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15/ENG03/025

CVE 506

Highway Assignment

1) The following non-linear speed-density relationship is assumed for a highway link: $u = 0.001(K-250)^2 - 1.4$ where u has units of km/h and K has unit of vehicles per km

Estimate the free-flow speed, the jam density, the speed and density of max. flow and the lane capacity of the link in question

=) solution

Free flow speed = Zero density

$K=0$, $\therefore u=0$

solving the equation

$K = 287$ or 212 veh/km

At max q,

Sharing the quadratic equation

choose 80.58 veh/km

$4k = 80.58$ veh/km

2) the following flow-density relationship is assumed for a highway link: $q + 60u(\ln u) = 230u$. Estimate the free-flow speed, the speed at max. flow, the max. flow on the link in question and the density at max. flow

3 sdn

a) $t = 30s$

$$P(0) = \frac{15}{100} = 0.15$$

$$P(n) = \frac{(\lambda t)^n e^{-\lambda t}}{n!}$$

$$P(0) = \frac{(\lambda t)^0 e^{\lambda t}}{0!} = 0.15$$

Therefore

$e^{\lambda t} = 0.15$

$-\lambda t = \ln(0.15) = -1.89712$

$\lambda - 1.89712 + 30 = 0.0632$

Therefore

$$P(3) = \frac{(0.0632 \times 30)^3 e^{-(0.0632-30)}}{3!}$$

$$= \frac{(1.892)^{30} e^{(-1.892) - 0.17)}}{6}$$

There is thus a 17.19 chance that 3 vehicles will cross within any one interval

b) $P(\text{headway} > 6) = e^{-6}$

$= 0.684$, 0.684% of the time

c) $P(\text{headway} \geq 4) = e^{(-0.652 - 6)} = 0.772$ or 77.2% of time

Therefore $(\text{headway} \leq 4) = 1 - P(\text{headway} > 4)$

$= 1 - 0.772$

$= 0.223$ or 28.3% of the time