Lecture #13

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Example

***Blood & Gore*, a Halloween gift store, claims that the store revenue averages a $100k/mo. with a std. dev. of $20k. Monthly revenue is normally distributed. The IRS (Internal Revenue Service) wants to check the claim.**

Part 1: The IRS randomly selects four months of data -- sample mean revenue calculated to be $120k. Assuming a risk level of α = 0.05, evaluate the claim.

Part 2: Want to find upper and lower rejection limits to automate the hypothesis testing for a single X. Use α=0.05. Find the values for X_L and X_U.

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Example #3

Part 3: Draw the graph for β risk.

Chapter #4

- The origins and nature of variability
- Process evolution over time
- Shewhart's concept of statistical control
- Managing variability using control charts
- The *process* of statistical process control

Origin and Nature of Variability

We focus on variation in product function

- Outer Noise - external sources or environmental effects
- Inner Noise - internal changes (wear, aging, etc.)
- Variational Noise: uncertainties due to manufacturing

Consider a football . . .

Consider a baseball bat . . .

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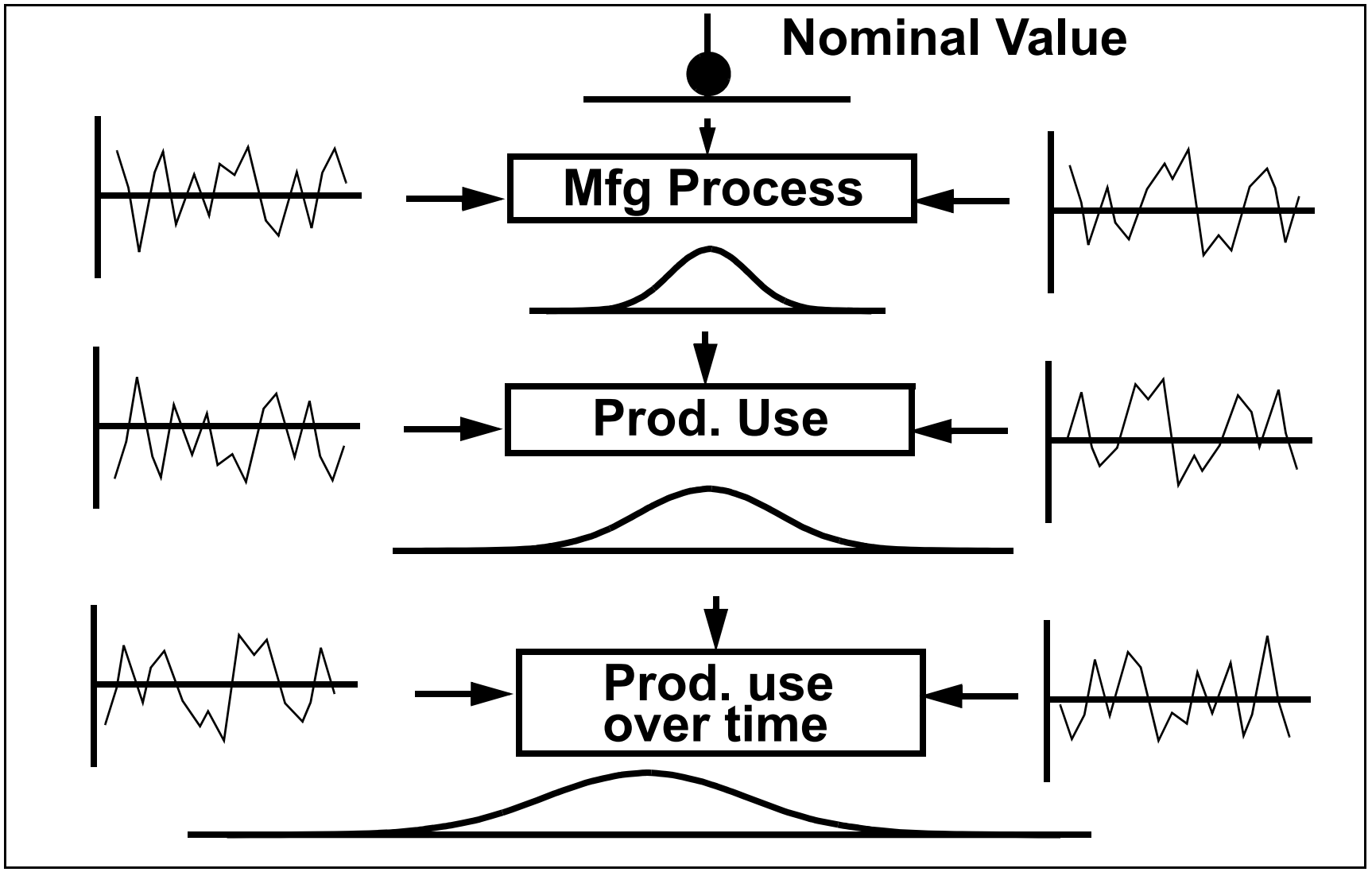

Nominal Value
Mfg Process
Prod. Use
Prod. use
over time

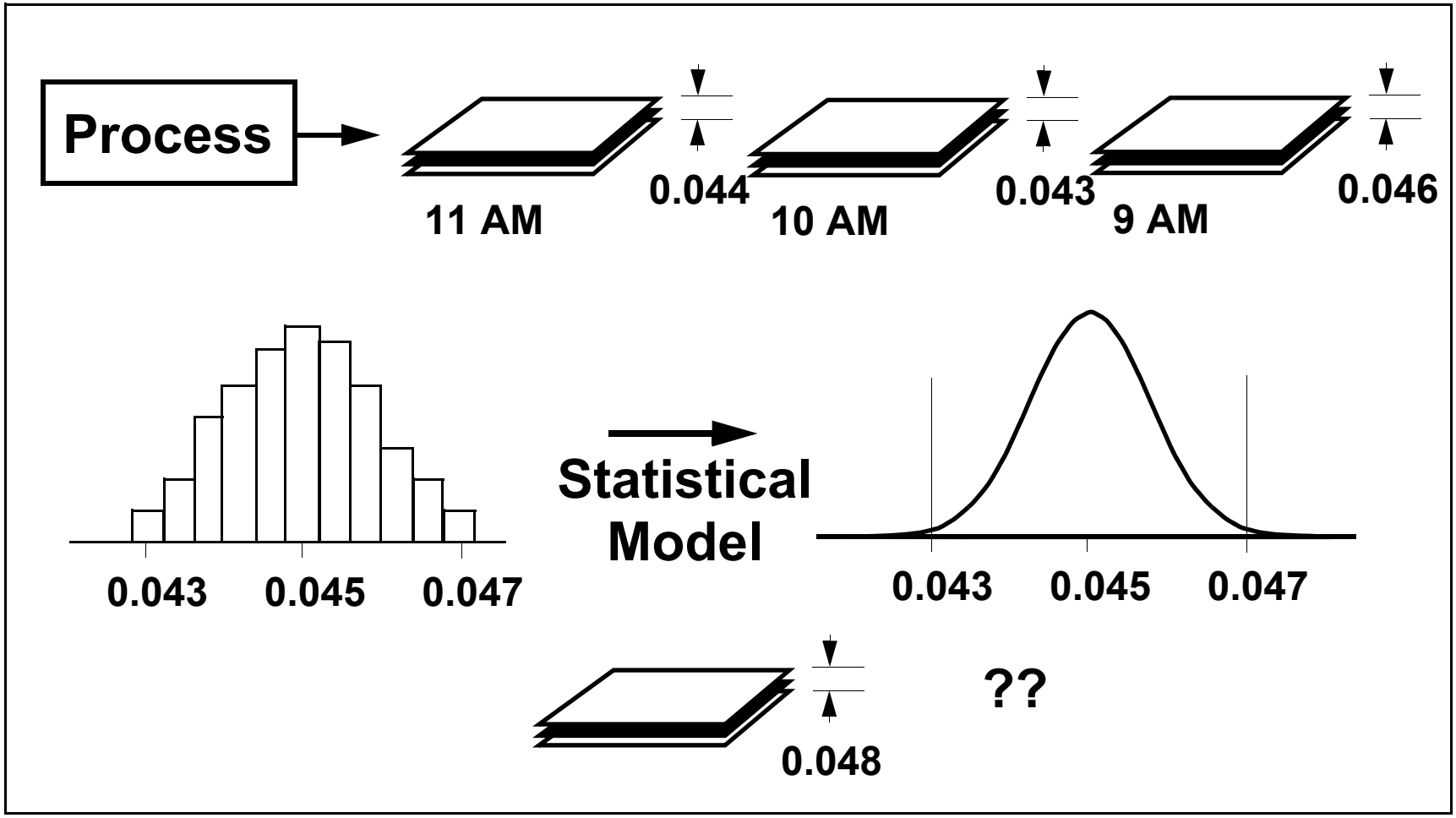
Manufacturing/Process Variation

Faults	**Local faults** **Special causes** **Sporadic problems** **Assignable causes**	**System faults** **Common causes** **Chronic problems** **Chance causes**
Examples		
Action	**Correctable locally**	**Requires a system change**

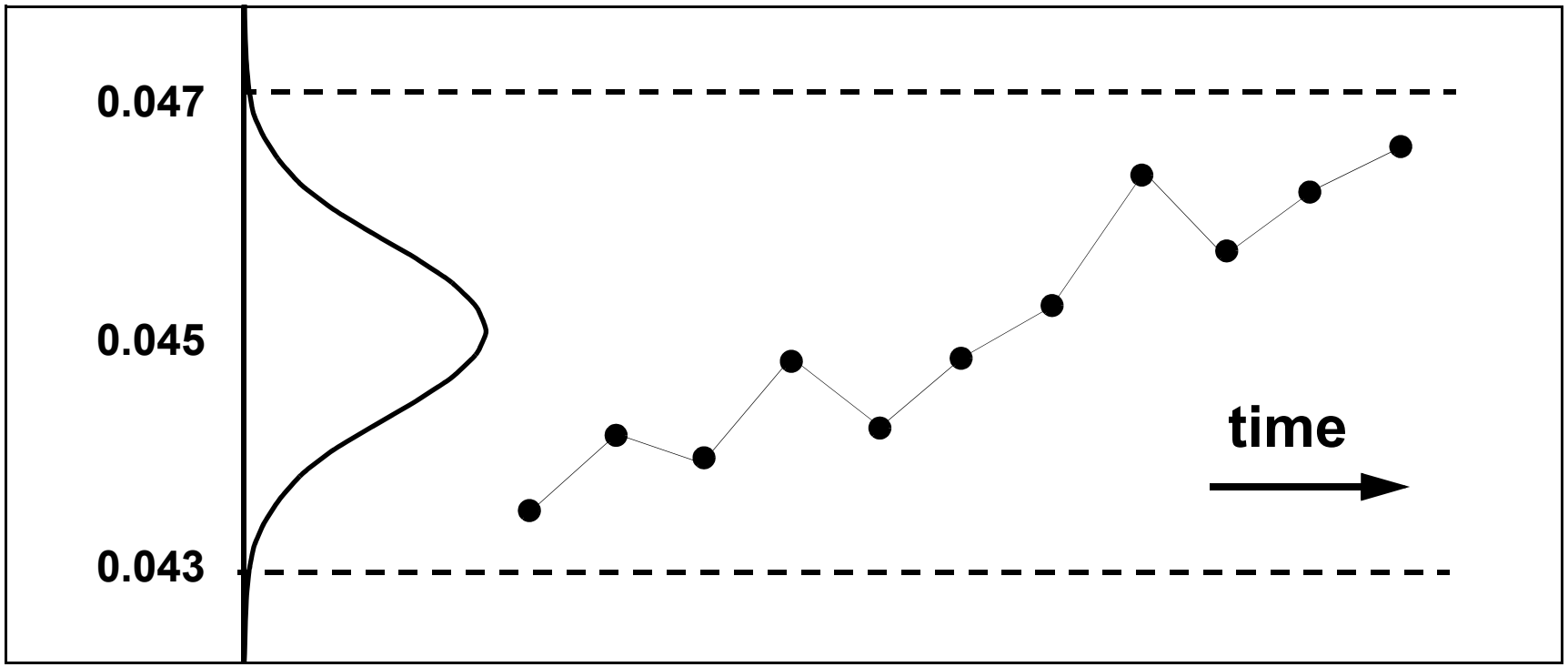
Summary - Variation

- Understanding origin of variation is key to knowing what action to take and determining who is responsible
- Quality - loss due to functional variation. Functional variation: manufacturing variation + inner noise + outer noise
- SPC can address manufacturing variation
- Robust design can address all sources of functional variation

Process as a Statistical Distn.



Process Behavior over Time



The behavior of the process as a function of time - this is a big piece of the puzzle

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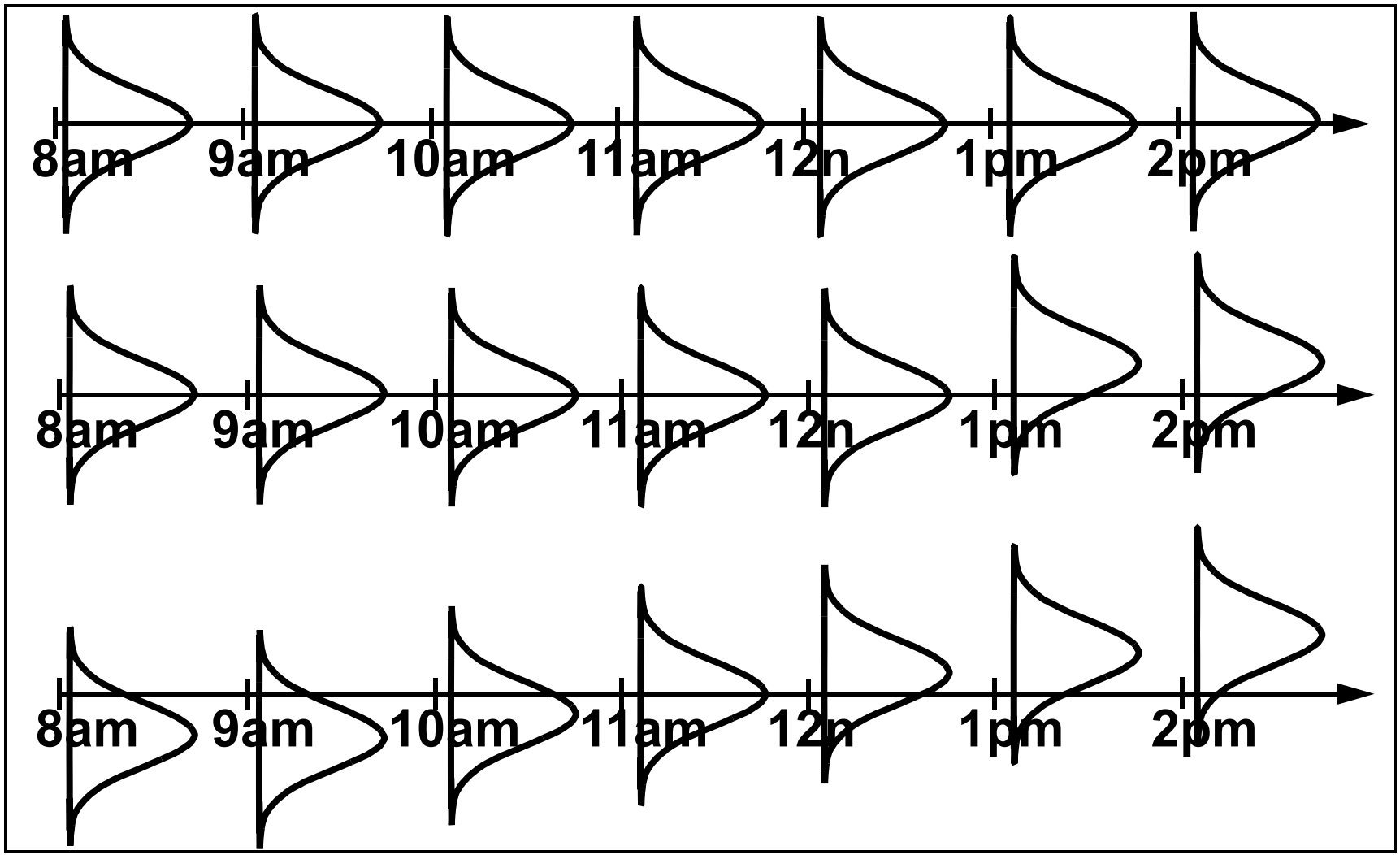
Changes in Process Behavior



Changes in Mean & Variability

Summary - Evolution of Process Behavior

- Data collected over time may be used to develop a statistical model for the process -- assumes process is subject to only common causes
- Process mean and variability may change over time -- indicates a lack of process stability, inconsistency, "out of control", not predictable
- Track process behavior (periodic sampling) -- detect changes in mean / variability

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Shewhart's View of SPC

Shewhart's book - *Economic Control of Quality of Manufactured Product* (1931) - preface establishes the principles of SPC

1. **Fundamental focus is on the process: "ways and means of satisfying human wants."**

2. **Overarching objective - economic process operation: "Reduce everything possible to routines requiring a minimum amount of effort."**

3. **Normal process operation - behavior w/in predictable limits: "It has been found possible to set up limits within which the results of routine efforts must lie if they are to be economical."**

4. **Deviations outside the limits signal presence of problems that are jeopardizing economic success: "Deviations in the results of a routine process outside such limits indicate that the routine has broken down and will no longer be economical."**

5. **Deviations outside the limits - find root cause of the trouble in the process and remove it: "The routine has broken down and will no longer be economical until the cause of trouble is removed."**

Comments

- No mention of the product or conformance of the product to specifications.
- A controlled process is one where, based on experience, we can predict (within limits) future behavior.
- Special causes are sources of waste/inefficiency
- When a process is not in control (i.e., special causes present), it is no longer operating routinely/ predictably, economic success is jeopardized.