

USING THE FREIGHT ANALYSIS FRAMEWORK (FAF3) TO UNDERSTAND AGGREGATE FREIGHT MODELING

FACILITATION GUIDE FACILITATION GUIDE

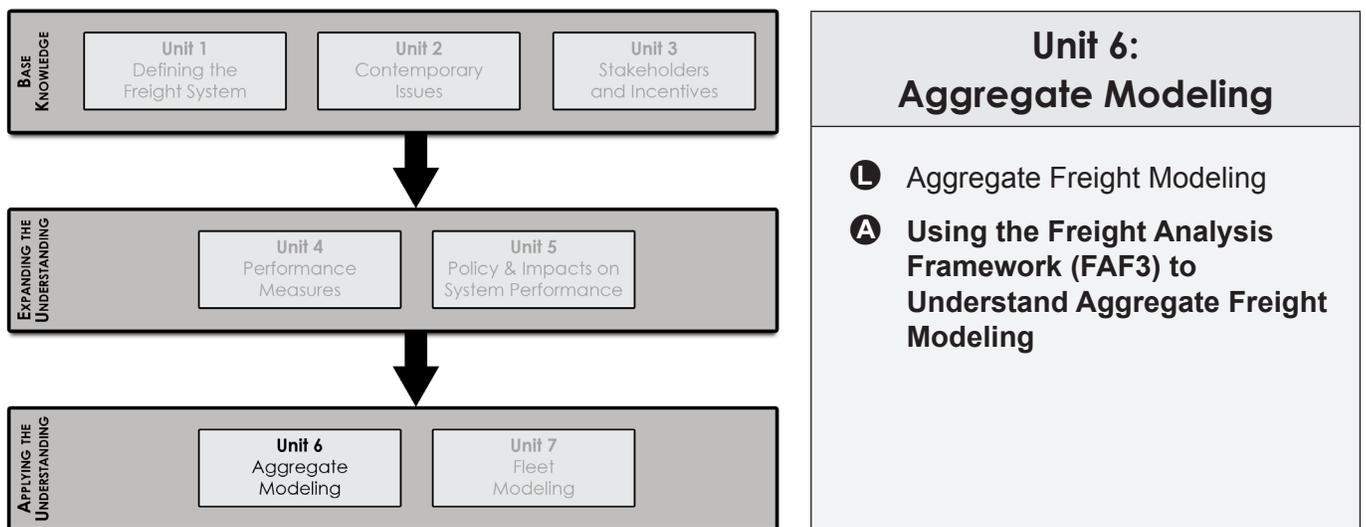
BEFORE CLASS

Connection	Activity Overview	Required Resources	Agenda & Instructor Notes
Review to see how this activity fits as part of the course and Unit 6.	Read to learn more about the content of the activity.	Review to make sure you have the materials you need for this activity.	Read to prepare for what you will do in class during the activity.

CONNECTION

Activity #9 is the only activity within Unit 6: Aggregate Modeling. This activity uses background information and concepts presented in a lecture on aggregate freight modeling and allows students to use real-world tools to better understand the concept of aggregate model and its applications. The information provided in Unit 6 builds on previous units and provides a glimpse into real-life applications and further studies within freight transportation.

In Activity #9, students gain background knowledge on the Freight Analysis Framework (FAF3), a better understanding of the input and output data provided by FAF3, and how this information can be useful to inform planning and engineering decisions regarding freight transportation.



ACTIVITY OVERVIEW

Activity #9 consists of both a pre-class (9a) and in-class (9b) component. In the pre-class activity, students are asked to write a one to two-page summary of the Freight Analysis Framework. The summary is to include (but is not limited to) the following:

- Purpose
- History
- Who the framework was developed by
- Origin and types of inputs
- Types of outputs

The pre-activity prepares students for the in-class portion of the activity by introducing them to FAF before they are asked to use it.

In the in-class activity, students work together to gather information from FAF which will assist in answering the Critical Thinking Questions within the activity. The purpose of this portion of the activity is to make students aware of the information available within FAF and introduce them to the kinds of questions FAF can be used to answer.

Within the in-class activity, students are asked to use the FAF website together to gather information to answer the Critical Thinking Questions. While students are encouraged to collaborate while working on the questions, each student must submit their individual answers. The questions within the activity range from simple data retrieval questions, to questions that require an understanding of how FAF works, to questions relating back to past lectures, to questions that ask them to apply information gathered in FAF.

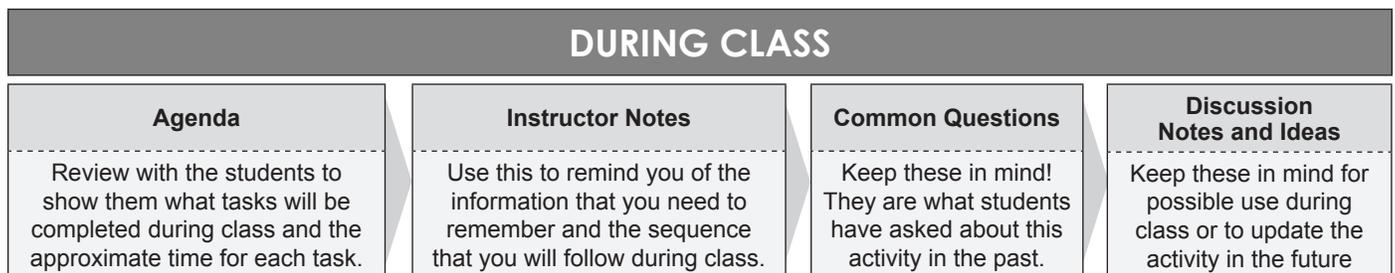
The **learning objectives** for Activity #9 include:

- To become familiar with FAF, including its development, components, and uses.
- To practice written communication skills.
- To gain an understanding of the data that can be extracted by FAF3.
- To use information from FAF3 to verify previously discussed concepts regarding freight movements.

REQUIRED RESOURCES

You will need the following material for this activity:

- Activity text
- A computer with internet access
- A projector



AGENDA

Pre-class activity (#9a)

- Introduce and assign students pre-class assignment

In-class activity (#9b)

- Hand out activity and provide computer and projector for student use.
- Students should work together to use FAF (on the provided computer) to gather data to answer the Critical Thinking Questions. Students should take turns going to the front of the class and using FAF. This can be facilitated by the instructor.
- Students are to answer questions individually but are encouraged to discuss with other students.

Post-class

- Students should complete any of the activity which was not completed within the class period.

INSTRUCTOR NOTES

The Critical Thinking Questions require students to gather data from FAF. Some questions can be answered just by providing the information from FAF, while others require students to use and/or synthesize the data. The instructor should facilitate the students taking turns using the computer at the front of the room to use FAF (with input from the other students). There could be as many as 40 individual “tasks” using FAF to be completed in this activity but several of these tasks could also be completed in one step. The instructor should consider how many students are in the class when facilitating the rotation of students on the computer.

The instructor should facilitate the activity by keeping students on track and moving through the questions. The instructor should make sure students have enough time to record the data collected by FAF, briefly discuss with classmates and write down quick notes regarding the answer to the question. In order to not make students feel rushed, the instructor should encourage students to formalize their answers after all the data has been gathered through FAF.

COMMON QUESTIONS/CONCERNS

As noted in the student activity sheet, this assignment contains uncertainty. Students are reminded that there are several different ways to interpret and answer many of the questions within the assignment. It is suggested that students include parameters used within the FAF3 model in their responses, as well as specify proper units.

DISCUSSION NOTES/IDEAS

Additional questions:

- What do you expect to be the top US import? Are you right?
- What do you expect to be the top US export? Are you correct?
- Formulate a research question that you could use FAF to help you answer.
- What are the limitations of FAF?

AFTER CLASS

Answers and Notes	Activity Assessment	Next Steps
Use the information here to help you evaluate student performance.	Use this space to take notes regarding the implementation and facilitation of the activity which can be used to make any necessary adjustments to the activity.	This is a reminder of what comes next, including any homework or preparation that students need to complete for the next class or activity.

ANSWERS AND NOTES

Pre-class assignment: example deliverable

The Freight Analysis Framework (FAF) was developed in 2002 through a collaboration between the Center for Transportation Analysis (CTA) and the Federal Highway Administration (FHWA). The CTA was the main developer of this tool. CTA is a division of the Oak Ridge National Laboratory (ORNL). The FAF is a multi-commodity freight database that can be used for analysis of freight flows to, from and within the United States.

The FAF is designed to be useful for developing successful policy with respect to planning, operation and management of the freight system. It can be used to improve our understanding of the structure and dynamics of transport system. Additionally the framework can provide important information with respect to the development of capacity solutions. Due to the challenges of using FAF data for metropolitan area projects, it is best suited for application on a national level.

The data contained in the FAF is the most complete source of publically available data on freight currently available. The FAF separates traffic flow into 114 zones, each representing an origin and a destination throughout the US. Though it is not available down to the local level, it does provide useful data that can be used to inform freight flowing models. Additionally, there are ways to disaggregate the data and gain granularity. I found one paper that discusses using socio-economic variables to break the data down into much smaller areas that they called traffic analysis zones (Sharma et al 2010).

The FAF aggregates data on all the transportation modes. The intermodal category includes shipments that are moved by one or more modes. The shipments are classed by commodity type. The data for the commodities comes out of the Commodity Flow Survey and other data sources. The four types of commodity data collected are the following:

- Shipment origination
- Shipment destination
- Commodity Class
- Mode Used

The framework estimates a weight and a dollar value for the commodities based on economic census trends.

FAF produces outputs of its aggregated data that can be downloaded from the ORNL website. The extraction tool can be used to acquire data on total flows, domestic flows, imports, and exports. Additional available data includes:

- Shipments within and between states by mode, weight or value.
- Shipments within and between states by commodity, weight or value.

Hu, Patricia. (no date). Research Brief: Freight Analysis Framework. Oak Ridge National Laboratory. <http://www.ornl.gov/sci/ees/etsd/cta/Freight%20Analysis%20Framework%20%28FAF%29.pdf>

Sharma, N. S., Harris, G. A., Anderson, M. D., Farrington, P. A., & Swain, J. J. (August 14, 2010). Freight Data Mining Strategy Using Socio-economic Variables for Metropolitan Planning. IEEE Conference. 396-401.

In-Class Assignment: Critical Thinking Questions:

1. How many zones (when examining imports/exports) does FAF3 divide the US into? Briefly describe how the zones are divided.

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Metropolitan areas are considered as individual zones. Some metropolitan areas span more than one state thus there are individual zones for those areas in each state. The remainder of the state not within a metropolitan area is considered together as another zone.

2. How much freight (in \$-value and in weight) was imported into Seattle in 2010?

DMS_ORIG	Total Ktons in 2010	Total Ton-Mile in 2010	Total M\$ in 2010	Total Current M\$ in 2010
Seattle WA CSA	14,643.23	16,856.99	57,048.58	61,266.07

3. Is the answer to the previous question based on actual observations, or a forecast? What is the difference between “Total M\$ in 2010” and “Total Current M\$ in 2010”?

It is based on a forecast from 2007 observations. Total \$ is calculated in 2007 dollars while Total Current \$ is calculated in 2010 dollars.

4. How many tons of imported agriculture products (“other ag prods”) are transported from Washington to New York State in 2010?

DMS ORIG	DMS DEST	SCTG2	Total Ktons in 2010	Total Ton-Mile in 2010	Total M\$ in 2010	Total Current M\$ in 2010
Washington	New York	Other ag prods.	16.01	45.18	17.59	21.30

5. How do you expect this to compare to the volume (tonnage) of domestic agriculture products (“other ag prods”) transported from Washington to New York State in 2010? Are you right? (Predict and then check your prediction.)

I would expect the domestic value to be greater because I know that Washington produces a lot of agriculture products and given the perishability of such products, I would expect them to come from closer origins to the final destination. My prediction is correct.

DMS ORIG	DMS DEST	SCTG2	Total Ktons in 2010	Total Ton-Mile in 2010	Total M\$ in 2010	Total Current M\$ in 2010
Washington	New York	Other ag prods.	39.28	110.57	34.89	42.39

6. Explain why there is a difference between looking at goods moving from Washington to New York under the Import Flows page and under the Domestic Flows page.

The import page is reporting goods that originate outside of the country but travel from a domestic destination of Washington to New York state. The domestic page is reporting goods that originate in Washington and move to New York state.

7. Who (given the foreign origin choices in FAF) do you think is the US’s largest trading partner? Are you right? Check considering flow of goods (sum of imports and exports) by value in 2007.

Import

FR_ORIG	Total Ktons in 2007	Total M\$ in 2007
Canada	397,681.01	318,454.15
Mexico	141,531.44	209,894.93
Rest of Americas	256,196.17	199,825.02
Europe	121,421.86	317,505.11
Africa	167,516.60	89,145.00
SW & Central Asia	140,547.15	109,026.37
Eastern Asia	120,709.93	681,548.67
SE Asia & Oceania	26,601.20	71,611.39

Export

FR_DEST	Total Ktons in 2007	Total M\$ in 2007
Canada	144,081.12	248,190.28
Mexico	87,391.03	136,197.04
Rest of Americas	91,533.20	176,797.13
Europe	93,538.07	260,144.34
Africa	32,913.64	21,442.92
SW & Central Asia	39,792.96	68,716.04
Eastern Asia	141,304.84	233,599.73
SE Asia & Oceania	24,525.50	51,265.78

Regarding imports, Canada is the US's largest trading partner when considering volumes, but East Asia is the US's largest trading partner by value. Considering exports, the ranking are more consistent comparing volume and value. Canada is the largest recipient of US exports by both metrics.

8. Considering the domestic flow of electronics, gravel, and meat and seafood. What is the breakdown between modes of transport in 2007? Based on previous lectures and activities, is this what you expected? Explain.

SCTG2	DMS_MODE	Total Ktons in 2007	Total Ton-Mile in 2007	Total M\$ in 2007
Meat/seafood	Truck	102,513.45	39,455.45	291,048.14
Meat/seafood	Rail	292.87	527.39	663.00
Meat/seafood	Water	463.38	278.72	968.62
Meat/seafood	Air (include truck-air)	86.51	140.69	869.18
Meat/seafood	Multiple modes & mail	823.21	1,222.10	3,434.48
Meat/seafood	Other and unknown	797.27	333.49	2,836.25
Gravel	Truck	2,037,059.20	175,488.45	20,453.68
Gravel	Rail	77,881.26	22,566.14	1,039.67
Gravel	Water	49,929.79	25,110.67	296.95
Gravel	Multiple modes & mail	67,166.30	28,032.12	879.74
Gravel	Other and unknown	31,598.10	3,178.91	843.92
Electronics	Truck	48,889.85	25,788.45	572,301.69
Electronics	Rail	517.39	978.43	6,117.00
Electronics	Water	0.88	0.48	34.78
Electronics	Air (include truck-air)	362.78	495.80	44,463.72
Electronics	Multiple modes & mail	4,090.91	5,258.61	328,948.96
Electronics	Other and unknown	2,600.00	1,502.02	25,395.33

Truck is the predominate mode for all 3 commodities. Gravel does not travel by plane (not surprising given it's weight). I was surprised that more electronics and meat/seafood travel by rail (slow) than air (fast), given that these commodities are "expensive" and perishable, respectively.

9. What is the breakdown of volume based on foreign origin of goods being imported to final destinations of Chicago and of Phoenix in 2007 (how much does each foreign origin import)? How does this breakdown compare between the two cities? What are some possible reasons for this?

FR_ORIG	Chicago Total KTONs in 2007	Phoenix Total KTONs in 2007
Canada	30,530.07	806.13
Mexico	3,008.55	2,282.09
Rest of Americas	4,270.53	321.30
Europe	4,421.62	113.94
Africa	320.59	2.21
SW & Central Asia	1,162.38	103.13
Eastern Asia	7,469.87	431.35
SE Asia & Oceania	950.92	69.88

The largest foreign origin to Chicago is Canada. In Arizona it is Mexico. This agrees with their proximity to each country. Chicago serves as a hub for goods travelling into the interior US/Midwest. Phoenix serves as a hub for a smaller set of destinations (mainly the southwest), thus the volumes travelling into Phoenix are expected to be smaller than those travelling into Chicago, as seen in the FAF output.

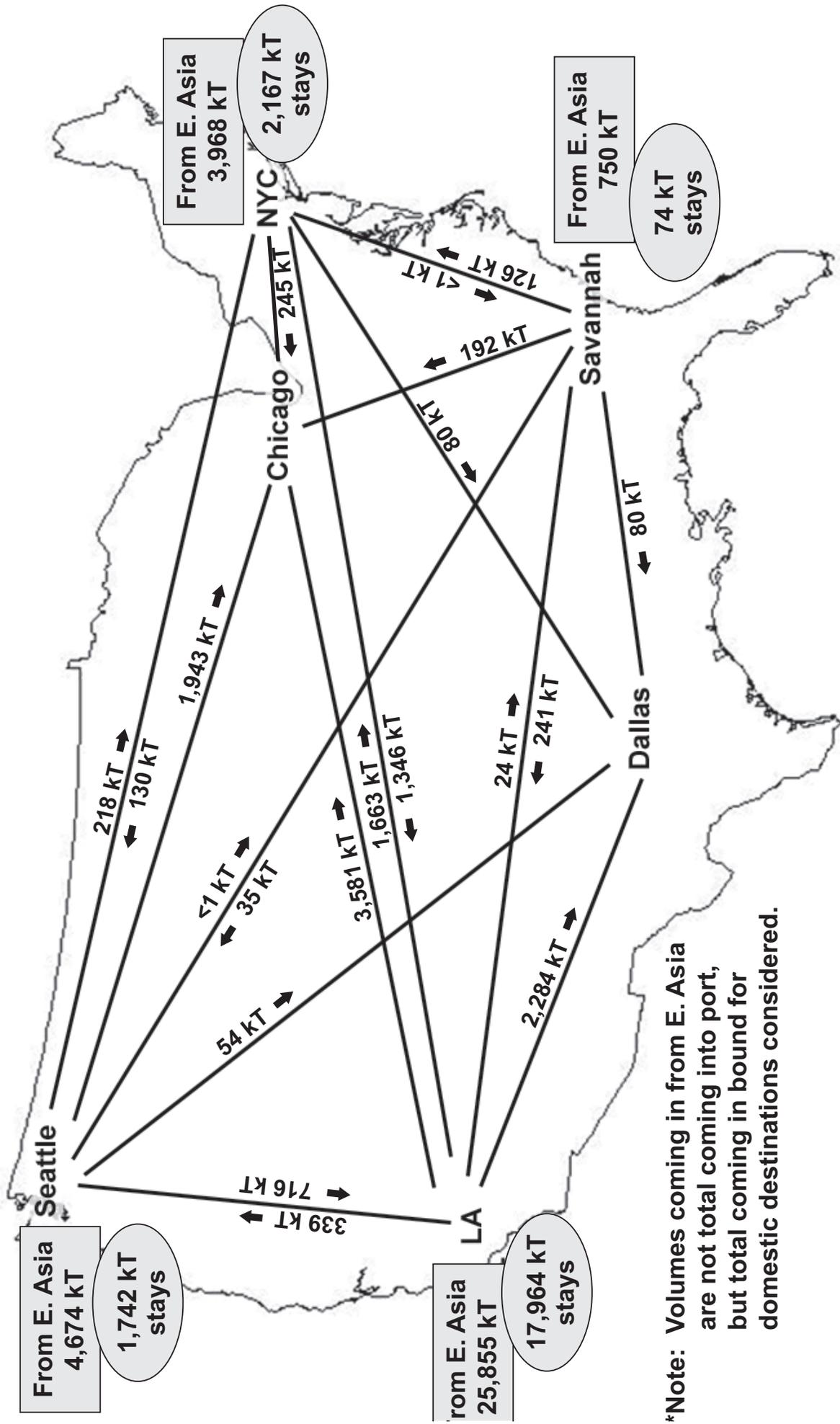
10. Considering (2007) volumes, illustrate how goods travel from East Asia through LA, Seattle, Savannah and New York City (NJ-Part) to LA, Seattle, Savannah, New York City (NY-Part), Dallas and Chicago (IL-Part). You can use the map on the next page to show the goods flows visually. Additionally, answer the following questions:

- a. What is the percentage of total goods (from East Asia) that enter east coast ports versus west coast ports?

<i>Total goods entering the US from East Asia:</i>	<i>87% enters through West Coast ports</i>
<i>4,674 kT (Seattle)</i>	<i>(LA and Seattle)</i>
<i>25,855 kT (LA)</i>	<i>13% enters through East Coast ports</i>
<i>3,967 kT (NYC)</i>	<i>(NYC and Savannah)</i>
<i>750 kT (Savannah)</i>	
<i>35,246 kT (total)</i>	

- b. What percentage of goods imported into each city from East Asia stays in that city (supplies the local demand)?

1,742 kT out of 4,674 kT, or 37% stays in Seattle
17,964 kT out of 25,855 kT or 69% stays in LA
2,167 kT out of 3,968 kT or 55% stays in NYC
74 kT out of 750 kT or 9% stays in Savannah



*Note: Volumes coming in from E. Asia are not total coming into port, but total coming in bound for domestic destinations considered.

- c. What are the percentages of total goods imported into Chicago from each of the US port cities? Into Dallas?

Into Chicago (5,961 kT total):

From Seattle 1,943 kT or 33%
From LA 3,581 kT of 60%
From NYC 245 kT or 3%
From Savannah 192 kT or 3%

Into Dallas (2,498 kT total):

From Seattle 54 kT or 2%
From LA 2,284 kT of 91%
From NYC 80 kT or 3%
From Savannah 80 kT or 3%

- d. Based on the answers to the previous questions, make two conclusions about goods movement in the US.

Goods coming from Asia predominantly travel through West Coast ports.

Cities with larger populations (LA and NYC) have a larger percentage of goods remaining in the city.

Goods moving into Dallas predominately move from LA to Dallas.

Data used in solution:

FR_ORIG	DMS_ORIG	DMS_DEST	Total KTONs in 2007
Eastern Asia	Los Angeles CA CSA	Los Angeles CA CSA	17,964.31
Eastern Asia	Los Angeles CA CSA	Savannah GA CSA	24.11
Eastern Asia	Los Angeles CA CSA	Chicago IL-IN-WI CSA (IL Part)	3,580.80
Eastern Asia	Los Angeles CA CSA	New York NY-NJ-CT-PA CSA (NY Part)	1,662.64
Eastern Asia	Los Angeles CA CSA	Dallas-Fort Worth TX CSA	2,284.17
Eastern Asia	Los Angeles CA CSA	Seattle WA CSA	339.40
Eastern Asia	Savannah GA CSA	Los Angeles CA CSA	240.86
Eastern Asia	Savannah GA CSA	Savannah GA CSA	74.09
Eastern Asia	Savannah GA CSA	Chicago IL-IN-WI CSA (IL Part)	191.93
Eastern Asia	Savannah GA CSA	New York NY-NJ-CT-PA CSA (NY Part)	126.14
Eastern Asia	Savannah GA CSA	Dallas-Fort Worth TX CSA	80.66
Eastern Asia	Savannah GA CSA	Seattle WA CSA	35.77
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	Los Angeles CA CSA	1,345.55
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	Savannah GA CSA	0.25
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	Chicago IL-IN-WI CSA (IL Part)	244.64
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	New York NY-NJ-CT-PA CSA (NY Part)	2,167.09
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	Dallas-Fort Worth TX CSA	80.41
Eastern Asia	New York NY-NJ-CT-PA CSA (NJ Part)	Seattle WA CSA	130.40
Eastern Asia	Seattle WA CSA	Los Angeles CA CSA	716.46
Eastern Asia	Seattle WA CSA	Savannah GA CSA	0.72
Eastern Asia	Seattle WA CSA	Chicago IL-IN-WI CSA (IL Part)	1,943.33
Eastern Asia	Seattle WA CSA	New York NY-NJ-CT-PA CSA (NY Part)	217.66
Eastern Asia	Seattle WA CSA	Dallas-Fort Worth TX CSA	53.65
Eastern Asia	Seattle WA CSA	Seattle WA CSA	1,741.67

The greatest volumes of goods from East Asia come into the US through the West Coast ports. These ports are closest to the origin. Over half the goods coming into LA and NYC stay in those cities.

11. Let's jump ahead several years and say it is now 2040. How could you use FAF to examine the impact of the Panama Canal widening (completed in 2015) on freight flows in the US? Explain what data you would extract and compare. Assume that data from as far back as 1997 is available on the FAF site.

I would first look at data from before the Panama Canal was widened. I would extract data on imports by volume into ports on the West Coast (Seattle, Oakland, and LA/LB) and on the East Coast (Houston, New Orleans, Savannah, Charleston, Norfolk, Baltimore and NY/NJ). I would compare this data to the same data from after the canal was widened. Because it may take a bit of time for trade patterns to stabilize, I extract data for the year with most recent observed (not forecasted) data. Because total trade volumes will (hopefully) increase over time, I would consider the proportion of trade by volume which is imported into each port.

**Note – not all ports mentioned need to be examined, but the student should have selected several from each coast.*

12. Reflection: How is FAF useful as a tool within research? Within practice? What are the limitations of FAF within both?

Reflections will vary by student.

ACTIVITY ASSESSMENT

NEXT STEPS

This activity is the final activity in Unit 6. Unit 7 follows.