Regression based predictions for irradiation doses

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Abstract

Radiotherapy is an effective treatment for breast cancer, but it can bring significant late morbidity, particularly to the heart. The radiation dose to the heart may individually vary in the supine versus the prone position in most cases. For the gold standard decision about the preferable treatment position, series of CT scans and therapy plans are needed in both positions. This method is expensive and means extra radioactive dose to the patients.
Our goal was to set up a parsimonious classifier method that predicts the preferable setup.
The dataset consisted of 138 patients of breast cancer measured in both positions. Indicator of the risk is the irradiation dose to the left anterior descendent coronary artery (LAD). The LAD dose difference (D) is a continuous dependent variable. For some classification methods it was dichotomised according to its sign.
We compared different classification methods (multiple logistic regression, discriminant analysis, decision tree, neural networks), finally the use of a multiple linear regression gave the best results with D as dependent variable and three predictors. We estimated not only the proportion of misclassified patients, but also the distribution of the misclassified dose also with a 1000 times random cross validation method. Three SPSS macros (regression macro, recode macro, cleaning macro) were used. The optimal cutpoint was determined with ROC (receiver operating characteristics) analysis.
The regression based method resulted with a good classification of the cases (overall accuracy: greater than .83, average misclassified doses: less than 2Gy).

Keywords: Linear regression, cross-validation, ROC analysis.
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Bibliography

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