

**An Accurate Monitoring of Truck
Waiting and Flow Times
at a Terminal in the Los Angeles/Long
Beach Ports**

2nd National Urban Freight Conference

Thursday, December 6, 2007

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The Need for Turn-time Statistics

- Know efficiency of terminal operations
- Verify reported efficiency from terminal operators
- Use data for simulation and other modeling studies
- Useful data for trucking companies

Turn-Time Measurements

- Turn time is defined as the time from a truck's arrival at the terminal to its exit
- Terminal operators typically track transaction time: from verification of transaction at pedestal stations to exit gate

What is Missing?

- Waiting time, including:
 - Inside terminal, from entry gate to pedestal stations waiting for verification of transaction
 - Outside terminal, waiting in line to enter terminal entry gate
- Trouble time and break time during transaction
- No detailed distribution
- Solution: collect our own data

Project Objectives

- Track the equivalence of one full-day of day-time's truck movements through a selected terminal, and produce the following data :
 - Distribution of truck wait times (from arrival to admittance with transaction verified at pedestals).
 - Distribution of truck transaction times (from pedestal stations to exit gate).
 - Distribution of truck turn times (from arrival to the exit gate).
 - Arrival pattern to the main entry gate as well as the bobtail gate.
 - Queue lengths outside of the entry gates.

Methodology

- Data collection
- Database setup and data entry
- Truck matching
- Data extraction
- Statistical analysis

Data Collection

- 5 sessions spread over 4 days:
 - 4/11/06 (Tuesday) 11 AM – 2 PM
 - 4/13/06 (Thursday) 2 PM – 5 PM
 - 4/20/06 (Thursday) 8 AM – 11 AM
 - 5/25/06 (Thursday) 8 AM – 11 AM
 - 5/25/06 (Thursday) 5 PM – 7 PM
- All during middle of the week
- 4/20 session unexpectedly cut short, replaced by 5/25 AM session
- All sessions combined cover the bulk of day-time shift

Are These Days Representative?

- Terminal X provided the following gate volume data:

- During day shift of the selected days:

4/11	1134	-5.7% from Average
4/13	1203	0%
4/20	1280	+6.4%
5/25	1194	-0.7%
Average	1203	

- Weekly gate volume in 2005:

Jul & Aug: Highest (5.2% & 5.1% above mean)

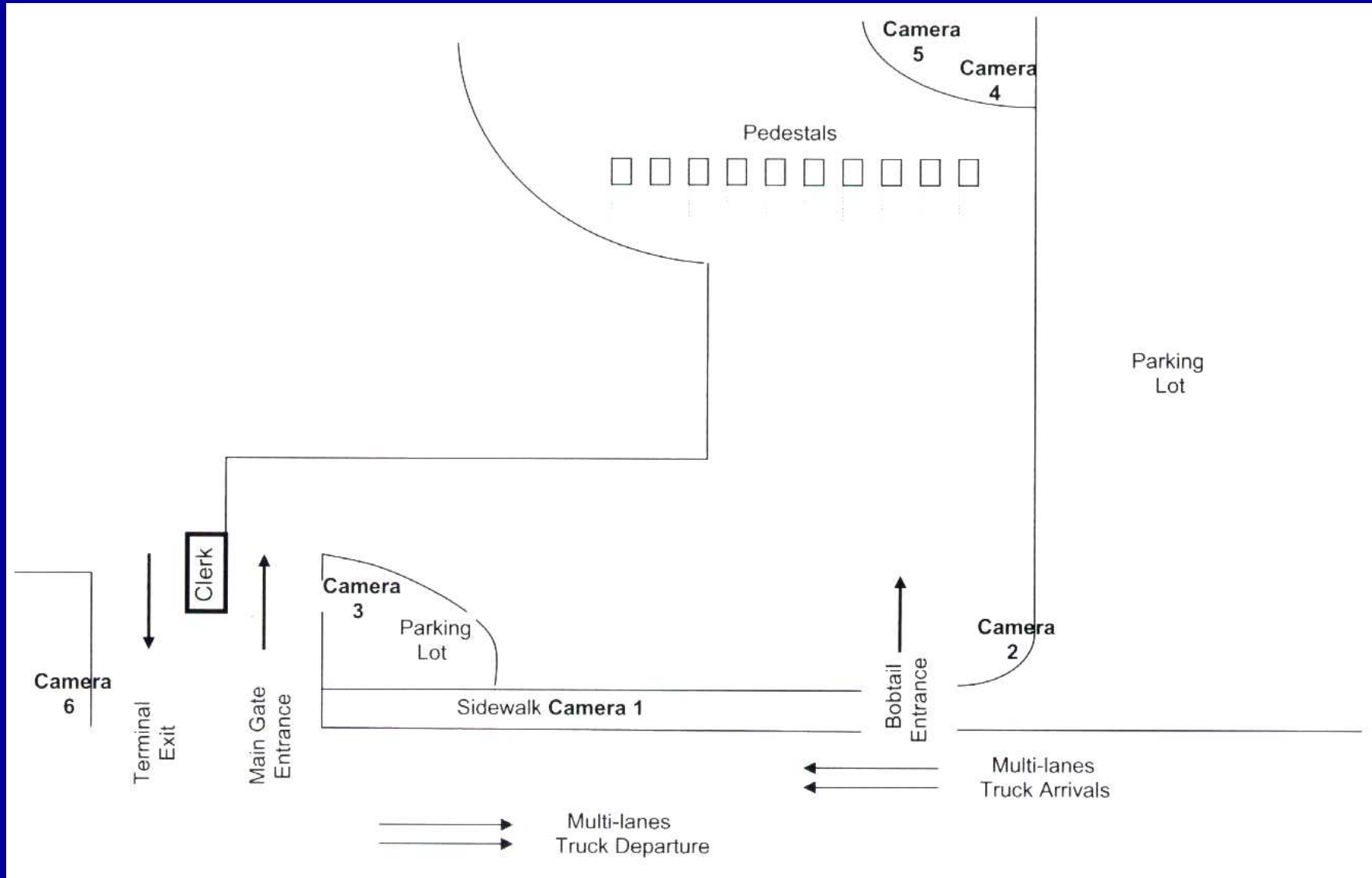
Mar: Lowest (11.6 below mean)

Apr & May: about mean (0.3% & 1.2% above mean)

Data Collection

- Set up 6 digital cameras at 5 vantage points:
 - (1) Side walk along the truck arrival lanes before entering terminal gate
 - (2) Bobtail gate
 - (3) Main entry gate
 - (4) & (5) Pedestal stations
 - (6) Exit gate
- All cameras synchronized to the minute.
- Each capture every truck passing that vantage point (except load is split at the 10-lane pedestals).

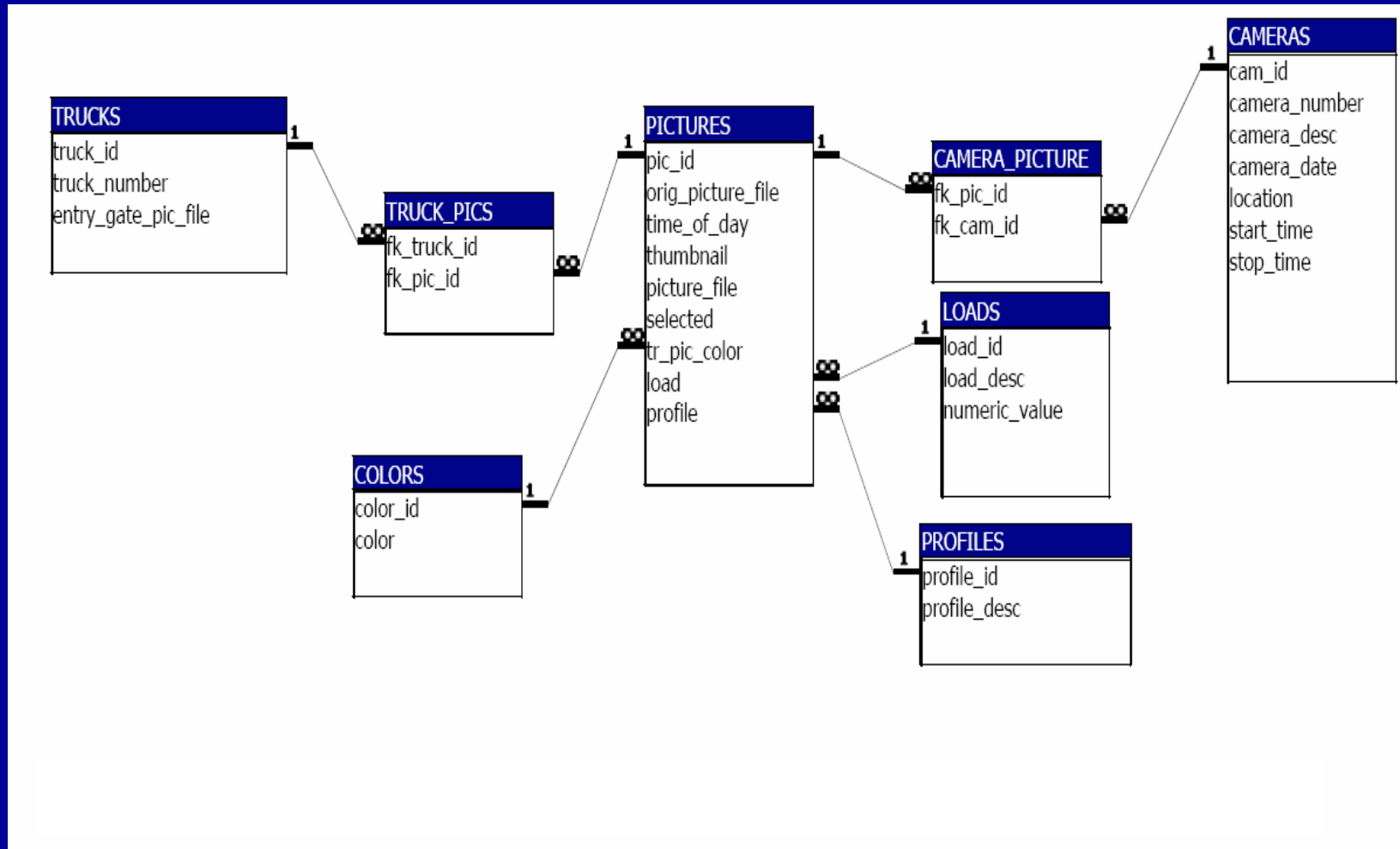
Data Collection



Database Setup and Data Entry

- Upload all pictures onto computer
- Prepare one Excel spreadsheet for each camera date & location, with picture filename, timestamp, color, truck profile & load data for each truck picture
- Populate Microsoft Access database using these spreadsheet

Access database used for truck data storage



Truck Matching

- Developed a Web interface application to enable visual inspection and matching
- Input to application: picture files and truck database
- Students are assigned specific subset of truck files taken at entries for matching
- With each entry truck shown on screen, the mostly likely choices at pedestal or exit would be presented for user to select & match
- A truck trip is complete when the same truck is identified at entry, pedestal, and exit in a reasonable time sequence
- Students can work from home, independently

Truck Matching

Thursday April 13, 2006: cam 6 - exit gate Trucks: blue not flat



03:09:11PM
cam6_041306_148.jpg.jpg
blue nf container



03:48:04PM
cam6_041306_232.jpg.jpg
blue nf unknown



03:58:06PM
cam6_041306_262.jpg.jpg
blue nf none (bobtail)

truck close

pedestal cam 4

pedestal cam 5

exit cam 6

Review a completed truck

Unmatched Trucks

253 blue not flat

complete

Truck matches completed

29b

completed



Thursday April 13, 2006 Location: cam 3 - main gate

Target: Number: 29 Time: 02:15:33PM

Color: blue Load: unknown File: cam3_041306_029.jpg.jpg



02:27:17PM
Camera: 5 pedestal two
container

Delete

OK



02:37:58PM
Camera: 6 - exit gate
unknown

[view complete truck trip report for Thursday April 13, 2006](#)

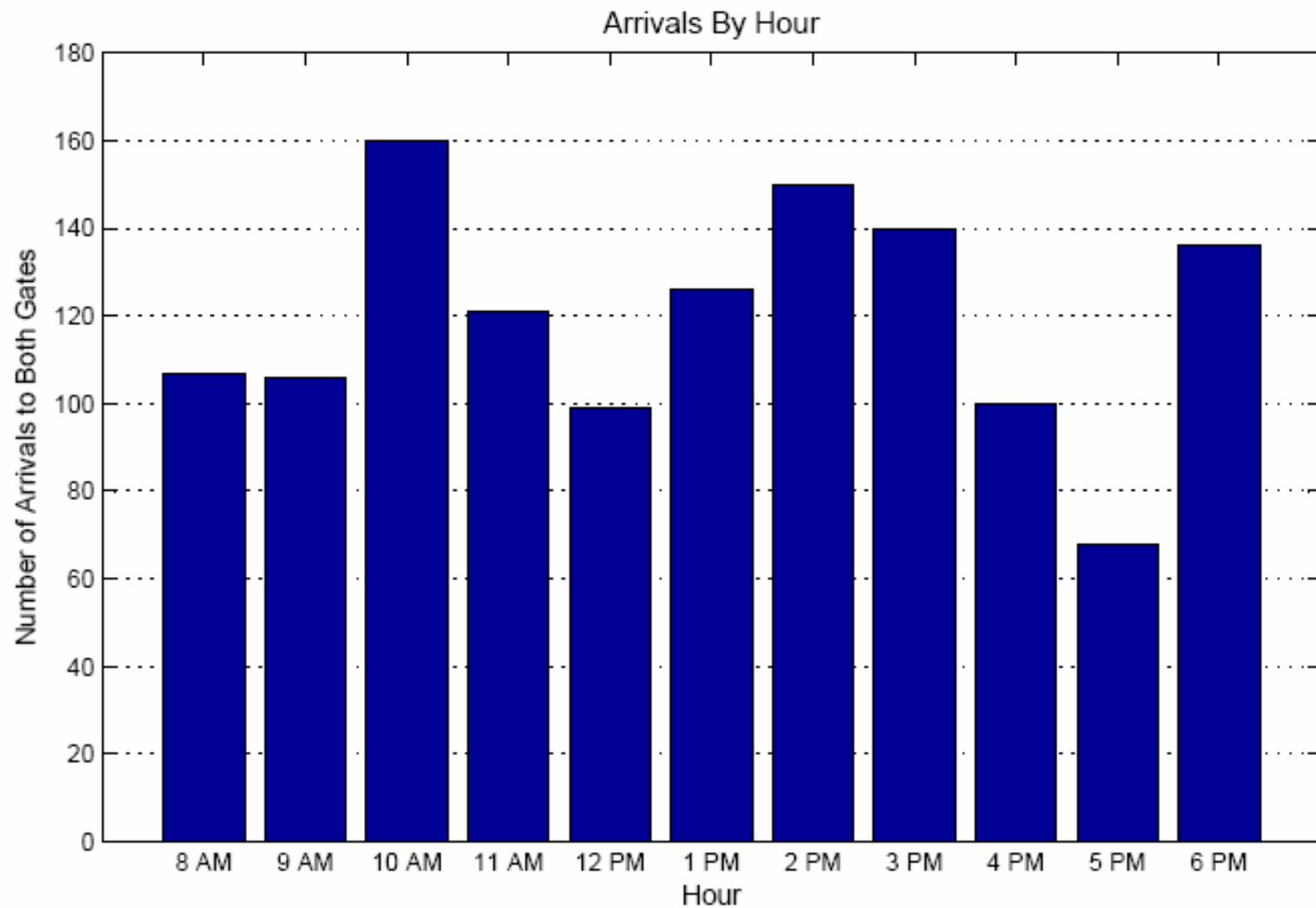
Data Extraction

- Result of truck matching contains the data of every truck recorded during monitoring, from arrival, to gate, to pedestal, then exit
- Use queries to retrieve these data onto Excel spreadsheet
- Data retrieved for statistical analysis include:
 - Arrivals at bobtail gate
 - Arrivals at main entry gate
 - Arrivals at both gates (i.e. all arrivals)
 - Complete truck trips and truck loads

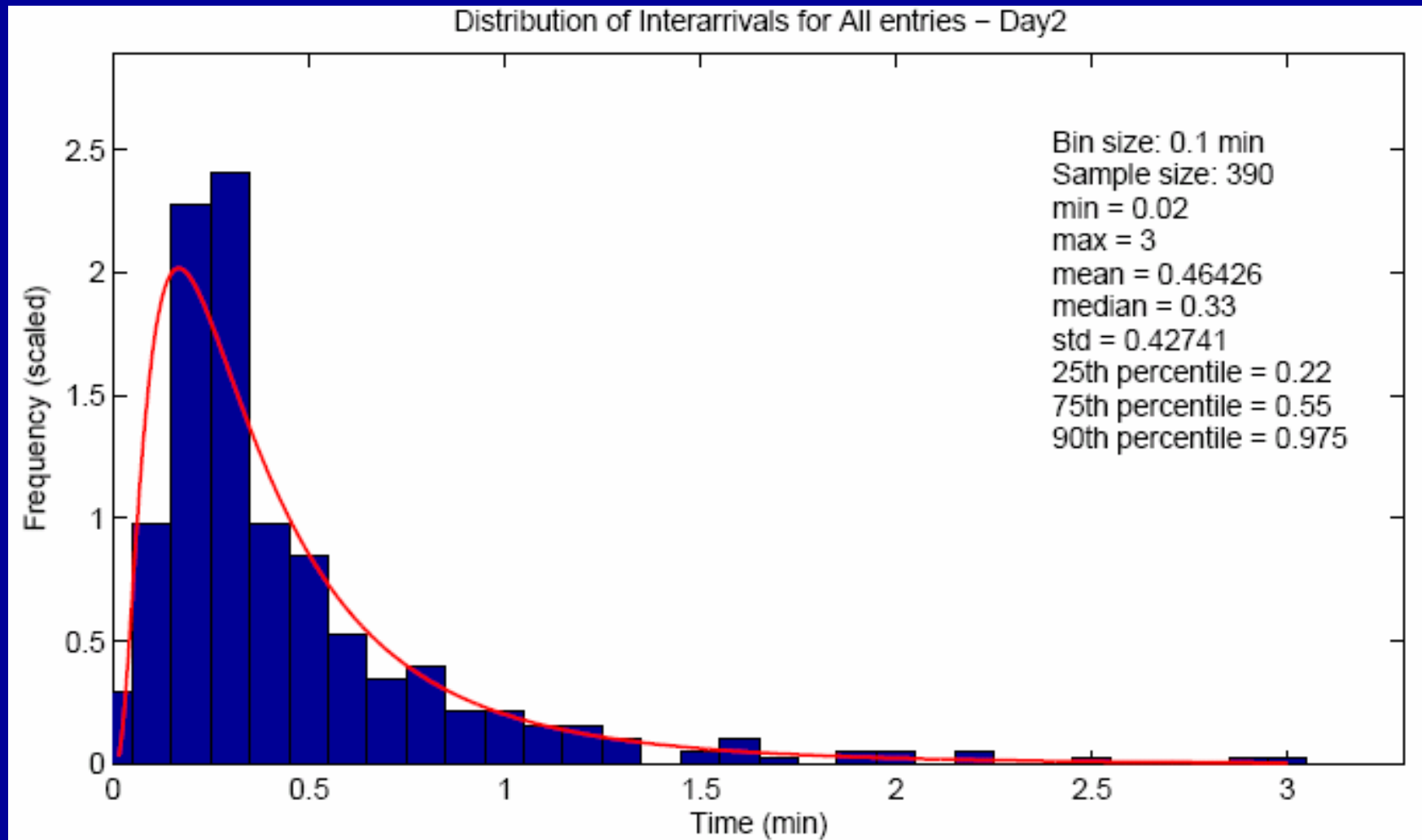
Truck Matching Accuracy

		Hour 1	Hour 2	Hour 3	All 3 Hours
4/11	# entered	102	86	109	297
	# exit found	98	83	75	256
	% matched	96%	97%	69%	86%
4/13	# entered	149	140	103	392
	# exit found	147	140	63	350
	% matched	99%	100%	61%	89%
5/25	# entered	107	106	164	377
	# exit found	103	104	126	333
	% matched	96%	98%	77%	88%
All 3 days	# entered	358	332	375	1066
	# exit found	348	327	264	939
	% matched	97%	98%	70%	88%

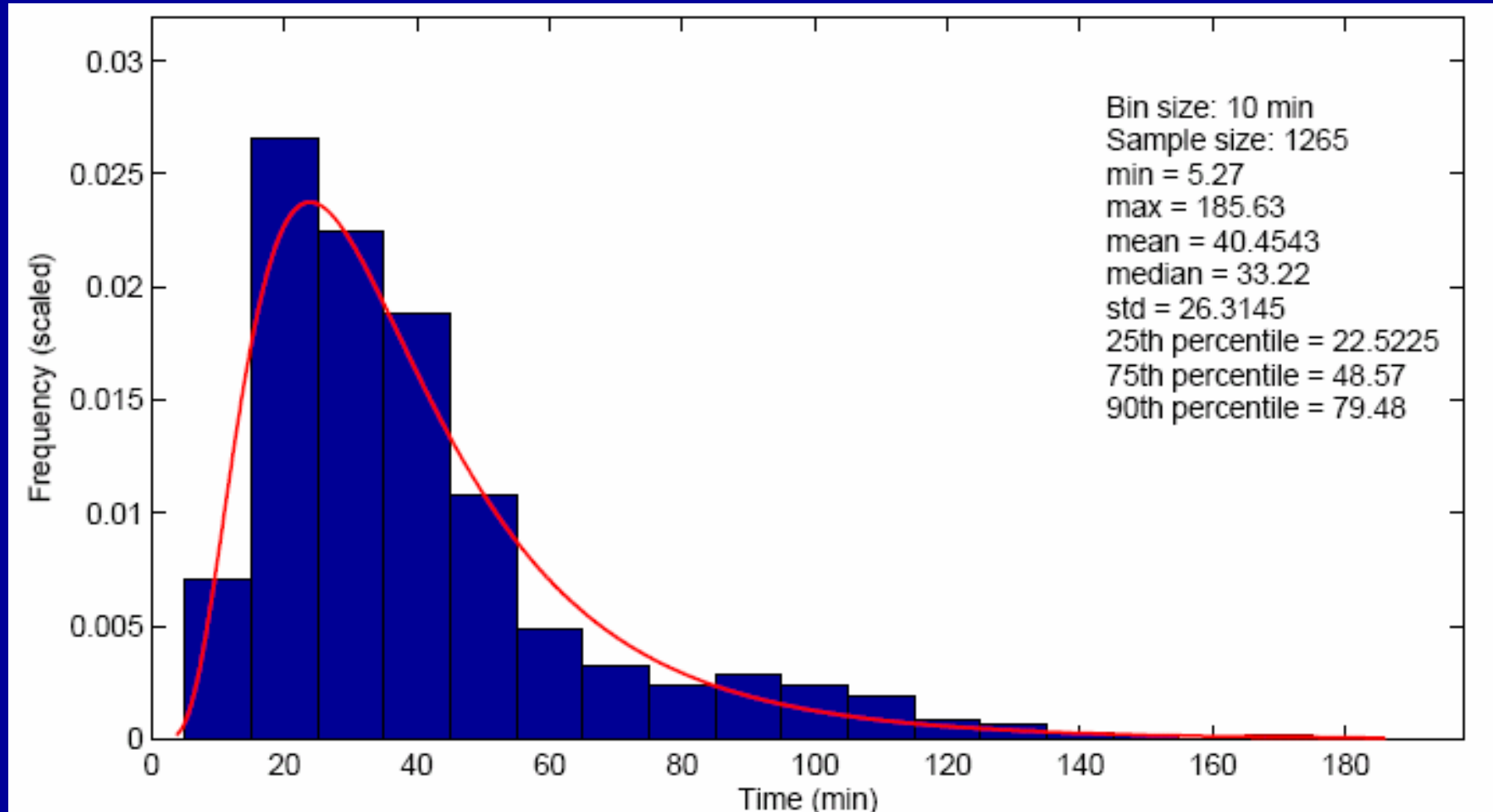
Arrival by Hour



Interarrival Time Distribution



Turn Time Distribution



Truck Wait/Transaction/Turn Time Statistics (in Minutes)

Statistic	Wait Time	Transaction Time	Turn Time
Mean	9	31	40
Median	6	22	32
75 th Percentile	13	37	49
90 th Percentile	20	71	88

Truck Wait/Transaction/Turn Time Statistics Using Only
Hours 1 & 2 of Each Monitoring Session (in Minutes)

Statistic	Wait Time	Transaction Time	Turn Time
Mean	9	35	44
Median	6	24	33
75 th Percentile	11	43	57
90 th Percentile	22	79	97

Truck Turn Time by Transaction Type (in Minutes)

Statistic	Bobtail in / Container out	Container in / Bobtail out	Container in / Container out
Mean	50 (40)	36 (38)	60 (61)
Median	39 (42)	24 (38)	54 (61)
75 th Percentile	60 (60)	40 (58)	80 (86)
90 th Percentile	98 (90)	81 (112)	109 (126)

Conclusions

- Truck arrivals peak in mid morning and mid afternoon.
- No real line formed outside of terminal gate.
- Transaction time is 35 minutes on average (79 minutes at 90th percentile), much longer than the 20-25 minutes often cited by terminal operators. Reasons: break time and trouble time are deducted from their statistics.
- Dual transactions (Container in / Container out) on the average take 60 minutes to complete, identical to findings in Giuliano et al. (METTRANS, March 2006).

Lessons Learned

- The split of monitoring into 3-hour sessions on separate days led to biased statistics for the 3rd hour arrivals. Perhaps better to keep the 3-hour sessions all on same day.
- Though rare, some trucks were able to make multiple trips in and out of terminal during a monitoring session. Be aware so as to avoid erroneous matching.
- The use of truck colors and profile was found extremely help in reducing potential choice, hence speed up matching. Color and profile choice must be clearly distinct to avoid judgment errors in identification of matching.