Catcam

Lusia

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AADT Modeling

The data is obtained from each city (open data, you can click to access the data):

- Guelph Road
- Kitchener Road
- Bruce County
- Ontario
- Waterloo Road
- Cambridge Road

Polynomial model is created using the common parameters found in datasets.

```
Kit_AADT_2 <- lm(log(Aadt) ~ OPSCLASS + DEAD_END + ROADCLASS + LANES + TRUCKROUTE +
    STREET_TYPE + SPEED, data = Kitchener_road)
vif(Kit_AADT_2)
```

```
##                  GVIF Df GVIF^(1/(2*Df))
## OPSCLASS    21.458429  4        1.467066
## DEAD_END     2.859418  1        1.690982
## ROADCLASS   34.273552  4        1.555500
## LANES        9.302208  8        1.149573
```

```
## TRUCKROUTE   3.842283  1        1.960174
## STREET_TYPE 11.671172 21        1.060248
## SPEED        9.477228  5        1.252184
```

```r
anova(Kit_AADT_2)
```

```
## Analysis of Variance Table
##
## Response: log(Aadt)
##               Df  Sum Sq Mean Sq   F value    Pr(>F)
## OPSCLASS       4 11958.4 2989.59 14880.013 < 2.2e-16 ***
## DEAD_END       1   403.6  403.64  2009.044 < 2.2e-16 ***
## ROADCLASS      4   111.0   27.74   138.065 < 2.2e-16 ***
## LANES          8    51.0    6.37    31.718 < 2.2e-16 ***
## TRUCKROUTE     1     4.4    4.40    21.905 2.932e-06 ***
## STREET_TYPE   21    59.5    2.83    14.093 < 2.2e-16 ***
## SPEED          5    28.6    5.72    28.459 < 2.2e-16 ***
## Residuals   5639  1132.9    0.20
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Summary of the model:

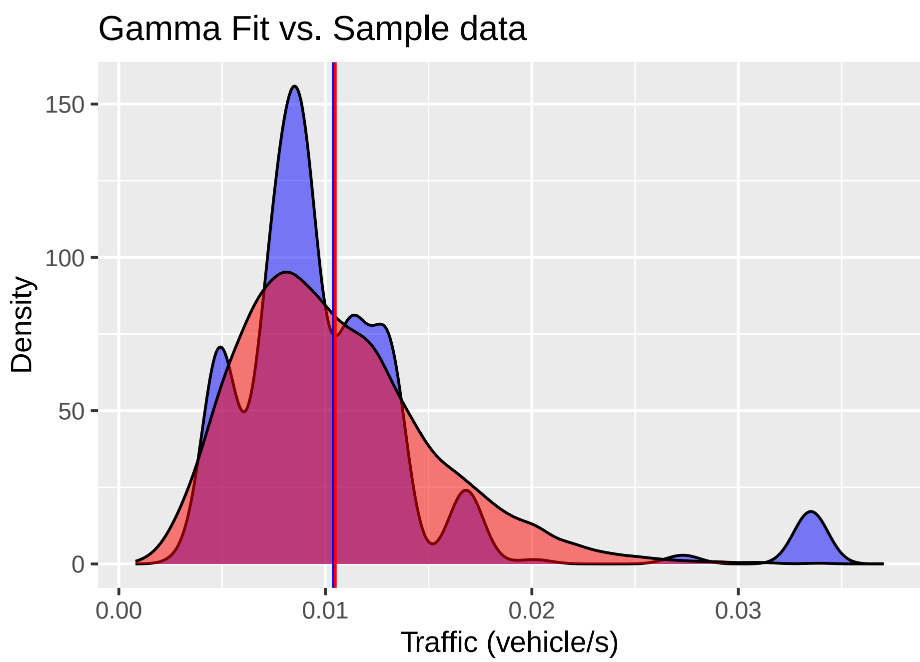
```
Residual standard error: 0.4482 on 5639 degrees of freedom
  (168 observations deleted due to missingness)
Multiple R-squared:  0.9176,    Adjusted R-squared:  0.917
F-statistic:  1427 on 44 and 5639 DF,  p-value: < 2.2e-16
```

Variable estimators

A positive integral value dataset, such as frequency and duration, is assumed to follow gamma distribution. Each variables are tested for different distributions, such as log-normal, zero-inflated, and negative binomial. To increase quality of the estimator, multiple distributions of parameters were tested and all data was used instead of cutting out the data. Gamma distribution is estimated using the sample data and it is shown red. Blue graph is sample data distribution. Blue vertical line indicates sample mean and red indicates the expected value.

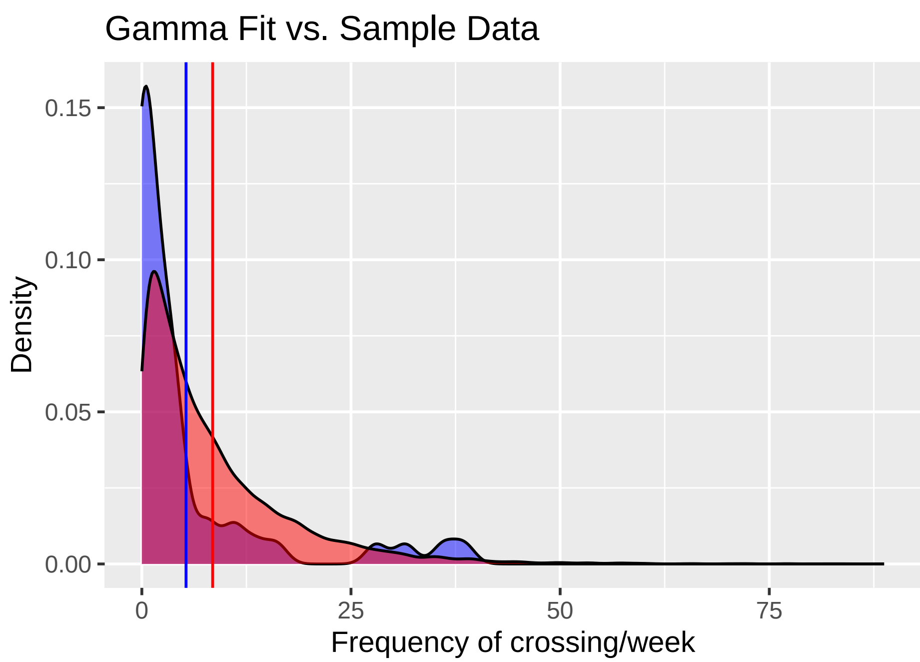
Traffic volume

```
  estimate Std. Error
  shape 5.094035 0.3802488
  rate 490.092739 38.4476214
  Loglikelihood: 1358.259 AIC: -2712.518 BIC: -2704.877
  Correlation matrix:
shape rate
shape 1.000000 0.951499
rate 0.951499 1.000000
```



Frequency of crossing

```
estimate Std. Error

shape 0.8860221 0.19923256

rate 0.1048266 0.03112522

Loglikelihood: -93.88528 AIC: 191.7706 BIC: 195.513

Correlation matrix:

shape rate

shape 1.0000000 0.7571975

rate 0.7571975 1.0000000

Min. 1st Qu. Median Mean 3rd Qu. Max.

0.00004 2.19988 5.68819 8.54521 11.71171 115.11790
```



Mortality calculation

Probability of getting hit by a car is multiplied by 0.7, which is the mortality per accident found in epidemiology study and survey. Expected values of each parameter distribution were used to calculate the expected mortality.

Mortality using v=2m/s, road width=10m

The expected value of crossing frequency per week and traffic volume per second were used to calculate the weekly mortality of crossing.

```
Success_p <- exp(-expected_t * 5)
print(Success_p)
```

```
## [1] 0.9499665
```

```r
# Per crossing
(1 - Success_p) * 0.7
```

```
## [1] 0.03502344
```

```r
# Per week
(1 - ((Success_p * 0.7)^expected_f))
```

```
## [1] 0.0397909
```

Mortality using v=13m/s, road width=10m

```r
Success_p2 <- exp(-expected_t * 0.769)
Mortality_p2 <- 1 - Success_p2 * 0.7
print(Success_p2)
```

```
## [1] 0.9921367
```

```r
print(Mortality_p2)
```

```
## [1] 0.3055043
```

```r
# Per crossing
(1 - Success_p2) * 0.7
```

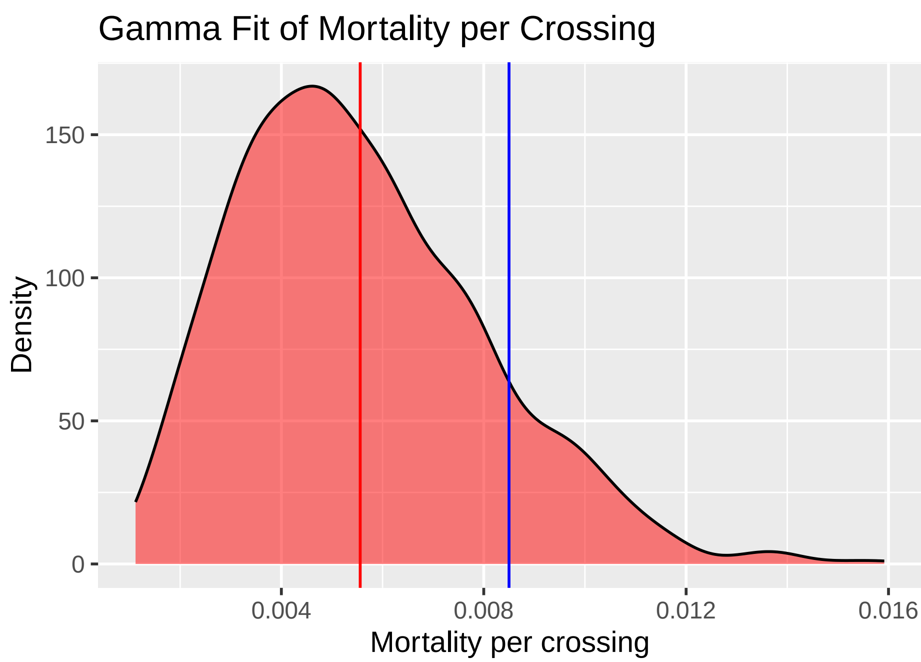
```
## [1] 0.005504277
```

```r
# Per week
(1 - ((Success_p2 * 0.7)^expected_f))
```

```
## [1] 0.03563137
```

Mortality simulation

Distribution of the mortality per crossing, which follows gamma distribution. The blue vertical line indicates the mean mortality value.



Annual mortality was calculated, frequency/year, under assumption of consistent frequency/week throughout the year.

```
## Mortality per crossing summary
summary(Mortality)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## 0.000197 0.003745 0.005186 0.005544 0.006946 0.020729
```

```
## Annual mortality using v=2m/s, road width=10m
(1 - ((Success_p * 0.7)^(expected_f * 26)))
```

```
## [1] 0.6520545
```

```
## Annual mortality using v=13m/s, road width=10m
(1 - ((Success_p2 * 0.7)^(expected_f * 26)))
```

```
## [1] 0.6106682
```