Trend Guidelines at NCHS: Present and Future

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Background

Beginning:

- Jennifer Madans' request for the formation of an inter-divisional workgroup to assess the state of trend analysis at the Center
- An interdivisional workgroup of volunteers was formed in 2013 workgroup members (mostly analysts):

Deborah Ingram(OAE)
Diane Makuc(OAE)
Renee Gindi(NHIS)
Vladislav Beresovsky(DRM)
Julia Holmes(OAE)
Manisha Sengupta(NHCS)
Abera Wouhib(DRM)

Donald Malec(DRM)
Deanna Kruszon-Moran(DHANES)
Michael Albert(DHCS)
Brady Hamilton(DVS)
Jeannine Schiller(DHIS)
Jennifer Peregoy(DHIS)

Timeline

- 2013 - 2015: Regular, frequent meetings
  - workgroup members brought issues they have encountered
  - provided material for cross-checking
- 2015: first draft
  - feedback from the Associate Directors of Science, Division Chiefs and staff
  - presented revised goals to BSC
- 2016: extensive revision
- 2017: further revision based on both analyst's use and on internal and external (NCI) reviews
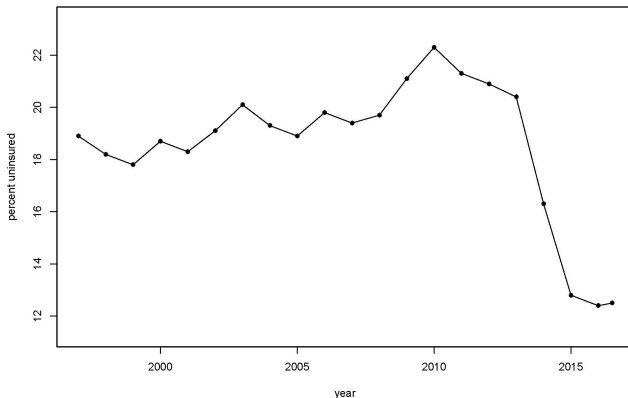
Background: an example of two trends

Figure : Birth rates for women aged 15-17 and 18-19: United States, 1991-2013.
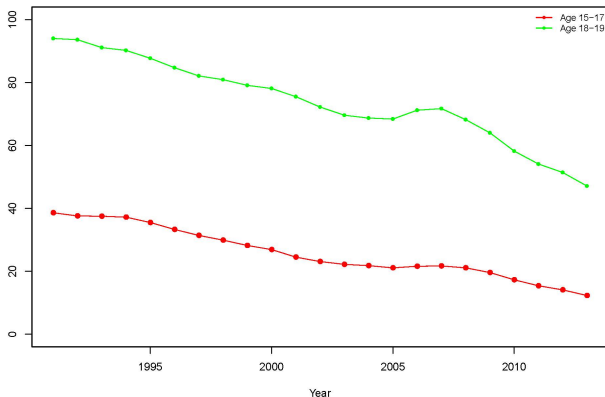
Background: another ...

Figure : Percentage of adults aged 18 - 64 who were uninsured at the time of interview: United States, 1997 - June 2017

Background: Types of trend analysis commonly performed at NCHS

- **Linear regression (straight line)**
  - least squares fit to population prevalence
  - population weighted least squares fit to population prevalence
  - sample variance weighted least squares fit to population prevalence
- **Specific Comparisons**
  - Comparison to a benchmark year
  - pairwise comparisons
- **Curves**
  - polynomial regression ... orthogonal polynomials
  - linear splines ... joinpoint regression using NCI software
  - log transform, logistic transform of prevalence rates
  - smoothing by collapsing years, followed by additional analysis

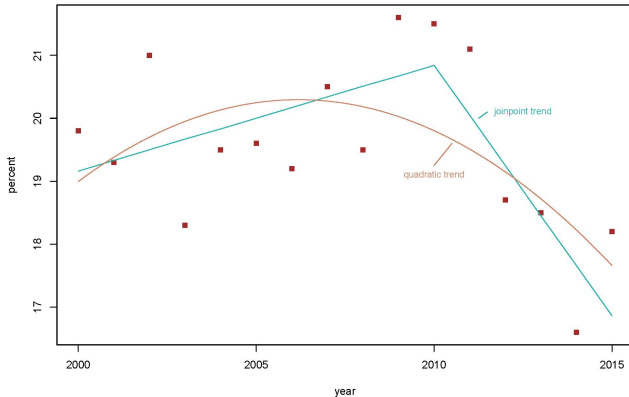# Scope of the Guidance Document for Trend Analysis

Three Main Sections

1. Guidance section: Lists Twelve Separate issues regarding Trends analysis and provides guidelines

2. Example Section: Provides several full examples using different NCHS data systems

3. Technical Section: Nine Appendices

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Contents of Main Guidance Section:

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Figure : Percent of persons with any emergency room use in past 12 months among uninsured adults ages 18-64: NHIS 2000-2013.

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Guidance Does Not include:

- ➤ Detailed guidance on choice of software
- ➤ Time series methods
- ➤ Age period cohort models
- ➤ Causal analysis
- ➤ Superpopulation models
- ➤ **Nonparametric trend analysis - increasing vs decreasing**
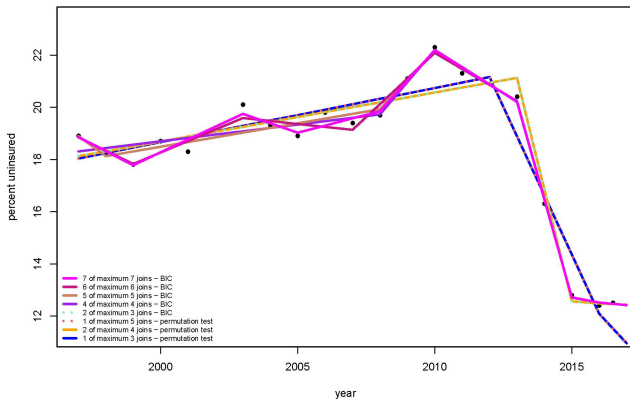- ➤ **Model fitting - new methods - choice of "goodness of fit"**

An Illustrative Example of the Choice of Model-fitting Criteria:

Fitting a trend to uninsured adults illustrates that Joinpoint software settings affect identification of changes in trend

Joinpoint Setting:

➢ Allow a possible joinpoint at each year

➢ Evaluate the effect of limiting the total number of joinpoints that are possible in the model selection

➢ Evaluate the use of the "permutation test criterion" versus the "Bayesian Information Criterion (BIC)"

➢ Compare results with conservative simultaneous confidence bands made directly from the survey design without any model selection

➢ See how polynomial models work in this situation

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Joinpoint - Permutation and BIC Model Fitting Criteria

Legend:
- 7 of maximum 7 joins – BIC
- 6 of maximum 6 joins – BIC
- 5 of maximum 5 joins – BIC
- 4 of maximum 4 joins – BIC
- 2 of maximum 3 joins – BIC
- 1 of maximum 5 joins – permutation test
- 2 of maximum 4 joins – permutation test
- 1 of maximum 3 joins – permutation test

Conservative simultaneous 95% confidence intervals based only on sample estimates - no additional modeling

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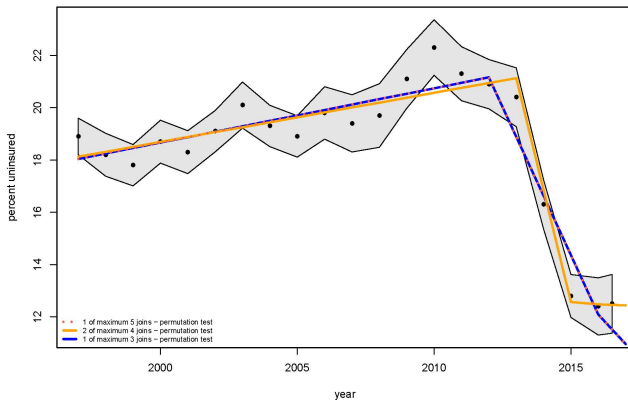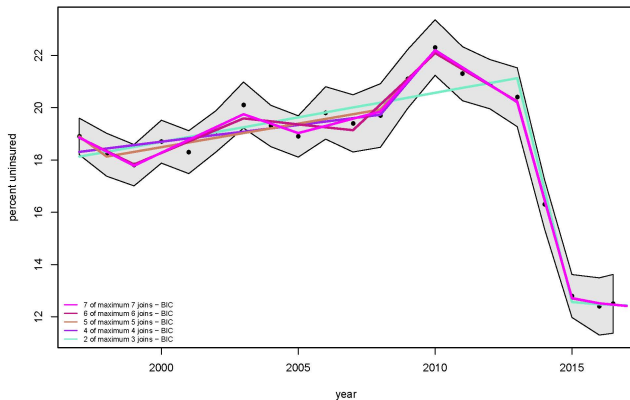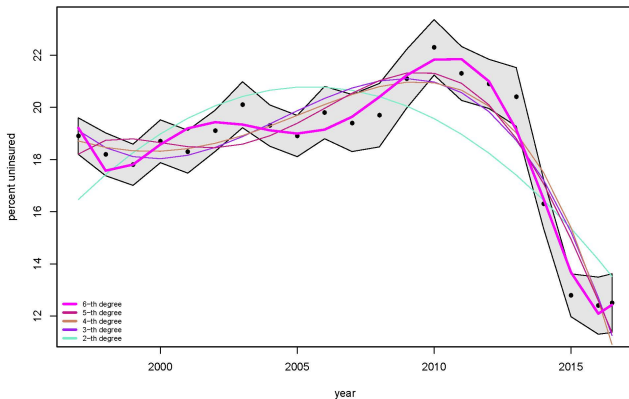
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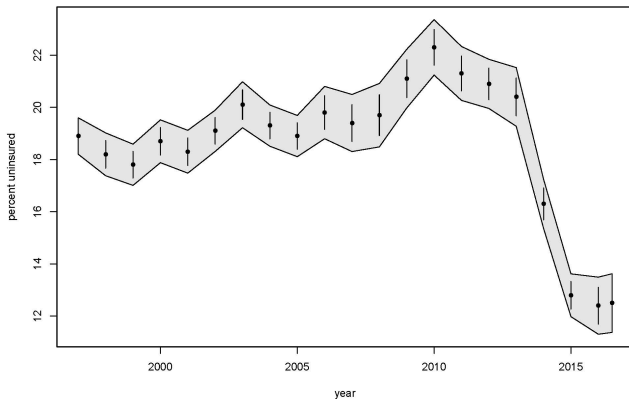
Polynomial Models

Joinpoint model selection may not be clear to analysts

Permutation Test Criterion

- Sample size that is permuted is the number of time periods not the sample size
- Alternative hypothesis can be accepted
- Always uses the smaller JP model as the Null (not nested)
- Influenced by the total number of tests - dependent on maximum number of joinpoints allowed
- Influenced by the type I error specification in the JP menu
- Nonparametric

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Joinpoint model selection may not be clear to analysts

BIC

> Based on Normality - appropriate for large samples at each year
>
> - correlation caused by sample selection not allowed as input

> "prior free" property depends on large number of years - not large sample size

Joinpoint model selection may not be clear to analysts

- ➢ Joinpoint's confidence intervals around joins should be used
- ➢ Both the BIC and the permutation test criterion use average model fit to pick joinpoints
- ➢ Identifying the largest trend changes is often more important than average fit

Overall Accomplishments of Trends Guideline

- ➤ Highlights the Issues that an analyst needs to be prepared to face while working on a trend
    - including what not to do
- ➤ Provides several worked-out actual trend analyses using NCHS data
- ➤ Includes answers to some common technical questions
- ➤ Provides some guidance on using NCI's Joinpoint software
- ➤ Fosters an awareness that there is more than one way to analyze a trend
    - ➤ Analyst should be prepared to defend their analytic choices
    - ➤ Analysts should be aware that alternative approaches may affect the results

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