TOWERS PERRIN
TILLINGHAST

# Determination of Statistically Optimal Territory Boundaries

Session PL-4
2007 CAS Ratemaking Seminar
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# Risk Classification

**Definition** — A grouping of risks with similar risk characteristics so that differences in expected costs may be recognized

**Purpose** — Means by which data can be gathered so as to measure and quantify a specific risk characteristic's relation to the propensity for loss

**Example** — Territorial classes are a means to gather data so as to measure and quantify geographic risk factors relative to the propensity for loss

# Homogeneity

**Definition** — A risk classification is homogeneous if all risks in the class have the same or a similar expected degree of risk with respect to the risk factor being measured

**Purpose** — Homogeneity of the class increases the credibility of the loss data generated by the class

**Example** — A territory is considered homogeneous if all risks in the territory represent the same, or approximately the same, level of geographical risk (all else being equal)

# Statistical Test of Homogeneity

**Within Variance =** Based on the squared difference between each zip code pure premium in the cluster and the average pure premium for the specific cluster being tested

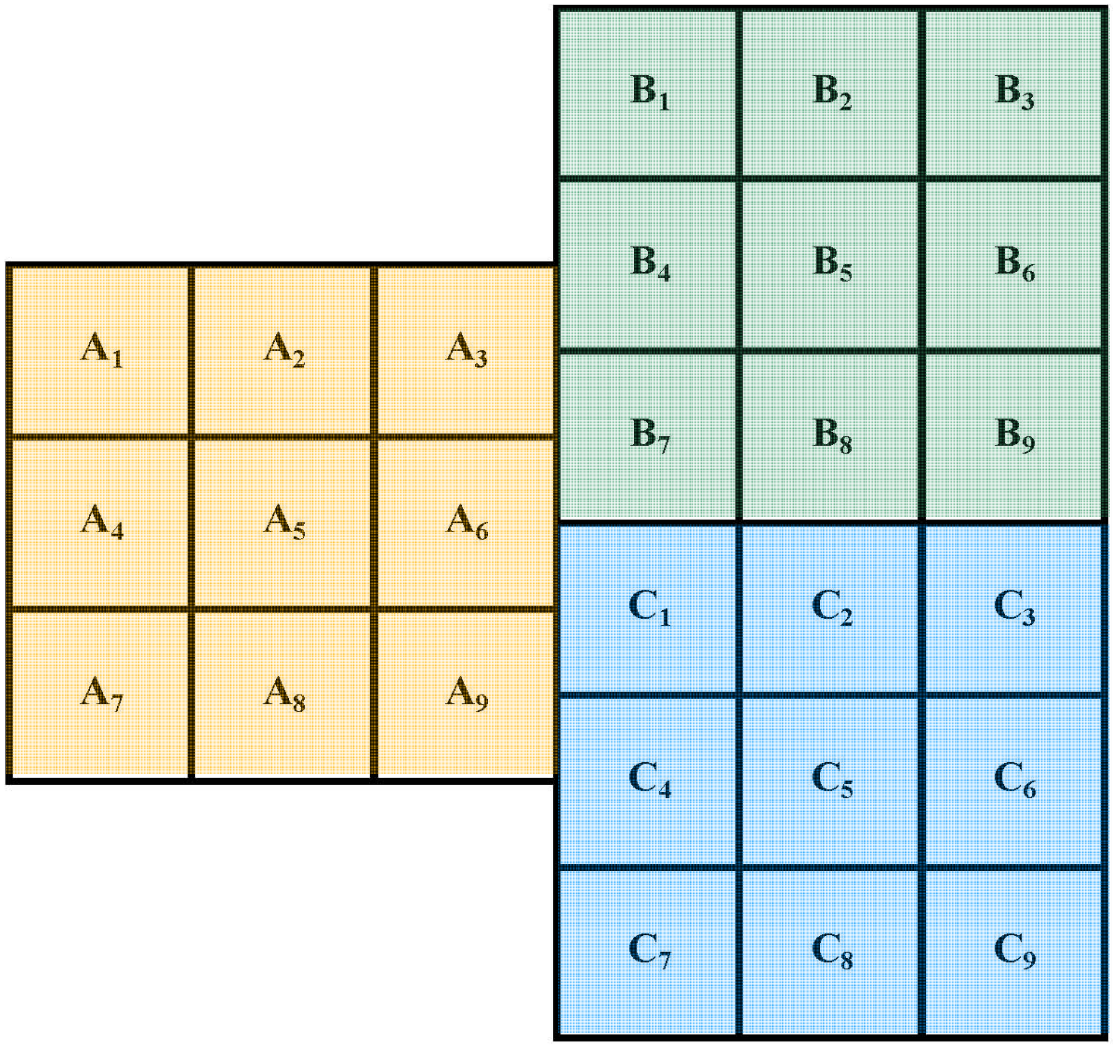
**Between Variance =** Based on the squared difference between each cluster's pure premium and the statewide average pure premium

**Total Variance =** Within Variance + Between Variance

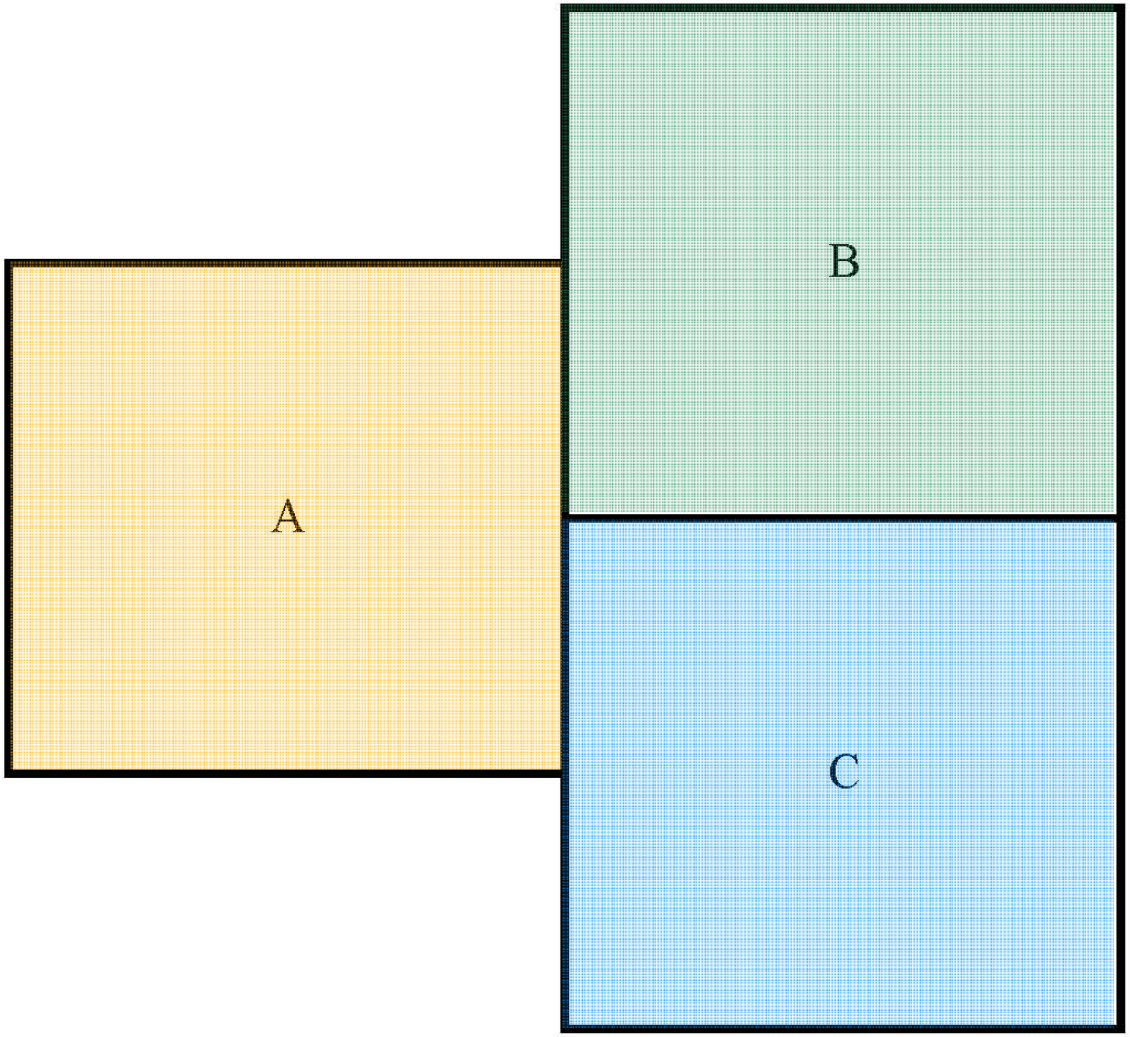
**Within Variance Percentage** = Within Variance divided by Total Variance

**Goals =** $\frac{\text{Low Percentage of Total Variance Within}}{\text{High Percentage of Total Variance Between}}$

# Building Blocks



# Territorial Risk Classes



# Basis to Group Areas

## County

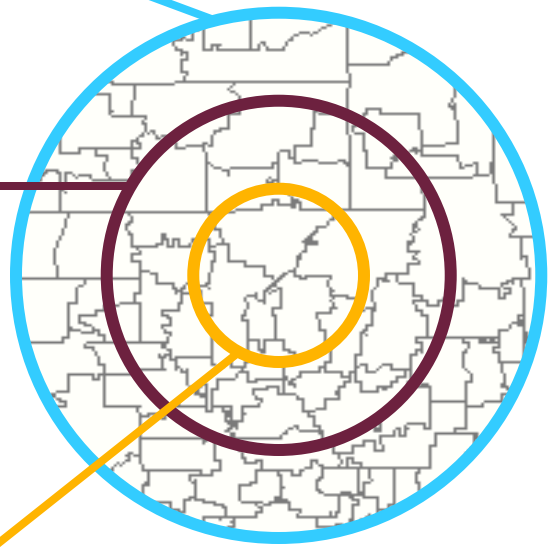
- Largely stable over time
- Broad area

## ZIP Code

- Narrowly defined — may be beneficial to define territories
- Useful for online rating
- Main disadvantage is need to deal with change over time

## Geo-Coding

- Finest detail
- Static over time
- No predefined grouping



# Loss Index Normalized Pure Premium

**Normalized Zip Code Pure Premium**

=

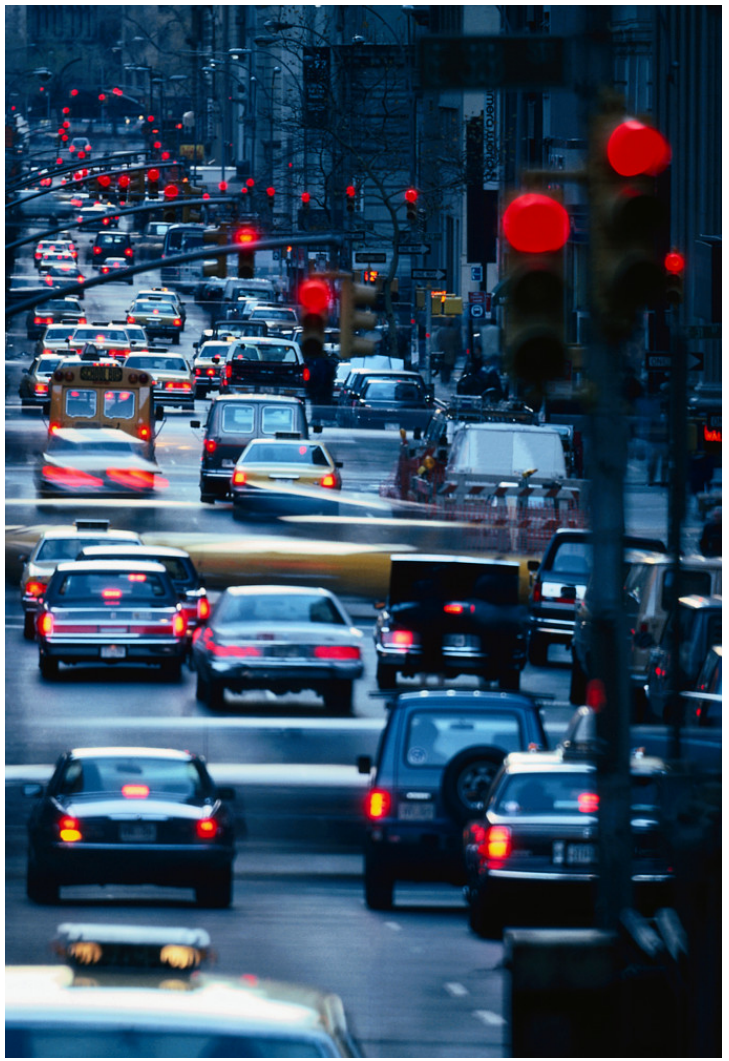
**Actual Zip Code Pure Premium**

X

$$\frac{\text{State Avg. Prem.}}{\text{State Avg. Base}} \div \frac{\text{Zip Avg. Prem.}}{\text{Zip Base}}$$

# Loss Index Econometric Model — Private Passenger Auto

- Population Density
- Vehicle Density
- Accidents per Vehicle
- Injuries per Accident
- Thefts per Vehicle



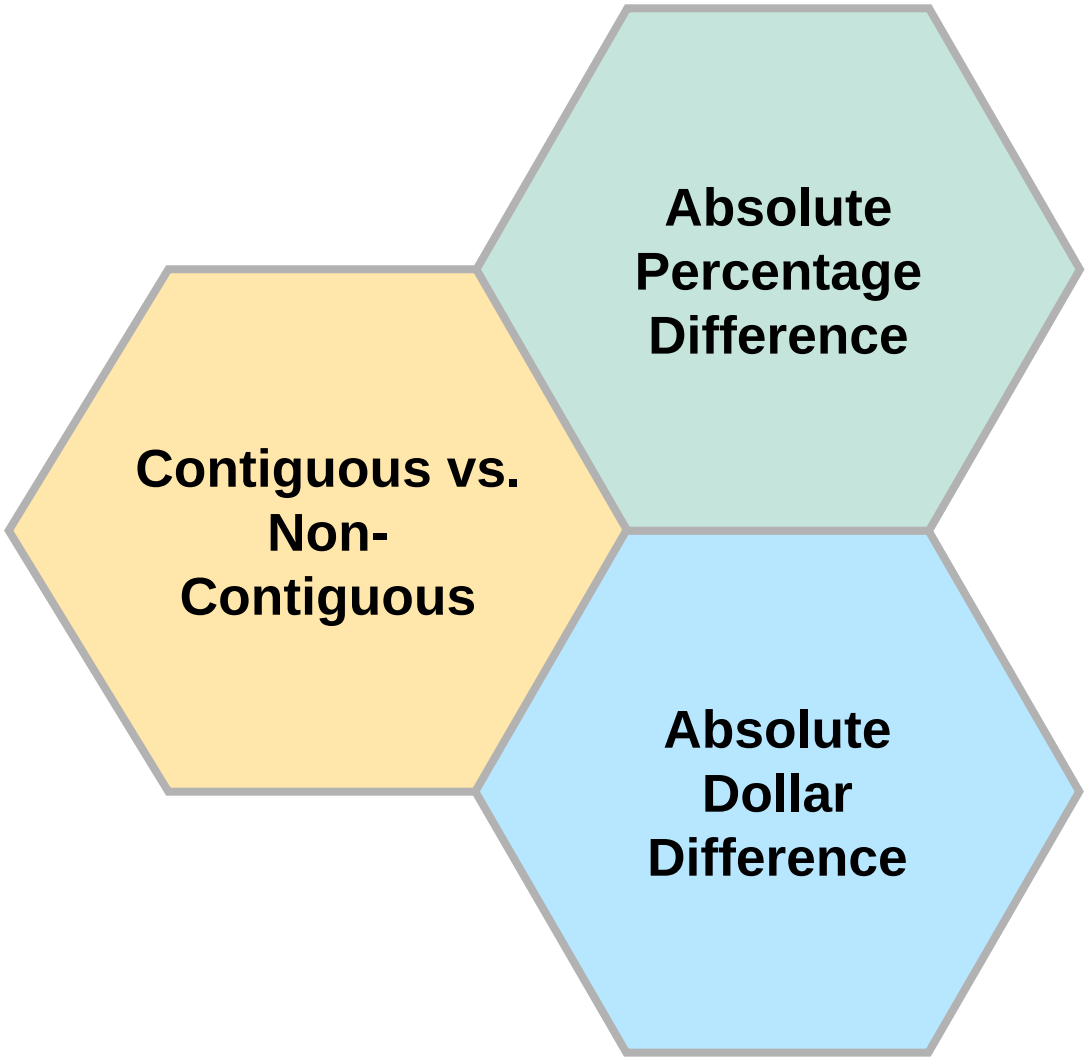
# Loss Index Econometric Model — Business Owners Liability

- Departure from Normal Temperature
- Population Density
- Number of Days Maximum Temperature is Below Freezing
- Population Growth
- Percent of Population Using Public Transportation
- Total Precipitation

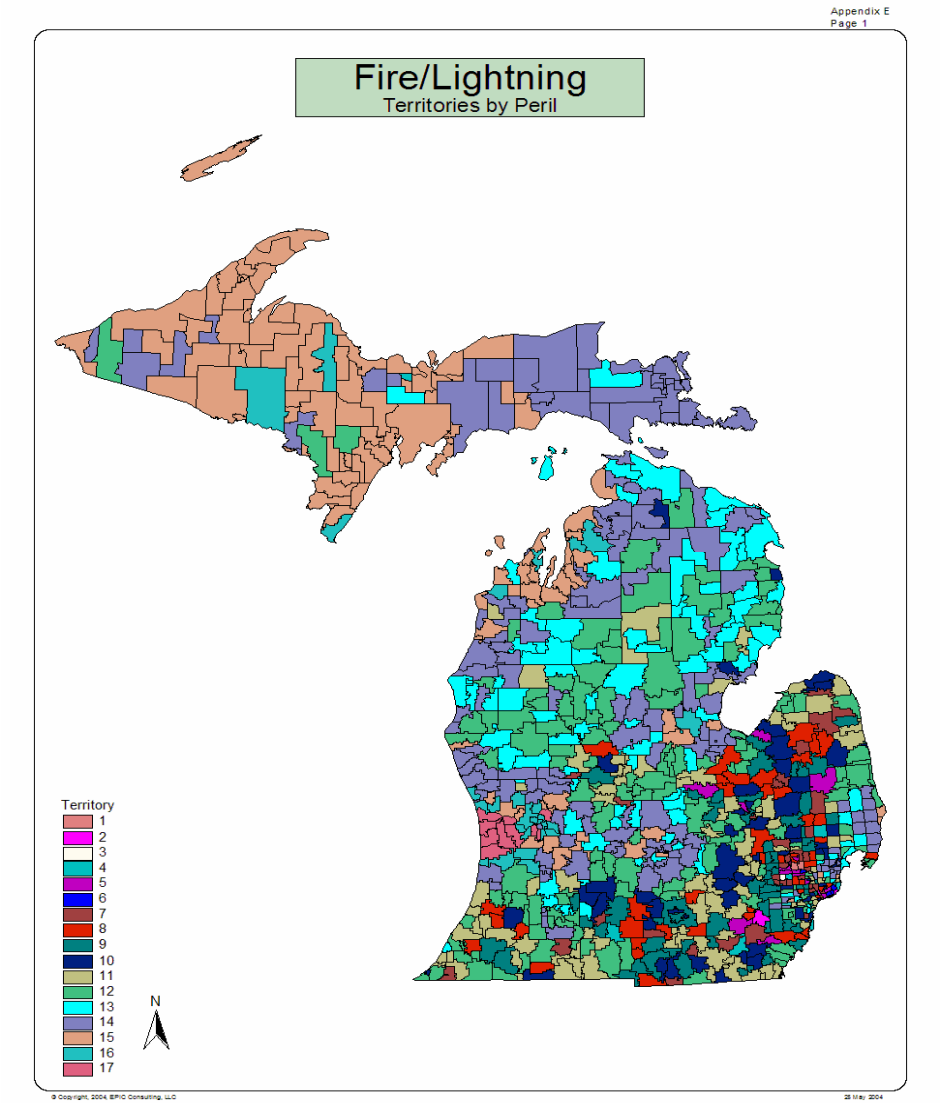
# Credibility

- No “right” answer
- We commonly use:
  - 3,000 Claims
  - With complement applied to:
    - Neighborhood Pure Premium
    - Within Two Miles
    - One Mile Extensions

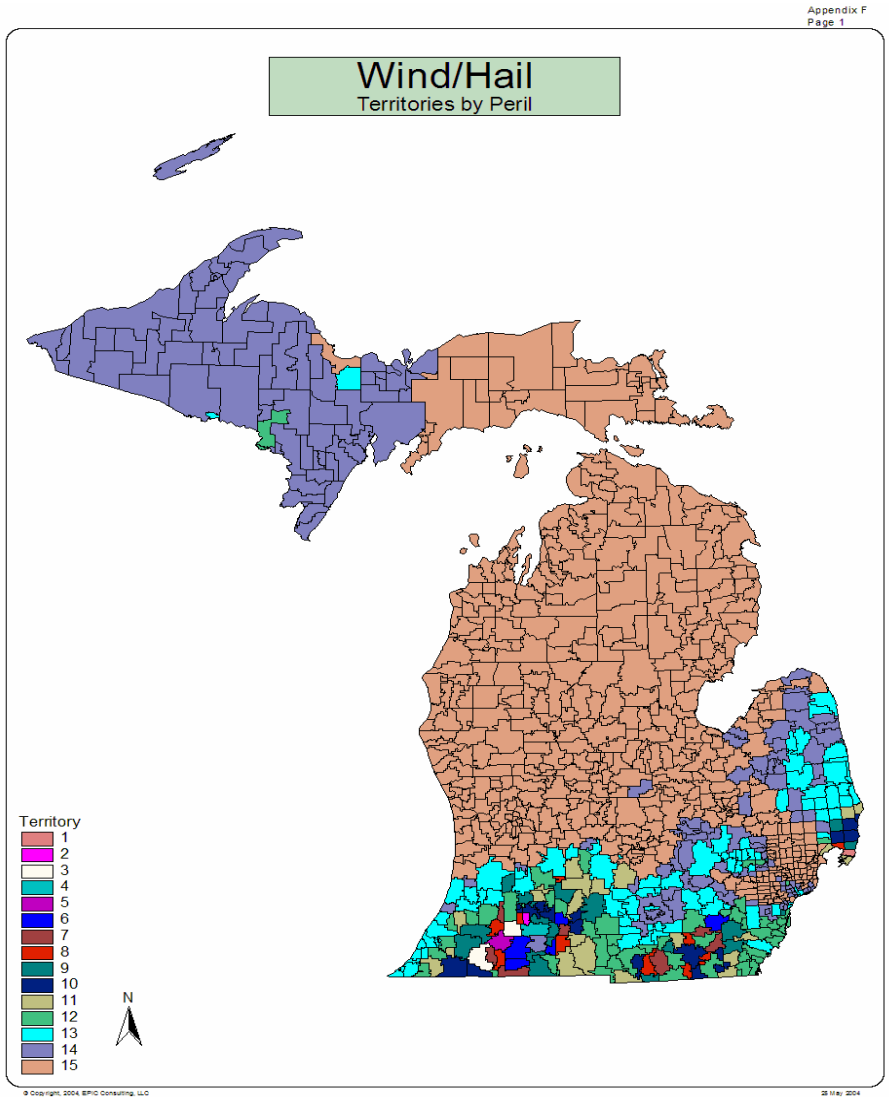
# Clustering



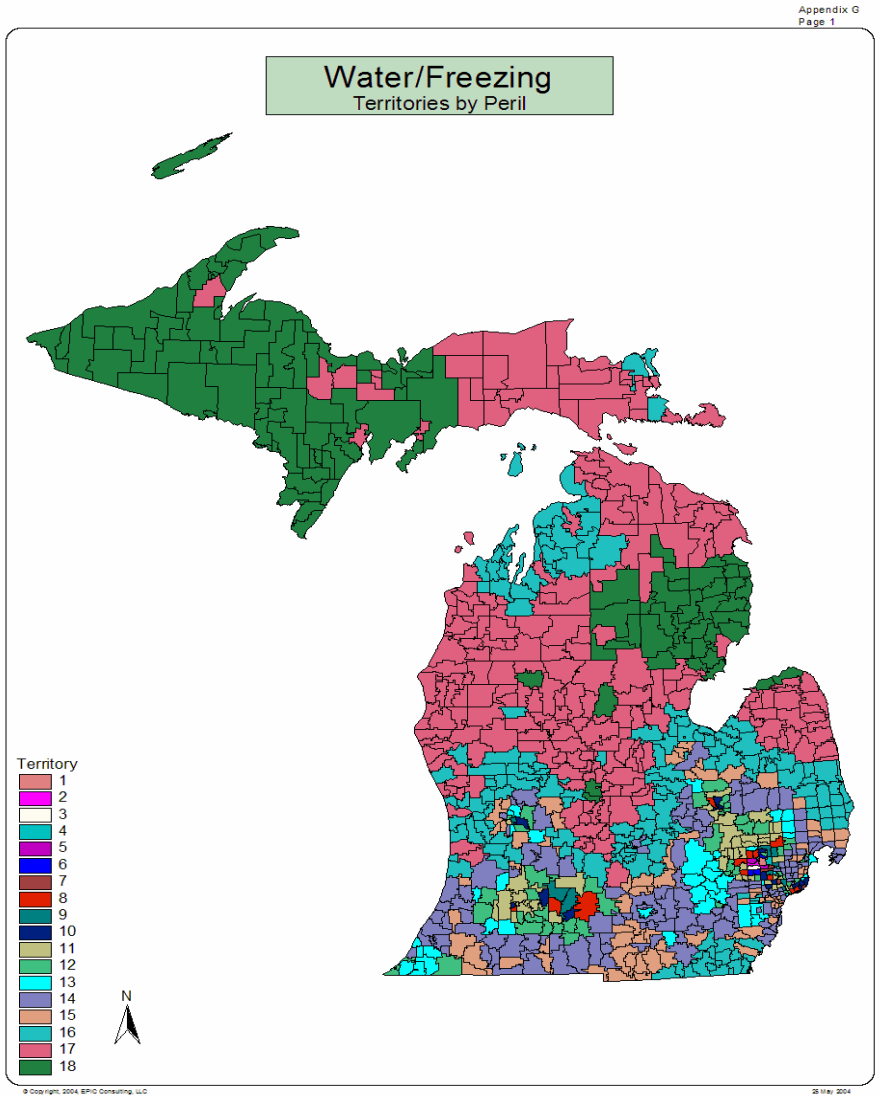
# Michigan Industry — Fire (Non-Contiguous)



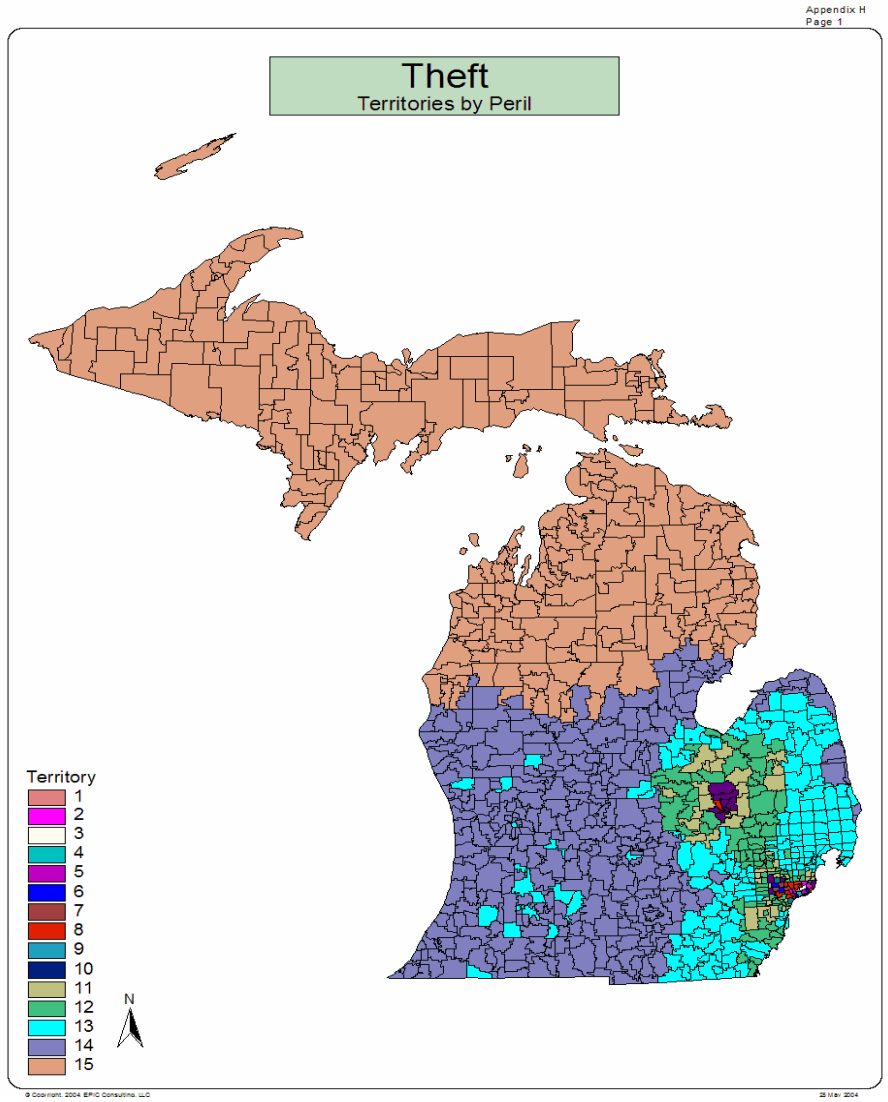
# Michigan Industry — Wind/Hail **(Non-Contiguous)**



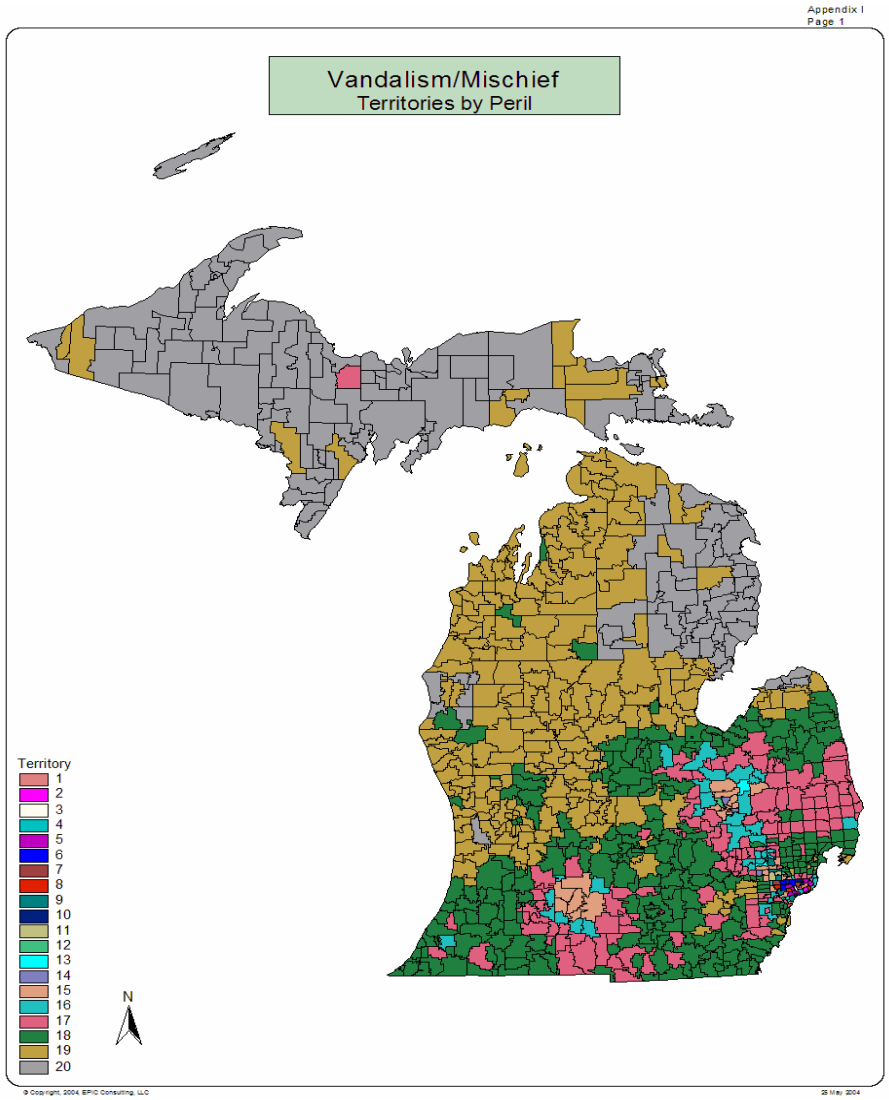
# Michigan Industry — Water/Freezing **(Non-Contiguous)**



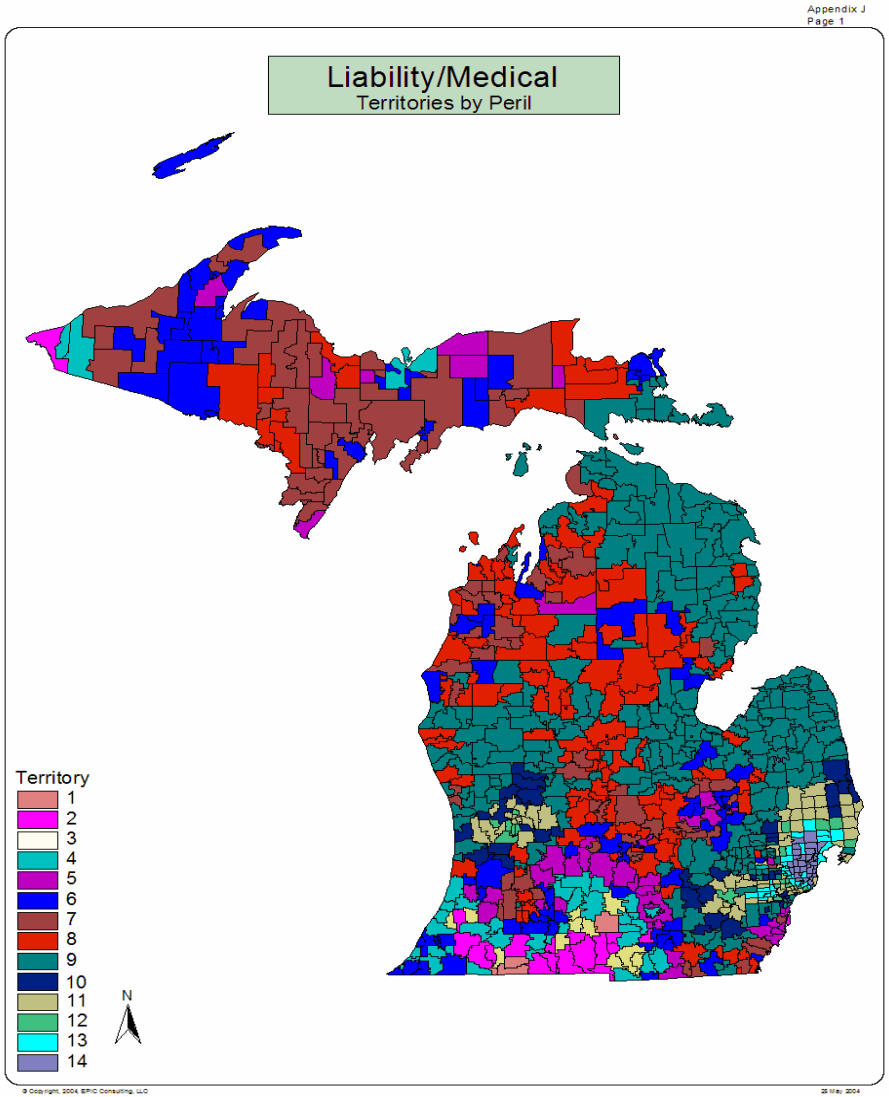
# Michigan Industry — Theft **(Non-Contiguous)**



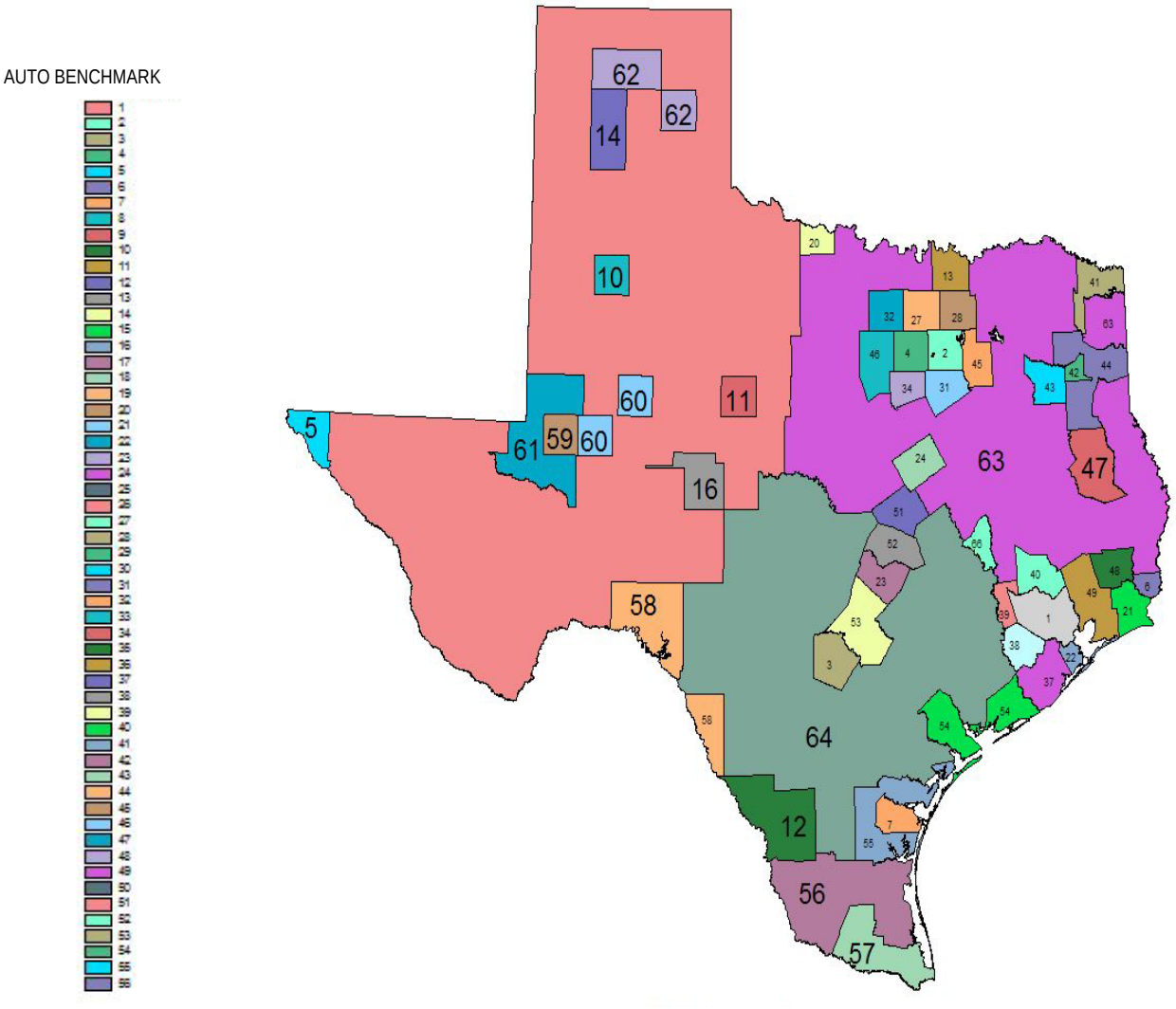
# Michigan Industry — Vandalism **(Non-Contiguous)**



# Michigan Industry — Liability **(Non-Contiguous)**

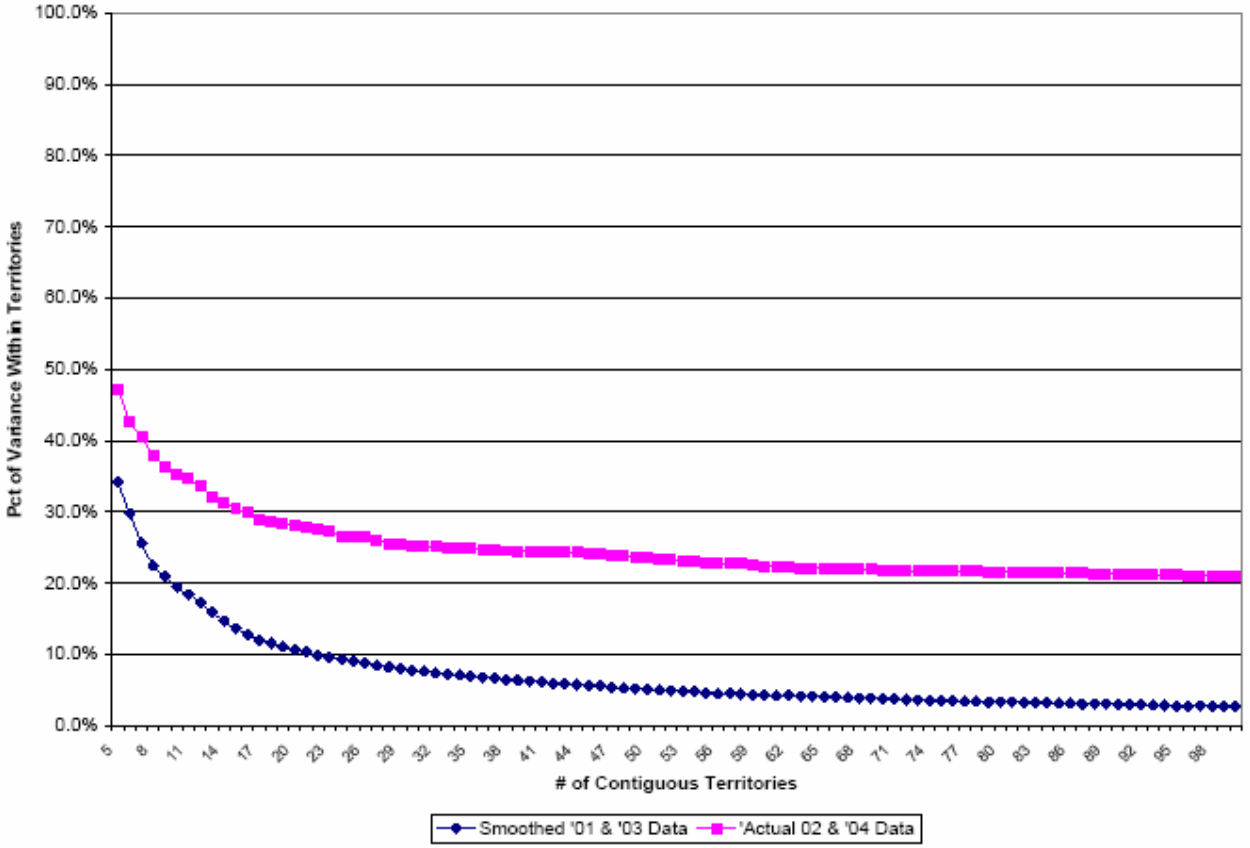


# Texas Auto Benchmark



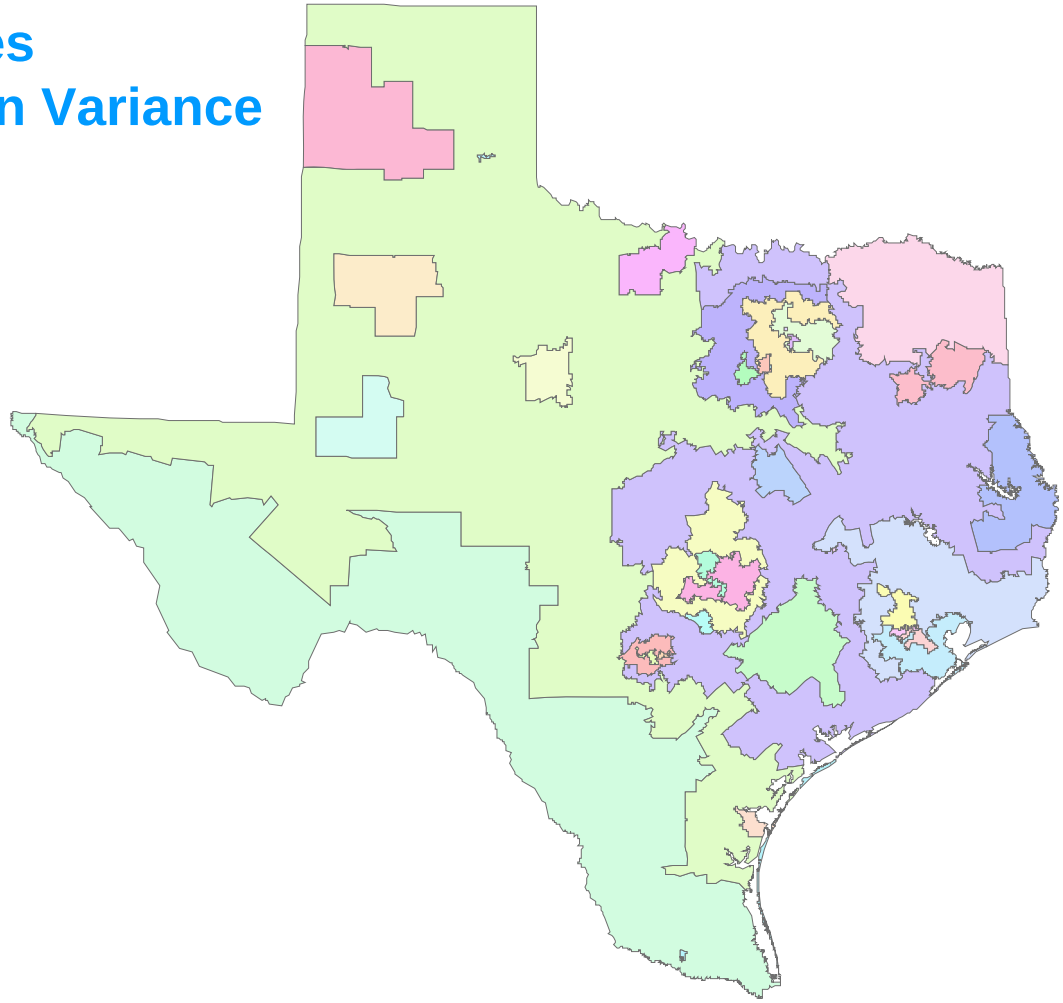
# Within Territory Variance as a Percentage of Total Variance — Property Damage **(Contiguous)**

## Texas



# Indicated Auto Territories — Property Damage **(Contiguous)**

**Texas**
**34 Territories**
**24.9% Within Variance**



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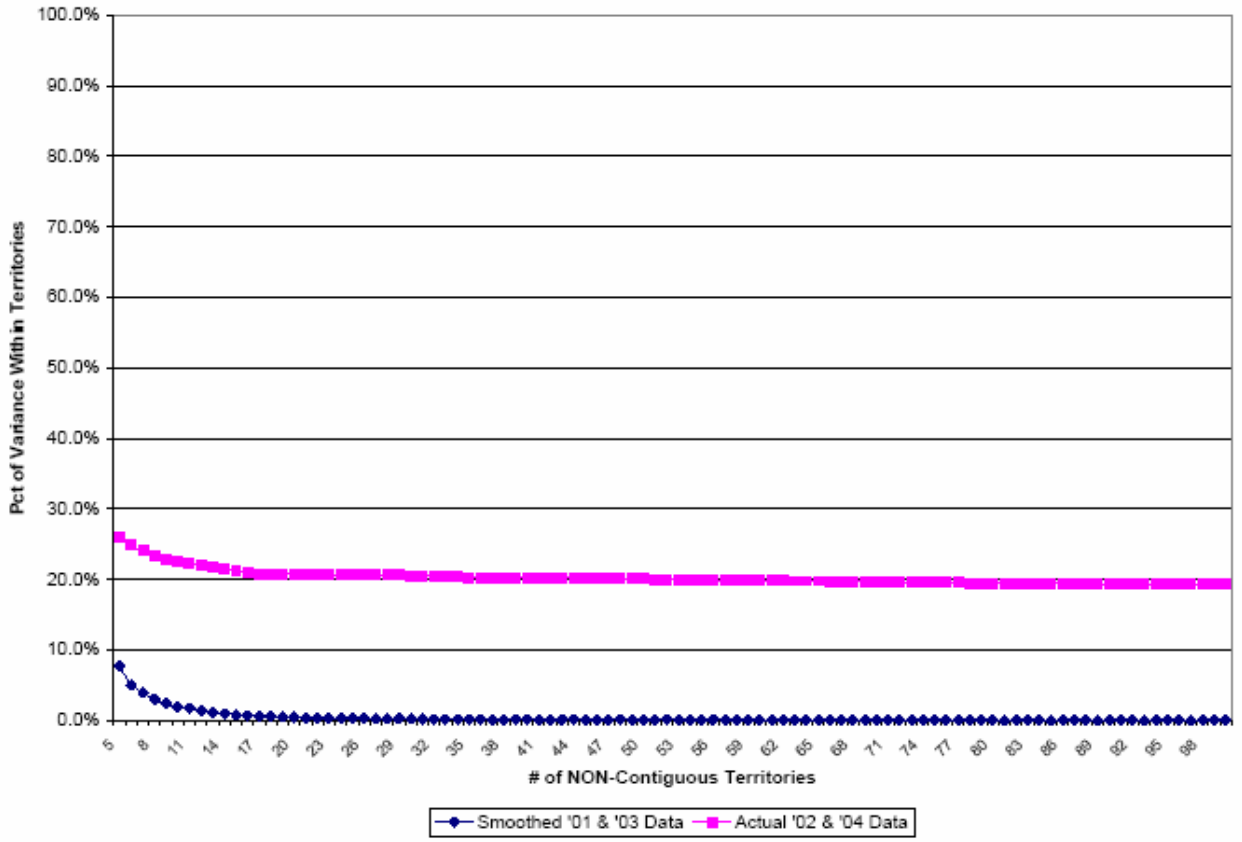
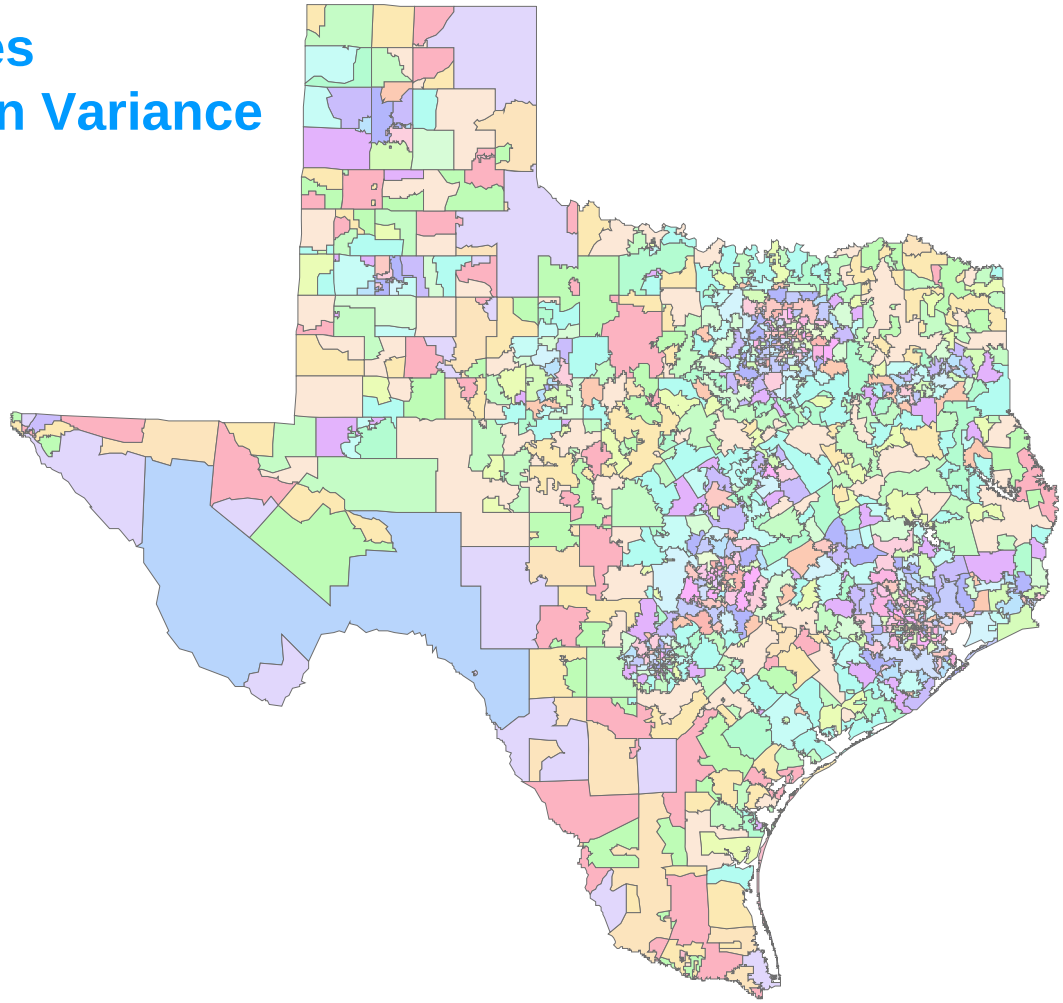


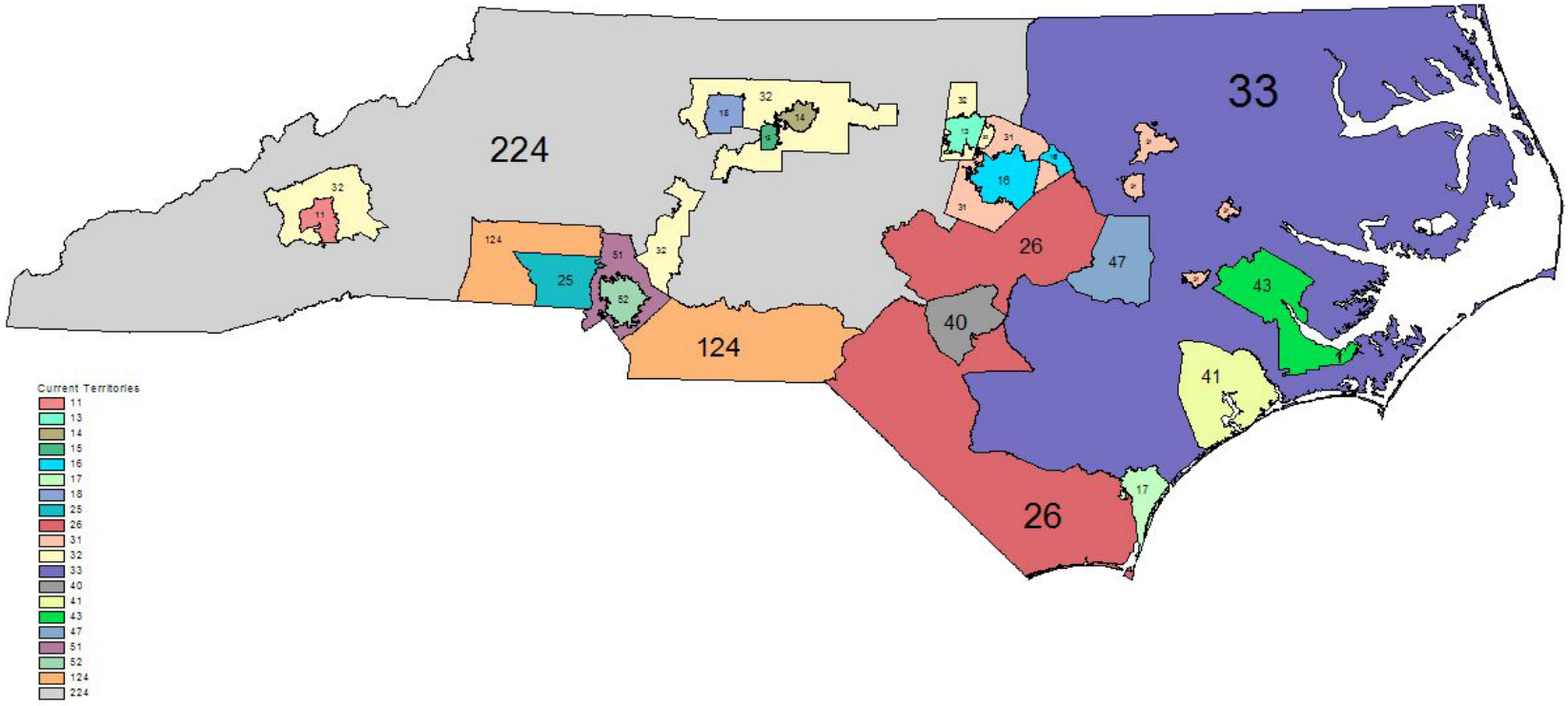
# Indicated Auto Territories — Property Damage **(Non-Contiguous)**

**Texas**
**34 Territories**
**20.3% Within Variance**



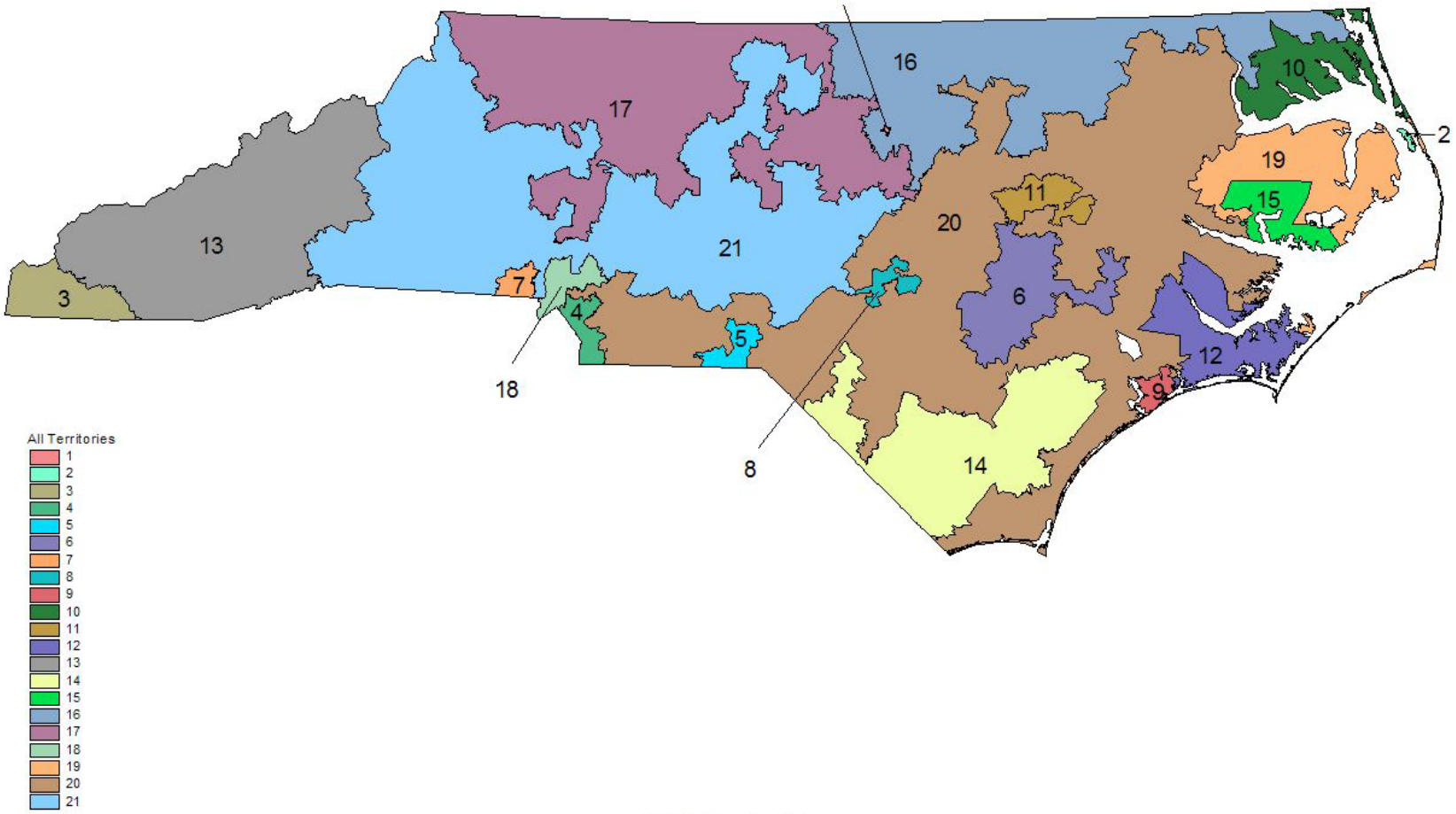
# Current Auto Territories — All Coverages

## North Carolina



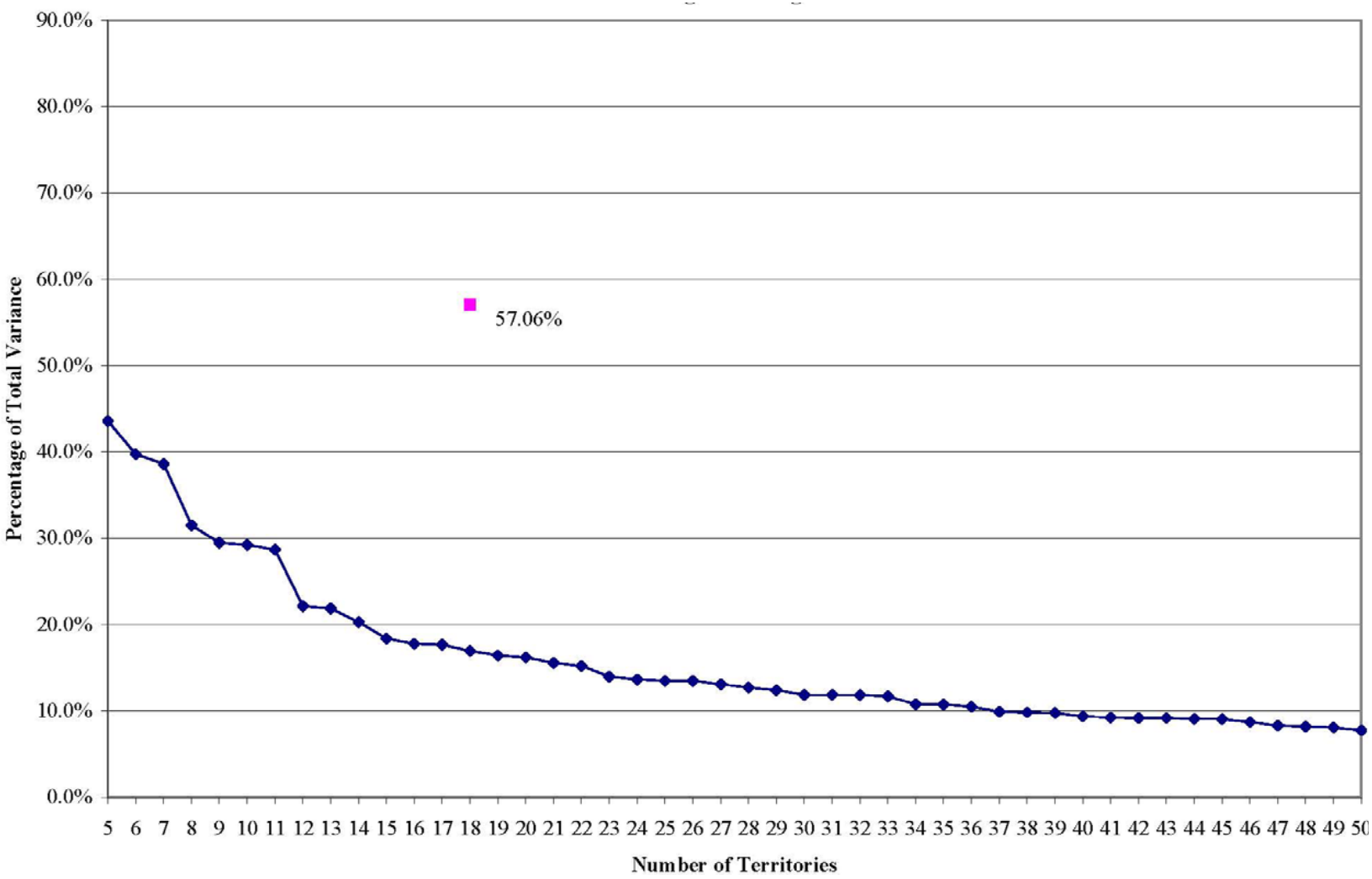
# 1997 – 1999 Indicated Auto Territories — All Coverages **(Contiguous)**

## North Carolina



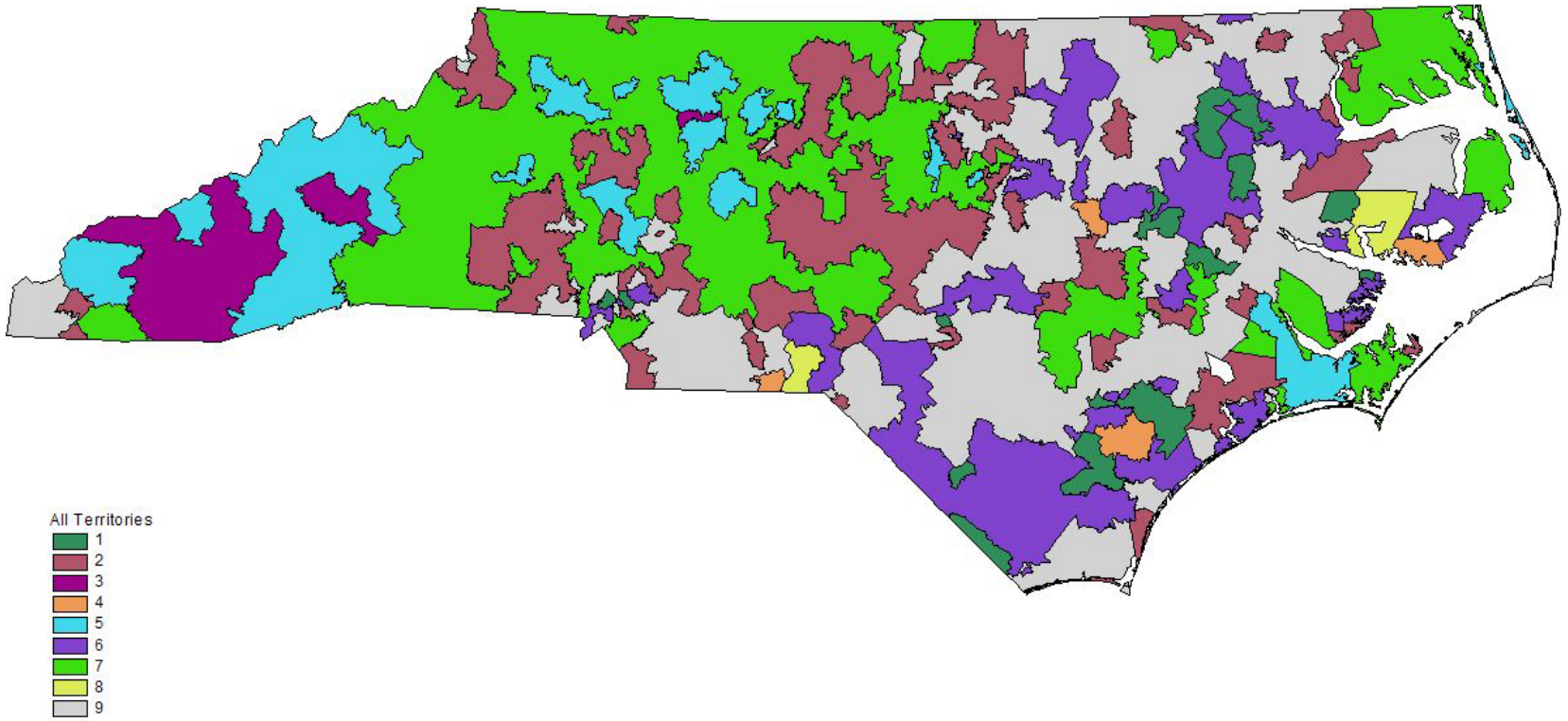
# Within Territory Variance as a Percentage of Total Variance — All Coverages **(Contiguous)**

## North Carolina



# 1997 – 1999* Indicated Auto Territories — All Coverages **(Non-Contiguous)**

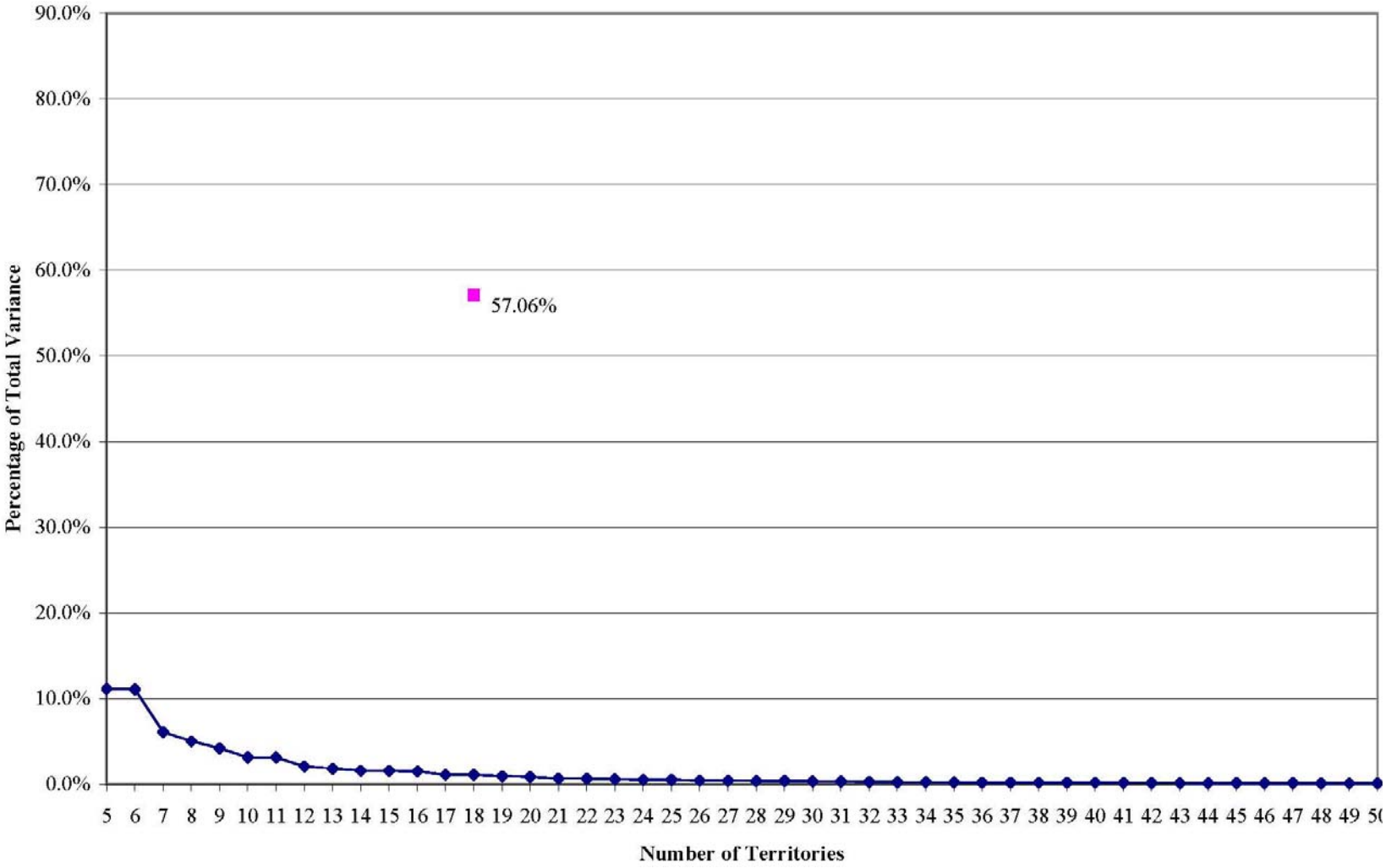
## North Carolina




* 1993 – 1999 for Comprehensive

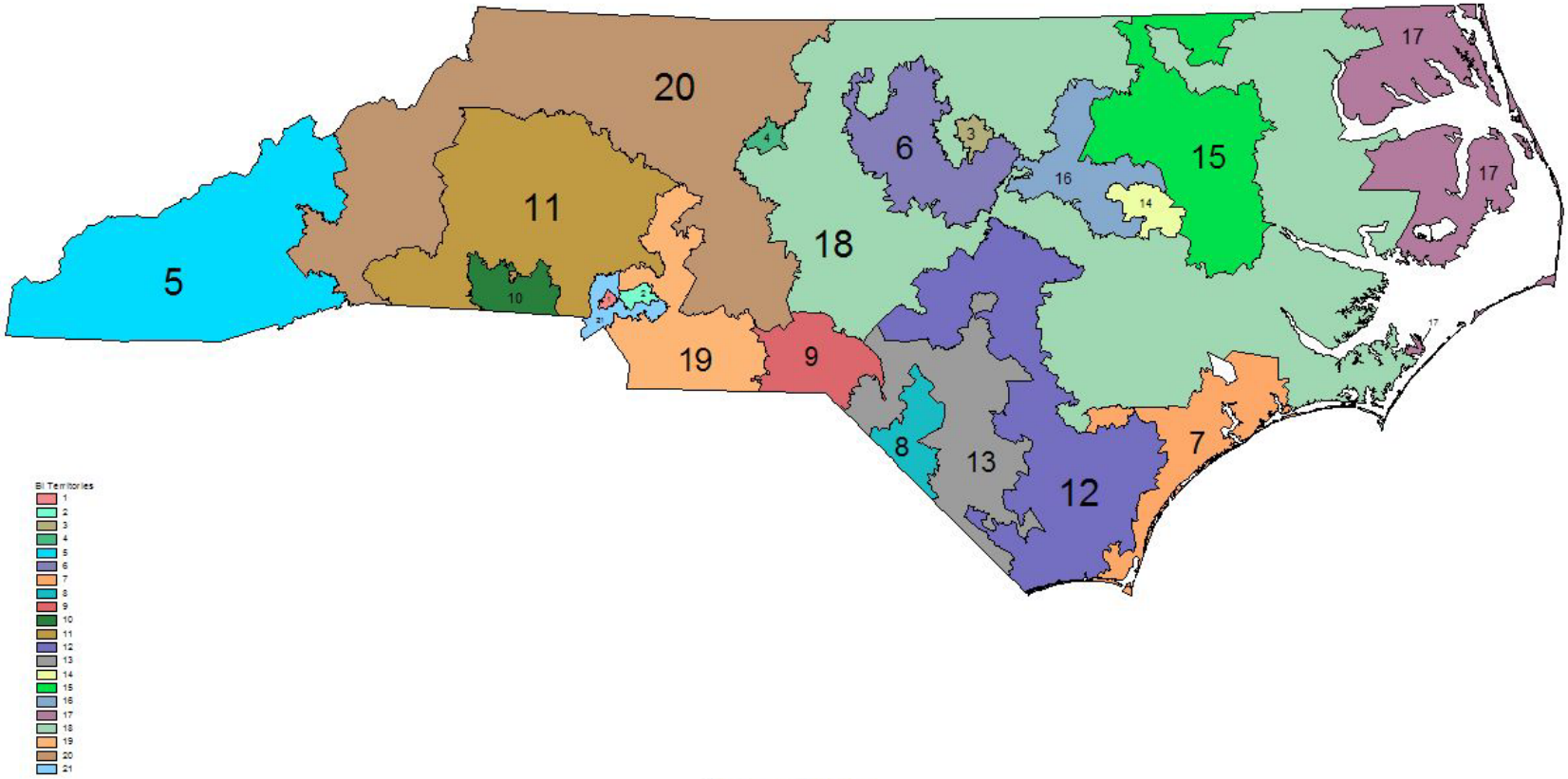
# Within Territory Variance as a Percentage of Total Variance — All Coverages **(Non-Contiguous)**

## North Carolina



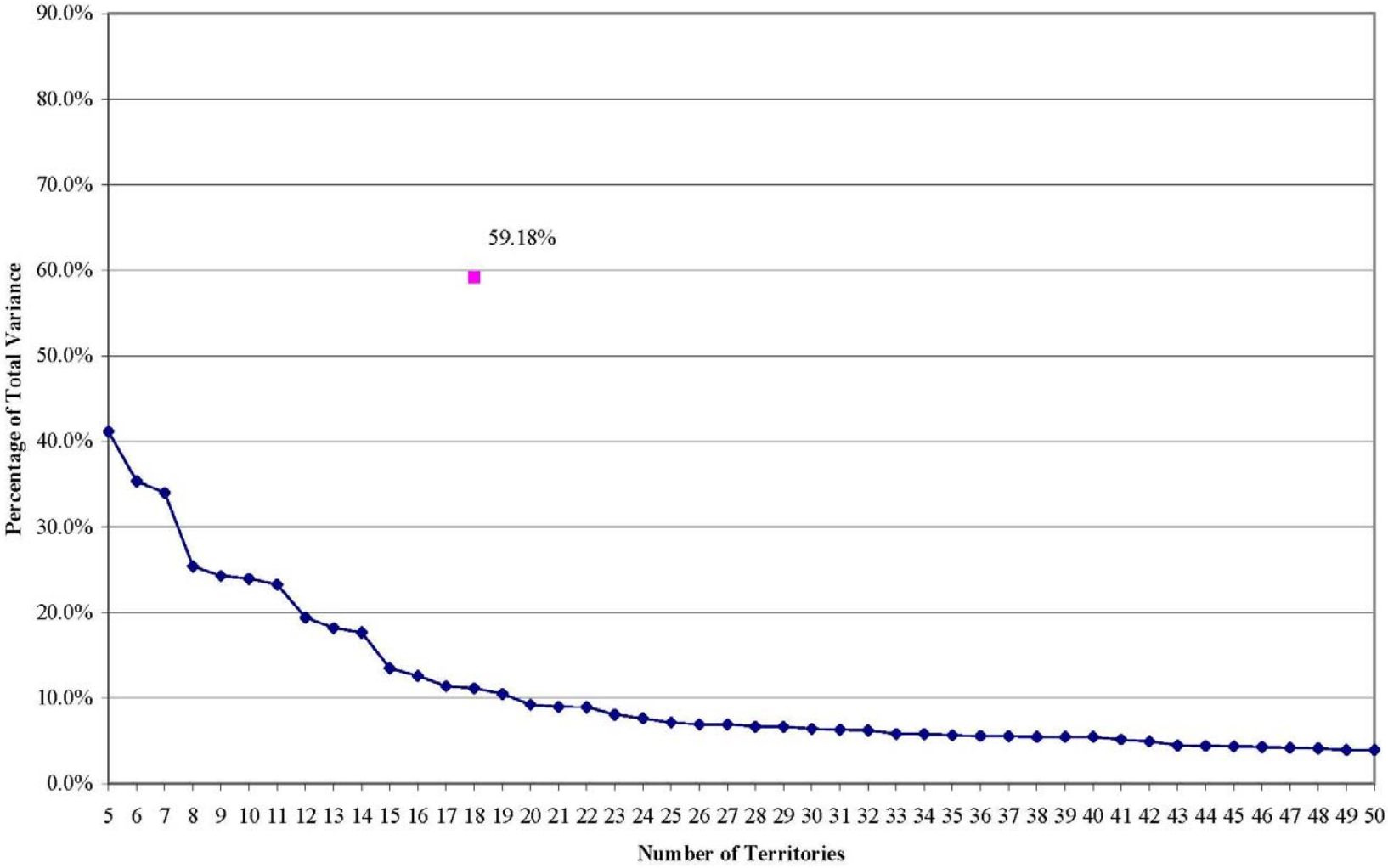
# 1997 – 1999 Indicated Auto Territories — Bodily Injury **(Contiguous)**

## North Carolina



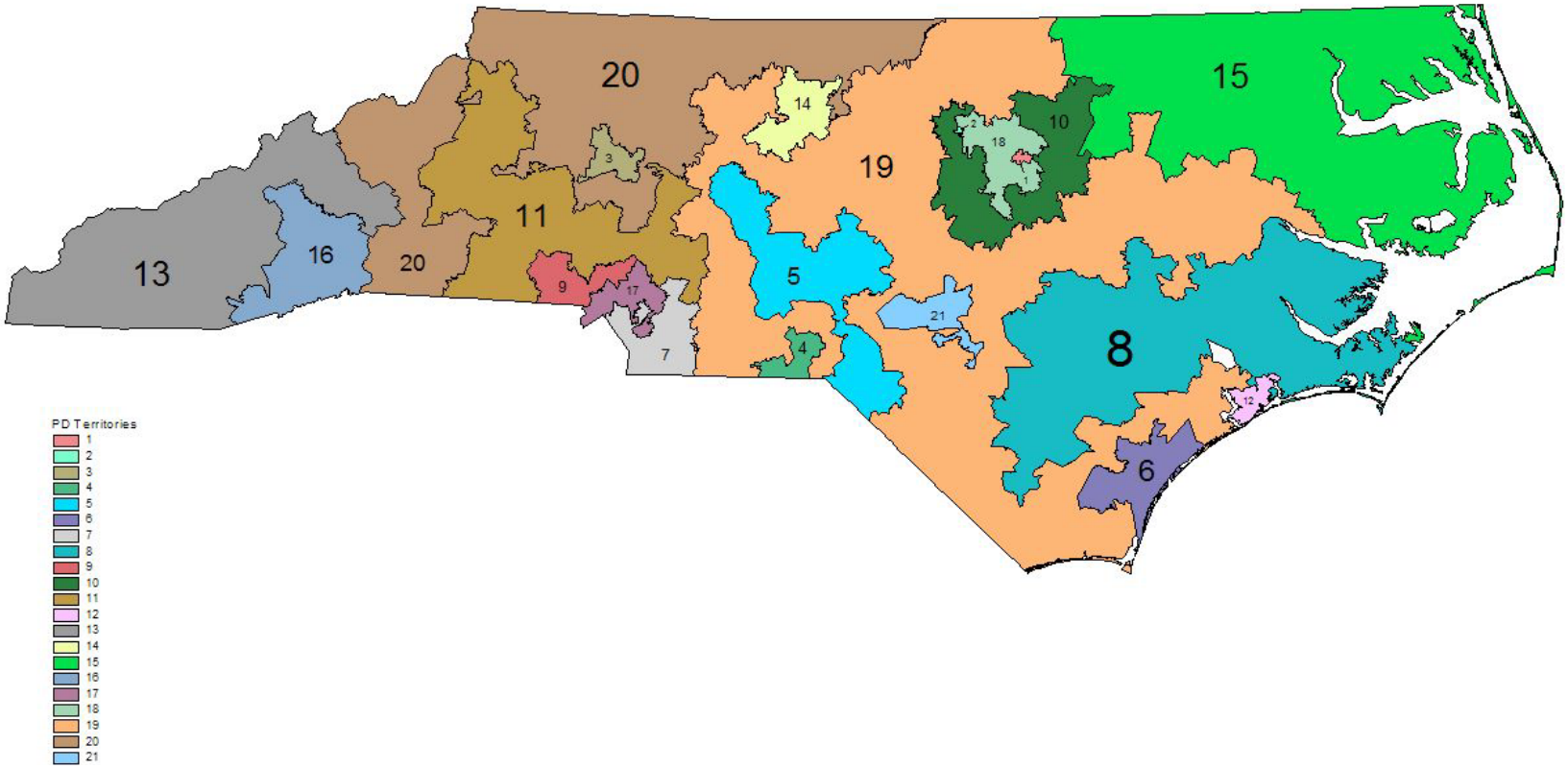
# Within Territory Variance as a Percentage of Total Variance — Bodily Injury **(Contiguous)**

## North Carolina



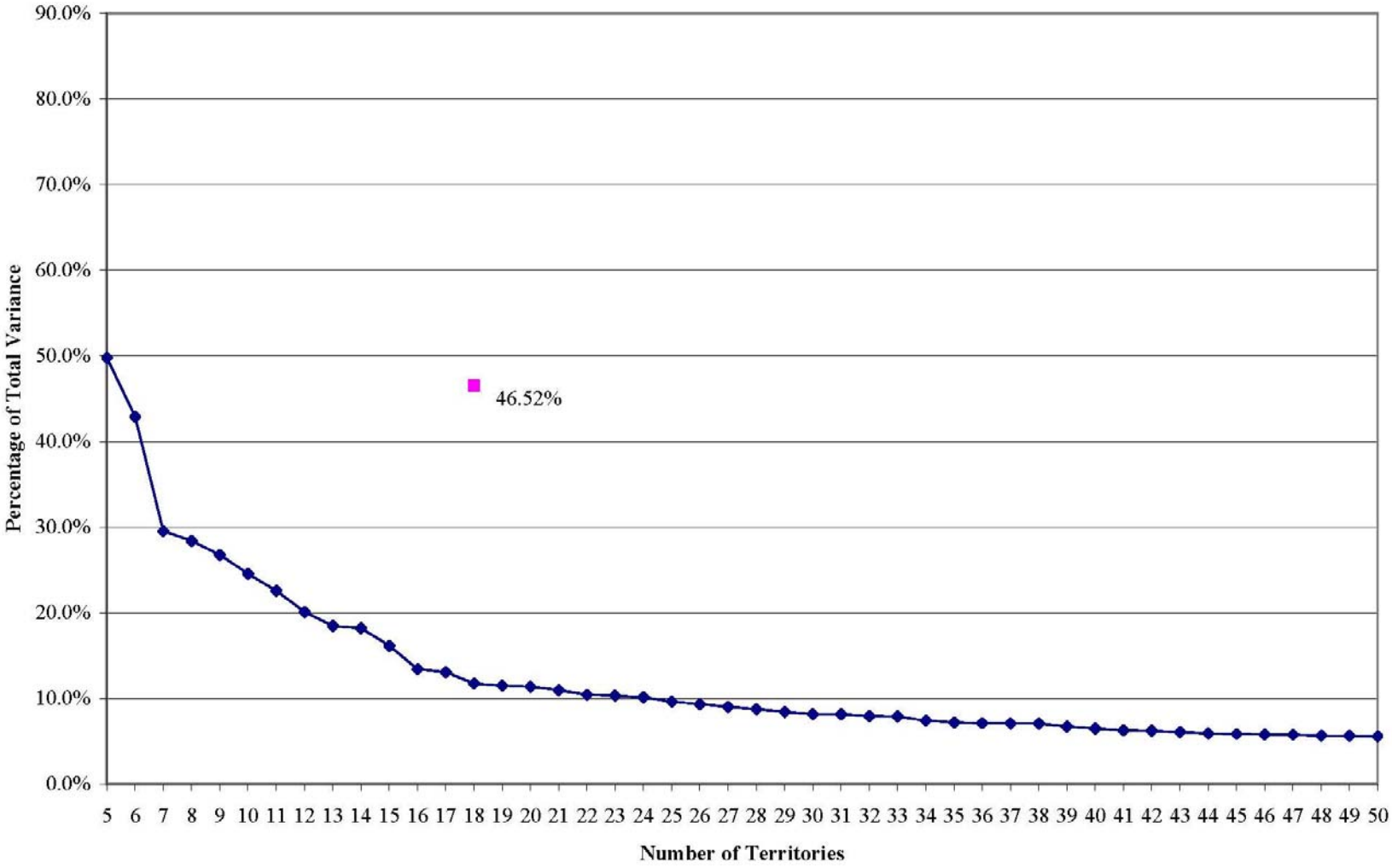
# 1997 – 1999 Indicated Auto Territories — Property Damage **(Contiguous)**

## North Carolina



# Within Territory Variance as a Percentage of Total Variance — Property Damage **(Contiguous)**

## North Carolina



# 1993 – 1999 Indicated Auto Territories — Comprehensive **(Contiguous)**

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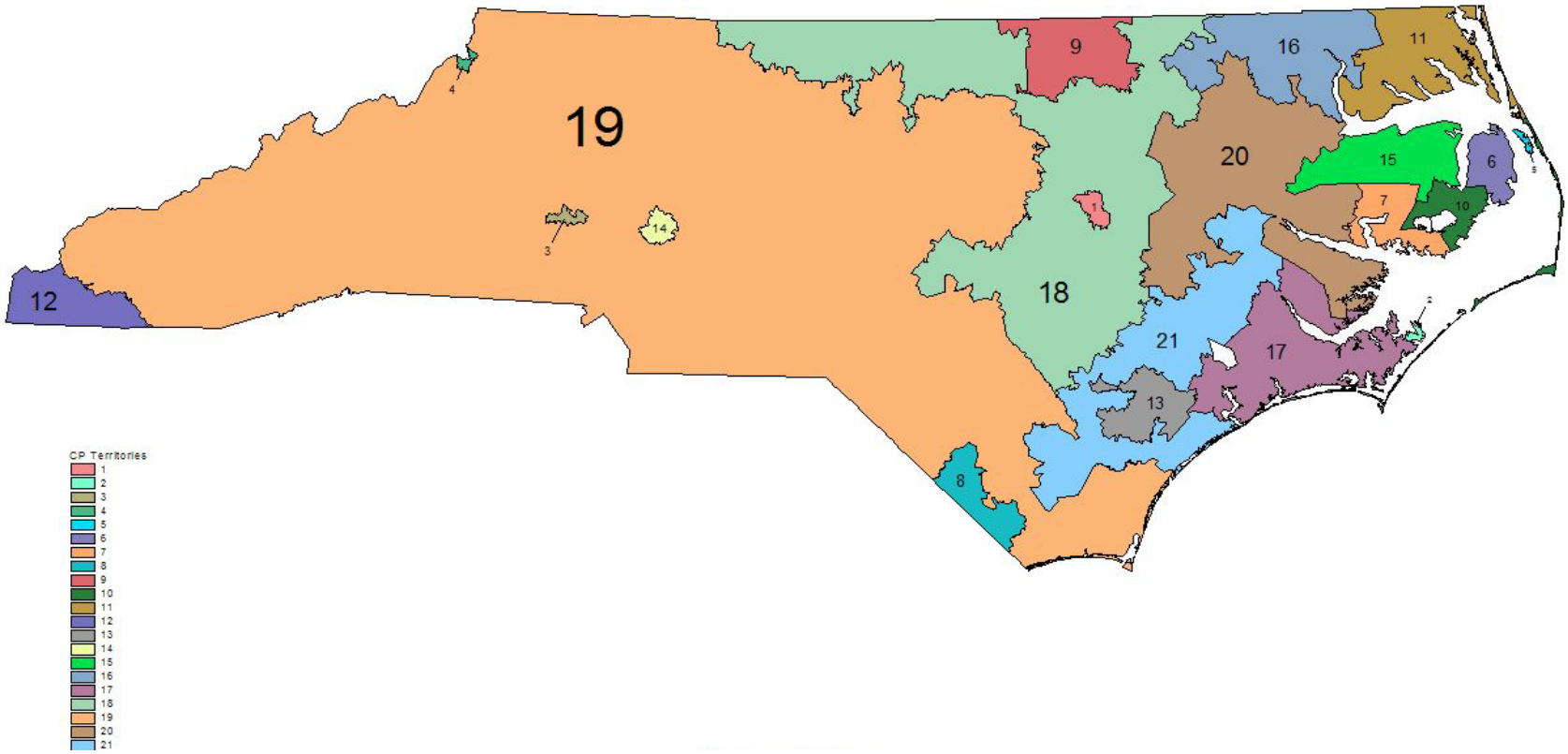
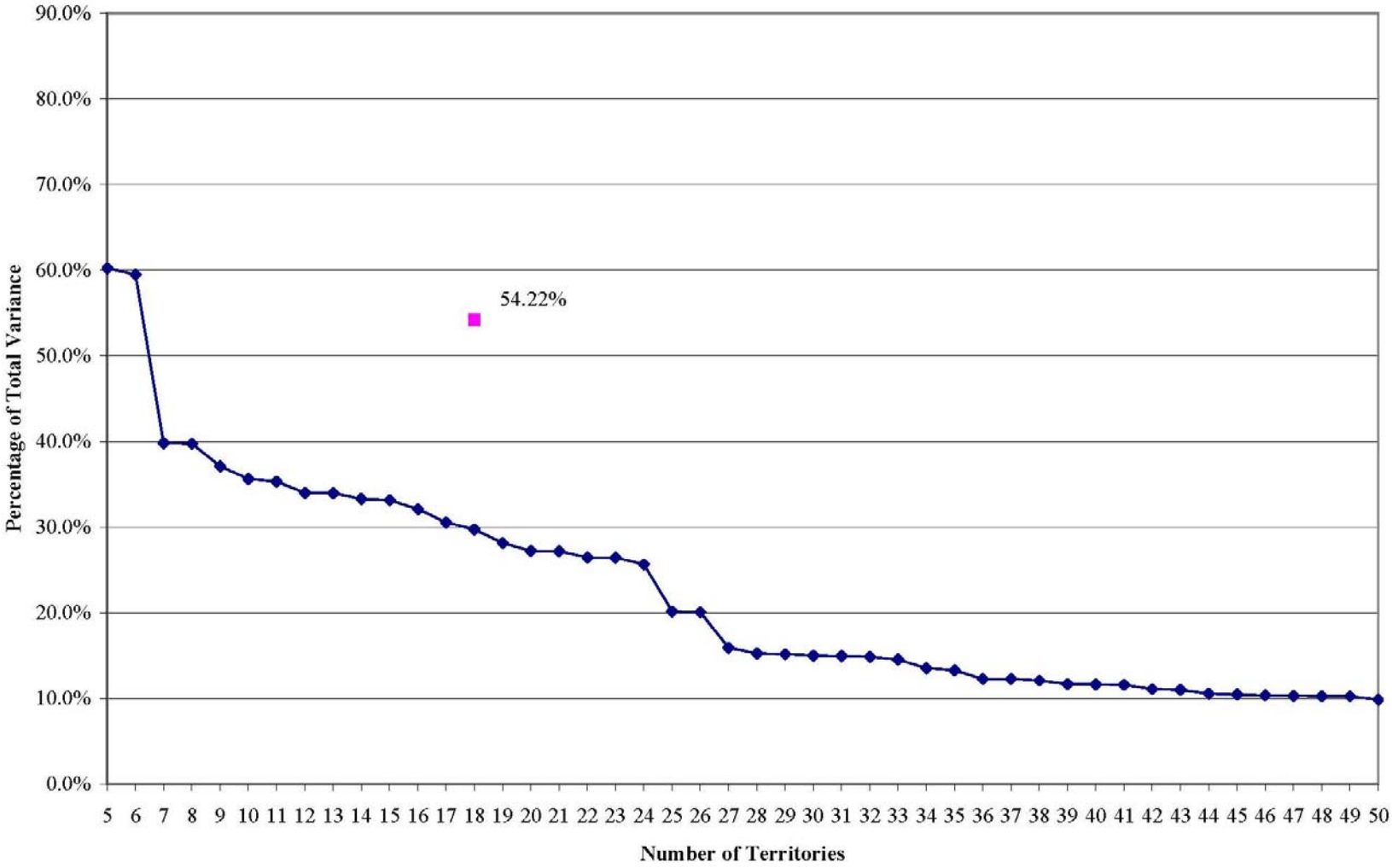


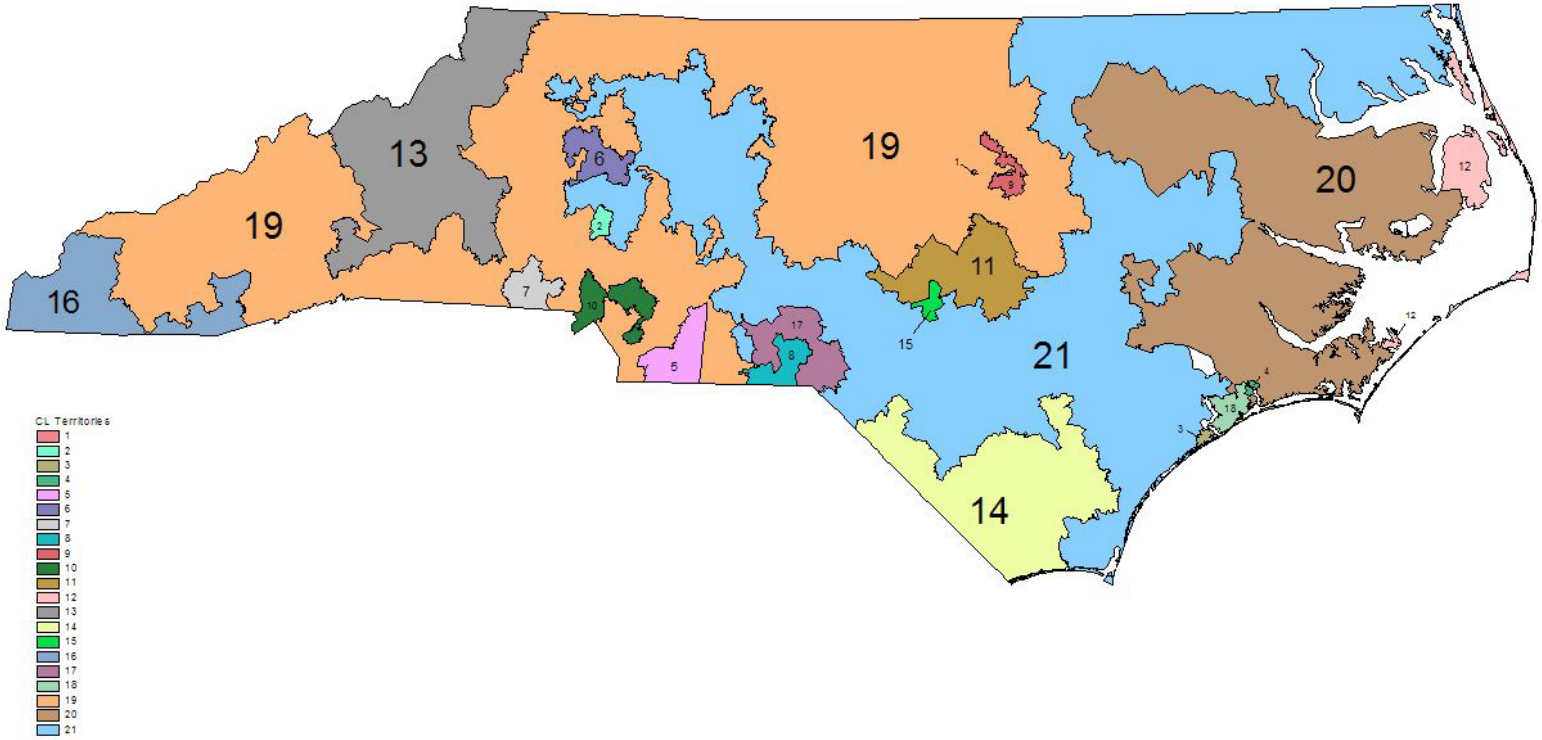
# Within Territory Variance as a Percentage of Total Variance — Comprehensive **(Contiguous)**

## North Carolina



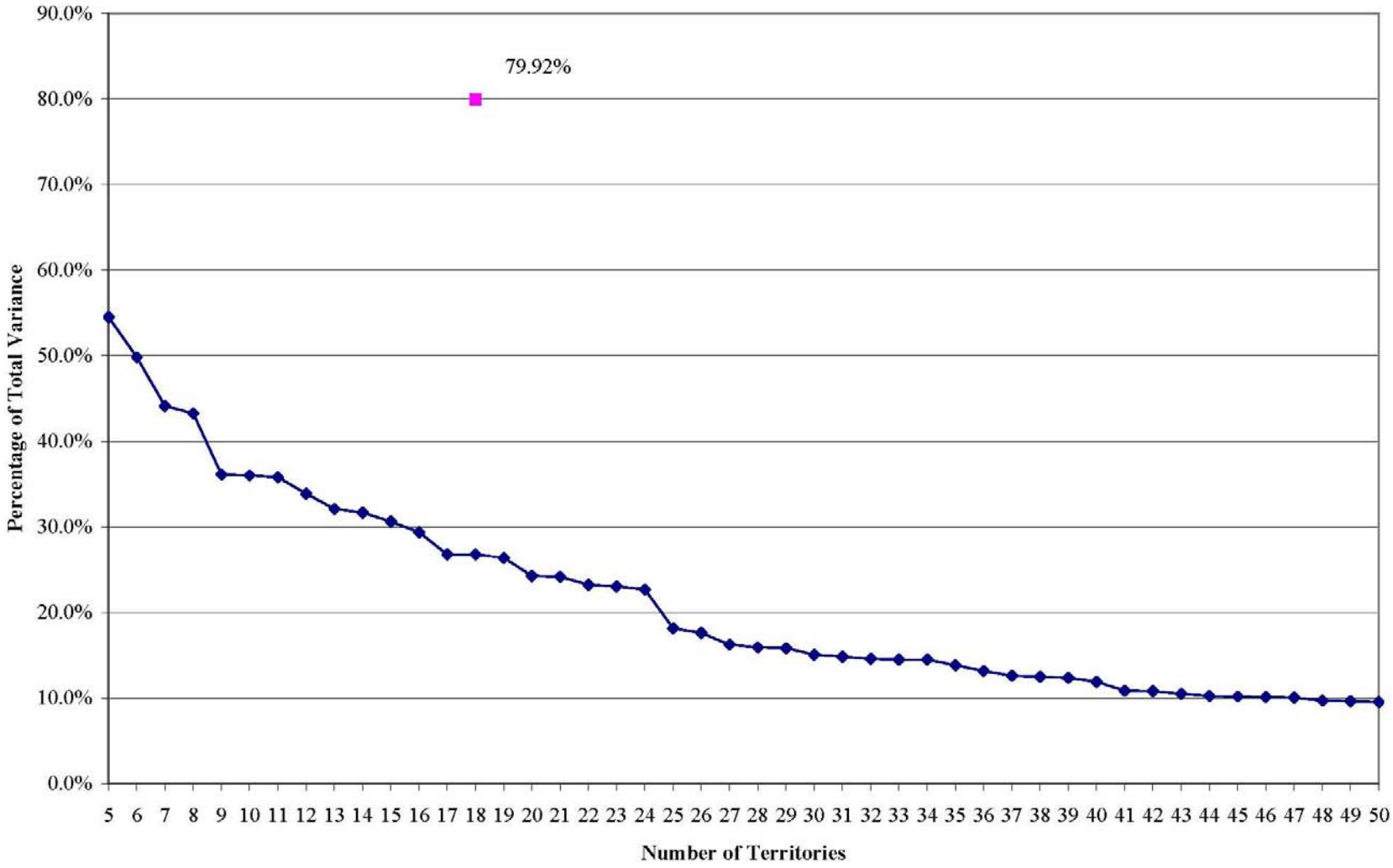
# 1997 – 1999 Indicated Auto Territories — Collision **(Contiguous)**

## North Carolina



# Within Territory Variance as a Percentage of Total Variance — Collision **(Contiguous)**

## North Carolina



# Stability

## Predictive stability

- Choice of perils included in data
- Number of years of data

## Rating stability

- Limit movement between zones
- Use of capping
- Use of confidence intervals to help analyze changes

# Predictive Power and Stability

## Predictive Power — Test #1

- 1993 – 1994 versus 1995 – 1996
- Correlation coefficient
- Tested boundaries based on 1994 – 1996
- Non-contiguous better

## Predictive Power — Test #2

- 1993 – 1995 versus 1994 – 1996
- Tested boundaries based on 1994 – 1996
- Within variance only marginally better for 1994 – 1996 data

## Stability

- 1993 – 1995 clusters versus 1994 – 1996 clusters
- Compared indicated boundaries and relativities
- Little dislocation