Data Science applied to Wastewater Engineering

Data Science

- Systematic techniques to draw useful conclusions from large and diverse data sets. Four main areas: analytic model design, exploration, prediction, and inference.

Wastewater Data Science

- Model design: builds mathematical models of each element of a coupled system: physical, chemical, hydrodynamical and biological.
  Uses methods of numerical linear algebra, differential equations, and chemical and mechanical engineering.
- Exploration: Acquires empirical data from operating waste water treatment systems. Used to calibrate and refine analytical models of actual operating systems, and for day-to-day operations and maintenance.

Exploration of these data sets depends upon rapid visualization, coupled with descriptive statistics drawn from data sets to build and refine intuition about actual functional relationships, e.g., between pH, alkalinity, temperature, and biomass formation.

- Prediction depends on executing models of the systems, coupled with machine learning techniques applied to actual data sets to calibrate the analytics. Optimization techiques are applied in this adaptive model allow dynamic improvement.
- Inference from observed data allows accurate estimation of probabilities and error bars.

This book describes the aspects of waste water engineering applicable to non-sewered sanitation systems: new toilet systems, new septic tank processing technologies, sludge processing and reclamation of nutrients and new testing and monitoring technologies. New techniques include biome specification utilising antibody probes, polymerase chain reaction genetic analysis, and multi-site Affymetric species identification.