\*\*Risk Factor Calculation\*\*

The risk factor can be calculated using the formula:

4 roads have been chosen:

Road 1: Northbourne Ave

Road 2: Gungahlin Dr

Road 3: Barton Hwy

Road 4: Parkes Way

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: 0.5

Crash density of road 2: 0.429

Crash density of road 3: 0.88

Crash density of road 4: 0.24

This python code has been used compute the crash density:

from geopy.distance import geodesic

from shapely.geometry import LineString, Point

from pyproj import Geod

import numpy

# 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("The crash density in road NorthBAvenue, GungDr, BartonHwy, and ParkesWay are: ", crashdensity\_NorthBAvenue, crashdensity\_GungDr, crashdensity\_BartonHwy, crashdensity\_ParkesWay)

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.

Using the weighting factors: α = 1.0

β = 0.01 per km/h

* Penalties/bonus (based on crossing/footpath/separation you asked about):
  + Northbourne Ave: crossing 0.00, missing-footpath 0.00, separation bonus 0.00
  + Gungahlin Dr: crossing +0.30, missing-footpath +0.30, separation bonus −0.20
  + Barton Hwy: crossing +0.20, missing-footpath +0.20, separation bonus −0.10
  + Parkes Way: crossing +0.30, missing-footpath +0.30, separation bonus −0.20

**Calculations**

* Road 1 (Northbourne Ave): 0.50 + 60·0.01 + 0 + 0 − 0 = **1.10**
* Road 2 (Gungahlin Dr): 0.429 + 90·0.01 + 0.30 + 0.30 − 0.20 = **1.729**
* Road 3 (Barton Hwy): 0.88 + 100·0.01 + 0.20 + 0.20 − 0.10 = **2.18**
* Road 4 (Parkes Way): 0.24 + 80·0.01 + 0.30 + 0.30 − 0.20 = **1.44**

**Result (with these weights)**

* **Road 3 (Barton Hwy): 2.18**
* **Road 2 (Gungahlin Dr): 1.729**
* **Road 4 (Parkes Way): 1.44**
* **Road 1 (Northbourne Ave): 1.10**