

## Development of Optimized Sampling vs Bin-SPRT in Qualification of High-Speed Assembly Lines

**Location:** German Innovation Center – Euskirchen, North Rhine-Westphalia, Germany

### Job Description

We seek for a candidate with Statistics background to optimize sampling processes at high confidence levels in finished product testing, used in qualification procedures. This includes:

- Defining a more affordable sampling approach than currently used (Binomial SPRT) to estimate rate of attribute defects in high-speed product assembly lines.
- Evaluating current versus state-of-the-art approaches and develop alternative, more affordable techniques & tools.
- Analyzing historical data from qualification events and studying opportunities to leverage prior experiences, e.g. developing a user-friendly tool to estimate sampling needs, accounting for factors or events influencing total probabilities, and able to feed a database for further historical trend analyses.
- Explore/propose possible applications of ML approaches (e.g. Genetic Algorithms) leveraging historical/converter data & prediction of defect rate, to eliminate unnecessary sampling while maintaining confidence levels.
- Develop a compelling case for the organization to drive implementation of improved approaches.

We believe expertise in one or more of the following techniques may be relevant: Bayesian optimization, Network meta-analysis, Gaussian Process Modeling, and Mixed effect modeling, as well machine learning modeling techniques.

### Additional Background:

- The qualification of new & impacted process/equipment involves inspection of defects (Attributes of pass/fail nature) through sequential probability ratio tests (Binomial SPRT), used in Quality Assurance for  $\geq 20$  years. The test approach is based on comparing the likelihood ratio between a  $H_0$  [e.g. defect rate < allocation] vs the alternative  $H_1$  [e.g. defect rate > allocation], stopping data collection as soon as said ratio supports either one.
- For health & safety-related attributes (with 250 PPM allowance @ 95% confidence)  $\geq 12000$  samples are required (manually inspected for zero defects, and in cases via destructive tests), resulting in long wait times, stopped production lines, and financial impact.
- Technology advances enabled use of automatic detection/reject systems (able to inspect single products at high speeds); however limited in the range of observable failure modes; and partially able to detect/eliminate defects due to location constraints (as new ones may occur downstream); in addition, information provided by such systems is not officially leveraged in qualifications.
- Though “*the lower the true defect rate for a system, the higher sampling needed to estimate it*”, the ultimate goal in our qualification procedures is to reassure the lowest likelihood of making/shipping defects as a total system; and take advantage of known conditional & marginal probabilities (e.g. using the [law of total probability](#) estimating defect occurrence; influenced by auto-reject systems, or the frequency of maintenance/restorage of base conditions).
- Since conception of SPRTs (Wald, 1945) efficiency studies have been made ([S. Pramanik, et al., 2021](#); [Lenz & Wilrich, 2006](#), [Lorden, 1976](#)); or progress in defect prediction with ML defect models ([Binder, 2020](#)), suggesting value in reviewing current procedures.

### Qualifications

The successful candidate will have:

- A Background in Statistics or a related field - familiarity with a broad range of statistical methods, along with passion for applying statistical skills to partner disciplines in ways that accelerate business processes.
- Strong communication & collaboration skills, with an ability to explain sophisticated statistical concepts to non-experts and maintain relationships both within our immediate team and several partner organizations.
- Coding skills in Python, R, and/or SAS & ability to connect to cloud databases and write queries to download data.
- Awareness of techniques with strong foundation in Bayesian optimization & other sequential learning approaches.
- Ability to apply statistical engineering or similar methodologies to (1) define problems and providing structure and metrics for solving them, (2) develop experimental plans, (3) model data, (4) extract insights, and (5) scale successful models for broader use.
- Awareness of any of the following would be of additional benefit: Foundations of machine learning / artificial intelligence; JMP software; GitHub; SQL and/or Databricks.

Your statistical expertise will help project teams to learn more effectively (i.e., bringing more insights from the same amount of data, bringing similar insights from less data, bringing similar insights more quickly).

### What we Offer

- Cutting-edge technology and tools on impactful innovations
- Exciting work and responsibility from Day 1.
- Collaborate with multi-functional teams with international spirit, work with colleagues of all levels across the globe.

### Application

To optimally prepare for our online assessment & interviews, make sure you fully understand our application process.

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