

# Incorporating Statistical Process Control and Statistical Quality Control Techniques into a Quality Assurance Program

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# Purpose

- Incorporate SPC and SQC methods into quality assurance program
- Monitor and improve interviewer performance to ensure the collection of high quality data in real time
- Examine different types of quality indicators

# Outline

- Background
- Cluster Analysis
- Statistical Process Control (SPC) and Statistical Quality Control (SQC) Methodology
- SPC and SQC Examples
- Next Steps
- Conclusion

# Data for Analysis

- National Health Interview Survey 2008 to 2010 data
- Quality indicators: include item don't know and refusals responses
  - Item nonresponse rates for the current asthma estimate, family income question, and pneumonia shot question
- Quality indicators: exclude don't know, refusals and missing responses
  - Current asthma estimate: proportion of "no" responses
  - Family income question: average and standard deviation
  - Pneumonia shot question: proportion of "yes" responses

# Cluster Analysis

- Compare interviewers working in similar census tracts with similar workloads
- Choose clustering variables (variable reduction)
  - Census 2000 Planning Database
  - Nine variables chosen
- Create clusters within Regional Office (RO)
  - Group census tracts into clusters
  - 4 to 8 clusters within each RO

# SPC and SQC Terminology

## ➤ Statistical Process Control (SPC)

- Graphical tool to measure and analyze variation in a process over time
- Control charts: use control limits and time component
- Multivariate charts: reduces amount of charts for correlated measures

## ➤ Statistical Quality Control (SQC)

- Broad array of statistical tools to measure and improve operational procedures
- Analysis of Means (ANOM) charts: use decision limits
- ANOM charts: interviewer is an example of a rational subgroup

# SPC and SQC Methodology

- Construct cluster-level control chart including historical months data
  - Historical months: January 2008 to November 2010
  
- Construct the trial control limits by removing observations outside the limits
  
- Construct final cluster-level control chart including historical and current months data
  - Current month: December 2010

# SPC and SQC Methodology Continued

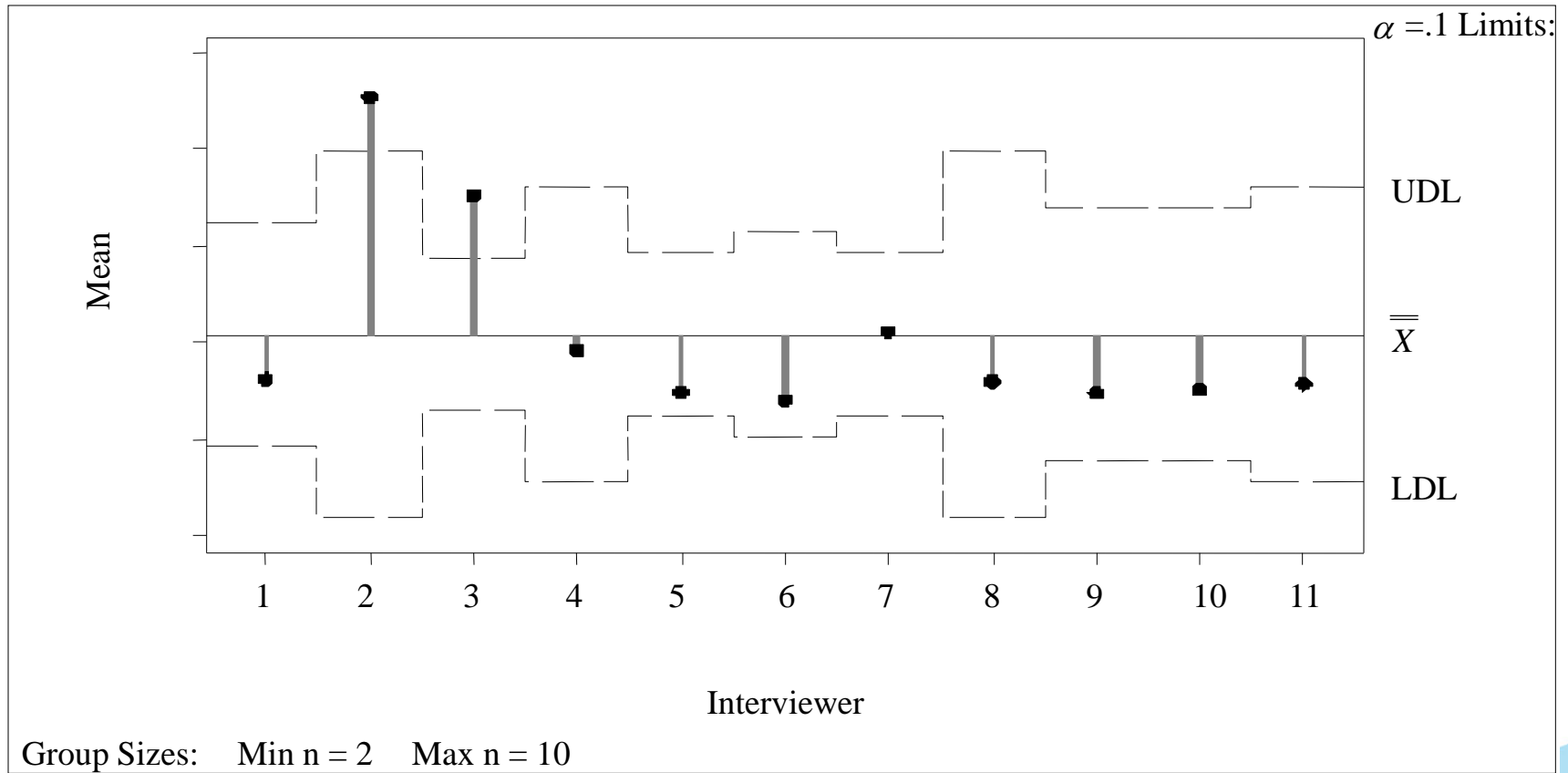
- Construct Analysis of Means (ANOM) charts for the current month (December 2010)
  
- Construct interviewer-level control charts if overall average or proportion outside decision limits in ANOM chart



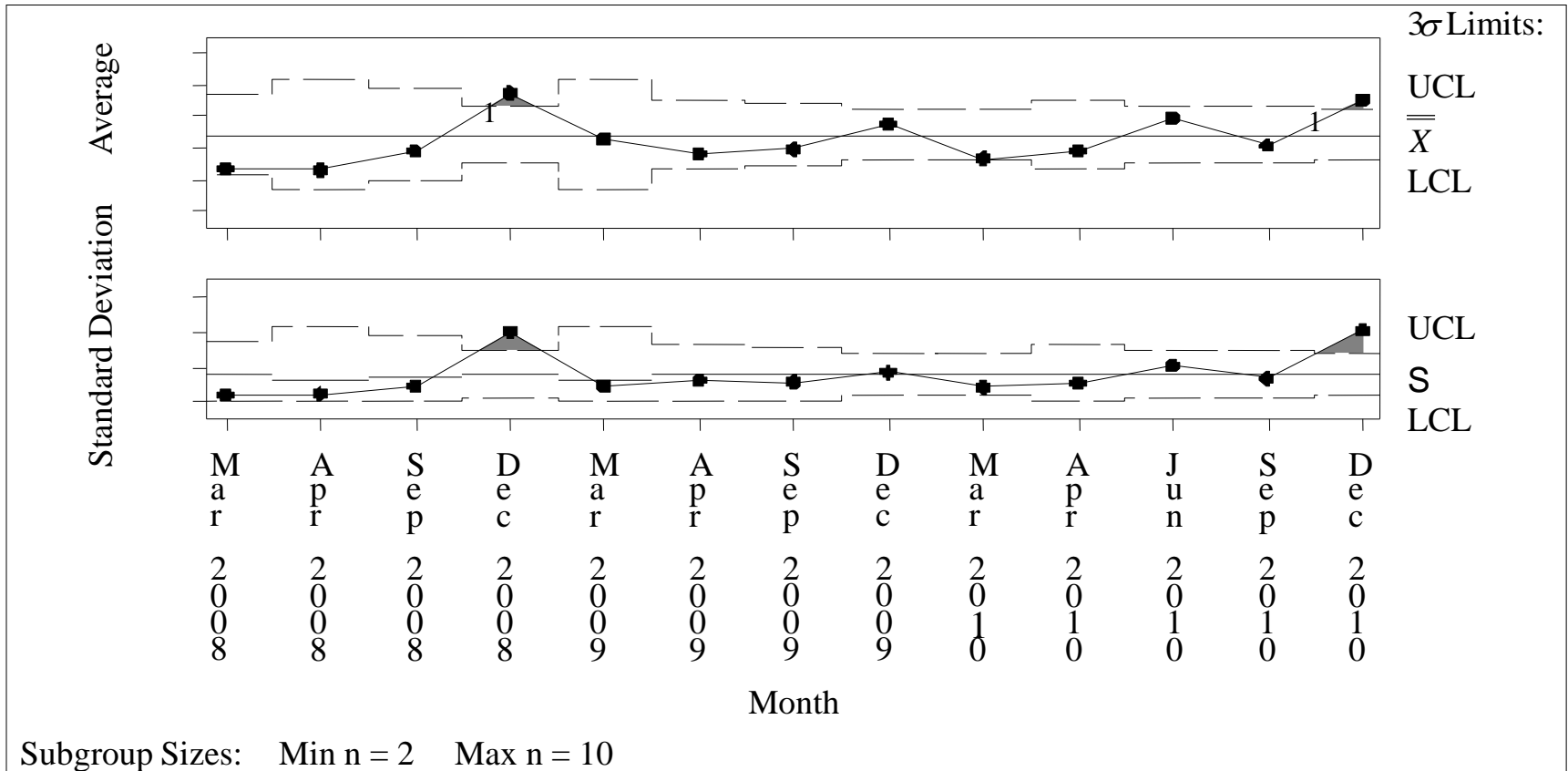
# Family Income Example

- Average and standard deviation of family income
- Family income item nonresponse rate
- SPC and SQC techniques used to improve interviewer performance in real time
  - Current month: December 2010

# Analysis of Means Chart December 2010 (RO = 1, Cluster = 4)



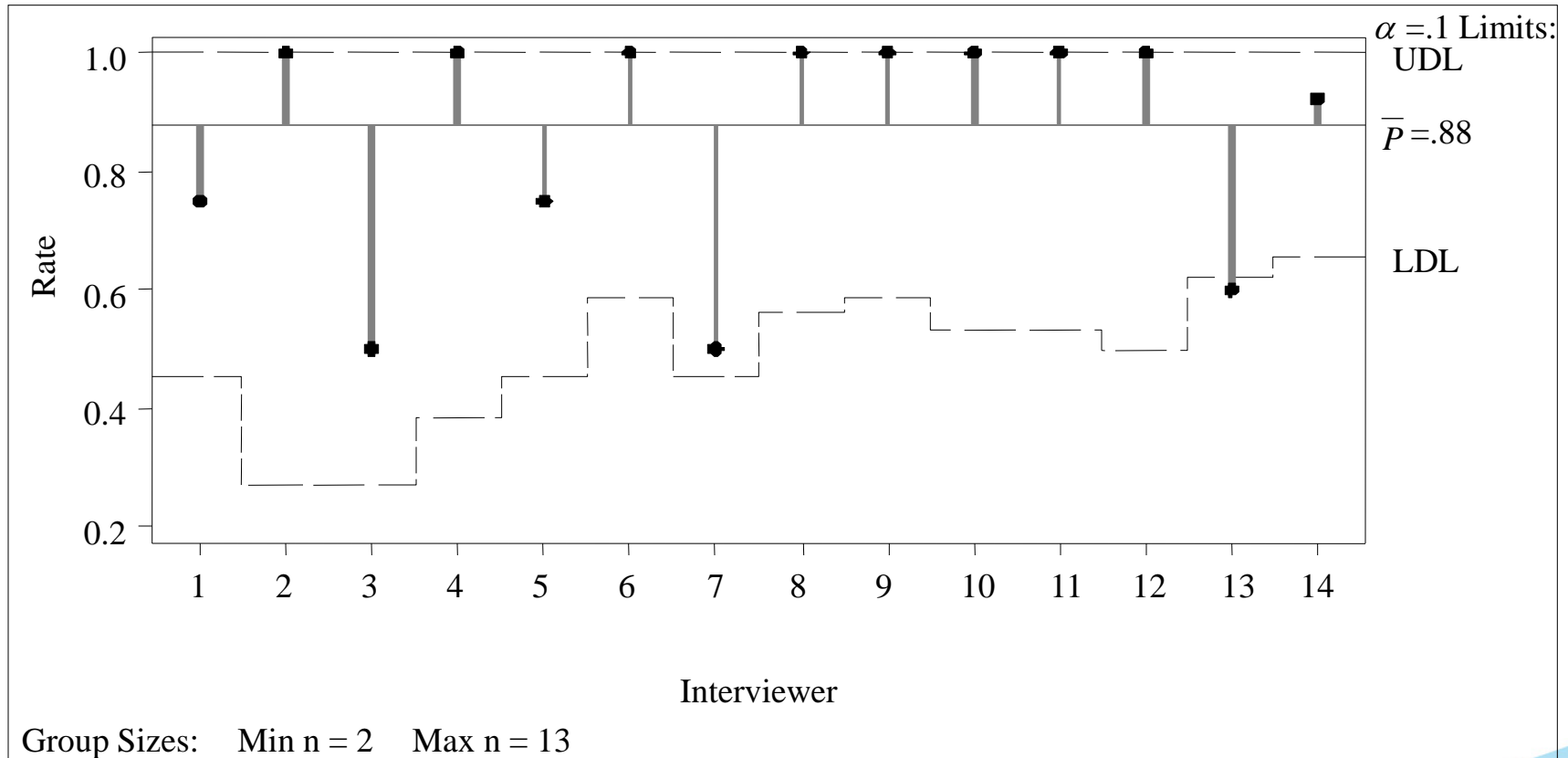
# Process Not in Control (RO = 1, Cluster = 4, Interviewer = 3)



# Current Asthma Estimate Example

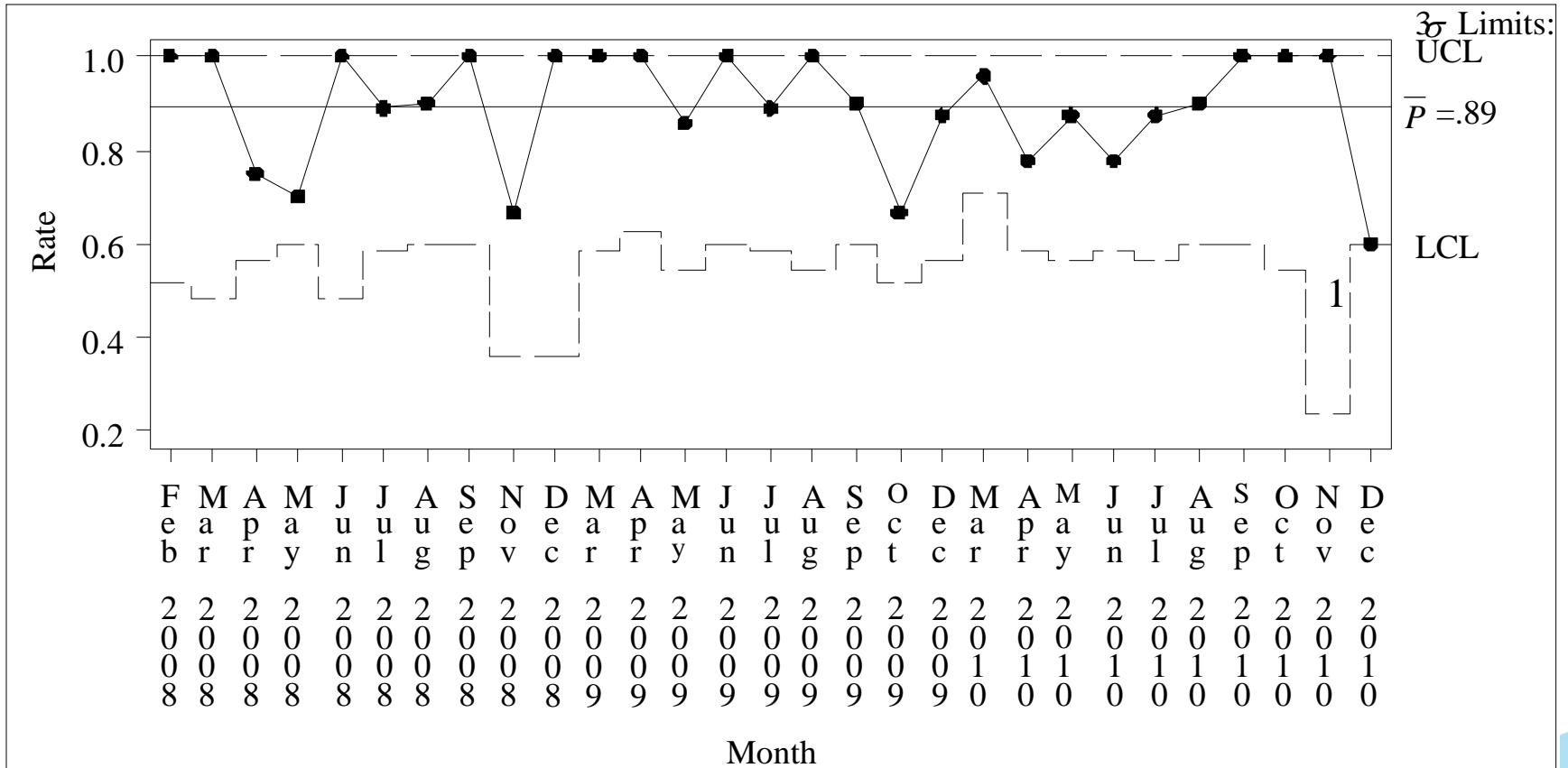
- Current asthma estimate uses responses from three questions
- Proportion of “no” responses for current asthma estimate
- Current asthma estimate item nonresponse rate

# Analysis of Means Chart December 2010 (RO = 2, Cluster = 3)



# Process Not in Control

(RO = 2, Cluster = 3, Interviewer = 13)



Subgroup Sizes: Min n = 2 Max n = 24

# Summary of Charts

- Current Asthma Estimate
  - Process not in control in interviewer-level control chart
- Family Income
  - Average and standard deviation exceed the control limits in interviewer-level control chart
- Interviewers did not have item nonresponse rates significantly different from RO and cluster for December 2010

# Implementation of SPC and SQC Techniques

- Choose quality indicators
  - Multivariate charts minimize the number of charts to monitor by combining correlated measures
- Select interviewers to follow-up
  - Most quality indicators where process is not in control
  - Highest difference between control limits and quality indicator for current month



# Next Steps

- Incorporate SPC and SQC techniques into current quality assurance program
  
- Current quality assurance program: conduct second interview to determine if interviewers conducting interview in accordance with established procedures
  
- Current sampling method: random and supplemental
  - Stratified random sampling
  - Supplemental sampling: additional cases and interviewers identified by Headquarters and the Regional Office

# Next Steps Continued

- Add targeted sampling method
  - Target interview cases which bear hallmarks of suspected falsification
  
- Choose quality indicators to select cases for targeted sampling method
  - Use statistical models to choose indicators which predict potential data quality issues
  - Includes using digit frequency and length of field techniques
  - Includes indicators from PANDA system such as interview times and contact attempts

# Next Steps Continued

- Choose methods for targeted sampling method
  - SPC and SQC techniques
  - Statistical tests such as chi-square test to compare distributions
  - Unlikely response pattern analysis
  
- Use weighting equations to leverage best available methods and measures to optimize detection of potential data quality issues
  
- Select additional interviewers just using SPC and SQC techniques and then other interviewers using different methods

# Conclusion

- Crucial to monitor both item nonresponse rates and other quality indicators
- Develop method to identify interviewers whose work should be investigated given the available amount of resources for follow-up purposes

# Contact Information

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