

FOUNDATIONS OF STATISTICAL QUALITY CONTROL

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Abstract

The origins of statistical quality control are first reviewed relative to the concept of statistical control. A recent *Bayesian* approach developed at AT&T laboratories for replacing Shewart-type control charts is critiqued. Finally, a compound Kalman filter approach to an inventory problem, closely related to quality control and based on Bayesian decision analysis, is described and compared to other approaches.

Statistical Control

The control chart for industrial statistical quality control was invented by Dr. Walter A Shewhart in 1924 and was the foundation for his *Economic Control of Quality of Manufactured Product*—his 1931 book. (A highly recommended recent reference is Deming, 1986.) On the basis of Shewhart's industrial experience, he formulated several basic and important ideas. Recognizing that all production processes will show variation in product if measurements of quality are sufficiently precise, Shewhart described two sources of variation; namely

- i) variation due to *chance causes* (called *common causes* by Deming, 1986);
- ii) variation due to *assignable causes* (called *special causes* by Deming, 1986).

Chance causes are inherent in the system of production while assignable causes, if they exist, can be traced to a particular machine, a particular worker, a particular material, etc. According to both Shewart and Deming, if variation in product is only due to chance causes, then the process is said to be in *statistical control*. Nelson (1982) describes a process in statistical control as follows: "A process is said to have reached a state of *statistical control* when changes in

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