

Fatality Risk Model for Passenger Vehicles

- 1 **CRS** = Combined Risk SCORE = $100 \cdot ([RISK_{front} \cdot WEIGHT_{fatalityratio}] + [RISK_{side} \cdot A_{bag}] + RISK_{rear} + [RISK_{roll} \cdot E_{factor}])$
- 2 $RISK_{front}$ = frontal impact risk = $100 \cdot (Z_1 \cdot N_{frontp} + Z_3 \cdot I_{front}) \cdot Z_4$
- 3 N_{frontd_t} = NHTSA frontal impact Risk = $Risk_{head} + Risk_{chest} - Risk_{head} \cdot Risk_{chest}$ [= .15 when Risk is unknown]
- 4 $Risk_{head_t}$ = $\{1 + \exp[5.02 - 0.00351 \cdot Z_6]\}^{-1}$
- 5 $Risk_{chest_t}$ = $\{1 + \exp[5.55 - 0.0693 \cdot Z_7]\}^{-1}$
- 6 I_{front} = IIHS frontal impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_8
- 7 Z_1 = .50 = assumed % of frontal crash fatality risk measured by NHTSA's frontal impact test
- 8 Z_3 = .50 = assumed % of frontal crash fatality risk measured by IIHS's frontal impact test
- 9 Z_4 = $Z_5 / RISK_{frontAveVehicle}$
- 10 Z_5 = 38% = .38 = percentage of all fatalities due to frontal impact
- 11 Z_6 = NHTSA measured head forces from frontal impact [average of driver and passenger]
- 12 Z_7 = NHTSA measured chest forces from frontal impact [average of driver and passenger]
- 13 Z_8 = IIHS frontal rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or ACCEPTABLE when rating not known]
- 14 $WEIGHT_{fatalityratio}$ = [driver fatality rate]/[average weight pass car driver fatality rate] = W_{dfr} / Z_9
- 15 Z_9 = average weight pass car driver fatality rate = 40.15 deaths per million registered-vehicle-years
- 16 = driver fatality rate =
- 17 = for passenger cars and vans < 5000 lbs. = $209.07 \cdot e^{-0.0005 \cdot Z_{10}}$
- 18 = for passenger cars and vans > 5000 lbs. = 17.164
- 19 = for SUVs < 5250 lbs. = $210.1 \cdot e^{-0.0005 \cdot Z_{10}}$
- 20 = for SUVs > 5250 lbs. = 15.227
- 21 = for Pickups < 5250 lbs. = $130.52 \cdot e^{-0.0003 \cdot Z_{10}}$
- 22 = for Pickups > 5250 lbs. = 27.026
- 23 Z_{10} Vehicle Weight (lbs. as published by NHTSA)
- 24 $RISK_{side}$ = side impact risk = $100 \cdot (Z_{11} \cdot N_{siderf} + Z_{12} \cdot N_{sider} + Z_{13} \cdot I_{side}) \cdot Z_{14}$
- 25 N_{siderf} = NHTSA side impact front seat rating contribution = 5%, 10%, 20%, 25% or 30% RISK corresponding to star ratings Z_{16}
- 26 N_{sider} = NHTSA side impact rear seat rating contribution = 5%, 10%, 20%, 25% or 30% RISK corresponding to star ratings Z_{17}
- 27 I_{side} = IIHS side impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_{18}
- 28 A_{bag} = Side-curtain airbag factor = .55 and applies when Z_{19} = YES and I_{side} not known, otherwise = 1.00 { A_{bag}
- 29 Z_{11} = .25 = assumed % of side crash fatality risk measured by NHTSA's side impact test for front seat
- 30 Z_{12} = .25 = assumed % of side crash fatality risk measured by NHTSA's side impact test for rear seat
- 31 Z_{13} = .50 = assumed % of side crash fatality risk measured by IIHS's side impact test
- 32 Z_{14} = $Z_{15} / RISK_{sideAveVehicle}$
- 33 Z_{15} = 26% = .26 = percentage of all fatalities due to side impact
- 34 Z_{16} = NHTSA side impact star rating (front seat) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]
- 35 Z_{17} = NHTSA side impact star rating (rear seat) = 1,2,3,4 or 5 STARS [or 4.5 STARS when rating not known]
- 36 Z_{18} = IIHS side impact rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or MARGINAL when rating not known]
- 37 Z_{19} = Side-curtain airbag (included in IIHS side impact rating). [otherwise Z_{19} ave. @ 50% benefit = .775 factor when SAB available]
- 38 $RISK_{rear}$ = $100 \cdot I_{rear} \cdot Z_{20}$
- 39 I_{rear} = IIHS rear impact rating contribution = 10%, 20%, 30%, 40% RISK corresponding to IIHS ratings Z_{21}
- 40 Z_{20} = $Z_{22} / RISK_{rearAveVehicle}$
- 41 Z_{21} = IIHS rear impact rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or MARGINAL when rating not known]
- 42 Z_{22} = 3% = .03 = percentage of all fatalities due to rear impact
- 43 $RISK_{roll}$ = $100 \cdot N_{roll} \cdot Z_{23} \cdot I_{roof}$
- 44 N_{roll} = NHTSA rollover RISK = actual rollover RISK otherwise 45%, 35%, 25%, 15%, 8% risk corresponding to NHTSA star ratings Z_{24}
- 45 E_{factor} = Electronic Stability Control (ESC) included in NHTSA rollover rating [otherwise $E_{Factor Ave.}$ @ 50% benefit = .785 when ESC available]
- 46 Z_{23} = $Z_{25} / RISK_{rollAveVehicle}$
- 47 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]
- 48 Z_{25} = 33% = .33 = percentage of all fatalities due to rollover
- 49 Z_{26} = ESC availability (Y=YES, N=NO)
- 50 Z_{27} = IIHS roof strength rating = G (GOOD), A (ACCEPTABLE), M (MARGINAL) or P (POOR) [or POOR when rating not known]
- 51 I_{roof} = IIHS roof strength rating factor = .75, .833, .92, 1.0 corresponding to IIHS ratings Z_{27}