Digital Libraries

Evaluation of Library Services

Week 11 Min-Yen KAN

Why Evaluation?

- Run as a business, need to justify costs and expenditure
- Quantitative data analysis necessitated by evolution into automated and digital libraries

- Need benchmarks to evaluate effectiveness of library

Quantitative metrics

- Circulation per capita
- Library visits per capita
- Program attendance per capita
- Turnover rate
- Registration as % of population

- *Output measures for public libraries*

Zweizig and Rodger (1982)

Evaluation types

- Macroevaluation
  - Quantitative
  - Degree of exposure
- Microevaluation
  - Diagnostic
  - Gives rationale for performance

Macroevaluation

- Axiom
  - The more a book in a library is exposed, the more effective the library.
- Defining “an exposure” as a simple count
  - Pros
    - Easy; can different levels of granularity
  - Cons
    - 5 × 1 day borrowing is five times more exposure than 1 × 5 day borrowing
    - Shorter circulation would increase counts

More exact ways to quantify exposure

- Item-use days: Meier (61)
  - A book borrowed for five days may not be used at all
- Effective user hours: De Prospo *et al.* (73)
  - Sample users in library

Bang for the buck?

The more aware the public is
The more assistance given
The more liberal the usage period
The more branch locations
The more titles provided
The more index methods available
The more copies provided
_______________________________,
the greater the exposure.

Macroevaluation - Conclusions

- In general, more exact measures require sampling and tend towards microevaluation
  - So it's a continuum after all

- Administrators use a battery of measures; not a single one, to measure effectiveness – Spray (76)

Microevaluation Axes

- Quality
- Time
- Costs (including human effort)
- User satisfaction (ultimately, they are bearing the library's operating costs)

Microevaluation

- The more concrete the need, the easier to evaluate
- Failure is harder to measure than success
  - Case 1: Got a sub-optimal resource
  - Case 2: Got some material but not all

	Technical Services	Public Services
Quality	1. Select and acquisition Size, appropriateness, and balance of collection 2. Cataloging and Indexing Accuracy, consistency, and completeness	1. Range of services offered 2. Helpfulness of shelf order and guidance 3. Catalog Completeness, accuracy and ease of use 4. Reference and retrieval Completeness, accuracy and percentage success 5. Document Delivery Percentage Success
Time	1. Delays in Acquisition 2. Delays in Cataloging 3. Productivity of Staff	1. Hours of Service 2. Response Time 3. Loan Periods
Cost	1. Unit cost to purchase 2. Unit cost to process Accession Classify Catalog	1. Effort of use Location of library Physical accessibility of collection Assistance from staff 2. Charges Levied

- From Baker & Lancaster (91) p 21

Material-centered collection evaluation

What's the purpose…

… of the collection

- ○ Who's the readership – academic, public?

… of the evaluation

- ○ Document change in demand?
- ○ Justify funding?
- ○ Select areas to weed materials?
- ○ Adjust shelving/organization?

Principled methods for material-based evaluations

- Checklist
  - Use standard reference bibliographies to check against
- Citation
  - Use an initial seed of resources to search for resources that cite and are cited by them

Are these methods really distinct?

- How do people compile bibliographies in the first place?

Use-centered collection evaluation

Circulation

- ○ General
- ○ Interlibrary Loan (ILL)

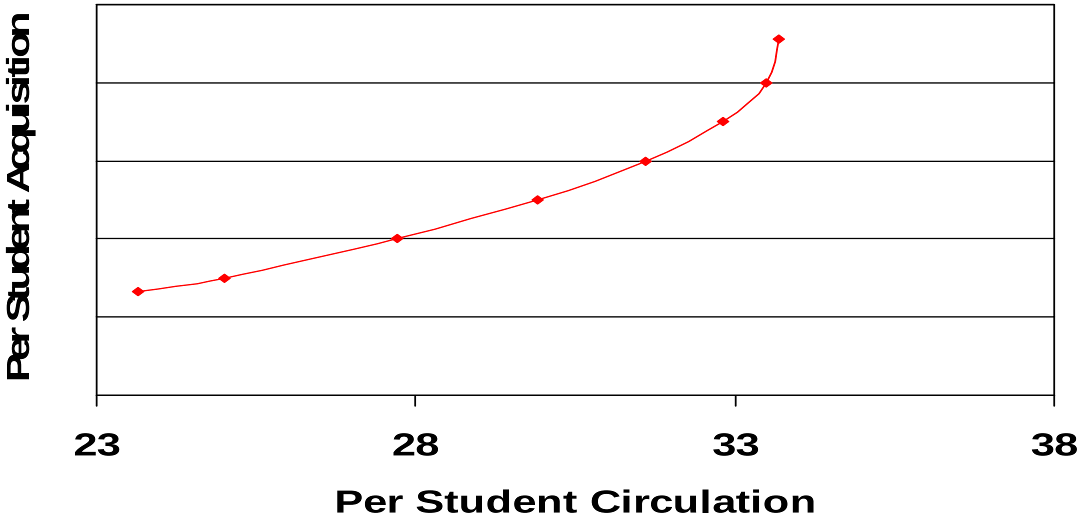
In-house uses

- ○ Stack
- ○ Catalog

Effectiveness as Circulation

- Need a minimal size to function at all
- The larger the collection the better…

  … to a point



- From Hodowanec (78)

Collection Mapping

- ○ Idea: Build the collection in parts
  - Prioritize and budget specific subjects
    - ○ Shrink, grow, keep constant
  - Evaluate subjects according to specific use
    - ○ Which courses it serves, what are each courses' needs

To think about:

• Which of these approaches are **micro** and which are **macro**?

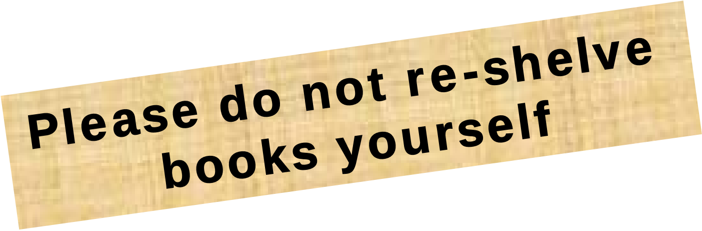
Use Factors

- Age
- Language
- Subject
- Shelf Arrangement
- Quality
- Expected Use
  - Popularity
  - **Information Chain** placement

In-House Use Evaluation Methods

Mostly done by sampling

- ○ Table Counting
- ○ Slip
- ○ Interviews
- ○ Observation



Please do not re-shelve books yourself

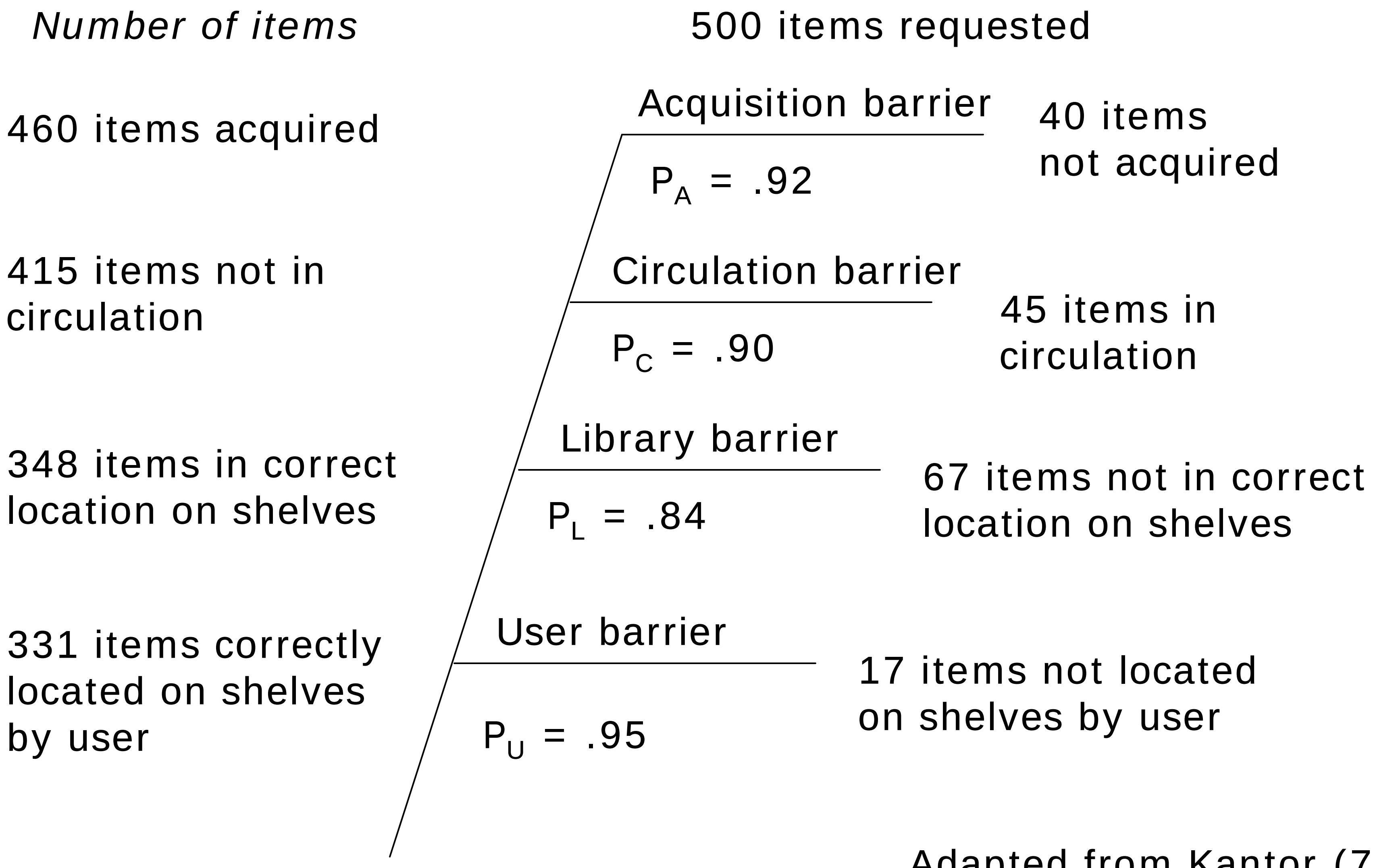
Seen this notice before?

It’s not because you can’t remember where it goes…

Material Availability

The myth: If we have it, you can get it.

The reality: If we have it, you have a chance of getting it.



Number of items

500 items requested

Acquisition barrier

$P_A = .92$

460 items acquired

40 items not acquired

Circulation barrier

$P_C = .90$

415 items not in circulation

45 items in circulation

Library barrier

$P_L = .84$

348 items in correct location on shelves

67 items not in correct location on shelves

User barrier

$P_U = .95$

331 items correctly located on shelves by user

17 items not located on shelves by user

Adapted from Kantor (76)

$$P_S = P_A \times P_C \times P_L \times P_U$$
$$P_S = .66$$

Dried Squid Break

- Yay! See you later…

Digital Libraries

IR Evaluation Metrics

Week 11 Min-Yen KAN

* - Parts of this lecture come from Lilian Tang's lecture material at the Univ. of Surrey

Evaluation Contingency Table

	System says is **relevant**	System says is **irrelevant**
Document is actually **relevant**	TP (True Positive)	FN (False Negative)
Document is actually **irrelevant**	FP (False Positive)	TN (True Negative)

Sensitivity, specificity, positive and negative predictive value

		Relevant			
		+	-		
Test (System)	+	True Positive (TP)	False Positive (FP)	All with Positive Test TP+FP	*Positive Predictive Value* = TP / (TP+FP)
	-	False Negative (FN)	True Negative (TN)	All with Negative Test FN+TN	*Negative Predictive Value* = TN / (FN+TN)
		All Relevant	All non-relevant	All documents = TP+FP+FN+TN	
		Sensitivity = TP / (TP+FN)	*Specificity* = TN / (FP+TN)	Pre-Test Probability of Relevance = (TP+FN) / (TP+FP+FN+TN) (in this case = *prevalence*)	

Evaluation Metrics

$$\frac{TP}{TP+FP}$$

- Precision = Positive Predictive Value
  - “ratio of the number of relevant documents retrieved over the total number of documents retrieved”
  - how much extra stuff did you get?

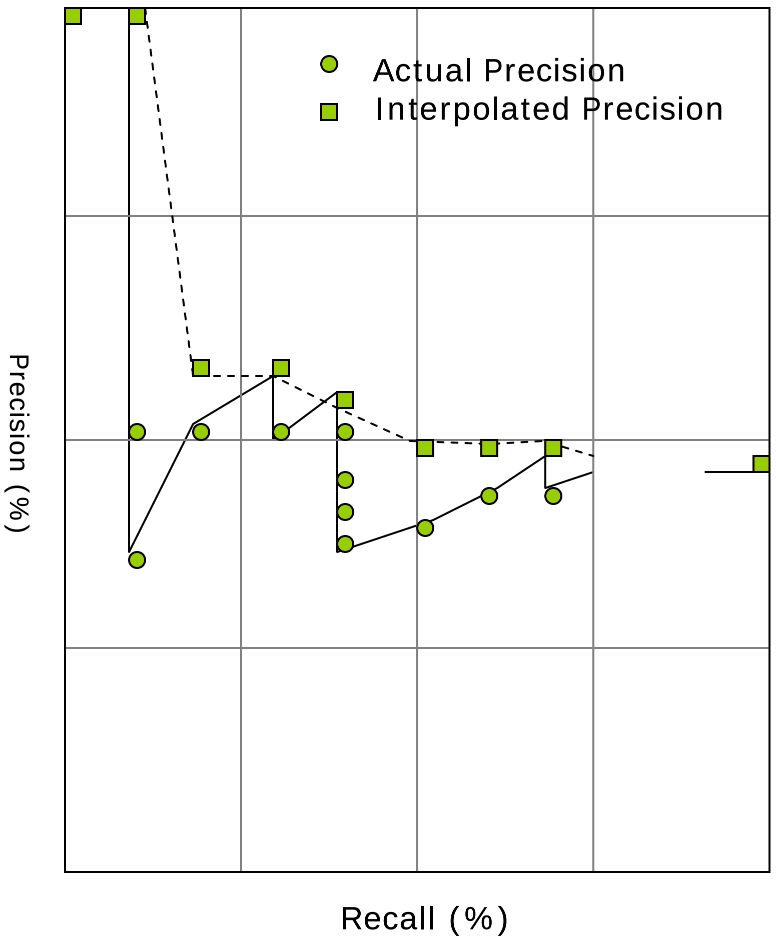
$$\frac{TP}{TP+FN}$$

- Recall = Sensitivity
  - “ratio of relevant documents retrieved for a given query over the number of relevant documents for that query in the database”
  - how much did you miss?

P/R: an example

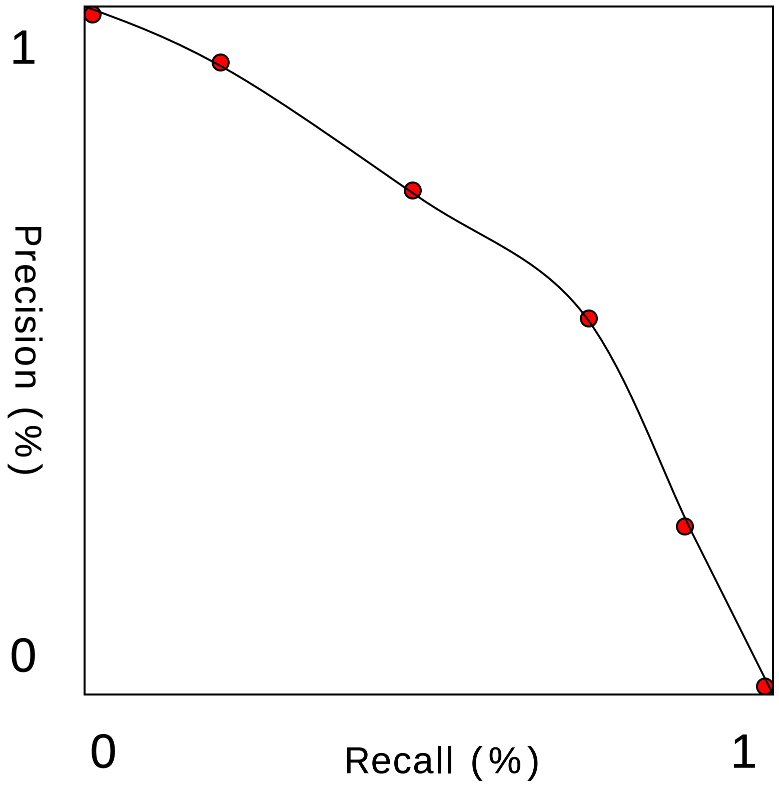
Rank	Decision	$R_{@r}$	$P_{@r}$
1	R	10%	100%
2		10%	50%
3		10%	33%
4	R	20%	50%
5	R	30%	60%
6		30%	50%
7	R	40%	57%
8		40%	50%
9		40%	44%
10		40%	40%
11		40%	36%
12	R	50%	42%
13	R	60%	46%
14	R	70%	50%
…			
22	R	100%	45%

From: Managing Gigabytes



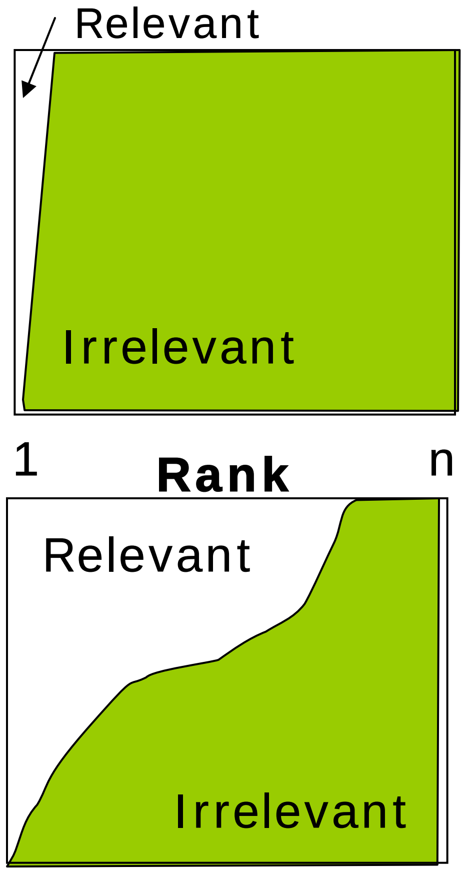
Precision / Recall

- Interpolated precision gives a non-increasing curve
- But doesn't factor in the size of the corpus
  - Previous example on a corpus of 25 docs = 40% precision
  - On a corpus of 2.5 M docs = also 40%



Factoring in size of a corpus

- Look at how P/R or Sn/Sp varies as a function of rank:
- Choose a number of different ranks and calculate P/R or Sn/Sp
  - Correspond to vertical lines on graphs at right
  - Plot Sn vs. 1-Sp to get points for ROC curve. Interpolate curve.

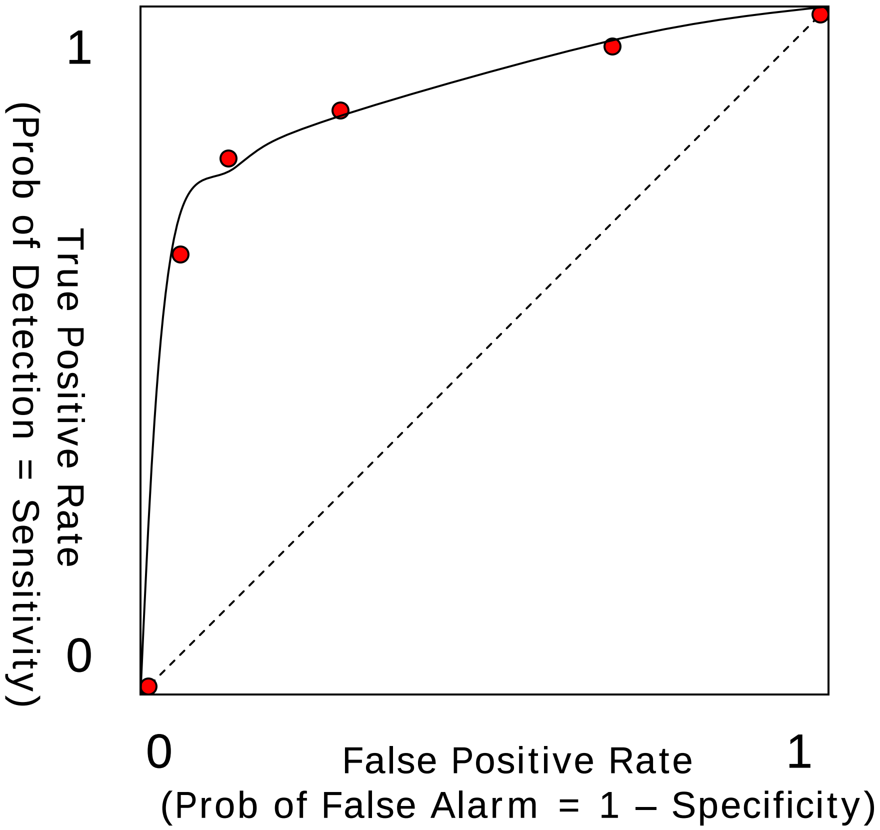


Which of these examples is which from the previous slide?

ROC Curve

Look at the **probability** or **rate** of detection

- What does the diagonal represent?
- How do we compare ROC curves versus each other?



Getting a single number

- 11 pt average
  - Average precision at each .1 interval in recall
- Precision at recall point (% or absolute)
- F Measure
  - Ratio of precision to recall: (e.g., F_3 = weight precision heavier)

$$F_b = \frac{(b^2+1)\,PR}{b^2P + R}$$

- Area under ROC curve (Accuracy)
  - 1 = perfect, .9 excellent, .5 worthless

- What’s the difference between these measures?
- Which measures are best suited to which scenarios?

References for Today

- Witten, Moffat and Bell (99) *Managing Gigabytes*, Section 4.5
- Lesk (1997), Chapter 7, *Usability and Retrieval Evaluation*, Sections 7.6
- Baker and Lancaster (91) *The Measurement and Evaluation of Library Services*, Information Resources Press