UNIVERSITY OF LOUISVILLE.

COLLEGE OF EDUCATION & HUMAN DEVELOPMENT

Standard(s) Statistics: Exploring Common Core Statistics Content and Practices

Susan A. Peters
s.peters@louisville.edu

Jonathan Watkins
Victoria Miller-Bennett
Oxana Kopeikin

Acknowledgement

- The activities we will explore were developed from a project, CAREER: Investigating Middle and Secondary Mathematics Teachers' Transformative Learning of Statistics within Professional Development, funded by NSF through the DR K-12 program (#1149403).

Any opinions, findings, and conclusions or recommendations expressed are mine and do not necessarily reflect the views of the National Science Foundation.

UNIVERSITY OF LOUISVILLE

Statistics in CCSS-M

- Grade 6
  - Develop understanding of statistical variability.
  - Summarize and describe distributions.
- Grade 7
  - Use random sampling to draw inferences about a population.
  - Draw informal comparative inferences about two populations.
- Grade 8
  - Investigate patterns of association in bivariate data.

Statistics in CCSS-M

- High School
  - Summarize, represent, and interpret data on a single count or measurement variable.
  - Summarize, represent, and interpret data on two categorical and quantitative variables.
  - Interpret linear models.
  - Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Statistics in CCSS-M

- Standards for Mathematical Practice
  - Make sense of problems and persevere in solving them.
  - Reason abstractly and quantitatively.
  - Construct viable arguments and critique the reasoning of others.
  - Model with mathematics.
  - Use appropriate tools strategically.
  - Attend to precision.
  - Look for and make use of structure.
  - Look for and express regularity in repeated reasoning.

Statistical Problem Solving

Investigative process involving four components

- Formulate questions
- Collect data
- Analyze data
- Interpret results

Guidelines for Assessment and Instruction in Statistics Education (Franklin et al., 2007)

UNIVERSITY OF LOUISVILLE

Ready?

Teachers' Work Day

American Time Use Survey

A local newspaper recently printed results from a report on the American Time Use Survey. One result, in particular, generated considerable community conversation: "on average for all days of the week, teachers worked 18 fewer minutes per day…than all other full-time professionals" (Krantz-Kent, 2008, p. 58). **What information would you like to know about the American Time Use Survey to be able to discuss the survey results with community members and why?**

Data Collection

Community teachers believe the ATUS report is no longer valid because the data used in the report were collected from 2003 to 2006—before adoption of the Common Core State Standards (2010). They decide to collect their own data to take increased demands from implementing Common Core Standards into consideration. **What issues and questions should teachers consider for collecting data from other teachers? How should the teachers collect data about how much teachers work each day?**

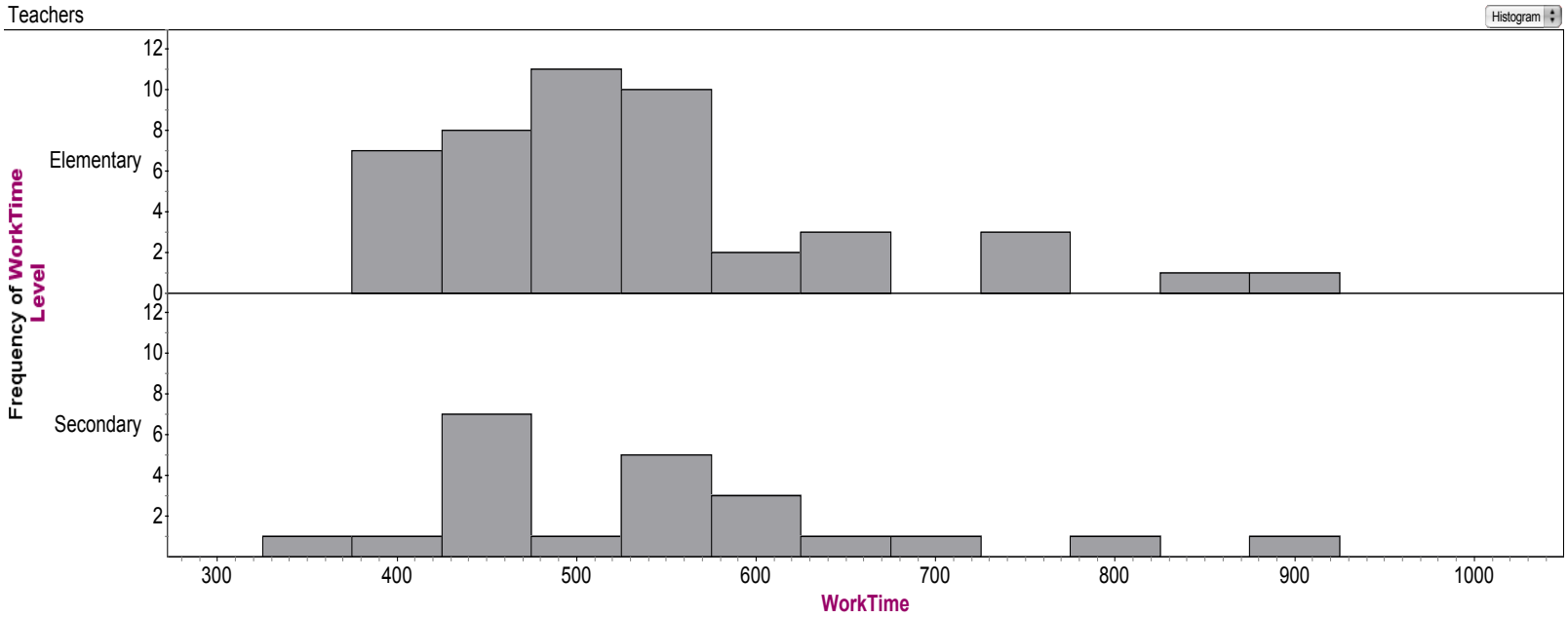
Teachers' Work Day

Questions

The teachers collect data from other teachers in their community district and claim that teachers in their district work longer days than reported from ATUS for "other full-time professionals." Further, the teachers claim that elementary teachers work more minutes than middle and secondary teachers. **What question(s) are the teachers investigating? What would you like to know about the data and analyses teachers used to draw their conclusions in response to the question(s)?**

Teachers' Work Day

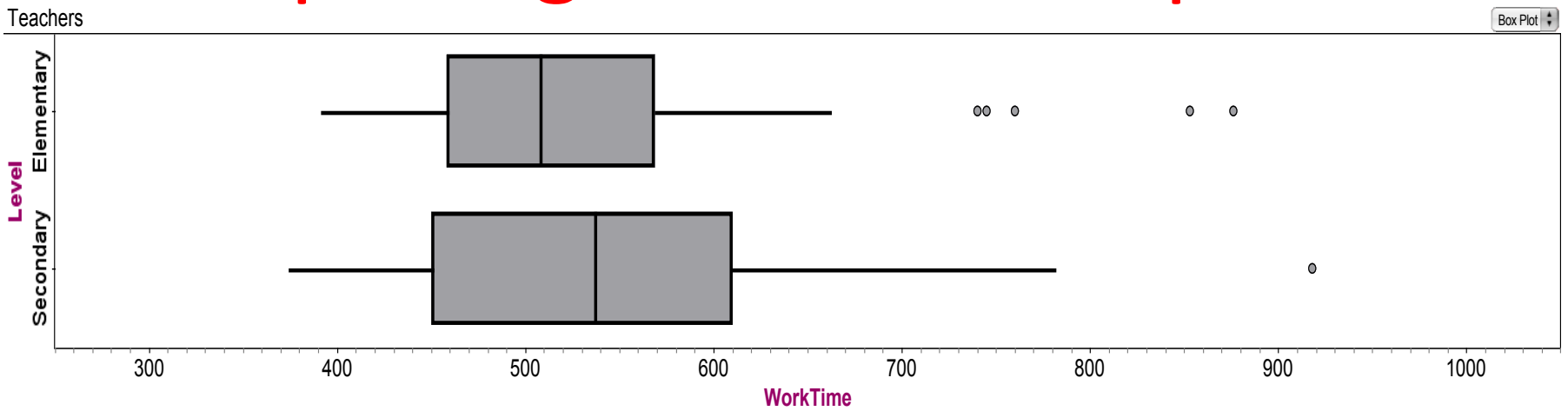
Exploring the Data: Histograms



Using the histograms, what conclusions can you draw about work time for elementary and secondary teachers and why?

Teachers' Work Day

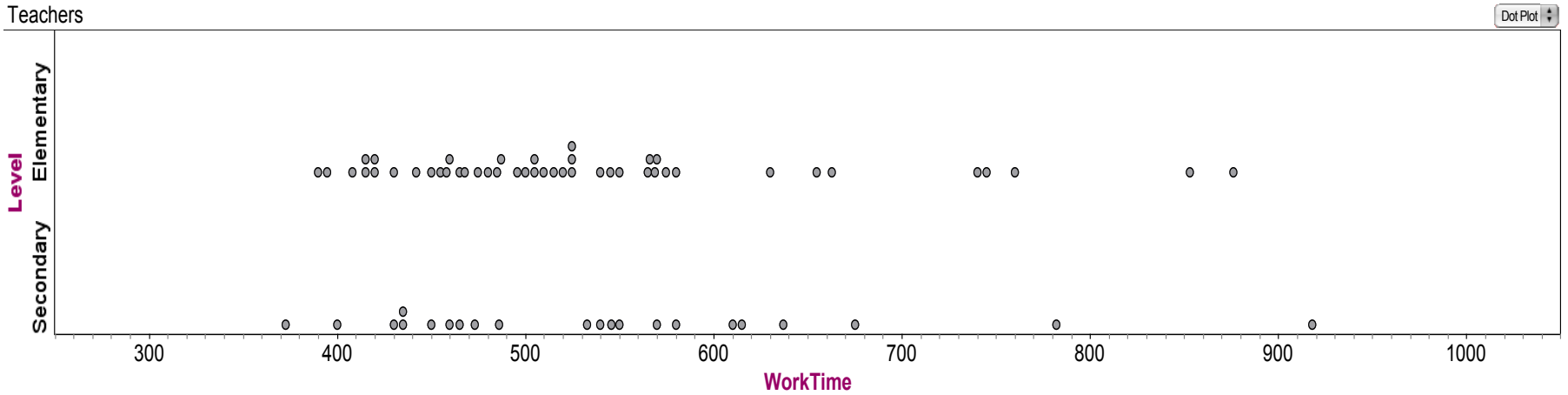
Exploring the Data: Boxplots



- Using the boxplots, what conclusions can you draw about work time for elementary and secondary teachers and why?
- How, if at all, do your conclusions about work time differ from using the boxplots for interpretation in place of the histograms?
- Compare and contrast what boxplots and histograms reveal or obscure about the relationship between work time for elementary and secondary teachers.

Teachers' Work Day

Exploring the Data: Dotplots



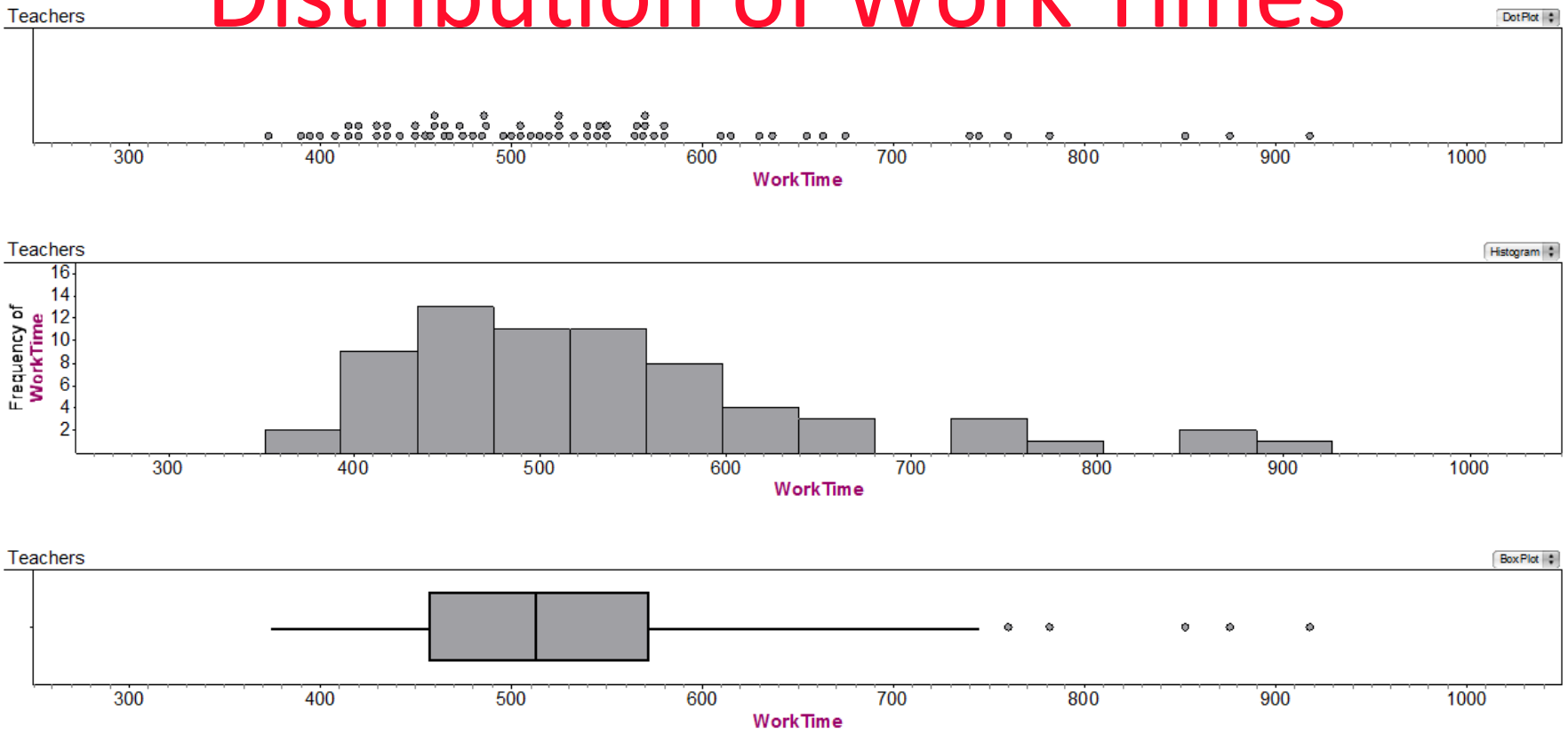
- Using the dotplots, what conclusions can you draw about work time for elementary and secondary teachers and why?
- How, if at all, do your conclusions about work time differ from using the dotplots for interpretation?
- Compare and contrast what boxplots, histograms, and dotplots reveal or obscure about the relationship between work time for elementary and secondary teachers.

Teachers' Work Day

- Draw a rough sketch of distributions that would reveal meaningful differences in work times between elementary and secondary teachers.

Teachers' Work Day

Distribution of Work Times



- Describe the distribution of work times for teachers.
- What conclusions would you draw about work time for teachers in comparison with the approximately 504 minutes per day worked by all other full-time professionals?

Teachers' Work Day

Summary Statistics

Teachers

	Level		Row Summary	
	Elementary	Secondary		
WorkTime	114.095	129.311	118.361	S1 = stdDev ( )
	16.8224	27.5692	14.3533	S2 = stdError ( )
	0	0	0	S3 = count (missing ( ))
	390	373	373	S4 = min ( )
	458	450	456.5	S5 = Q1 ( )
	507.5	536.5	512.5	S6 = median ( )
	569	610	572.5	S7 = Q3 ( )
	876	918	918	S8 = max ( )
	46	22	68	S9 = count ( )
	533.174	543.773	536.603	S10 = mean ( )

Consider whether the information brings into question any aspect of your conclusions about differences in work time between elementary and secondary teachers and whether teachers work less time than "all other full-time professionals."

Teachers' Work Day

Summary Statistics

Teachers

	Level		Row Summary	
	Elementary	Secondary		
WorkTime	114.095	129.311	118.361	S1 = stdDev ( )
	16.8224	27.5692	14.3533	S2 = stdError ( )
	0	0	0	S3 = count (missing ( ))
	390	373	373	S4 = min ( )
	458	450	456.5	S5 = Q1 ( )
	507.5	536.5	512.5	S6 = median ( )
	569	610	572.5	S7 = Q3 ( )
	876	918	918	S8 = max ( )
	46	22	68	S9 = count ( )
	533.174	543.773	536.603	S10 = mean ( )

- Between the mean and the median, which better represents elementary and secondary work times and why?
- What do the standard deviation values tell you about the data?

Reflection on Activity

- The context of teachers' workdays is not likely to be as engaging for students as it is for teachers. What contexts might be of interest to students?

How about considering the following claim?

- Chris Christie, governor of New Jersey, suggests: "It is time to lengthen both the school day and school year" (*Washington Post,* January 14, 2014**).**

http://www.washingtonpost.com/politics/full-text-of-new-jersey-gov-chris-christies-2014-state-of-the-state-speech/2014/01/14/8fd12f08-7d55-11e3-9556-4a4bf7bcbd84_story.html

UNIVERSITY OF LOUISVILLE

Teachers' Work Day

What important aspects of data analysis surfaced while working through the entire activity?

- Statistical problem-solving process
  - Questions and design
  - Multiple representations
- Differences between statistics and mathematics
  - Nature of variability
  - Role of context

UNIVERSITY OF LOUISVILLE

Other Design Elements

- Real data within contexts of potential interest
- Active engagement
- Focus on fundamental statistics concepts
- Examining why in addition to what and how
- Dilemma/Conflict/Perturbation
- Opportunity for discourse/group engagement
- Opportunities for reflection

Reflection on Activity

- The activity we just explored is likely to be longer than those you will pursue with your students. What can you take from this activity to use in your classroom? What adaptations/extensions might be needed for use with students?

Teachers' Work Day

What does the DRAFT language mean?

More Activities

Typical Age

- Prior to activity: Teachers described the age(s) of their children using data collected via a Google Form.
- Teachers compared displays and interpretations of "typical" age and questions appropriate to answer from the collected data.
- Teachers recorded their definitions of mean, median, and mode.

Blood Pressure: Revisited

- Teachers explored their own systolic blood pressure data to consider center as signal within the noise of data.
- Teachers previously completed investigations focused on center (mean as fair share, mean as balance point, median, mode), variation (measures, within and between distributions), distribution (growing samples, characteristics, relationship between shape and center), and design (sampling and experimentation).

UNIVERSITY OF LOUISVILLE

More Activities

Mentos Fountain Activity

- Prior to activity: Teachers explored data: examining various measures of central tendency, measures of variation, distributions, and graphical displays of data.
- Prior to activity: Teachers explored data using technology, including Fathom and TinkerPlots.
- Alternative technology: Core Math Tools http://www.nctm.org/resources/content.aspx?id=32702

Focus only on one of the activities.

UNIVERSITY OF LOUISVILLE

Focus on:

- What are some key characteristics of the activities?
- How might the activities enable development of conceptual understanding of statistics content?

Resource Sites: Downloading Data

- FedStats government data: http://www.fedstats.gov/
- Data and Story Library: http://lib.stat.cmu.edu/DASL/
- StatLib: http://lib.stat.cmu.edu/modules.php?op=modload&name=Downloads&file=index&req=viewdownload&cid=2
- *Journal of Statistics Education* Data Archive: http://www.amstat.org/publications/jse/jse_data_archive.htm
- Sports Data Resources: http://www.amstat.org/sections/SIS/Sports%20Data%20Resources/
- Exploring Data: http://exploringdata.net/
- StatSci.org links to data resources: http://www.statsci.org/datasets.html

Resource Sites: Collecting Data

- Census at School: http://www.amstat.org/censusatschool/
- Google Forms: http://www.google.com/drive/apps.html
- SurveyMonkey: http://www.surveymonkey.com/

UNIVERSITY OF LOUISVILLE

Thank You!

s.peters@louisville.edu