Convertibility Between IFPUG and COSMIC Functional Size Measurements

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Outline

- Introduction
- Functional Size Measurement Methods:
  - IFPUG and COSMIC
- Correspondence between COSMIC and IFPUG
- Conversion Rule
- Validation
- Conclusions and Future Work

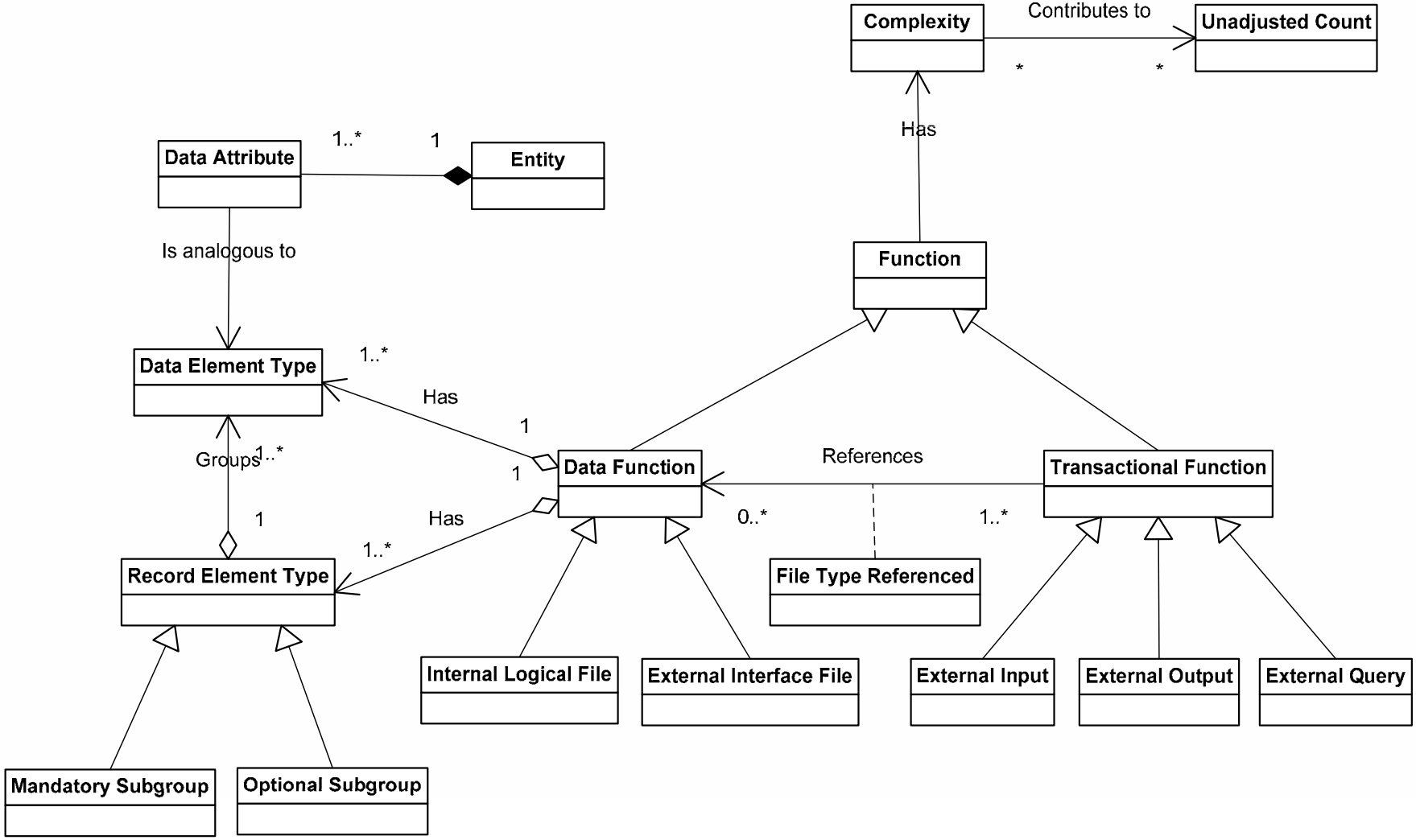
Introduction: Functional Size Measurement

- Currently Function Points (FP) based methods are most popular software size measurement methods.
- We propose a conversion model from the IFPUG method to COSMIC
  - The model proposed here is based on analysis and comparison of IFPUG and COSMIC definitions and measurement rules.
  - Model verified using a relatively large data set, 33 software projects measured with both methods

IFPUG

- IFPUG - International Function Point Users Group
  - Proposed by Albrecht at IBM in 1979
  - Many variants and the most used nowadays:
    - Feature Points – Capers Jones
    - MkII Function Point Method – Charles Symons
    - 3D Function Points – Boeing
    - NESMA – Dutch Software Metrics Association
    - COSMIC FFP
  - http://www.ifpug.org/

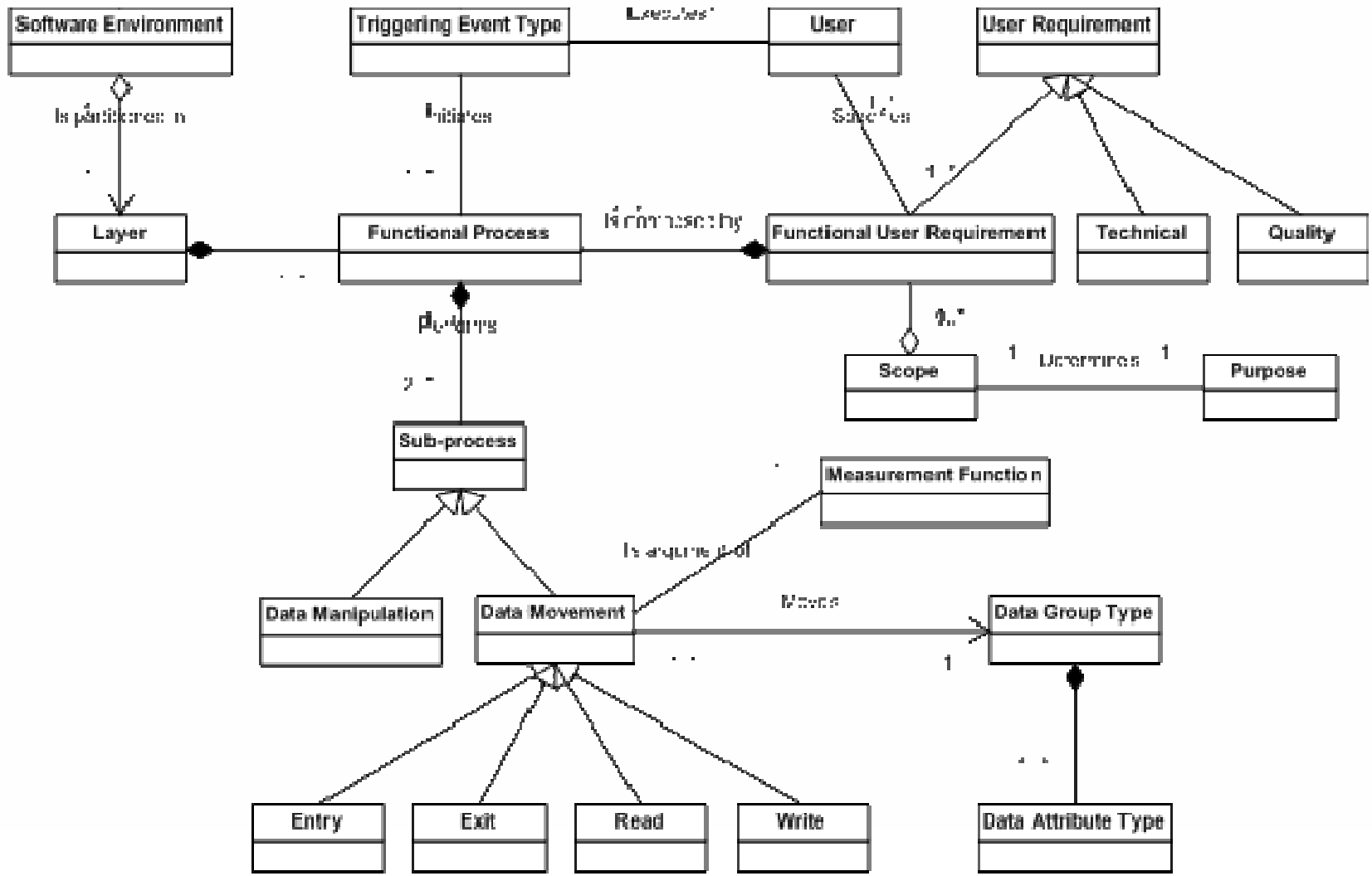
IFPUG Diagram



COSMIC

- In 1998, a set of experts in software measurement created the Common Software Measurement International Consortium (COSMIC)
  - Proposed an improved measurement method known as Full Function Points
  - http://www.cosmicon.com/

COSMIC Diagram



International Standards Organization

- In 1994 the ISO/IEC set up a working group to establish an international standard for functional size measurement.
- This group produced a set of standards and technical documents about functional size measurement methods, known as the ISO/IEC 14143 series.
- FPA becomes the standard ISO/IEC 20926 in 2003
  - Compliant with the ISO/IEC 14143.
- COSMIC is standard ISO/IEC 19761 in 2003
  - Also ISO/IEC 14143 compliant.

Correspondence between Definitions

- High level concepts of IFPUG and COSMIC are similar:
  - the purpose of a measurement
  - the scope of a measurement
  - the definition of boundary.
- The same happens with concepts related to data:
  - the object of interest or entity
  - the data group or file
  - The data attribute or data elements
- and its transformation processes :
  - the functional process
  - transactional function

Correspondence between Processes

- Counting procedures are similar in both methods.
- The first phase in both consists of defining the *purpose of a measurement* or count, the *scope of the measurement* or count, and the application *boundary*.
  - These concepts correspond themselves in both methods, and the phases from which they result are analogous in both methods.
  - COSMIC defines explicitly two phases:
    - *mapping* and *measurement*.
    - In IFPUG those phases are not defined as such, but there is a mapping phase and a measurement phase.

Correspondence between Definitions

- After analyzing both methods, we conclude:
  - the software functional size measures obtained are comparable when the purpose and the scope of the measurement coincide, as well as the application boundary. These concepts are practically identical in both methods
  - both methods coincide when they divide the user data processing requirements into units, using practically the same criterion. functional processes in COSMIC will be transactional functions in IFPUG and vice versa
  - both methods also coincide in grouping datasets using practically the same criterion. Consequently, data groups in COSMIC will correspond to files in IFPUG and vice versa.

Correspondence between Definitions

COSMIC FPP	IFPUG
Purpose of a measurement	Purpose of the count
Scope of a measurement	Scope of the count
Boundary	Application boundary
User	User
Object of interest	Entity
Data group	File
Data attribute	Data elements
Functional process	Transactional function

Conversion Rule

- Given an IFPUG measurement, we propose that such application will have a COSMIC size within the interval given by the following equation:

$$\sum_{i=1}^{EI} Max(2, FTR_i + 1) + \sum_{i=1}^{EO} Max(2, FTR_i + 1) + \sum_{i=1}^{EQ} Max(2, FTR_i + 1) \leq CFSU \leq \sum_{i=1}^{EI} Max(2, 2 \cdot FTR + 1) + \sum_{i=1}^{EO} Max(2, 2 \cdot FTR + 1) + \sum_{i=1}^{EQ} Max(2, 2 \cdot FTR + 1)$$

Experimental Validation - Applications

- Data used in this qualitative analysis come from 33 software applications, measured with IFPUG version 4.1 and COSMIC version 2.2
  - 3 projects obtained from:
    - IFPUG, IBM Rational, Fetcke
  - The rest of the applications:
    - Students: last year computer science at the university of Alcala.

Experimental Validation – Dataset

- Set of measures vary between 78 and 462 FP

ID	IFPUG	ILF+EIF	EI+EO+EQ	FTR	COSMIC
1	95	5	16	27	68
2	126	10	14	37	80
…	…	…	…	…	…
33	320	15	47	103	155

Experimental Validation – D↓ and D↑

- Two new variables were defined: D↓ and D↑, providing the difference given by conversion rule.

Id	Min	CSFU	Max	D↓	D↑
1	43	68	73	25	5
…	…	…	…	…	…
33	150	155	269	5	114

- Descriptive statistics:

	D ↓	*D* ↑
Mean	60.36	53.64
Σ	35.68	55.75
σ^2	1272.99	3108.05
Median	62	34
Min	5	1
Max	124	236

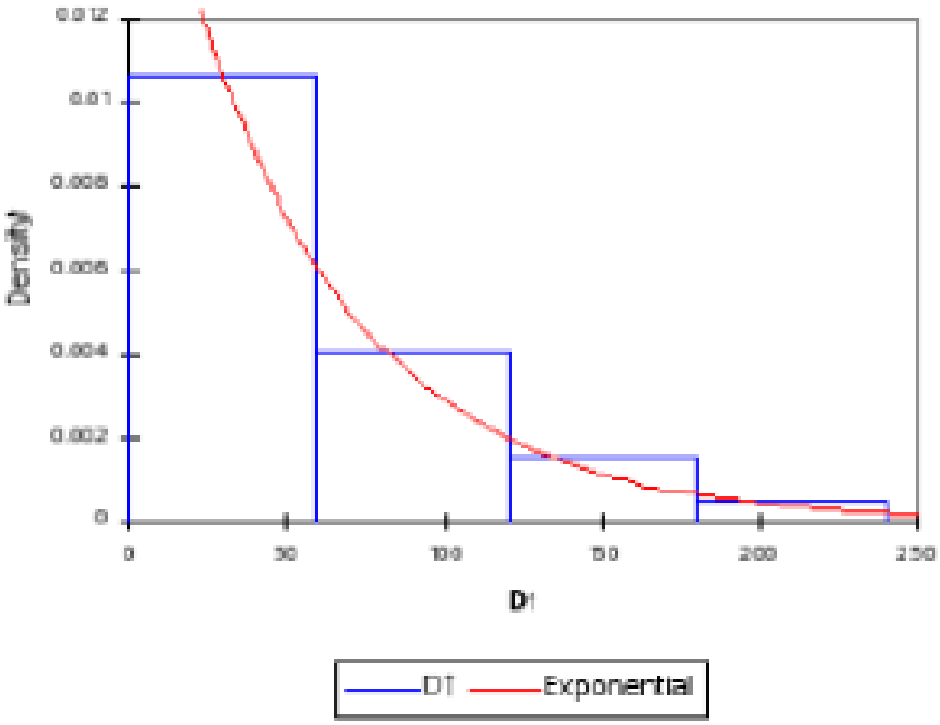
Kolmogorov-Smirnov test

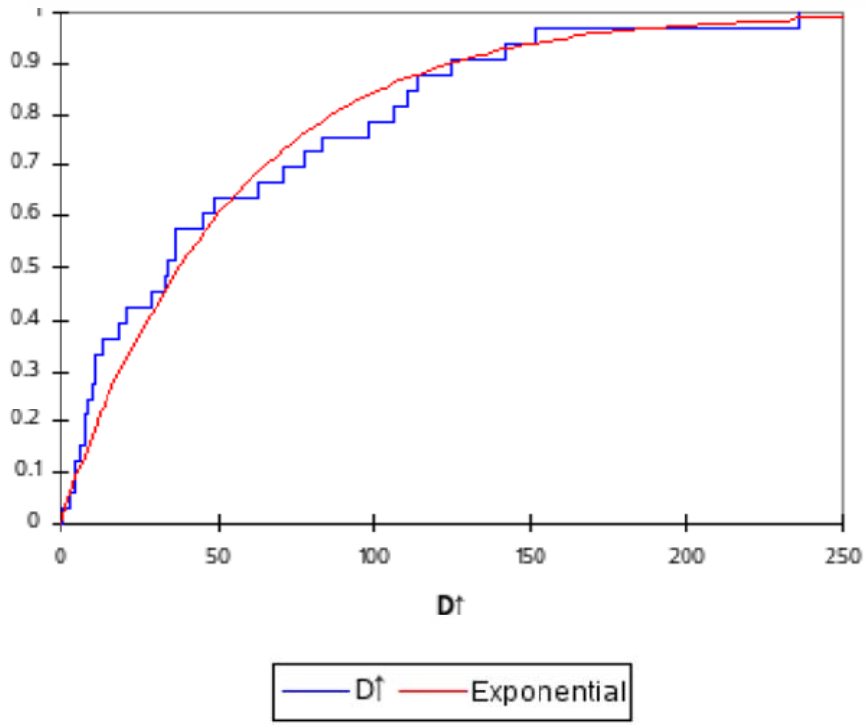
- D↓ and D↑, follow an exponential distribution.
  - Kolmogorov-Smirnov test for variables *D ↓ and D ↑*

	D↓	D↑
D	0.173	0.148
p-value	0.254	0.431
a	0.02	0.02

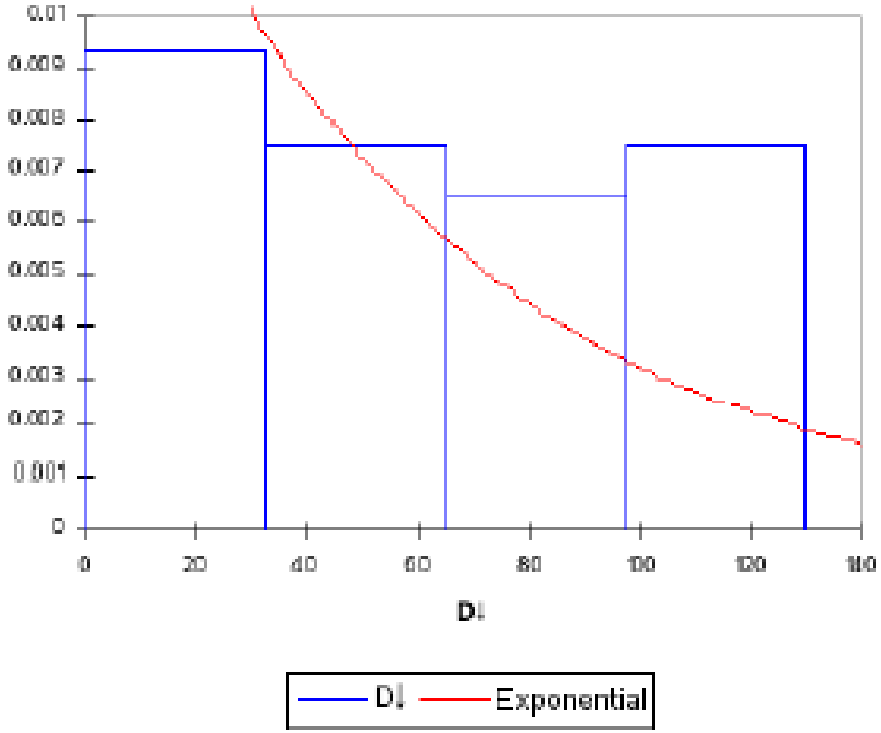
- This further corroborates our hypothesis.
  - The probability of obtaining smaller differences between measures and extremes is higher,
  - and the probability of obtaining larger differences between measures and extremes is lower.

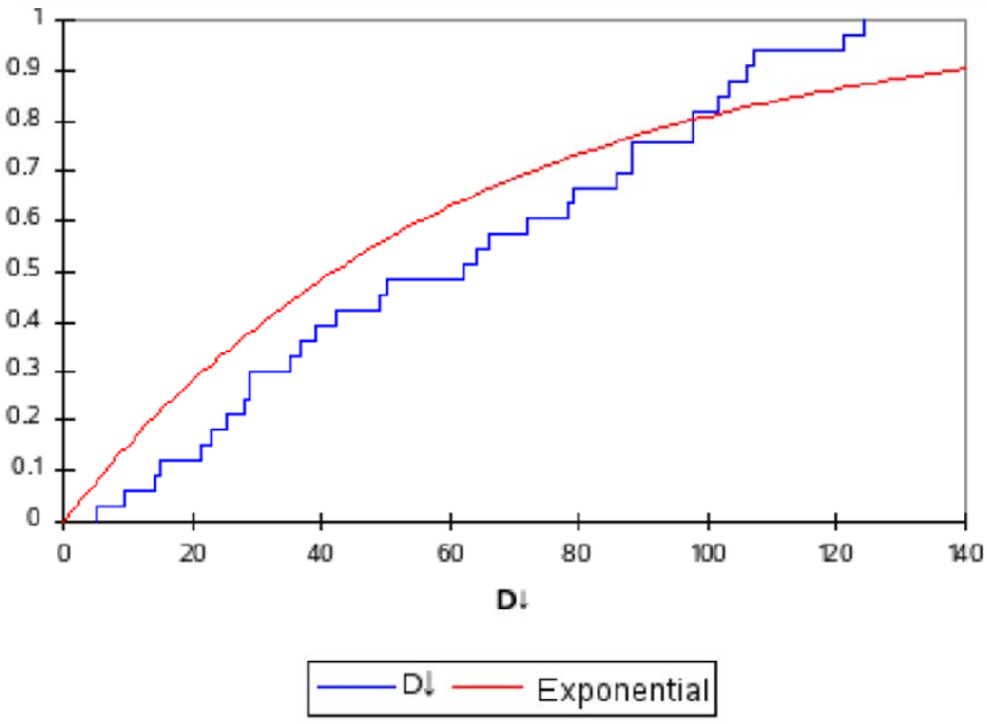
Histogram and Accumulative Frequency for D↑





Histogram and Accumulative Frequency for D↓





Conclusions

- Both methods have analogous measurement procedures, although implicitly
- Proposed a method to convert from IFPUG Function Points to COSMIC FFP
  - Although both methods produce different results, we have empirically shown an equation that limits interval of the conversion to be within a range.
  - It can be beneficial to companies using both measurement methods (as an additional validation procedure) or in the process of migrating to COSMIC