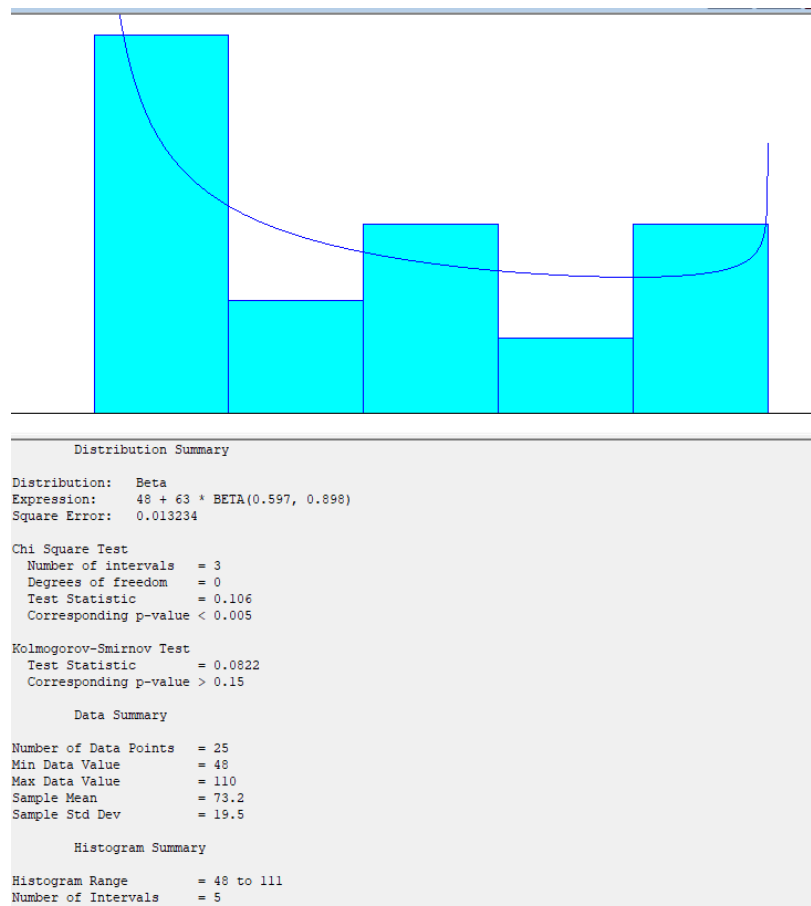


Figure 06: Distrbution summary of processing time in Central Area

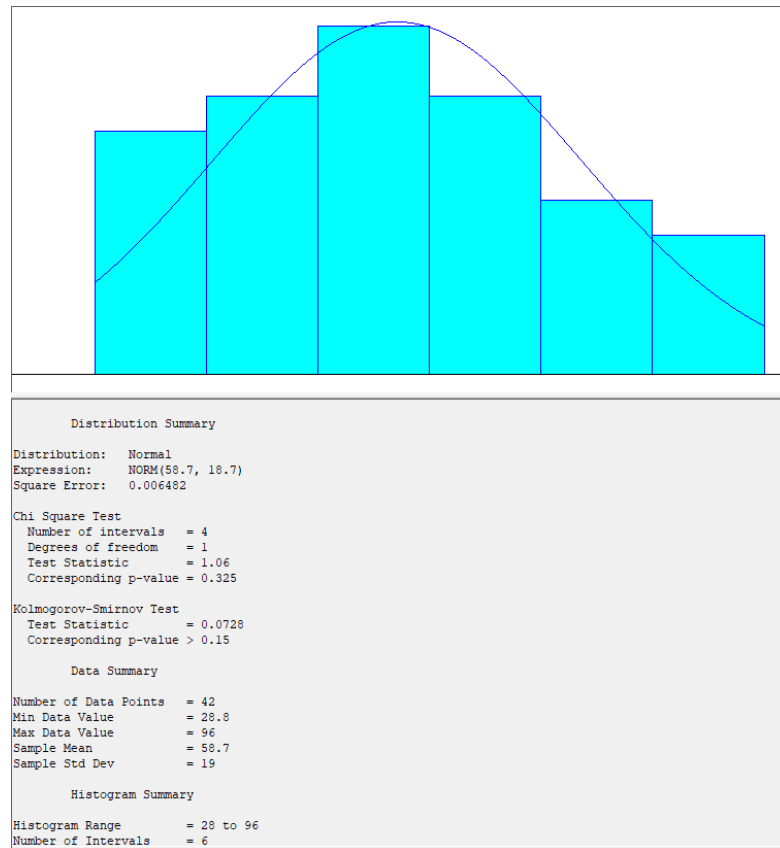


Figure 07: Distrbution summary of processing time in Southern Area

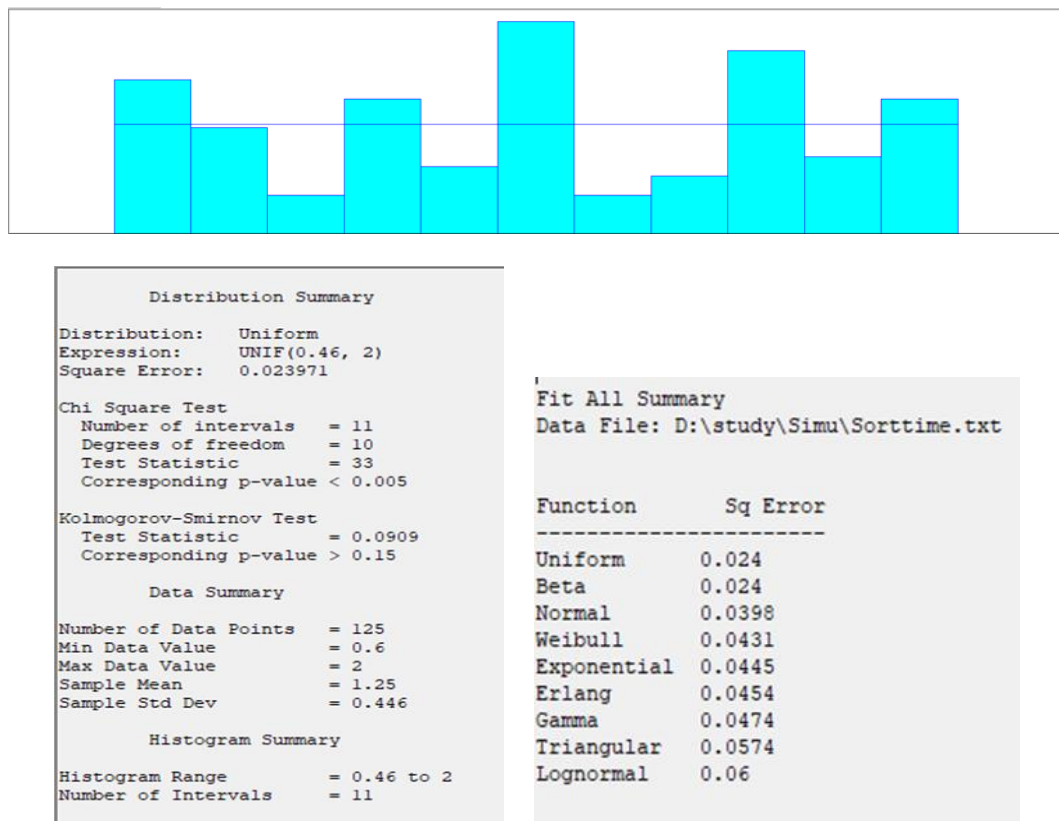


Figure 08: Distrbution summary of processing time in HCMC Area

2.2.2.4 Hub customers

Based on the previously sorted Location, the goods will be delivered to the Hubs closest to the customer's district.

Processing time at this stage is the waiting time in the warehouse until the shipper comes to pick up the goods to ship.

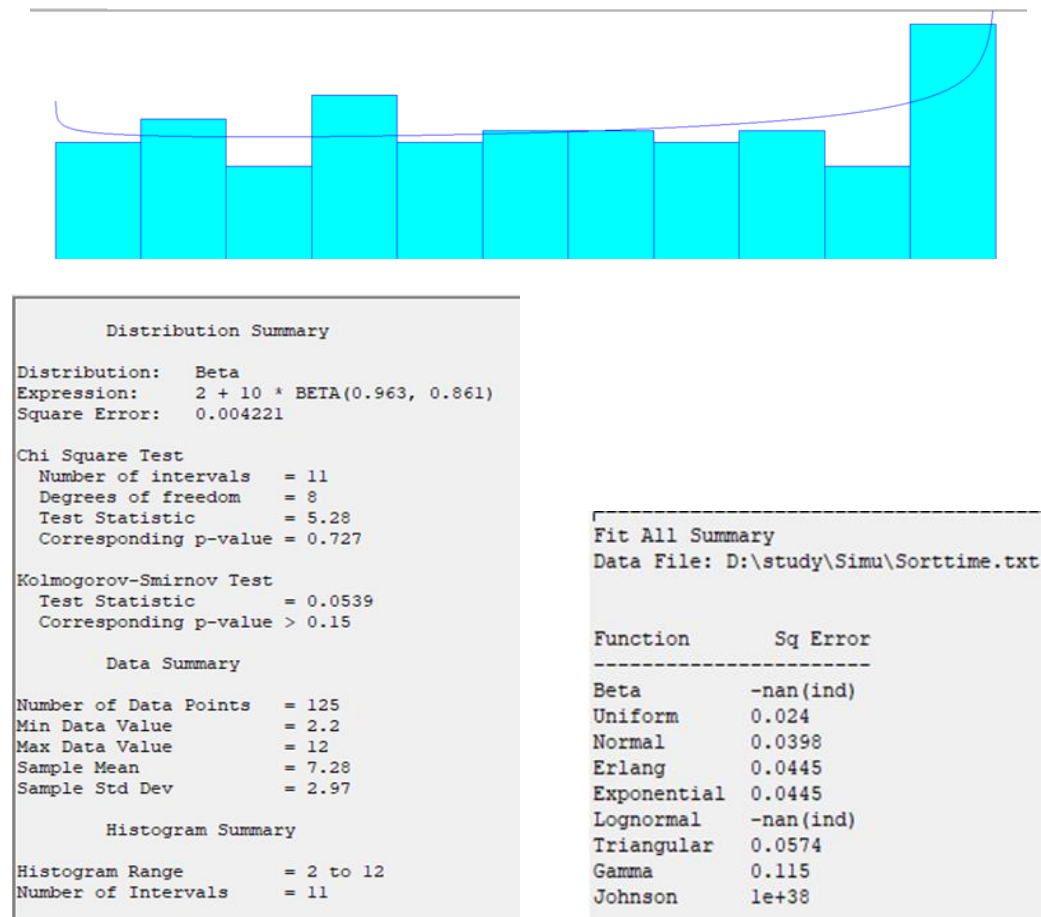
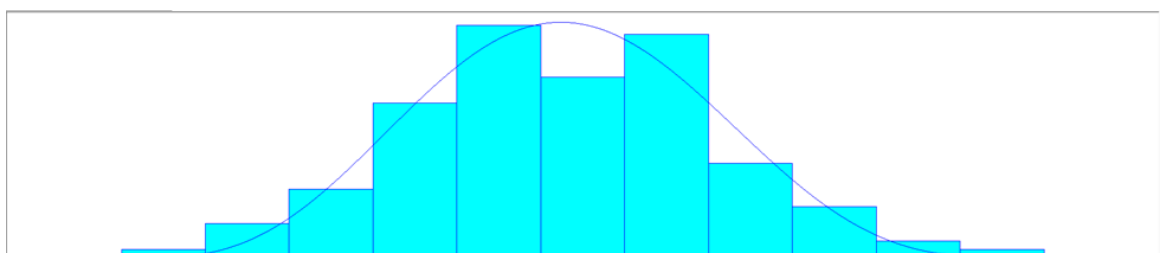


Figure 09: Distrbution summary of waiting time

2.2.2.5 Processing time and delivery resources

From the time the orders arrive at the Hub, the shippers will pick up and deliver the orders within the same day.



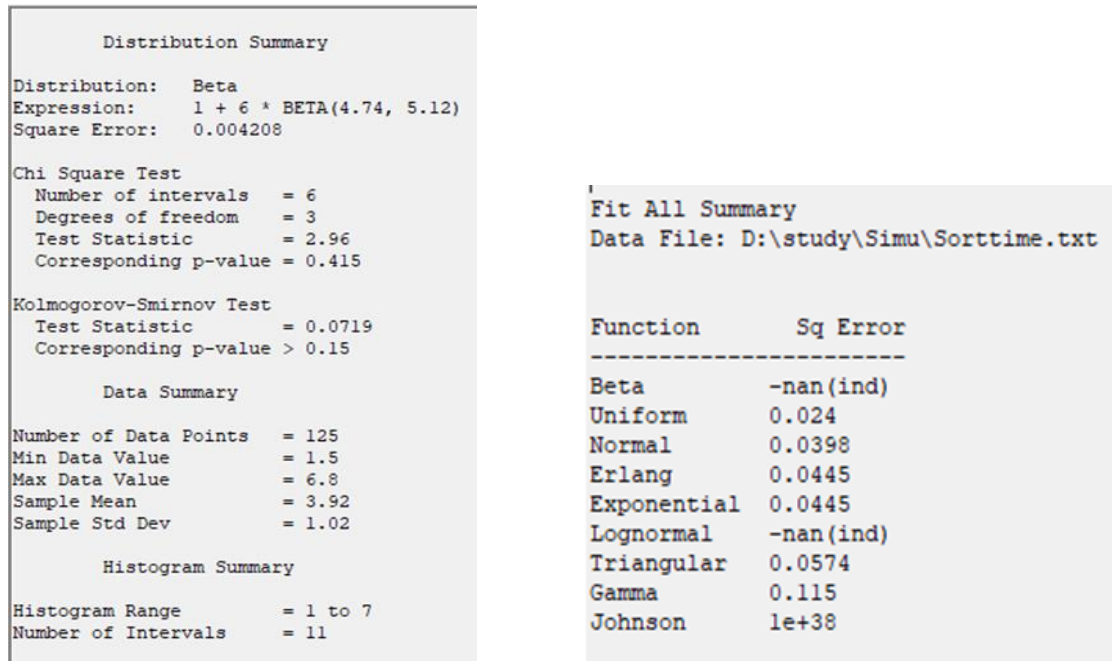


Figure 10: Distrbution summary of delivery time

2.2.2.6 Probabilty of customer satisfaction

To collect this data, we conducted a survey. The result is a total of 125 forms, of which 78 people respond to the "Satisfied" form and 14 people choose "Unsatisfied". Hence, we calculated the ratio and applied it to the assumed number of customer satisfaction in this project.

Customer satisfaction	Quantity	Proba
Satisfied	78	62%
Unsatisfied	14	11%

Table 03: Probability of customer satisfaction

2.2.3 Express delivery

2.2.3.1 Method

The data was collected through a survey sent among social media, relatives and friends that have high frequency using Shopee services. As per the policy of Shopee about their express delivery and user experience, a time range is fixed not to violate the practical issue. However, private information such as the number of shippers, number of orders

confirmation or batch size of one shipment is not public for the sake of user security of the seller, customer, and shipper. Therefore, a sample size of shipper and batch size must be assumed to fit the model on simulation and the limited size of the simulation software.

2.2.3.2 Input Analyzer

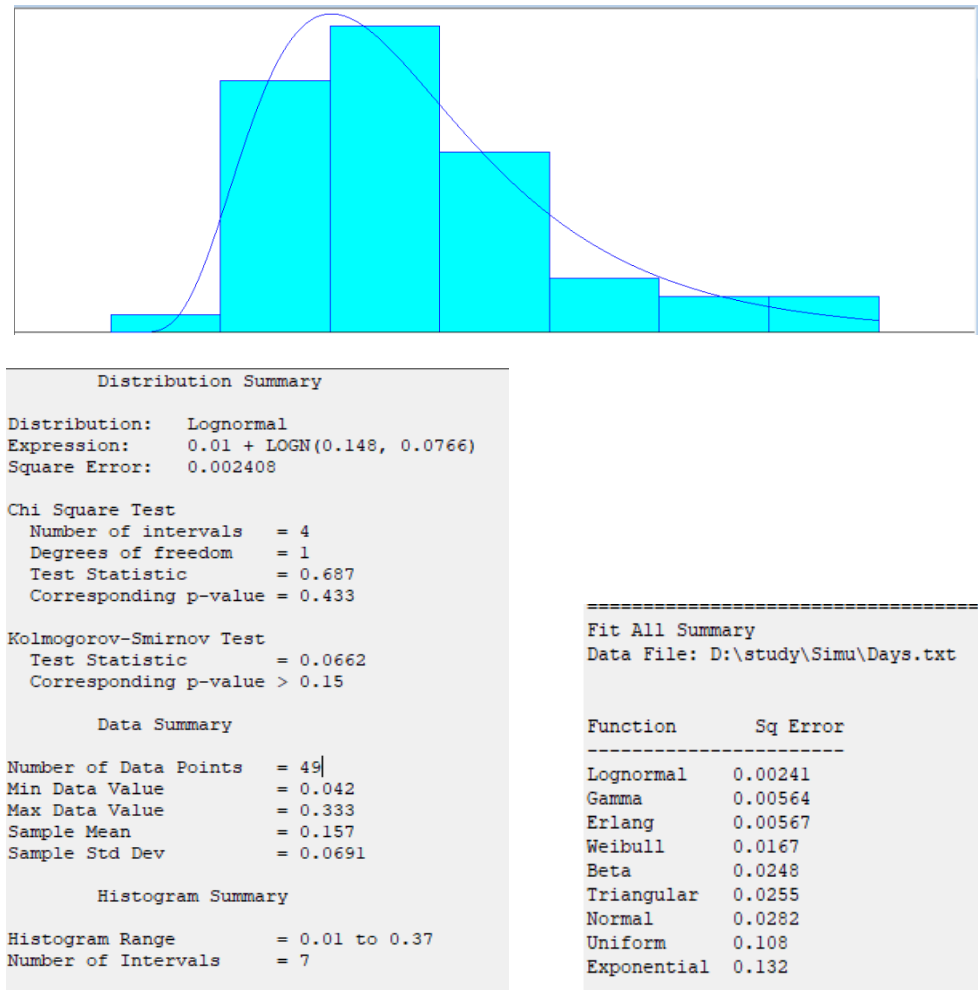
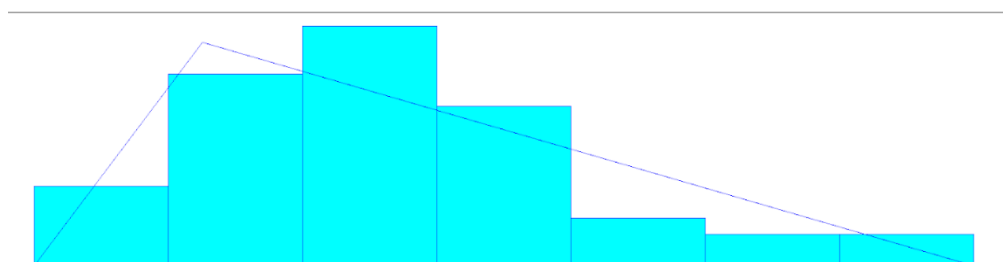


Figure 11: Distribution summary of delivery time based on day



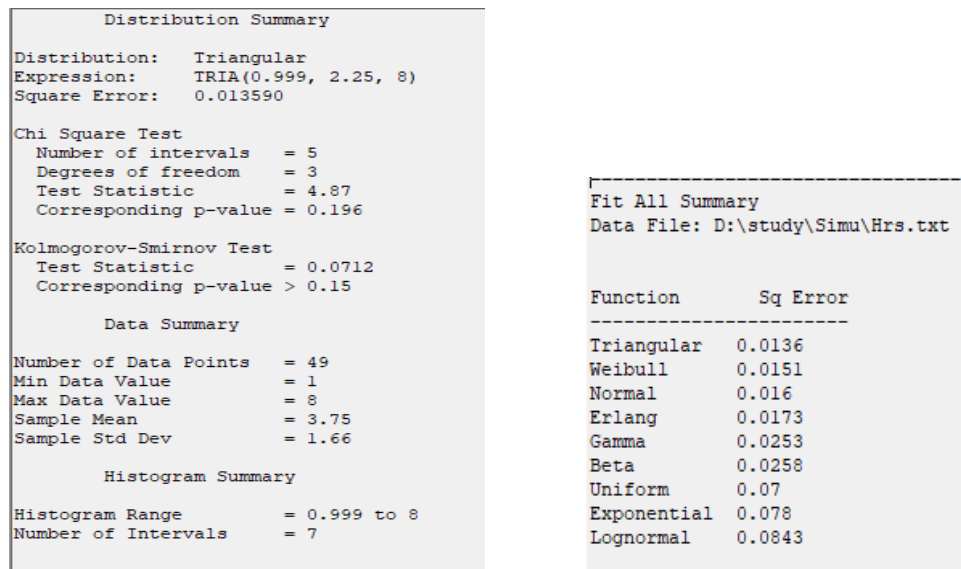


Figure 12: Distribution summary of delivery time based on hours

2.3 ARENA model

The model includes 6 different phases, respectively.

Phase 1: Determine delivery type

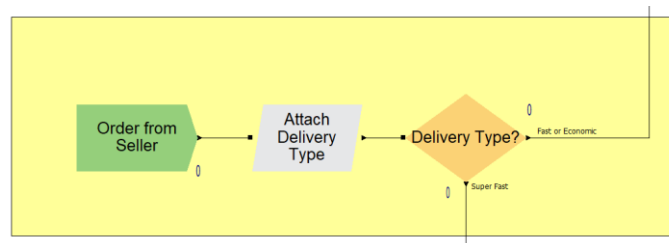


Figure 13: Determine delivery type

Orders were initially placed on the internet marketplace Shopee. Since this version of the ARENA program was intended for students, it restricts the maximum entities to just 150 for a number of entities, limiting the maximum arrivals to only 149. An order is represented by an entity. Because Shopee received a large number of orders per day (up to thousands), the time between arrivals in this model is assumed to be a constant of one minute. This one minute reflected the system's processing time. The kind of delivery for the orders will next be decided—fast (or economical) delivery or expedited delivery. Our goal is to assess Shopee's present shipping mechanism, thus the information we gathered will be used.

Create ? X

Name:		Entity Type:
Order from Seller		Order
Time Between Arrivals		
Type:	Value:	Units:
Constant	1	Minutes
Entities per Arrival:	Max Arrivals:	First Creation:
1	147	0.0

Figure 14: Create module “Order from Seller”

ReadWrite ? X

Name:	
Attach Delivery Type	
Type:	Arena File Name:
Read from File	File 1
Recordset ID:	Record Number:
Recordset 1	
Assignments:	
Attribute: OrderID	Add...
Attribute: DelType	Edit...
<End of list>	Delete

Figure 15: ReadWrite module "Attach Delivery Type"

There are two different sorts of delivery; first, we'll look over the Fast (or Economic) Delivery process, and then we'll go through the Express Delivery process.

Phase 2: Orders being delivered to the nearest customer's location

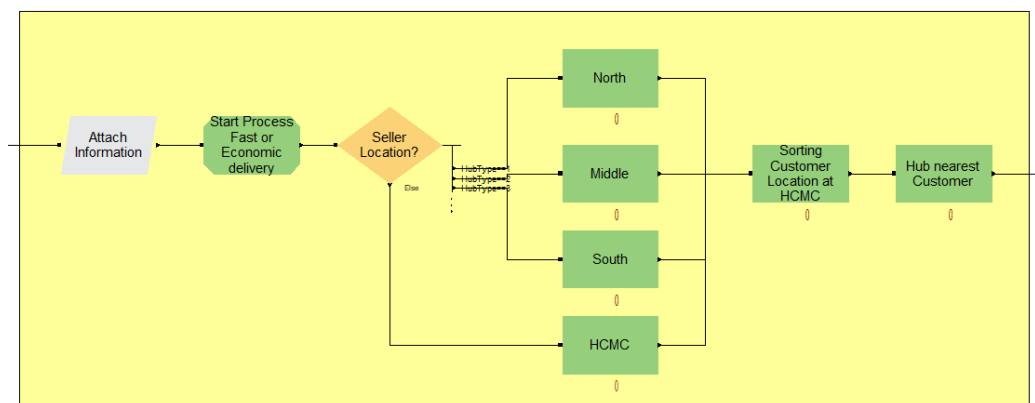


Figure 16: Orders being delivered to the nearest customer's location

Once it has been determined that the orders are for fast (or economical) delivery, the items will go via three phases to the closest customer's location. First, it will be necessary to assess how long it takes for each order to be processed at each of the remaining stages. The "Assign" module is then required to begin counting to examine the overall processing time for each order. The orders will then be handled at several regional hubs based on the attribute attached before comingling to a main hub in Ho Chi Minh City (HCMC). Differentiating the first hub will be rendered easier by the "Decide" module. The processing time for this stage increases with the distance from the area to HCMC. Orders will be sorted by customer address after being delivered to a significant hub in HCMC in order to send the items to the hub that is closest to the consumer's place of residence.

ReadWrite ? × Assignments

Name: Attach Information

Type: Read from File Arena File Name: File 1

Recordset ID: Recordset 2 Record Number:

Assignments:

	Type	Attribute Name
1	Attribute	HubType
2	Attribute	HubTime
3	Attribute	SortTime
4	Attribute	HubCustTime
5	Attribute	ShipTime
6	Attribute	Delay1?
7	Attribute	Delay1Time
8	Attribute	Delay2?
9	Attribute	Delay2Time

Attribute, HubType
Attribute, HubTime
Attribute, SortTime
Attribute, HubCustTime
Attribute, ShipTime
Attribute, Delay1?
Attribute, Delay1Time
Attribute, Delay2?

Add... Edit... Delete

Figure 17: ReadWrite module "Attach information" and the list of Attributes

Assign

Name: Start Process Fast or Economic delivery

Assignments:

Attribute, StartTime, TNOW
<End of list>

Figure 18: Assign module "Start Process Fast or Economic delivery"

Decide

Name: Seller Location? Type: N-way by Condition

Conditions:

- Expression, HubType==1
- Expression, HubType==2
- Expression, HubType==3
- <End of list>

Add... Edit... Delete

Figure 19: Decide module “Seller Location”

Phase 3: Shipping to customers

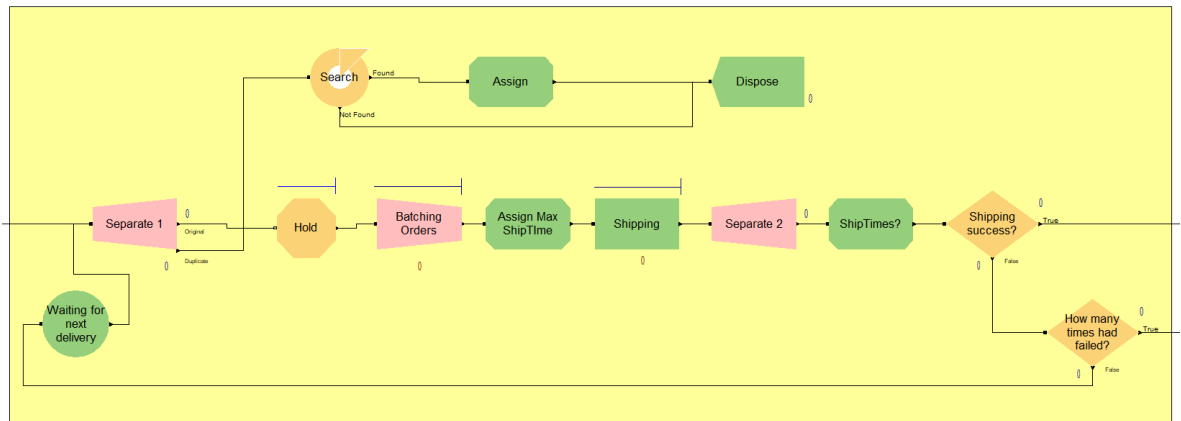


Figure 20: Shipping to customers

After gathering at the hub closest to the customers, the idea for this phase is that the items will be packaged in batches. Ten orders are included in each batch, and one batch is included in each shipment (per shipper). The issue is that while each order has a distinct shipping processing time (based on the input data) if they are packed in batches, the maximum value for each order's shipping processing time will be used as the batch's shipping processing time. Below, the specific procedure will be described:

- Module “Separate 1”: duplicate the entity in order to find the maximum value of the shipping process in 1 batch including 5 orders.
- Module “Hold”: hold 5 entities (orders) in a queue (named Searching.queue) to examine the maximum shipping processing time value.

Hold

Name: Hold Type: Scan for Condition

Condition: nq(Searching.Queue)==5

Queue Type: Queue

Queue Name: Searching.Queue

Figure 21: Hold module

- Module “Search”: search in a Searching.queue for a maximum value by the function Max(ShipTime) with the starting value is “1” and the ending value is the number of entities in Searching.queue (nq(Searching.queue)). If the search condition is true, J is set to rank the first entity and move to the next module. Otherwise, the entity will be disposed.

Search

Name: Search

Type: Search a Queue Queue Name: Searching.Queue

Starting Value: 1 Ending Value: nq(Searching.Queue)

Search Condition: MAX(ShipTime)

Figure 22: Search module

- Module “Assign”: if the entity has the maximum shipping processing time value, this assign module will attach this value to Variable 1 in order to set this variable to the batch. The function AQUE(Searching.Queue,j,NSYM(ShipTime)) means that it will return the value of a general-purpose attribute of the entity at the specified Rank (J) in queue Queue ID (Searching.queue); Attribute Number (NSYM(ShipTime)) is the number of the desired general-purpose attribute. The function NSYM was used to return the integer value number corresponding to the construct name, in this problem an attribute name (ShipTime) was into the desired Attribute Number.

Assign

Name:
Assign

Assignments:
Variable, Variable 1, AQUE(Searching.Queue,j,NSYM(ShipTime))
<End of list>

Figure 23: Assign module

- Module “Batching Orders”: pack 5 orders that have been searched for the maximum value in a batch The setting is temporary.

Batch ? X

Name: Batching Orders Type: Temporary

Batch Size: 5 Save Criterion: First

Rule: Any Entity

Figure 24: Batch module “Batching Orders”

- Module “Assign Max ShipTime”: assign the shipping processing time value that has been searched in the previous module to the batch for shipping.

Assign

Name:
Assign Max ShipTime

Assignments:
Attribute, ShipTime, Variable 1
<End of list>

Figure 25: Assign module “Assign Max ShipTime”

- Module “Shipping”: shipping process with a fixed number of shippers (resource) and the processing time equals the shipping processing time that has been assigned.

The 'Process' module configuration for 'Shipping' is shown. The Name is 'Shipping' and the Type is 'Standard'. The Logic section shows the Action is 'Seize Delay Release' and the Priority is 'Medium(2)'. The Resources section shows 'Resource, Shipper, 1' and '<End of list>'. The Delay Type is 'Expression', Units are 'Hours', and Allocation is 'Value Added'. The Expression is 'ShipTime'.

1	Shipper	Fixed Capacity	11	0.0	0.0	0.0	0 rows
---	---------	----------------	----	-----	-----	-----	--------

Figure 26: Process module “Shipping” and the resource “Shipper” setting

- Module “Separate 2”: for simulation, it needs to separate the batch into entities to determine if it was delivered successfully or not.
- Module “ShipTimes”: used to count how many times an order (entity) has been in the shipping process and assign that number to a variable (each entity has a different variable).

The 'Assign' module configuration for 'ShipTimes?' is shown. The Name is 'ShipTimes?'. The Assignments section shows 'Other, ShipTimes(OrderID), ShipTimes(OrderID) + 1' and '<End of list>'. The table below shows the variable 'ShipTimes' with a value of 125, type 'Real', and system 'System'.

2	ShipTimes	125	Real	System	1 rows
---	-----------	-----	------	--------	--------

Figure 27: Assign module “ShipTimes?” and Variable “ShipTimes” setting

- Two Decide modules: determine whether the orders were delivered successfully or not. Depending on the variable that has been assigned in the module “ShipTimes”, there are two scenarios:
 - + Scenario 1 - variable equal to 1: if delivery succeeded, the next step is the ending stage of the process. If the delivery fails, the order will go back to the hub and wait for the next shipment.

+ Scenario 2 - variable equal to 2: it means that the order has been delivered unsuccessfully once, so the second failed time, the order will be kept in a hub for a fixed time. In other words, the order will not go on any shipment afterward.

Decide ? X

Name: Shipping success? Type: 2-way by Condition

If: Expression

Value: (Delay1?==0) || (Delay1?==1 && ShipTimes(OrderID)==2)

Figure 28: Decide module "Shipping success?"

Decide ? X

Name: How many times had failed? Type: 2-way by Condition

If: Expression

Value: ShipTimes(OrderID)==2

Figure 29: Decide module "How many times had failed?"

Phase 4: End of process (Fast and Economic Delivery)

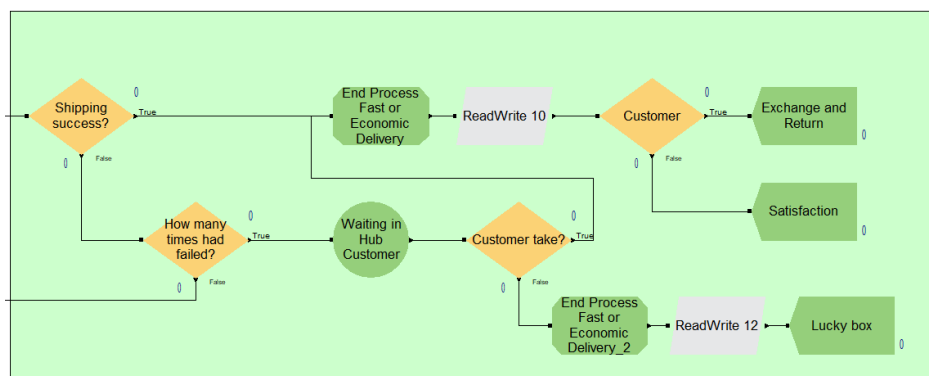


Figure 30: End of process for Fast and Economic Delivery

There are two endings, as was already indicated. The "Assign" module will be used to record the ending process time for the first one, which involves returning to the order's initial shipping. Following that, customers will provide input regarding their satisfaction,

exchange, or return. The second one has to do with the order's second unsuccessful shipment attempt. The products will now be held in the nearby hub for a predetermined period of time (more than 24 hours) at this point. If consumers still did not accept the order after this period, Shopee's "Lucky Box" policy will be applied.

Furthermore, the "Assign" module will have two attributes: "Entity.VATime" and "Entity.WaitTime" to track the processing time and the waiting time of orders in order to assess the system's effectiveness.

All of the findings were written to the Excel file for the next assessment using the "ReadWrite" module.

Based on the provided data, two "Decide" modules calculated the real percentage.

Assign

Name: End Process Fast or Economic Delivery

Assignments:

- Attribute, ProcessTime, Entity.VATime
- Attribute, WaitTime, Entity.WaitTime
- Attribute, EndTime, TNOW
- <End of list>

Figure 31: Assign module "End Process Fast or Economic Delivery"

The fourth and last phase of fast (or economical) delivery is referred to as phase 4. The next two stages are part of express delivery.

Phase 5: Shipping directly to customers

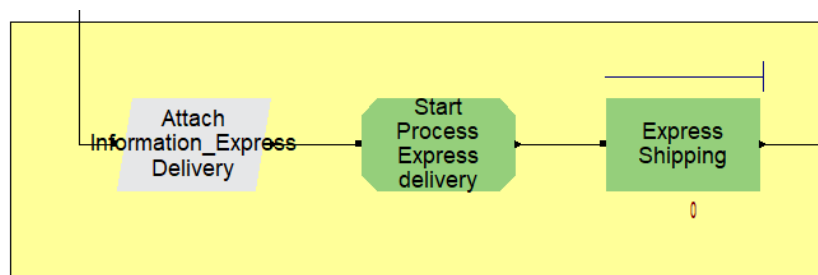


Figure 32: Shipping to customers

At the beginning of Express delivery, similar to the initial one, all the necessary information will be connected first, and the "Assign" module will then be utilized to record the start process time. Express delivery, as opposed to Fast (or Economic) delivery, ships products to clients right away. Although the delivery time is typically between two and four hours, the data was previously submitted.

The screenshot shows the 'Process' configuration window. The 'Name' is 'Express Shipping' and the 'Type' is 'Standard'. The 'Logic' section shows the 'Action' as 'Seize Delay Release' and the 'Priority' as 'Medium(2)'. The 'Resources' section lists 'Resource, ShipperExpress, 1' and '<End of list>'. The 'Delay Type' is 'Expression', 'Units' are 'Hours', and 'Allocation' is 'Value Added'. The 'Expression' is 'ShipTime'. Below the window, a table shows the resource 'ShipperExpress' with a 'Fixed Capacity' of 10 and a '0 rows' checkbox checked.

Resource	Capacity	Fixed Capacity	0 rows
ShipperExpress	10	0.0	0.0

Figure 33: Process module “Express Shipping” and Resource “ShipperExpress” setting

Phase 6: End of process (Express Delivery)

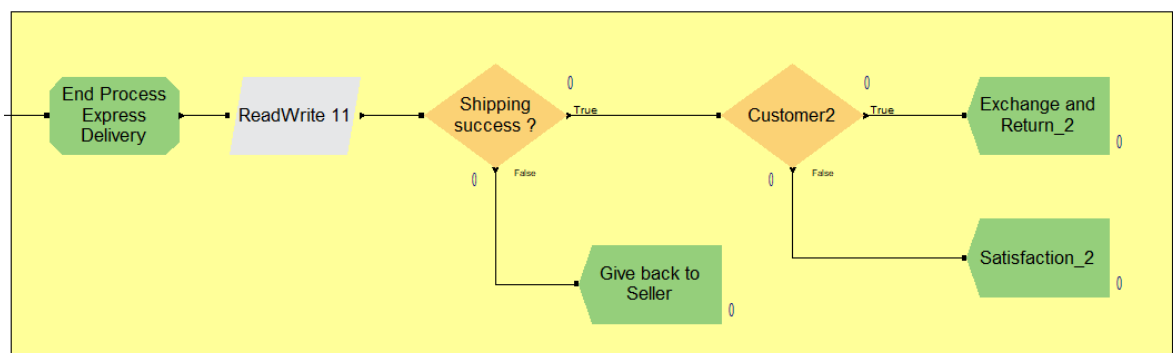


Figure 34: End of Express delivery process

Only one express delivery will be made. The products will be given back to the seller if clients fail to receive them. Customers, on the other side, will accept orders and provide feedback.

Similar to Phase 4, two "Decide" modules—"Assign" and "ReadWrite"—will do the same tasks using the same parameters and logic.

CHAPTER 3: VALIDATION

We concentrate on the Average Total Delivery Time in our problem, which is determined by adding together the times that the order is placed and when the client receives the items.

In the real system, the average total delivery time is 81.87 hours.

3.1 Type II error

We consider the type II error (β) method with the sample size of 5 replications, and a desired power level of 0.8 and 5% significance. The estimated critical difference (ϵ) between the average total delivery time obtained from the simulation model and the real system is 0.5 hours.

Replication	Y	(Y - Y mean)^2
1	82.7567	0.480597894
2	81.8351	0.052115422
3	81.916	0.021734234
4	81.858	0.042204733
5	81.951	0.0125665

The average: $\bar{Y} = 82.06$

Standard deviation; $S = \sqrt{\frac{\sum_{i=1}^n (Y_{2i} - \bar{Y}_2)^2}{n-1}} = 0.39$

Delta: $\delta = \frac{|E(Y_2) - \mu_0|}{S} = 1.28$

By using OC Curve with $\alpha = 0.05$, the number of replications of 7 is appropriate to test the simulation model.

3.2 The hypothesis testing

The average total delivery time observed is 81.87 hours, consider this number to be the true mean value $\mu_0 = 81.87$.

The hypothesis testing

$$H_0: E(Y_1) = 81.87$$

$$H_1: E(Y_1) \neq 81.87$$

The statistics testing: 2-tailed t test

Chose level of significance $\alpha = 0.05$ and sample size $n = 7$

Replication	Average Total delivery time
1	82.76
2	81.84
3	81.92
4	81.86
5	81.95
6	82.15
7	81.75

The sample mean: $\bar{Y} = 82.03$

$$\text{Standard deviation; } S = \sqrt{\frac{\sum_{i=1}^n (Y_{2i} - \bar{Y}_2)^2}{n-1}} = 0.34$$

$$\text{The critical value: } t_0 = \frac{\bar{Y}_2 - \mu_0}{S/\sqrt{n}} = 1.23$$

$$\text{Test statistics critical value: } t_{\frac{0.05}{2}, 6} = 2.45$$

Since $|t_0| < t_{\frac{0.05}{2}, 6}$, accept H_0 . Conclude that the model is adequate.

3.3 Confidence interval testing

$$\bar{Y} \pm \frac{t_{\frac{0.05}{2}, 6} \times S}{\sqrt{n}} = [81.7136; 82.3486]$$

$$\text{Best case error} = |81.87 - 81.7136| = 0.16$$

$$\text{Worst case error} = |81.87 - 82.3486| = 0.48$$

Since the worst case error $= 0.48 < \varepsilon = 0.5$, accept the model

By the two test above, we can conclude that the model is valid.

CHAPTER 4: OUTPUT ANALYSIS OF CURRENT SYSTEM PERFORMANCE

4.1 Point estimation

The point estimator of θ , based on the data $\{Y_1, \dots, Y_n\}$ is defined by:

$$\hat{\theta} = \frac{1}{n} \sum_{i=1}^n Y_i$$

Where $\hat{\theta}$ is sample mean based on a sample size n .

Replication	Average Total delivery time
1	82.76
2	81.84
3	81.92
4	81.86
5	81.95
6	82.15
7	81.75
$\hat{\theta}$	82.03

4.2 Confidence – Interval Estimation

Confidence – interval is a measure of the error that \bar{Y} (estimator of θ) is different of θ .

The confidence interval is:

$$\hat{\theta} \pm \frac{t_{\frac{\alpha}{2}, n-1} \times S}{\sqrt{n}}$$

$$\text{With } S = \sqrt{\frac{\sum_{i=1}^n (Y_i - \hat{\theta})^2}{n-1}} = 0.34$$

The confidence interval of average total delivery time is:

$$\hat{\theta} \pm \frac{t_{\frac{\alpha}{2}, n-1} \times S}{\sqrt{n}} = 82.03 \pm \frac{t_{0.05, 6-1} \times 0.34}{\sqrt{6}} = 82.03 \pm 0.3175$$

So, our best guess of the long-run average of the average total delivery time is 82.03 hours, but there could be as much as ± 0.3175 hours error in this estimate.

CHAPTER 5: EXPERIMENTATION

5.1 Adjustment Shipper of Fast (or Economic) delivery

In order to compare the differences in the average total delivery time (or Order.WIP in ARENA terminology), we will initially alter the number of shippers for Fast (or Economical) delivery. The number of shippers as of the time indicated in Scenario 1 in the table below will change in Scenarios 2 through 7.








	Scenario Properties				Controls		Response
	S	Name	Program File	Reps	Shipper	ShipperExpresses	Order.WIP
1		Scenario 1	43 : Project.p	7	11.0000	10.0000	81.572
2		Scenario 2	43 : Project.p	7	10.0000	10.0000	81.572
3		Scenario 3	43 : Project.p	7	9.0000	10.0000	81.572
4		Scenario 4	43 : Project.p	7	8.0000	10.0000	81.572
5		Scenario 5	43 : Project.p	7	7.0000	10.0000	81.572
6		Scenario 6	43 : Project.p	7	12.0000	10.0000	81.572
7		Scenario 7	43 : Project.p	7	13.0000	10.0000	81.572

Figure 35: Adjustment Shipper of Fast (or Economical) delivery

It is obvious that it appears the average overall delivery time will remain constant regardless of whether there are more or fewer shippers. Therefore, the quantity of shippers in Fast (or Economical) delivery has no overall impact on the procedure.

5.2 Adjustment Shipper of Express delivery

In the present scenario, the number of Express delivery shippers will be adjusted to determine whether it affects the outcome in any way.










	Scenario Properties				Controls		Response
	S	Name	Program File	Reps	Shipper	ShipperExpresses	Order.WIP
8		Scenario 8	43 : Project.p	7	11.0000	9.0000	81.606
9		Scenario 9	43 : Project.p	7	11.0000	8.0000	81.654
10		Scenario 10	43 : Project.p	7	11.0000	7.0000	81.712
11		Scenario 11	43 : Project.p	7	11.0000	6.0000	81.791
12		Scenario 12	43 : Project.p	7	11.0000	5.0000	81.903
13		Scenario 13	43 : Project.p	7	11.0000	4.0000	82.082
14		Scenario 14	43 : Project.p	7	11.0000	11.0000	81.546
15		Scenario 15	43 : Project.p	7	11.0000	12.0000	81.522
16		Scenario 16	43 : Project.p	7	11.0000	13.0000	81.503

Figure 36: Adjustment Shipper of Express delivery

The table shows that the average total delivery time will decrease if the number of Express delivery shippers rises, yet the Order.WIP will increase if the number of shippers is decreased. Therefore, it can be inferred that the number of Express delivery shippers has a significant impact on the outcome.

5.3 Suggestion scenario

According to the figures provided above, the average total delivery time decreases as the number of Express delivery shippers increases. In order to determine if this scenario of adding one more Express shipper is genuine or not, we will evaluate it and do a statistical test.

The hypothesis testing (new scenario)

The average total delivery time observed is 81.87 hours, consider this number to be the true mean value $\mu_0 = 81.87$.

The hypothesis testing

$$H_0: E(Y1) = 81.87$$

$$H_1: E(Y1) \neq 81.87$$

The statistics testing: 2-tailed t test

Chose level of significance $\alpha = 0.05$ and sample size $n = 7$

Replication	Average Total delivery time
1	82.60
2	81.71
3	81.80
4	81.75
5	81.85
6	82.05
7	81.67

The sample mean: $\bar{Y} = 81.92$

$$\text{Standard deviation; } S = \sqrt{\frac{\sum_{i=1}^n (Y_{2i} - \bar{Y}_2)^2}{n-1}} = 0.32691$$

The critical value: $t_0 = \frac{\bar{Y}_2 - \mu_0}{S/\sqrt{n}} = 1.21$

Test statistics critical value: $t_{\frac{0.05}{2}, 6} = 2.45$

Since $|t_0| < t_{\frac{0.05}{2}, 6}$, accept H_0 . So, this scenario model is adequate.

Point and interval estimation

Y_1 : represents the average total delivery time of current system

Y_2 : represents the average total delivery time of the suggested scenario

Replication	Y_1	Y_2	Difference
1	82.76	82.60	0.16
2	81.84	81.71	0.13
3	81.92	81.80	0.12
4	81.86	81.75	0.11
5	81.95	81.85	0.10
6	82.15	82.05	0.10
7	81.75	81.67	0.09
Mean	82.03	81.92	
S	0.34287	0.32691	

The same mean and sample standard deviation over the R replications:

$$R = 7 \rightarrow v = R - 1 = 6$$

$$\text{The mean difference } \bar{D} = \frac{1}{R} \sum_{r=1}^R D_r = 0.11$$

$$\text{The difference standard deviation } S_D = \sqrt{\frac{\sum_{i=1}^n (D_r - \bar{D})^2}{R-1}} = 0.02285$$

$$\text{s.e.}(\bar{D}) = \text{s.e.}(\bar{Y}_1 - \bar{Y}_2) = \frac{S_D}{\sqrt{R}} = \frac{0.02285}{\sqrt{10}} = 0.00723$$

$$\text{Test statistics critical value: } t_{\frac{0.05}{2}, 6} = 2.45$$

Two-sided $100(1 - 0.05\%)$ confidence intervals of $\theta_1 - \theta_2$

$$\Leftrightarrow \bar{Y}_1 - \bar{Y}_2 - t_{\frac{0.05}{2}, 6} \text{ s.e. } (\bar{Y}_1 - \bar{Y}_2) \leq \theta_1 - \theta_2 \leq \bar{Y}_1 - \bar{Y}_2 + t_{\frac{0.05}{2}, 6} \text{ s.e. } (\bar{Y}_1 - \bar{Y}_2)$$

$$\Leftrightarrow 0.11 - 2.45 \times 0.00723 \leq \theta_1 - \theta_2 \leq 0.11 + 2.45 \times 0.00723$$

$$\Leftrightarrow 0.0922865 \leq \theta_1 - \theta_2 \leq 0.1277135$$

There is no the significant difference between the current system and the proposed scenario since the confidence interval is $[0.0922865; 0.1277135]$ and the mean $\bar{D} = 0.11$ is within the confidence interval.

In conclusion, increased Express delivery shippers will result in a shorter overall average delivery time, but in practice, other considerations including shippers' wages and cargo costs must also be taken into account. We might provide the optimal system approach by incorporating all the relevant factors.

CHAPTER 6: CONCLUSION

6.1 Conclusion

In conclusion, this research paper focused on analyzing the performance of Delivery of Shopee Express and proposed a methodology to alleviate congestion within the system. Our study involved collecting data on shipping time in 7 periods with 11 shippers for the Economical way and 10 for the fast way with a batch of 5 for input into the simulation. Through the utilization of ARENA v16.0, we successfully replicated the delivery flow of this e-commerce. The verification and validation process confirmed the accuracy and reliability of our simulation model, ensuring its representation of the actual shipping time. We can apply the same analytical approach to the delivery operations of the Shopee Express project. By collecting relevant data on delivery times, analyzing key performance indicators, and simulating the delivery process, we can identify potential bottlenecks and propose targeted solutions.

In the context of Shopee Express, the conclusions drawn from this research can guide decision-making to optimize the delivery system. By implementing measures to address bottlenecks and streamline the delivery process, Shopee Express can enhance its efficiency, reduce delivery times, and improve overall customer satisfaction. It is crucial to continuously monitor and evaluate the system's performance, making adjustments and enhancements as needed, to ensure a seamless and reliable delivery service.

6.2 Recommendation

As the report shows, the findings of this research paper provide valuable insights into the performance of the Shopee Express delivery system. The analysis revealed that certain aspects of the system, particularly related to the number of economical shippers, are causing bottlenecks and resulting in higher average busy times. To enhance productivity and address these bottlenecks, we recommend implementing specific measures.

Firstly, upgrading the delivery infrastructure, such as optimizing door time or moving time, can significantly improve efficiency. By streamlining these processes, the overall delivery time can be reduced, leading to a smoother and more expedited service for Shopee Express customers.

Secondly, the establishment of new policies is crucial to alleviate congestion and enhance productivity. These policies may include prioritizing certain types of deliveries or reorganizing the route planning system. By strategically managing the delivery flow, Shopee Express can ensure timely deliveries and minimize waiting times.

Implementing these recommendations aims to alleviate congestion, improve efficiency, and ultimately enhance the overall delivery performance of Shopee Express. It is essential for Shopee Express to continuously monitor the delivery system's performance, analyze data, and make necessary adjustments to optimize the delivery process. By doing so, Shopee Express can provide a reliable and efficient delivery service, leading to greater customer satisfaction and loyalty.

In summary, this research paper offers actionable insights and recommendations to enhance the delivery performance of Shopee Express. By addressing bottlenecks, optimizing processes, and implementing effective policies, Shopee Express can improve its overall efficiency and provide an exceptional delivery experience for its customers.

APPENDIX

Table A-01: Total delivery time of Fast and Economical Delivery

STT	Days	Hours
1	4,5	107,1
2	4,2	100,8
3	5,7	136,8
4	4,5	107,7
5	6,0	144,9
6	4,7	112,4
7	4,4	104,8
8	4,3	103,4
9	6,0	144,0
10	5,7	136,8
11	5,0	120,7
12	5,3	126,2
13	3,8	92,0
14	4,5	108,0
15	5,8	139,2
16	3,4	80,7
17	4,9	118,2
18	5,8	139,2
19	4,8	114,5
20	5,6	134,7

21	5,7	135,8
22	4,3	102,7
23	4,8	116,2
24	5,4	130,8
25	4,5	108,0
26	5,4	128,8
27	4,3	104,2
28	4,4	104,9
29	5,3	126,7
30	5,1	121,6
31	5,6	134,8
32	4,3	102,9
33	4,8	114,5
34	4,3	102,8
35	4,7	113,1
36	5,6	134,4
37	3,8	91,4
38	5,2	124,5
39	5,6	133,8
40	5,3	127,2

41	3,9	94,3
42	4,6	110,4
43	3,8	92,0
44	4,2	99,7
45	4,1	97,8
46	4,3	103,9
47	4,5	107,9
48	5,3	127,6
49	4,8	114,3
50	2,9	68,5
51	4,0	96,1
52	3,3	79,5
53	3,9	93,9
54	2,8	68,1
55	2,5	60,8
56	4,0	96,0
57	2,9	68,9
58	4,5	107,4
59	4,0	95,6
60	3,4	82,1

61	3,1	75,2
62	3,6	86,1
63	4,5	107,2
64	3,9	93,7
65	2,7	65,4
66	3,8	91,3
67	4,1	98,5
68	4,9	117,1
69	3,0	72,3
70	3,4	82,5
71	4,0	96,6
72	3,6	86,6
73	2,9	69,1
74	3,7	88,2
75	2,4	58,2
76	3,0	71,0
77	3,3	80,1
78	1,7	39,7
79	2,6	63,3
80	3,0	71,7

81	2,1	49,6
82	2,8	66,9
83	3,1	74,9
84	2,3	55,0
85	3,3	80,0
86	2,6	61,5
87	4,2	100,6
88	3,5	83,0
89	2,1	50,3
90	2,3	56,1
91	3,9	93,9
92	2,3	56,3
93	2,5	59,5
94	4,5	107,9
95	4,9	117,3
96	4,2	100,6
97	2,1	51,0
98	1,9	46,4
99	2,6	61,9
100	2,7	64,2

101	1,7	40,3
102	3,9	94,0
103	2,5	58,9
104	3,1	73,3
105	3,9	93,6
106	3,6	85,7
107	3,7	87,7
108	4,7	112,8
109	3,4	81,1
110	5,0	120,0
111	2,8	66,1
112	3,3	80,3
113	2,8	67,4
114	1,4	33,2
115	2,2	53,9
116	2,4	58,4
117	3,0	72,2
118	2,6	63,1
119	2,9	68,8
120	3,4	80,5
121	3,6	86,4
122	2,0	48,9
123	2,8	67,8
124	3,0	71,9
125	3,3	79,8

Table A-02: Processing time of The first Hub in Nothern Area of Fast and Economical Delivery

Code orders	N.O	Days	Hours
230303DU19JS1C	1	4	96
230303DUN0WXAV	2	3,7	88,8
230207BST4Y1Y5	3	5,2	124,8
230303E13S8E30	4	3,8	91,2
221225JFAHAYF5	5	5,1	122,4
2011068KHFU148	6	4,2	100,8
221120J2YCHFX0	7	3,5	84
221015DNHY280N	8	3,7	88,8
230404708GT35D	9	4,6	110,4
230404705TY9E9	10	4,2	100,8
220505C5KAX9MR	11	4	96
220415N2FBPW0T	12	4,1	98,4
2204118X2YPPN2	13	3,5	84
220315VDBS0ERF	14	3,7	88,8
220315VDDB6XGJ	15	4,3	103,2
220308C71W9NMD	16	3	72
2203150AE5TORC	17	4,5	108
220315VD8TG6ND	18	4,8	115,2
2203079A4UJP6Q	19	4,4	105,6
220303VKK26CKT	20	4,7	112,8

220303VKDMDNVQ	21	5	120
22030799Y3W7AR	22	3,9	93,6
220302U6T3BD43	23	4,2	100,8
220303UB75XQYA	24	5	120
220302U7EXVCAD	25	3,3	79,2
220215G994M924	26	4,2	100,8
220215G91NHNMG	27	3,6	86,4
2201064B07M2TX	28	3,8	91,2
210909S1XQ80TX	29	4,5	108
210915BRCT7P95	30	4,7	112,8
210909QXV2512H	31	5,1	122,4
210909S100T659	32	3,3	79,2
210909QXX304FK	33	4,1	98,4
2108083S1SS32W	34	3,9	93,6
2108083M9GN26F	35	4,1	98,4
2210100YW9NAQC	36	5,2	124,8
22101010084NCY	37	3,4	81,6
210704382MV54C	38	4	96
210606K8E94KTM	39	4,1	98,4
2105218AKA0DXH	40	3,9	93,6

2107150R3E8568	41	3,2	76,8
2107150QWRW07T	42	3,4	81,6
210709ENJHAU01	43	3,1	74,4
210709ENGEKCES	44	3,5	84
2107079F8F534M	45	3,4	81,6
2210101031R3W6	46	3,9	93,6

Table A-03: Processing time of The first Hub in Central Area of Fast and Economical Delivery

Code orders	N.O	Days	Hours
22111549GHTDVF	47	4,2	100,8
221111SKRMB0QD	48	4,6	110,4
221111SKGG0XB0	49	4,2	100,8
221015DNB3NT09	50	2,5	60
221015DN9F8UHW	51	3,5	84
230505TRJ07JJK	52	2,6	62,4
230315EY1WV7JW	53	2,4	57,6
220925PXA07HWB	54	2	48
230505TQUWHB7W	55	2,2	52,8
221225HFR2693M	56	2,5	60
220925PYW5KJN8	57	2,3	55,2
220925PXCK4PQC	58	4,1	98,4
220915SEA7H3K5	59	3,5	84
220909BP1Q53DF	60	2,9	69,6
220915SEW36P3H	61	2,8	67,2
220915SE7ESUQG	62	2,5	60
220909ABNDE8DH	63	3,7	88,8
220909AEWJENBH	64	3,4	81,6
220909BNVPV261	65	2	48
220909AF0GVXMB	66	3,1	74,4
230303DXR3VF1W	67	3,6	86,4
220101NUQCFP8G	68	4,2	100,8
2112144MA8N3RP	69	2,1	50,4
211217C6GBT75H	70	2	48
211215747T73YQ	71	3,3	79,2

Table A-04: Processing time of The first Hub in Southern Area of Fast and Economical Delivery

Code orders	N.O	Days	Hours
230303E13S8E30	72	3,3	79,2
230303DUBGR8V7	73	2,5	60
2302152S15EDTK	74	3,4	81,6
230207BSV5SD3F	75	2	48
230207BSXMMWKWU	76	2,4	57,6
230207BSPV0D2A	77	2,5	60
230207BT0D5763	78	1,2	28,8
221212DWS8U9AF	79	2,3	55,2
221111Q845R0BW	80	2,6	62,4
221111QBFFY1QC	81	1,7	40,8
221111Q80R1XX8	82	2,2	52,8
230420KNK3WN8H	83	2,1	50,4
2304155J8NNN1F	84	1,4	33,6
230410PDTG569J	85	2,6	62,4
23040470CPBW72	86	2	48
220620CBJP6FE9	87	3,5	84
2205158EH9DFB8	88	3	72
2205158E8QD81W	89	1,7	40,8
2205158EE9RE8C	90	1,4	33,6
220516BC60V7QV	91	2,5	60
220505CHAPHT9D	92	1,7	40,8
220505B4XV8PNA	93	1,8	43,2
23040470FFX8CA	94	3,9	93,6
221225HFE4EAT3	95	4	96
220303UCTMCS1P	96	3,7	88,8
220303UBDAG2VK	97	1,5	36
220303VKB7BKH4	98	1,3	31,2
19090923263RWRG	99	2,2	52,8
220505CH99PYU2	100	2,2	52,8
220303UCTMCS1P	101	1,3	31,2
190727184346VP7	102	3,3	79,2
190727184366VP6	103	1,2	28,8
2112144M4HPC3J	104	2,5	60
190526010678A0D	105	3,5	84
220505C59NMGXE	106	2,9	69,6
190719142879G6C	107	3	72
211115KAYX5N0B	108	3,8	91,2
19011420490MKWW	109	3	72
211126GEH3795D	110	2,7	64,8
211126GF71FU0P	111	2,1	50,4
211116M8T10PNV	112	2,6	62,4
2111117QUUK6HG	113	2,2	52,8

Table A-05: Processing time of The first Hub in HCMC Area of Fast and Economical Delivery

STT	Hours	Location
1	0,7	District 3
2	0,6	District 1
3	0,9	District 6
4	1,9	Gò Vấp District
5	0,7	District 9
6	1,3	Thủ Đức District
7	1,1	District 4
8	0,6	District 8
9	1,5	District 1
10	1,6	District 2
11	1,2	District 3
12	1,3	District 6
13	1,8	District 7
14	1,6	District 9
15	1,2	Tân Bình District
16	1,8	District 10
17	0,6	District 11
18	1,5	District 12
19	0,6	Bình Tân District
20	0,6	Tân Phú District
21	1,0	Phú Nhuận District
22	1,6	Gò Vấp District
23	2,0	Bình Thạnh District
24	1,9	District 5
25	1,3	Thủ Đức District
26	0,7	District 1
27	1,7	District 5
28	1,4	District 2
29	1,2	District 3
30	1,6	District 4
31	1,6	District 6
32	1,4	District 7
33	1,8	District 8
34	1,5	District 10
35	0,9	District 11
36	1,2	District 12
37	1,2	Bình Tân District
38	1,1	District 9
39	1,1	Tân Phú District
40	1,9	Phú Nhuận District
41	0,8	Phú Nhuận District
42	0,9	Gò Vấp District
43	1,9	District 3
44	1,3	Bình Thạnh District
45	1,7	District 1
46	1,9	Tân Bình District
47	0,6	District 1
48	1,5	District 1
49	1,1	Tân Bình District
50	0,7	District 3
51	0,6	District 5
52	1,8	Gò Vấp District
53	0,9	District 10
54	1,7	Phú Nhuận District
55	0,8	District 10
56	1,9	District 1
57	1,6	Tân Phú District
58	1,3	District 3
59	1,1	District 8
60	0,7	Phú Nhuận District
61	1,7	Bình Thạnh District
62	1,5	Bình Thạnh District
63	0,6	District 2
64	1,7	District 7
65	1,9	District 12
66	0,6	Phú Nhuận District
67	1,9	Gò Vấp District
68	1,0	District 6
69	0,6	District 7
70	0,6	District 9
71	1,9	District 6
72	1,0	District 8
73	0,7	District 4
74	1,4	District 1
75	1,8	District 5
76	2,0	Gò Vấp District
77	1,2	District 5
78	1,6	District 2
79	1,9	District 1
80	1,0	District 1
81	1,4	District 4
82	0,6	District 3
83	1,5	District 1
84	1,2	District 1
85	1,8	District 4
86	1,3	District 7
87	1,6	District 4

88	0,7	District 4
89	1,8	District 1
90	0,9	Bình Thạnh District
91	0,6	District 1
92	2,0	District 2
93	0,9	District 1
94	1,7	District 7
95	0,9	District 2
96	1,2	District 1
97	1,0	District 6
98	0,6	District 1
99	0,7	District 6
100	1,0	District 9
101	0,7	Bình Tân District
102	1,2	District 1
103	2,0	District 5
104	1,3	District 6
105	1,3	District 1
106	1,8	District 4
107	1,2	Thủ Đức District
108	0,7	Thủ Đức District

109	1,3	District 1
110	1,6	District 1
111	0,6	District 3
112	1,6	District 1
113	1,2	Bình Thạnh District
114	1,6	District 3
115	1,6	District 7
116	0,7	District 4
117	1,7	Bình Thạnh District
118	1,1	District 5
119	0,8	District 3
120	0,8	District 4
121	1,2	District 8
122	1,0	Thủ Đức District
123	1,2	Gò Vấp District
124	1,1	Thủ Đức District
125	0,6	Tân Phú District

Table A-06: Hub near Customers of Fast and Economical Delivery

STT	Location	Hub Cust.	Days	Hours
1	District 3	Tân Bình District	0,31	7,3
2	District 1	District 10	0,40	9,5
3	District 6	Tân Phú District	0,33	8,0
4	Gò Vấp District	Gò Vấp District	0,40	9,6
5	District 9	Thủ Đức District	0,30	7,2
6	Thủ Đức District	Gò Vấp District	0,24	5,7
7	District 4	District 11	0,16	3,8
8	District 8	District 8	0,49	11,8
9	District 1	District 10	0,14	3,4
10	District 2	Bình Thạnh District	0,25	6,0
11	District 3	Tân Bình District	0,30	7,2
12	District 6	Tân Phú District	0,49	11,7
13	District 7	District 8	0,11	2,6
14	District 9	Thủ Đức District	0,50	11,9
15	Tân Bình District	Tân Bình District	0,32	7,8
16	District 10	District 10	0,12	2,8
17	District 11	District 11	0,27	6,4
18	District 12	District 12	0,11	2,6
19	District Bình Tân	Tân Phú District	0,16	3,8
20	Tân Phú District	Tân Phú District	0,32	7,7

21	District Phú Nhuận	Gò Vấp District	0,33	8,0
22	Gò Vấp District	Gò Vấp District	0,12	2,9
23	Bình Thạnh District	Bình Thạnh District	0,40	9,6
24	District 5	District 5	0,19	4,6
25	Thủ Đức District	Thủ Đức District	0,23	5,5
26	District 1	District 10	0,44	10,5
27	District 5	District 5	0,48	11,6
28	District 2	Bình Thạnh District	0,38	9,1
29	District 3	Tân Bình District	0,49	11,8
30	District 4	District 11	0,17	4,1
31	District 6	Tân Phú District	0,33	7,8
32	District 7	District 8	0,27	6,5
33	District 8	District 8	0,40	9,6
34	District 10	District 10	0,16	3,7
35	District 11	District 11	0,42	10,0
36	District 12	District 12	0,18	4,2
37	District Bình Tân	Tân Phú District	0,23	5,5
38	District 9	Thủ Đức District	0,47	11,2
39	Tân Phú District	Tân Phú District	0,35	8,5
40	District Phú Nhuận	Gò Vấp District	0,17	4,1
41	District Phú Nhuận	Gò Vấp District	0,48	11,4
42	Gò Vấp District	Gò Vấp District	0,46	11,0
43	District 3	Tân Bình District	0,46	11,1
44	Bình Thạnh District	Bình Thạnh District	0,45	10,8
45	District 1	District 10	0,48	11,6
46	Tân Bình District	Tân Bình District	0,16	3,8
47	District 1	District 10	0,11	2,7
48	District 1	District 10	0,46	11,0
49	Tân Bình District	Tân Bình District	0,28	6,6
50	District 3	Tân Bình District	0,17	4,2
51	District 5	District 5	0,22	5,2
52	Gò Vấp District	Gò Vấp District	0,48	11,5
53	District 10	District 10	0,42	10,1
54	District Phú Nhuận	Gò Vấp District	0,20	4,7
55	District 10	District 10	0,11	2,7
56	District 1	District 10	0,46	11,1
57	Tân Phú District	Tân Phú District	0,33	7,9

58	District 3	Tân Bình District	0,16	3,8
59	District 8	District 8	0,36	8,6
60	District Phú Nhuận	Gò Vấp District	0,34	8,3
61	Bình Thạnh District	Bình Thạnh District	0,20	4,8
62	Bình Thạnh District	Bình Thạnh District	0,36	8,7
63	District 2	Bình Thạnh District	0,48	11,5
64	District 7	District 8	0,29	6,9
65	District 12	District 12	0,48	11,5
66	District Phú Nhuận	Gò Vấp District	0,47	11,4
67	Gò Vấp District	Gò Vấp District	0,26	6,3
68	District 6	Tân Phú District	0,42	10,0
69	District 7	District 8	0,27	6,6
70	District 9	Thủ Đức District	0,44	10,4
71	District 6	Tân Phú District	0,47	11,3
72	District 8	District 8	0,11	2,6
73	District 4	District 11	0,24	5,8
74	District 1	District 10	0,14	3,3
75	District 5	District 5	0,22	5,3
76	Gò Vấp District	Gò Vấp District	0,28	6,7
77	District 5	District 5	0,26	6,3
78	District 2	Bình Thạnh District	0,21	5,1
79	District 1	District 10	0,10	2,3
80	District 1	District 10	0,15	3,6
81	District 4	District 11	0,21	5,0
82	District 3	Tân Bình District	0,36	8,7
83	District 1	District 10	0,32	7,7
84	District 1	District 10	0,26	6,2
85	District 4	District 11	0,44	10,5
86	District 7	District 8	0,39	9,4
87	District 4	District 11	0,48	11,5
88	District 4	District 11	0,32	7,6
89	District 1	District 10	0,14	3,2
90	Bình Thạnh District	Bình Thạnh District	0,24	5,8
91	District 1	District 10	0,28	6,6
92	District 2	Bình Thạnh District	0,33	7,9
93	District 1	District 10	0,50	11,9
94	District 7	District 8	0,33	8,0

95	District 2	Bình Thạnh District	0,20	4,8
96	District 1	District 10	0,29	6,9
97	District 6	Tân Phú District	0,36	8,7
98	District 1	District 10	0,50	12,0
99	District 6	Tân Phú District	0,13	3,1
100	District 9	Thủ Đức District	0,26	6,4
101	District Bình Tân	Tân Phú District	0,21	5,0
102	District 1	District 10	0,44	10,6
103	District 5	District 5	0,46	10,9
104	District 6	Tân Phú District	0,35	8,4
105	District 1	District 10	0,23	5,6
106	District 4	District 11	0,40	9,7
107	Thủ Đức District	Gò Vấp District	0,41	9,8
108	Thủ Đức District	Thủ Đức District	0,09	2,2
109	District 1	District 10	0,23	5,4
110	District 1	District 10	0,23	5,4
111	District 3	Tân Bình District	0,48	11,6
112	District 1	District 10	0,48	11,5
113	Bình Thạnh District	Bình Thạnh District	0,41	9,9
114	District 3	Tân Bình District	0,21	5,2
115	District 7	District 8	0,30	7,1
116	District 4	District 11	0,17	4,0
117	Bình Thạnh District	Bình Thạnh District	0,13	3,1
118	District 5	District 5	0,38	9,1
119	District 3	Tân Bình District	0,14	3,4
120	District 4	District 11	0,36	8,6
121	District 8	District 8	0,35	8,4
122	Thủ Đức District	Thủ Đức District	0,10	2,4
123	Gò Vấp District	Gò Vấp District	0,29	6,9
124	Thủ Đức District	Thủ Đức District	0,23	5,5
125	Tân Phú District	Tân Phú District	0,17	4,1

Table A-07: Delivery time of Fast and Economical Delivery

STT	Ship time	
	Days	Hours
1	0.13	3.1
2	0.08	1.9
3	0.13	3.2
4	0.20	4.9
5	0.15	3.6
6	0.19	4.6
7	0.15	3.5
8	0.09	2.2
9	0.15	3.5
10	0.12	2.8
11	0.13	3.0
12	0.22	5.3
13	0.15	3.7
14	0.24	5.7
15	0.20	4.7
16	0.17	4.1
17	0.13	3.2
18	0.16	3.8
19	0.19	4.5
20	0.16	3.8
21	0.28	6.8

22	0.19	4.6
23	0.16	3.8
24	0.18	4.3
25	0.15	3.7
26	0.10	2.5
27	0.19	4.5
28	0.13	3.2
29	0.23	5.6
30	0.13	3.1
31	0.12	3.0
32	0.19	4.6
33	0.20	4.7
34	0.17	4.0
35	0.16	3.8
36	0.18	4.2
37	0.13	3.1
38	0.16	3.9
39	0.15	3.6
40	0.10	2.5
41	0.22	5.3
42	0.18	4.2
43	0.19	4.6

44	0.15	3.6
45	0.12	2.9
46	0.19	4.5
47	0.16	3.8
48	0.20	4.7
49	0.24	5.8
50	0.15	3.6
51	0.26	6.3
52	0.15	3.7
53	0.15	3.7
54	0.19	4.6
55	0.19	4.5
56	0.13	3.0
57	0.18	4.2
58	0.16	3.9
59	0.08	2.0
60	0.15	3.5
61	0.06	1.5
62	0.17	4.0
63	0.26	6.3
64	0.15	3.5

65	0.17	4.1
66	0.20	4.9
67	0.16	3.8
68	0.22	5.2
69	0.08	2.0
70	0.13	3.2
71	0.18	4.3
72	0.16	3.9
73	0.11	2.7
74	0.08	2.0
75	0.13	3.1
76	0.20	4.7
77	0.15	3.6
78	0.18	4.2
79	0.16	3.9
80	0.20	4.7
81	0.10	2.4
82	0.20	4.7
83	0.13	3.1
84	0.17	4.0
85	0.22	5.3

86	0.12	2.8
87	0.15	3.5
88	0.11	2.7
89	0.19	4.5
90	0.14	3.4
91	0.10	2.5
92	0.23	5.6
93	0.15	3.5
94	0.20	4.7
95	0.24	5.8
96	0.15	3.7
97	0.22	5.3
98	0.11	2.7
99	0.22	5.3
100	0.17	4.0
101	0.15	3.5
102	0.13	3.0
103	0.14	3.4
104	0.15	3.6
105	0.11	2.7
106	0.19	4.6

107	0.20	4.7
108	0.20	4.9
109	0.10	2.4
110	0.21	5.0
111	0.15	3.6
112	0.20	4.7
113	0.15	3.6
114	0.10	2.5
115	0.18	4.3
116	0.23	5.6
117	0.15	3.5
118	0.11	2.6
119	0.19	4.6
120	0.16	3.9
121	0.22	5.3
122	0.20	4.7
123	0.19	4.5
124	0.13	3.0
125	0.13	3.1

Table A-08: Total delivery time of Express Delivery

STT	Days	Hours
1	0,13	3
2	0,09	2,1
3	0,15	3,5
4	0,11	2,7
5	0,15	3,5
6	0,10	2,3
7	0,10	2,5
8	0,18	4,3
9	0,11	2,7
10	0,16	3,9
11	0,15	3,6
12	0,12	2,8
13	0,16	3,9
14	0,10	2,5
15	0,13	3,2
16	0,16	3,8
17	0,07	1,6
18	0,09	2,2
19	0,08	1,9
20	0,14	3,3
21	0,15	3,5
22	0,12	2,9