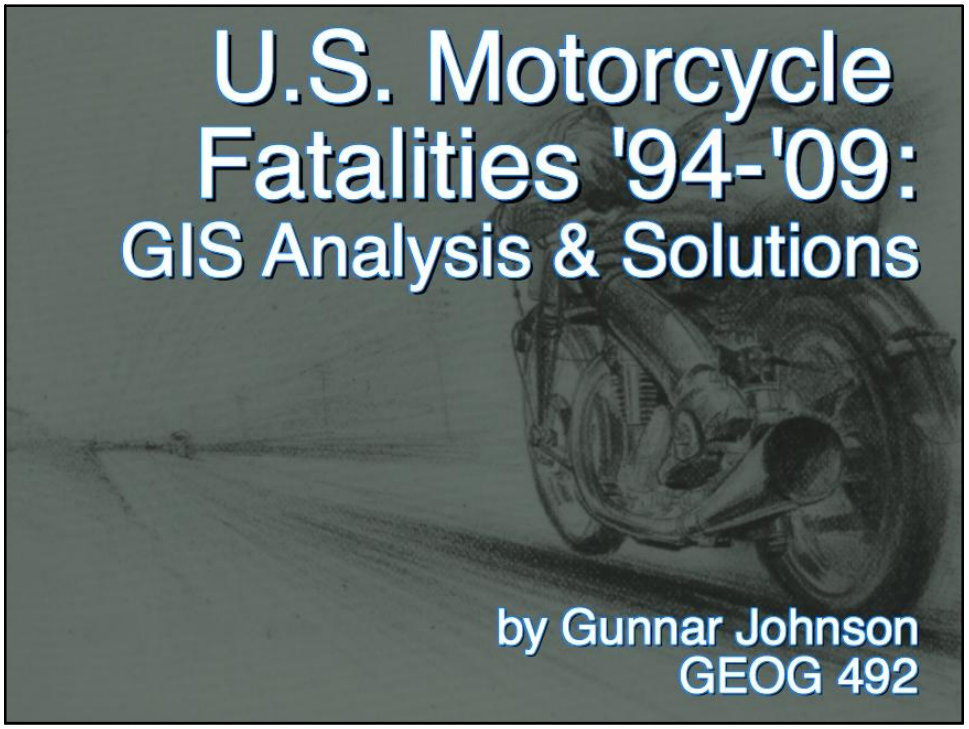
U.S. Motorcycle Fatalities '94-'09:
GIS Analysis & Solutions



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GEOG 492

Motorcycle History 101

- Multiple designs appeared simultaneously across Europe during the late 19th century
- Become reasonably affordable means of personal transport around 1930
- Europe and Asia embrace motorcycles first, establishing manufacturing dominance
- Finally see wide adoption in the U.S. after WWII, but rarely as primary means of transport

Early Motorcycles

- Unique low-power engine designs, ranging from steam power to radial internal combustion
- Rarely suspended, exceedingly heavy, poor range and performance
- Prohibitively expensive to purchase, ride and maintain

Modern Motorcycles

- Three common high-power internal combustion engine designs predominate
- High technology materials and construction throughout, obscene performance
- Affordable to purchase, ride and maintain

Current U.S. Usage

- Nearly 7 million registered motorcycles, but only 5% are used year round
- Approximately 250,000 motorcycle commuters on an average weekday
- Accounted for approximately 1.5% of all personal vehicle miles traveled in 2009
- Expected to account for 15% of all personal vehicle miles traveled by 2030

Motorcycle Accidents

Early Accidents

- Common causes
  - low performance characteristics
  - mechanical failure
  - road conditions
- Usually involved other traffic
- Slow speeds, rarely fatal

Modern Accidents

- Common causes
  - high performance characteristics
  - operator error
  - road conditions
- Often single vehicle incidents
- High speeds, often fatal

GIS Fatality Analysis

Last year over 5000 motorcyclists died on roads in the U.S. Why?

- Collect data on fatal accidents and possible contributing factors
- Integrate tabular data into GIS database for spatial analysis
- Mine historical fatality trends for factor weights using advanced statistics software
- Predict future fatality trends and recommend specific states for educational and regulatory focus

Changes in Fatality Rates

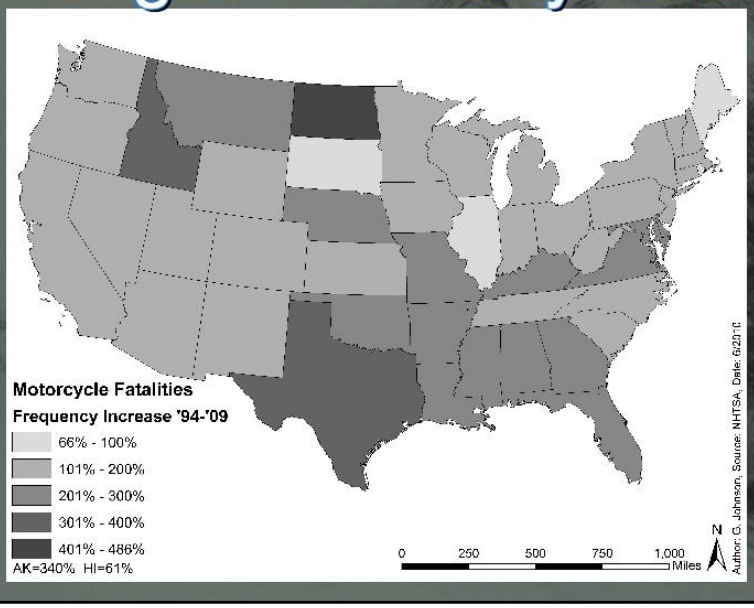
Between '94-'09 **NO** states showed reduced motorcycle fatality rates

- Best: Hawaii, +67% fatalities per MVM
- Worst: North Dakota, +486% fatalities per MVM
- Mean Change: +191% fatalities per MVM

Between '94-'09 **ALL** states showed reduced overall vehicle fatality rates

- Best: Washington D.C., -53% fatalities per MVM
- Worst: North Dakota, -5% fatalities per MVM
- Mean Change: -27% fatalities per MVM

Changes in Fatality Rates



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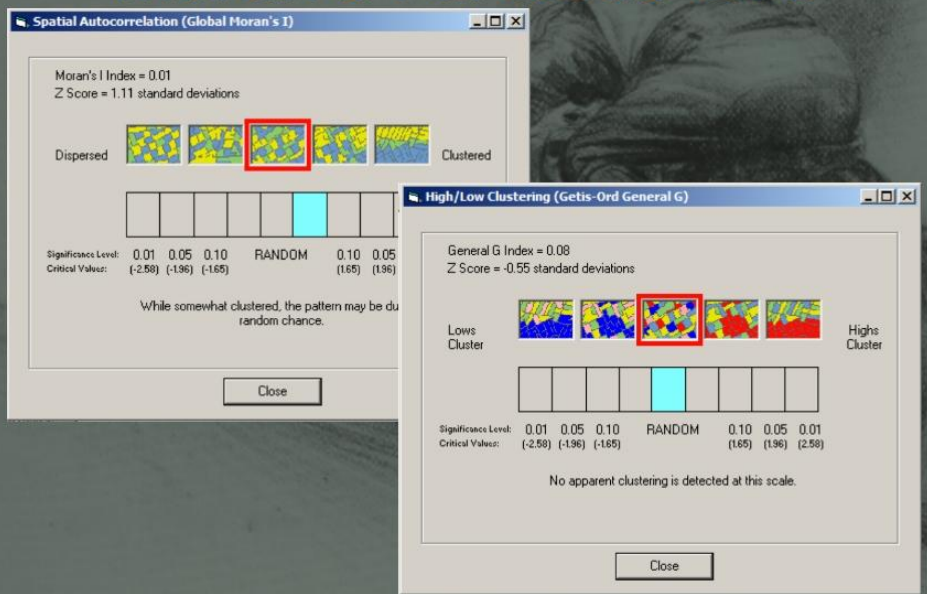
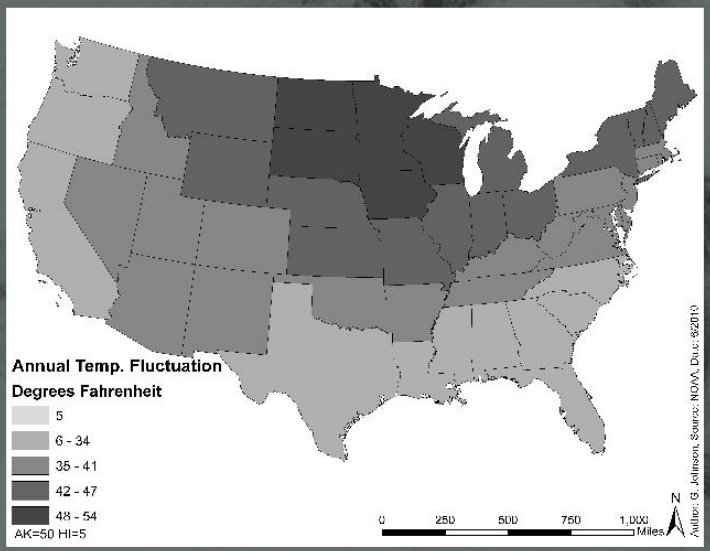


Factors Evaluated

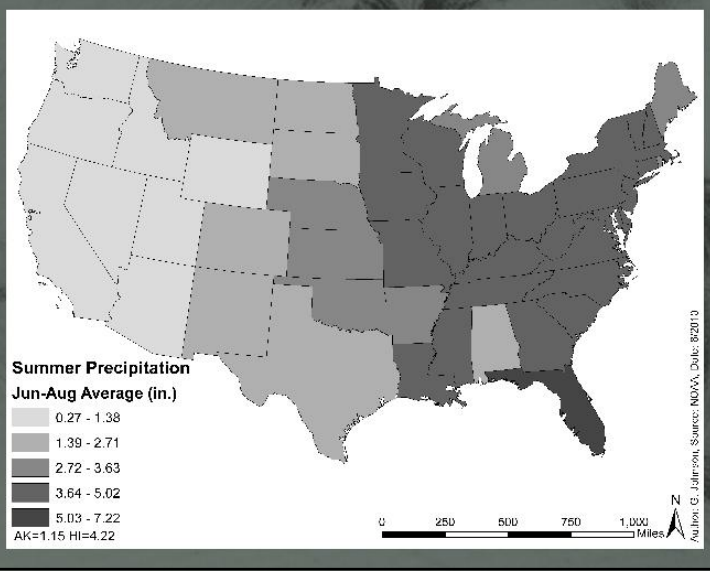
16 factors considered

- Weather averages and fluctuations
- Land cover and vegetation
- Helmet and insurance mandates
- Road maintenance budgets

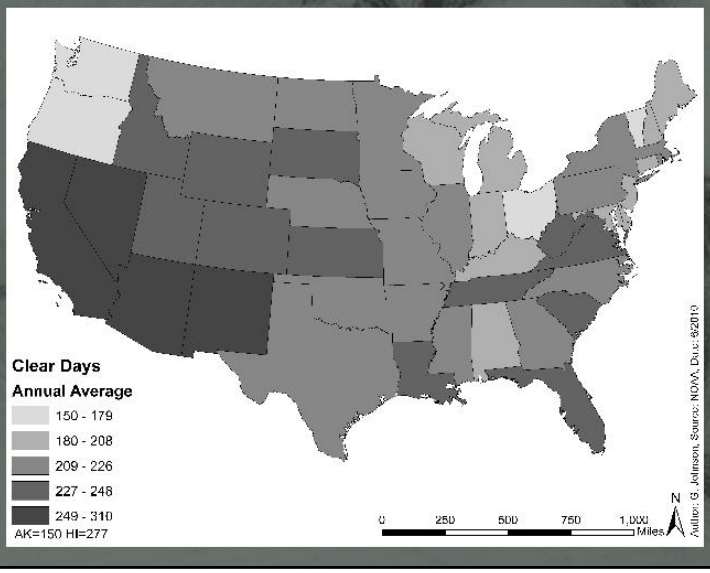
Temperature Fluctuations



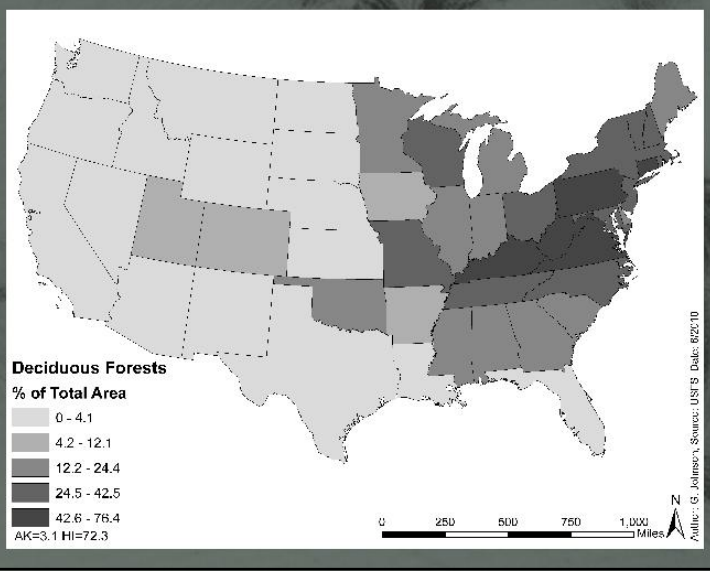
Summer Precipitation



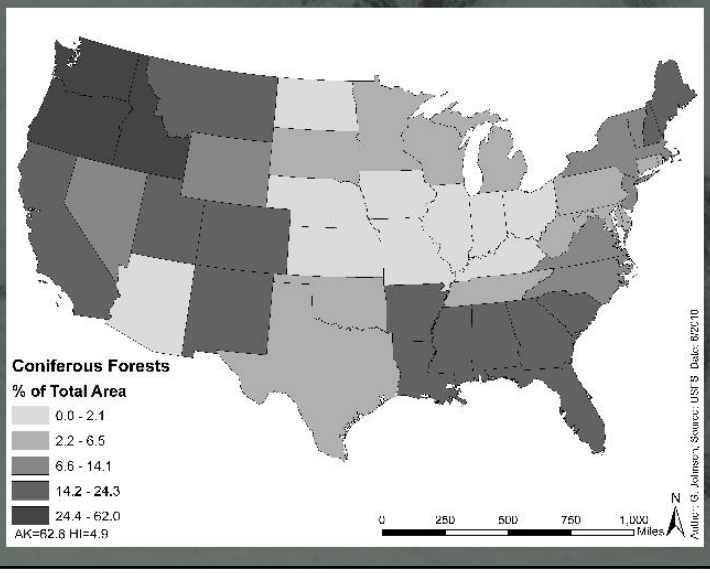
Clear Days



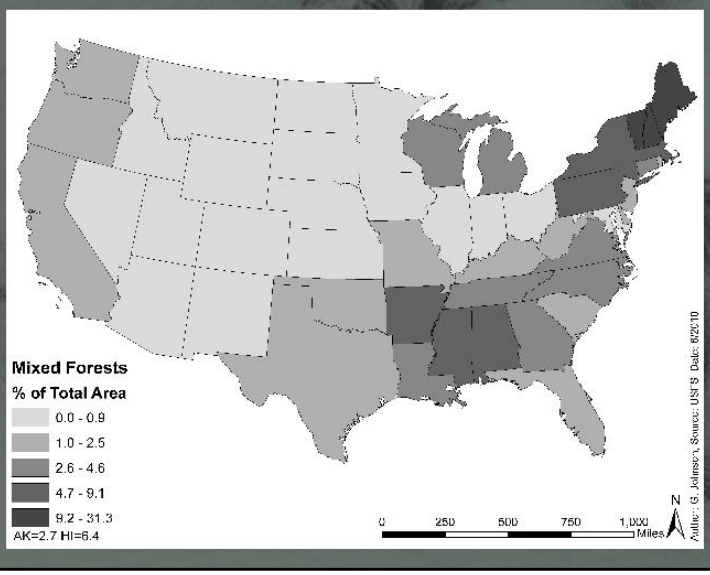
Deciduous Forests



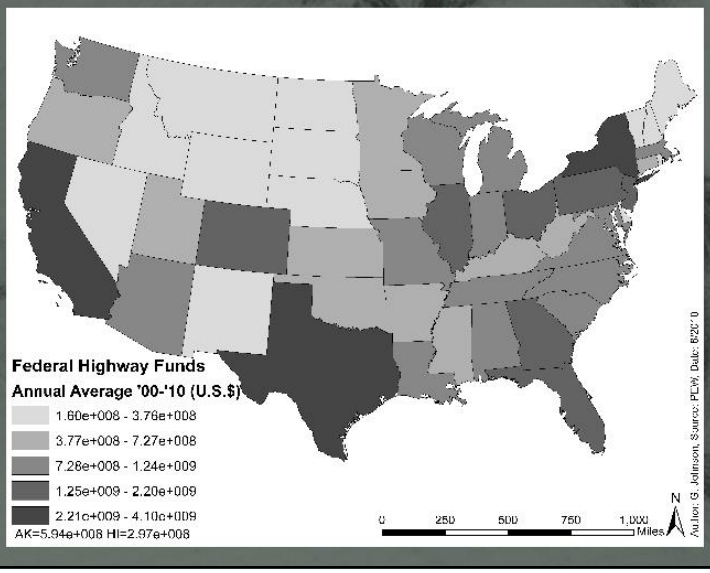
Coniferous Forests



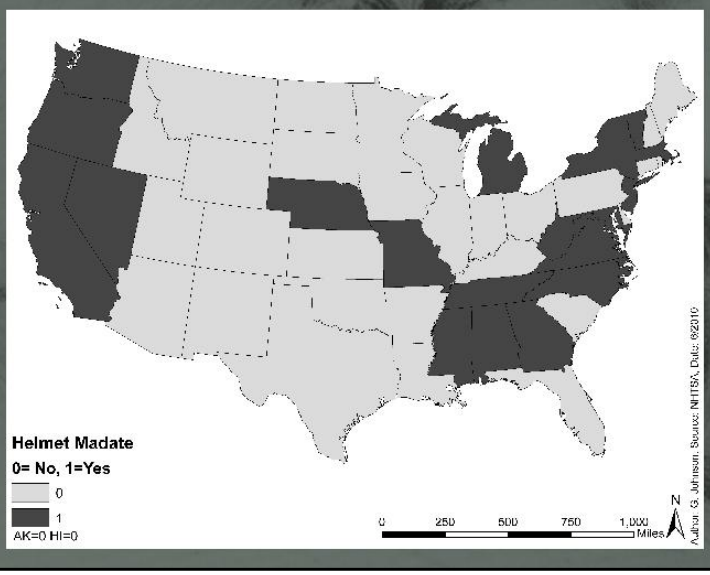
Mixed Forests



Federal Highway Funds



Helmet Mandates



Supercomputer Analysis

Factor Weights

- Over 300 trillion formulas were tested using Cornell University's free Eureqa computation engine
- The following equation correctly forecasts 77% of observed increases:

  q=-ln(a)*((b+3.2c+d+.08e/f)/g) +26.57h+cos(3.29i)+(6.14j/k-1.57)^(.04l-m) +(2.6n*-.05o^p)
- a=% increase in miles, b=win avg temp, c=spr avg temp, d=sum avg temp, e=fal avg temp, f=win-sum temp diff, g=win precip, h=spr precip, i=sum precip, j=fal precip, k= clear days, l=helmet mandate, m=federal highway $, n=% decid coverage, o=% conif coverage, p=% mix coverage, q=% increase in motorcycle fatalities

Future Predictions

- Observed trends will likely continue in the absence of serious regulatory and educational reform
- Top five states to watch: Virginia, Ohio, Utah, South Carolina, Kansas
- Suggest federal funding of Motorcycle Safety Foundation or equivalent courses for all new riders, as well as tying federal highway funds to reduced motorcycle fatalities

Data Sources

- Fatalities: NHTSA (nhtsa.gov)
- Helmet Laws: NHTSA (nhtsa.gov)
- Weather: NOAA (noaa.gov)
- Vegetation: USFS (fs.fed.us)
- Highway Subsidies: PEW (subsidyscope.com)
- U.S. Basemap: ESRI (esri.com)
- Expert Knowledge: Me (10+ bikes, 100k+ miles)
- Photos: Wikimedia (commons.wikimedia.org)