

Mathematics for Decisions

Project 1: The RBBC Case InterLibrary Loan Service

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November 10, 2020

Overview

Introduction

Our case

Data

Requirements

Conclusions

References

Teaching cases



- Constructivist teaching method based on **cases** (different from “case studies”);
- Cases present a situation (or problem space) not necessarily taken from real life;
- No solution is provided but it is up to the learners to generate possible solutions that might fit the facts of the case;
- By challenging yourselves, you explore the case to **make a decision** or **solve a problem**;
- Meanwhile, you acquire **specific skills** and **knowledge** through inquiry.

Strategy

What you'll do:

- Reason critically;
- Propose appropriate courses of action.

What you'll use:

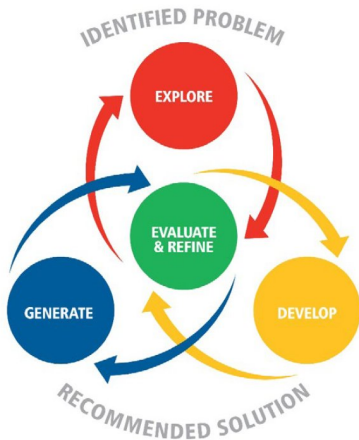
- Your own understanding;
- Your values, perspectives and ideas;
- Your knowledge and background.

What you'll need to develop:

- An analysis of the problem;
- A “plan of attack”;
- One or more possible solutions.

What you'll cultivate and get:

- Analytical skills;
- Critical thinking;
- Ability to identify issues as they arise;
- Ability to evaluate information;
- Ability to extract informative data;
- Collaborative skills.



Teamwork

How will you do this?

- Discussions;
- Group projects;
- Cooperative learning;
- Individual research.



InterLibrary Loan Service (ILS)



A service that allows you to borrow books, music sheets, CDs, DVDs and other items not only from your library, but **from all libraries** in the network.

ILS – How it works?

1. The user makes a request to his or her home library, in person or through an online catalogue on the system;
2. The request is received and accepted by one of the libraries having the desired item;
3. This second library prepares the desired item, which is subsequently collected by a courier;
4. After a while (usually a few days or a week), the courier delivers the desired item at the user's home library, which notifies the user that the item is ready.

Our case – RBBC

Rete Bibliotecaria Bresciana e Cremonese (i.e., RBBC, Brescia and Cremona Library Network)

- *Network*: composed of the public libraries in the provinces of Brescia, Cremona and Mantova;
- *Channels*: to use ILS, the user can ask directly to his or her home library or use the *Online Public Access Catalogue* (i.e., OPAC) platform;
- *Price*: completely free for users.

RBBC – Online Public Access Catalogue (OPAC)

The screenshot shows the RBBC (Rete Bibliotecaria Bresciana e Cremonese) OPAC homepage. The header is red with the RBBC logo on the left, the name 'Rete Bibliotecaria Bresciana e Cremonese' in the center, and a search bar with 'Ricerca nel catalogo' and 'Cerca' buttons. On the right, there are links for 'Logout', 'Aiuto', and a language selector. Below the header, there's a navigation bar with links like 'Home', 'Catalogo', 'Ragazzi', 'Sezione Locale', 'Generi fiction', 'Classifiche', 'Consigli di lettura', 'MLOL', 'Chi siamo', and 'Archivi'. A statistics bar shows 'Prestiti in corso 256.209', 'Prestiti di oggi 1.590', and 'Iscritti alla RBBC 183.824'. A large banner for 'Laboratori creativi 2020' is featured, with details about dates, location, and booking. On the right, there's a section for 'Ultimi arrivi' (New arrivals) with book covers and titles like 'Mercato nero' and 'La fiamma nel buio'.

Alice Raffaele MyDiscovery 5 1 9 Prestiti in ritardo (1) Logout Aiuto Community Eventi Biblioteche

Ricerca nel catalogo Cerca
Ricerca avanzata Ricerca per liste

Home Catalogo Ragazzi Sezione Locale Generi fiction Classifiche Consigli di lettura MLOL Chi siamo Archivi

Prestiti in corso 256.209 Prestiti di oggi 1.590 Iscritti alla RBBC 183.824

Ultimi arrivi Vedi tutti

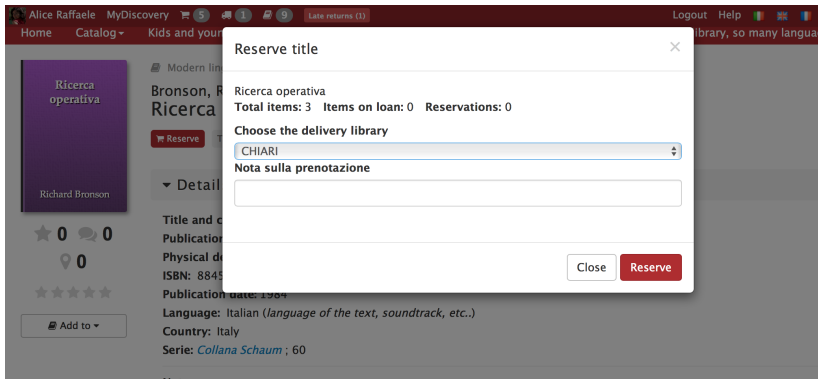
Laboratori creativi 2020
dal 12 febbraio al 27 maggio con Adriana, Giorgia, Mariangela e Serena
nella Biblioteca Sabao al mercoledì alle ore 14.30
Prenotazione necessaria
designed by freepik

Mercato nero
Gian Mauro Costa

La fiamma nel buio
Michael Connelly

- After logging in, the user can see its current situation in the “MyDiscovery” section;
- The user can look for any resources in the network.

RBBC – Booking a resource online



- In this case, the user can select the delivery library, i.e., the user can choose where he or she would like to collect the desired item (**not** the library where the desired item will come from).

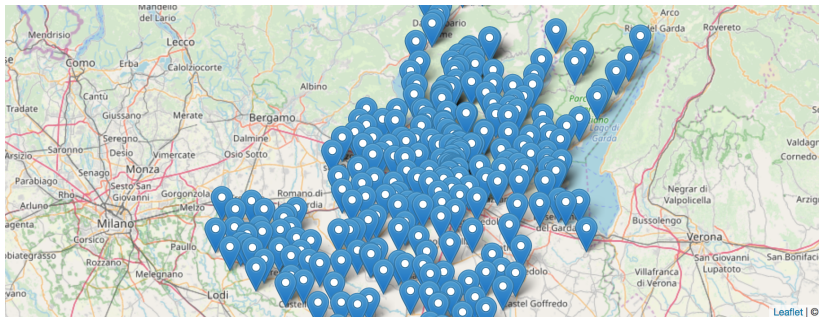
RBBC – More details about the requests

- Every resource is **owned** by a particular library, but it can actually be requested by users all over the network;
- The user can **request any resource** not labelled as “local loan” (i.e., only users of the owner library can borrow the resource);
- **Duration of interlibrary loan:** 30 days (books and media kits) or 15 days (magazines, DVDs and music);
- Every user can borrow **at most 10 resources** at the same time.
- The user can **return the item to any libraries** in the network (not necessarily where he or she borrowed it).

RBBC – The couriers

- RBBC uses a service provided by a **logistics company**;
- By contract, the company offers a maximum number of **couriers to move items** from one library to another: RBBC pays some **fixed** amount for the rental of vehicles, plus some **variable costs** related to the length of the routes travelled by couriers;
- Couriers are supposed to **visit each library on a regular basis**, tentatively on the same day of the week, usually during their opening hours. It may also happen during lunch breaks or when the library is closed to the public;
- When couriers visit a library, they simultaneously **pick-up** all items that have to go somewhere else and **deliver** all the ones addressed to that library;
- They do not deliver items immediately after pick-up, but bring them instead to **depots** located in the network.

RBBC – The network



The network is composed of:

- 329 libraries + 2 offices (i.e., the “Ufficio Biblioteche” of the Province of Brescia and the “Ufficio Biblioteche” of the Province of Cremona);
- Depots to temporarily collect items.

RBBC – Lines

- Currently, libraries are organized in **fixed lines**;
- Each line is served by a courier multiple times a week, according to the demand;
- Couriers start from a depot, then reach the start of the line and visit all libraries assigned to that line until the end, picking-up or delivering requested items; then couriers go back to the depot, where they leave all items picked-up.

code	library	line	library_system
PI	ACCADEMIA SANTA GIULIA	8	BRESCIA - SPECIALI
EA	ACQUAFREDDA	2	BRESCIA EST
QA	ADRO	4	OVEST BRESCIANO
LA	AGNADELLO	10	CREMASCO
SA	AGNOSINE	6	NORD EST
SB	ANFO	6	NORD EST
VA	ANGOLO TERME	7	VALCAMONICA
YA	ANNICCO	10	CREMASCO
UA	ARCHIVIO PROVINCIALE	8	BRESCIA - SPECIALI
VB	ARTOGNE	7	VALCAMONICA
LB	AZZANELLO	10	CREMASCO
AA	AZZANO MELLA	3	BASSA
YB	BAGNOLO CREMASCO	10	CREMASCO
BB	BAGNOLO MELLA	2	BASSA
SC	BAGOLINO	6	NORD EST
BC	BARBARIGA	3	BASSA
SD	BARGHE	6	NORD EST
BN	BASiglio BRESCIANO	9	BASCA

Data – Libraries

library_system	library_id	description	label	library_code	address	phone	fax	email	billing_address	city	province	latitude	longi
Bassa Bresciana Centi	1	BIBLIOTECA DI AZZANO MELLA	AZZANO MELLA	AA	Via Vittorio Veneto 2	309748804	0	biblioteca@comune.azzanomella.b	25020	AZZANO MELLA	BS	454.547.087	101.1
Bassa Bresciana Centi	2	BIBLIOTECA DI BORGIO SAN I BORGIO SAN GIACOP	BORGIO SAN GIACOP	AB	Piazza San Giacomo 3	309948348		biblioteca@comune.borgiosan	25022	BORGIO SAN GIACOP	BS	453.497.176	99.66
Bassa Bresciana Centi	3	BIBLIOTECA DI DELLO	DELLO	AD	Via XI Febbraio 5	309719220		biblioteca@comune.dello.bs.it	25020	DELLO	BS	454.177.374	100.1
Bassa Bresciana Centi	4	BIBLIOTECA DI MAIRANO	MAIRANO	AH	Via Mazzini 3/F - Pieve	309975612	3E+08	biblioteca.mairano@gmail.com	25030	MAIRANO	BS	454.614.100	100.8
Bassa Bresciana Centi	5	BIBLIOTECA DON ANGELO BI POMPIANO	POMPIANO	AI	Piazza Sant'Andrea 30/A	309465310		biblio@comune.pompiano.brescia	25030	POMPIANO	BS	454.314.600	99.81
Bassa Bresciana Centi	6	BIBLIOTECA DI SAN GERVASI SAN GERVASIO BRES	SAN GERVASIO BRES	AI	Via Barbara Ferrazzi 24	309934124		biblioteca@comunessangervasio.it	25020	SAN GERVASIO BRES	BS	453.061.720	101.5
Bassa Bresciana Centi	7	BIBLIOTECA DI SAN PAOLO	SAN PAOLO	AK	Piazza Aldo Moro 27	309970001		biblioteca@comune.sanpaolo.bs.it	25020	SAN PAOLO	BS	453.476.876	99.70
Bassa Bresciana Centi	8	BIBLIOTECA DI ISORELLA	ISORELLA	AL	Via Garibaldi 3	0309958117	int.8	biblioteca@comune.isorella.bs.it	25015	ISORELLA	BS	453.087.589	103.2
Bassa Bresciana Centi	9	SISTEMA BIBLIOTECARIO BA/SISTEMA BIBLIOTEC	MANERBIO	BO	VIA INSURREZIONE NAZION	309387294		sistemabbc@comune.manerbio.bs	25020	MANERBIO	BS	453.534.331	101.4
Bassa Bresciana Centi	10	BIBLIOTECA DI ALFIANELLO	ALFIANELLO	BA	P.ZZA PAVONI	0	0	mail	25020	ALFIANELLO	BS	452.671.600	101.4
Bassa Bresciana Centi	11	BIBLIOTECA DI BAGNOLO MI BAGNOLO MELLA	BAGNOLO MELLA	BB	Via XXVI Aprile 48	30620828	3E+08	biblioteca@comune.bagnolomella	25021	BAGNOLO MELLA	BS	454.298.063	101.8
Bassa Bresciana Centi	12	BIBLIOTECA DI BARBARIGA	BARBARIGA	BC	Via Roma 29	309971356		biblioteca@comune.barbariga.bs.it	25030	BARBARIGA	BS	454.051.715	100.5
Bassa Bresciana Centi	13	BIBLIOTECA DI BASSANO BRI BASSANO BRES	BASSANO BRES	BD	Via Martignengo 33	309935112	3E+08	biblioteca@comune.bassano-bres	25020	BASSANO BRES	BS	453.258.357	101.2
Bassa Bresciana Centi	14	BIBLIOTECA DI BRANDICO	BRANDICO	BE	Via IV Novembre 8	30975893		biblioteca.brandico@gmail.com	25030	BRANDICO	BS	454.546.800	100.5
Bassa Bresciana Centi	15	BIBLIOTECA DI CAPIRIANO DI CAPIRIANO DEL COL	CAPRIANO DEL COL	BF	Piazza Mazzini 8	309748683		biblioteca@comune.capriano.bs.it	25020	CAPRIANO DEL COL	BS	454.551.200	101.2
Bassa Bresciana Centi	16	BIBLIOTECA DI CIGOLE	CIGOLE	BG	Via Roma 19	309959767		biblioteca@comune.cigole.bs.it	25020	CIGOLE	BS	453.092.567	101.5
Bassa Bresciana Centi	17	BIBLIOTECA R.REMONDI* FIE FIESSE	FIESSE	BH	Via Gramsci 1	309950044		biblioteca@comune.fiesse.bs.it	25020	FIESSE	BS	452.321.201	103.2

- **library_system**: the system the library belongs to;
- **library_id** and **library_code**: two values to univocally identify the library;
- **description** and **label**: short and full name of the library;
- **address**, **phone**, **fax**, **email**, **billing_address**, **city**, **province**
- **latitude** and **longitude**: exact position of the library.

Data – Interlibrary loans

loan_id	patron_id	patron_age	patron_city	request_date	loan_date_begin	loan_date_end	due_date	from_library	to_library	end_library
15842662	*461CAA12F8C0	15	VOBARNO	18/09/12 16:26	29/05/13 18:10	25/07/13 13:03	28/06/13 18:09	136	164	149
15843559	*3E2DD1D0311C	38	BOVEZZO	21/03/12 00:00	19/09/16 16:34	19/09/16 16:34	04/10/16 00:00	128	168	168
15849314	*76D8176F2019	23	ISORELLA	19/09/12 17:36	28/02/13 16:53	28/02/13 18:01	30/03/13 16:53	15	8	8
15857437	*2B85B335333B	56	MANERBIO	20/09/12 17:32	10/01/13 21:16	10/01/13 21:17	09/02/13 21:15	25	22	22
15868584	*2F08C397120A	32	ADRO	22/09/12 11:35	15/01/13 14:35	15/01/13 14:37	14/02/13 14:35	201	96	96
15870174	*7E4A6F981956F	27	CARPENEDOLO	22/09/12 10:19	27/05/13 14:32	06/07/13 09:31	26/07/13 00:00	143	68	68
15894472	*FB6CEBC9D141	13	BOVEZZO	06/09/12 00:00	15/03/13 09:35	15/03/13 09:35	14/04/13 10:35	96	168	168
15897305	*1883A62556E4	9	CARPENEDOLA DI VOBARNO (BS)	27/09/12 18:02	29/05/13 18:10	12/08/13 15:51	28/06/13 18:09	163	164	164
15912403	*553F581CB092	20	GAVARDO	01/10/12 17:32	11/01/13 16:04	11/01/13 16:04	10/02/13 16:03	47	149	149
15913505	*09627AE88B21	20	26020 PALAZZO PIGNANO	02/10/12 11:00	18/01/13 11:17	18/01/13 11:18	17/02/13 11:17	52	268	268
15914865	*2A698761942A	34	25014 CASTENEDOLO	01/10/12 13:03	15/01/13 16:15	15/01/13 16:15	14/02/13 16:15	100	96	96
15922060	*A59F4928137B	71	PERSICO DOSIMO	03/10/12 12:23	21/10/13 17:48	30/08/14 10:21	20/11/13 16:48	245	244	245
15923913	*787D92805340	NULL	CONCESIO	02/10/12 11:33	08/01/13 12:57	05/04/13 16:26	07/02/13 12:57	184	173	173
15925061	*6155509B4B4F	14	SAREZZO	03/10/12 16:18	08/01/13 17:20	08/01/13 17:20	07/02/13 17:19	183	185	185
15927651	*425C7DDA423E	14	GARDONE VT	03/10/12 17:11	07/01/13 17:17	07/01/13 17:17	06/02/13 17:17	180	174	174
15931451	*8C28489E86BE1	53	GADESCO PIEVE DELMONA	04/10/12 14:08	14/02/13 16:54	19/02/13 12:47	16/03/13 16:54	108	238	238
15933054	*C4D518DAFA8A	92	25081 BEDIZZOLE	04/10/12 16:22	07/02/13 16:30	19/02/13 17:08	09/03/13 16:30	82	63	63
15936080	*FEA5FA37AD0F	18	Pandino	05/10/12 15:00	18/01/13 11:18	18/01/13 11:18	17/02/13 11:18	69	268	268
15937068	*89FD87FC2E83	20	Pandino	05/10/12 15:47	08/05/13 17:12	08/05/13 17:12	07/06/13 17:12	92	268	268
15941159	*E9D221E8924D	15	BOVEZZO	05/10/12 15:44	25/01/13 08:37	25/01/13 08:40	24/02/13 08:37	185	168	168
15953528	*B9F25BBF4857F	47	ISORELLA	08/10/12 08:19	02/01/13 16:12	02/01/13 16:12	01/02/13 16:12	30	8	8

- **loan_id**: a value to univocally identify the loan;
- **patron_id**, **patron_age** and **patron_city**: user data;
- **request_date**: when the user makes the request;
- **loan_date_begin** and **loan_date_end**: duration of the loan;
- **due_date**: deadline for the user to return the item;
- **from_library** and **to_library**: pick-up and delivery libraries for the item;
- **end_library**: the library where the user returned the item.

Requirements – Focus

The goal is to **optimize the InterLibrary Loan Service**.

Of course, one cannot think about optimizing right away all the phases of the service; you will focus on the pick-up and delivery parts by developing routes for couriers, while trying to reduce the costs paid by RBBC.

There are **some aspects** to take into account, for instance:

- How many times a week should couriers visit a particular library?
- Where should the depots be located?
- What is the capacity of a vehicle? And are vehicles *homogenous* or not?

Variables, parameters, constraints... Can you identify them in this problem? Thinking about and discussing the problem, you may also find other things to keep in consideration.

Requirements – What you can do

- Provide a **mathematical formulation** of the problem, maybe using linear programming, mixed-integer linear programming or whatever model you think it would be suitable;
- Analyze data using **statistics**, developing charts, figures, etc.;
- Look for similar problems in the **literature** and compare how they have been solved;
- **Implement** your model and use existing solvers to get a solution.

...basically **all you need to understand it better!**

Note: you don't have to strictly follow how RBBC is currently tackling the problem. You have to **stick to the data**, but for instance you may not use lines. You are **completely free!**

Requirements – What we are asking

- We **do not know the exact solution** and we are not asking you to find it (well, if you develop an optimal method...);
- We are looking for innovative **ideas and methods** to tackle this problem, **providing RBBC with new insights and suggestions** about the decisions they have to make, for instance choosing a good logistics company.

Requirements – Tools

- You are free to use **any tools** you prefer;
- You can use methods, techniques and softwares we're going to study in this course, but also others you already know.

Requirements – Final report

- You will act like a **real consultant** for RBBC;
- In the end, you'll need to develop an **appropriate report**, containing:
 - How you have studied the problem;
 - Analyses you have done;
 - Methods you have developed;
 - What you suggest to RBBC to improve its management of the ILS, according to your results;
 - Everything else you think it's relevant.

Conclusions

- If you have any questions, don't hesitate and write to us!
- We are in contact with the IT manager of RBBC, thus we can share with him all doubts and issues, or things we are not convinced of;
- We'll guide you through this path and in the development of your work.

References



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<https://renaebrown.weebly.com/case-study.htm>

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