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Study of Effects on Human Health due to Vehicles in Kathmandu Using Fuzzy Relation

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Abstract- Because of the concentration of economic activities within Kathmandu valley and the rapid growth of the population in the valley, the number of vehicles in the valley is also very large and it is growing at an alarming rate. This paper deals a diagnostic method is evolved for the effects of human health causes due t o vehicular emission using the composition of fuzzy relations.

Keywords: max-min composition of fuzzy relation, vehicle, fuzzy relation

1. INTRODUCTION

Although urbanization itself is not bad because urban areas generate employment opportunities and economic development, unmanaged urban growth can ignite many problems. Atmospheric pollution is a product of urbanization, population growth, mushrooming of polluting industries, unmanaged transportation system. In the case of Kathmandu, capital of Nepal, the vehicular pollution has been associated with serious atmospheric problems today. In this paper we have suggested a procedure for the analysis based on the max-min, composition of fuzzy relation of serious disease of human due to vehicular emissions.

Definition 1:

A fuzzy relation R from X to Y which is expressed by the membership function.

μ_R: $X \times Y \rightarrow [0, 1]$

when A is a fuzzy subset of X, the max-min composition of R with A denoted by $R \circ A$ which is a fuzzy subset of Y defined as

[1] $\mu_{R\circ A}(Y) = \underset{x\epsilon X}{max} [\min(\mu_A(X), \mu_R(X,Y))]$ for all $y \in Y$.

It is also written with $\vee$(max) & $\wedge$(min) operators,

$\mu_{R\circ A}(Y) = \underset{x\epsilon X}{\vee} [(\mu_A(X) \wedge \mu_R(X,Y))]$ for all $y \in Y$.

where X and Y are finite sets.

Definition-2: Let Q be a fuzzy relation from X to Y and R be a fuzzy relation from Y to Z. The max-min composition of R with Q representing R*o* Q which is a fuzzy relation from X to Z is defined by

$\mu_{R\circ Q}(X, Z) = \underset{x\epsilon X}{\vee} [(\mu_Q(X,Y) \wedge \mu_R(Y,Z))]$ where $y \in Y$ for all (X, Z) in $X \times Z$.

2. HEALTH IMPLICATIONS OF AIR POLLUTION DUE TO VEHICLES

Consider the set 's' of common air pollutants S= { S_1, S_2, S_3, S_4, S_5, S_6, S_7}

S_1→ Sulphur dioxide

S_4→ Carbon monoxide

S_7 → Ozone

S_2 → Nitrogen Oxide

S_5→ Ammonia

S_3 → Hydrogen Sulphide

S_6 → Lead

And also consider the following set of common vehicles 'V' belonging to the emission of air pollutants.

V= (V_1, V_2, V_3, V_4, V_5, V_6, V_7}

V_1 =Bus

V_5 = Truck

V_2 = Jeep

V_6 = Car

V_3 = micro

V_7 = Van

V_4 = Two wheelers

Let A be a fuzzy subset of S related to an effected patient. Grading of membership in A as follows:

S_1	S_2	S_3	S_4	S_5	S_6	S_7
0.2	1	0	1	0	0.9	0.8

By the data collected from Kathmandu Valley Vehicular Emission Control Project (KVVECP), we arrive at the following fuzzy relation R from S to V which can be represented as

	V_1	V_2	V_3	V_4	V_5	V_6	V_7
S_1	0	0.3	0.2	0.3	1	0.8	0.6
S_2	0.2	0.8	0.7	0.8	1	0.9	0.9
S_3	0	0.2	0	0.4	0.4	0	0.1
S_4	0.6	1	0.8	0.9	1	0.9	0.8
S_5	0	0	0	0	0.2	0	0
S_6	0.5	0.7	0.7	0.8	1	0.8	0.8
S_7	0.3	0.8	0.6	0.7	1	0.5	0.4

This max-min composition $R \circ A$ is assumed to describe the state of patient in terms of pathological effect as a fuzzy subset $R \circ A$ of V expressed by its membership function.

(2) $\mu_{R\circ A}(Y) = \underset{s\epsilon S}{max} [(\mu_A(S) \wedge \mu_R(S,V))]$ for all $v \in V$.

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Using (2),
First fix v= v_i & vary S
$\mu_A(s_1) \wedge \mu_R(s_1, v_1) = 0.2 \wedge 0 = 0$
$\mu_A(s_2) \wedge \mu_R(s_2, v_1) = 1 \wedge 0.2 = 0.2$
$\mu_A(s_3) \wedge \mu_R(s_3, v_1) = 0 \wedge 0 = 0$
$\mu_A(s_4) \wedge \mu(s_4, v_1) = 1 \wedge 0.6 = 0.6$
$\mu_A(s_5) \wedge \mu(s_5, v_1) = 0 \wedge 0 = 0$
$\mu_A(s_6) \wedge \mu(s_6, v_1) = 0.9 \wedge 0.5 = 0.5$
$\mu_A(s_7) \wedge \mu(s_7, v_1) = 0.8 \wedge 0.3 = 0.3$
∴ The max[m] of all these terms and obtain the value of relation,
$\mu_{R \circ A}(S, V_1) = 6$
Thus the grades of membership of R∘A is as follows:

V_1	V_2	V_3	V_4	V_5	V_6	V_7
0.6	1	0.8	0.9	1	0.9	0.9

From the above fuzzy data we observed that high levels of pollutants are emitted from vehicle V_2 and V_5. So many people (P) are most affected from these vehicles.
Let R be a fuzzy relation from S to V consider several people P_1, P_2, P_3, P_4 (member of P). Consider fuzzy relation Q from P to S and T, a fuzzy relation from P to V such that T = R∘Q, i. e.
(3) $\mu_T(P, V) = \max_{s \in S} [(\mu_Q(P, S) \wedge \mu_R(S, V))]$, (P, V) ∈ P×V
The grades of membership of P is as follows

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
P_1	0.8	0	0	0.7	1	1	0.6
P_2	0.4	0.9	0	0	0.8	0.8	0.5
P_3	0	0	0	0	0.8	0.8	1
P_4	1	0.9	0	5	0.4	0.4	0.8

Now fuzzy relation R from S to V and a fuzzy relation Q from P to S are known Determine T = R∘Q by using (3) and proceed in the following manner:
Fix P_1, V_1 and vary S:
$\mu_Q(P_1, S_1) \wedge \mu_R(S_1, V_1) = 0.8 \wedge 0 = 0$
$\mu_Q(P_1, S_2) \wedge \mu_R(S_2, V_1) = 0 \wedge 0.2 = 0$
$\mu_Q(P_1, S_3) \wedge \mu_R(S_3, V_1) = 0 \wedge 0 = 0$
$\mu_Q(P_1, S_4) \wedge \mu_R(S_4, V_1) = 0.7 \wedge 0.6 = 0.6$
$\mu_Q(P_1, S_5) \wedge \mu_R(S_5, V_1) = 0 \wedge 0 = 0$
$\mu_Q(P_1, S_6) \wedge \mu_R(S_6, V_1) = 1 \wedge 0.5 = 0.5$
$\mu_Q(P_1, S_7) \wedge \mu_R(S_7, V_1) = 0.6 \wedge 0.3 = 0.3$
The maximum of all these terms is the value of the (P_1, V_1) elements of the relation
$\mu_T(P_1, V_1) = 0.6$
In the similar manner, we determine the grades of membership for all other pairs and finally we have T = R∘Q

	V_1	V_2	V_3	V_4	V_5	V_6	V_7
P_1	0.6	0.8	0.7	0.8	1	0.8	0.8
P_2	0.6	1	0.8	0.9	1	0.9	0.9
P_3	0.6	0.9	0.8	0.9	1	0.9	0.8
P_4	0.4	0.8	0.7	0.8	1	0.9	0.9

Thus, from the above fuzzy data --
The people P_1 is the most possibly affected from V_5 i.e. Truck.
The people P_2 is the most affected from V_2 and V_5 i.e. Jeep & Truck
The people P_3 is affected from V_5 i.e. Truck.
The people P_4 is affected from V_5 i.e. Truck.

3. DISCUSSION AND CONCLUSION

It is clear that from above fuzzy data people are affected from high level due to vehicles (jeep &truck) which discharge maximum pollutants in the air. In Kathmandu valley, new building construction is increasing day by day and for this, truck (old model) is only way to bearing building material. So people of Kathmandu are living in an environment consist of vehicles which release high level of pollutants in the air.
To minimize pollutants and pollutants affected disease in Kathmandu immediate restrict of jeep and truck (old model) in urban areas.

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