**Body Temperature – Part I**

The common concept of 98.6°F (37°C) being the normal human body temperature was established in the 19th century. One of the most influential in establishing the normal temperature was Carl Wunderlich in his 1868 book. Recent studies, however, have critically examined the normal body temperature of 98.6°F (e.g., Mackowiak, Wasserman, & Levine, 1992[[1]](#footnote-1); Sund-Levander, Forsberg, & Wahren, 2002[[2]](#footnote-2)). In particular, they were interested in the following research question:

**Research Question:** What is the average body temperature for healthy humans?

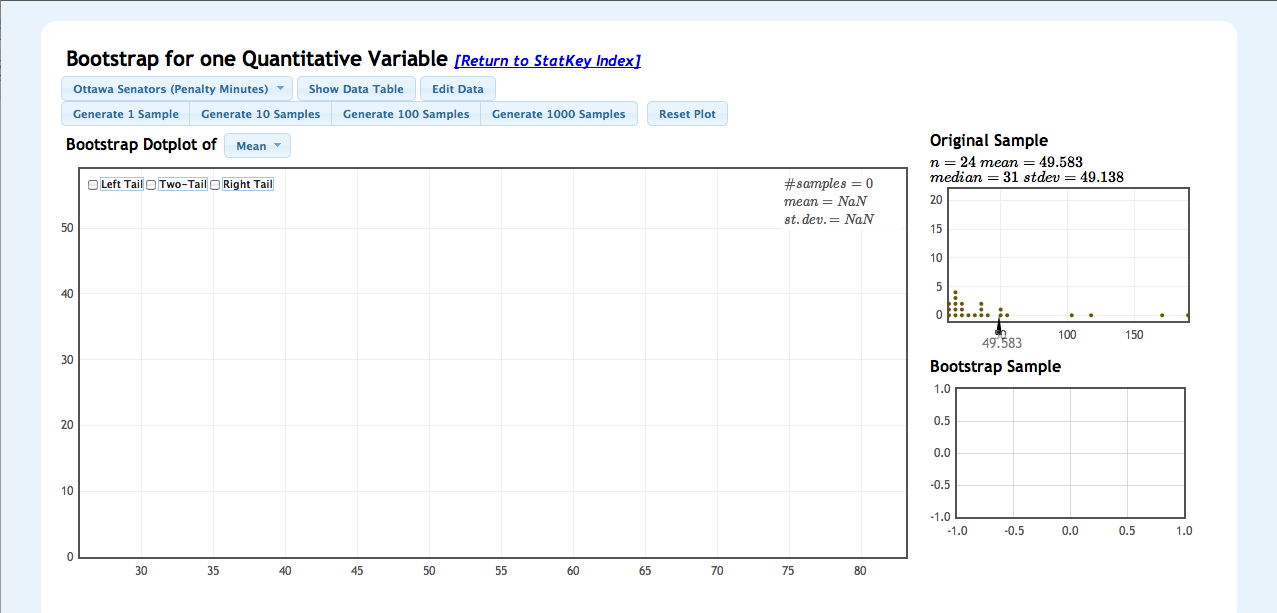
**Discuss the Following Questions**

1. What is the summary measure of interest in the research question?
2. How might you go about collecting data to answer this research question?
3. What statistical method might you use to help answer this research question?
4. Recall how to construct an interval estimate. Provide some instructions on how you might go about doing that using slips of paper.

Instead of doing the hands-on approach as you did with M&Ms, the computer generate bootstrap samples instead.

**CREATING A BOOTSTRAP CONFIDENCE INTERVAL USING STATKEY**

* Open a web browser and go to <http://lock5stat.com/statkey>.
* Click on the link *CI for Single Mean, Median, St. Dev*.



* In the upper left-hand corner, click on the button that says *Ottawa Senators (Penalty Minutes)*.
* Select *BodyTemp50 (Temperature)* from the drop-down menu. This will change the data set to *BodyTemp50*.

The dotplot labeled Original Sample on the right-hand side of the screen displays the *BodyTemp50* data. It also computes relevant summary statistics of the data. Because this plot and statistics are the original sample data, they will not change when creating bootstrap samples.

1. Report and describe some of the numerical summaries for the *BodyTemp50* data set.

* To get a single bootstrap sample, click the *Generate 1 Sample* button.

The bootstrap sample is displayed in the lower right-hand corner of the screen, under the dotplot labeled Bootstrap Sample. Relevant summary statistics are also computed for the bootstrap sample.

1. How was this bootstrap sample obtained? Be as specific as possible.
2. What is the difference between a bootstrap sample and the original sample?
3. What is the value of the bootstrap statistic for the single bootstrap sample?
4. Compare how you create a bootstrap sample in a hands-on simulation to how *StatKey* creates a bootstrap sample.
5. Does everyone in your group (or a neighboring group) have the same bootstrap statistic? Why does this make sense?

The bootstrap statistic is added as a dot to the bootstrap distribution, the large plot window entitled Bootstrap Dotplot of Mean. Generate a few more bootstrap samples one at a time, look at each bootstrap plot and corresponding bootstrap statistic, and see how each one contributes to the bootstrap distribution.

Once you fully understand this process, you can generate bootstrap samples more quickly, using the buttons to generate 10, 100, or 1000 samples. Continue generating samples until you have at least 10,000 bootstrap statistics contributing to the bootstrap distribution (the number of bootstrap samples is displayed at the top of the bootstrap distribution).

1. Sketch a plot of the bootstrap distribution below.
2. Where is the plot centered? Why does this make sense?
3. What does each of the dots in the bootstrap distribution plot represent? How do these dots compare to the dots in the bootstrap sample plot?
4. What is the standard deviation of the bootstrap statistics? What does this statistic tell you?
5. Use the standard deviation of the bootstrap statistics (also known as standard error) to construct a 95% confidence interval (see p. 199 for reference).
6. In order to answer the research question, provide an interpretation of the interval you created.

1. Mackowiak, P.A., Wasserman, S.S., & Levine, M.M. (1992). A critical appraisal of 98.6°F, the upper limit of the normal body temperature, and other legacies of Carl Reinhold August Wunderlich. *The Journal of the American Medical Association*, 268(12), p. 1578-1580. [↑](#footnote-ref-1)
2. Sund-Levander, M., Forsberg, C., & Wahren, L.K. (2002). Normal oral, rectal, tympanic and axiliary body temperature in adult men and women: a systematic literature review. *Scandinavian Journal of Caring Sciences*, 16, p. 122-128. [↑](#footnote-ref-2)