Lunar Effects on UW-Eau Claire On-Campus Housing Incidents

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Introduction

The relationship between lunar phases and human behavior has been a topic of folklore for centuries. In the last century, it has been studied scientifically with varying results. In this study, we analyzed the effect of the full moon on incidents reported in UWEC housing. We used Non-parametric methods, as well as Time Series and Generalized Linear Models.

Definitions

- Weekend: Friday, Saturday, Sunday, 12:00 am to 11:59 pm
- Full Moon: the three days surrounding the full moon (day of, day before, and day after)
- Severity: For analysis and confidentiality, incidents were sorted into levels of severity using prior experience as a Resident Assistant.

Data Set

The data includes cases in which a student of UWEC was found responsible of a policy violation. The violation is reported by Resident Assistants, Hall Directors, Campus Police, and other housing staff. We received 4,880 records from 8/22/2012 through 12/23/2016, before Summer and Winterim records were removed.

To ensure confidentiality, only data from Fall and Spring semesters (no breaks, Summer, or Winterim sessions) were analyzed. We performed all analyses using both the number of incidents and the number of students found responsible on each day.

Non-parametric Analysis

We used Non-parametric tests since there is a relatively small count of "full moon days" (101 of 1016 days fell on a full moon), and the distributions of incident and student counts are heavily right-skewed. Non-parametric tests (with minimal assumptions) are appropriate for data such as this. We used the Kolmogorov-Smirnov test (KS), the χ^2 test of Independence (claimed by both Non-parametric and parametric statistics), and the Mantel-Haenszel test (MH).

- KS: tests if there is evidence that two populations have different distribution functions.
- χ^2 Test of Independence: tests for an association between variables.
- MH test: assesses stratum of $2x2$ tables to determine whether the tables behave similarly.

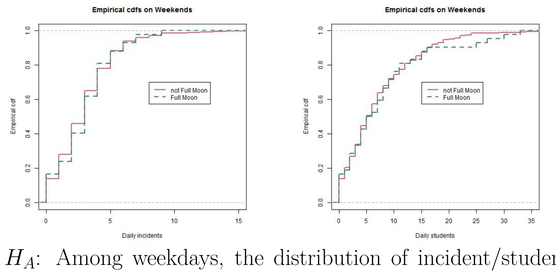
Distribution Comparisons

H_A: The distribution of incident/student counts on full moon days differs from non-full moon days (using the KS test).

Data	Test Statistic	P-value	Interpretation
Incident Count	.0327	1	Not significant
Student Count	.061659	.8666	Not significant

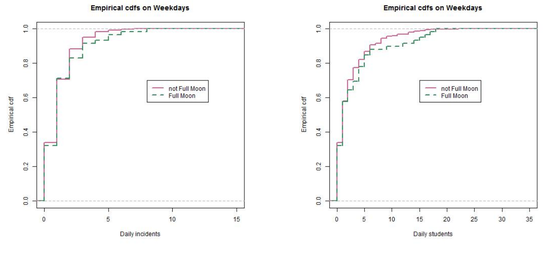
H_A: During the weekend, the distribution of incident/student counts on a full moon day differs from the distribution on a non-full moon day (using the KS test).

Data	Test Statistic	P-value	Interpretation
Incident Count	.0282	1	Not significant
Student Count	.0906	.8950	Not significant



H_A: Among weekdays, the distribution of incident/student counts on a full moon day differs from the distribution on a non-full moon day (using the KS test).

Data	Test Statistic	P-value	Interpretation
Incident Count	.1348	.2822	Not significant
Student Count	.1645	.1088	Not significant



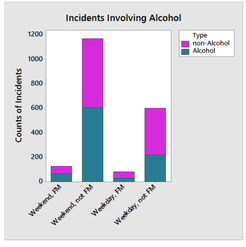
Alcohol Sanctions

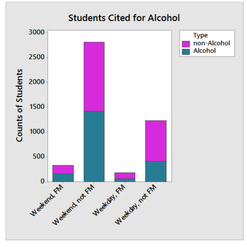
H_A: For student counts, there is an association between the full moon and alcohol related incidents (using the χ^2 Test).

Data	Test Statistic	P-value	Interpretation
Weekend	.3167	.5735	Not significant
Weekdays	$< .0001$	1	Not significant

H_A: For incident / student counts, there is an association between the full moon and alcohol related incidents on either Weekends or Weekdays (using the MH Test).

Data	Test Statistic	P-value	Interpretation
Incident Counts	.0185	.891674	Not significant
Student Counts	.2077	.6486	Not significant

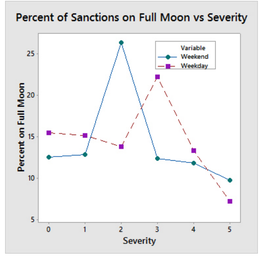




Severity of Sanctions

H_A: For sanction counts, there is an association between the full moon and severity of sanctions on either Weekends or Weekdays (using the χ^2 Test).

Data	Test Statistic	P-value	Interpretation
Weekend	14.162	0.015	Significant
Weekdays	11.259	0.046	Marginally significant



Discussion

Overall, the non-parametric analyses reveal no significant interaction between policy violations and the full moon. Additionally, there is not evidence of an interaction between the full moon and alcohol related incidents. However, there is evidence of an association between the severity of a sanction and the full moon. Of particular interest, the proportion of sanctions occurring on full moon is much higher for *Severity 2* on weekends, but much higher for *Severity 3* on weekdays.

Generalized Linear Models and Time Series Analysis

Generalized Linear models with Poisson response:
We are estimating, using maximum likelihood techniques, the parameters β_0, β_1, ..., β_k with the equation

$$\mu = e^{\beta_0+\beta_1 \cdot x_1+\beta_2 \cdot x_2+\cdots+\beta_k \cdot x_k} = e^{\beta_0} \cdot e^{\beta_1 \cdot x_1} \cdot e^{\beta_2 \cdot x_2} \cdots e^{\beta_k \cdot x_k}$$

For the mean of the Poisson-distributed count, when x_j is an indicator variable at $x_j = 1$, this multiplies the mean by e^{β_j}.

Count Time Series Following Generalized Linear Models:
We model the count time series of generalized linear models using the package "tscount" in R. This method allows us to estimate coefficients β_0, β_1, ..., β_k using quasi conditional maximum likelihood and to analyze models with logarithmic link function with Poisson conditional distribution, and including a first-order autoregressive term.

Results: Overall GLM Analysis

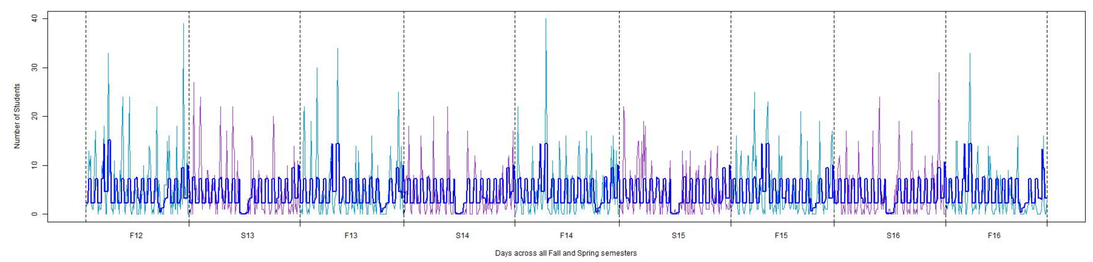


Figure 1: Number of students involved in housing incidents across all Fall and Spring semesters; model fit by Generalized Linear Model with Poisson mean

Response: Number of Students	Overall GLM	GLM F15	TSGLM F15	GLM S16	TSGLM S16
Main effect	2.2869	2.8138	2.6340	1.9689	2.0625
Autocorrelation effect	NA	NA	*0.0749*	NA	*-0.0610*
Weekend effect	3.1490	2.1307	2.0019	3.8751	4.1190
Full moon effect	1.4466	1.8285	1.7494	*0.3232*	*0.3240*
Weekend & Full moon effect	0.7309	*1.5507*	*1.4857*	*1.6754*	*1.5700*
Thanksgiving effect	0.1805	0.3183	0.3397	NA	NA
Spring Break effect	0.3230	NA	NA	0.0476	0.0438
Homecoming effect	1.9999	1.8447	1.7704	NA	NA
Weekend before Finals effect	1.3215	0.5289	0.5635	2.0919	2.1893
Finals effect	1.4053	2.7826	2.5348	*1.0827*	*1.1004*

Interpretation: The main effect on **overall GLM** is 2.2869, meaning that we estimate an average of 2.3 students involved in housing incidents on a typical day. The average number of students is estimated to multiplicatively increase by 3.15 times during weekends, 1.45 times during full moon, and 3.33 times during a full moon weekend. Other influential effects are Homecoming, finals, and the weekend before finals, which multiply the mean number of students by 2 times, 1.4 times, and 1.3 times respectively. This interpretation for overall GLM can be used to interpret GLM F15, GLM S16, TSGLM F15, and TSGLM S16 in similar manner. In TSGLM method, there's also an autocorrelation effect, which means that we are effectively regressing the response on the 1-day-prior response value; in both cases (Fall and Spring semesters), the response was not significantly associated with the prior response value. *Italicized results are not statistically significant.*

Fall 2015 Analysis

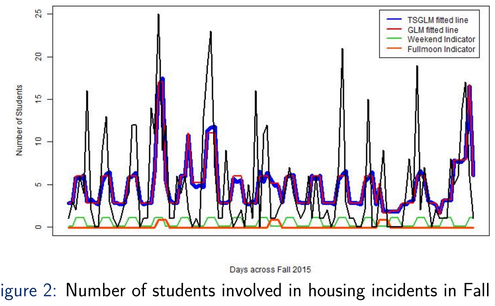


Figure 2: Number of students involved in housing incidents in Fall 2015

Spring 2016 Analysis

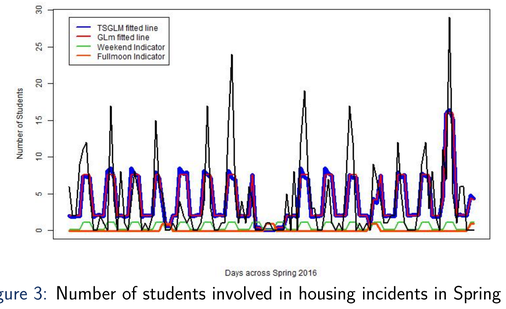


Figure 3: Number of students involved in housing incidents in Spring 2016

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Future Questions

- Does temperature influence incident occurrence in UWEC Housing?
- Is there a gender difference between incidents and Full Moons?
- Is there association between crime in the city of Eau Claire and full moon?
- Does longer lag or moving average produce a more useful time series model?

References

- Conover, W.J. Practical Nonparametric Statistics, Third Edition. 1999.
- Liboschik, T., Fokianos, K., & Fried, R. "tscount: An R Package for Analysis of Count Time Series Following Generalized Linear Models". Vignette of R package, v.1.3.0. 2016.
- Agresti, A. Categorical Data Analysis. Third edition. Wiley. 2013.
- Hollander, M., Wolfe, D.A., & Chicken, E. Nonparametric Statistical Methods. Third Edition. 2014.