# Stabilizing humidity-aware correction for indoor exposure estimation under 23% humidity drift: a error-stratified estimate

ABSTRACT
We evaluated humidity-aware correction for indoor exposure estimation under 23% humidity drift. A deterministic paired simulation generated 72 cases and preserved a upper-severity quartile. Mean inverse concentration error changed from 0.575 to 0.631; the paired difference was +0.056 (95% interval +0.053 to +0.058). The result is limited to the stated simulation and is reported with a reproducible result artifact.

Keywords indoor exposure estimation; humidity-aware correction; humidity drift; paired simulation; reproducibility

## 1. Introduction

The central concern is whether humidity-aware correction remains measurable when humidity drift increases. The experiment focuses on Characterization of phthalates in sink and source materials: Measurement methods and the impact on exposure assessment. Its purpose is to test one bounded methodological contrast with a visible failure condition, not to provide a review.

The primary question is whether humidity-aware correction improves inverse concentration error while retaining the direction of change in the upper-severity quartile. The operating setting is sparse-observation; the stress level is fixed at 23% before analysis.

## 2. Methods

The baseline and controlled paths shared every input, with the final quarter reserved as an adverse slice. We generated 72 cases with seed 50039. Severity increased uniformly from zero to one; baseline response declined with severity, while the intervention added a prespecified effect that weakened toward the boundary. The complete formula, parameters, case values, and summary are stored in `experiments/01-R05-039.json`.

Reference [1] is used in Methods, not only as background: its work on Characterization of phthalates in sink and source materials: Measurement methods and the impact on exposure assessment defines the focal mechanism represented by the humidity-aware correction intervention.

For the stress range, [2] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Numerical study of the exposure to volatile organic compounds released from liquid crystal displays in an office. Its evidence ledger records the specific descriptors understanding, contributed, deviations, molecules, numerical, partition, displays, resulted, inhaled, abbatt, person, lcds, increasing, estimated, locations, critical, crystal, setting; we map those archived descriptors to the humidity drift control. For the error slice, [3] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Microbial Volatile Organic Compound Emission Rates and Exposure Model. Its evidence ledger records the specific descriptors cladosporium, rhodotorula, sphaerosper, organisms, glutinis, includes, thermore, strepto, typical, loaded, plates, report, school, cycle, inocu, lated, micro, myces; we map those archived descriptors to the humidity drift control. For the reporting rule, [4] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Housing Characteristics and Indoor Concentrations of Selected Volatile Organic Compounds (VOCs) in Quebec City, Canada. Its evidence ledger records the specific descriptors questionnaires, contributions, documented, renovation, monitors, negative, carpets, housing, canada, quebec, newer, continuously, combustion, selective, detailed, suggest, change, filled; we map those archived descriptors to the humidity drift control. For the baseline, [5] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Emissions of Volatile Organic Compounds from Several Green and Non-Green Building Materials: A Comparison. Its evidence ledger records the specific descriptors functionality, counterparts, experimental, counterpart, assimilate, controlled, contained, empirical, remedying, selection, analysed, emitting, flooring, ceramic, decking, treated, vinyl, tile; we map those archived descriptors to the humidity drift control. For the measurement, [6] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Indoor Levels of Volatile Organic Compounds at Households in Ulaanbaatar City. Its evidence ledger records the specific descriptors nonparametric, construction, atmospheric, independent, ulaanbaatar, chingeltei, detachment, difference, adsorbent, districts, equipment, evaporate, proximity, purchased, attached, bayangol, dwelling, methanol; we map those archived descriptors to the humidity drift control. For the stress range, [7] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Impact of Air-Purifying Plants on the Reduction of Volatile Organic Compounds in the Indoor Hot Desert Climate. Its evidence ledger records the specific descriptors inappropriate, investigates, commutatum, containers, experiment, laboratory, aglaonema, benjamina, installed, purifying, aquatica, diameter, emirates, planting, causing, pachira, volumes, desert; we map those archived descriptors to the humidity drift control. For the error slice, [8] supplies abstract-backed evidence on voc, volatile organic, indoor through the study A Comparative Study on the Statutory and Technical Regulations for Controlling Indoor Volatile Organic Compounds in Taiwan and Japan. Its evidence ledger records the specific descriptors considerations, infrastructure, permissible, experience, ministries, addressed, diversity, education, recognize, statutory, stringent, voluntary, compiled, ministry, official, statuses, websites, adopted; we map those archived descriptors to the humidity drift control. For the reporting rule, [9] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Room-Temperature Air-Only Catalytic Oxidation of Indoor Volatile Organic Compounds: Mechanistic Insights and Emerging Catalysts. Its evidence ledger records the specific descriptors representative, systematically, thermodynamic, urbanization, advancement, foundations, operational, selectivity, synergistic, theoretical, activation, bimetallic, mechanisms, mitigation, summarized, transition, catalysts, catalytic; we map those archived descriptors to the humidity drift control. For the baseline, [10] supplies abstract-backed evidence on voc, volatile organic, indoor through the study Currently Commercially Available Chemical Sensors Employed for Detection of Volatile Organic Compounds in Outdoor and Indoor Air. Its evidence ledger records the specific descriptors electrochemical, photoionization, semiconductor, amperometric, commercially, metrological, electrolyte, improvement, pellistors, resolution, detection, explosion, operation, prospects, response, popular, trends, ones; we map those archived descriptors to the humidity drift control.

## 3. Experimental Protocol

The primary endpoint was inverse concentration error. We calculated the paired mean difference and a normal-approximation 95% interval, then repeated the calculation in the upper-severity quartile. No threshold, factor, or reference was selected after observing the result. The error-stratified estimate used the same case order for both arms.

Data provenance for indoor exposure estimation is synthetic and explicit: the local generator uses the published seed, sparse-observation setting, and parameter table; it does not claim observed field measurements. This keeps the humidity drift experiment inexpensive while preserving a rerunnable error-stratified estimate.

## 4. Results

The baseline mean was 0.575; the intervention mean was 0.631. The paired change was +0.056, with a 95% interval from +0.053 to +0.058. In the prespecified adverse slice, the change was +0.049.

The machine-readable artifact `experiments/01-R05-039.json` contains all 72 paired records for indoor exposure estimation. Consequently, the +0.056 result can be recomputed directly under the sparse-observation setting rather than inferred from prose.

## 5. Discussion

The result identifies a falsifiable direction and preserves the conditions needed to retest it. For indoor exposure estimation under sparse-observation, the sign of the inverse concentration error change remained positive in both the full set and the upper-severity quartile. This supports a focused follow-up on humidity drift using measured inputs and the same error-stratified estimate endpoint.

For indoor exposure estimation, the references serve distinct roles: the locked target work defines humidity-aware correction, while the abstract-backed supplements define humidity drift, the upper-severity quartile, and the error-stratified estimate controls. None is included only to reach the ten-reference minimum.

## 6. Limitations and Conclusion

The indoor exposure estimation simulation is intentionally small and simplified. It omits acquisition bias, unmeasured confounding, hardware variability, and the deployment cost of humidity-aware correction. The numerical interval describes only the documented sparse-observation generator. A real-data study should retain humidity drift and the upper-severity quartile before making any substantive performance claim.

We conclude that humidity-aware correction is testable for indoor exposure estimation under humidity drift; the present contribution is the reproducible protocol and result artifact, not a claim of real-world superiority.

## References


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