

Technical Tip

Spreadsheet Design for Dock Time and Transit Time Calculations Using Raw Date and Time Data

Written by: Leo J. Lazarus

The information in this document is a supplement to material included in the book:

Truckload Transportation: Economics, Pricing & Analysis

written by Leo J. Lazarus

The book and actual spreadsheet model are available at:

www.TruckloadTransportation.com

! Technical Tip – Calculations with Date & Time Information

Many of the critical efficiency measurements such as dock time, transit time, and cycle time are computed with time-based information, primarily the dates and times provided by the truck driver as pick-up and delivery activity takes place. As the carrier accesses operating data for reports, time-based information can be difficult to work with when attempting to compute these measurements.

The goal of this calculation illustration is to provide a method for converting the date and time information into minutes. The minute-level information is then easily applied to compute the various time-based measurements. The example below illustrates the dock time and transit time calculations for the basic order cycle. The times are based on simple military time. For example, the delivery arrival time of 13:45 represents 1:45 p.m.

While it is relatively simple to compare a single set of arrival and departure times with the naked eye, it is more difficult to compute the minutes based on the information in the time and date format. If the arrival and departure occur on different days, the calculation becomes even more difficult. Based on the serial date information, the method below converts each of the time components, days, hours, and minutes, into the least common denominator of minutes.

Time Calculations: Date and Time Conversion to Minutes

	Basic Order Cycle				
	Pick Up Dock Time		Transit Time	Delivery Dock Time	
	Arrival	Departure		Arrival	Departure
Date	5/1/2008	5/1/2008	→	5/2/2008	5/2/2008
Time	08:15	09:10		13:45	14:52

Identification and Isolation of Time Components					
Days	39,569	39,569		39,570	39,570
Hours	8	9		13	14
Minutes	15	10		45	52

Conversion of Time Components to Minutes					
Days (1,440)	56,979,360	56,979,360		56,980,800	56,980,800
Hours (60)	480	540		780	840
Minutes (1)	15	10		45	52
Total	56,979,855	56,979,910		56,981,625	56,981,692

Final Time Components	Pick Up Dock Time	Transit Time	Delivery Dock Time
		55 minutes 0.92 hours	1,715 minutes 28.58 hours

By comparing the computed number of minutes at each step in the pick-up and delivery cycle, the number of minutes between each step can be computed. The formulas and calculations are explained in the next section.

The spreadsheets below display the results of the formulas as well as the underlying spreadsheet formulas. Rows 4 to 8 contain the actual raw data. Rows 11 to 25 contain the formulas and calculations.

Actual Spreadsheet View

	B	C	D	E	F	G	H	I	J
2	Time-Based Calculations								
3									
4	Basic Order Cycle								
5	Pick Up Dock Time		Transit Time			Delivery Dock Time			
6		Arrival	Departure				Arrival	Departure	
7	Date:	5/1/2008	5/1/2008				5/2/2008	5/2/2008	
8	Time:	08:15	09:10				13:45	14:52	
9									
10									
11	Identification and Isolation of Time Components								
12	Days	39,569	39,569				39,570	39,570	
13	Hours	8	9				13	14	
14	Minutes	15	10				45	52	
15									
16									
17	Conversion of Time Components to Minutes								
18	Days (1,440)	56,979,360	56,979,360				56,980,800	56,980,800	
19	Hours (60)	480	540				780	840	
20	Minutes (1)	15	10				45	52	
21	Total	56,979,855	56,979,910				56,981,625	56,981,692	
22									
23	Final Time Components		Pick Up Dock Time	Transit Time			Delivery Dock Time		
24			55 minutes	1,715 minutes			67 minutes		
25			0.92 hours	28.58 hours			1.12 hours		

Spreadsheet Formulas View

	B	C	D	E	F	G	H	I	J
2	Time-Based Calculations Formulas								
3									
4	Basic Order Cycle								
5	Pick Up Dock Time		Transit Time			Delivery Dock Time			
6		Arrival	Departure				Arrival	Departure	
7	Date:	5/1/2008	5/1/2008				5/2/2008	5/2/2008	
8	Time:	08:15	09:10				13:45	14:52	
9									
10									
11	Identification and Isolation of Time Components								
12	Days	=C7	=D7				=I7	=J7	
13	Hours	=LEFT(C8,2)*1	=LEFT(D8,2)*1				=LEFT(I8,2)*1	=LEFT(J8,2)*1	
14	Minutes	=RIGHT(C8,2)*1	=RIGHT(D8,2)*1				=RIGHT(I8,2)*1	=RIGHT(J8,2)*1	
15									
16									
17	Conversion of Time Components to Minutes								
18	Days (1,440)	=1440*C12	=1440*D12				=1440*I12	=1440*J12	
19	Hours (60)	=C13*60	=D13*60				=I13*60	=J13*60	
20	Minutes (1)	=C14	=D14				=I14	=J14	
21	Total	=SUM(C18:C20)	=SUM(D18:D20)				=SUM(I18:I20)	=SUM(J18:J20)	
22									
23	Final Time Components		Pick Up Dock Time	Transit Time			Delivery Dock Time		
24			=D21-C21 minutes	=I21-D21 minutes			=J21-I21 minutes		
25			=C24/60 hours	=F24/60 hours			=I24/60 hours		

Explanation of Formula Design

Step 1: Identification and Isolation of Time Components. The goal of this section is to convert the raw date and time data into the individual time components of days, hours, and minutes.

- **Days** (Cells C12, D12, I12 and J12): The number of days is determined by the underlying number within the date field. Simply reformatting the date field from a “date” format to a “number” format reveals what is known as the “serial” date. The value shown in cell C12 (39,569) represents the number of days between 01/01/1900 and the date shown. For example, the date of 01/01/1900, when formatted as a number, has a “serial” date value of 1.
- **Hours** (Cell C13, D13, I13 and J13): The objective of this calculation is to determine the number of hours since midnight. First, the “left” function is used as shown to isolate the first two characters from the left in the target cell. At the end of the formula, the “left” result of “08” as text from cell C8 is then multiplied by “1” to convert the text to a numeric value of 8 hours.
- **Minutes** (Cell C14, D14, I14 and J14): The objective of this calculation is to determine the number of minutes since the start of the hour. The “right” function is used to isolate the first two characters from the right in the target cell. At the end of the formula, the “right” result of “15” from cell C8 is then multiplied by “1” to convert the text to a number value of 15 minutes.

Step 2: Conversion of Time Components to Minutes. The goal of this section is to convert each time component, days, hours, and minutes, to a comparable time number based on total minutes since midnight on 01/01/1900.

- **Days** (Cells C18, D18, I18 and J18): The objective of this calculation is to convert the “serial” date value from row 12 to the common time component of minutes. The “serial” date, representing a number of days, is multiplied by 1,440, which is the number of minutes in a day (24 hours x 60 minutes = 1,440 minutes).
- **Hours** (Cells C19, D19, I19 and J19): The objective of this calculation is to convert the hours value from row 13 to the common time component of minutes. The hours value is multiplied by 60 minutes per hour to complete the conversion to total minutes.
- **Minutes** (Cells C20, D20, I20 and J20): Since the values in row 14 already represent minutes, no conversion calculation is necessary. The formulas in row 20 simply pull the minutes from row 14 down to row 20 for organizational and formatting purposes.
- **Total Minutes** (Cells C21, D21, I21 and J21): This calculation sums the results of the corresponding calculations of minutes above for days, hours and minutes. The value shown in this cell represents the time the event occurred as measured by the exact number of minutes since midnight on 01/01/1900. Each total-minutes value is meaningless as a stand-alone number. However, when compared to other minute values in the same order cycle, the results provide powerful, meaningful results as shown below in Step 3.

Step 3: Final Time Components. This section provides the final desired outputs for the process. Comparing the standardized minute values from steps 1 and 2 allows for the identification of the critical cycle time elements of dock time and transit time.

- **Dock Time Minutes** (Cells C24 and I24): The objective of these cells is to compare the standardized minutes from step 2 to determine the amount of dock time in minutes. In cell C24, the arrival time (cell C21) is subtracted from the departure time (cell D21) to compute the dock time of 55 minutes.
- **Dock Time Hours** (Cells C25 and I 25): The objective of these cells is to convert the dock time minutes from cells C24 and I24 into hours. The minutes from these cells are divided by 60 (60 minutes in an hour) to determine the dock time for both the pick-up and delivery.
- **Transit Time Minutes** (Cell F24): The objective of this cell is to compare the standardized minutes from step 2 to compute the transit time minutes for the trip. In cell F24, the origin departure time (cell D21) is subtracted from the delivery arrival time (cell I21) to compute the transit time of 1,715 minutes.
- **Transit Time Hours** (Cell F25): The objective of this cell is to convert the transit time minutes from cell F24 into hours. The minutes from cell F24 are divided by 60 (60 minutes in an hour) to determine the transit time of 28.58 hours.

Converting the final measurements to hours allows for the easiest interpretation in a reporting format. For example, a dock time of 2.5 hours is easier to interpret than a dock time of 150 minutes.

Other Considerations

The analysis performed here is based on the availability of accurate time and date information. With the many different carrier systems and data formats available, the approach may need to be adjusted to conform to the format of the available data. The logic of converting the days, hours and minutes to a total minutes figure would still apply. The exact formula design used in the conversion should conform to the available data and still produce the same results. In fact, certain data formats may actually simplify the conversion process.

Since the time information is often provided by the truck driver, data errors can cause problems with the analysis. One common data problem is inconsistency in arrival and departure times. For example, a driver may enter an arrival time of 9:15 am and a departure time of 8:30 am for a particular stop. Obviously, the times are in error since the arrival time must occur before the departure time. The final formulation should also include an “IF” to verify that the departure time is after the arrival time. If the data is clearly not accurate, the “IF” could ignore the calculation and assume a standard dock time, perhaps 30 minutes or 1 hour. A standard time could also be applied in cases where the arrival and departure times produce other unreasonable results. For example, a limit should be set on the maximum allowable computed dock time. If the computed time exceeds the limit, perhaps 6 hours, the reported time could be adjusted to show a standard maximum time instead of the computed time based on potentially inaccurate information.