ITMF, ICCTM
Stickiness Working group

Quality criteria of measurements based on counts

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Quality criterion of measurements based on counts

Useful measurement must be
1 correlated to practical properties of the analyzed material
2 reproducible

Measurements are variable
Variability => risk in decisions
need of criteria to measure variability : e.g. CV=5%

Is a single figure of standard deviation or a CV useful for count data? Is a 5% CV a good benchmark?
Outline

• Variability of some defects measurements on yarn and fiber

• Known probability distributions as theoretical landmarks

• Some practical recommendations to evaluate precision + discussion
• Variability of some defects measurements on yarn and fiber

• Known probability distributions as theoretical landmarks

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200% Neps on yarn
5 samples of 200m per yarn
(Cirad laboratory)
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Poisson distribution:
Variance = mean
Afis n ASTM D 5866
repeatability within laboratories

CV (%)

Mean

0 10 20 30 40 50 60

0 100 200 300 400 500 600 700 800 900
Afis n ASTM D 5866
repeatability within laboratories

LogN
(1+Variance)

Overdispersion = \frac{\text{Variance}}{\text{mean}}

≈ Log(\text{overdispersion})
Trash count
(Cirad laboratory)

LogN
(1+Variance)

LogN(1+Mean)
• Variability of some defects measurements on yarn and fiber

• Known probability distributions as theoretical landmarks

• Some practical recommendaitions to evaluate precision + discussion
Landmark probability distributions

- Independently located defects in a homogeneous material
  
  Poisson distribution \[ \sigma^2 = \mu \]

- Patchy located defects in a homogeneous material
  
  Neyman type A distribution \[ \sigma^2 = \mu(1+\varphi) \]

- Independently located defects in an heterogeneous material: density varies randomly: compound distribution
  
  - Log-normal density:
    
    Poisson-lognormal distribution \[ \sigma^2 = \mu \varphi \]
  
  - Gamma density
    
    Negative binomial distribution \[ \sigma^2 = \mu(1+\mu/k) \]
• Variability of some defects measurements on yarn and fiber

• Known probability distributions as theoretical landmarks

• Some practical recommendations to evaluate precision + discussion
• Distributions are only landmarks

• Addition of multiple effects: operator, laboratory, calibration yields a more complex compound distribution

• Any of the observed mean-to-variance relationships could be fitted with an overdispersed negative binomial, where

\[ \frac{\sigma^2}{\mu} = \phi \left(1 + \frac{\mu}{k}\right) \]
Mean-to-variance relationship summary

overdispersion

mean

instr_prep  AFIS-n  repeat  AFIS-n  repord
H2SD        mixed   Trashm  Yarn-Nep  repeat
Mean-to-variance relationship summary

stdev

mean

instr_prep  AFIS-n  repeat  AFIS-n  reprod
H2SD       mixed    Trashm  repeat
Yarn-Nep   repeat   

0  2  4  6  8  10  12  14  16  18  20
Mean-to-variance relationship summary

\[ P_r = \sum_{\lambda=0}^{\infty} \frac{\lambda^r e^{-\lambda}}{r!} f(\lambda) d\lambda, \quad r = 0, 1, 2 \ldots \]
Trash area
(Cirad laboratory)

LogN
(1+Variance)