# Included Datasets

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1. References

# AppendixDatasets: Included datasets

Several datasets are included in the online software.

**Dataset 1**: TONY in the code, is a clinical FROC study[1](#_ENREF_1) in which 5 radiologists interpreted 96 non-diseased and 89 breast imaging cases in two modalities. Modality 1 was 3D breast tomosynthesis (3DBT) and modality 2 was 2D digital mammography (2DDM). Details of the study and the analysis are in a SPIE proceedings paper[2](#_ENREF_2), a pre-publication copy of which, TonyDevSPIE2011.pdf, is included in the online material.

**Dataset 2**: Carolyn Van Dyke, MD, conducted an MRMC ROC study[3](#_ENREF_3) comparing single spin-echo magnetic resonance imaging and cine MRI in detecting thoracic aortic dissection. There were 45 patients with an aortic dissection[[1]](#footnote-1) and 69 patients without a dissection imaged with both SE-MRI (modality 1) and cine-MRI (modality 2). Five radiologists independently interpreted all of the images using a 5-point positive directed ordinal scale. The data file is named VanDyke.lrc. The "lrc" format is described in the document "OR DBM MRMC 2.4 User Guide", authored by Steve Hillis, Kevin Schartz and Kevin Berbaum, on the University of Iowa ROC website. This dataset, and the following one, are well known in the ROC methodology field, because they have been used repeatedly to illustrate the evolution of ROC analysis methods [4-9](#_ENREF_4).

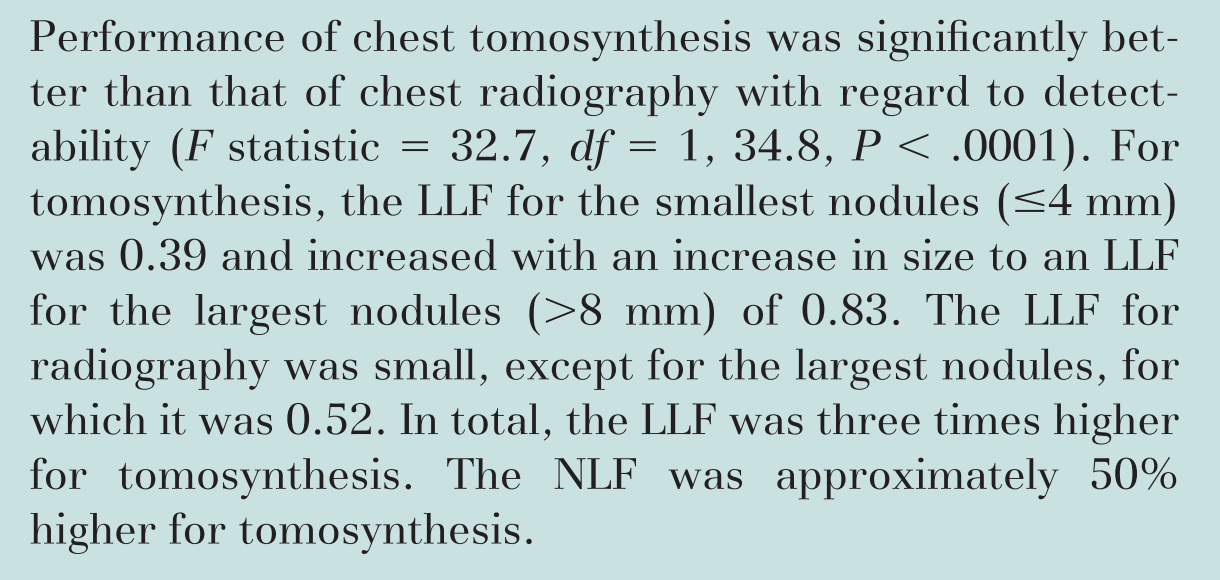
**Dataset 3**: Franken et al[10](#_ENREF_10) compared diagnostic accuracy of interpreting clinical neonatal chest and abdominal radiographs for signs of diseased, using a picture archiving and communication system (PACS) workstation (modality 1) versus plain film (modality 2). This was acquired in the early days of digital imaging technology, when there were doubts whether the limited spatial resolution of digital would be good enough to match mature analog film/screen technology. The case sample consisted of 100 chest or abdominal radiographs (67 diseased and 33 non-diseased). The readers were four radiologists with considerable experience in interpreting neonatal examinations. The readers rated each patient image on a 5-point positive directed integer scale. The data file is named Franken1.lrc.

**Dataset 4**: This is a 5 modality 4 radiologist dataset[11](#_ENREF_11) acquired by Dr. Federica Zanca. The 5 modalities are different image processing methods applied to 100 non-diseased single view mammograms and 100 simulated diseased single-view mammograms constructed by superposing microcalcification cluster profiles. All diseased cases are simulated microcalcifications created by superposing high-resolution images of thin-section excised breast specimens of biopsy-proven microcalcifications on non-diseased cases[12](#_ENREF_12).

**Dataset 5**: This study evaluated nodule detection in an anthropomorphic chest phantom in computed tomography (CT). The phantom was scanned at 4 values of mAs (10, 20, 30, and 40) and images were reconstructed with both adaptive iterative dose reduction 3D (AIDR3D) and filtered back projection (FBP). Thus there are *two treatment* factors and the factors are *crossed* since for each value of the mAs factor there were two values of the reconstruction algorithm factor. This is referred to in the code as the "JT" dataset. A good example of the latter is studies conducted with phantoms[13](#_ENREF_13),[14](#_ENREF_14). In the cited studies an anthropomorphic chest phantom (Lungman N1 Multipurpose Chest Phantom, Kyoto Kagaku Company, Japan; <https://www.kyotokagaku.com/products/detail03/ph-1.html>) representing a 70Kg male was loaded with simulated nodular lesions of different sizes and contrasts. This phantom allows insertion of lesions inside the chest cavity, so effects of vasculature overlap and mimicking of lesions are simulated. But there is only one such phantom, manufactured to strict quality control standards assuring that all copies are identical. In this situation the concept of extrapolating to the populations of phantoms is implausible. Therefore, with phantom studies one should only report random-reader fixed-case analysis.

**Dataset 6**: This is referred to in the code as the "MAG" dataset.[15](#_ENREF_15)

To compare chest tomosynthesis with chest radiography in the detection of pulmonary nodules by using multidetector computed tomography (CT) as the reference method. The Regional Ethical Review Board approved this study, and all participants gave informed consent. Four tho- racic radiologists acted as observers in a jackknife free- response receiver operating characteristic (JAFROC) study conducted in 42 patients with and 47 patients without pulmonary nodules examined with chest tomo- synthesis and chest radiography. Multidetector CT served as reference method. The observers marked sus- pected nodules on the images by using a four-point rating scale for the confidence of presence. The JAFROC figure of merit was used as the measure of detectability. The number of lesion localizations relative to the total number of lesions (lesion localization fraction [LLF]) and the number of nonlesion localizations relative to the total number of cases (nonlesion localization fraction [NLF]) were determined. Performance of chest tomosynthesis was significantly bet- ter than that of chest radiography with regard to detect- ability (F statistic ? 32.7, df ? 1, 34.8, P ? .0001). For tomosynthesis, the LLF for the smallest nodules (?4 mm) was 0.39 and increased with an increase in size to an LLF for the largest nodules (?8 mm) of 0.83. The LLF for radiography was small, except for the largest nodules, for which it was 0.52. In total, the LLF was three times higher for tomosynthesis. The NLF was approximately 50% higher for tomosynthesis. For the detection of pulmonary nodules, the performance of chest tomosynthesis is better, with increased sensitivity especially for nodules smaller than 9 mm, than that of chest radiography. ? RSNA, 2008 Radiology:



**Dataset 7**: This is referred to in the code as the "OPT" dataset.[16](#_ENREF_16) Threshold gold thickness at five different image qualities: DR at normal, half, and quarter dose levels shown with disc points, and CR at normal and half dose levels shown with square points: (a) 0.1 mm gold disc diameter and (b) 0.25 mm gold disc diameter. Acceptable and achievable standards as set in the European protocol (Ref. 15) are also shown along with dose limit for a breast thickness equivalent to 50 mm PMMA. Quarter dose left out of file

> print(ret$ciAvgRdrEachTrtRRRC)

Treatment Area StdErr DF CI Lower CI Upper

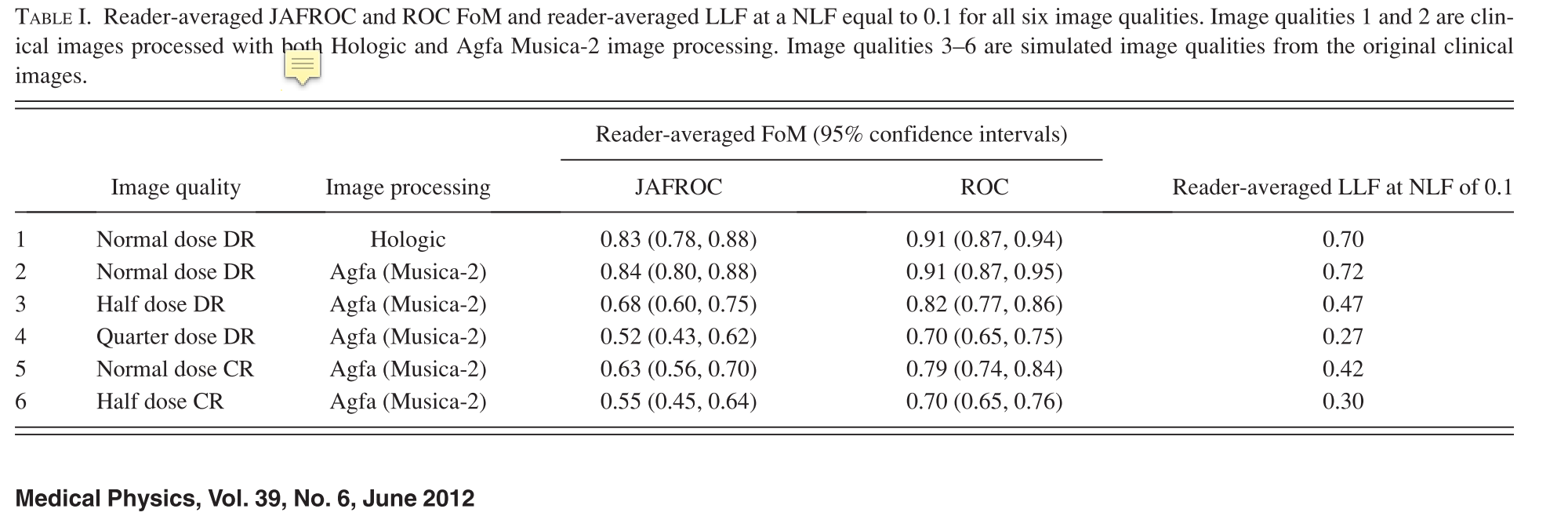
1 1 0.8313434 0.02375184 44.11423 0.7834782 0.8792085

2 2 0.6334379 0.03356088 26.95101 0.5645708 0.7023050

3 3 0.6768897 0.03504769 21.65440 0.6041379 0.7496415

4 4 0.5461831 0.04209587 12.34044 0.4547440 0.6376223

5 6 0.8367514 0.01999903 38.31947 0.7962766 0.8772263

****

**Dataset 8**: This is referred to in the code as the "PEN" dataset.[17](#_ENREF_17)

MATERIALS AND METHODS: The use of the images in this retrospective image- collection study was approved by the institutional review board, and patient in- formed consent was not required. One hundred twelve mammographic images (28 with one or two clusters of microcalcifications, 19 with one mass, 17 with both abnormal findings, and 48 with normal findings) obtained in 60 women who ranged in age from 25 to 79 years were digitized and compressed at 40:1 and 80:1 by using the JPEG2000 and object-based SPIHT methods. Five experienced radiol- ogists were asked to locate and rate clusters of microcalcifications and masses on the original and compressed images in a free-response receiver operating characteristic (FROC) data acquisition paradigm. Observer performance was evaluated with the jackknife FROC method. RESULTS: The mean FROC figures of merit for detecting clusters of microcalcifi- cations, masses, and both radiographic findings on uncompressed images were 0.80, 0.81, and 0.72, respectively. With object-based SPIHT 80:1 compression, the corresponding values were larger than the values for uncompressed images by 0.005, 0.009, and ?0.005, respectively. The 95% confidence interval for the differences in figures of merit between compressed and uncompressed images was ?0.039, 0.033 for the microcalcification finding; ?0.055, 0.034 for the mass finding; and ?0.039, 0.030 for both findings. Because each of these confidence intervals includes zero, no significant difference in detection accuracy between uncompressed and object-based SPIHT 80:1 compression was observed at a P value of 5%. The F test of the null hypothesis that all of the modes (uncompressed and four compressed modes) were equivalent yielded the following results: F ? 0.255, P?.903 for the microcalcification finding; F?0.340, P?.848 for the mass finding; and F ? 0.122, P ? .975 for both findings.

fileName = PEN

Treatment Area StdErr DF CI Lower CI Upper

1 0 0.8239583 0.03705225 15.83284 0.7453436 0.9025730

2 1 0.8160482 0.03124021 21.52732 0.7511774 0.8809190

3 2 0.8152018 0.04007620 15.44054 0.7299932 0.9004104

4 3 0.8201497 0.03620888 14.42060 0.7427014 0.8975981

5 4 0.8042969 0.03875517 17.17770 0.7225950 0.8859987

**Dataset 9**: This is referred to in the code as the "NICO" dataset. The study[18](#_ENREF_18), also referred to as the *Hupse-Karssemeijer study*, compared standalone performance of a CAD device to that of 9 radiologists interpreting the same cases (120 non-diseased and 80 with a single malignant mass per diseased case) using the location receiver operating characteristic (LROC) paradigm[19-22](#_ENREF_19). In LROC for each case the radiologist gives an overall rating for presence of disease, i.e., an ROC rating, and indicates the location of the most suspicious region. On non-diseased cases the rating is classified as a false positive rating (i.e., the location is ignored), but on a diseased case the rating is classified as a *correct localization* if the mark is sufficiently close to the lesion, otherwise it is classified as an *incorrect localization*.

The third dataset is a recently conducted study on which the author acted as the statistical consultant.

**Dataset 10**: This is referred to in the code as the "DOB1" dataset. Dobbins et al.[23](#_ENREF_23) conducted a multi-institutional, MRMC study to compare the performance of digital tomosynthesis (GE's VolumeRad device), dual-energy (DE) imaging, and conventional chest radiography for pulmonary nodule detection and management. All study images were obtained with a flat-panel detector developed by GE. The case set consisted of 158 subjects, of which 43 were non-diseased and the rest had 1 – xx pulmonary nodules independently verified, using with CT images, by 3 experts who did not participate in the observer study. The patients were enrolled at four institutions and the readers came from different institutions. The detection study used FROC paradigm data collection. The outcome study, on a 5-point scale, used ROC paradigm data collection. The data file is named CXRinvisible3-20mm.xlsx. The Excel data format accommodates all paradigms in current usage: ROC, FROC, LROC and ROI. The format is described in documents available on the author's website, [www.expertcadanalytics.com](http://www.devchakraborty.com), and in the RJafroc package documentation, <https://cran.r-project.org/web/packages/RJafroc/index.html>. For this dataset[24](#_ENREF_24)

there are 4 modalities labeled 1 – 4:

1. 2-view digital chest x-rays (CXR) with a flat-panel detector;
2. CXR + dual energy images (DE);
3. Chest tomosynthesis images (TOMO) with the GE's VolumeRad device, and
4. TOMO + DE.

A *pdf* file "GEHealthcare-Education-TiP-App-Library\_XR-Volume-Rad-Quicksteps.pdf" describing VolumeRad is included in the software directory. It has a good description of how it works.

**Dataset 11**: This contains action-ability ROC data from the Dobbins et al.[24](#_ENREF_24) study described above. Each reader was asked if the case ought to be considered *actionable*, i.e., needed further investigation. The data file is named actionability.xlsx. As with dataset 3, there are 4 modalities labeled 1 – 4 as described for dataset 3. Data was acquired on a 4-point positive directed scale. This is referred to in the code as the "DOB2" dataset.

Table 09.C.1: Summary characteristics of datasets used in this book. [I = # modalities, J = # readers, K1 = number of non-diseased cases, K2 = number of diseased cases.]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Dataset #** | **Dataset Name** | **Type** | **I** | **J** | **K1** | **K2** | **K** | **Comments** |
| **Dataset #** | **Dataset Name** | **Type** | **I** | **J** | **K1** | **K2** | **K** | **Comments** |
| 1 | TONY9 | FROC | 2 | 5 | 96 | 89 | 185 |  |
| 2 | VD10 | ROC | 2 | 5 | 69 | 45 | 114 |  |
| 3 | FR11 | ROC | 2 | 4 | 33 | 67 | 100 |  |
| 4 | FED12 | FROC | 5 | 4 | 100 | 100 | 200 |  |
| 5 | JT13 | FROC | 2 | 9 | 45 | 47 | 92 |  |
| 6 | MAG14 | FROC | 2 | 4 | 47 | 42 | 89 |  |
| 7 | OPT15 | FROC | 5 | 7 | 81 | 81 | 162 |  |
| 8 | PEN16 | FROC | 5 | 5 | 48 | 64 | 112 |  |
| 9 | NICO17 | LROC | 1 | 10 | 120 | 80 | 200 |  |
| 10 | RUS18 | FROC | 3 | 8 | 50 | 40 | 90 |  |
| 11 | DOB119 | FROC | 4 | 5 | 43 | 115 | 158 |  |
| 12 | DOB219 | ROC | 4 | 5 | 64 | 88 | 152 |  |
| 13 | DOB319 | FROC | 4 | 5 | 52 | 106 | 158 |  |

dsfakjlaskl .

# 9.15 References

1. Svahn T, Andersson I, Chakraborty D, et al. The Diagnostic Accuracy of Dual-View Digital Mammography, Single-View Breast Tomosynthesis and a Dual-View Combination of Breast Tomosynthesis and Digital Mammography in a Free-response Observer Performance Study. *Radiat Prot Dosimetry.* 2010;139:113–117.

2. Chakraborty DP, Svahn T. Estimating the parameters of a model of visual search from ROC data: an alternate method for fitting proper ROC curves. *Proc SPIE 7966.* 2011;7966.

3. Van Dyke CW, White RD, Obuchowski NA, Geisinger MA, Lorig RJ, Meziane MA. Cine MRI in the diagnosis of thoracic aortic dissection. *79th RSNA Meetings.* 1993.

4. Hillis SL. A comparison of denominator degrees of freedom methods for multiple observer ROC studies. *Statistics in Medicine.* 2007;26:596-619.

5. Hillis SL, Berbaum KS. Power Estimation for the Dorfman-Berbaum-Metz Method. *Acad Radiol.* 2004;11(11):1260-1273.

6. Hillis SL, Berbaum KS. Monte Carlo validation of the Dorfman-Berbaum-Metz method using normalized pseudovalues and less data-based model simplification. *Acad Radiol.* 2005;12(12):1534-1541.

7. Hillis SL, Berbaum KS, Metz CE. Recent developments in the Dorfman-Berbaum-Metz procedure for multireader ROC study analysis. *Acad Radiol.* 2008;15(5):647-661.

8. Hillis SL, Obuchowski NA, Berbaum KS. Power Estimation for Multireader ROC Methods: An Updated and Unified Approach. *Academic Radiology.* 2011;18(2):129-142.

9. Hillis SL, Obuchowski NA, Schartz KM, Berbaum KS. A comparison of the Dorfman-Berbaum-Metz and Obuchowski-Rockette methods for receiver operating characteristic (ROC) data. *Statistics in Medicine.* 2005;24(10):1579-1607.

10. Franken EA, Jr., Berbaum KS, Marley SM, et al. Evaluation of a Digital Workstation for Interpreting Neonatal Examinations: A Receiver Operating Characteristic Study. *Investigative Radiology.* 1992;27(9):732-737.

11. Zanca F, Jacobs J, Van Ongeval C, et al. Evaluation of clinical image processing algorithms used in digital mammography. *Medical Physics.* 2009;36(3):765-775.

12. Zanca F, Chakraborty DP, Van Ongeval C, et al. An improved method for simulating microcalcifications in digital mammograms. *Medical Physics.* 2008;35(9):4012-4018.

13. Thompson JD, Chakraborty DP, Szczepura K, et al. Effect of reconstruction methods and x-ray tube current-time product on nodule detection in an anthropomorphic thorax phantom: a crossed-modality JAFROC observer study. *Medical Physics.* 2016;43(3):1265-1274.

14. Thompson JD, Thomas NB, Manning DJ, Hogg P. The impact of grey-scale inversion on nodule detection in an anthropomorphic chest phantom: a free-response observer study. *The British journal of radiology.* 2016:20160249.

15. Vikgren J, Zachrisson S, Svalkvist A, et al. Comparison of Chest Tomosynthesis and Chest Radiography for Detection of Pulmonary Nodules: Human Observer Study of Clinical Cases. *Radiology.* 2008;249(3):1034-1041.

16. Warren LM, Mackenzie A, Cooke J, et al. Effect of image quality on calcification detection in digital mammography. *Medical Physics.* 2012;39(6):3202-3213.

17. Penedo M, Souto M, Tahoces PG, et al. Free-Response Receiver Operating Characteristic Evaluation of Lossy JPEG2000 and Object-based Set Partitioning in Hierarchical Trees Compression of Digitized Mammograms. *Radiology.* 2005;237(2):450-457.

18. Hupse R, Samulski M, Lobbes M, et al. Standalone computer-aided detection compared to radiologists’ performance for the detection of mammographic masses. *Eur Radiol.* 2013;23(1):93-100.

19. Metz CE, Starr SJ, Lusted LB. Observer performance in detecting multiple radiographic signals. Prediction and analysis using a generalized ROC approach. *Radiology.* 1976;121(2):337-347.

20. Starr SJ, Metz CE, Lusted LB, Goodenough DJ. Visual detection and localization of radiographic images. *Radiology.* 1975;116:533-538.

21. Swensson RG, Judy PF. Detection of noisy visual targets: Models for the effects of spatial uncertainty and signal-to-noise ratio. *Perception & Psychophyics.* 1981;29(6):521-534.

22. Swensson RG. Unified measurement of observer performance in detecting and localizing target objects on images. *Med Phys.* 1996;23(10):1709 -1725.

23. Dobbins III JT, McAdams HP, Sabol JM, et al. Multi-Institutional Evaluation of Digital Tomosynthesis, Dual-Energy Radiography, and Conventional Chest Radiography for the Detection and Management of Pulmonary Nodules. *Radiology.* 2016;282(1):236-250.

24. Dobbins JT, McAdams HP, Sabol JM, et al. Multi-Institutional Evaluation of Digital Tomosynthesis, Dual-Energy Radiography, and Conventional Chest Radiography for the Detection and Management of Pulmonary Nodules. Radiology. *Radiology.* 2016;000(000):(in press).

25. Zanca F, Hillis SL, Claus F, et al. Correlation of free-response and receiver-operating-characteristic area-under-the-curve estimates: Results from independently conducted FROC/ROC studies in mammography. *Med Phys.* 2012;39(10):5917-5929.

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(9.24) ddf

(9.34)

(9.35) Eqn. for AH-RRRC

(9.43)

(9.44)

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Online Appendix

Online Appendix 1.A

Fig. 1.1

Figure 1.A.4

Figure 1.A.5.1

Figure 1.A.5.2

Figure 1.A.5.2

Figure 1.A.5.1.2

2.9.2 PPV NPV

Table 2.1

Table 2.2

Table 2.3

Fig. 3.1

Fig. 3.2

Fig. 3.3

Fig. 3.A.2

Fig. 3.H.2.1

Fig. 3.H.2.2

Fig. 3.E.1

Fig. 3.4

Fig. 3.5

Fig. 3.6 beam et al study

Fig. 3.G.3

Fig. 3.C.4

Fig. 3.A.2

Fig. 3.C.1

Fig. 3.E.1

Fig. 3.G.2

Fig. 3.G.3

Fig. 4.G.4

Fig. 3.H.2.1

Fig. 3.I.2

3.10

Table 3.2

Table 3.3 beam et al study

Online Appendix 3.A

Online Appendix 3.B

Online Appendix 3.C

Online Appendix 3.D

Online Appendix 3.E Getting help in R-I

Online Appendix 3.F Getting help in R-II

Online Appendix 3.G

Online Appendix 3.H

Online Appendix 3.I

Fig. 4.1

Fig. 4.2

Fig. 4.3

Table 4.1 Roc counts table

Table 4.2

Table 4.3

Table 4.4

Table 4.5

Online Appendix 4.A

Fig. 5.1 operating point convention

Fig. 5.2

Fig. 5.3

Table 5.1

Table 5.2

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Online Appendix 5.A

Fig. 6.1

Fig. 6.2

Fig. 6.3

Fig. 6.4

Fig. 6.5

Appendix 6.A

Online Appendix 6.A

Online Appendix 6.B

Online Appendix 6.C

Online Appendix 6.D

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Online Appendix 6.F

6.2.6

6.4.2

Table 6.1

Table 6.2

Table 7.1

Table 7.2

Table 7.3

7.3.2

Fig. 7.1

Online Appendix 7.A

Online Appendix 7.B

Online Appendix 7.C

Online Appendix 7.D

Online Appendix 7.E

Eqn.(7.6)

Fig. 8.1

Table 8.1

Fig. 9.1

Fig. 9.2

Fig. 9.3

Fig. 9.4

Fig. 9.5

(9.24) dds

(9.34) Definition of ncp

(9.35) Eqn. AH – RRRC

(9.24)

(9.34)

(9.35)

(9.43)

(9.44)

(9.43)

(9.44)

(9.52)

(9.53)

9.10.2.2 Interactions

Table 9.1

Table 9.2

Table 9.3

Table 9.4

Table 9.5

Table 9.6

Table 9.7

Table 9.7

Table 9.8

9.13: Meaning of pseudovalues

Fig. 9.A.2

Fig. 9.A.3.1

Table 09.C.1

Table 9.E.1

Table 9.H.1

Online Appendix 9.A

Online Appendix 9.B

Online Appendix 9.C

Online Appendix 9.D

Online Appendix 9.E

Online Appendix 9.F

Online Appendix 9.G

10.2.5.1

10.2 1RIT

Fig. 10.1

Fig. 10.2

10.5.1

10.7 1TMultipleR

10.2.4 Meaning of Cov matrix

Online Appendix 10.A

Online Appendix 10.B

Online Appendix 10.C

Online Appendix 10.D

Online Appendix 10.E

Online Appendix 10.F

Table 11.1 2 types of errors

Fig. 11.1

11.8.1

11.8.4

Fig. 11.2

Fig. 11.3

Fig. 11.4

Fig. 11.5

11.12

Table 11.2

Table 11.3

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Online Appendix 11.B

Online Appendix 11.C

Online Appendix 11.D

Online Appendix 12.A

Online Appendix 12.B

Online Appendix 12.C

Fig. 12.B.2

12.6

Table 9.H.1

Table 13.1 FROC notation

Table 13.2

Table 13.3

Table 13.4

Table 13.5

Fig. 13.1

Fig. 13.2

Fig. 13.3

Fig. 13.4

Fig. 13.5

Fig. 13.6

Fig. 13.7

Fig. 13.8

Fig. 13.9

13.6

13.7

13.4.1

13.16.2

13.10.1

13.10.3.1

13.10

13.10.5.1

13.15.1

13.15

Appendix 13.A.1

13.11.1

13.11.2

13.11.3

13.12.1

13.13.1

Table 14.C.1

Fig. 14.1

Fig. 14.2

Fig. 14.3

Fig. 14.4

Fig. 14.5

Fig. 14.6

14.5.1

14.5.2

14.2

Online Appendix 14.A

Online Appendix 14.B

Online Appendix 14.C

Online Appendix 14.D

Table 14.1

Table 14.2

Fig. 15.2.1

Fig. 15.2.2

Fig. 15.4.2

Fig. 15.6.1

Fig. 15.6.2

Fig. 15.7.1

Fig. 15.A.1

Appendix 15A

Appendix 15B

Appendix 15C

Appendix 15D

Table 16.1

16.4

Online Appendix 16.A.1

Online Appendix 16.B.1

Online Appendix 16.C.1

17.3

Fig. 17.1

Fig. 17.2

17.5.1

17.5.2

Fig. 17.3

Fig. 17.4

Fig. 17.5

Fig. 17.6

Fig. 17.7

Fig. 17.8

Fig. 17.9

Fig. 17.10

Table 17.1

Table 17.2

Table 17.3

17.5.1

17.5.2

17.6.1

17.6.2

17.7.2

17.8

17.9

17.10

17.10.1

17.11

17.11.2.1

17.11.4

Online Appendix 17.A

Online Appendix 17.B

Online Appendix 17.C

Online Appendix 17.G

Online Appendix 17.D.1

Online Appendix 17.D.2

Online Appendix 17.F

Online Appendix 17.F.1

Online Appendix 17.F.2

Online Appendix 17.F.3

Online Appendix 17.G

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Fig. 18.1

Fig. 18.2

Fig. 18.3

Fig. 18.3

Table 18.1

Table 18.2

Table 18.3

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19.2.3

19.7 Sample size

19.5

19.5.2

19.5.3

19.5.4

Fig. 19.1

Fig. 19.2

Fig. 19.3

Fig. 19.4

Fig. 19.5

Fig. 19.6

Fig. 19.7

Fig. 19.8

Fig. 19.9

Fig. 19.10

Fig. 19.11

Fig. 19.12

Table 19.1

Table 19.2

Table 19.3  
Table 19.4

Table 19.5

Table 19.6

Table 19.7

Table 19.8

Online Appendix 19A

Online Appendix 19.A.1

Online Appendix 19.A.2

Online Appendix 19.A.3

Online Appendix 19.A.4

Online Appendix 19.A.3

Online Appendix 19.A.4

Online Appendix 19.C

Online Appendix 19.C.1

Online Appendix 19.C.2

Online Appendix 19.C.3

Online Appendix 19.C.4

Online Appendix 19.C.5

Online Appendix 19.C.6

Online Appendix 19.C.7

Online Appendix 19.C.8

20.7.2.1

Fig. 20.1

Fig. 20.2

Fig. 20.3

Fig. 20.4

Fig. 20.5

Fig. 20.6

Fig. 20.7

Fig. 20.8

Fig. 20.9

Fig. 20.10

Table 20.1

Table 20.2

Online Appendix 20.A

Online Appendix 20.B

Online Appendix 20.B.2

Online Appendix 20.B.4

Online Appendix 20.D

Fig. 21.1

Fig. 21.2

Fig. 21.4

Fig. 21.5

Table 21.1

Table 21.2

Fig. 21.B.1

Fig. 21.D.1

Fig. 21.D.2

Fig. 21.D.3

Fig. 21.D.4

Fig. 21.D.5

Fig. 21.D.6

Online Appendix 21.A

Online Appendix 21.B

Online Appendix 21.C

Online Appendix 21.D

Online Appendix 21.E

Table 22.1

Table 22.2

Table 22.3

Online Appendix 22.A

Online Appendix 22.B

22.2.1.1

22.2.1.2

22.2.1.3

22.2.1.4

Fig. 22.1

Fig. 22.2

Table 22.2

22.4

22.5

Table 22.3

23.A.1

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1. Aortic dissection is separation of the layers within the aortic wall. Tears in the intimal layer result in the propagation of dissection (proximally or distally) secondary to blood entering the intima-media space. Mortality is still high despite advances in diagnostic and therapeutic modalities (http://emedicine.medscape.com/article/2062452-overview). [↑](#footnote-ref-1)