Lecture #37

Prof. John W. Sutherland

Nov. 29, 2004
Chapter 13
Control Charts -- Attribute Data

• What is an attribute?

• Definitions
  - Defect, a fault or nonconformity on an item
  - Defective, an item with one or more defects
  - # of Defectives, d
  - # of Defects, c
  - Fraction Defective, p
Operational Definitions

- What constitutes a defect??

- Many defects judged visually

- Need to insure that all inspectors are consistent with their decisions

- Need precise, quantitative definitions as to what constitutes a defect.

- Product vs. Process Control (order of checking for defects, visual/non-visual, severity of defects)
Examples

• Assembled Engine
  - Missing dipstick
  - Missing ID tag
  - Fail dyno test
  - Paint runs
  - Bolts missing

• Injection molded radiator grille
  - Voids
  - Oil/grease
  - Flash
  - Scratches/scuffs
  - Black spots
  - Splay
  - Sinks
  - Flow lines
  - Burns
  - Short shots
Number of defects = c =
Number of defectives = d =
Fraction defective = p =
Defects/unit = u =
Fraction Defective

- Auto instrument panels
- Types of defects looked for: flash, splay, voids, and short shots
- 30 samples collected (100 panels per shift)
- Number of defectives recorded for each sample
- Fraction defective, $p = d/n$, calculated for each sample
Refer to Table 13.1 and Figure 13.4 in the text

- To construct control limits for the $p$ values, we need to understand how these values arise in a frequency sense

- This means we need to know about the binomial sampling situation
1,000,000 parts
50,000 defectives
950,000 non-defectives

True Fraction Defective, $p'$

$p' = 0.05$

Probability of pulling out a defective?

Probability of pulling out a non-defective?
Binomial Distribution Assumptions

- Only 2 outcomes possible for each trial
- Sampling with replacement
- Independence of successive trials
Probability of getting a defective in one draw?

Probability of getting a conforming item in one draw?

Probability of 2 defectives (D,D)?

Probability of 2 non-defectives (N,N)?

Probability of a defective & non-defective?
Let’s say we draw 5 items.

\[ P(5D) = \]

\[ P(4D,1N) = \]

\[ P(3D,2N) = \]
\[ P(2D,3N) = \]

\[ P(1D,4N) = \]

\[ P(5N) = \]
The General Form

\[ P(d) = \binom{n}{d} (p')^d (1 - p')^{n-d} \]

where, \[ \binom{n}{d} = \frac{n!}{d!(n-d)!} \]

what if \[ \binom{1000000}{2} = ? \]
So, when \( n = 5, \ p' = 0.05, \ P(d=1) = ?? \)

When \( n = 10, \ p' = 0.10, \ P(d=3) = ?? \)
b(d; n=5, p’=0.05)
Mean and Variance

\[ \mu_d = np' \]

\[ \sigma^2_d = np'(1 - p') \]

\[ \mu_p = E[p] = \]

\[ \sigma^2_p = Var[p] \]