# Evaluation of Reflective Backplates on Crash Frequency

*Final Report*

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| 5. Supplementary Notes | |

6. Abstract

This study evaluates the impact of reflective signal backplates on crash frequencies at signalized intersections in Washington County, Oregon. A reflective backplate is a signal backplate with 3-inch retroreflective tape installed along its perimeter. The analysis employed the Empirical Bayes (EB) method to develop a Crash Modification Factor (CMF), offering a statistically rigorous approach that accounts for regression to the mean using Safety Performance Functions (SPFs).

Sixteen treatment intersections with reflective backplates installed in 2017 were paired with control intersections without the treatment. Crash data from 2014–2016 (before) and 2018–2020 (after) were analyzed. The EB method produced a statistically significant CMF of 0.84 for all crashes, indicating a 16% reduction in crash frequency attributable to the treatment. This result aligns closely with the CMF of 0.85 published to the CMF Clearinghouse (ID 1410).

| 7. Key Words | 8. Distribution Statement |
|---|---|
| Safety, SPF, CMF, Retroreflective, Signal, Intersection, Empirical-Bayes | Available for public use. |

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## Introduction:

This memorandum summarizes an evaluation of the impact reflective backplates have on crash frequency, including the development of a Crash Modification Factor (CMF) using the Empirical Bayes (EB) method. A reflective backplate is a signal backplate with 3-inch reflective tape installed on the perimeter (Figure 1). A CMF is a multiplicative factor used to calculate the expected quantity of site-specific crashes after a treatment has been implemented.

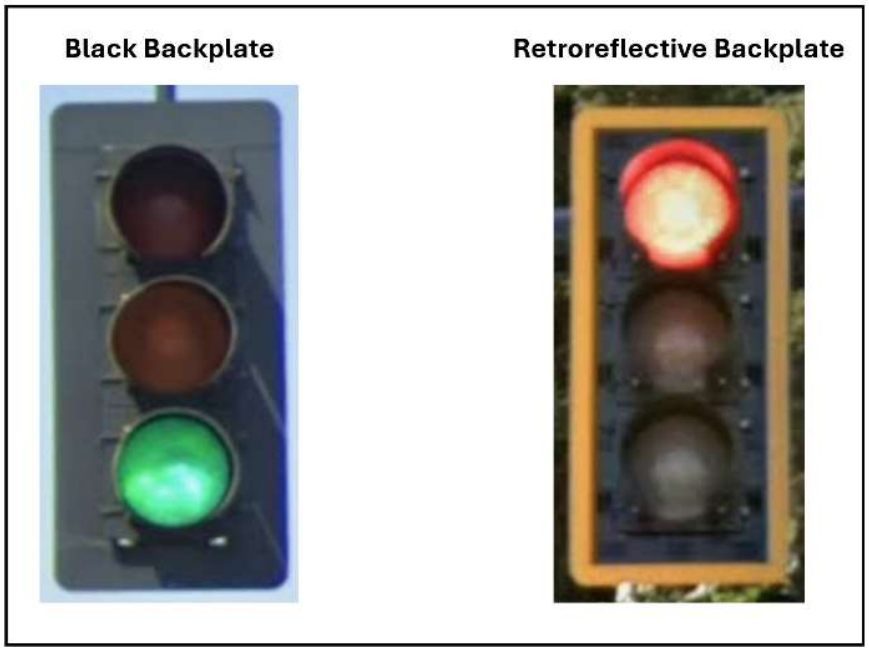


*Figure 1: Typical example of signal heads with black backplates (left) and retroreflective backplates (right).Figure 1: Typical example of signal heads with black backplates (left) and retroreflective backplates (right).*

This evaluation builds upon the October 7th, 2025, memo titled "Reflective Backplate CMF Evaluation," which developed a CMF using the Before-After with Comparison Group method. The EB method is more statistically rigorous than the Before-After with Comparison Group method, as it uses Safety Performance Functions (SPFs) to control for regression to the mean.

Reflective backplates were first installed on Washington County-owned signals as part of the 2016-2018 All Roads Transportation Safety (ARTS) Program. Since then, Washington County has continued to install reflective backplates at signalized intersections with documented safety concerns and at all new signalized intersections.

Sixteen intersections with reflective backplates installed in 2017 were selected as the Treatment group. Each Treatment intersection was paired with a Control intersection without reflective backplates. The full methodology for selecting Treatment and Control intersections is described in the Methodology section. Table 1 lists the Treatment and Control intersections.

**Table 1: Treatment and Control Intersections**

| # | Treatment | Control |
|---|---|---|
| *1 | Jenkins Road / Murray Boulevard | Cornelius Pass Road / Cornell Road |
| 2 | Century Boulevard / Evergreen Parkway | Laidlaw Road / West Union Road |
| 3 | Hart Road / Murray Boulevard | 158th Avenue / Walker Road |
| 4 | Evergreen Parkway / John Olsen Avenue | Farmington Road / Kinnaman Road |
| 5 | Nimbus Avenue / Scholls Ferry Road | 185th Avenue / Kinnaman Road |
| 6 | Barnes Road / Cedar Hills Boulevard | Brookwood Parkway / Cornell Road |
| 7 | Allen Boulevard / Murray Road | 185th Avenue / West Union Road |
| 8 | Cedar Hills Boulevard / Fairfield Street | Cornell Road / Saltzman Road |
| 9 | Murray Boulevard / Scholls Ferry Road | 185th Avenue / Cornell Road |
| 10 | 121st Avenue / Scholls Ferry Road | Cherry Drive / Cornelius Pass Road |
| 11 | 147th Terrace / Scholls Ferry Road | Bethany Boulevard / Wismer Drive |
| 12 | 125th Avenue / Scholls Ferry Road | 170th Avenue / Blanton Street |
| *13 | 135th Avenue / Scholls Ferry Road | Nyberg Street / Tualatin-Sherwood Road |
| 14 | Davies Road / Scholls Ferry Road | Meadow Drive / Walker Road |
| 15 | Evergreen Parkway / Stucki Road | Cornell Road / Stucki Road |
| 16 | Cedar Hills Boulevard / Park Way | Cornell Road / John Olsen Avenue |

**Identified as outlier during SPF development and removed from final analysis.*

A CMF of 0.84 for all crashes was estimated by this evaluation, with a 95% confidence interval of 0.68 to 0.99. A CMF for rear-end crashes was also estimated by this evaluation but was found to be statistically insignificant (95% confidence interval includes 1). The CMF calculated by this evaluation aligns closely with the CMF of 85% for all crashes referenced in the Oregon Department of Transportation (ODOT) Highway Safety Improvement Program (HSIP) Countermeasures and Crash Reduction Factors document (ODOT 2007).

## Previous Work:

Existing research on signal head visibility includes studies on indicator brightness levels (Sayed, Abdelwahab and Nepomuceno 1998), visibility for aging and color deficient drivers (ITE 2001), and nighttime visibility (Freedman, et al. 1985). Research like this has helped inform guidelines on signal head design (e.g. indicator size, brightness level, lens material).

Reflective backplates were granted interim approval in the MUTCD in 2004 and formally included in Chapter 4D of the 2009 MUTCD (FHWA 2004). Since their introduction, few studies have evaluated reflective backplates using CMFs. In 2017, a combined CMF of 0.955 for all crashes was calculated for low-cost safety improvements at signalized intersections. The low-cost safety improvements included

reflective backplates, but its effect was not isolated (Le, Gross and Harmon 2017). More recently, the Minnesota Department of Transportation (MnDOT) found that the effect of reflective backplates on crash frequencies was negligible (Moreland, et al. 2024).

As of November 2025, only one CMF study on reflective backplates is published to Clearinghouse (ID 1410), which found reflective backplates to have a CMF of 0.85 (Sayed, Leur and Pump 2005). This study is also referenced in the Oregon Department of Transportation (ODOT) Highway Safety Improvement Program (HSIP) Countermeasures and Crash Reduction Factors document (ODOT 2007).

## Methodology:

This evaluation used the EB method to estimate CMFs for reflective backplates. The EB method accounts for regression to the mean by using SPFs to estimate expected crash frequencies at treatment sites (Gross, Persaud and Lyon 2010). The study period for this study is 2014-2016 and 2018-2020 (three years before and after the treatment installation year).

*Treatment and Control Site Selection*

Sixteen intersections with reflective backplates installed in 2017 and no major improvements during the study period (2014-2020) were selected as the Treatment group. The criteria listed below was used to determine suitable Control intersections:

- Similar crash frequency, rate, and severity profile before 2017.
- Same jurisdiction (Washington County).
- Similar geometric and operational characteristics.
- No major improvements during the study period.

Based on the criteria, sixteen intersections were identified for the Control group (one per Treatment intersection). Figure 2 compares the signal configuration of Treatment intersections to their respective Control intersections. A summary of comparison characteristics can be found in the Appendix.


*Figure 2: Panel figure showing signal configuration of Treatment intersections and respective Control intersections.*

*Crash Data*

Crash data from 2014-2020 (excluding the treatment installation year 2017) were used. Crashes within 265-feet of the intersection's center were included. Crash data was cleaned to exclude crashes that fell within the 265-foot buffer but were attributed to adjacent intersections. Before period (2014-2016) and after period (2018-2020) crash data were compared by attribute (e.g. crash severity, crash type, roadway conditions) visually. Based on the visual test, all crashes, rear-end crashes, and nighttime (dark/dawn/dusk) crashes were selected for assessment of suitability.

*Sample Odds Ratio*

Suitability of the Control group was assessed using a Sample Odds Ratio. The Sample Odds Ratio is calculated using Equation (1). A ratio near 1.0 with a 95% confidence interval including 1.0 indicates a suitable Control group. How close to one is acceptable for a given study is qualitative and requires engineering judgement.

$$(1)\quad Sample\ Odds\ Ratio = \frac{(T_B\, C_A)(T_A C_B)}{1+\frac{1}{T_A}+\frac{1}{C_B}}$$

Where: $T_B, T_A$ = Treatment group total crashes before/after
$C_B, C_A$ = Control group total crashes before/after

*Safety Performance Function Development*

SPFs were developed using SPF-R. SPF-R was developed by the Kentucky Transportation Center in 2022 that uses methods outlined by the Highway Safety Manual (HSM) to develop SPFs using R statistical

software. SPF-R is included in the FHWA Safety Toolbox and is free and open-source (FHWA 2022). Four separate SPF models were created using Control group crash data for all crashes (before and after periods) and rear-end crashes (before and after periods). Variables of entering volumes, roadway speeds, number of through lanes, and crossing distances were assessed for model suitability. Individual intersections in the Control group were also assessed for outlier behavior to ensure they did not disproportionately influence the model. Assessment was done iteratively using the "goodness of fit" metrics produced by SPF-R:

- Overdispersion ($\theta$)
- Akaike Information Criterion (AIC)
- Modified Coefficient of Determination (modified $R^2$)
- Cumulative Residual Plot Deviation Percentage (CDP)
- Maximum Absolute Cumulative Residual Plot Deviation (MACD)
- Mean Absolute Deviation (MAD)
- Standard Error (SE)
- Statistical Significance (p-value)

Further details on the model development, "goodness of fit" metrics, and outlier intersections can be found in the Results section. The final model forms are shown in Equations (2) and (3). The same model forms were used for predicting frequencies of all crashes and rear-end crashes, however the model parameters differed.

(2) Before Period Model: $N_{predicted^{TB}} = e^{\alpha} \cdot ADT_1^{\beta_1} \cdot ADT_2^{\beta_2} \cdot V_2^{\beta_3} \cdot CD_1^{\beta_4}$

(3) After Period Model: $N_{predicted^{TA}} = e^{\alpha} \cdot e^{ADT_1 \cdot \beta_1} \cdot e^{ADT_2 \cdot \beta_2}$

Where:
- $N_{predicted^{TB}}, N_{predicted^{TA}}$ = Predicted number of crashes before/after
- $\alpha, \beta_1, \beta_2, \beta_3, \beta_4$ = SPF model parameters
- $ADT_1, ADT_2$ = Major- and minor road traffic volume (Average Daily Traffic)
- $V_2$ = Minor road posted speed limit
- $CD_1$ = Major road crossing distance

The SPF weight is derived from $N_{predicted^{TB}}$ and $\theta$, as shown in Equation (4). The SPF weight is used to determine how much influence $N_{predicted^{TB}}$ should have compared to $N_{observed^{TB}}$ (number of observed crashes in the before period) when calculating $N_{expected^{TA}}$ (number of crashes expected in the after period). Equation (5) shows how $N_{expected^{TA}}$ is calculated.

$$(4)\ SPF_w = \frac{1}{1+\left(N_{predicted^{TB}}\right)\theta^1}$$

Where:
$SPF_w$ = Safety Performance Function weight
$N_{predicted^{TB}}$ = Predicted number of crashes before
$\theta^1$ = Safety Performance Function overdispersion

$$(5)\ N_{expected^{TB}} = SPF_w\left(N_{predicted^{TB}}\right) + (1 - SPF_w)\left(N_{observed^{TB}}\right)$$

Where:
$N_{expected^{TB}}$ = Number of crashes expected before
$SPF_w$ = Safety Performance Function weight
$N_{predicted^{TB}}$ = Predicted number of crashes before
$N_{observed^{TB}}$ = Number of crashes observed before

In the EB method, the number of crashes predicted is the number of crashes forecasted by the SPF alone. The number of crashes observed is the actual number of crashes recorded during the study period. The number of crashes expected is a weighted average of the two, adjusted to account for regression to the mean. This concept is visualized in Figure 3.

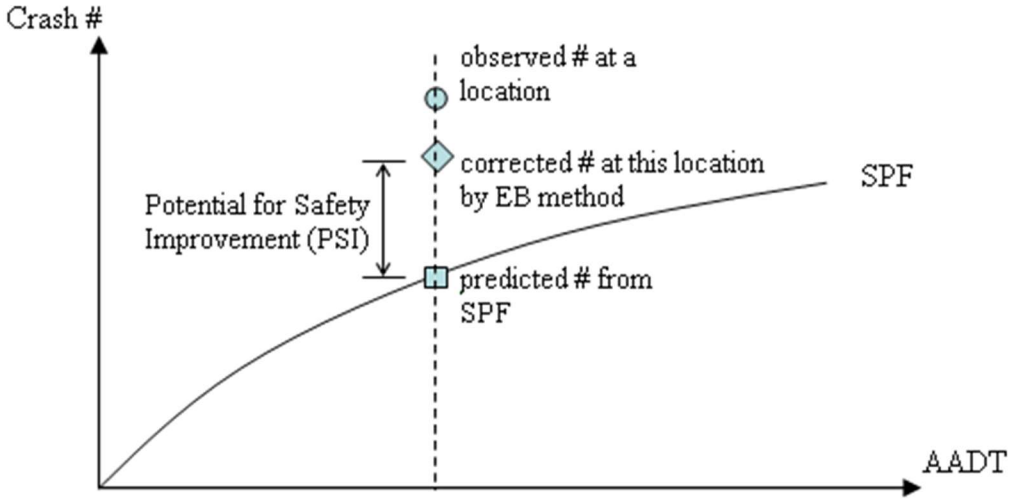


*Figure 3: Visualization of the predicted, observed, and expected number of crashes per the EB method (Piper 2014).*

$N_{expected^{TA}}$ and its variance is then calculated using Equations (6) and (7), which are used to calculate the CMF and its variance as shown in Equations (8) and (9).

$$(6)\ N_{expected^{TA}} = N_{expected^{TB}}\left(\frac{N_{predicted^{TA}}}{N_{predicted^{TB}}}\right)$$

$$(7)\ Var\left(N_{expected^{TA}}\right) = N_{expected^{TA}}\left(\frac{N_{predicted^{TA}}}{N_{predicted^{TB}}}\right)(1 - SPF_w)$$

Where: $N_{expected^{TB}}, N_{expected^{TA}}$ = Number of crashes expected before/after
$N_{predicted^{TB}}, N_{predicted^{TA}}$ = Predicted number of crashes before
$SPF_w$ = Safety Performance Function weight

$$(8)\ CMF = \frac{\left(\frac{N_{observed^{TA}}}{N_{expected^{TA}}}\right)}{1+\left(\frac{Var\left(N_{expected^{TA}}\right)}{N_{expected^{TA}}^{\ 2}}\right)}$$

$$(9)\ Var(CMF) = \frac{CMF^2\left[\left(\frac{1}{N_{observed^{TA}}}\right)+\left(\frac{Var\left(N_{expected^{TA}}\right)}{N_{expected^{TA}}^{\ 2}}\right)\right]}{\left(\frac{1+Var\left(N_{expected^{TA}}\right)}{N_{expected^{TA}}^{\ 2}}\right)^2}$$

**Results:**
All crashes, rear-end crashes, and nighttime (dark/dawn/dusk) crashes were selected for assessment of suitability by the Sample Odds Ratio test. Based on the Sample Odds Ratio, night crashes were excluded from further analysis due to low sample size and a wide confidence interval. All crashes and rear-end crashes were analyzed further. Table 2 summaries the results from the Sample Odds Ratio test. Complete Sample Odds Ratio calculations are found in the Appendix.

**Table 2: Sample Odds Ratio Test**

| | Total Crashes | Sample Odds Ratio | Standard Deviation | 95% Confidence Interval |
|---|---|---|---|---|
| All Crashes | 1,029 | 1.03 | 0.03 | 0.98 to 1.09 |
| Rear-End Crashes | 606 | 1.06 | 0.03 | 1.00 to 1.13 |
| Night Crashes | 85 | 0.79 | 0.33 | 0.15 to 1.43 |

Development of SPF was iterative, starting with evaluating that intersections are not outliers. Two intersections were identified and removed as outliers. Then models were created starting with ADT, speed, number of lanes, and crossing distance for the major and minor approaches. Variables were removed iteratively based on their p-value, which is an indicator of the variable's effect on crash frequency. Full SPF model outputs are found in the Appendix.

During model development, Cornelius Pass Road / Cornell Road and Nyberg Street / Tualatin-Sherwood Road were identified as outliers and removed. The respective Treatment intersections (Jenkins Road / Murray Boulevard and 135th Avenue / Scholls Ferry Road) were also removed from the analysis. Model fit was then assessed using "goodness of fit" metrics. These metrics are summarized in Table 3.

**Table 3: Goodness of Fit Metrics**

| | $\theta$ | AIC | Modified $R^2$ | CDP | MACD | MAD | St. Error |
|---|---|---|---|---|---|---|---|
| All Crashes - Before Period | 8.87 | 119 | 0.79 | 7.14 | 19.2 | 7.54 | 4.80 |
| Rear-End Crashes - Before Period | 11.8 | 103 | 0.93 | 7.14 | 12.9 | 4.32 | 9.64 |
| All Crashes - After Period | 103 | 91.2 | 0.94 | 7.14 | 10.5 | 3.92 | 215 |
| Rear-End Crashes - After Period | 17.6 | 88.7 | 0.90 | 7.14 | 10.5 | 3.67 | 23.4 |

CURE plots (shown in Figure 4) provide a visual way of evaluating model fit. A CURE plot with a cumulative residual line that oscillates above and below zero within the upper and lower bounds indicates that the model does not consistently over- or under- predict crash frequencies.

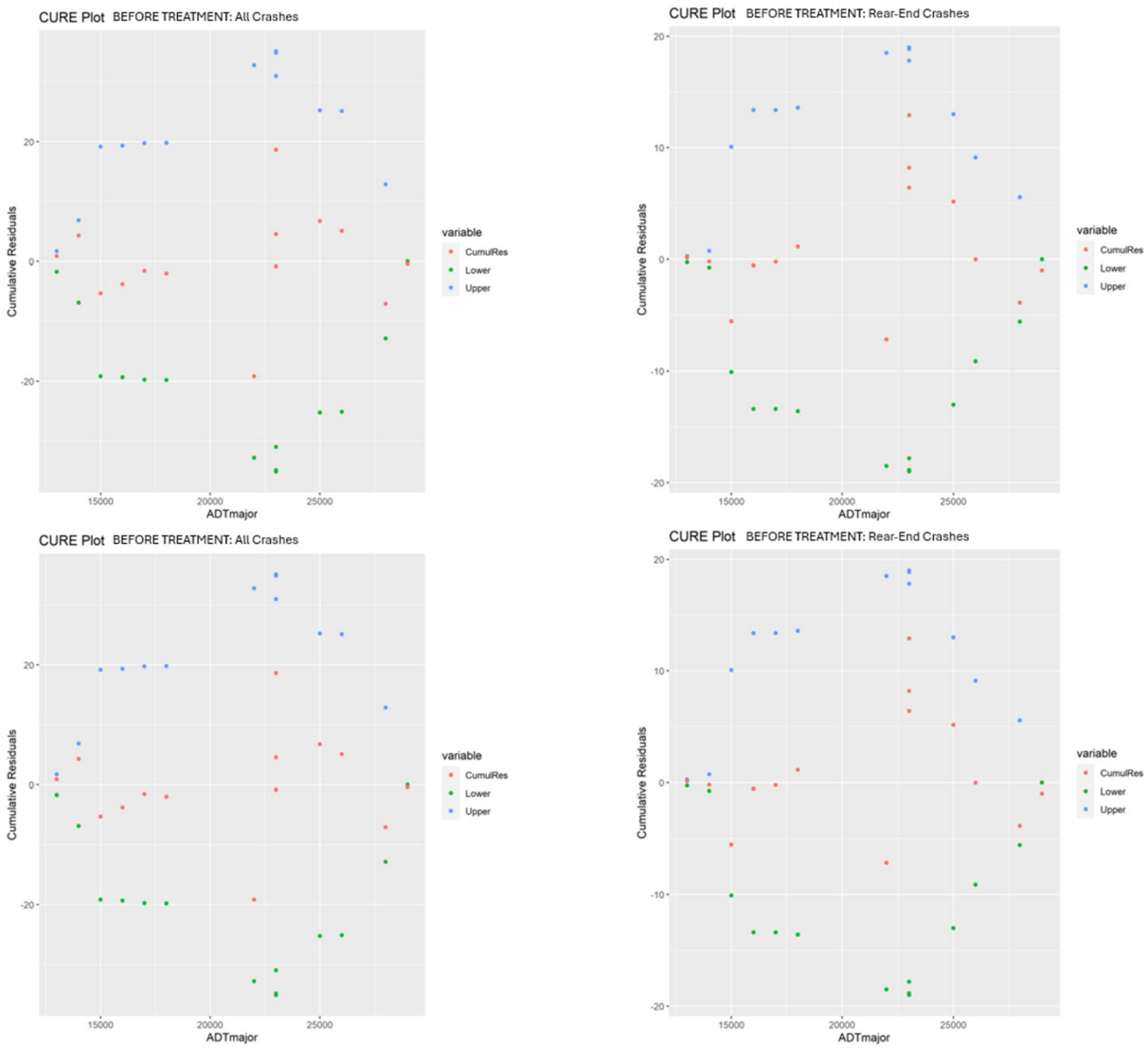


*Figure 4: CURE plots for all crashes before treatment model (left), all crashes after treatment model (left), rear-end crashes before treatment model (right), and rear-end crashes after treatment model (right) against volume on the major road.*

Final model variables of major- and minor- road traffic volume, minor road posted speed limit, and major road crossing distance were chosen for the before-period SPF model. The form that provided the best fitting before model was Log Normalized. Final model variables of major-and minor- road traffic volume was chosen for the after-period SPF model. The form that provided the best fitting after model was Exponent. Table 4 summarizes each model's parameter values.

| Table 4: Safety Performance Function Model Parameters | | | | | |
|---|---|---|---|---|---|
| | $\alpha$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ |
| All Crashes Before Period | -9.34 | 0.54 | -0.20 | 1.34 | 0.97 |
| Rear-End Crashes Before Period | -22.56 | 2.7 | -1.19 | 0.15 | 1.98 |
| All Crashes After Period | 2.03 | 0.000024 | 0.000052 | N/A | N/A |
| Rear-End Crashes After Period | 1.05 | 0.000031 | 0.000071 | N/A | N/A |

The calculated CMFs are shown in Table 5. The CMF for all crashes indicates a 16% decrease in crashes that can be attributed to reflective backplates. The CMF is statistically significant, with the 95% confidence interval being 0.68 to 0.99. The CMF for rear-end crashes indicates a 21% increase in crashes, however this CMF is not statistically significant (confidence interval includes 1).

| Table 5: CMF Results | | |
|---|---|---|
| | **All Crashes** | **Rear-End Crashes** |
| CMF | 0.84 | 1.21 |
| Variance | 0.0060 | 0.032 |
| Standard Error | 0.077 | 0.18 |
| 95% Confidence Interval | 0.68 to 0.99 | 0.86 to 1.56 |

While the overall CMF for all crashes indicates a reduction in crashes, CMFs calculated for each Treatment intersection varied. Figure 5 visualizes CMFs for all crashes by individual Treatment intersection.

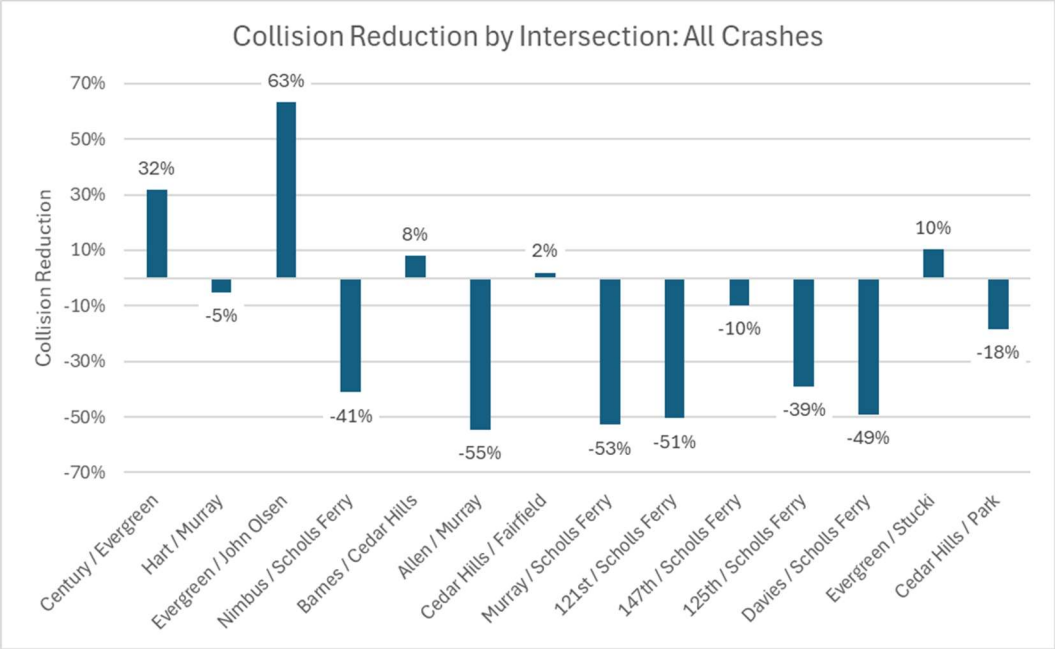


*Figure 5: CMF for all crashes by Treatment intersection.*

## Discussion & Conclusion:

The EB method produced a statistically significant CMF of 0.84 for all crashes, aligning closely with the CMF published to Clearinghouse (ID 1410), which found reflective backplates to have a CMF of 0.85 (Sayed, Leur and Pump 2005). Compared to the CMF derived from the Before–After with Comparison Group method, the EB-derived CMF demonstrates substantially reduced uncertainty—cutting the 95% confidence interval by approximately 50%. This improvement reflects the EB method's ability to control for regression to the mean and incorporate site-specific crash history more robustly.

While limitations in sample size constrained the fit of the Safety Performance Function (SPF) models, the resulting CMFs are consistent with findings from other national studies, lending credibility to the observed safety benefit of reflective backplates.

This CMF is most applicable to urban and suburban signalized intersections with similar geometric and operational characteristics to those studied—primarily within Washington County. Transferability to other contexts may be limited by differences in lighting infrastructure, traffic volumes, and driver behavior. Additional research with larger datasets and varied roadway environments would help validate broader applicability.

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## Appendix:

*Appendix A: Comparison Characteristics*
*Appendix B: Sampe Odds Ratio Calculations*
*Appendix C: SPF-R Model Outputs*
*Appendix D: CMF Calculations*

*Appendix A: Comparison Characteristics*

| TREATMENT GROUP Site Characteristics | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site Location | Roadway Class (major / minor) | State | Municipality | Area Type | Number Of Through Lanes (major / minor) | Speed Limit (major/ minor) | Traffic Volume | Traffic Control | Intersection Type | Intersection Geometry |
| Jenkins Rd / Murray Blvd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 45 mph | 49,000 | Signal | Signalized Intersection | 4-way |
| Century Blvd / Evergreen Pwky | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 4 lanes / 2 lanes | 45 mph / 40 mph | 21,000 | Signal | Signalized Intersection | 4-way |
| Hart Rd / Murray Blvd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 45 mph / 35 mph | 35,000 | Signal | Signalized Intersection | 4-way |
| Evergreen Pkwy / John Olsen Ave | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 35 mph | 22,000 | Signal | Signalized Intersection | 4-way |
| Nimbus Ave / Scholls Ferry Rd | Collector / Arterial | OR | Beaverton / Tigard | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 35 mph | 44,000 | Signal | Signalized Intersection | 4-way |
| Barnes Rd / Cedar Hills Blvd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 40 mph | 34,000 | Signal | Signalized Intersection | 4-way |
| Allen Blvd / Murray Blvd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 3 lanes | 40 mph / 30 mph | 41,000 | Signal | Signalized Intersection | 4-way |
| Cedar Hills Blvd / Fairfield St | Arterial / Neighborhood | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 35 mph / 25 mph | 34,000 | Signal | Signalized Intersection | 4-way |
| Murray Blvd / Scholls Ferry Rd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 4 lanes | 40 mph / 35 mph | 46,000 | Signal | Signalized Intersection | 4-way |
| 121st Ave / Boones Bend Dr / Scholls Ferry Rd | Arterial / Collector | OR | Tiagard | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 30 mph | 25,000 | Signal | Signalized Intersection | 4-way |
| 147th Ter / Murray Scholls Pl / Scholls Ferry Rd | Arterial / Neighborhood | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 15 mph | 25,000 | Signal | Signalized Intersection | 4-way |
| 125th Ave / Scholls Ferry Rd | Arterial / Arterial | OR | Tigard / Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 35 mph | 42,000 | Signal | Signalized Intersection | 4-way |
| 135th Ave / Scholls Ferry Rd | Arterial / Collector | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 35 mph | 37,000 | Signal | Signalized Intersection | 4-way |
| Davies Rd / Scholls Ferry Rd | Arterial / Collector | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 30 mph | 34,000 | Signal | Signalized Intersection | 4-way |
| Evergreen Pkwy / Stucki Ave | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 40 mph | 27,000 | Signal | Signalized Intersection | 4-way |
| Cedar Hills Blvd / Park Way | Arterial / Collector | OR | Beaverton | Urban / Suburban | 4 lanes / 2 lanes | 35 mph / 35 mph | 22,000 | Signal | Signalized Intersection | 4-way |

| CONTROL GROUP Site Characteristics | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site location | Roadway Class (major / minor) | State | Municipality | Area Type | Number Of Through Lanes (major / minor) | Speed Limit (major/ minor) | Traffic Volume | Traffic Control | Intersection Type | Intersection Geometry |
| Cornelius Pass Rd / Cornell Rd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 45 mph | 60,000 | Signal | Signalized Intersection | 4-way |
| Laidlaw Rd / West Union Rd | Arterial / Collector | OR | Unincorporated | Urban / Suburban | 2 lanes / 2 lanes | 30 mph / 40 mph | 17,000 | Signal | Signalized Intersection | 4-way |
| 158th Ave / Walker Rd | Arterial / Arterial | OR | Beaverton | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 40 mph | 39,000 | Signal | Signalized Intersection | 4-way |
| Farmington Rd / Kinnaman Rd | Arterial / Collector / Local | OR | Unincorporated | Urban / Suburban | 3 lanes / 4lanes | 40 mph / 45 mph | 28,000 | Signal | Signalized Intersection | 4-way |
| 185th Ave / Kinnaman Rd | Arterial / Collector | OR | Unincorporated | Urban / Suburban | 4 lanes / 2 lanes | 35 mph / 35 mph | 25,000 | Signal | Signalized Intersection | 4-way |
| Brookwood Pkwy / Cornell Rd | Arterial / Arterial | OR | Unincorporated | Urban / Suburban | 4 lanes / 3 lanes | 45 mph / 45 mph | 49,000 | Signal | Signalized Intersection | 4-way |
| West Union Ave / 185th Ave | Arterial / Arterial | OR | Unincorporated | Urban / Suburban | 4 lanes / 3 lanes | 40 mph / 45 mph | 29,000 | Signal | Signalized Intersection | 4-way |
| Cornell Rd / Saltzman Rd | Arterial / Arterial | OR | Unincorporated | Urban / Suburban | 3 lanes / 3 lanes | 35 mph / 30 mph | 22,000 | Signal | Signalized Intersection | 4-way |
| 185th Ave / Cornell Rd | Arterial / Arterial | OR | Hillsboro | Urban / Suburban | 4 lanes / 5 lanes | 40 mph / 45 mph | 50,000 | Signal | Signalized Intersection | 4-way |
| Cherry Dr / Cornelius Pass Rd | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 2 lanes / 4 lanes | 35 mph / 45 mph | 31,000 | Signal | Signalized Intersection | 4-way |
| Bethany Blvd / Kaiser Rd / Wismer Dr | Arterial / Collector | OR | Unincorporated | Urban / Suburban | 3 lanes / 2 lanes | 35 mph / 25 mph | 21,000 | Signal | Signalized Intersection | 4-way |
| 170th Ave / Blanton St | Arterial / Collector | OR | Unincorporated | Urban / Suburban | 4 lanes / 2 lanes | 40 mph / 25 mph | 20,000 | Signal | Signalized Intersection | 4-way |
| Nyberg St / Tualatin-Sherwood Rd | Arterial / Collector | OR | Tualatin | Urban / Suburban | 3 lanes / 6 lanes | 30 mph / 35 mph | 36,000 | Signal | Signalized Intersection | 4-way |
| Meadow Dr / Walker Rd | Arterial / Collector | OR | Beaverton | Urban / Suburban | 2 lanes / 4 lanes | 25 mph / 45 mph | 26,000 | Signal | Signalized Intersection | 4-way |
| Cornell Rd / Stucki Rd | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 4 lanes / 4 lanes | 45 mph / 45 mph | 25,000 | Signal | Signalized Intersection | 4-way |
| Cornell Rd / John Olsen Ave | Arterial / Collector | OR | Hillsboro | Urban / Suburban | 4 lanes / 2 lanes | 45 mph / 35 mph | 23,000 | Signal | Signalized Intersection | 4-way |

*Notes:*

*The number in column A corresponds to the intersection group. For example, treatment intersection #1 is compared directly to control intersection #1 in later steps of the analysis.*

*Traffic volumes are derived from the 2018-2020 SPIS list. Other characteristics collected in 2025.*

*All intersections are Washington County owned and maintained.*

## *Appendix B: Sampe Odds Ratio Calculations*

| Intersection Group: 1 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Jenkins Rd / Murray Blvd | 30 | 16 | 30 |
| **Comparison Site** | Cornelius Pass Rd / Cornell Rd | 7 | 12 | 11 |

| Intersection Group: 2 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Century Blvd / Evergreen Pwky | 8 | 12 | 12 |
| **Comparison Site** | Laidlaw Rd / West Union Rd | 9 | 4 | 5 |

| Intersection Group: 3 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Hart Rd / Murray Blvd | 16 | 9 | 8 |
| **Comparison Site** | 158th Ave / Walker Rd | 16 | 15 | 19 |

| Intersection Group: 4 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Evergreen Pkwy / John Olsen Ave | 4 | 4 | 7 |
| **Comparison Site** | Farmington Rd / Kinnaman Rd | 13 | 19 | 8 |

| Intersection Group: 5 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Nimbus Ave / Scholls Ferry Rd | 17 | 10 | 12 |
| **Comparison Site** | 185th Ave / Kinnaman Rd | 7 | 12 | 13 |

| Intersection Group: 6 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Barnes Rd / Cedar Hills Blvd | 20 | 17 | 11 |
| **Comparison Site** | Brookwood Pkwy / Cornell Rd | 28 | 12 | 26 |

| Intersection Group: 7 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Allen Blvd / Murray Blvd | 16 | 22 | 3 |
| **Comparison Site** | 185th Ave / West Union Ave | 11 | 6 | 10 |

| Intersection Group: 8 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Cedar Hills Blvd / Fairfield St | 3 | 7 | 6 |
| **Comparison Site** | Cornell Rd / Saltzman Rd | 12 | 11 | 6 |

| Intersection Group: 9 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Murray Blvd / Scholls Ferry Rd | 14 | 15 | 18 |
| **Comparison Site** | 185th Ave / Cornell Rd | 21 | 25 | 17 |

| Intersection Group: 10 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | 121st Ave / Boones Bend Dr / Scholls Ferry Rd | 8 | 5 | 15 |
| **Comparison Site** | Cherry Dr / Cornelius Pass Rd | 4 | 5 | 6 |

| Intersection Group: 11 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | 147th Ter / Murray Scholls Pl / Scholls Ferry Rd | 5 | 1 | 7 |
| **Comparison Site** | Bethany Blvd / Kaiser Rd / Wismer Dr | 3 | 2 | 0 |

| Intersection Group: 12 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | 125th Ave / Scholls Ferry Rd | 14 | 17 | 15 |
| **Comparison Site** | 170th Ave / Blanton St | 5 | 5 | 6 |

| Intersection Group: 13 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | 135th Ave / Scholls Ferry Rd | 7 | 8 | 7 |
| **Comparison Site** | Nyberg St / Tualatin-Sherwood Rd | 6 | 14 | 11 |

| Intersection Group: 14 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Davies Rd / Scholls Ferry Rd | 1 | 12 | 8 |
| **Comparison Site** | Meadow Dr / Walker Rd | 2 | 4 | 4 |

| Intersection Group: 15 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Evergreen Pkwy / Stucki Ave | 18 | 10 | 10 |
| **Comparison Site** | Cornell Rd / Stucki Rd | 11 | 10 | 15 |

| Intersection Group: 16 | | | | |
|---|---|---|---|---|
| | **Intersection** | **2014 Crash Total** | **2015 Crash Total** | **2016 Crash Total** |
| **Treatment Site** | Cedar Hills Blvd / Park Way | 2 | 4 | 3 |
| **Comparison Site** | Cornell Rd / John Olsen Ave | 13 | 9 | 15 |

| Sample Odds Ratio Calculation | | | |
|---|---|---|---|
| | *Crash Type:* | All Crashes | |
| | **2014** | **2015** | **2016** |
| **Treatment Group** | 183 | 169 | 172 |
| **Control Group** | 168 | 165 | 172 |
| | **2014-2015** | **2015-2016** | |
| **Sample Odds Ratio** | 1.05 | 1.01 | |
| **Mean** | 1.03 | <-overall sample odds ratio | |
| **Standard Deviation** | 0.03 | | |
| **95th Percentile Confidence Interval** | | | |
| 0.98 | *to* | 1.09 | |

*Notes:*

*Crash totals are sum of crashes within 265-feet of the center of the i*

| Intersection Group: 1 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Jenkins Rd / Murray Blvd | 28 | 9 | 23 |
| Comparison Site | Cornelius Pass Rd / Cornell Rd | 3 | 10 | 10 |

| Intersection Group: 2 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Century Blvd / Evergreen Pwky | 3 | 4 | 3 |
| Comparison Site | Laidlaw Rd / West Union Rd | 2 | 1 | 2 |

| Intersection Group: 3 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Hart Rd / Murray Blvd | 10 | 6 | 7 |
| Comparison Site | 158th Ave / Walker Rd | 12 | 9 | 12 |

| Intersection Group: 4 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Evergreen Pkwy / John Olsen Ave | 1 | 1 | 2 |
| Comparison Site | Farmington Rd / Kinnaman Rd | 9 | 12 | 8 |

| Intersection Group: 5 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Nimbus Ave / Scholls Ferry Rd | 13 | 9 | 9 |
| Comparison Site | 185th Ave / Kinnaman Rd | 4 | 6 | 7 |

| Intersection Group: 6 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Barnes Rd / Cedar Hills Blvd | 14 | 15 | 10 |
| Comparison Site | Brookwood Pkwy / Cornell Rd | 20 | 9 | 16 |

| Intersection Group: 7 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Allen Blvd / Murray Blvd | 11 | 14 | 0 |
| Comparison Site | 185th Ave / West Union Ave | 7 | 2 | 4 |

| Intersection Group: 8 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Cedar Hills Blvd / Fairfield St | 1 | 0 | 1 |
| Comparison Site | Cornell Rd / Saltzman Rd | 6 | 5 | 1 |

| Intersection Group: 9 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Murray Blvd / Scholls Ferry Rd | 10 | 12 | 14 |
| Comparison Site | 185th Ave / Cornell Rd | 17 | 18 | 11 |

| Intersection Group: 10 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 121st Ave / Boones Bend Dr / Scholls Ferry Rd | 5 | 3 | 6 |
| Comparison Site | Cherry Dr / Cornelius Pass Rd | 3 | 4 | 4 |

| Intersection Group: 11 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 147th Ter / Murray Scholls Pl / Scholls Ferry Rd | 3 | 0 | 2 |
| Comparison Site | Bethany Blvd / Kaiser Rd / Wismer Dr | 0 | 0 | 0 |

| Intersection Group: 12 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 125th Ave / Scholls Ferry Rd | 13 | 10 | 9 |
| Comparison Site | 170th Ave / Blanton St | 1 | 1 | 3 |

| Intersection Group: 13 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 135th Ave / Scholls Ferry Rd | 3 | 5 | 4 |
| Comparison Site | Nyberg St / Tualatin-Sherwood Rd | 3 | 7 | 2 |

| Intersection Group: 14 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Davies Rd / Scholls Ferry Rd | 1 | 8 | 3 |
| Comparison Site | Meadow Dr / Walker Rd | 1 | 3 | 3 |

| Intersection Group: 15 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Evergreen Pkwy / Stucki Ave | 1 | 1 | 3 |
| Comparison Site | Cornell Rd / Stucki Rd | 7 | 5 | 6 |

| Intersection Group: 16 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Cedar Hills Blvd / Park Way | 1 | 4 | 3 |
| Comparison Site | Cornell Rd / John Olsen Ave | 3 | 1 | 8 |

| Sample Odds Ratio Calculation | | | |
|---|---|---|---|
| | *Crash Type:* | Rear-End Crashes | |
| | 2014 | 2015 | 2016 |
| Treatment Group | 118 | 101 | 99 |
| Control Group | 98 | 93 | 97 |
| | 2014-2015 | 2015-2016 | |
| Sample Odds Ratio | 1.09 | 1.04 | |
| Mean | 1.06 | <-overall sample odds ratio | |
| Standard Deviation | 0.03 | | |
| 95th Percentile Confidence Interval | | | |
| 1.00 | *to* | 1.13 | |

*Notes:*
*Crash totals are sum of crashes within 265-feet of the center of the i*

| Intersection Group: 1 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Jenkins Rd / Murray Blvd | 2 | 2 | 1 |
| Comparison Site | Cornelius Pass Rd / Cornell Rd | 1 | 2 | 0 |

| Intersection Group: 2 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Century Blvd / Evergreen Pwky | 0 | 2 | 1 |
| Comparison Site | Laidlaw Rd / West Union Rd | 0 | 0 | 0 |

| Intersection Group: 3 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Hart Rd / Murray Blvd | 3 | 1 | 2 |
| Comparison Site | 158th Ave / Walker Rd | 0 | 4 | 1 |

| Intersection Group: 4 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Evergreen Pkwy / John Olsen Ave | 0 | 1 | 0 |
| Comparison Site | Farmington Rd / Kinnaman Rd | 0 | 2 | 0 |

| Intersection Group: 5 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Nimbus Ave / Scholls Ferry Rd | 2 | 1 | 3 |
| Comparison Site | 185th Ave / Kinnaman Rd | 1 | 0 | 1 |

| Intersection Group: 6 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Barnes Rd / Cedar Hills Blvd | 1 | 0 | 3 |
| Comparison Site | Brookwood Pkwy / Cornell Rd | 1 | 0 | 2 |

| Intersection Group: 7 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Allen Blvd / Murray Blvd | 3 | 1 | 0 |
| Comparison Site | 185th Ave / West Union Ave | 2 | 0 | 1 |

| Intersection Group: 8 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Cedar Hills Blvd / Fairfield St | 1 | 1 | 1 |
| Comparison Site | Cornell Rd / Saltzman Rd | 0 | 2 | 1 |

| Intersection Group: 9 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Murray Blvd / Scholls Ferry Rd | 0 | 2 | 2 |
| Comparison Site | 185th Ave / Cornell Rd | 3 | 1 | 0 |

| Intersection Group: 10 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 121st Ave / Boones Bend Dr / Scholls Ferry Rd | 0 | 0 | 1 |
| Comparison Site | Cherry Dr / Cornelius Pass Rd | 0 | 0 | 0 |

| Intersection Group: 11 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 147th Ter / Murray Scholls Pl / Scholls Ferry Rd | 0 | 1 | 1 |
| Comparison Site | Bethany Blvd / Kaiser Rd / Wismer Dr | 0 | 0 | 0 |

| Intersection Group: 12 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 125th Ave / Scholls Ferry Rd | 0 | 3 | 1 |
| Comparison Site | 170th Ave / Blanton St | 0 | 1 | 1 |

| Intersection Group: 13 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | 135th Ave / Scholls Ferry Rd | 1 | 1 | 1 |
| Comparison Site | Nyberg St / Tualatin-Sherwood Rd | 0 | 1 | 0 |

| Intersection Group: 14 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Davies Rd / Scholls Ferry Rd | 0 | 2 | 0 |
| Comparison Site | Meadow Dr / Walker Rd | 0 | 1 | 0 |

| Intersection Group: 15 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Evergreen Pkwy / Stucki Ave | 1 | 1 | 0 |
| Comparison Site | Cornell Rd / Stucki Rd | 2 | 2 | 1 |

| Intersection Group: 16 | | | | |
|---|---|---|---|---|
| | Intersection | 2014 Crash Total | 2015 Crash Total | 2016 Crash Total |
| Treatment Site | Cedar Hills Blvd / Park Way | 0 | 0 | 0 |
| Comparison Site | Cornell Rd / John Olsen Ave | 0 | 0 | 1 |

| Sample Odds Ratio Calculation | | | |
|---|---|---|---|
| | | *Crash Type:* | Night Crashes |
| | 2014 | 2015 | 2016 |
| Treatment Group | 14 | 19 | 17 |
| Control Group | 10 | 16 | 9 |
| | 2014-2015 | 2015-2016 | |
| Sample Odds Ratio | 1.02 | 0.56 | |
| Mean | 0.79 | <-overall sample odds ratio | |
| Standard Deviation | 0.33 | | |
| 95th Percentile Confidence Interval | | | |
| 0.15 | *to* | 1.43 | |

*Notes:*
*Crash totals are sum of crashes within 265-feet of the center of the i*

*Appendix C: SPF-R Model Outputs*

SPF-R

# Results:

**Date/Time Run: 11/4/2025 7:17:52 PM**

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## Equation:

$$Crashes = e^{ADTmajor \cdot b0} \cdot e^{ADTminor \cdot b1} \cdot e^{a}$$

## Parameters

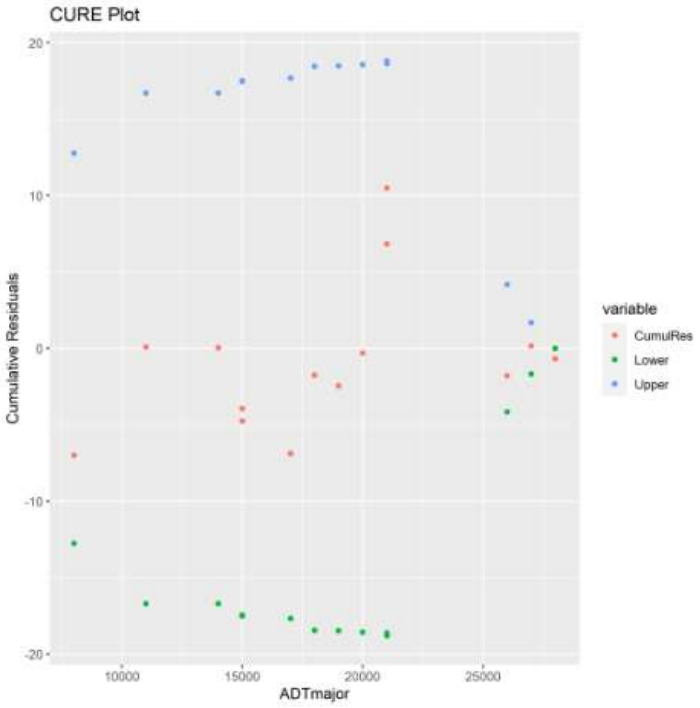
| | |
|---|---|
| Adjustment Factor | None |
| Overdispersion | 102.628822 |
| Model form | |
| | a=2.028, intercept, stderror = 0.242, statistic = 8.363, pvalue = 0 |
| | b0=2.4E-05, var1, stderror = 0, statistic = 1.752, pvalue = 0.08 |
| | b1=5.2E-05, var2, stderror = 0, statistic = 4.898, pvalue = 0 |

## Metrics

| | |
|---|---|
| Sample | 14 |
| Mileage | |
| Crashes | 291 (ideally 300 crashes per year) |
| Modified RSquared | 0.944 (Higher values preferred) |
| CDP | 7.143 (ideally less than 5%) |
| MACD | 10.5 (Smaller values preferred) |
| MAD | 3.922 (Smaller values preferred) |
| StdErr | 215.081 (theta approximate standard error) |

| | |
|---|---|
| AIC | 91.242 (lower values preferred - ensure sample size is similar) |
| Filter | No filter |

## Cure Plot:




## Road and Crash Details

| | |
|---|---|
| Crash Type | |
| Crash Severity | |
| Road Type | |
| Intersection Type | |
| Timeframe | |
| Other details | |

## Settings

| | |
|---|---|
| Initial Theta | 0.1 |
| Overdispersion Type | Constant Over-dispersion |
| Timeout | 60 |
| Intersections | No length required |

## R-Code:

```
library(MASS)
library(ggplot2)
library(broom)
data=read.csv('C:/pathtoyourfile/yourFileName.csv',header=T)
data<- data[ order(data$ADTmajor),]
dep=data$Crashes
var1=data$ADTmajor
var2=data$ADTminor
init.theta = 0.1
SPF=glm.nb(dep~var1+var2)
coef<-coefficients(SPF)
summary(SPF)
theta<-SPF$theta
out<-
cbind(data,Predicted=SPF$fitted.values,Residuals=resid(SPF,type='resp'),CumulRes=cumsum(resid(SPF,type='resp'
)))
out$ADTmajor <- data$ADTmajor
out$CumulRes = out$CumulRes
out$Squared_Res = out$Residuals^2
out$CumulSqRes = cumsum(out$Squared_Res)
out$SigmaSum = sqrt(out$CumulSqRes)
out$StdDev = out$SigmaSum*sqrt(1-out$CumulSqRes/sum(out$Squared_Res))
out$UpperLimit = out$StdDev * 1.96
out$LowerLimit = out$StdDev * (-1.96)
out$Per_CURE = ifelse(out$CumulRes>out$UpperLimit,1,ifelse(out$CumulRes<out$LowerLimit,1,0))
nrow(out)
sum(out$Crashes)
ObsAvg = mean(out$Crashes)
tmpTerm = sum((out$Crashes-ObsAvg) ^ 2)
tmpTerm2 = sum((out$Crashes-out$Predicted)^2)
(tmpTerm - tmpTerm2) / (tmpTerm - sum(out$Predicted)) # Modified RSquared
sum(out$Per_CURE)/length(out$Per_CURE)*100 #CDP
max(abs(out$CumulRes)) # MACD
mean(abs(out$Residuals)) #MAD
SPF$SE.theta # std err
SPF$aic # AIC
out$Weight=1/(1+out$Predicted/SPF$theta)
out$EB_Estimate <- out$Crashes*(1-out$Weight) + out$Predicted*(out$Weight)
out$EEC <- out$EB_Estimate - out$Predicted
out$CI <- sqrt((1-out$Weight)*out$EB_Estimate)
CUREPlot <- ggplot(out, aes(out$ADTmajor, y = value, color = variable)) + geom_point(aes(y = UpperLimit, col
= 'Upper')) + geom_point(aes(y = LowerLimit, col = 'Lower')) + geom_point(aes(y = CumulRes, col =
'CumulRes')) + ggtitle('CURE Plot') + labs(x = 'ADTmajor', y = 'Cumulative Residuals'
ggsave('C:/outpath.PNG')
write.csv(out,'C:/outpath.csv', row.names = TRUE)
```

SPF-R

# Results:

**Date/Time Run: 11/4/2025 6:43:54 PM**

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## Equation:

$$Crashes = ADTmajor^{b0} \cdot ADTminor^{b1} \cdot SpeedMinor^{b2} \cdot CrossMajor^{b3} \cdot e^{a}$$

## Parameters

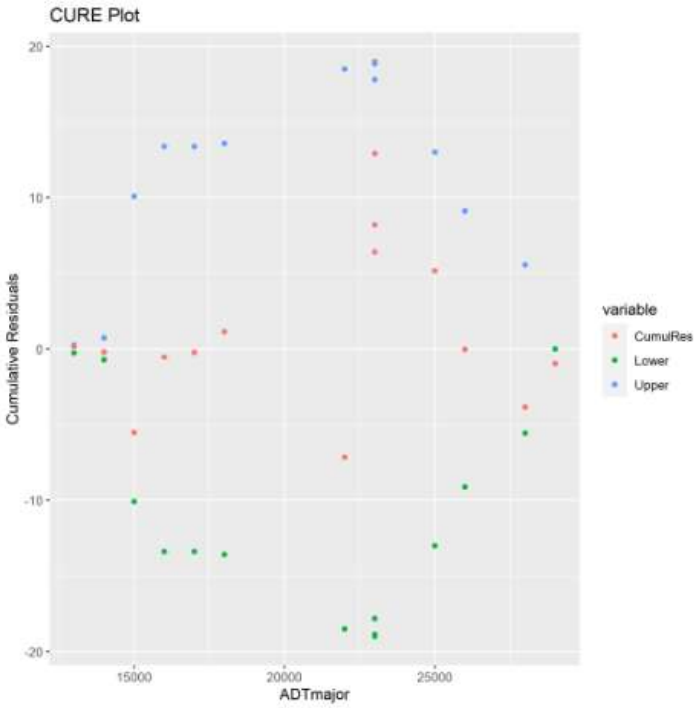
| | |
|---|---|
| Adjustment Factor | None |
| Overdispersion | 11.75881 |
| Model form | |
| | a=-22.56, intercept, stderror = 4.701, statistic = -4.799, pvalue = 0 |
| | b0=2.704097, var1, stderror = 1.383, statistic = 1.956, pvalue = 0.051 |
| | b1=-1.189737, var2, stderror = 1.003, statistic = -1.186, pvalue = 0.235 |
| | b2=0.148195, var3, stderror = 0.98, statistic = 0.151, pvalue = 0.88 |
| | b3=1.975872, var4, stderror = 0.569, statistic = 3.471, pvalue = 0.001 |

## Metrics

| | |
|---|---|
| Sample | 14 |
| Mileage | |
| Crashes | 253 (ideally 300 crashes per year) |
| Modified RSquared | 0.926 (Higher values preferred) |
| CDP | 7.143 (ideally less than 5%) |
| MACD | 12.9 (Smaller values preferred) |

| | |
|---|---|
| MAD | 4.315 (Smaller values preferred) |
| StdErr | 9.638 (theta approximate standard error) |
| AIC | 102.535 (lower values preferred - ensure sample size is similar) |
| Filter | No filter |

## Cure Plot:




## Road and Crash Details

| | |
|---|---|
| Crash Type | |
| Crash Severity | |
| Road Type | |
| Intersection Type | |
| Timeframe | |
| Other details | |

## Settings

| | |
|---|---|
| Initial Theta | 0.1 |
| Overdispersion Type | Constant Over-dispersion |
| Timeout | 60 |
| Intersections | No length required |

## R-Code:

```
library(MASS)
library(ggplot2)
library(broom)
data=read.csv('C:/pathtoyourfile/yourFileName.csv',header=T)
data<- data[ order(data$ADTmajor),]
dep=data$Crashes
var1=log(data$ADTmajor)
var2=log(data$ADTminor)
var3=log(data$SpeedMinor)
var4=log(data$CrossMajor)
init.theta = 0.1
SPF=glm.nb(dep~var1+var2+var3+var4)
coef<-coefficients(SPF)
summary(SPF)
theta<-SPF$theta
out<-
cbind(data,Predicted=SPF$fitted.values,Residuals=resid(SPF,type='resp'),CumulRes=cumsum(resid(SPF,type='resp'
)))
out$ADTmajor <- data$ADTmajor
out$CumulRes = out$CumulRes
out$Squared_Res = out$Residuals^2
out$CumulSqRes = cumsum(out$Squared_Res)
out$SigmaSum = sqrt(out$CumulSqRes)
out$StdDev = out$SigmaSum*sqrt(1-out$CumulSqRes/sum(out$Squared_Res))
out$UpperLimit = out$StdDev * 1.96
out$LowerLimit = out$StdDev * (-1.96)
out$Per_CURE = ifelse(out$CumulRes>out$UpperLimit,1,ifelse(out$CumulRes<out$LowerLimit,1,0))
nrow(out)
sum(out$Crashes)
ObsAvg = mean(out$Crashes)
tmpTerm = sum((out$Crashes-ObsAvg) ^ 2)
tmpTerm2 = sum((out$Crashes-out$Predicted)^2)
(tmpTerm - tmpTerm2) / (tmpTerm - sum(out$Predicted)) # Modified RSquared
sum(out$Per_CURE)/length(out$Per_CURE)*100 #CDP
max(abs(out$CumulRes)) # MACD
mean(abs(out$Residuals)) #MAD
SPF$SE.theta # std err
SPF$aic # AIC
out$Weight=1/(1+out$Predicted/SPF$theta)
out$EB_Estimate <- out$Crashes*(1-out$Weight) + out$Predicted*(out$Weight)
out$EEC <- out$EB_Estimate - out$Predicted
out$CI <- sqrt((1-out$Weight)*out$EB_Estimate)
CUREPlot <- ggplot(out, aes(out$ADTmajor, y = value, color = variable)) + geom_point(aes(y = UpperLimit, col
= 'Upper')) + geom_point(aes(y = LowerLimit, col = 'Lower')) + geom_point(aes(y = CumulRes, col =
'CumulRes')) + ggtitle('CURE Plot') + labs(x = 'ADTmajor', y = 'Cumulative Residuals'
ggsave('C:/outpath.PNG')
write.csv(out,'C:/outpath.csv', row.names = TRUE)
```

SPF-R

# Results:

**Date/Time Run: 11/4/2025 6:25:13 PM**

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## Equation:

$$Crashes = ADTmajor^{b0} \cdot ADTminor^{b1} \cdot SpeedMinor^{b2} \cdot CrossMajor^{b3} \cdot e^{a}$$

## Parameters

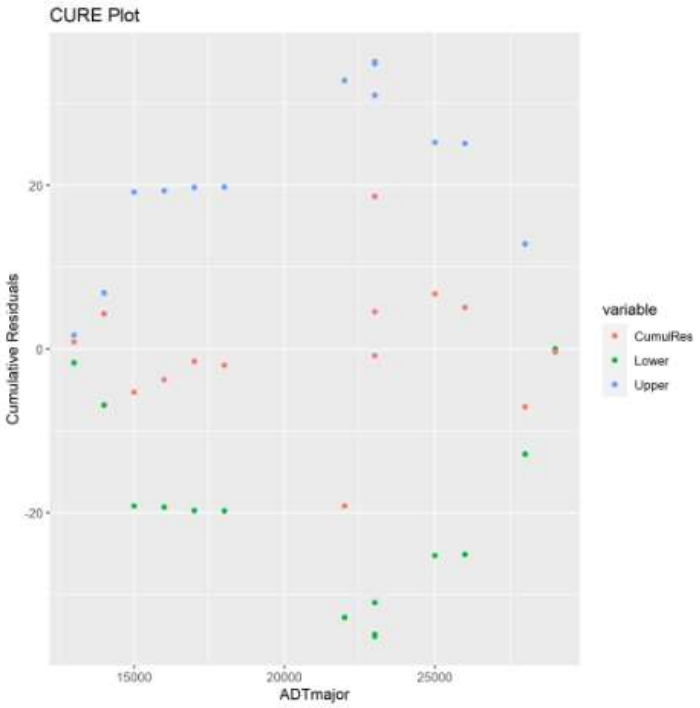
| | |
|---|---|
| Adjustment Factor | None |
| Overdispersion | 8.872563 |
| Model form | |
| | a=-9.338, intercept, stderror = 4.35, statistic = -2.147, pvalue = 0.032 |
| | b0=0.540953, var1, stderror = 1.354, statistic = 0.399, pvalue = 0.69 |
| | b1=-0.195098, var2, stderror = 0.962, statistic = -0.203, pvalue = 0.839 |
| | b2=1.341762, var3, stderror = 0.945, statistic = 1.42, pvalue = 0.156 |
| | b3=0.974226, var4, stderror = 0.536, statistic = 1.819, pvalue = 0.069 |

## Metrics

| | |
|---|---|
| Sample | 14 |
| Mileage | |
| Crashes | 444 (ideally 300 crashes per year) |
| Modified RSquared | 0.788 (Higher values preferred) |
| CDP | 7.143 (ideally less than 5%) |
| MACD | 19.2 (Smaller values preferred) |

| | |
|---|---|
| MAD | 7.538 (Smaller values preferred) |
| StdErr | 4.802 (theta approximate standard error) |
| AIC | 118.695 (lower values preferred - ensure sample size is similar) |
| Filter | No filter |

## Cure Plot:




## Road and Crash Details

| | |
|---|---|
| Crash Type | |
| Crash Severity | |
| Road Type | |
| Intersection Type | |
| Timeframe | |
| Other details | |

## Settings

| | |
|---|---|
| Initial Theta | 0.1 |
| Overdispersion Type | Constant Over-dispersion |
| Timeout | 60 |
| Intersections | No length required |

## R-Code:

```
library(MASS)
library(ggplot2)
library(broom)
data=read.csv('C:/pathtoyourfile/yourFileName.csv',header=T)
data<- data[ order(data$ADTmajor),]
dep=data$Crashes
var1=log(data$ADTmajor)
var2=log(data$ADTminor)
var3=log(data$SpeedMinor)
var4=log(data$CrossMajor)
init.theta = 0.1
SPF=glm.nb(dep~var1+var2+var3+var4)
coef<-coefficients(SPF)
summary(SPF)
theta<-SPF$theta
out<-
cbind(data,Predicted=SPF$fitted.values,Residuals=resid(SPF,type='resp'),CumulRes=cumsum(resid(SPF,type='resp'
)))
out$ADTmajor <- data$ADTmajor
out$CumulRes = out$CumulRes
out$Squared_Res = out$Residuals^2
out$CumulSqRes = cumsum(out$Squared_Res)
out$SigmaSum = sqrt(out$CumulSqRes)
out$StdDev = out$SigmaSum*sqrt(1-out$CumulSqRes/sum(out$Squared_Res))
out$UpperLimit = out$StdDev * 1.96
out$LowerLimit = out$StdDev * (-1.96)
out$Per_CURE = ifelse(out$CumulRes>out$UpperLimit,1,ifelse(out$CumulRes<out$LowerLimit,1,0))
nrow(out)
sum(out$Crashes)
ObsAvg = mean(out$Crashes)
tmpTerm = sum((out$Crashes-ObsAvg) ^ 2)
tmpTerm2 = sum((out$Crashes-out$Predicted)^2)
(tmpTerm - tmpTerm2) / (tmpTerm - sum(out$Predicted)) # Modified RSquared
sum(out$Per_CURE)/length(out$Per_CURE)*100 #CDP
max(abs(out$CumulRes)) # MACD
mean(abs(out$Residuals)) #MAD
SPF$SE.theta # std err
SPF$aic # AIC
out$Weight=1/(1+out$Predicted/SPF$theta)
out$EB_Estimate <- out$Crashes*(1-out$Weight) + out$Predicted*(out$Weight)
out$EEC <- out$EB_Estimate - out$Predicted
out$CI <- sqrt((1-out$Weight)*out$EB_Estimate)
CUREPlot <- ggplot(out, aes(out$ADTmajor, y = value, color = variable)) + geom_point(aes(y = UpperLimit, col
= 'Upper')) + geom_point(aes(y = LowerLimit, col = 'Lower')) + geom_point(aes(y = CumulRes, col =
'CumulRes')) + ggtitle('CURE Plot') + labs(x = 'ADTmajor', y = 'Cumulative Residuals'
ggsave('C:/outpath.PNG')
write.csv(out,'C:/outpath.csv', row.names = TRUE)
```

SPF-R

# Results:

**Date/Time Run: 11/4/2025 6:03:07 PM**

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## Equation:

$$Crashes = e^{ADTmajor \cdot b0} \cdot e^{ADTminor \cdot b1} \cdot e^{a}$$

## Parameters

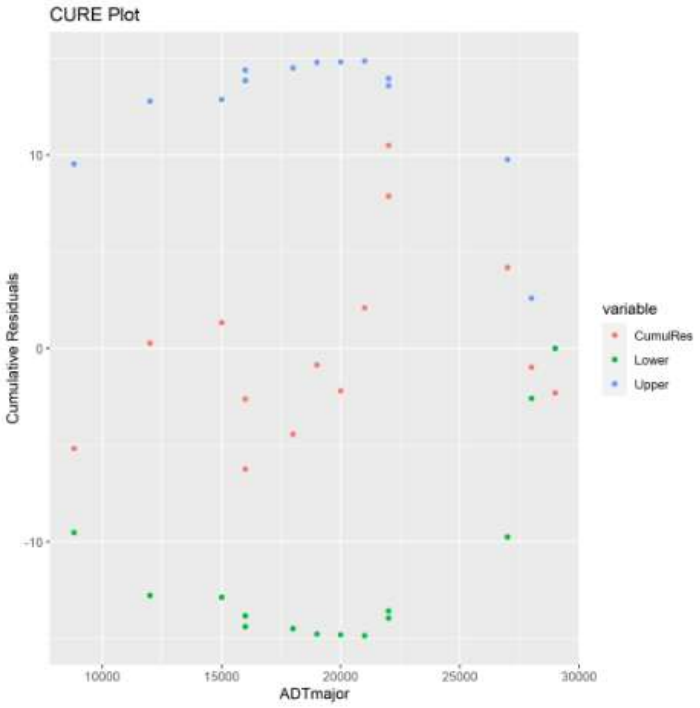
| | |
|---|---|
| Adjustment Factor | None |
| Overdispersion | 17.559118 |
| Model form | |
| | a=1.014, intercept, stderror = 0.414, statistic = 2.45, pvalue = 0.014 |
| | b0=3.1E-05, var1, stderror = 0, statistic = 1.382, pvalue = 0.167 |
| | b1=7.1E-05, var2, stderror = 0, statistic = 4.035, pvalue = 0 |

## Metrics

| | |
|---|---|
| Sample | 14 |
| Mileage | |
| Crashes | 156 (ideally 300 crashes per year) |
| Modified RSquared | 0.896 (Higher values preferred) |
| CDP | 7.143 (ideally less than 5%) |
| MACD | 10.5 (Smaller values preferred) |
| MAD | 3.673 (Smaller values preferred) |
| StdErr | 23.431 (theta approximate standard error) |

| | |
|---|---|
| AIC | 88.708 (lower values preferred - ensure sample size is similar) |
| Filter | No filter |

## Cure Plot:




## Road and Crash Details

| | |
|---|---|
| Crash Type | |
| Crash Severity | |
| Road Type | |
| Intersection Type | |
| Timeframe | |
| Other details | |

## Settings

| | |
|---|---|
| Initial Theta | 0.1 |
| Overdispersion Type | Constant Over-dispersion |
| Timeout | 60 |
| Intersections | No length required |

## R-Code:

```
library(MASS)
library(ggplot2)
library(broom)
data=read.csv('C:/pathtoyourfile/yourFileName.csv',header=T)
data<- data[ order(data$ADTmajor),]
dep=data$Crashes
var1=data$ADTmajor
var2=data$ADTminor
init.theta = 0.1
SPF=glm.nb(dep~var1+var2)
coef<-coefficients(SPF)
summary(SPF)
theta<-SPF$theta
out<-
cbind(data,Predicted=SPF$fitted.values,Residuals=resid(SPF,type='resp'),CumulRes=cumsum(resid(SPF,type='resp'
)))
out$ADTmajor <- data$ADTmajor
out$CumulRes = out$CumulRes
out$Squared_Res = out$Residuals^2
out$CumulSqRes = cumsum(out$Squared_Res)
out$SigmaSum = sqrt(out$CumulSqRes)
out$StdDev = out$SigmaSum*sqrt(1-out$CumulSqRes/sum(out$Squared_Res))
out$UpperLimit = out$StdDev * 1.96
out$LowerLimit = out$StdDev * (-1.96)
out$Per_CURE = ifelse(out$CumulRes>out$UpperLimit,1,ifelse(out$CumulRes<out$LowerLimit,1,0))
nrow(out)
sum(out$Crashes)
ObsAvg = mean(out$Crashes)
tmpTerm = sum((out$Crashes-ObsAvg) ^ 2)
tmpTerm2 = sum((out$Crashes-out$Predicted)^2)
(tmpTerm - tmpTerm2) / (tmpTerm - sum(out$Predicted)) # Modified RSquared
sum(out$Per_CURE)/length(out$Per_CURE)*100 #CDP
max(abs(out$CumulRes)) # MACD
mean(abs(out$Residuals)) #MAD
SPF$SE.theta # std err
SPF$aic # AIC
out$Weight=1/(1+out$Predicted/SPF$theta)
out$EB_Estimate <- out$Crashes*(1-out$Weight) + out$Predicted*(out$Weight)
out$EEC <- out$EB_Estimate - out$Predicted
out$CI <- sqrt((1-out$Weight)*out$EB_Estimate)
CUREPlot <- ggplot(out, aes(out$ADTmajor, y = value, color = variable)) + geom_point(aes(y = UpperLimit, col
= 'Upper')) + geom_point(aes(y = LowerLimit, col = 'Lower')) + geom_point(aes(y = CumulRes, col =
'CumulRes')) + ggtitle('CURE Plot') + labs(x = 'ADTmajor', y = 'Cumulative Residuals'
ggsave('C:/outpath.PNG')
write.csv(out,'C:/outpath.csv', row.names = TRUE)
```

## *Appendix D: CMF Calculations*

| Century / Evergreen All Crashes CMF Calculation | | | | | | | w | w x CMF | w^2 | w^2 x Var |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 29.4 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0038 | | 0.0038 | 0.005032 | 0.000015 | 0.000002 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 32 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 32.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 16.9 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 18.39 | crashes | | | | |
| $ADT_{major}$ | 16000 | 16000 | veh/day | $Var(N_{expectedTA})$ | 10.53 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 25 | crashes | | | | |
| $Speed_{minor}$ | 35 | | mph | CMF | 1.32 | | | | | |
| $Cross_{major}$ | 102 | | ft | Variance(CMF) | 0.12 | | | | | |

| Hart / Murray All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 23.4 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0048 | | 0.0048 | 0.004558 | 0.000023 | 0.000001 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 33 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 33.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 23.2 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 32.7 | crashes | | | | |
| $ADT_{major}$ | 27000 | 27000 | veh/day | $Var(N_{expectedTA})$ | 32.35 | | | | | |
| $ADT_{minor}$ | 9000 | 9000 | veh/day | $N_{observedTA}$ | 32 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.95 | | | | | |
| $Cross_{major}$ | 98 | | ft | Variance(CMF) | 0.052 | | | | | |

| Evergreen / John Olsen All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 31.7 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0035 | | 0.0035 | 0.005791 | 0.000013 | 0.000004 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 15 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 15.1 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 16.9 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 8.0 | crashes | | | | |
| $ADT_{major}$ | 16000 | 16000 | veh/day | $Var(N_{expectedTA})$ | 4.28 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 14 | crashes | | | | |
| $Speed_{minor}$ | 35 | | mph | CMF | 1.63 | | | | | |
| $Cross_{major}$ | 110 | | ft | Variance(CMF) | 0.323 | | | | | |

| Nimbus / Scholls Ferry All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 27.6 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0041 | | 0.0041 | 0.002392 | 0.000017 | 0.000000 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 39 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 39.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 25.8 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 36.5 | crashes | | | | |
| $ADT_{major}$ | 39000 | 38000 | veh/day | $Var(N_{expectedTA})$ | 34.07 | | | | | |
| $ADT_{minor}$ | 7000 | 6000 | veh/day | $N_{observedTA}$ | 22 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.59 | | | | | |
| $Cross_{major}$ | 90 | | ft | Variance(CMF) | 0.023 | | | | | |

| Barnes / Cedar Hills All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 38.4 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0029 | | 0.0029 | 0.003157 | 0.000009 | 0.000000 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 48 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 48.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 26.9 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 33.6 | crashes | | | | |
| $ADT_{major}$ | 18000 | 18000 | veh/day | $Var(N_{expectedTA})$ | 23.44 | | | | | |
| $ADT_{minor}$ | 17000 | 16000 | veh/day | $N_{observedTA}$ | 37 | crashes | | | | |
| $Speed_{minor}$ | 40 | | mph | CMF | 1.08 | | | | | |
| $Cross_{major}$ | 122 | | ft | Variance(CMF) | 0.053 | | | | | |

| Allen / Murray Hills All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 21.0 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0053 | | 0.0053 | 0.002422 | 0.000029 | 0.000000 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 41 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 40.9 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 30.9 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 60.3 | crashes | | | | |
| $ADT_{major}$ | 23000 | 26000 | veh/day | $Var(N_{expectedTA})$ | 88.37 | | | | | |
| $ADT_{minor}$ | 16000 | 15000 | veh/day | $N_{observedTA}$ | 28 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.45 | | | | | |
| $Cross_{major}$ | 108 | | ft | Variance(CMF) | 0.0118 | | | | | |

| Cedar Hills / Fairfield Hills All Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 14.9 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0075 | | 0.0075 | 0.007671 | 0.000057 | 0.000006 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 16 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 16.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 18.0 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 19.4 | crashes | | | | |
| $ADT_{major}$ | 23000 | 23000 | veh/day | $Var(N_{expectedTA})$ | 23.34 | | | | | |
| $ADT_{minor}$ | 7000 | 6000 | veh/day | $N_{observedTA}$ | 21 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 1.02 | | | | | |
| $Cross_{major}$ | 64 | | ft | Variance(CMF) | 0.10 | | | | | |

| All Crashes CMF | 0.84 | | |
|---|---|---|---|
| CMF Variance | 0.0060 | | |
| Standard Error | 0.077 | | |
| 95% Confidence Interval | 0.68 | to | 0.99 |

**Murray / Scholls Ferry All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 38.7 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0029 | | 0.0029 | 0.001368 | 0.000008 | 0.000000 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 47 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 47.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 41.1 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 49.9 | crashes | | | | |
| $ADT_{major}$ | 27000 | 27000 | veh/day | $Var(N_{expectedTA})$ | 52.76 | | | | | |
| $ADT_{minor}$ | 20000 | 20000 | veh/day | $N_{observedTA}$ | 24 | crashes | | | | |
| $Speed_{minor}$ | 35 | | mph | CMF | 0.47 | | | | | |
| $Cross_{major}$ | 122 | | ft | Variance(CMF) | 0.013 | | | | | |

**121st / Scholls Ferry All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 18.8 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0060 | | 0.0060 | 0.002949 | 0.000036 | 0.000001 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 28 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 27.9 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 35.4 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 52.7 | crashes | | | | |
| $ADT_{major}$ | 37000 | 36000 | veh/day | $Var(N_{expectedTA})$ | 98.95 | | | | | |
| $ADT_{minor}$ | 14000 | 13000 | veh/day | $N_{observedTA}$ | 27 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.49 | | | | | |
| $Cross_{major}$ | 72 | | ft | Variance(CMF) | 0.017 | | | | | |

**147th / Scholls Ferry All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 18.4 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0061 | | 0.0061 | 0.005489 | 0.000037 | 0.000004 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 13 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 13.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 18.9 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 13.4 | crashes | | | | |
| $ADT_{major}$ | 25000 | 25000 | veh/day | $Var(N_{expectedTA})$ | 13.71 | | | | | |
| $ADT_{minor}$ | 7000 | 6000 | veh/day | $N_{observedTA}$ | 13 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.90 | | | | | |
| $Cross_{major}$ | 76 | | ft | Variance(CMF) | 0.11 | | | | | |

**125th / Scholls Ferry All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 24.4 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0046 | | 0.0046 | 0.002801 | 0.000021 | 0.000000 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 46 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 45.9 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 27.3 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 51.4 | crashes | | | | |
| $ADT_{major}$ | 37000 | 36000 | veh/day | $Var(N_{expectedTA})$ | 57.31 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 32 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.61 | | | | | |
| $Cross_{major}$ | 84 | | ft | Variance(CMF) | 0.019 | | | | | |

**Davies / Scholls Ferry All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 24.6 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0046 | | 0.0046 | 0.002321 | 0.000021 | 0.000001 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 21 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 21.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 19.8 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 16.9 | crashes | | | | |
| $ADT_{major}$ | 29000 | 29000 | veh/day | $Var(N_{expectedTA})$ | 13.53 | | | | | |
| $ADT_{minor}$ | 5000 | 5000 | veh/day | $N_{observedTA}$ | 9 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.51 | | | | | |
| $Cross_{major}$ | 88 | | ft | Variance(CMF) | 0.04 | | | | | |

**Evergreen / Stucki All Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 27.6 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0041 | | 0.0041 | 0.004489 | 0.000017 | 0.000001 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 38 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 38.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 18.6 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 25.6 | crashes | | | | |
| $ADT_{major}$ | 17000 | 20000 | veh/day | $Var(N_{expectedTA})$ | 17.26 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 29 | crashes | | | | |
| $Speed_{minor}$ | 30 | | mph | CMF | 1.10 | | | | | |
| $Cross_{major}$ | 114 | | ft | Variance(CMF) | 0.07 | | | | | |

**Cedar Hills / Park Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 8.9 | 103 | | $N_{predictedTB}$ | 15.9 | crashes | | | | |
| a | -9.34 | 2.03 | | $SPF_{weight}$ | 0.0070 | | 0.0070 | 0.005734 | 0.000049 | 0.000006 |
| $b_0$ | 0.54 | 0.000024 | | $N_{observedTB}$ | 9 | crashes | | | | |
| $b_1$ | -0.20 | 0.000052 | | $N_{expectedTB}$ | 9.0 | crashes | | | | |
| $b_2$ | 1.34 | | | $N_{predictedTA}$ | 15.5 | crashes | | | | |
| $b_3$ | 0.97 | | | $N_{expectedTA}$ | 8.8 | crashes | | | | |
| $ADT_{major}$ | 20000 | 19000 | veh/day | $Var(N_{expectedTA})$ | 8.55 | | | | | |
| $ADT_{minor}$ | 6000 | 5000 | veh/day | $N_{observedTA}$ | 8 | crashes | | | | |
| $Speed_{minor}$ | 25 | | mph | CMF | 0.82 | | | | | |
| $Cross_{major}$ | 72 | | ft | Variance(CMF) | 0.13 | | | | | |

| Century / Evergreen Rear-End Crashes CMF Calculation | | | | | | | w | w x CMF | w^2 | w^2 x Var |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 13.3 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0063 | | 0.0063 | 0.01019 | 0.000040 | 0.000016 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 10 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 10.0 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 8.3 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 6.22 | crashes | | | | |
| $ADT_{major}$ | 16000 | 16000 | veh/day | $Var(N_{expectedTA})$ | 3.84 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 11 | crashes | | | | |
| $Speed_{minor}$ | 35 | [redacted] | mph | CMF | 1.61 | | | | | |
| $Cross_{major}$ | 102 | | ft | Variance(CMF) | 0.41 | | | | | |

| Hart / Murray Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 41.9 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0020 | | 0.0020 | 0.003671 | 0.000004 | 0.000001 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 23 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 23.0 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 12.5 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 6.9 | crashes | | | | |
| $ADT_{major}$ | 27000 | 27000 | veh/day | $Var(N_{expectedTA})$ | 2.04 | | | | | |
| $ADT_{minor}$ | 9000 | 9000 | veh/day | $N_{observedTA}$ | 13 | crashes | | | | |
| $Speed_{minor}$ | 25 | [redacted] | mph | CMF | 1.81 | | | | | |
| $Cross_{major}$ | 98 | | ft | Variance(CMF) | 0.36 | | | | | |

| Evergreen / John Olsen Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 15.5 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0055 | | 0.0055 | 0.006058 | 0.000030 | 0.000014 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 4 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 4.1 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 8.3 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 2.2 | crashes | | | | |
| $ADT_{major}$ | 16000 | 16000 | veh/day | $Var(N_{expectedTA})$ | 1.16 | | | | | |
| $ADT_{minor}$ | 8000 | 8000 | veh/day | $N_{observedTA}$ | 3 | crashes | | | | |
| $Speed_{minor}$ | 35 | [redacted] | mph | CMF | 1.11 | | | | | |
| $Cross_{major}$ | 110 | | ft | Variance(CMF) | 0.46 | | | | | |

| Nimbus / Scholls Ferry Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 129.2 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0007 | | 0.0007 | 0.002238 | 0.000000 | 0.000001 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 31 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 31.1 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 14.2 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 3.4 | crashes | | | | |
| $ADT_{major}$ | 39000 | 38000 | veh/day | $Var(N_{expectedTA})$ | 0.38 | | | | | |
| $ADT_{minor}$ | 7000 | 6000 | veh/day | $N_{observedTA}$ | 12 | crashes | | | | |
| $Speed_{minor}$ | 25 | [redacted] | mph | CMF | 3.40 | | | | | |
| $Cross_{major}$ | 90 | | ft | Variance(CMF) | 1.26 | | | | | |

| Barnes / Cedar Hills Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 10.9 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0078 | | 0.0078 | 0.003411 | 0.000060 | 0.000001 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 39 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 38.8 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 15.5 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 55.5 | crashes | | | | |
| $ADT_{major}$ | 18000 | 18000 | veh/day | $Var(N_{expectedTA})$ | 78.77 | | | | | |
| $ADT_{minor}$ | 17000 | 16000 | veh/day | $N_{observedTA}$ | 25 | crashes | | | | |
| $Speed_{minor}$ | 40 | [redacted] | mph | CMF | 0.44 | | | | | |
| $Cross_{major}$ | 122 | | ft | Variance(CMF) | 0.01 | | | | | |

| Allen / Murray Hills Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 16.6 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0051 | | 0.0051 | 0.002811 | 0.000026 | 0.000001 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 25 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 25.0 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 18.6 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 27.9 | crashes | | | | |
| $ADT_{major}$ | 23000 | 26000 | veh/day | $Var(N_{expectedTA})$ | 30.99 | | | | | |
| $ADT_{minor}$ | 16000 | 15000 | veh/day | $N_{observedTA}$ | 16 | crashes | | | | |
| $Speed_{minor}$ | 25 | [redacted] | mph | CMF | 0.55 | | | | | |
| $Cross_{major}$ | 108 | | ft | Variance(CMF) | 0.03 | | | | | |

| Cedar Hills / Fairfield Hills Rear-End Crashes CMF Calculation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | | | | | | | | |
| Overdispersion | 11.8 | 17.4 | | $N_{predictedTB}$ | 15.8 | crashes | | | | |
| a | -22.56 | 1.05 | | $SPF_{weight}$ | 0.0054 | | 0.0054 | 0.003088 | 0.000029 | 0.000006 |
| $b_0$ | 2.70 | 0.000031 | | $N_{observedTB}$ | 2 | crashes | | | | |
| $b_1$ | -1.19 | 0.000071 | | $N_{expectedTB}$ | 2.1 | crashes | | | | |
| $b_2$ | 0.15 | | | $N_{predictedTA}$ | 8.9 | crashes | | | | |
| $b_3$ | 1.98 | | | $N_{expectedTA}$ | 1.2 | crashes | | | | |
| $ADT_{major}$ | 23000 | 23000 | veh/day | $Var(N_{expectedTA})$ | 0.66 | | | | | |
| $ADT_{minor}$ | 7000 | 6000 | veh/day | $N_{observedTA}$ | 1 | crashes | | | | |
| $Speed_{minor}$ | 25 | [redacted] | mph | CMF | 0.58 | | | | | |
| $Cross_{major}$ | 64 | | ft | Variance(CMF) | 0.22 | | | | | |

| | | | |
|---|---|---|---|
| Rear-End Crashes CMF | 1.21 | | |
| CMF Variance | 0.032 | | |
| Standard Error | 0.18 | | |
| 95% Confidence Interval | 0.86 | to | 1.56 |

**Murray / Scholls Ferry Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 26.3 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0032 | | 0.0032 | 0.001176 | 0.000010 | 0.000000 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 36 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 36.0 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 27.3 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 37.4 | crashes | | | | | |
| $ADT_{major}$ | 27000 | 27000 veh/day | $Var(N_{expectedTA})$ | 38.68 | | | | | | |
| $ADT_{minor}$ | 20000 | 20000 veh/day | $N_{observedTA}$ | 14 | crashes | | | | | |
| $Speed_{minor}$ | 35 | mph | CMF | 0.36 | | | | | | |
| $Cross_{major}$ | 122 | ft | Variance(CMF) | 0.01 | | | | | | |

**121st / Scholls Ferry Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 31.6 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0027 | | 0.0027 | 0.003081 | 0.000007 | 0.000001 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 14 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 14.0 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 22.0 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 9.8 | crashes | | | | | |
| $ADT_{major}$ | 37000 | 36000 veh/day | $Var(N_{expectedTA})$ | 6.76 | | | | | | |
| $ADT_{minor}$ | 14000 | 13000 veh/day | $N_{observedTA}$ | 12 | crashes | | | | | |
| $Speed_{minor}$ | 25 | mph | CMF | 1.15 | | | | | | |
| $Cross_{major}$ | 72 | ft | Variance(CMF) | 0.18 | | | | | | |

**147th / Scholls Ferry Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 27.8 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0031 | | 0.0031 | 0.007358 | 0.000009 | 0.000015 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 5 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 5.1 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 9.5 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 1.7 | crashes | | | | | |
| $ADT_{major}$ | 25000 | 25000 veh/day | $Var(N_{expectedTA})$ | 0.59 | | | | | | |
| $ADT_{minor}$ | 7000 | 6000 veh/day | $N_{observedTA}$ | 5 | crashes | | | | | |
| $Speed_{minor}$ | 25 | mph | CMF | 2.41 | | | | | | |
| $Cross_{major}$ | 76 | ft | Variance(CMF) | 1.61 | | | | | | |

**125th / Scholls Ferry Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 83.4 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0010 | | 0.0010 | 0.003339 | 0.000001 | 0.000001 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 32 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 32.1 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 15.4 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 5.9 | crashes | | | | | |
| $ADT_{major}$ | 37000 | 36000 veh/day | $Var(N_{expectedTA})$ | 1.09 | | | | | | |
| $ADT_{minor}$ | 8000 | 8000 veh/day | $N_{observedTA}$ | 20 | crashes | | | | | |
| $Speed_{minor}$ | 25 | mph | CMF | 3.28 | | | | | | |
| $Cross_{major}$ | 84 | ft | Variance(CMF) | 0.82 | | | | | | |

**Davies / Scholls Ferry Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 82.8 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0010 | | 0.0010 | 0.002596 | 0.000001 | 0.000002 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 12 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 12.1 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 10.0 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 1.5 | crashes | | | | | |
| $ADT_{major}$ | 29000 | 29000 veh/day | $Var(N_{expectedTA})$ | 0.18 | | | | | | |
| $ADT_{minor}$ | 5000 | 5000 veh/day | $N_{observedTA}$ | 4 | crashes | | | | | |
| $Speed_{minor}$ | 25 | mph | CMF | 2.53 | | | | | | |
| $Cross_{major}$ | 88 | ft | Variance(CMF) | 1.82 | | | | | | |

**Evergreen / Stucki Rear-End Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 19.1 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0044 | | 0.0044 | 0.008945 | 0.000020 | 0.000020 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 5 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 5.1 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 9.4 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 2.5 | crashes | | | | | |
| $ADT_{major}$ | 17000 | 20000 veh/day | $Var(N_{expectedTA})$ | 1.21 | | | | | | |
| $ADT_{minor}$ | 8000 | 8000 veh/day | $N_{observedTA}$ | 6 | crashes | | | | | |
| $Speed_{minor}$ | 30 | mph | CMF | 2.02 | | | | | | |
| $Cross_{major}$ | 114 | ft | Variance(CMF) | 1.04 | | | | | | |

**Cedar Hills / Park Crashes CMF Calculation**

| | Before | After | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overdispersion | 11.8 | 17.4 | $N_{predictedTB}$ | 16.4 | crashes | | | | | |
| a | -22.56 | 1.05 | $SPF_{weight}$ | 0.0052 | | 0.0052 | 0.006372 | 0.000027 | 0.000010 | |
| $b_0$ | 2.70 | 0.000031 | $N_{observedTB}$ | 8 | crashes | | | | | |
| $b_1$ | -1.19 | 0.000071 | $N_{expectedTB}$ | 8.0 | crashes | | | | | |
| $b_2$ | 0.15 | | $N_{predictedTA}$ | 7.3 | crashes | | | | | |
| $b_3$ | 1.98 | | $N_{expectedTA}$ | 3.6 | crashes | | | | | |
| $ADT_{major}$ | 20000 | 19000 veh/day | $Var(N_{expectedTA})$ | 1.60 | | | | | | |
| $ADT_{minor}$ | 6000 | 5000 veh/day | $N_{observedTA}$ | 5 | crashes | | | | | |
| $Speed_{minor}$ | 25 | mph | CMF | 1.24 | | | | | | |
| $Cross_{major}$ | 72 | ft | Variance(CMF) | 0.35 | | | | | | |