\*\*Risk Factor Calculation\*\*

The risk factor can be calculated using the formula:

Four roads have been chosen in which a vast number of ACT schools are concentrated. They are as follows:

* Road 1: Northbourne Ave
* Road 2: Gungahlin Dr
* Road 3: Barton Hwy
* Road 4: Parkes Way

From the dataset given by ACT government regarding the locations of the crashes occurred from 2015 to 2021. <https://www.data.act.gov.au/Transport/ACT-Road-Crash-Data/6jn4-m8rx/data_preview>

The number of crashes within 1 kilometre of each road has been calculated using Python in Visual Studio Code. They are as follows:

Number of crashes for road 1 in distance 1 kilometres or less is: 2

Number of crashes for road 2 in distance 1 kilometres or less is: 2

Number of crashes for road 3 in distance 1 kilometres or less is: 2

Number of crashes for road 4 in distance 1 kilometres or less is: 1

And length of road 1 is: 3.956 km

And the length of road 2 is: 4.657 km

And the length of road 3 is: 2.28 km

And the length of road 4 is: 4.158 km

And the crash densities associated with each road is:

Crash density of road 1: number of crashes within 1 km within road 1/length of road 1 = 0.5

Crash density of road 2: number of crashes within 1 km within road 2/length of road 2=0.4

Crash density of road 3: number of crashes within 1 km within road 3/length of road 3 = 0.9

Crash density of road 4: number of crashes within 1 km within road 4/length of road 4 = 0.2

This python code has been used to calculate the crash density, speed limit and risk factor for each road:

from geopy.distance import geodesic

from shapely.geometry import LineString, Point

from pyproj import Geod

import numpy

import math

# Define a geodesic object

geod = Geod(ellps="sphere")

line\_NorthBAvencoordin = [(-35.275707,149.129453), (-35.240601,149.137072)]

line\_GungDrcoordin = [(-35.224321,149.121756), (-35.257097,149.089787)]

line\_BartonHwycoordin= [(-35.240601,149.137072),(-35.224321,149.121756)]

line\_ParkesWaycoordin= [(-35.257097,149.089787),(-35.275707,149.129453)]

line\_NorthBAven=LineString(line\_NorthBAvencoordin)

line\_GungDr=LineString(line\_GungDrcoordin)

line\_BartonHwy=LineString(line\_BartonHwycoordin)

line\_ParkesWay=LineString(line\_ParkesWaycoordin)

crashPoints= {

    "point234892\_15": (-35.27438171, 149.1339523),

    "point231209\_15": (-35.39159842, 149.1618047),

    "point231240\_15": (-35.20581863, 149.0688988),

    "point231546\_15": (-35.30881723, 149.1295612),

    "point231562\_15": (-35.37718095,149.1131836),

    "point221639\_15": (-35.32147837,149.0640095),

    "point221375\_15": (-35.24015127,149.1376193),

    "point223849\_15": (-35.24134176,149.1494598),

    "point221821\_15": (-35.23266435,149.1251032),

    "point222603\_15": (-35.23920022,149.0574149),

    "point220238\_15": (-35.34545966,149.06315),

    "point234892\_15": (-35.27438171,149.1339523),

    "point232986\_16": (-35.23656526,149.0701561),

    "point230596\_16": (-35.24468208,149.0410726),

    "point246942\_16": (-35.28594211,149.128148),

    "point245246\_16": (-35.17782266,149.1063809),

    "point242161\_16": (-35.28926258,149.1411253),

    "point242245\_16": (-35.30255811,149.1782677),

    "point242562\_16": (-35.24879425,149.1423371),

    "point235422\_16": (-35.29065047,149.1272686),

    "point252315\_17": (-35.46047665,149.0992988),

    "point251851\_17": (-35.24574913,149.1345759),

    "point250627\_17": (-35.40839748,149.0821422),

    "point250401\_17": (-35.26895466,149.1306742),

    "point271494\_17": (-35.27542459,149.096827),

    "point269668\_17": (-35.37809492,149.1696535),

    "point267575\_17": (-35.24317501,149.0477503),

    "point267265\_17": (-35.3483043,149.06877),

    "point239564\_18": (-35.35012637,149.0706468),

    "point237398\_18": (-35.27347736,149.1219691),

    "point238935\_18": (-35.3419899,149.0669444),

    "point238509\_18": (-35.2600206,149.095859),

    "point269152\_18": (-35.2760467,149.1411386),

    "point269835\_18": (-35.23364316,149.0873371),

    "point272532\_18": (-35.31841833,149.3954681),

    "point271344\_18": (-35.31773958,149.1892973),

    "point236853\_19": (-35.32685616,149.04147),

    "point239410\_19": (-35.22493295,149.1239074),

    "point236436\_19": (-35.4236301,149.0787116),

    "point236532\_19": (-35.27385151,149.1177916),

    "point235797\_19": (-35.24335392,149.1100081),

    "point265102\_19": (-35.32021143,149.0982123),

    "point264264\_19": (-35.32010849,149.2088025),

    "point227956\_20": (-35.39591927,149.1557668),

    "point229694\_20": (-35.20143142,149.0949017),

    "point227307\_20": (-35.34106368,149.1616043),

    "point228630\_20": (-35.29866185,149.1782481),

    "point225860\_20": (-35.33976411,149.1703174),

    "point135\_21": (-35.33768572,149.176075),

    "point189\_21": (-35.20068908,149.1480236),

    "point226689\_21": (-35.26108034,149.1362937)

}

lenghtline1=geodesic(line\_NorthBAvencoordin[1],line\_NorthBAvencoordin[0]).km

lenghtline2=geodesic(line\_GungDrcoordin[1],line\_GungDrcoordin[0]).km

lenghtline3=geodesic(line\_BartonHwycoordin[1],line\_BartonHwycoordin[0]).km

lenghtline4=geodesic(line\_ParkesWaycoordin[1],line\_ParkesWaycoordin[0]).km

i1=0

i2=0

i3=0

i4=0

pointscoord= {name: Point(lon, lat) for name, (lat, lon) in crashPoints.items()}

for name, pt in pointscoord.items():

   pointsOnLine1 = line\_NorthBAven.interpolate(line\_NorthBAven.project(pt))

   pointsOnLine2 = line\_GungDr.interpolate(line\_GungDr.project(pt))

   pointsOnLine3 = line\_BartonHwy.interpolate(line\_BartonHwy.project(pt))

   pointsOnLine4 = line\_ParkesWay.interpolate(line\_ParkesWay.project(pt))

   result1 = geod.inv(pt.x, pt.y, pointsOnLine1.y, pointsOnLine1.x)

   result2=geod.inv(pt.x, pt.y, pointsOnLine2.y , pointsOnLine2.x)

   result3=geod.inv(pt.x, pt.y, pointsOnLine3.y, pointsOnLine3.x)

   result4=geod.inv(pt.x, pt.y, pointsOnLine4.y, pointsOnLine4.x)

   result1\_km=result1[2]/1000

   result2\_km=result2[2]/1000

   result3\_km=result3[2]/1000

   result4\_km=result4[2]/1000

   if(result1\_km < 1):

    print(f"Distance between {name} and NorthBAvenue is: {result1\_km:.1f} km")

    print("The lenght of the line NorthBAvenue Road is: ",lenghtline1)

    i1=i1+1

   if(result2\_km < 1):

    print(f"Distance between {name} and GungDr is: {result2\_km:.1f} km")

    print("The lenght of the line GungDr Road is: ",lenghtline2)

    i2=i2+1

   if(result3\_km < 1):

    print(f"Distance between {name} and BartonHwy is: {result3\_km:.1f} km")

    print("The lenght of the line BartonHwy Road is: ",lenghtline3)

    i3=i3+1

   if(result4\_km < 1):

    print(f"Distance between {name} and ParkesWay is: {result4\_km:.1f} km")

    print("The lenght of the line ParkesWay Road is: ",lenghtline4)

    i4=i4+1

crashdensity\_NorthBAvenue=i1 / lenghtline1

crashdensity\_GungDr=i2 / lenghtline2

crashdensity\_BartonHwy=i3 / lenghtline3

crashdensity\_ParkesWay=i4 / lenghtline4

print(f"The crash density in road NorthBAvenue is: {crashdensity\_NorthBAvenue:.1f}, and that of GungDr is: {crashdensity\_GungDr:.1f}, and that of BartonHwy is: {crashdensity\_BartonHwy:.1f}, and that of ParkesWay is: {crashdensity\_ParkesWay:.1f}")

speedlimitroad1=math.exp(0.01\*60)

speedlimitroad2=math.exp(0.01\*90)

speedlimitroad3=math.exp(0.01\*100)

speedlimitroad4=math.exp(0.01\*80)

print(f"The speed limit of road 1 is: {speedlimitroad1:.1f} and the speed limit of road 2 is: {speedlimitroad2:.1f} and the speed limit of road 3 is: {speedlimitroad3:.1f} and the speed limit of road 4 is: {speedlimitroad4:.1f}")

crossingPenalty=[0,0.2,0.3,0.1]

missingFootPathPenalty=[0,0.2,0.3,0.1]

separationBonus=[-0.3,-0.1,0,-0.2]

riskfactorRoad1=crashdensity\_NorthBAvenue + speedlimitroad1 + crossingPenalty[0] + missingFootPathPenalty[0] + separationBonus[0]

riskfactorRoad2=crashdensity\_GungDr + speedlimitroad2 + crossingPenalty[1] + missingFootPathPenalty[1] + separationBonus[1]

riskfactorRoad3=crashdensity\_BartonHwy + speedlimitroad3 + crossingPenalty[2] + missingFootPathPenalty[2] + separationBonus[2]

riskfactorRoad4=crashdensity\_ParkesWay + speedlimitroad4 + crossingPenalty[3] + missingFootPathPenalty[3] + separationBonus[3]

print(f"The risk factor of road 1 is : {riskfactorRoad1:.1f} and the risk factor of road 2 is: {riskfactorRoad2:.1f} and the risk factor of road 3 is: {riskfactorRoad3:.1f} and the risk factor of road 4 is: {riskfactorRoad4:.1f}")

Additionally, the speed limits of the roads are:

Road 1 speed limit=60km/h

Road 2 speed limit=90 km/h

Road 3 speed limit=100 km/h

Road 4 speed limit=80 km/h

The Road 1 has footpath and crossings, but the other roads does not have continuous crossings and footpath.

Additionally, mostly the speed limit rises nonlinearly, that is exponentially with the risk factor (), therefore an exponential function is incorporated into the formula. Here, β = 0.01 per km/h as the weighting factor.

In addition, the weighting factor of the crash densities is considered α = 1.0.

Penalties/bonus (based on crossing penalty/footpath penalty/separation bonus) are as follows:

* + Northbourne Ave: crossing 0.00, missing-footpath 0.00, separation bonus -0.3
  + Gungahlin Dr: crossing +0.20, missing-footpath +0.20, separation bonus −0.10
  + Barton Hwy: crossing +0.30, missing-footpath +0.30, separation bonus 0
  + Parkes Way: crossing +0.10, missing-footpath +0.10, separation bonus −0.20

**Calculations**

* Road 1 (Northbourne Ave): 0.50 + 1.8 + 0 + 0 – 0.3 = **2**
* Road 2 (Gungahlin Dr): 0.4 + 2.5 + 0.20 + 0.20 − 0.10 = **3.2**
* Road 3 (Barton Hwy): 0.9 + 2.7 + 0.30 + 0.30 − 0 = **4.2**
* Road 4 (Parkes Way): 0.2 + 2.2 + 0.10 + 0.10 − 0.20 = **2.5**

**Result (with these weights)**

* **Road 1 (Northbourne Ave): 2**
* **Road 2 (Gungahlin Dr): 3.2**
* **Road 3 (Barton Hwy): 4.2**
* **Road 4 (Parkes Way): 2.5**

Therefore, it can be seen that the safest road is Northbourne Ave for children to cross.