Solution

Little's Law

1.

$$\text{Frequency (TH)} = \frac{WIP}{CT} = \frac{3 \text{ buses}}{45 \text{ min/circuit}} = \frac{1}{15} \text{ bus/min}, \quad \text{Headway} = \frac{1}{\text{Freq.}} = 15 \text{ min/bus}$$

$$\text{Estimated wait time} = \sqrt{LB \times UB} = \sqrt{\frac{15}{2} \times 15} = 10.61 \text{ min}$$

Geo. Mean

2.

$$\frac{\$6.5e11}{3e8} \approx \$2,000 \text{ / person-yr}, \quad LB = 1 \text{ trips/wk}, UB = 7 \text{ trips/wk} \Rightarrow \sqrt{7} \times 52 = 100 \text{ trips/yr}$$

$$\frac{\$2,000}{100} = \$20 \text{ / person-trip}$$

Supermarket / Grocery Store Statistics	Data
Total number of grocery store employees	3,400,000
Total supermarket sales in 2015	$649,087,000,000
Total supermarket sales in 2012	$602,609,000,000
Total number of grocery stores / supermarkets	37,053
Median weekly sales per supermarket store	$384,911
Average grocery store transaction amount	$27.30
Average number of grocery store trips per week a consumers makes	2.2
Average number of items carried in a supermarket	38,718

(http://www.statisticbrain.com/supermarket-statistics/)

3.

Parameter		LB		UB	Estimate		
Cube per Truckload					3000	(ft3/TL)	
Cube per order	(2*2*2)/12^3 =	0.00463	4*5*10 =	200	0.96225	(ft3/order)	
Number of lanes operating		1		10	3.162278	(lanes)	
Orders per lane-hr		10		60	24.4949	(orders/lane-hr)	
Operating hours per day					15	(hr/day)	
Analysis							
Orders per day	(lanes) x (orders/lane-hr) x (hr/day) =				1161.895	(orders/day)	
Cube per day	(ft3/order) x (orders/day) =				1118.034	(ft3/day)	
TL per Day	(ft3/day)/(ft3/TL) =				0.372678	(TL/day)	
Days between TL	1/(TL/day) =				2.683282	(day/TL)	
TL per Week	(TL/day) x 7 =				2.608746	(TL/wk)	

Rounding: keep fraction