

Analyses of casualty collisions and casualties during statutory holidays in Saskatchewan

Rajib Sahaji

Traffic Safety Program Evaluation

SGI Auto Fund

March 11, 2015

- **Background**
- **Objectives**
- **Study Data**
- **Model Development**
- **SAS Modeling Procedures**
- **Results**
- **Conclusion and Recommendation**
- **Future Research**

Background

- **Statutory holidays observed in Saskatchewan in 2013 accounted for 463 casualty collisions, a 30.42% increase from 2009**
- **Traffic fatalities per day during holidays were 10.5% higher than that during non-holidays in 2013**
- **Elevated collision risk during statutory holidays triggered enhanced traffic safety enforcements and publicity campaigns around major holidays - Victoria Day, Thanksgiving and Christmas (VTC)**
- **Limited research conducted to investigate the impacts of the enhanced safety initiatives during statutory holidays**

Objectives

To investigate:

- **The differences in the rates of overall casualty collisions and casualties (death and serious injuries) between aggregated statutory holidays and non-holidays**
- **The relative risk of alcohol related (AR) casualty collisions and resulting casualties during statutory holidays**
- **The safety benefits of enhanced enforcement during Victoria Day, Thanksgiving and Christmas (VTC) holidays.**

Study Data

Holiday	Period
New Year	Dec 29 th – Jan 2 nd (weekday varies each year)
Easter	Dates varies each year (Friday – Monday)
Family Day	3 rd Monday of February (Friday – Monday)
Victoria Day	3 rd Monday of May (Friday – Monday)
Canada Day	Jun 29 th – July 2 nd (weekday varies each year)
Civic Holiday	1 st Monday of August (Friday – Monday)
Labour Day	1 st Monday of September (Friday – Monday)
Thanksgiving	2 nd Monday of October (Friday – Monday)
Remembrance Day	Nov 9 th – Nov 12 th (weekday varies each year)
Christmas	Dec 22 nd – Dec 26 th (weekday varies each year)

Statutory holidays observed in Saskatchewan (2008-2013)

Study Data

Holiday	Casualty Collisions	AR* Casualty Collisions	% of AR Casualty Collisions	Casualties	AR Casualties	% of AR Casualties
Canada Day	402	60	15%	22	11	50%
Christmas	376	27	7%	21	5	24%
Civic Holiday	336	71	21%	21	11	52%
Easter	234	36	15%	11	6	55%
Family Day	308	42	14%	8	3	38%
Labour Day	341	56	16%	29	12	41%
New Year	402	36	9%	15	8	53%
Remembrance Day	394	28	7%	21	5	24%
Thanksgiving	363	56	15%	25	11	44%
Victoria Day	308	54	18%	26	15	58%
Total Holiday	3,464	466	13%	199	87	44%
Total Non-Holiday	28,296	2,510	9%	1193	446	37%

*AR – Alcohol Related

**Frequency of casualty collisions and casualties
by holiday and non-holiday period (2008-2013)**

Model Development

- **Negative binomial modeling procedure was employed:**
- **Controlled for temporal factors (i.e., year, month, day of week) as well as holiday confounding factors**
- **Temporal factors were used as surrogates to the effect of weather, legislative changes and enforcements**
- **The holiday effect referred to the effect of each individual holiday and the aggregated holiday and non-holiday period**

Model Development

- **Negative binomial regression:**
 - Used to model a count of events (i.e., casualty collisions) that contains pronounced over-dispersion
 - GEE was introduced into the modeling effort to account for correlated observations within subjects
 - Modeled the risk of casualty collisions and casualties: aggregated statutory holidays vs. non-holidays; VTC vs. less-targeted statutory holidays
 - Model output are presented as relative risk (RR) ratios


SAS Modeling Procedures

- **PROC GENMOD:**
 - Fits a generalized linear model (GLM) (i.e., negative binomial model) to the data
 - Uses maximum likelihood (ML) method to estimate the model parameters
 - Can deal with correlated data that arises from repeated measurements (GEEs)
 - Similar in form to other SAS modeling procedures (REG, LOGISTIC, MIXED)

SAS Modeling Procedures

- **PROC GENMOD:**

```
libname rkdata "/af_adhoc/extract/rajib/Holiday";  
run;
```



```
proc genmod data=rkdata.cascols;  
class holiday (ref='non-holiday') year month day_of_week / param=ref;  
model Avg_cascol = holiday year month day_of_week /dist=nb link=log TYPE3 LRCI;  
REPEATED SUBJECT=year /TYPE=ar(1);  
run;
```

Sample syntax for PROC GENMOD fitting the NB model to the data: aggregated holiday vs. non-holidays

```
proc genmod data=rkdata.VTCcascols2;  
class holiday (ref='VTC') year month day_of_week /param=ref;  
model Cas_coll = holiday year month day_of_week /dist=nb link=log TYPE3 LRCI;  
REPEATED SUBJECT=year /TYPE=ar(1);  
run;
```

Sample syntax for PROC GENMOD fitting the NB model to the data: VTC vs. less-targeted holidays

SAS Modeling Procedures

Holiday	Year	Month	Day_of_Week	Total Casualty Collisions	Avg_cascoll
holiday	2008	1	3	8	8
holiday	2008	1	4	10	10
holiday	2008	2	1	14	14
holiday	2008	2	2	12	12
non-holiday	2008	1	1	35	9
non-holiday	2008	1	2	54	14
non-holiday	2008	1	3	78	20
non-holiday	2008	1	4	50	13

Sample input data for PROC GENMOD fitting the NB model: aggregated holiday vs. non-holidays

Holiday	Year	Month	Day_of_week	CAS_coll
Canada Day	2008	6	1	16
Canada Day	2008	6	2	22
Canada Day	2008	7	3	16
Canada Day	2008	7	4	18
Christmas	2008	12	2	18
Christmas	2008	12	3	17
Christmas	2008	12	4	18
Thanksgiving	2008	10	1	15
Thanksgiving	2008	10	2	9
Thanksgiving	2008	10	6	19
Thanksgiving	2008	10	7	13
Victoria Day	2008	5	1	9
Victoria Day	2008	5	2	8
Victoria Day	2008	5	6	16

Sample input data for PROC GENMOD fitting the NB model: VTC vs. less-targeted holidays

Results

- **NB Regression Results: Risk of Casualty Collisions (Aggregated Holiday vs. Non-holiday)**

Parameter	Estimate	Standard Error	95% C.I.		Pr > Z	Relative Risk (RR)
			Lower	Upper		
Overall Casualty Collisions						
Intercept	2.68	0.05	2.58	2.79	<.0001	-
Holiday	0.14	0.04	0.07	0.21	<.0001	1.15
**Non-holiday	0.00	0.00	0.00	NA	NA	-
AR Casualty Collisions						
Intercept	-2.13	0.08	-2.29	-1.97	<.0001	-
Holiday	0.47	0.04	0.39	0.54	<.0001	1.60
**Non-holiday	0.00	0.00	0.00	NA	NA	-
**Reference level						

Results

- NB Regression Results: Risk of Casualties (Aggregated Holiday vs. Non-holiday)**

Parameter	Estimate	Standard Error	95% C.I.		Pr > Z	Relative Risk (RR)
			Lower	Upper		
Overall Casualties						
Intercept	0.55	0.10	0.35	0.74	<.0001	-
Holiday	0.60	0.07	0.47	0.73	<.0001	1.82
**Non-holiday	0.00	0.00	0.00	NA	NA	-
AR Casualties						
Intercept	-0.23	0.25	-0.74	0.25	0.37	-
Holiday	0.94	0.10	0.73	1.14	<.0001	2.55
**Non-holiday	0.00	0.00	0.00	NA	NA	-

**Reference level

Results

- NB Regression Results: Risk of Casualty Collisions (VTC vs Less-targeted Holidays)**

Holiday	Estimate	95% C.I.		Standard Error	Collision Rate/Day	Pr > Z	Relative Risk (RR)
		Lower	Upper				
Intercept	2.52	2.36	2.69	0.08		<.0001	
Canada Day	0.04	-0.19	0.28	0.12	13.03	0.714	1.04
Civic Holiday	0.10	-0.01	0.20	0.05	13.75	0.070	1.10
Easter	-0.19	-0.30	-0.08	0.06	10.32	0.001	0.83
Family Day	0.06	-0.17	0.29	0.12	13.25	0.606	1.06
Labour Day	0.14	-0.05	0.33	0.10	14.36	0.154	1.15
New Year	0.01	-0.34	0.37	0.18	12.62	0.950	1.01
Remembrance Day	0.27	0.01	0.52	0.13	16.30	0.041	1.31
**VTC	0.00	0.00	0.00	0.00	12.43	-	1.00

**Reference level

Results

- NB Regression Results: Risk of Casualties (VTC vs Less-targeted Holidays)**

95% C.I.							
Holiday	Estimate	Lower	Upper	Standard Error	Casualty Rate/Day	Pr > Z	Relative Risk (RR)
Intercept	1.20	0.92	1.48	0.14		<.0001	
Canada Day	0.14	-0.31	0.59	0.23	3.82	0.5321	1.15
Civic Holiday	-0.20	-0.42	0.02	0.11	2.72	0.0752	0.82
Easter	-0.21	-0.74	0.33	0.27	2.69	0.4476	0.81
Family Day	-0.33	-0.57	-0.10	0.12	2.37	0.006	0.72
Labour Day	0.05	-0.34	0.43	0.20	3.47	0.8082	1.05
New Year	-0.30	-0.63	0.03	0.17	2.46	0.0793	0.74
Remembrance Day	0.02	-0.42	0.46	0.22	3.38	0.9294	1.02
**VTC	0.00	0.00	0.00	0.00	3.32	-	1.00

**Reference level

Conclusion and Recommendation

- **The study supports the common perception of elevated collision risk during statutory holiday periods**
- **Less targeted/enforced statutory holidays did not differ significantly from the enforced VTC holidays (except the Remembrance Day)**
- **Safety promotional programs are recommended on an on-going basis around holiday periods**
- **Promotional messages and enhanced enforcements against drinking and driving are highly recommended during all holiday periods to improve public safety.**

Future Research

- Effect of exposure count (traffic volume/vehicle miles traveled)
- Macro factors? (economic indicators, population)
- Other driver characteristics? (age, gender)
- Interaction terms? (age AND gender)

Questions?



DON'T DRINK
AND DRIVE!



Thank You!