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Estimation of Radiation Risk Accounting for Classical and Berkson Errors in Doses from the Chornobyl Accident

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With a binary response Y, the dose-response model under consideration is logistic in flavor with

$$pr(Y = 1/D) = R(1 + R)^{-1}, \quad R = \lambda_0 + \lambda_1 D,$$

where λ_0 is the baseline incidence rate and λ_1 is the excess absolute risk per gray. The calculated thyroid dose of a person i is expressed as

$$D_i^{mes} = f_i Q_i^{mes} / M_i^{mes}.$$

Here Q_i^{mes} is the measured content of radioiodine in the thyroid gland of person i at time t_{mes}, M_i^{mes} is the estimate of the thyroid mass, and f_i is the normalizing multiplier. The Q_i^{mes} and M_i^{mes} include multiplicative errors within the classical and Berkson measurement error model, respectively. By means of Full Maximum Likelihood, Regression Calibration, and properly tuned SIMEX method we study the influence of measurement errors in thyroid dose on the estimates of λ_0 and λ_1. The simulation study is presented based on a real sample from the epidemiological studies; the doses were reconstructed in the framework of the Ukrainian-American project on the investigation of Post-Chernobyl thyroid cancers in Ukraine. The results are joint with Dr. S. Shklyar, Dr. S. Masiuk, Prof. I. Likhtarov, Prof. L. Kovgan (Ukraine), Prof. R. Carroll and Dr. A. Bouville (USA).