Integrating Poisson regression into the undergraduate curriculum

USCOTS25 Breakout Session B3H

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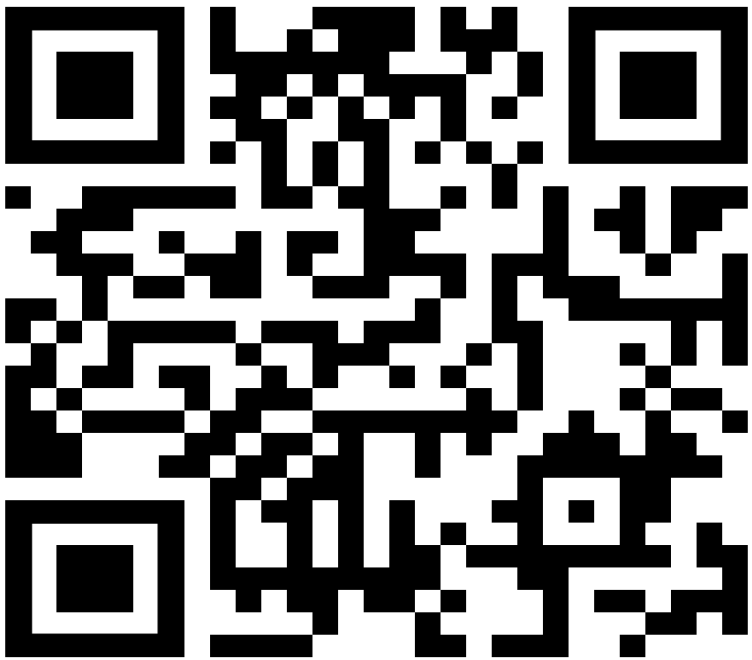
ST. OLAF COLLEGE

A quick initial survey!

Please click here or use the following QR code:



Poisson regression at St. Olaf

- 02-04: Not taught. Statistics concentration required Prob Theory and Math Stat plus 2 electives.
- 04-18: Taught as part of Advanced Statistical Modeling (Stat 316). Concentration required Statistical Modeling (Stat 272) and 316 plus 2 electives.
- 18-24: Still taught in Stat 316. Concentration renamed "Statistics and Data Science" and required 272 and Intro to Data Science plus 2 electives. Stat 316 now counts as an upper level elective.
- 24-current: Still taught in Stat 316. Concentration became a major. Stat 316 counts as a "Level 3 Stats Depth" elective course.

Advanced Statistical Modeling at St. Olaf

- Covers generalized linear models (Poisson regr, binomial regr, negative binomial regr, zero-inflated models, hurdle models, etc.) and multilevel modeling
- Prerequsites: Intro Stats and Stat Modeling (nothing else – calculus, linear algebra, computing, ...)
- Applied focus using R
- Uses Beyond Multiple Linear Regression: Applied Generlized Linear Models and Multilevel Models in R by Roback and Legler. Second edition by Roback, Boehm Vock, and Legler expected by Fall 2026.

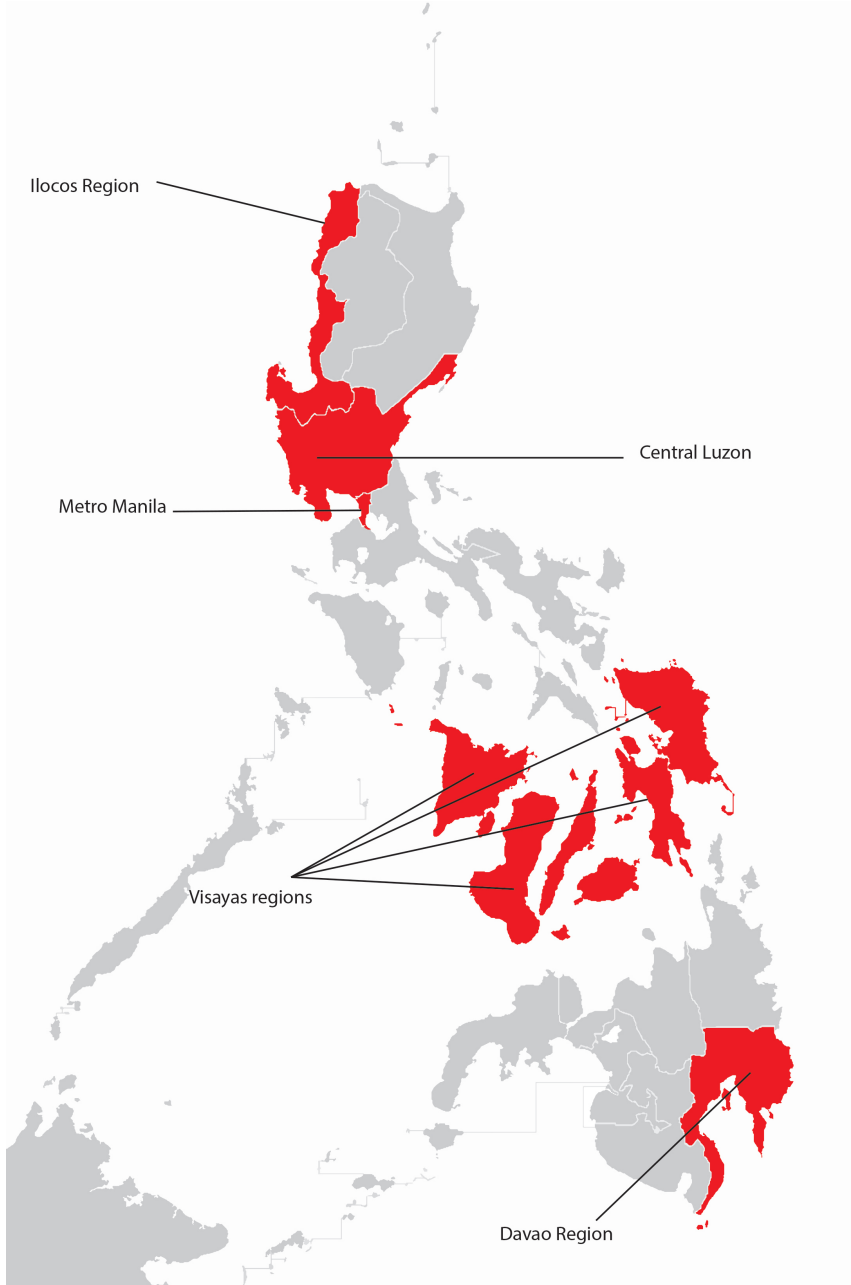
First case study: Philippine households

- International agencies often use household size to determine the magnitude of the household needs
- Want to discern factors associated with larger households
- Data is subset from 2015 Philippine Statistics Authority's Family Income and Expenditure Survey (FIES)
- Primary response is a count, which can make linear regression problematic

Philippine household data

Key variables:

- `location` = region (Central Luzon, Davao, Ilocos, Metro Manila, or Visayas)
- `age` = the age of the head of household
- `total` = the number of people in the household other than the head
- `numLT5` = the number in the household under 5 years of age
- `roof` = the type of roof (stronger material can be used as a proxy for greater wealth)



Sheena Easton and Game Theory

Sheena Easton describes the following scenario for her baby:

1. Takes the morning train
2. Works from nine 'til five
3. Takes another train home again
4. Finds Sheena Easton waiting for him

A Total Conflict Game Between Sheena Easton and Her Baby

	Stays Home	Goes to Work
Baby Home Again	-100, **100**	**100**, 0
Baby Stays at Work	**50**, 0	-100, **100**

Sheena Easton and her baby are playing a **zero-sum (total conflict) game**.

- Akin to Holmes-Moriarty game (see: von Neumann and Morgenstern)
- Solution: **mixed strategy**

Rick Astley's Re-election Platform

Rick Astley's campaign promises:

- Never gonna give you up.
- Never gonna let you down.
- Never gonna run around and desert you.
- Never gonna make you cry.
- Never gonna say goodbye.
- Never gonna tell a lie and hurt you.

Are these promises (if credible) sufficient to secure re-election?

Rick Astley and Median Voter Theorem

Whereas these pledges conform to the preferences of the **median voter**, we expect Congressman Astley to secure re-election.

Caribbean Queen and Operation Urgent Fury

Billy Ocean released "Caribbean Queen" in 1984.

- Emphasized sharing the same dream
- Hearts beating as one

"Caribbean Queen" is about the poor execution of Operation Urgent Fury.

- Echoed JCS chairman David Jones' frustrations with military establishment.

Billy Ocean is advocating for what became the Goldwater-Nichols Act.

- Wanted to take advantage of **economies of scale**, resolve **coordination problems** in U.S. military.

The Good Day Hypothesis

We know the following about Ice Cube's day.

1. The Lakers beat the Supersonics.
2. No helicopter looked for a murder.
3. Consumed Fatburger at 2 a.m.
4. Goodyear blimp: "Ice Cube's a pimp."

The Good Day Hypothesis

This leads to two different hypotheses:

- H_0: Ice Cube's day is statistically indistinguishable from a typical day.
- H_1: Ice Cube is having a good (i.e. greater than average) day.

These hypotheses are tested using archival data of Ice Cube's life.