Fatality Risk Model for Passenger Vehicles

CRS = Combined Risk SCORE = $100 \cdot ([RISK_{front} \cdot WEIGHT_{fatalityratio}] + [RISK_{side} \cdot A_{bag}] + RISK_{rear} + [RISK_{roll} \cdot E_{factor}])$

$RISK_{front}$ = frontal impact risk = $100 \cdot (Z_1 \cdot N_{frontd} + Z_2 \cdot N_{frontp} + Z_3 \cdot I_{front}) \cdot Z_4$

N_{frontd} = NHTSA frontal impact driver side rating contribution =10%, 20%, 35%, 45%, or 50% RISK corresponding to star ratings Z_6

N_{frontp} = NHTSA frontal impact passenger side rating contribution = 10%, 20%, 35%, 45%, or 50% RISK corresponding to star ratings Z_7

I_{front} = IIHS frontal impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_8

Z_1 = .25 = assumed % of frontal crash fatality risk measured by NHTSA's frontal impact test for driver's side

Z_2 = .25 = assumed% of frontal crash fatality risk measured by NHTSA's frontal impact test for passenger's side

Z_3 = .50 = assumed % of frontal crash fatality risk measured by IIHS's frontal impact test

$Z_4 = Z_5/RISK_{frontAveVehicle}$

Z_5 = 38% = .38 = percentage of all fatalities due to frontal impact

Z_6 = NHTSA frontal impact star rating (driver side) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]

Z_7 = NHTSA frontal impact star rating (driver side) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]

Z_8 = IIHS frontal rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or ACCEPTABLE when rating not known]

$WEIGHT_{fatalityratio}$ = [driver fatality rate]/[average weight pass car driver fatality rate] = W_{dfr}/Z_9

Z_9 = average weight pass car driver fatality rate = 40.15 deaths per million registered-vehicle-years

= driver fatality rate =

= for passenger cars and vans < 5000 lbs.= $2.09.07 \cdot e^{-.0005 \cdot Z_{10}}$

= for passenger cars and vans> 5000 lbs. = 17.164

= for SUVs <5250 lbs. = $210.1 \cdot e^{-.0005 \cdot Z_{10}}$

= for SUVs > 5250 lbs. = 15.227

= for Pickups < 5250 lbs. = $130.52 \cdot e^{-.0003 \cdot Z_{10}}$

= for Pickups > 5250 lbs. = 27.026

Z_{10} Vehicle Weight (lbs. as published by NHTSA)

$RISK_{side}$ = side impact risk = $100 \cdot (Z_{11} \cdot N_{sidef} + Z_{12} \cdot N_{sider} + Z_{13} \cdot I_{side}) \cdot Z_{14}$

N_{sidef} = NHTSA side impact front seat rating contribution = 5%, 10%, 20%, 25% or 30% RISK corresponding to star ratings Z_{16}

N_{sider} = NHTSA side impact rear seat rating contribution = 5%, 10%, 20%, 25% or 30% RISK corresponding to star ratings Z_{17}

I_{side} = IIHS side impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_{18}

A_{bag} = Side-curtain airbag factor = .55 and applies when Z_{19} = YES and I_{side} not known, otherwise = 1.00 {A_{bag}

Z_{11} = .25 = assumed % of side crash fatality risk measured by NHTSA's side impact test for front seat

Z_{12} = .25 = assumed % of side crash fatality risk measured by NHTSA's side impact test for rear seat

Z_{13} = .50 = assumed % of side crash fatality risk measured by IIHS's side impact test

$Z_{14} = Z_{15}/RISK_{sideAveVehicle}$

Z_{15} = 26% = .26 = percentage of all fatalities due to side impact

Z_{16} = NHTSA side impact star rating (front seat) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]

Z_{17} = NHTSA side impact star rating (rear seat) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]

Z_{18} = IIHS side impact rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or MARGINAL when rating not known]

Z_{19} = Side-curtain airbag availability (Y=YES [.55 factor], N=NO [1.00 factor]). [$Z_{19\ ave.}$ @ 50% benefit = .775 factor]

$RISK_{rear}$ = $100 \cdot I_{rear} \cdot Z_{20}$

I_{rear} = IIHS rear impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_{21}

$Z_{20} = Z_{22}/RISK_{rearAveVehicle}$

Z_{21} = IIHS rear impact rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or MARGINAL when rating not known]

Z_{22} = 3% = .03 = percentage of all fatalities due to rear impact

$RISK_{roll}$ = $100 \cdot N_{roll} \cdot Z_{23}$

N_{roll} = NHTSA rollover RISK = actual rollover RISK otherwise 45%, 35%, 25%, 15%, 8% risk corresponding to NHTSA star ratings Z24

E_{factor} = Electronic Stability Control (ESC) Factor = .57 when Z_{26} = YES, otherwise = 1.0 when Z_{26} = NO. Eave. [$E_{Factor\ Ave.}$ @ 50% benefit = .785]

$Z_{23} = Z_{25}/RISK_{rollAveVehicle}$

Z_{24} = NHTSA rollover star rating = 1,2,3,4 or 5 STARS [or when ratings unknown = 12% for Pass. Cars, = 23% Vans, = 28% SUVs or Pickups]

Z_{25} = 33% = .33 = percentage of all fatalities due to rollover

Z_{26} = ESC availability (Y=YES, N=NO)

END

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