5.4 The individual lanes on a long, tangent, two-lane directional freeway have identical traffic behavior patterns and each follows a linear speed-density relationship. It has been observed that the capacity is 2000 vehicles per hour per lane and occurs at a speed of 25 miles per hour. On one particular day when the input flow rate was 1800 vehicles per hour per lane, an accident occurred on the opposite side of the median which caused a gaper's block and caused the lane density to increase to 120 vehicles per mile. After 15 minutes the accident was removed and traffic began to return to normal operations. Draw the distance-time diagram showing shock waves and selected vehicles trajectories.

Solution:

capacity = 2000 veh/h/l vphpl (vehicles per hour per lane)

speed1 = 25 mph (miles per hour)
density1 = capacity/speed1 = 2000/25 vpmpl (vehicles per mile per lane) = 80 vpmpl
flow = 1800 vphpl

density2 = 120 vpmpl
speed2 = flow/density2 = 1800/120 mph = 15 mph

speed3 = flow/density3 = 1800/105.30 mph = 17.09 mph

density3 = 80 + 8410 vpmpl = 105.30 vpmpl

15 minutes   Time

Distance/mile

K1=25
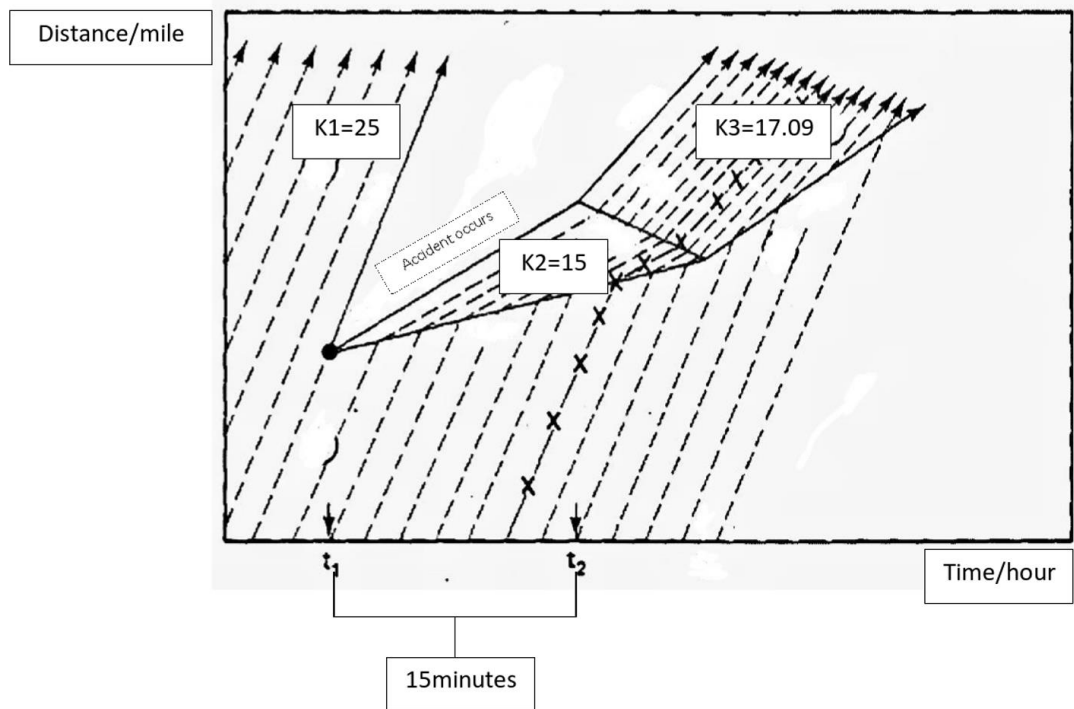
K3=17.09

Accident occurs

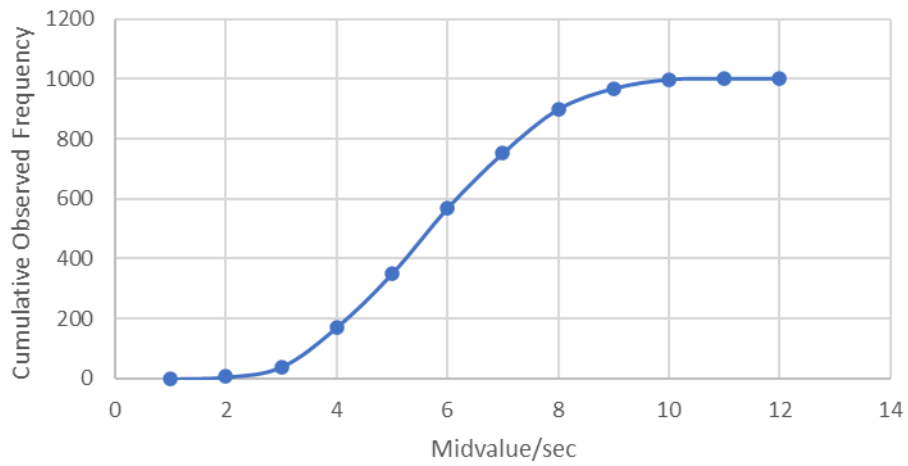K2=15

t_1

t_2

Time/hour

15minutes

5.5 The driver acceptance of time gaps in the main street were observed for the traffic on the minor street controlled by a stop sign. For the following frequency distribution, you need to:

(1) Plot the real cumulative frequency of the time gaps,

(2) Use "Logit" model to estimate the critical gap, and

(3) Plot the fitting curve of the "Logit" model.

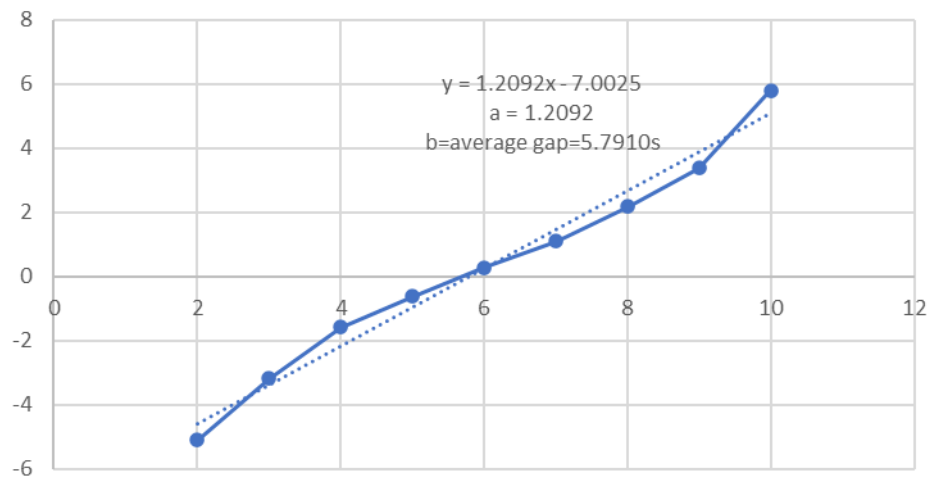| Mid value (sec)	Observed Frequency
1.0	0
2.0	6
3.0	34
4.0	132
5.0	179
6.0	218
7.0	183
8.0	146
9.0	69
10.0	30
11.0	3
12.0	0
Total	1000

Solution: (1) ...

(2) ...

(3) ...

The real cumulative frequency of the time gaps

Cumulative Observed Frequency (y-axis): 0, 200, 400, 600, 800, 1000, 1200

Midvalue/sec (x-axis): 0, 2, 4, 6, 8, 10, 12, 14

linear regression

y-axis: -6, -4, -2, 0, 2, 4, 6, 8

x-axis: 0, 2, 4, 6, 8, 10, 12

$y = 1.2092x - 7.0025$

$a = 1.2092$

b=average gap=5.7910s

the fitting curve of the Logit model

y-axis: 0, 0.2, 0.4, 0.6, 0.8, 1, 1.2

x-axis: 0, 2, 4, 6, 8, 10, 12, 14

$$P = \frac{e^{1.2092(x-5.9710)}}{1 + e^{1.2092(x-5.9710)}}$$

average gap=5.9710s