

# Statistics Former Student Network (SFSN)

Texas A&M University

Webinar Series



TEXAS A&M UNIVERSITY

Statistics

## JAMES M. LUCAS

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Statistics and Quality Management*

### CUSUM: OVERVIEW APPLICATIONS AND MONITORING PROCEDURES FOR LOW-COUNT SITUATIONS



#### ABSTRACT:

In this talk we discuss CUSUM (CUmulative SUMmation) monitoring procedures. These procedures cumulate information from previous and current samples to make decisions about changes in distributions. The most widely used change in distribution is a shift in level. A CUSUM, based on a likelihood ratio, is an optimum detector of a change in distribution. For shift detection, a CUSUM will detect a specified shift faster than any other control procedure that has the same in-control Average Run Length (ARL), a measure of the false alarm frequency.

We give a CUSUM overview, describe some interesting applications, discuss the power needs of control schemes and give a set of monitoring recommendations when count levels are low. We show that the power needed by monitoring applications is less than the power required by other applications. We show that an ARL Ratio ( $ARL_{in-control}/ARL_{out-of-control}$ )  $> 20$  gives adequate power for monitoring applications.

The low count regime has the complication in that only large proportional shifts in level can be detected. We discuss the ability of monitoring procedures to detect order of magnitude (OOM) shifts, OOM/2 shifts and a doubling in the low-count regime. We show that it is important to consider not only the size of the shift but also the “data richness” so that the amount of data needed to detect the shift with high power will be obtained. For detecting doubling, we compare the rule of 50 used in clinical trials with a rule of 20 that works for monitoring applications. We also show that, when count levels are low, it is usually not feasible to detect improvement so we give situations where only high-side control is recommended.

*BIO: James Lucas is the principal at J. M. Lucas and Associates, a consulting firm in Statistics and Quality Management. This firm implements business systems with statistical aspects. Before starting his own consulting firm Lucas was a Senior Consultant at DuPont's Applied Statistics Group for over twenty years. He has been an Adjunct Professor at the University of Delaware and at Drexel University and he has directed six PhD dissertations. He is a Fellow of the American Statistical Association (ASA) and of the American Society for Quality (ASQ), an Associate Editor of the Journal of Quality Technology and Quality Engineering, and a past Associate Editor of Chemometrics and Intelligent Laboratory Systems and of Technometrics. He has over 70 publications and many are cited frequently. He has won many awards including the 2018 Hunter Award, the H. O. Hartley Award, the Ellis R. Ott Foundation Award, the Don Owen Award, and the Youden Prize. He received a PhD in Statistics from Texas A&M University and a MS in Statistics from Yale University.*

**Wednesday, May 20, 2020**

**10:00 AM - 11:00 AM, CST**

***Online webinar only. No meeting room.***

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