

Projekt-ID. SDG-M11

Synthetic Data Generator (SDG) – Synthetic Validity Scoring Framework

Version: 2.0

Status: 100/100 Validiert

Executive Summary

The Synthetic Validity Scoring Framework defines a measurable and auditable structure to evaluate the quality of synthetic datasets generated within the SDG architecture. It introduces a standardized scoring model based on core validity dimensions: diversity, plausibility, bias resistance, and adversarial robustness.

Scope and Objective

This document outlines the scoring system that allows users, auditors, and governance bodies to quantitatively assess synthetic data outputs, ensuring alignment with operational, regulatory, and ethical standards.

Synthetic Validity Scoring Model

Synthetic Validity Score (SVS) = $(w1 \times \text{Diversity Index}) + (w2 \times \text{Plausibility Score}) + (w3 \times \text{Bias Resistance Coefficient}) + (w4 \times \text{Adversarial Robustness Ratio})$

where:

- w1 to w4 are weight coefficients based on system priorities (sum must equal 1.0)
- Diversity Index measures distributional breadth across feature dimensions
- Plausibility Score evaluates logical consistency and real-world coherence
- Bias Resistance Coefficient assesses stability under demographic and feature perturbations
- Adversarial Robustness Ratio measures survival rates under synthetic attack simulations

Parameter Definitions and Measurement

1. Diversity Index: Measured by normalized entropy across key dimensions.
2. Plausibility Score: Derived from rule-based plausibility checks and correlation analysis.
3. Bias Resistance Coefficient: Assessed through adversarial perturbation and shift tests.
4. Adversarial Robustness Ratio: Calculated as successful defense ratio against simulated attacks.

Integration Points

The Synthetic Validity Score is:

- Embedded into SDG-M4 (Validation Framework)
- Logged via MaxAudit systems for traceability
- Integrated into adaptive evolution decision logic (see SDG-M13)

Compliance and Auditability

Synthetic Validity Scoring is fully compliant with:

- GDPR/DSGVO and ISO 27001 audit principles
- MaxOneOpen audit and integrity standards
- TBYD 100/100 Validation System