

Logistic Regression (LRM) v. Artificial Neural Network (ANN)

Doug Gray

Case Analysis

Comparing logistic regression and neural network models in predicting the outcome of biopsy in breast cancer from MRI findings

Model Performance

Table 4. Comparative performance of the participating radiologist, neural network, logistic regression full model, and logistic regression reduced model on validation sample (n=61)

| Parameter | Radiologist | ANN | Logistic discriminant analysis | |
|-----------------------------------|---------------|---------------|--------------------------------|---------------|
| | | | Full model | Reduced model |
| Sensitivity (%) | 96 | 98 | 96 | 89 |
| Specificity (%) | 80 | 67 | 60 | 93 |
| Accuracy (%) | 92 | 90 | 87 | 90 |
| Misclassified rate (%) | 8 | 10 | 13 | 8 |
| Correlation* with pathology | 0.81 | 0.72 | 0.62 | 0.82 |
| P_value | 0.001 | 0.001 | 0.001 | 0.001 |
| Area under the ROC curve(A_z) | 0.9521±0.0294 | 0.9225±0.0561 | 0.9243±0.0393 | 0.9448±0.0357 |

*The measures of association of model's output and radiologist confirmed relations.

Top Ten Key Takeaways: LRM vs. ANN

1. Binary outcome: cancer, no cancer
2. Identify malignance, benign patterns
3. Reduce number of benign cases sent for biopsy
4. Patient quality of care, outcome, i.e., correct diagnosis *without* surgery where possible
5. Economic, financial efficiency, as surgery is expensive for all parties
6. Data on measurable predictor factors, mass, size, shape, margins, etc.
7. ANN is an *excellent predictor*, better than LRM and radiologist, however...
8. ANN is *less easily interpreted*, i.e., explaining which findings are more relevant in reaching the diagnosis
9. *Reduced* LRM had best performance of both high specificity *and* high sensitivity
10. Potential synergies with remote telemedicine and AI computer vision, as with Qure.ai

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Return To Work (RTW)

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Case Analysis

Predicting the likelihood of a disability
patient returning to work

Factors Influencing Return to Work

Table 5. Role of various factors in helping or hindering new DI beneficiaries' return to work

- Probability of achieving milestones increases with:
 - Sensory impairments, being black, years of education, and DI award at initial adjudication level
- Probability of achieving milestones decreases with:
 - Age at award, back and other musculoskeletal disorders, higher levels of DI benefits at award, receipt of SSI or Medicare at time of DI award, DAC status, and higher state unemployment rates
- Differences across age and impairment persist after accounting for other characteristics
- There are large variations across state of residence at award and return-to-work outcomes
- The patterns of award-month fixed effects are considerably different for service enrollment than the other three milestones; these fixed effects might be capturing changes in policy and unobserved characteristics of new awardees

Top Ten Key Takeaways: Return to Work

1. Binary outcome: return to work, or not
2. Identify factors influencing return to work
3. + Age (youth), impairment type, years of education, race, lower state unemployment
4. – Higher benefit amount at award, higher adjudicative level, beneficiary is receiving other benefits at the time of award
5. *Large variations* in the impact of impairment type, state of residence, state and local economic conditions, and award month on RTW outcomes
6. Social security disability insurance (DI) is the ***largest federal income support program*** for working-age people with (long-term) disabilities
7. Importance of ***longitudinal studies*** of 5–10 years in tracking RTW cases and determining factors
8. *Descriptive statistics* lead to RTW trends, patterns
9. *Linear probability regression model* to predict RTW
10. RTW has *enormous implications* on financial, decision-making, and policy-making issues

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