

## Benchmarking and Evaluating the Interpretation of Bibliographic Records

Joffrey Decourselle · Fabien Duchateau · Trond Aalberg · Naimdjon Takhirov · Nicolas Lumineau

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**Abstract** In a global context which promotes the use of explicit semantics for sharing information and developing new services, the MACHine Readable Cataloguing (MARC) format that is commonly used by libraries worldwide has demonstrated its limitations. The semantic model for representing cultural items presented in the Functional Requirements for Bibliographic Records (FRBR) is expected to be a successor of MARC, and the complex transformation of MARC catalogs to FRBR catalogs (FRBRization) led to the proposition of various tools and approaches. However, these projects and the results they achieve are difficult to compare on a fair basis due to a lack of common datasets and appropriate metrics. Our contributions fill this gap by proposing the first public benchmark for the FRBRization process.

**Keywords** benchmark · migration · record interpretation · FRBRization · LRM · FRBR · MARC · dataset · evaluation metric

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Note that this paper is an extension of a previous version published in TPDL 2016 [1].

## 1 Assessing strengths and weaknesses - results by test

This first experiment aims at demonstrating the benefit of the dataset T42 when it comes to evaluating the strengths and weaknesses of FRBRization tools. For the three tools, we have run each test from the dataset T42 and the evaluation is performed using post-FRBRization metrics. In other words, each tool has produced a FRBR collection for each test, and these generated FRBR collections have been compared to the expert ones provided in the benchmark. A basic set of rules is available with each tool. For equity reasons, we have not tuned the tools by updating their set of rules.

In the following plots, the results are organized by tool and by test.

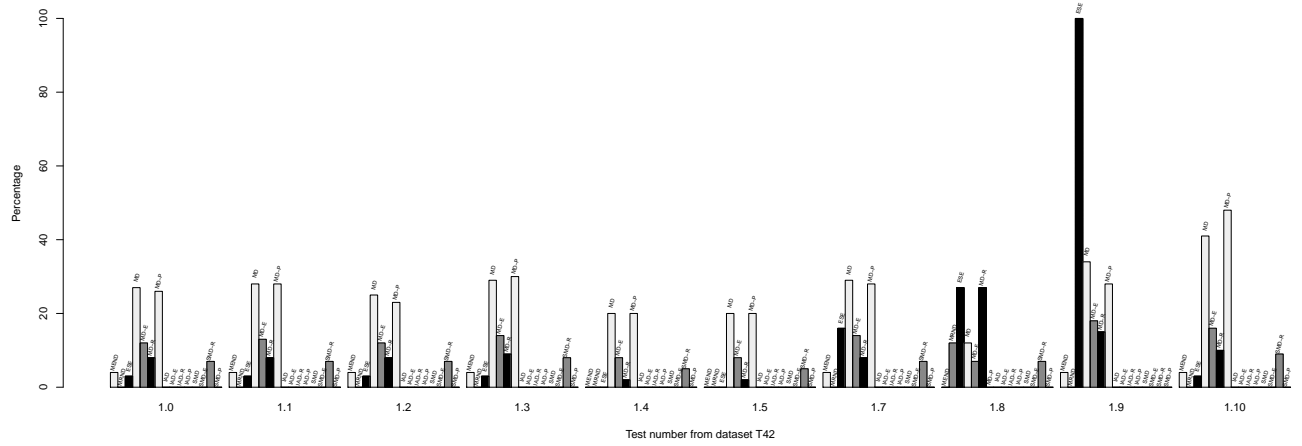


Fig. 1 Quality results for FRBR-ML with dataset T42 tests 1.x

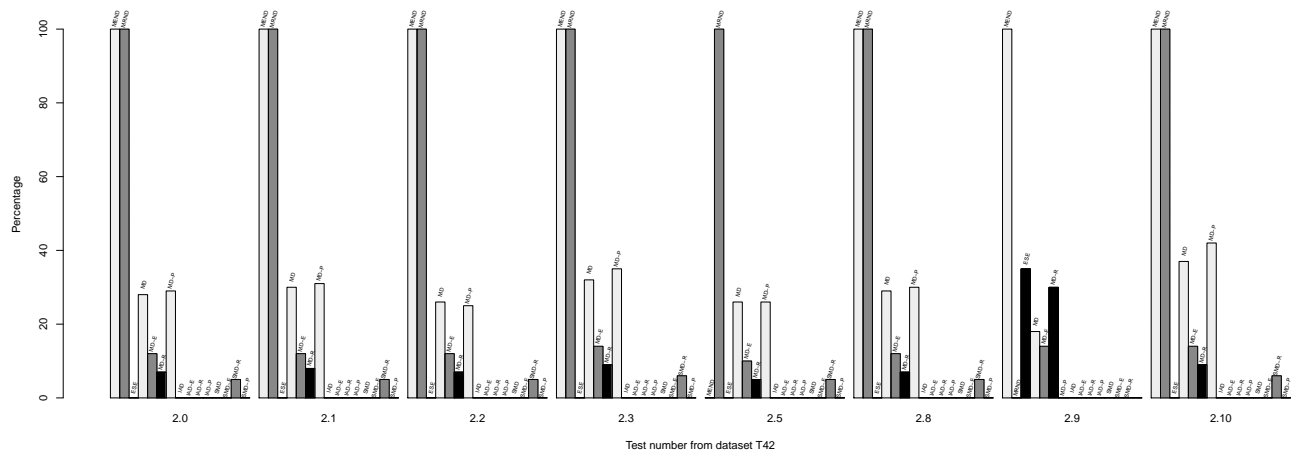


Fig. 2 Quality results for FRBR-ML with dataset T42 tests 2.x



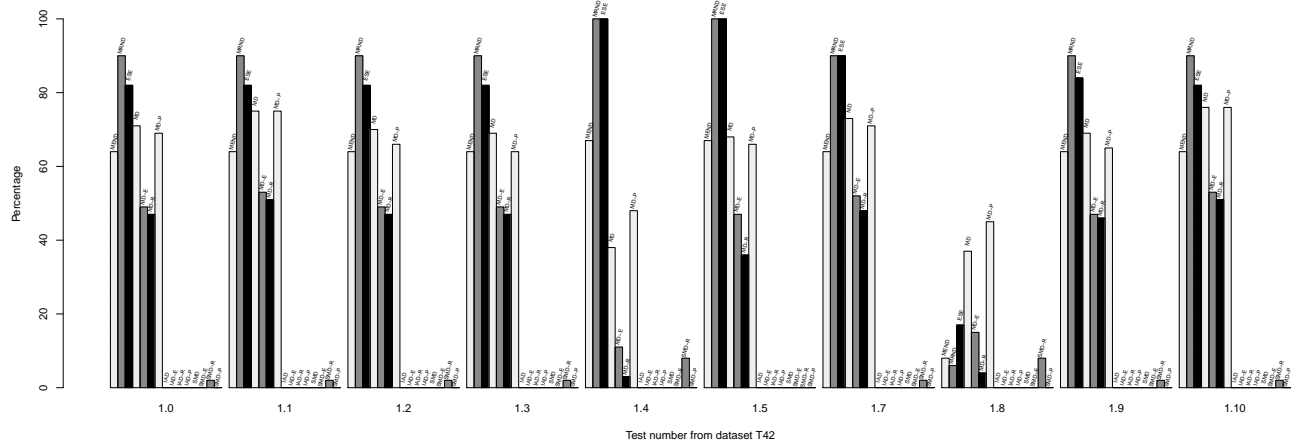


Fig. 6 Quality results for Variation/VFRBR with dataset T42 tests 1.x

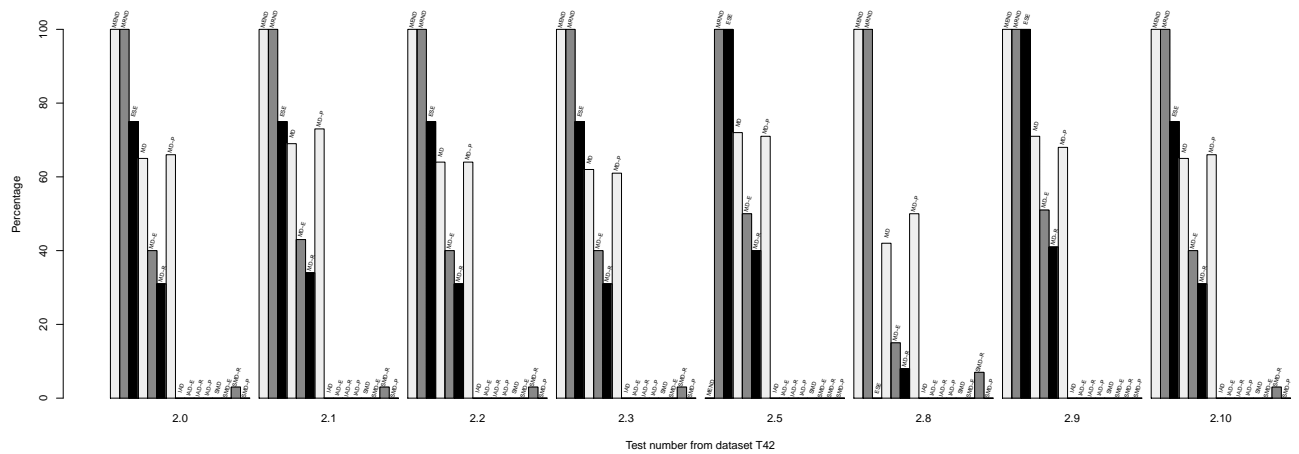


Fig. 7 Quality results for Variation/VFRBR with dataset T42 tests 2.x







## 2 Assessing strengths and weaknesses - results by metric

This first experiment aims at demonstrating the benefit of the dataset T42 when it comes to evaluating the strengths and weaknesses of FRBRization tools. For the three tools, we have run each test from the dataset T42 and the evaluation is performed using post-FRBRization metrics. In other words, each tool has produced a FRBR collection for each test, and these generated FRBR collections have been compared to the expert ones provided in the benchmark. A basic set of rules is available with each tool. For equity reasons, we have not tuned the tools by updating their set of rules.

In the following plots, the results are organized by tool and by metric.

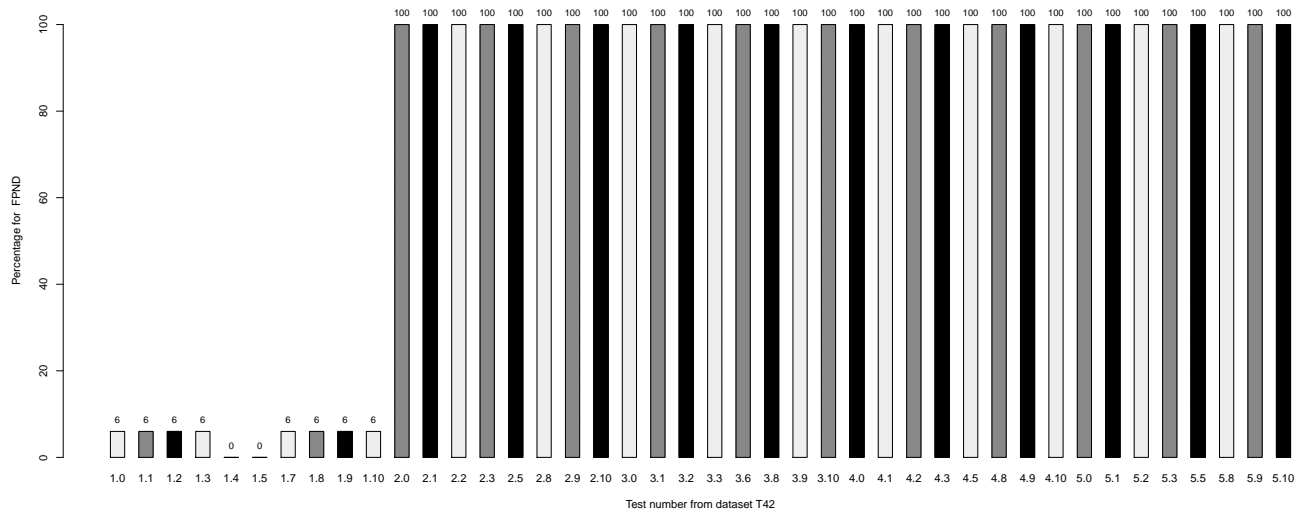


Fig. 16 Quality results for FRBR-ML with dataset T42 and metric FPNB

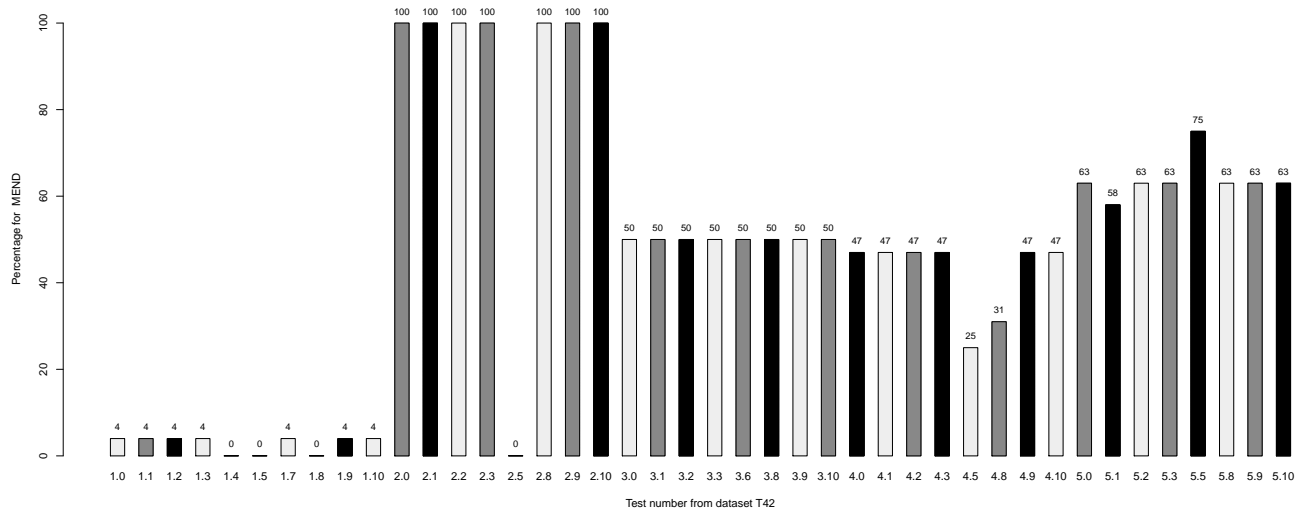


Fig. 17 Quality results for FRBR-ML with dataset T42 and metric MEND



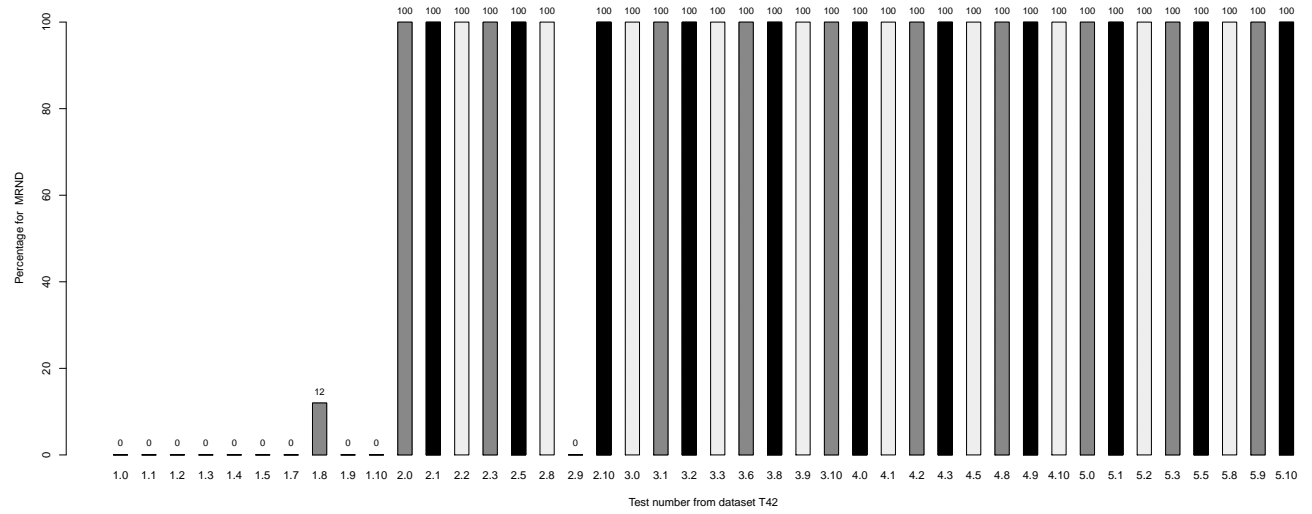


Fig. 18 Quality results for FRBR-ML with dataset T42 and metric MRND

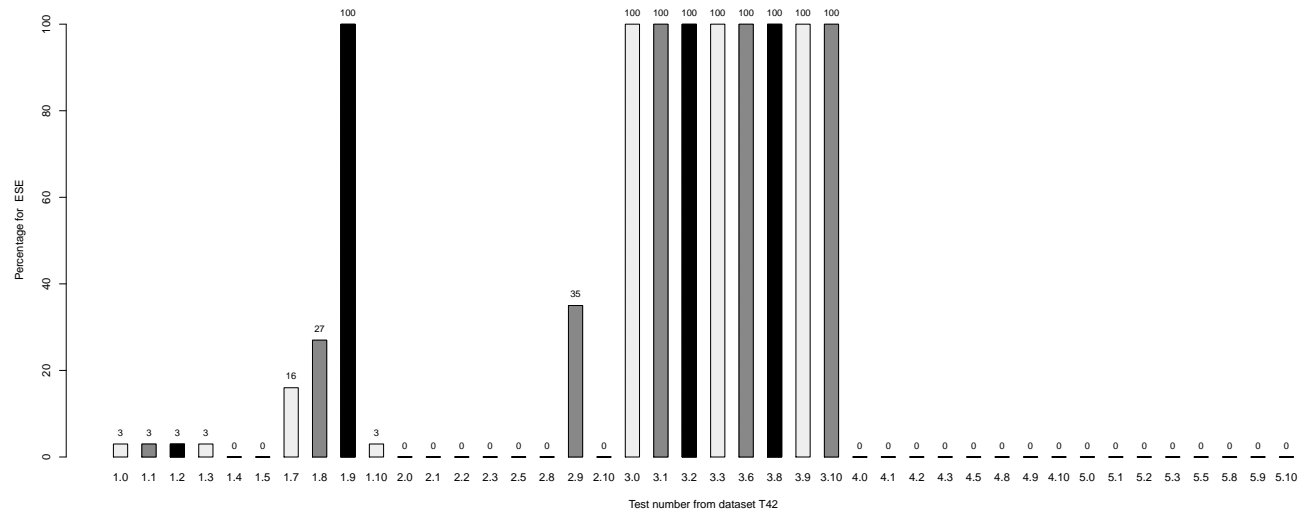
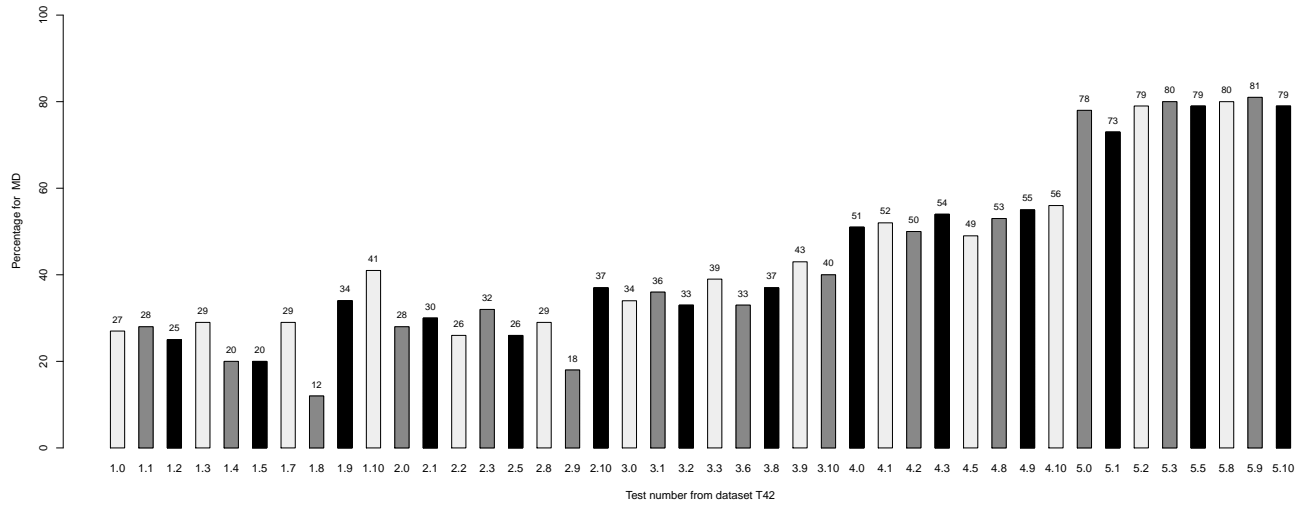
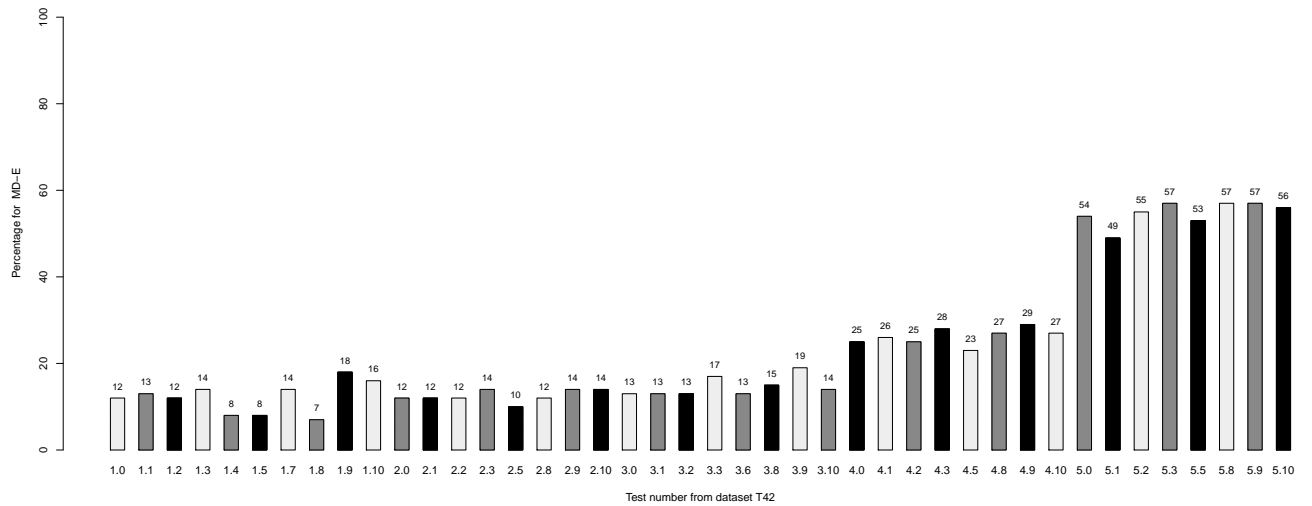


Fig. 19 Quality results for FRBR-ML with dataset T42 and metric ESE



**Fig. 20** Quality results for FRBR-ML with dataset T42 and metric MD



**Fig. 21** Quality results for FRBR-ML with dataset T42 and metric MD-E

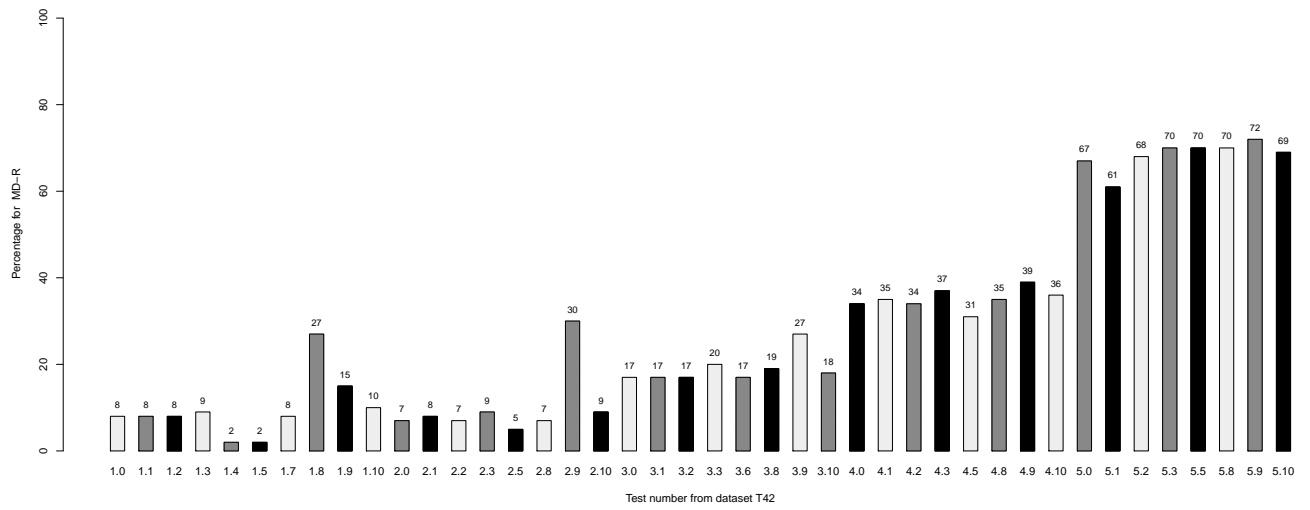


Fig. 22 Quality results for FRBR-ML with dataset T42 and metric MD-R

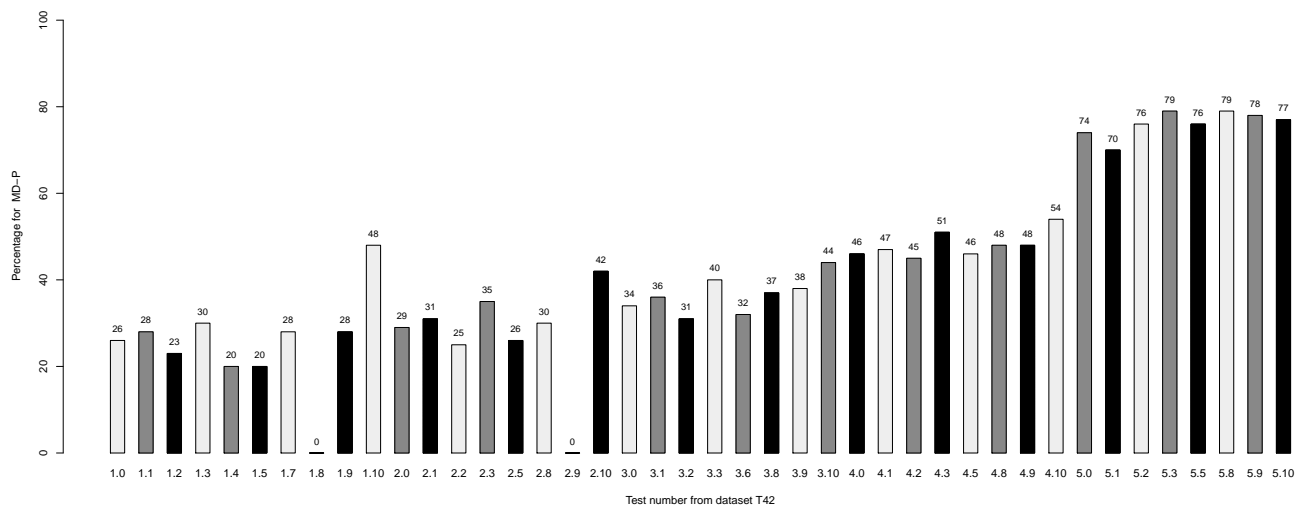
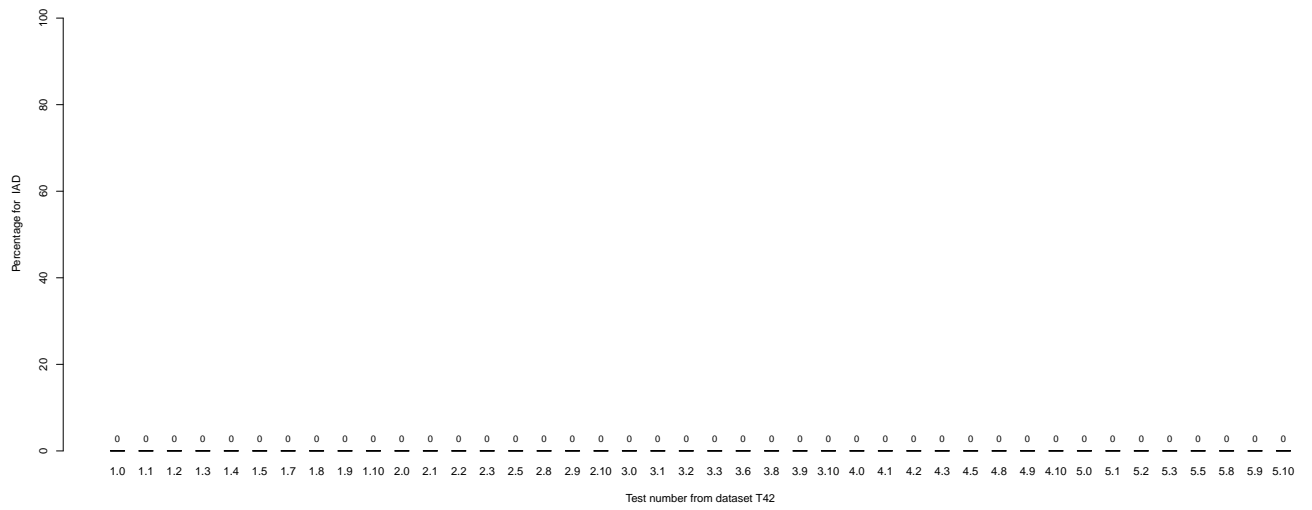
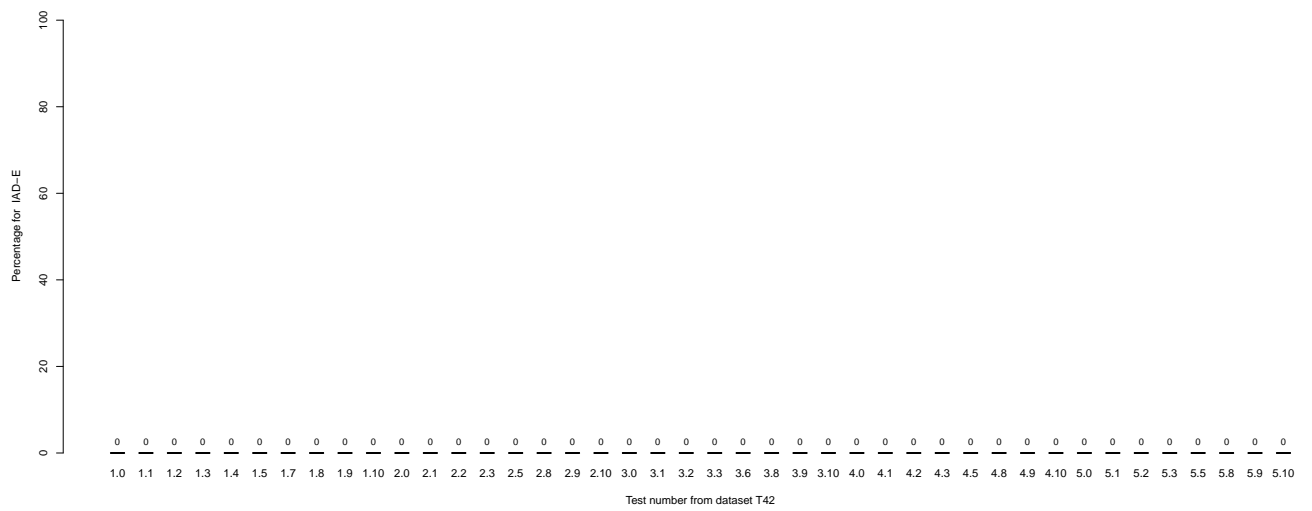


Fig. 23 Quality results for FRBR-ML with dataset T42 and metric MD-P



**Fig. 24** Quality results for FRBR-ML with dataset T42 and metric IAD



**Fig. 25** Quality results for FRBR-ML with dataset T42 and metric IAD-E

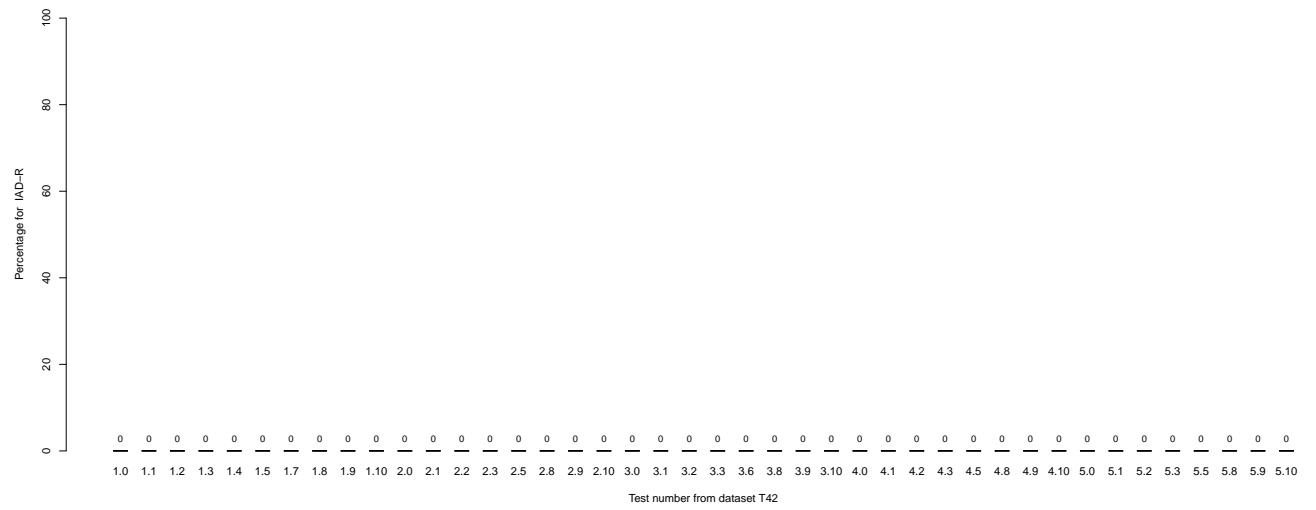


Fig. 26 Quality results for FRBR-ML with dataset T42 and metric IAD-R

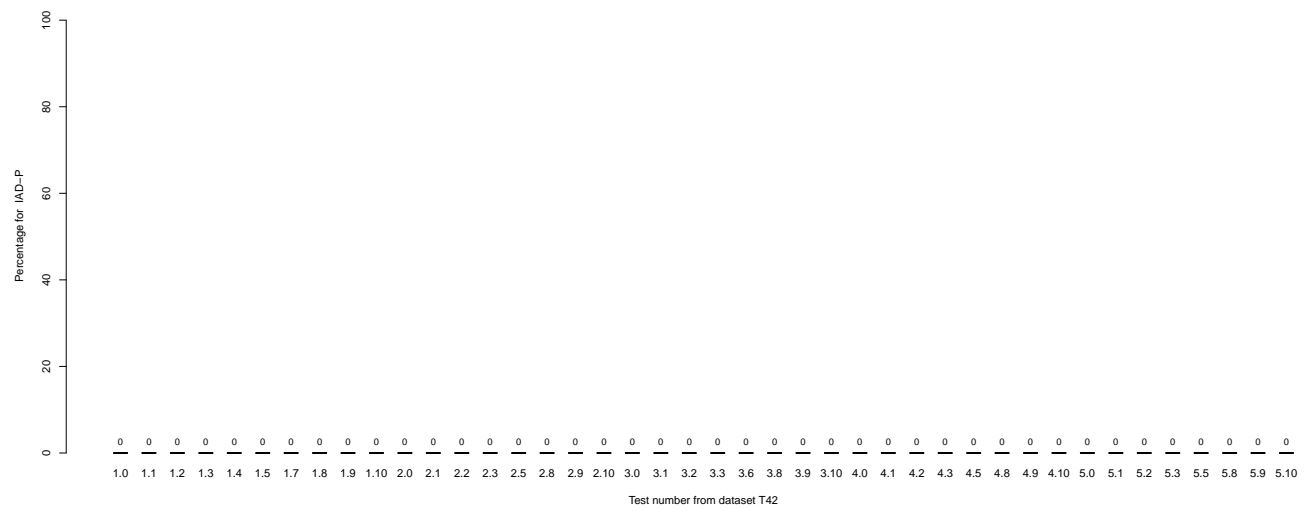
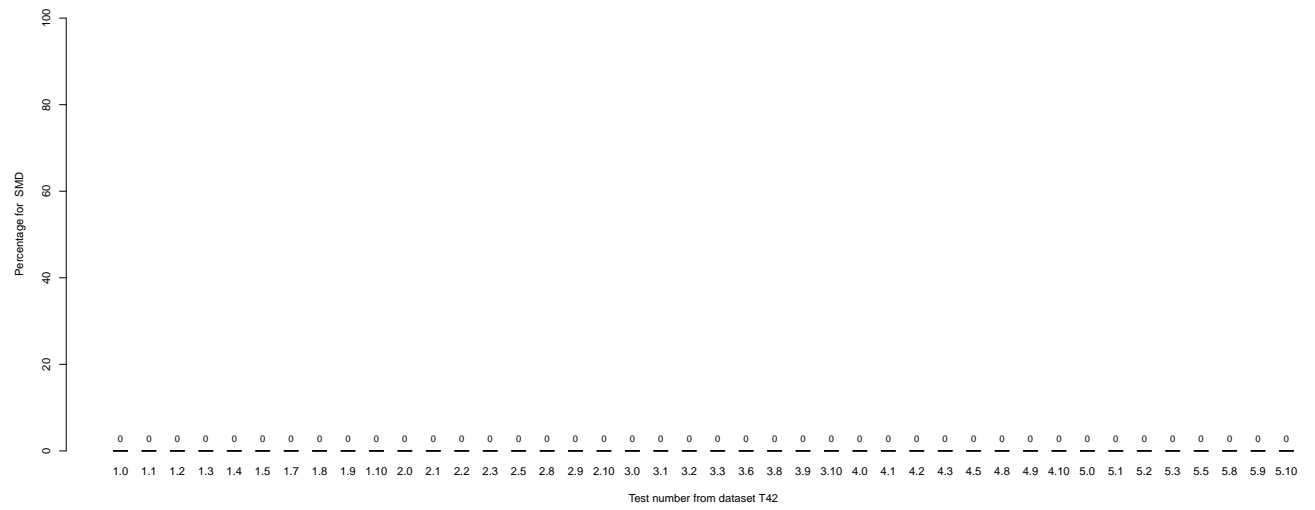
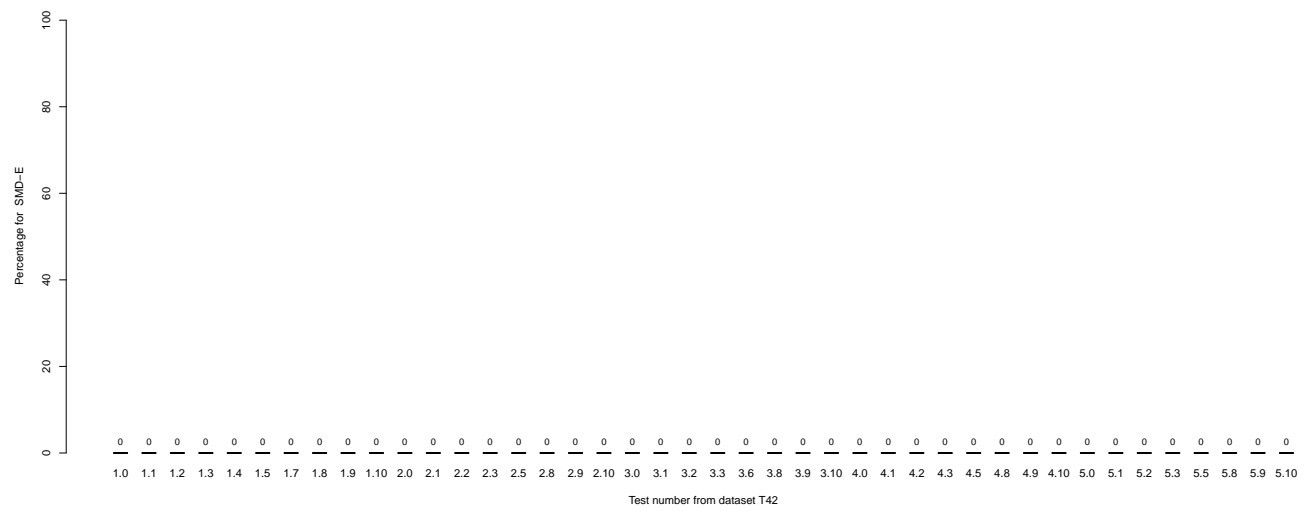


Fig. 27 Quality results for FRBR-ML with dataset T42 and metric IAD-P



**Fig. 28** Quality results for FRBR-ML with dataset T42 and metric SMD



**Fig. 29** Quality results for FRBR-ML with dataset T42 and metric SMD-E

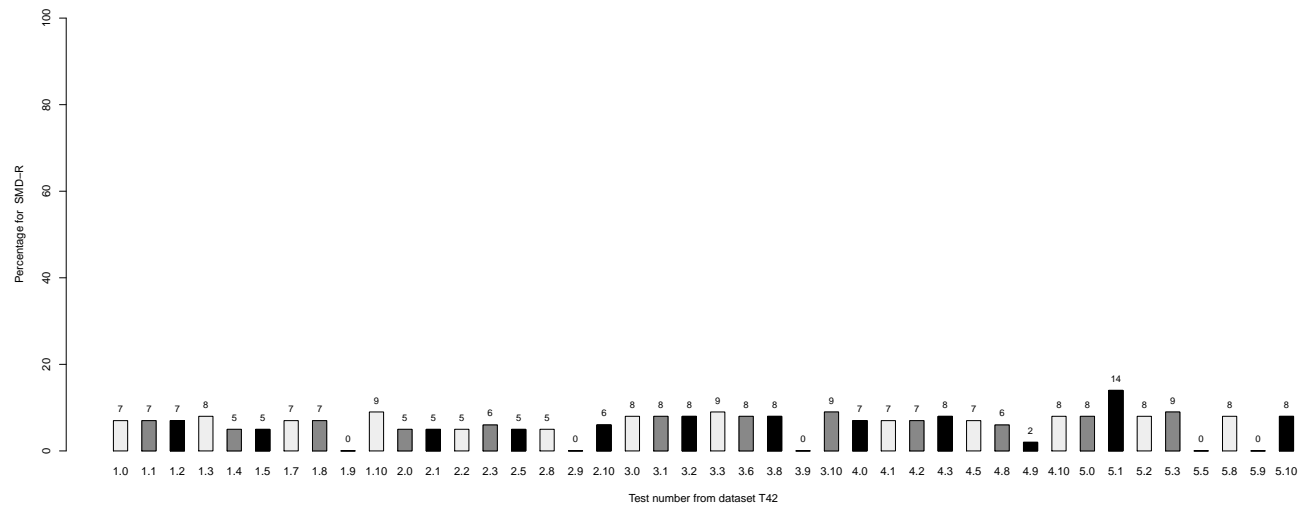


Fig. 30 Quality results for FRBR-ML with dataset T42 and metric SMD-R

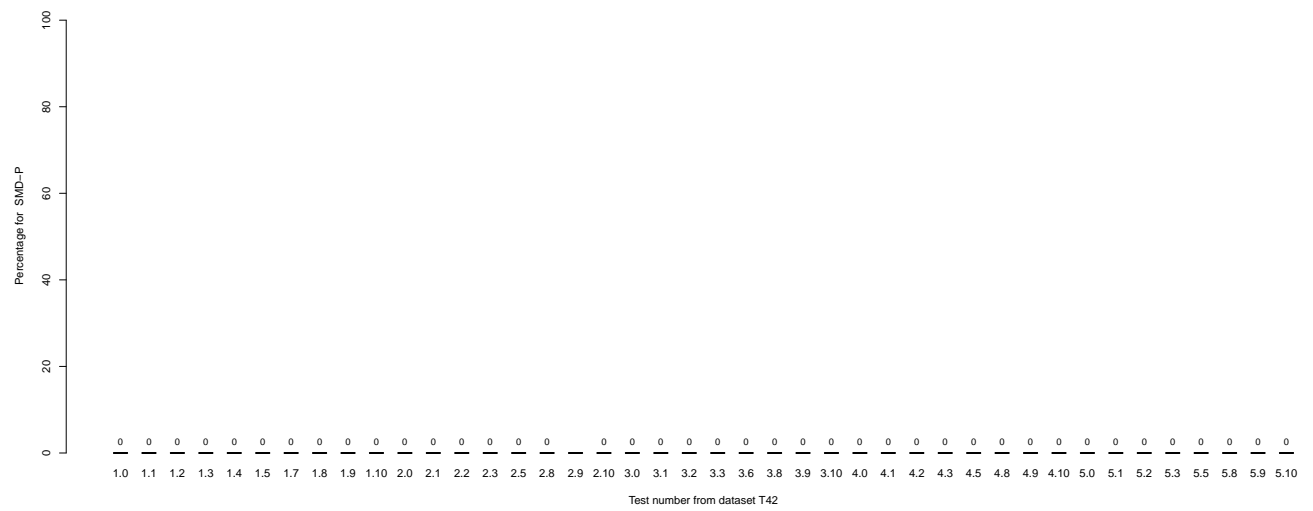


Fig. 31 Quality results for FRBR-ML with dataset T42 and metric SMD-P

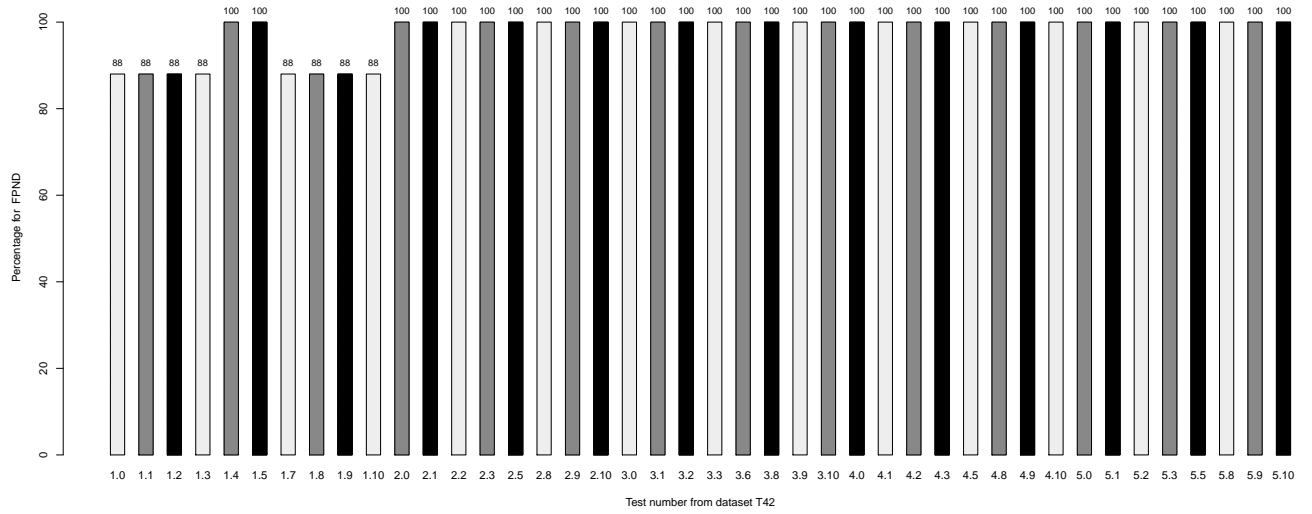


Fig. 32 Quality results for Variation/VFRBR with dataset T42 and metric FPND

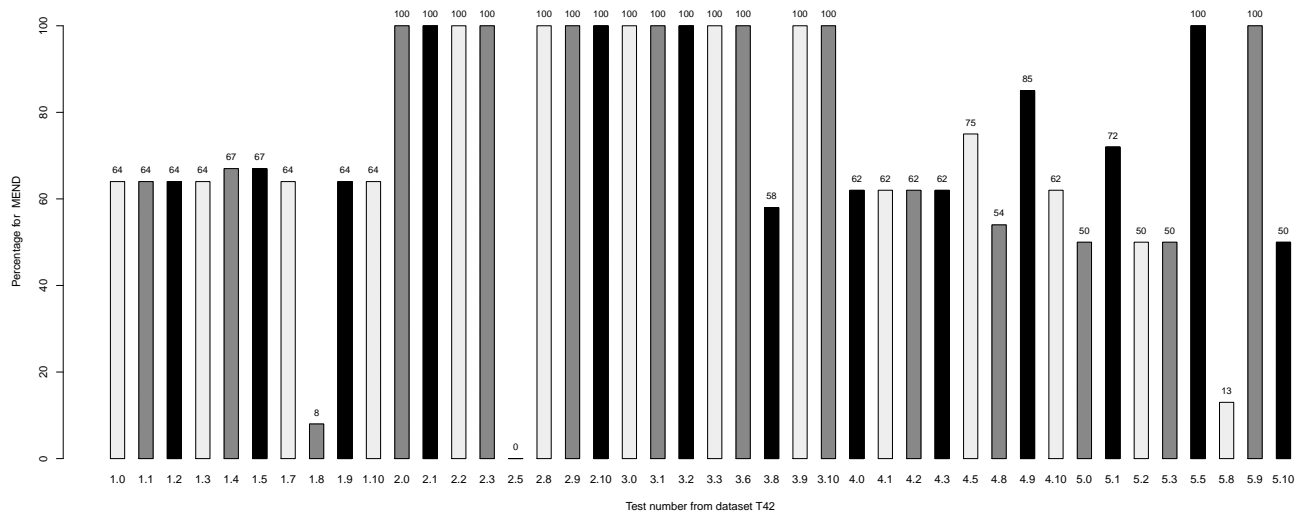


Fig. 33 Quality results for Variation/VFRBR with dataset T42 and metric MEND



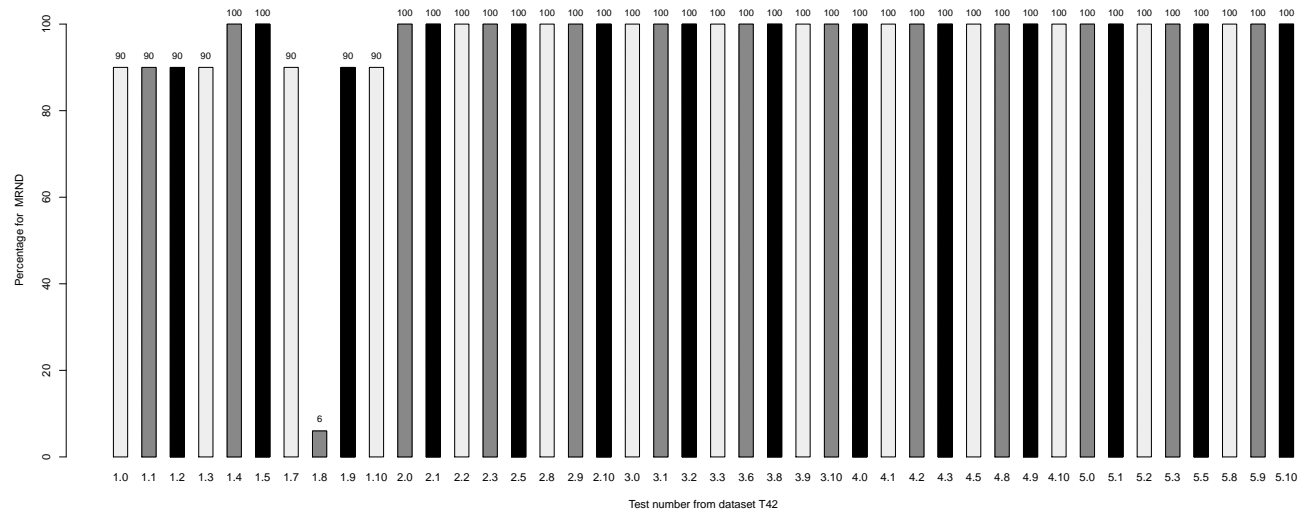


Fig. 34 Quality results for Variation/VFRBR with dataset T42 and metric MRND

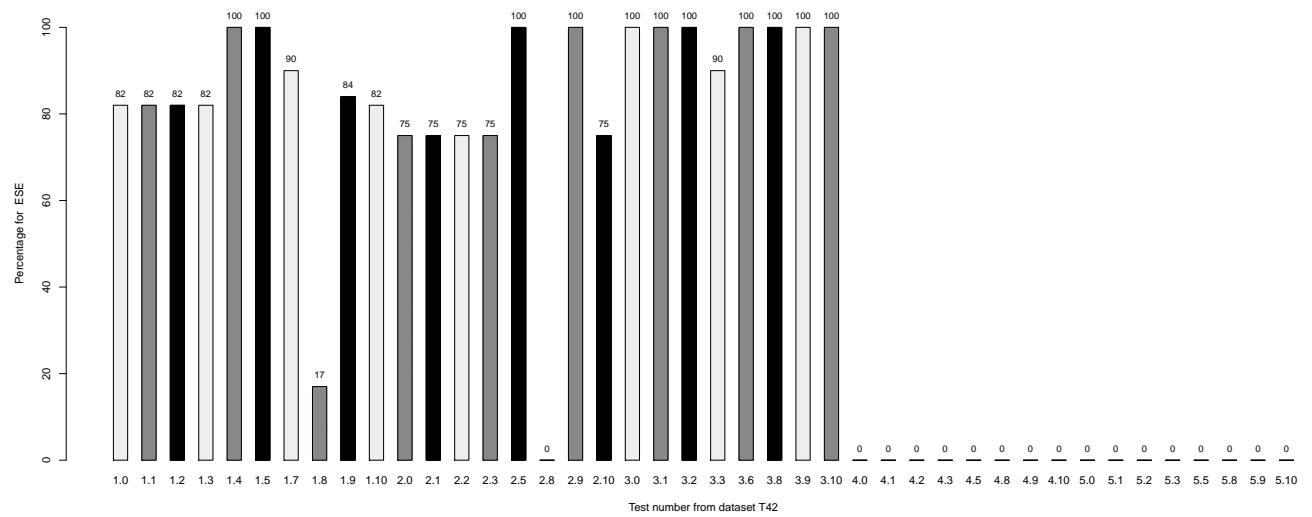
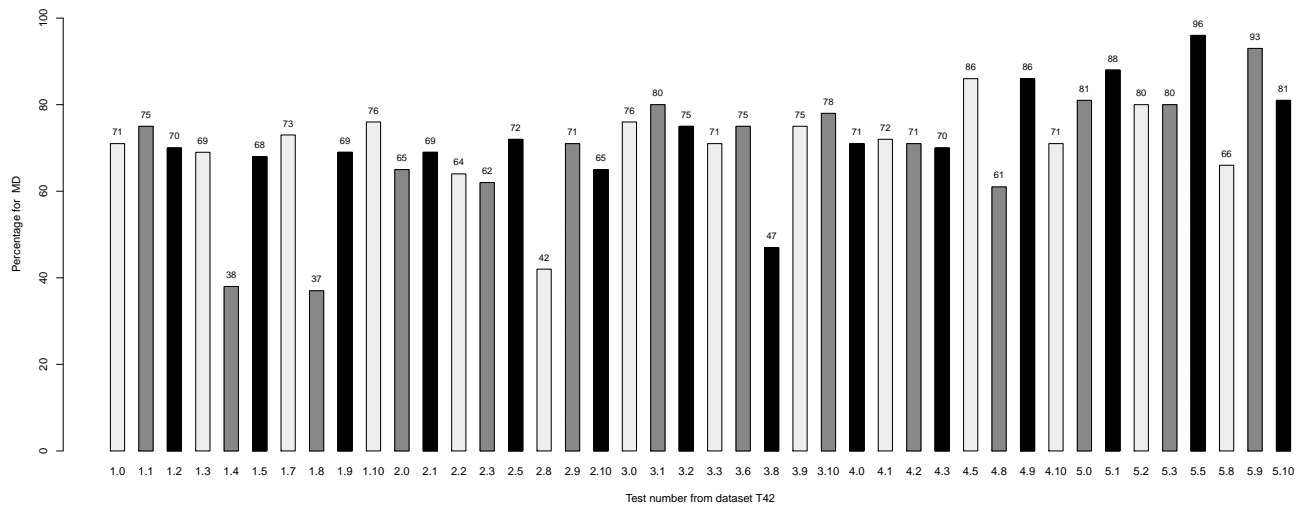
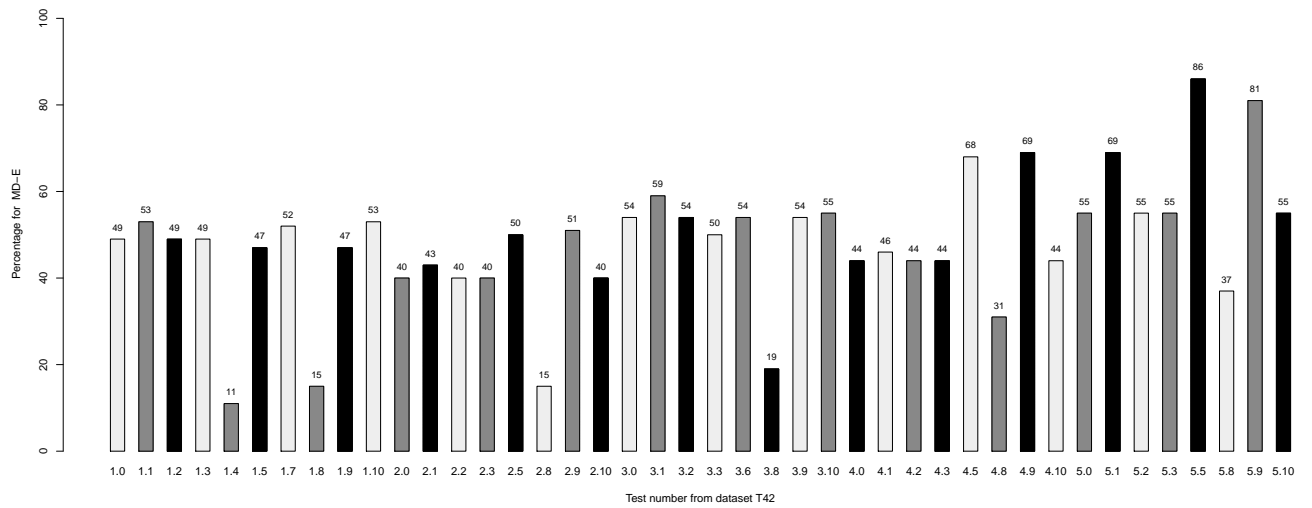


Fig. 35 Quality results for Variation/VFRBR with dataset T42 and metric ESE



**Fig. 36** Quality results for Variation/VFRBR with dataset T42 and metric MD



**Fig. 37** Quality results for Variation/VFRBR with dataset T42 and metric MD-E

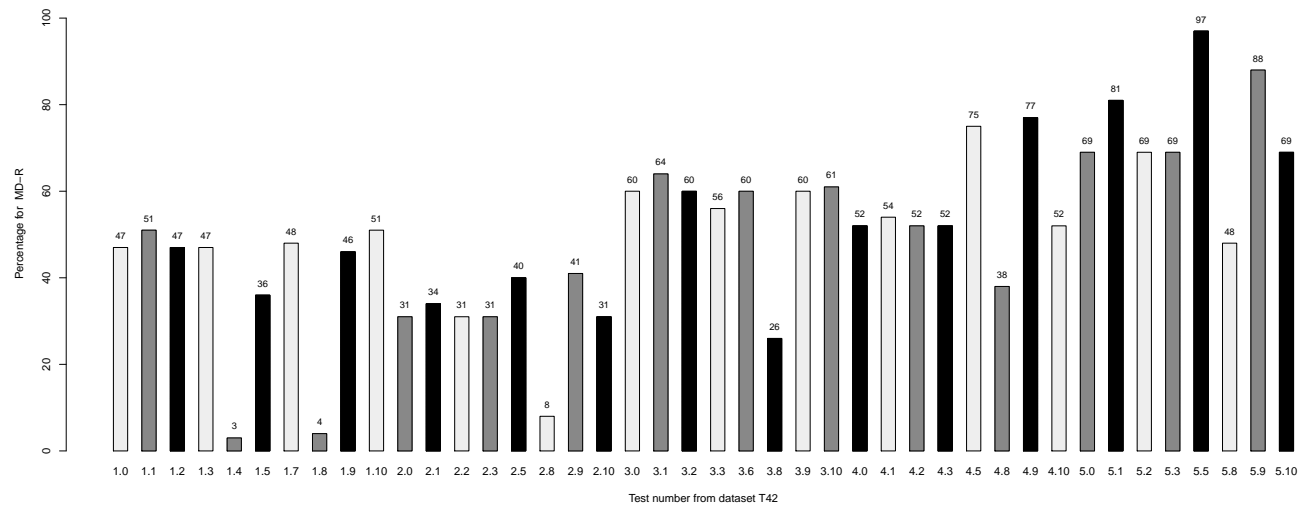


Fig. 38 Quality results for Variation/VFRBR with dataset T42 and metric MD-R

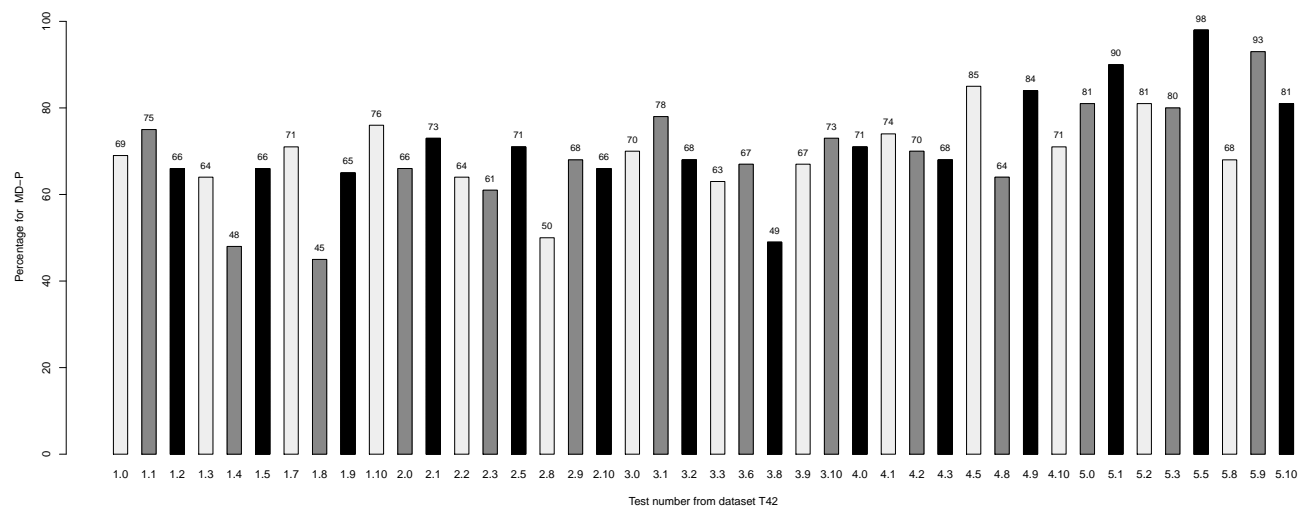
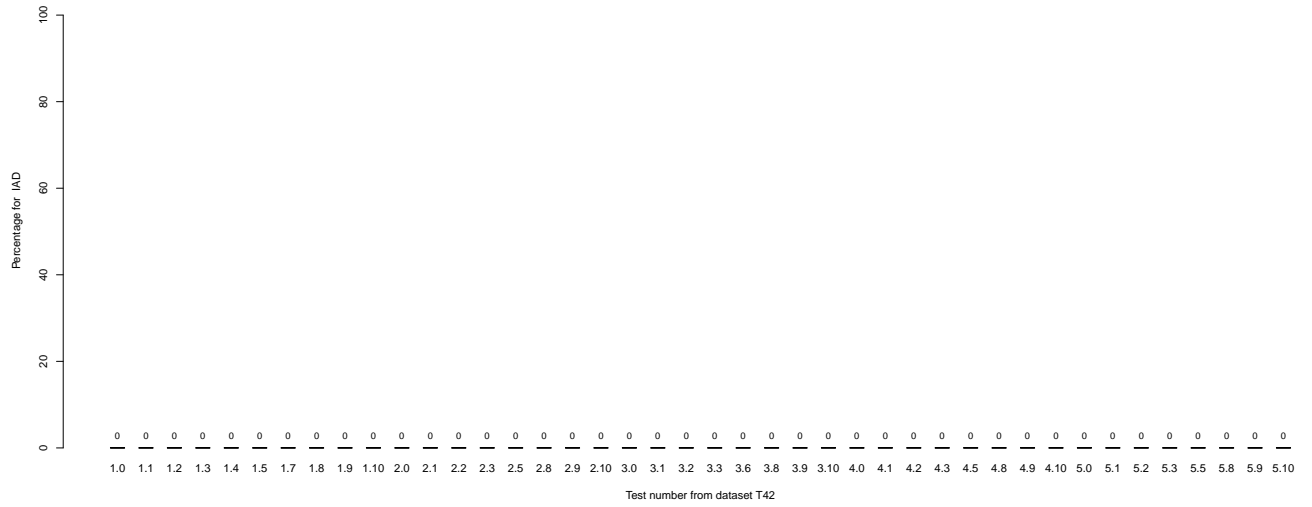
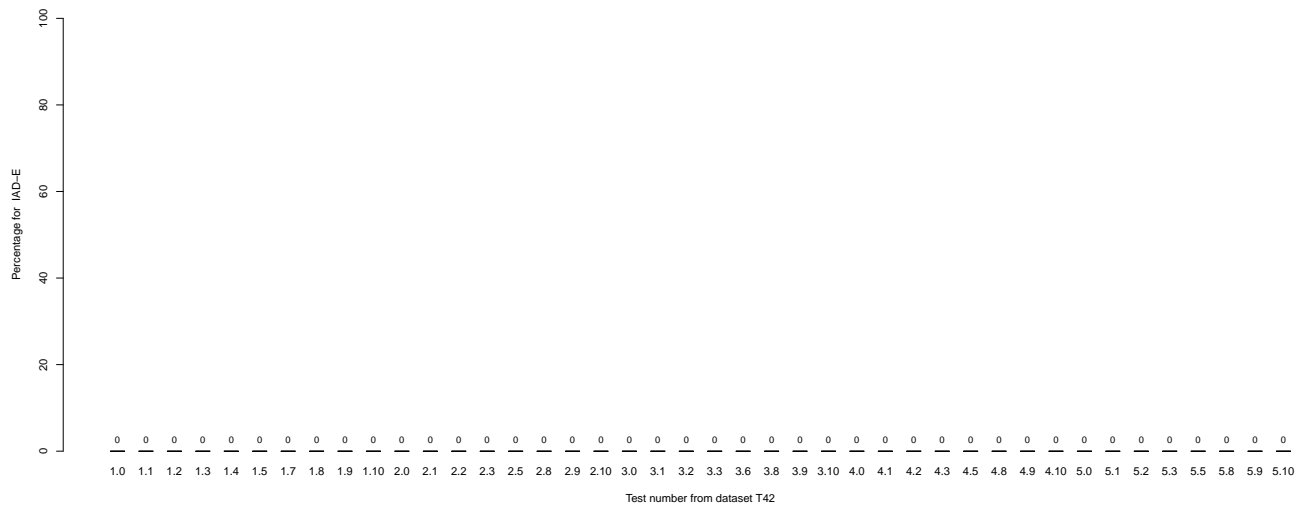


Fig. 39 Quality results for Variation/VFRBR with dataset T42 and metric MD-P



**Fig. 40** Quality results for Variation/VFRBR with dataset T42 and metric IAD



**Fig. 41** Quality results for Variation/VFRBR with dataset T42 and metric IAD-E

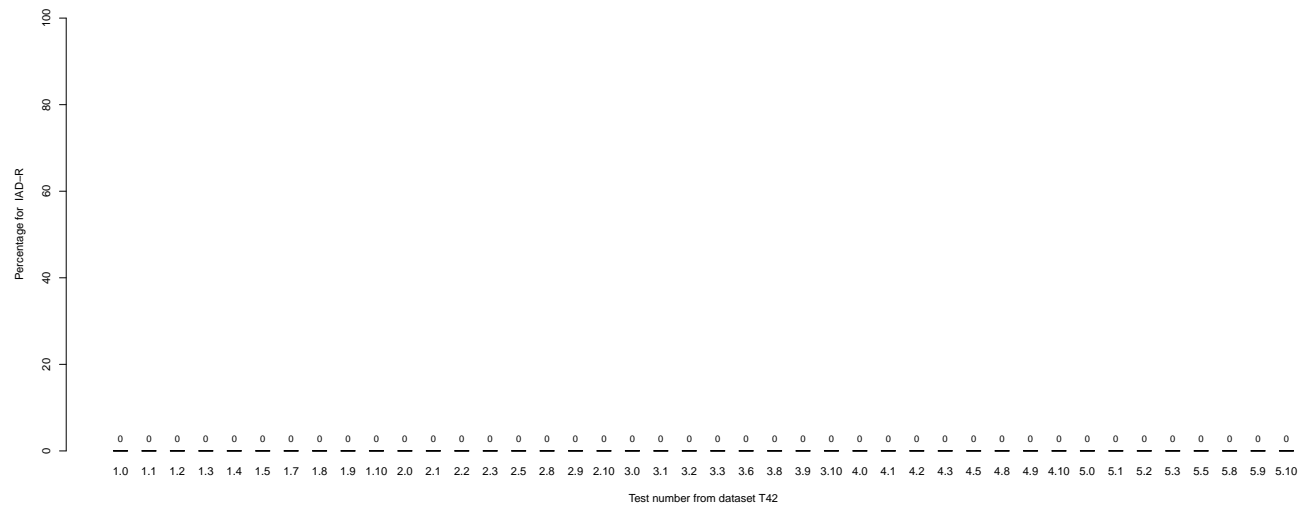


Fig. 42 Quality results for Variation/VFRBR with dataset T42 and metric IAD-R

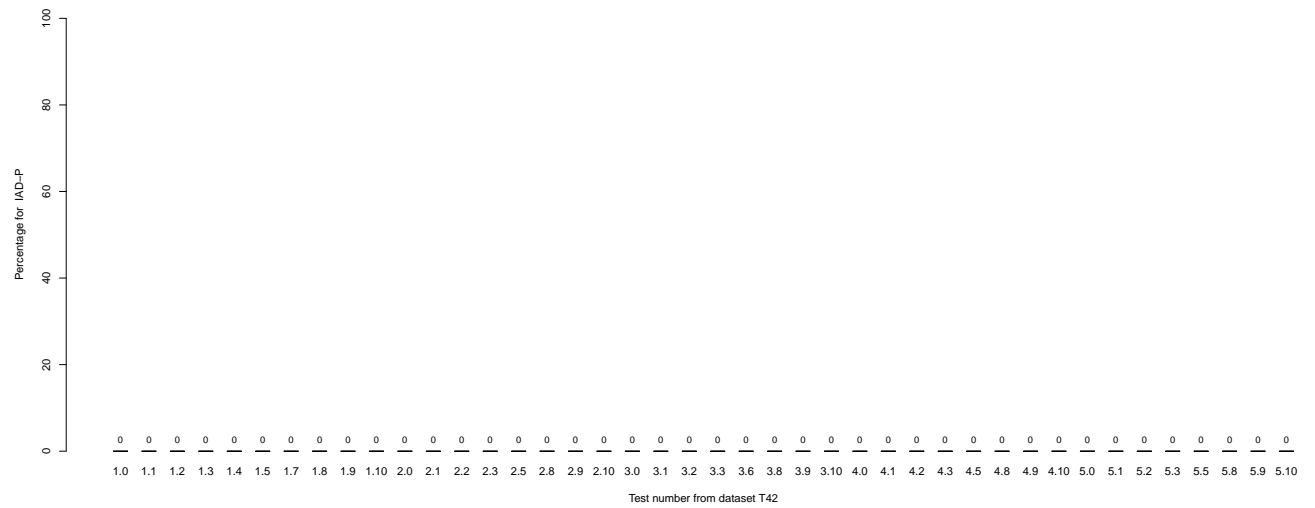
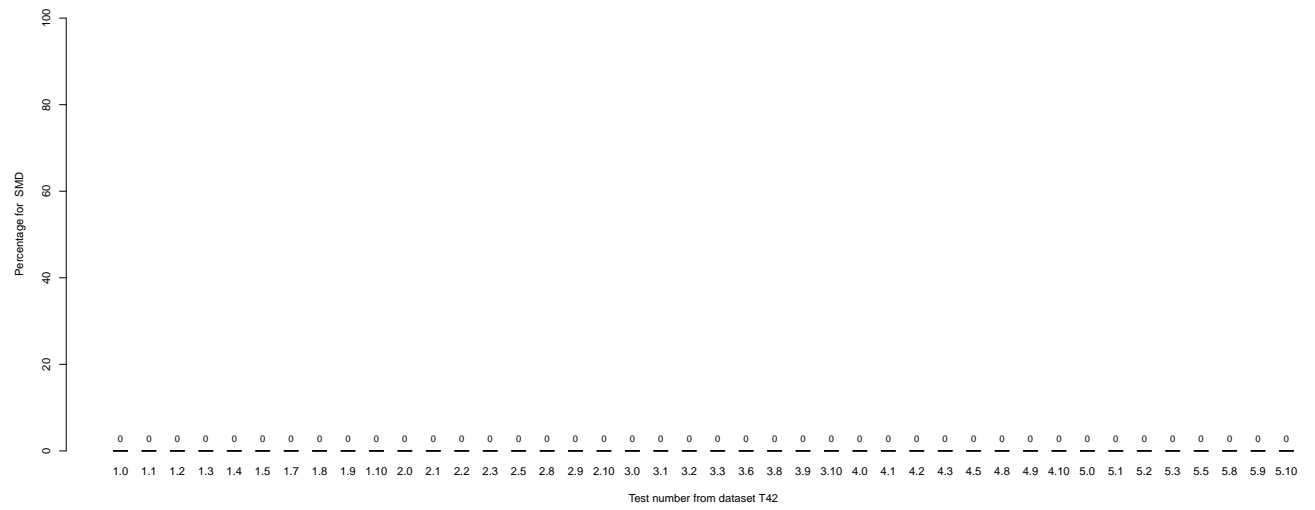
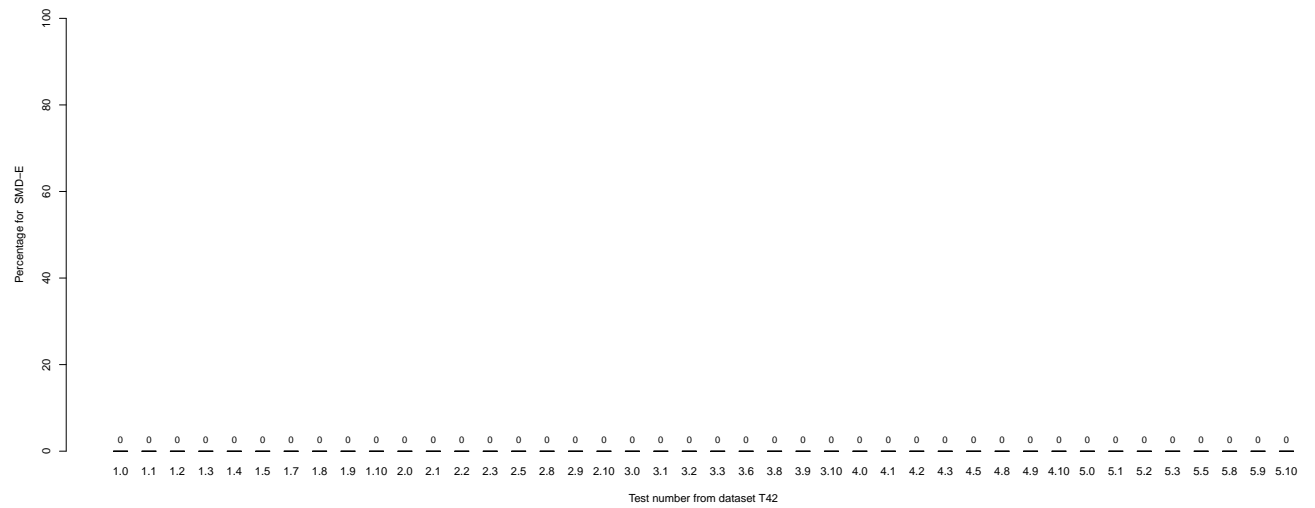


Fig. 43 Quality results for Variation/VFRBR with dataset T42 and metric IAD-P



**Fig. 44** Quality results for Variation/VFRBR with dataset T42 and metric SMD



**Fig. 45** Quality results for Variation/VFRBR with dataset T42 and metric SMD-E

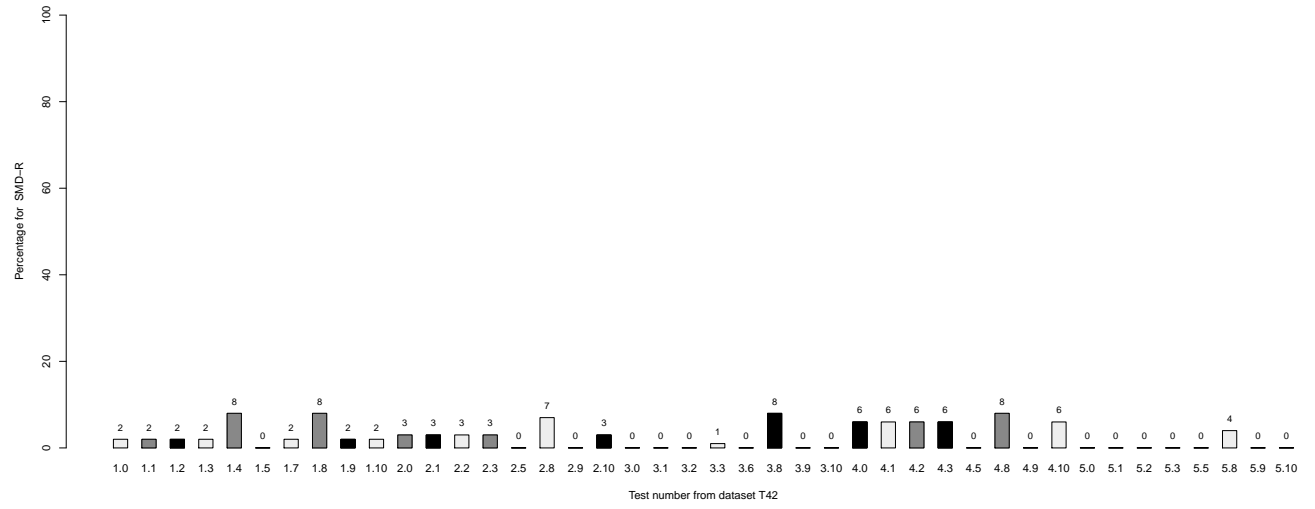


Fig. 46 Quality results for Variation/VFRBR with dataset T42 and metric SMD-R

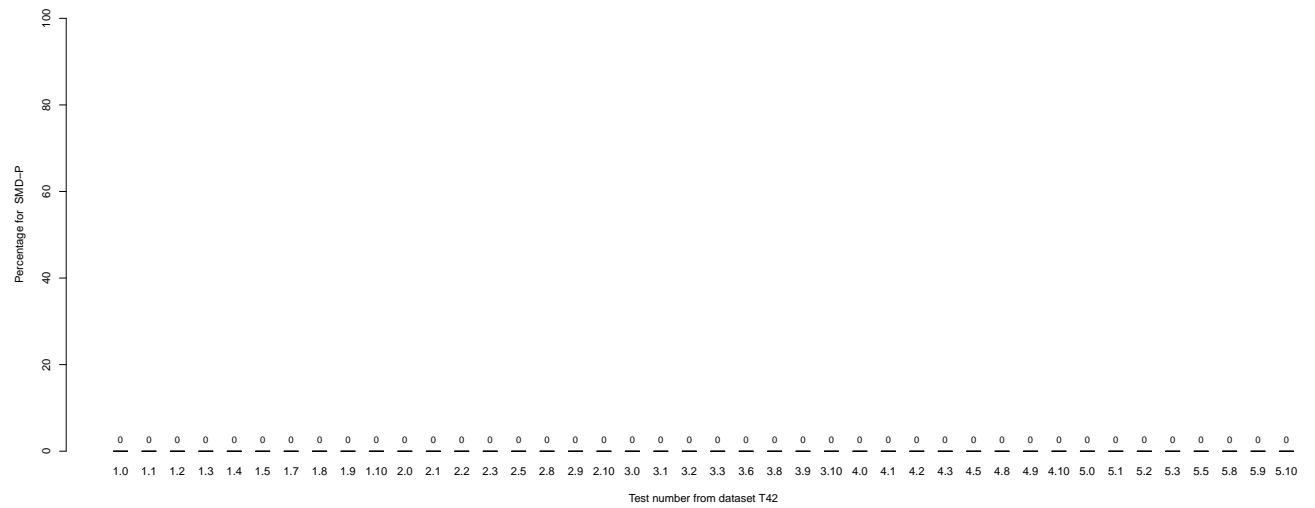


Fig. 47 Quality results for Variation/VFRBR with dataset T42 and metric SMD-P

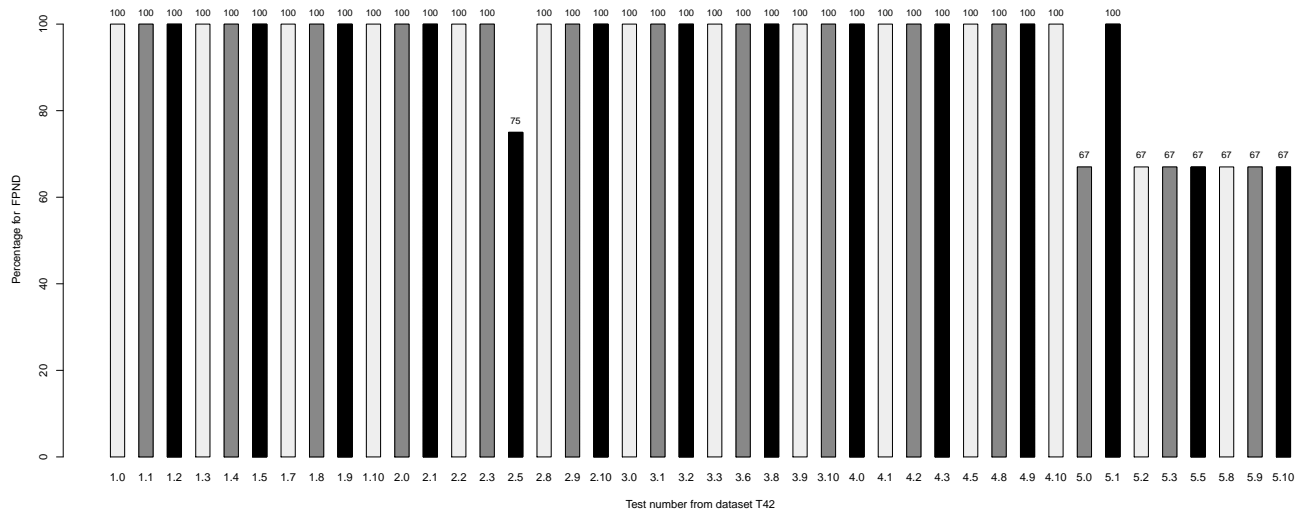


Fig. 48 Quality results for XC with dataset T42 and metric FPND

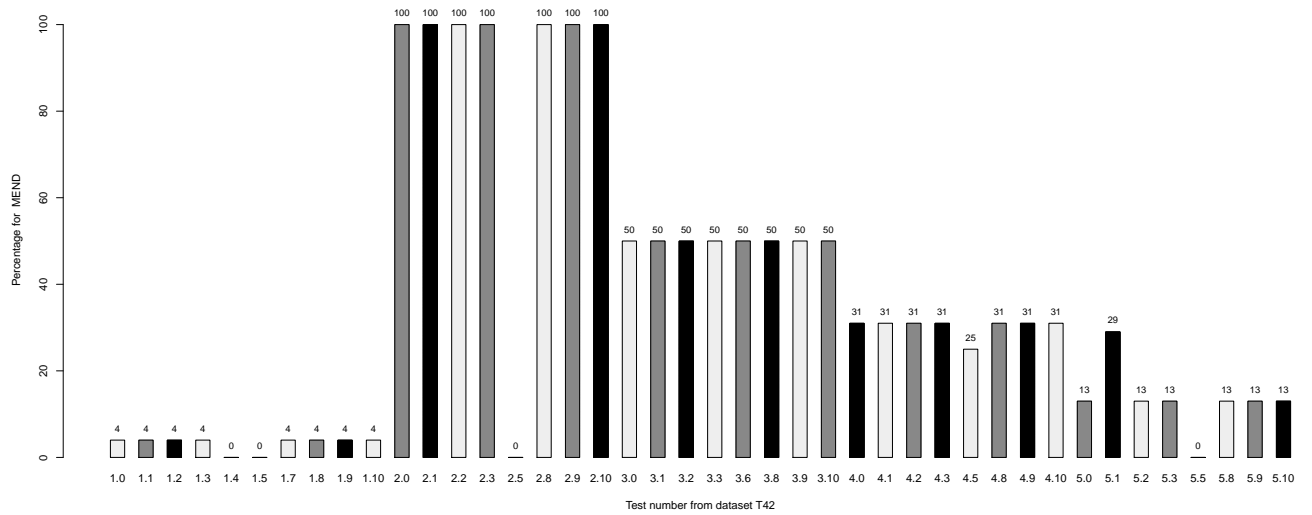


Fig. 49 Quality results for XC with dataset T42 and metric MEND



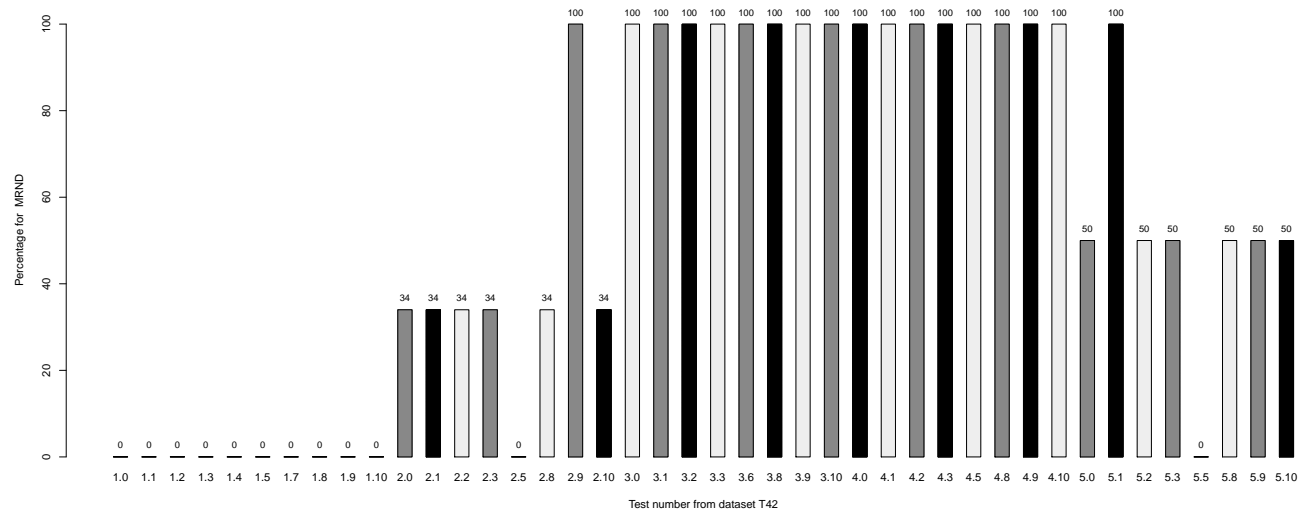


Fig. 50 Quality results for XC with dataset T42 and metric MRND

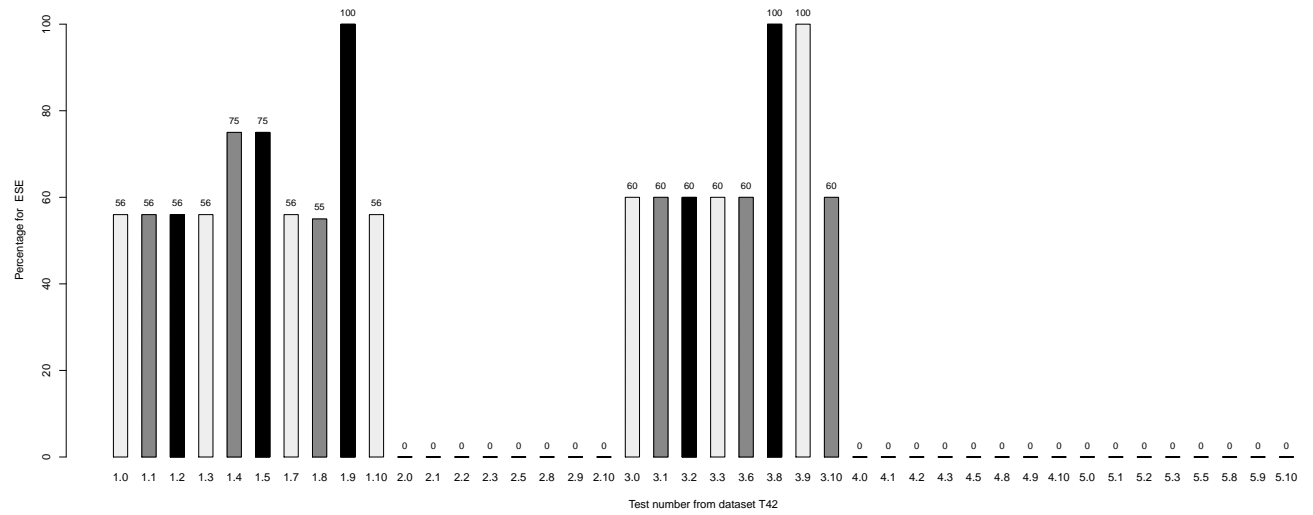
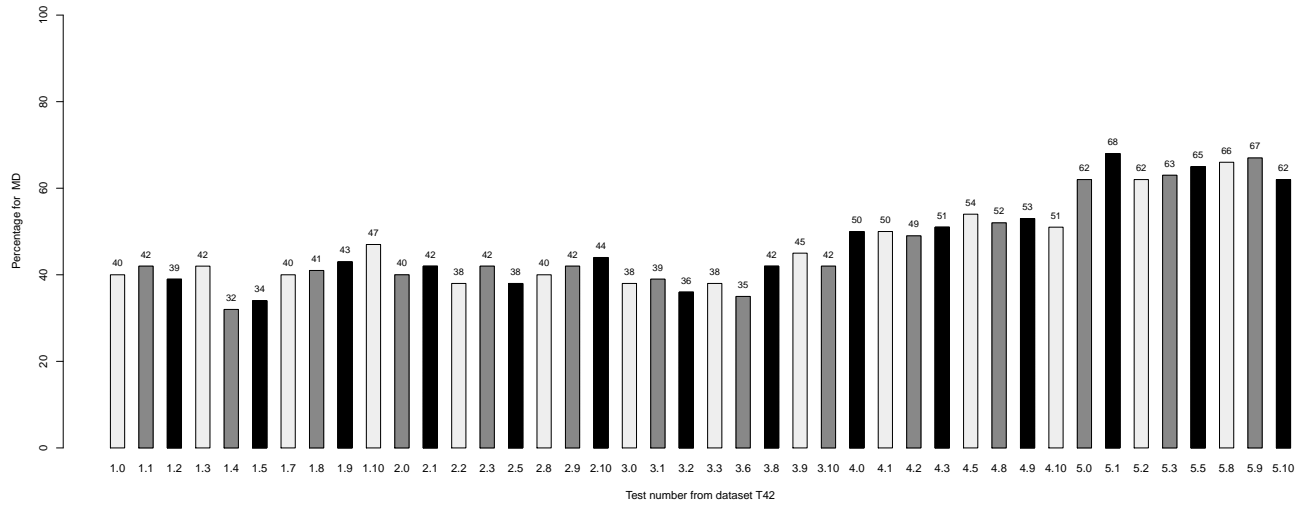
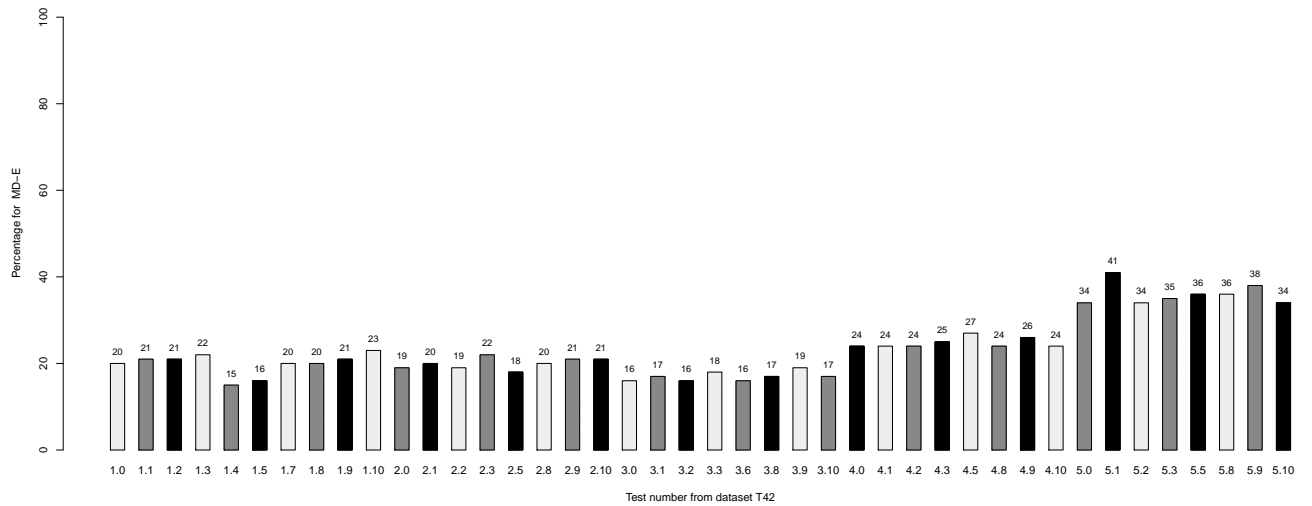


Fig. 51 Quality results for XC with dataset T42 and metric ESE



**Fig. 52** Quality results for XC with dataset T42 and metric MD



**Fig. 53** Quality results for XC with dataset T42 and metric MD-E

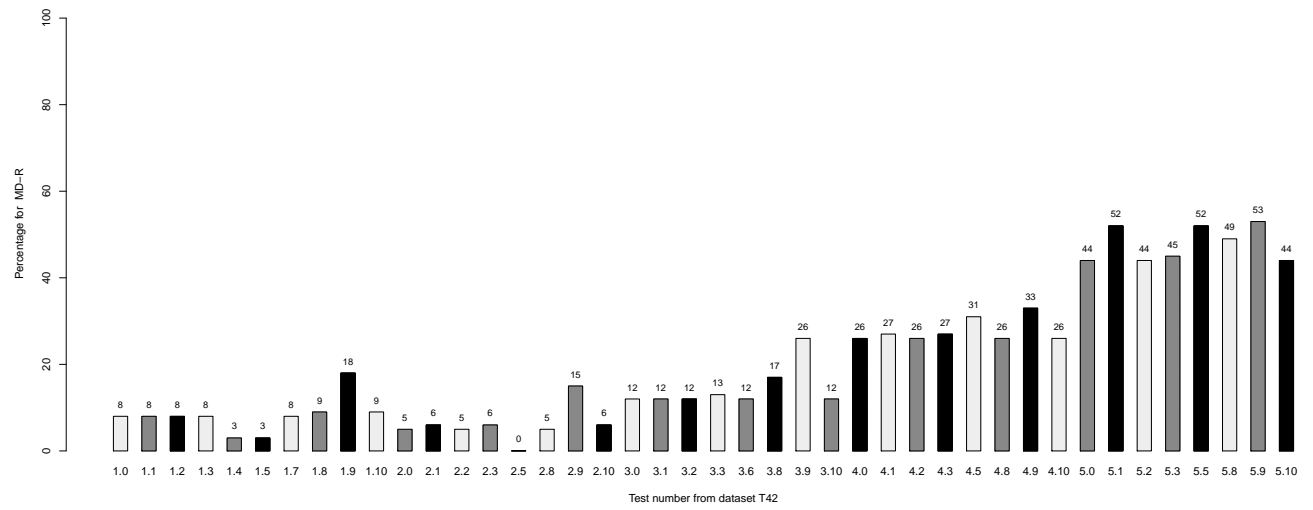


Fig. 54 Quality results for XC with dataset T42 and metric MD-R

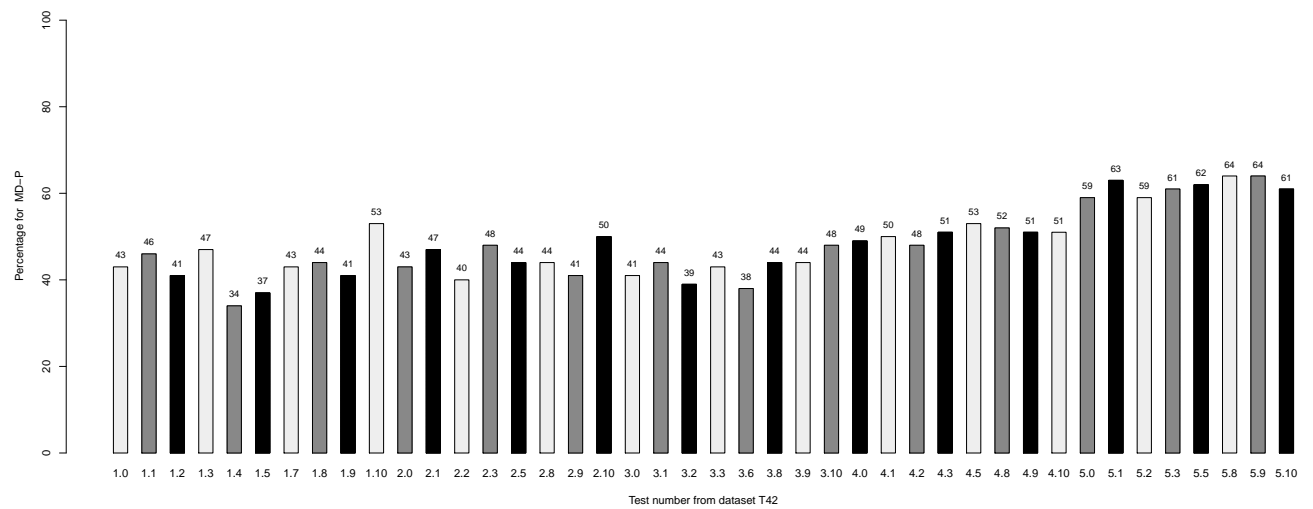
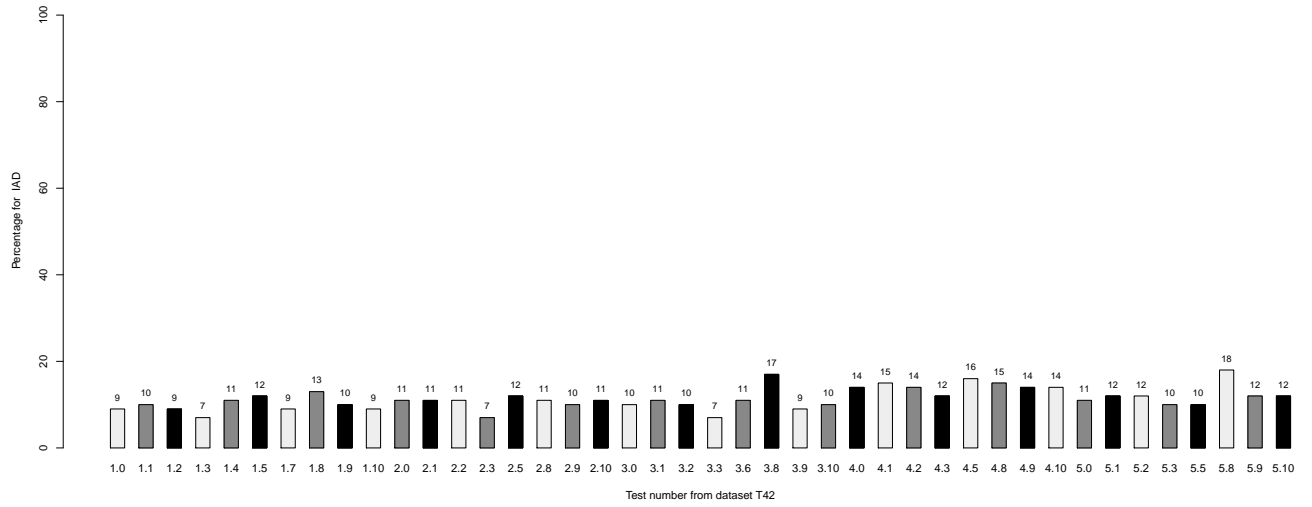
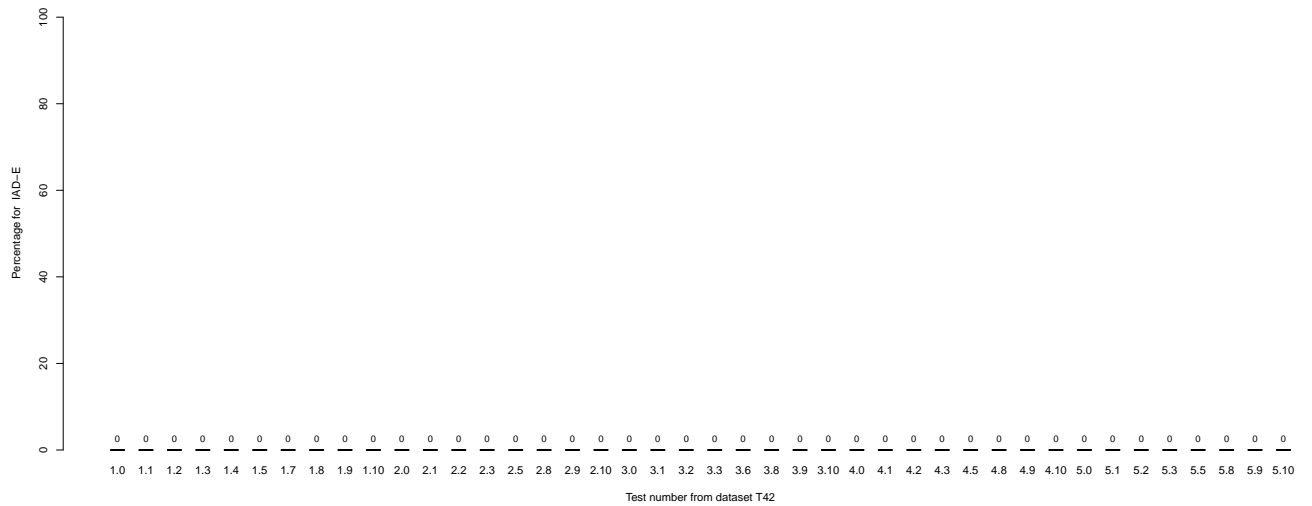


Fig. 55 Quality results for XC with dataset T42 and metric MD-P



**Fig. 56** Quality results for XC with dataset T42 and metric IAD



**Fig. 57** Quality results for XC with dataset T42 and metric IAD-E

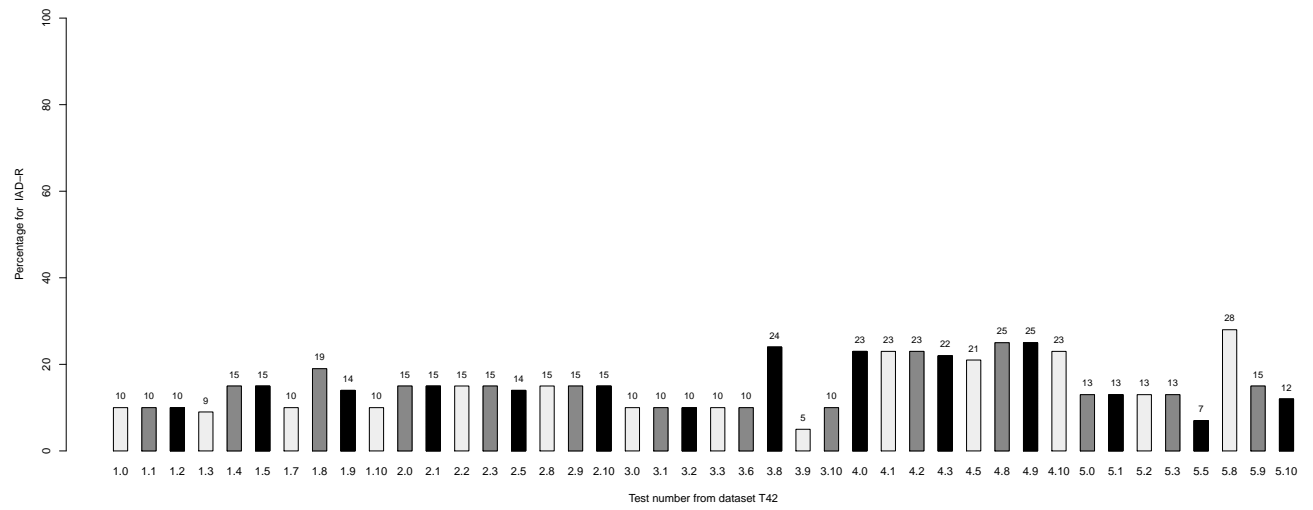


Fig. 58 Quality results for XC with dataset T42 and metric IAD-R

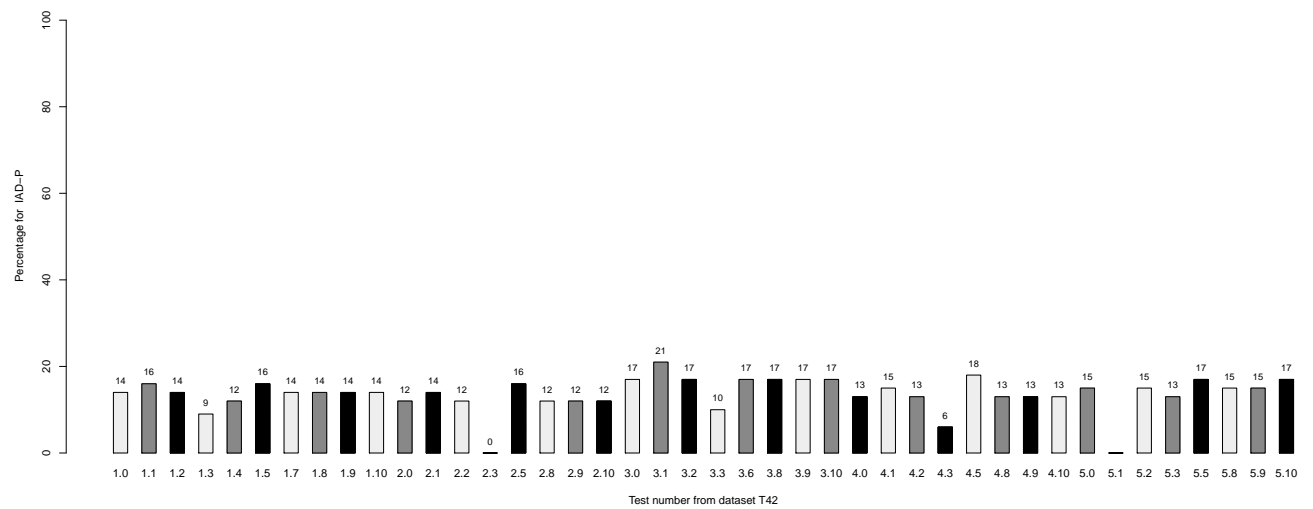
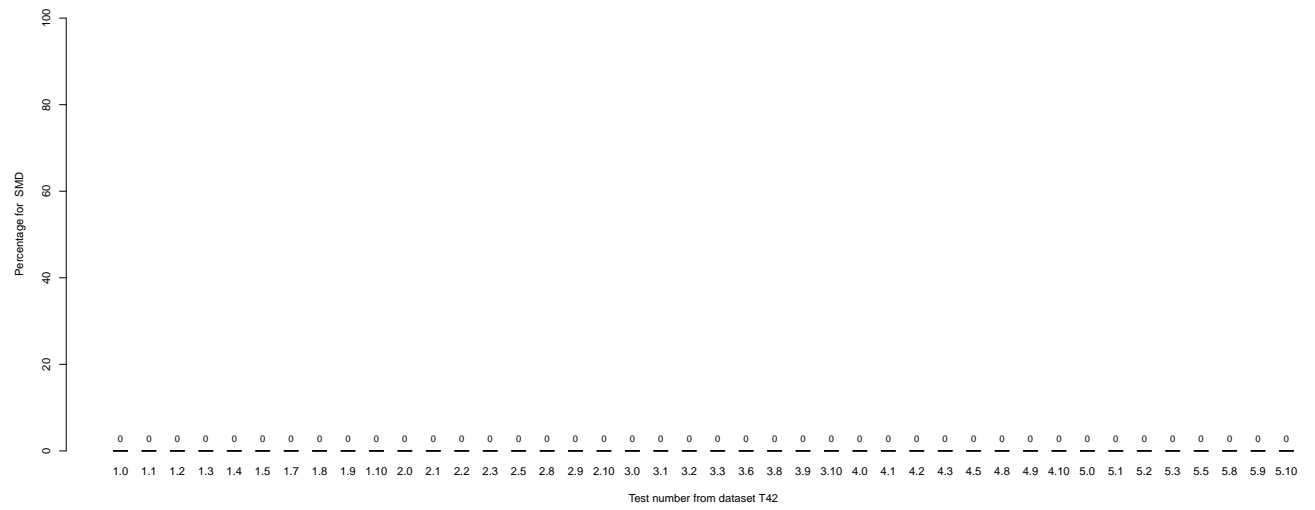
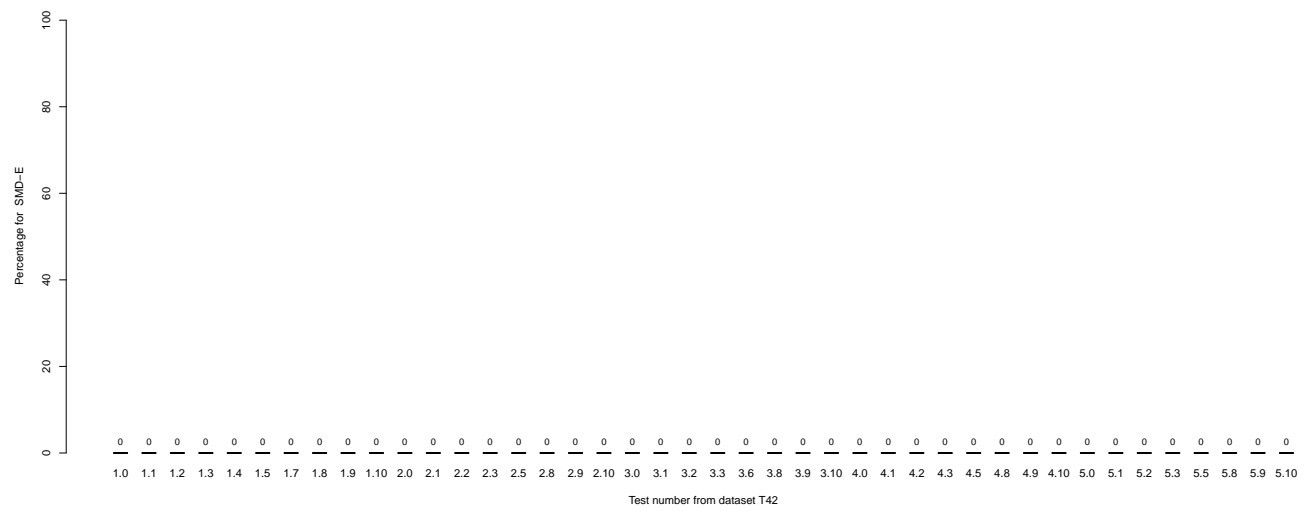


Fig. 59 Quality results for XC with dataset T42 and metric IAD-P



**Fig. 60** Quality results for XC with dataset T42 and metric SMD



**Fig. 61** Quality results for XC with dataset T42 and metric SMD-E

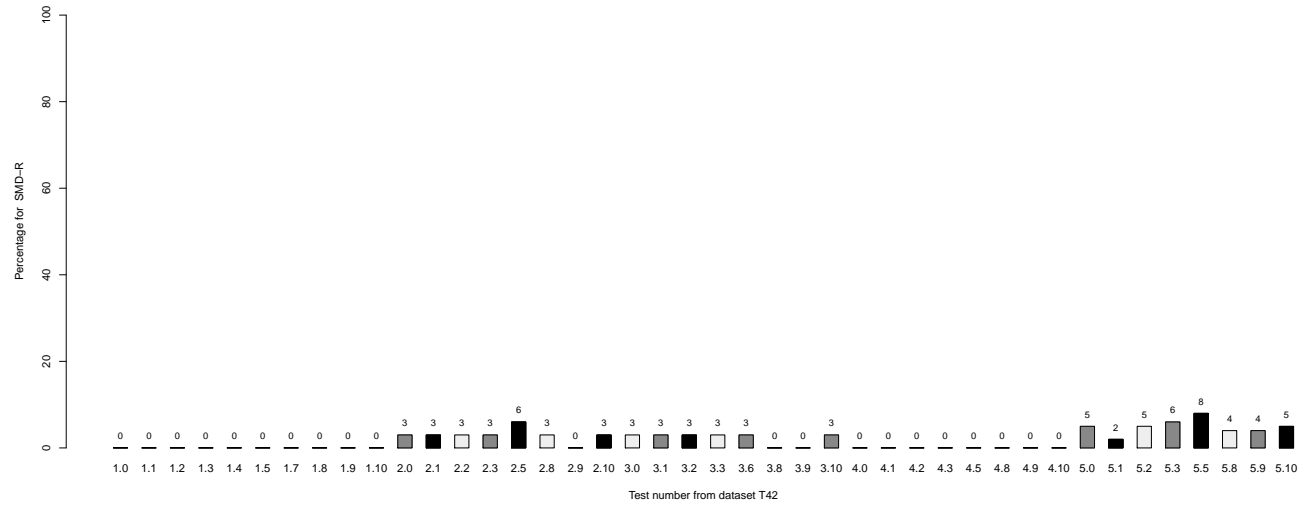


Fig. 62 Quality results for XC with dataset T42 and metric SMD-R

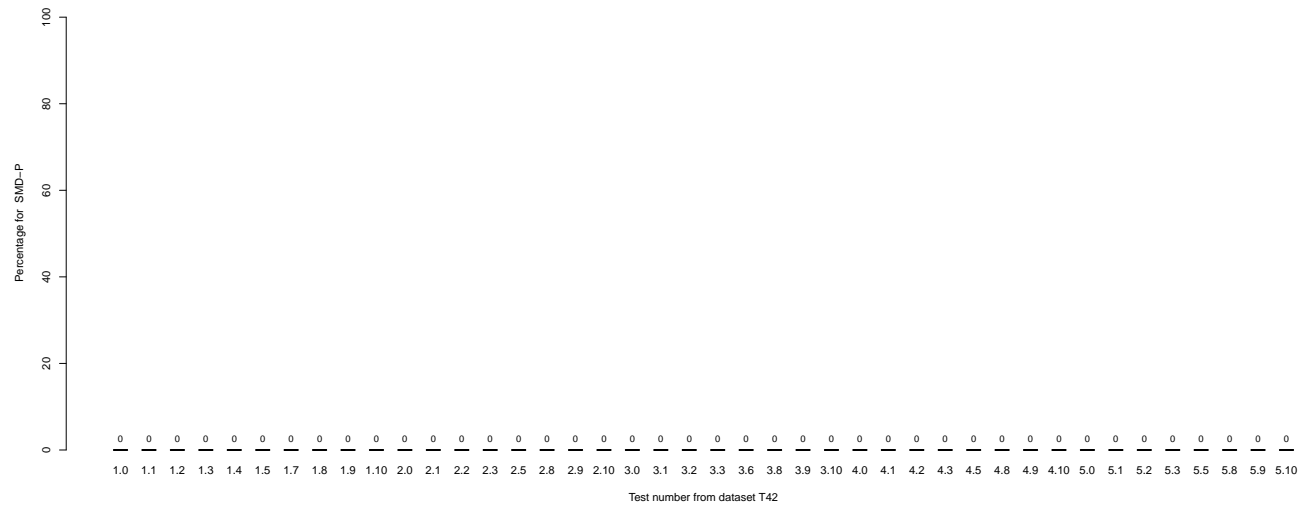
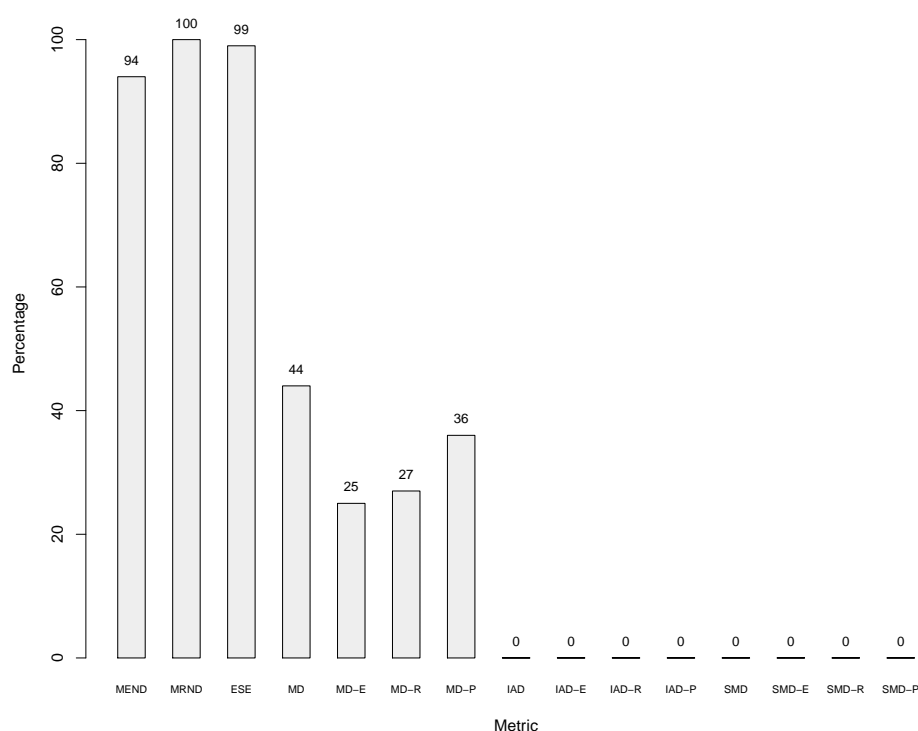


Fig. 63 Quality results for XC with dataset and metric SMD-P

### 3 Comparing tools in real-world context

The objective of this second experiment is to compare FRBRization tools in a real-world context using both FRBRization and post-FRBRization metrics. All tools rely on their basic set of rules (no tuning). Contrary to the dataset T42, all records from the dataset BIB-RCAT come from various institutions. This means that these real-world records can be rather simple or may contain several bibliographic patterns and issues. Note that the FRBRization metrics ETC, ETD and NRT could not be presented, because the tools did not implement these features. Instead, we provide the overall execution time for FRBRizing the dataset BIB-RCAT. The post-FRBRization metric DLE is also not given, since there exists many authority files or knowledge bases (e.g., Linked Open Data) and the expert FRBRized collection cannot include a link for each of these sources.

In the following plots, the results are organized by tool.



**Fig. 64** Quality results for FRBR-ML basic (no tuning) on dataset BIB-RCAT



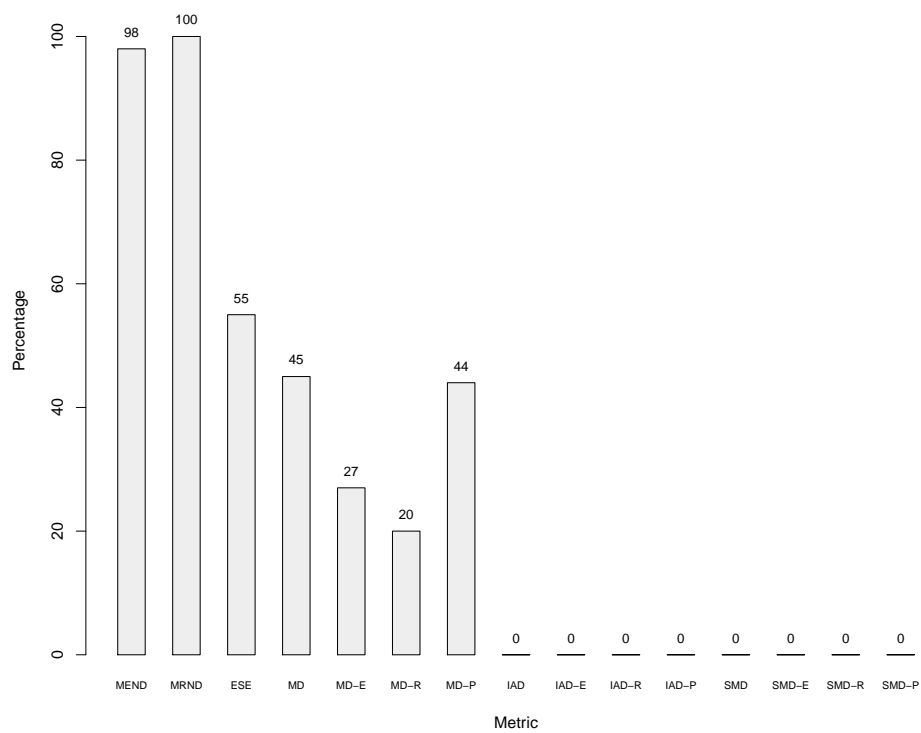
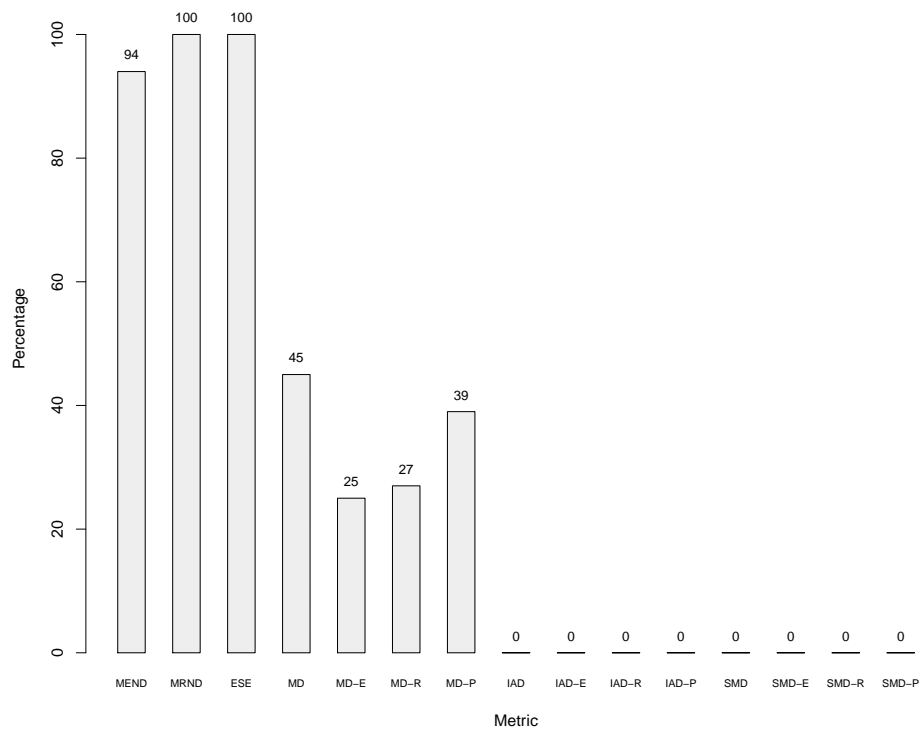
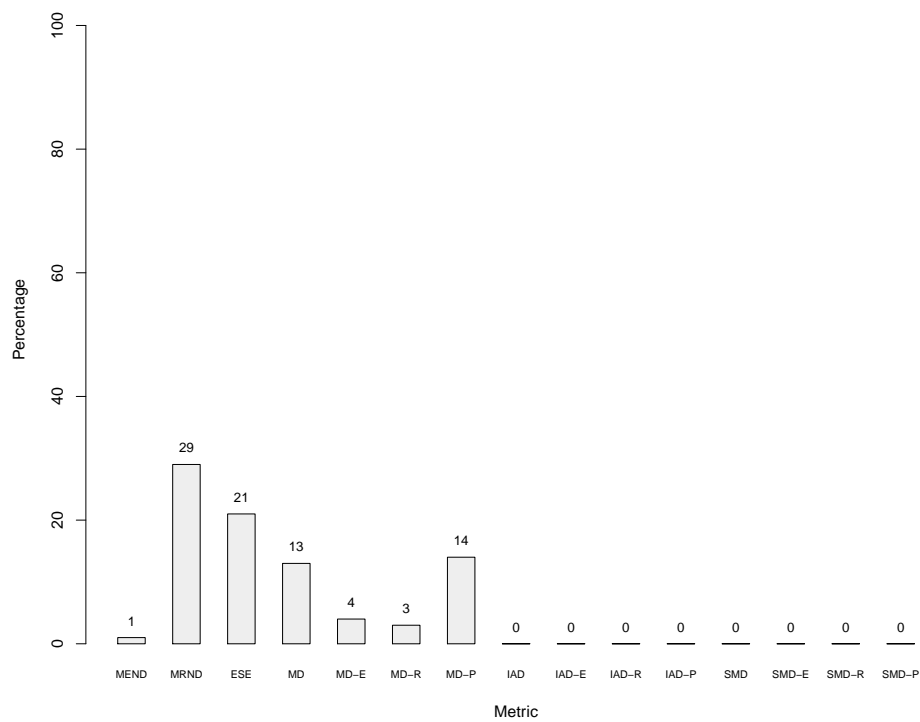


Fig. 65 Quality results for VFRBR on dataset BIB-RCAT



**Fig. 66** Quality results for XC on dataset BIB-RCAT



**Fig. 67** Quality results for FRBR-ML tuned (enhanced set of rules) on dataset BIB-RCAT

#### 4 Additional information about experiments

In this section, we provide screenshots of the tools that have been used during experiments.

Figure 68 depicts (an extract of) the FRBRized collection of the BIB-RCAT dataset using FRBR-ML.

**FRBR-ML v0.1**

This is a user-friendly display of XML file: /Users/takhirov/Dropbox/projects/FRBR-ML/examples/marc21/output/frbr.example.records.xml

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**Mireille l'abeille (Krings, Antoon)**  
 Mireille l'abeille  
 Antoon Krings / Mireille l'abeille  
 Antoon Krings / Mireille l'abeille  
 Antoon Krings / Mireille l'abeille  
 Antoon Krings / Mireille l'abeille

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**Un sac de billes (Joffo, Joseph)**  
 Un sac de billes  
 Joseph Joffo; illustrations Claude Lapointe / Un sac de billes  
 Joseph Joffo; illustrations Claude Lapointe / Un sac de billes

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**La Vénus d'Ille (Mérimée, Prosper)**  
 La Vénus d'Ille ; La chambre bleue La Vénus d'Ille  
 Prosper Mérimée; Prosper Mérimée / La Vénus d'Ille ; La chambre bleue  
 Mérimée; édition Dominique Fleur-Schulthess, Claudine Zenou-Grinstein / La Vénus d'Ille

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**Les allumettes suédoises (Sabatier, Robert)**  
 Les allumettes suédoises  
 Robert Sabatier; lu par Jean Barrier / Les allumettes suédoises  
 Robert Sabatier / Les allumettes suédoises  
 Robert Sabatier; illustrations Louis Constantin / Les allumettes suédoises  
 Robert Sabatier; illustrations Louis Constantin / Les allumettes suédoises  
 Robert Sabatier; illustrations Louis Constantin / Les allumettes suédoises

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**Tous à poil ! (Franek, Claire)**  
 Tous à poil !  
 Claire Franek, Marc Daniau / Tous à poil !

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**Les contes bleus du chat perché (Aymé, Marcel)**  
 Les contes bleus du chat perché  
 Marcel Aymé; illustrations Claudine et Roland Sabatier / Les contes bleus du chat perché

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**Un sac de billes (Bouton, Alain)**  
 Un sac de billes  
 d'après Joseph Joffo; scénario Alain Bouton; dessins Marc Malès / Un sac de billes

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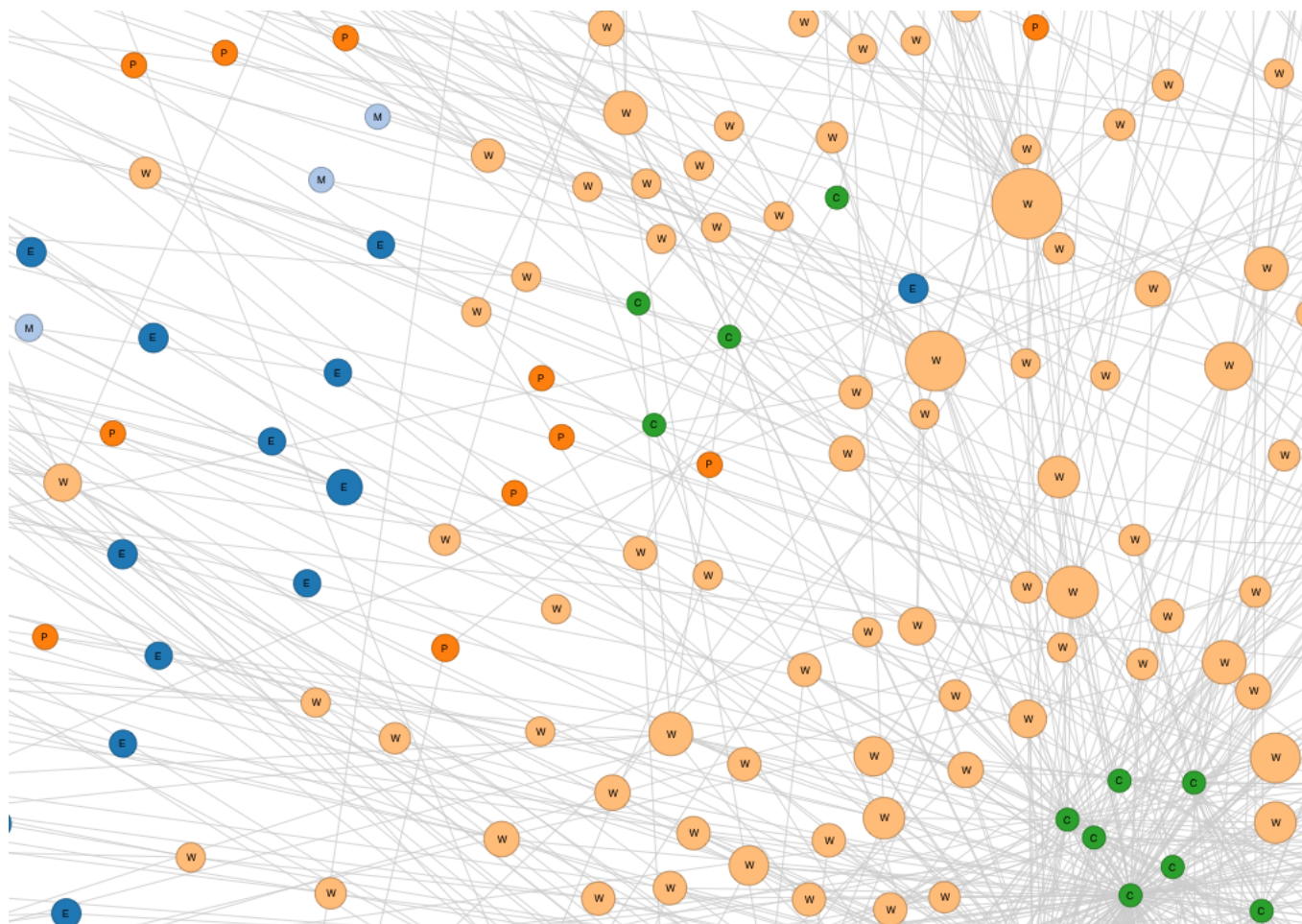
**365 contes pour tous les âges (Bloch, Muriel)**  
 365 contes pour tous les âges  
 Muriel Bloch; illustrations Mireille Vautier / 365 contes pour tous les âges  
 Muriel Bloch; illustrations Grégoire Solotareff / 365 contes pour tous les âges  
 Muriel Bloch / 365 contes pour tous les âges

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**La belle lisse poire du prince de Motordu ()**  
 La belle lisse noire du prince de Motordu : et 4 autres histoires La belle lisse noire du

Fig. 68 Extract of the FRBRized BIB-RCAT dataset in FRBR-ML

Figure 69 depicts (an extract of) the relationships between FRBR entities in the FRBRized collection of the BIB-RCAT dataset using FRBR-ML.



**Fig. 69** Extract of a graph-based visualization of the FRBRized BIB-RCAT dataset in FRBR-ML

Figure 70 depicts (an extract of) the FRBRized collection of the BIB-RCAT dataset using Variations (Scherzo).

The screenshot shows a web browser window with the URL `dijon.idi.ntnu.no:8085/scherzo/SearchResults.action?sKeyword=%3A*&sManifType=&submit=Submit&_sourcePage=-uULSJpYbNGdWihUtBib3hooltNjLffRTW...`. The page header includes the Indiana University logo and the text "INDIANA UNIVERSITY". The main heading is "Scherzo" with a "New search" link. Below the heading, the search criteria are displayed as "Search: "\*" as Keyword." with a "Modify Search" link.

The results are organized into three sections:

- Browse Results By:** A sidebar with two categories: "Creator/Composer" and "hide... Performer/Conductor or Arranger/Editor".
- Works: 207 results for "\*" as Keyword**
  1. La Fontaine, Jean de  
[show...](#)
  2. Brunhoff, Jean de  
[show...](#)
  3. Guillot, Ren  
[show...](#)
  4. Daudet, Alphonse  
[show...](#)
  5. Molière  
[show...](#)
- Recordings/Scores: 560 results for "\*" as Keyword**
  1. **Fables. racontés par Louis de Funès; illustrations Bruno Robert.** Paris Formulette production 17/06/2015.  
Contents: Les fables de La Fontaine  
People: La Fontaine, Jean de  
Copies: [See Catalog](#)
  2. **Histoire de Babar : le petit lionnet.** Jean de Brunhoff. Vanves (Hauts-de-Seine) Hachette Jeunesse 09/06/2015.  
Contents: Histoire de Babar  
People: Brunhoff, Jean de  
Copies: [See Catalog](#)
  3. **Crin-Blanc.** Ren Guillot; d'après le film d'Albert Lamorisse; illustrations Akos Szabo. Paris Le Livre de poche jeunesse 09/06/2015.  
Contents: Crin-Blanc  
People: Guillot, Ren  
Copies: [See Catalog](#)
  4. **Les lettres de mon moulin.** Alphonse Daudet. Paris Libro 28/08/2013.  
Contents: Lettres de mon moulin  
People: Daudet, Alphonse  
Copies: [See Catalog](#)
  5. **Les fourberies de Scapin.** Molière. Paris Libro 28/08/2013.  
Contents: Les fourberies de Scapin  
People: Molière  
Copies: [See Catalog](#)
  6. **La belle et la bête. Riquet à la houppe. La Belle aux cheveux d'or La belle et la bête; Riquet à la houppe; La Belle aux cheveux d'or.** madame Leprince de Beaumont; d'édition présentée par Nicolas Saulais. Paris Nathan 23/08/2013.  
Contents: La Belle et la Bête  
People: Leprince de Beaumont, Jeanne-Marie  
Copies: [See Catalog](#)
  7. **pièce anonyme La farce de maître Pathelin.** d'édition présentée, annoté et commenté par Thierry Revol; traduction de Alain Miç. Paris Larousse 21/08/2013.  
Copies: [See Catalog](#)
  8. **Les allumettes suédoises.** Robert Sabatier; lu par Jean Barrier. La Bazoge (Sarthe) Cdl Ed. livres audio 28/06/2013.  
Contents: Les allumettes suédoises  
People: Sabatier, Robert  
Copies: [See Catalog](#)
  9. **Yvain ou Le chevalier au lion : extraits choisis.** Chrétien de Troyes; traduction en français moderne et appareil pédagogique établis par Hildegarde Dardelin; lexique établi par Michèle Sendre. Paris Magnard 21/06/2013.  
Contents: Yvain ou Le chevalier au lion  
People: Chrétien de Troyes; Dardelin, Hildegarde

Fig. 70 Extract of the FRBRized BIB-RCAT dataset in Scherzo (Variations/VFRBR)

Below we present the interpretation of a MARC record in FRBR using XC. Figure 71 depicts the initial MARC record. Figures 72, 73 and 74 respectively illustrate the FRBRization into a Work, an Expression and a Manifestation.

```

Status: Active
Repository: MSTOAI
Repository URL: http://localhost:8080/OAIToolkit/oai-request.do
Schema: marc21
Sets: MSTOAI:Bibliographic records , MSTOAI
Created at: 2016-01-08 09:58:29.0
Updated at: 2016-01-08 10:02:03.0
OAI timestamp:
OAI identifier: oai:syrtis.research:datasetT42/11
  3 Successors

<marc:record xmlns:marc="http://www.loc.gov/MARC21/slim" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.loc.gov/MARC21/slim http://localhost:8080/OAIToolkit/schema/MARC21slim_custom.xsd">
  <marc:leader>01208cam a2200277 i 4500</marc:leader>
  <marc:controlfield tag="001">2200008</marc:controlfield>
  <marc:controlfield tag="005">08030518101543.0</marc:controlfield>
  <marc:controlfield tag="008">080730s1976 dcu f000 0 eng d</marc:controlfield>
  <marc:datafield ind1=" " ind2=" " tag="020">
    <marc:subfield code="a">9782081209633</marc:subfield>
    <marc:subfield code="c">2,70 euro</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2=" " tag="041">
    <marc:subfield code="a">French</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2=" " tag="100">
    <marc:subfield code="a">Keime, Christian</marc:subfield>
    <marc:subfield code="4">drt</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2="0" tag="240">
    <marc:subfield code="a">Roman de Renart</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2="0" tag="245">
    <marc:subfield code="a">Roman de Renart. (Le)</marc:subfield>
    <marc:subfield code="c">Christian Keime; Monique Lachet-Lagarde</marc:subfield>
    <marc:subfield code="h">[publication]</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="3" ind2=" " tag="260">
    <marc:subfield code="a">Paris</marc:subfield>
    <marc:subfield code="b">Flammarion</marc:subfield>
    <marc:subfield code="c">2008</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1=" " ind2=" " tag="300">
    <marc:subfield code="a">159 pages</marc:subfield>
    <marc:subfield code="b">Illustrations, cover with colorful illustrations</marc:subfield>
    <marc:subfield code="c">18 cm</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="0" ind2=" " tag="490">
    <marc:subfield code="a">Etonnants classiques. 335</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2=" " tag="700">
    <marc:subfield code="a">Lachet-Lagarde, Monique</marc:subfield>
    <marc:subfield code="4">adp</marc:subfield>
  </marc:datafield>
  <marc:datafield ind1="1" ind2=" " tag="760">
    <marc:subfield code="w">colauth-007</marc:subfield>
    <marc:subfield code="t">Etonnants classiques</marc:subfield>
  </marc:datafield>
</marc:record>

```

MetadataServicesToolkit v 1.5.5 - svn.version:

Fig. 71 A MARC record displayed in XC web interface



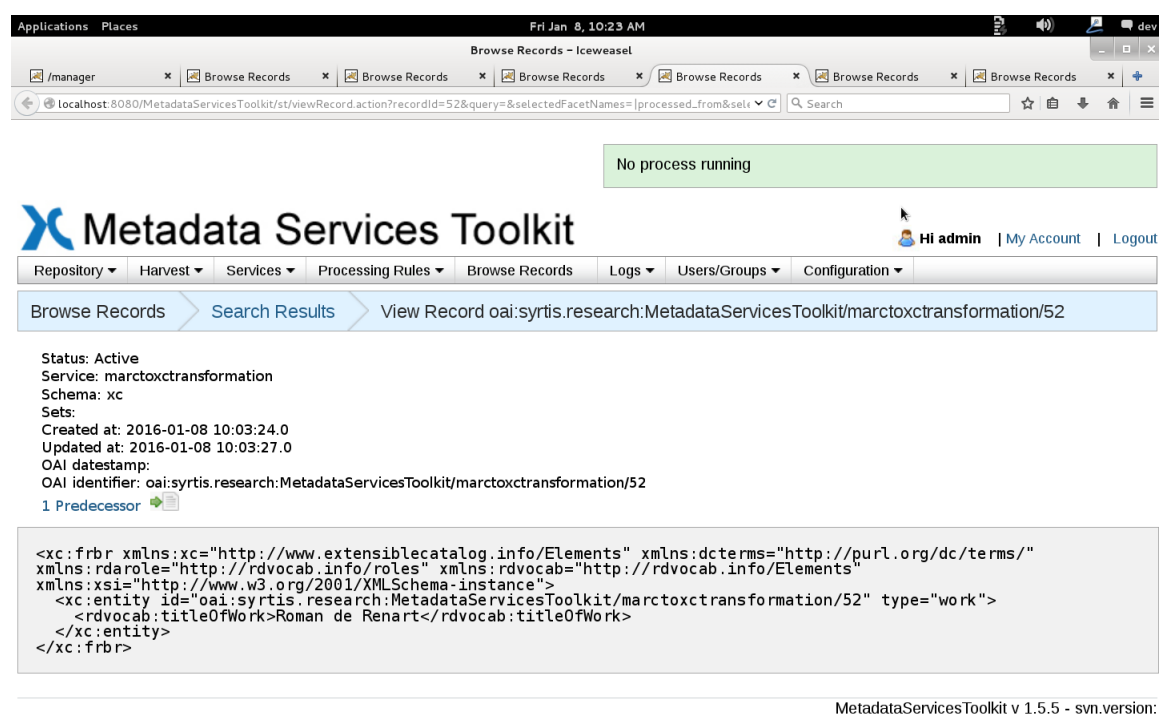


Fig. 72 A FRBR Work entity displayed in XC web interface

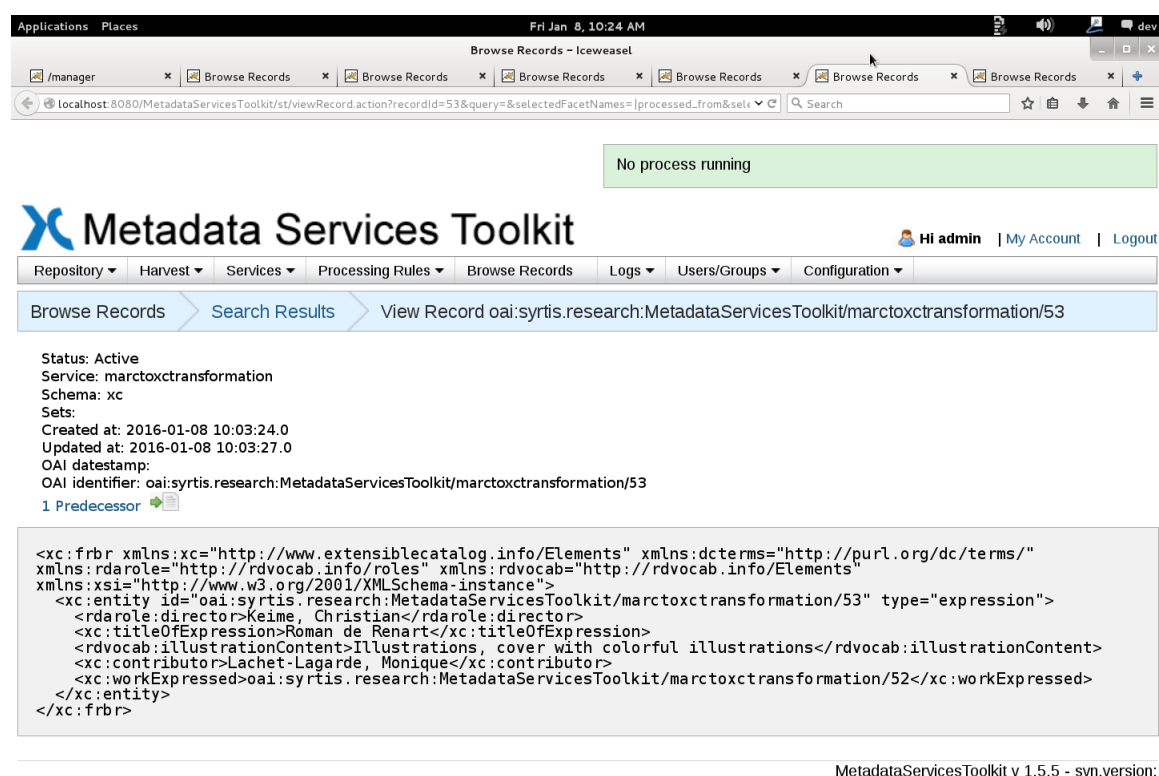


Fig. 73 A FRBR Expression entity displayed in XC web interface

The screenshot shows the Metadata Services Toolkit web interface. The browser address bar displays the URL: localhost:8080/MetadataServicesToolkit/st/viewRecord.action?recordId=51&query=&selectedFacetNames=|processed\_from&sel... The page title is "Browse Records - Iceweasel". The main header features the "Metadata Services Toolkit" logo and a user profile for "Hi admin" with links for "My Account" and "Logout". A navigation menu includes "Repository", "Harvest", "Services", "Processing Rules", "Browse Records", "Logs", "Users/Groups", and "Configuration". The breadcrumb trail is "Browse Records > Search Results > View Record oai:syrtis.research:MetadataServicesToolkit/marctoxctransformation/51".

The record details section shows:

- Status: Active
- Service: marctoxctransformation
- Schema: xc
- Sets:
- Created at: 2016-01-08 10:03:24.0
- Updated at: 2016-01-08 10:03:27.0
- OAI datestamp:
- OAI identifier: oai:syrtis.research:MetadataServicesToolkit/marctoxctransformation/51
- 1 Predecessor

The XML view of the record is displayed below:

```
<xc:frbr xmlns:xc="http://www.extensiblecatalog.info/Elements" xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:rdarole="http://rdvocab.info/roles" xmlns:rdvocab="http://rdvocab.info/Elements"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <xc:entity id="oai:syrtis.research:MetadataServicesToolkit/marctoxctransformation/51" type="manifestation">
    <rdvocab:statementOfResponsibilityRelatingToTitle>Christian Keime; Monique Lachet-
Lagarde</rdvocab:statementOfResponsibilityRelatingToTitle>
    <dcterms:title>Roman de Renart (Le)</dcterms:title>
    <rdvocab:placeOfProduction>Paris</rdvocab:placeOfProduction>
    <dcterms:publisher>Flammarion</dcterms:publisher>
    <dcterms:issued>2008</dcterms:issued>
    <dcterms:extent>159 pages</dcterms:extent>
    <rdvocab:dimensions>18 cm</rdvocab:dimensions>
    <dcterms:isPartOf>Etonnants classiques. 335</dcterms:isPartOf>
    <dcterms:isPartOf>Etonnants classiques</dcterms:isPartOf>
    <xc:expressionManifested>oai:syrtis.research:MetadataServicesToolkit/marctoxctransformation
/53</xc:expressionManifested>
  </xc:entity>
</xc:frbr>
```

MetadataServicesToolkit v 1.5.5 - svn.version:...

Fig. 74 A FRBR Manifestation entity displayed in XC web interface

## 5 Acknowledgments

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## References

1. Decourselle, J., Duchateau, F., Aalberg, T., Takhirov, N., Lumineau, N.: BIB-R: a Benchmark for the Interpretation of Bibliographic Records. In: Theory and Practice of Digital Libraries (TPDL). Hannover, Germany (2016). URL <https://hal.archives-ouvertes.fr/hal-01324529>