Quantitative Research Methods IV - 17.806

Recitation, Week 3.

Topic: Unsupervised Learning II and Supervised Learning I.

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1/ Supervised Learning

Supervised Learning

- Supervised ML: Predict the value of Y based on $\boldsymbol{X}$: $p(Y|\boldsymbol{X})$.

L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	
dem	dlang	drel	durable	ef	ef2	ehet	elfo	elfo2	etdo4590	expgdp	fedpol3	fuelexp	gdpgrowth	geo1	geo2	geo34	g
1	3	1	9	0.2549	0.064974	6	31	961	1	6.598187	0	8.721501	0.04505	0	0	0	
1	3	1	10	0.2549	0.064974	6	31	961	1	6.303922	0	9.464923	0.044299	0	0	0	
1	3	1	11	0.2549	0.064974	6	31	961	1	6.805417	0	10.48014	-0.04141	0	0	0	
1	3	1	12	0.2549	0.064974	6	31	961	1	8.497777	0.133966	10.37251	0.041724	0	0	0	
1	3	1	13	0.2549	0.064974	6	31	961	1	8.875194	0.13386	12.99692	0.067412	0	0	0	
1	3	1	14	0.2549	0.064974	6	31	961	1	9.020614	0.132572	11.69704	0.025479	0	0	0	
1	3	1	15	0.2549	0.064974	6	31	961	1	33.54913	0.132229	15.33493	-0.04604	0	0	0	
0	23.1615	9.250124	16	0.440955	0.264102	38.93193	37.83801	2211.235	0.451153	33.58702	0.132183	15.31455	-0.01736	0.193761	0.097129	0.125969	
1	6	6	20.70214	0.1338	0.017902	12	38.13281	2234.575	0.455181	33.70278	0.129773	15.65272	0.022349	0	1	0	
1	6	6	0	0.1338	0.017902	12	38.20399	2243.33	0.453018	33.77172	0	15.76527	-0.42968	0	1	0	
1	6	6	1	0.1338	0.017902	12	37.94931	2218.898	0.454227	33.74917	0	15.67645	-0.09924	0	1	0	
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1	6	6	3	0.1338	0.017902	12	37.85729	2211.733	0.453112	33.73692	0	15.50992	0.065588	0	1	0	
0	6	6	0	0.1338	0.017902	12	37.94684	2219.891	0.451914	33.63824	0.132027	15.3354	0.054727	0	1	0	
0	6	6	0	0.1338	0.017902	12	37.84507	2211.604	0.451948	33.5797	0.132613	15.31375	0.029936	0	1	0	
0	6	6	1	0.1338	0.017902	12	37.81882	2208.832	0.452331	33.58608	0.132975	15.29686	0.070858	0	1	0	
0	6	6	0	0.1338	0.017902	12	37.87026	2213.022	0.451946	33.61426	0.132769	15.28771	0.022549	0	1	0	
0	23.15573	9.251361	1	0.441019	0.264049	38.94884	37.83476	2210.08	0.452106	33.59021	0.133037	15.31451	0.022583	0.194304	0.0974	0.126086	
0	5	2	21.02088	0.148504	0.022053	12	37.89471	2211.006	0.45533	33.59899	0.133255	15.45635	-0.06047	0	0	0	
1	5	2	0	0.148504	0.022053	12	37.88968	2211.608	0.454709	33.58667	1	15.35245	-0.04656	0	0	0	
1	5	2	0	0.148504	0.022053	12	37.88434	2211.125	0.454627	33.58871	1	15.34972	0.010539	0	0	0	
1	5	2	0	0.148504	0.022053	12	37.88583	2211.828	0.454255	33.57175	1	15.36617	0.045481	0	0	0	
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1	5	2	0	0.148504	0.022053	12	37.85563	2208.557	0.455008	33.58314	1	15.35867	0.048982	0	0	0	
1	5	2	50	0.148504	0.022053	12	37.8391	2207.537	0.454194	33.60403	1	15.36008	-0.00988	0	0	0	

Can you explain the following concepts in this example?

- Classification/regression, dimensionality.
- OLS, overfitting, cross-validation, regularization, Ridge/LASSO.

2/ Problem Set Hints

Problem Set Reminders

- Collaborators: You must note all of your collaborators. If you work alone, please indicate that as well.
- Annotating code: Please annotate your code thoroughly so that other people including me can easily follow each step. This is an important practice especially when you do collaborative research.
- Embedding code: If you use Rmarkdown or Rsweave, please make sure that lines do not get cut off. You can avoid this by `tidy=TRUE` option in code chunks.

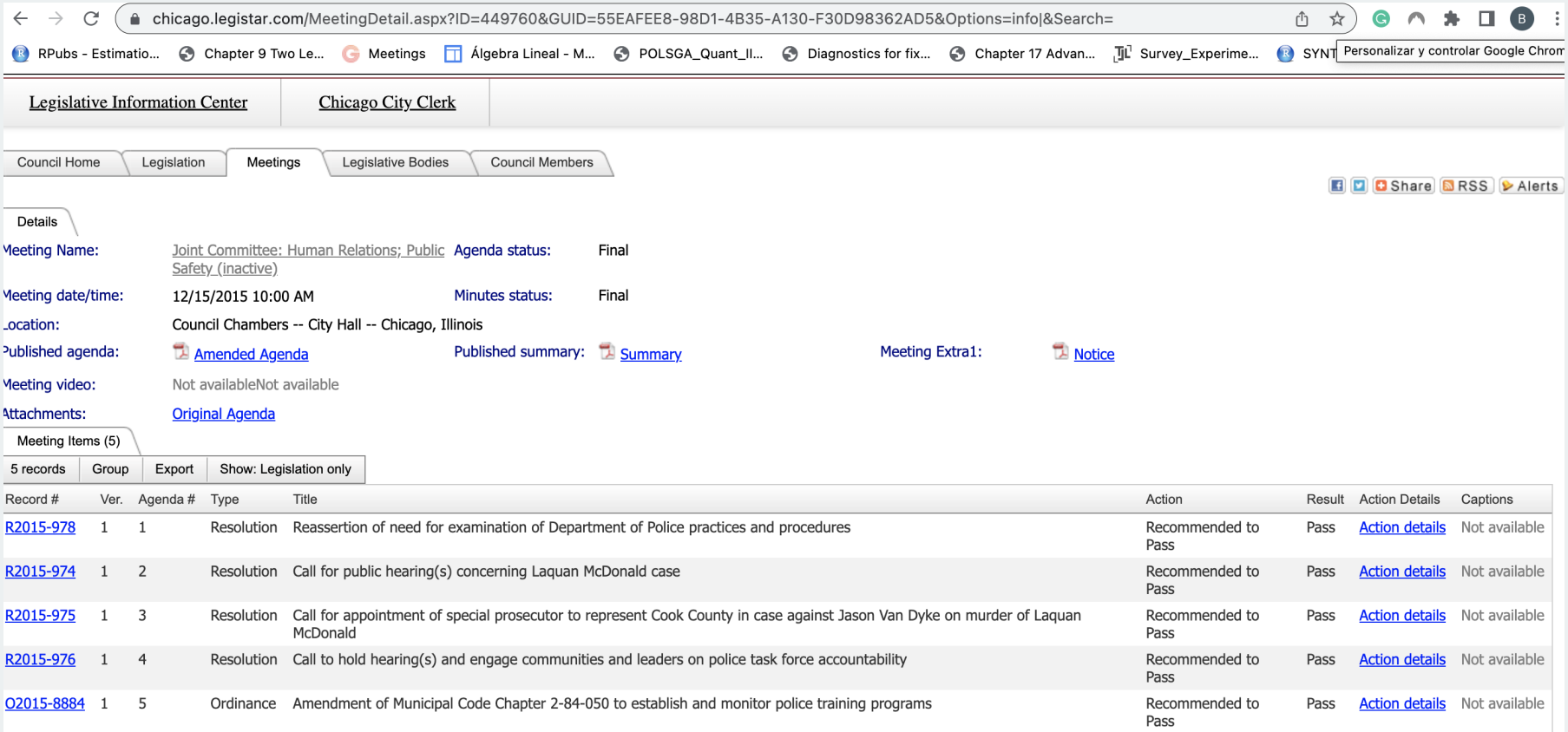
Pset 1: Webscraping and regular expression

- Problem 1 and 2: You will use regular expression and scraping tools to download, structure, and name files.
- Procedure:
  1. Analyze the html by extracting tags and attributes that contain data
  2. Download data and use regex to name each downloaded data.
- Some tips
  - Vectorize (`stringr` functions accept a vector as input).
  - Read html file carefully.
  - Start with one string and repeat (try & error).
  - Use `Sys.sleep` to randomize your wait time.

Data Collection: Chicago

```
4:1  (Top Level)
Console  Background Jobs
R 4.2.1 · ~/Documents/PSet_N1/
> head(df_url_1519)
# A tibble: 6 × 2
  date       url
  <date>     <chr>
1 2015-12-15 https://chicago.legistar.com/MeetingDetail.aspx?ID=449760&GUID=55EAFEE8-98D1-4B35-A130-F30D98362AD5&Options=info|&Search=
2 2015-12-14 https://chicago.legistar.com/MeetingDetail.aspx?ID=448641&GUID=4C91FCF5-0D66-4AF5-B2AC-6D7FE699A058&Options=info|&Search=
3 2015-12-09 https://chicago.legistar.com/MeetingDetail.aspx?ID=445253&GUID=DA07B999-1303-4B0F-9FD0-FDC65AA04009&Options=info|&Search=
4 2015-12-09 https://chicago.legistar.com/MeetingDetail.aspx?ID=448681&GUID=2F6FF8B5-B8C0-425C-A5A0-AF7120B4F3FC&Options=info|&Search=
5 2015-12-08 https://chicago.legistar.com/MeetingDetail.aspx?ID=445254&GUID=591024C3-407E-401C-B7B7-F31D952C28B0&Options=info|&Search=
6 2015-12-08 https://chicago.legistar.com/MeetingDetail.aspx?ID=445802&GUID=F977B654-1646-4345-B391-7BCBB531DA1C&Options=info|&Search=
>
```

- Explore different URLs available in the dataset:
  - Link First row.
  - Link Third row.
- HTML tags and CSS elements:
  1. td.
  2. nth-child.
- Use **Selector Gadget** and/or Inspect.
- Handy functions in the `rvest` and `xml2` packages:
  1. `read_html:` read HTML file.
  2. `html_element:` find HTML element using CSS selectors or XPath expressions.
  3. `html_attr:` gets a single attribute.
  4. `html_text2:` get element text.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RPubs - Estimatio...
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POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
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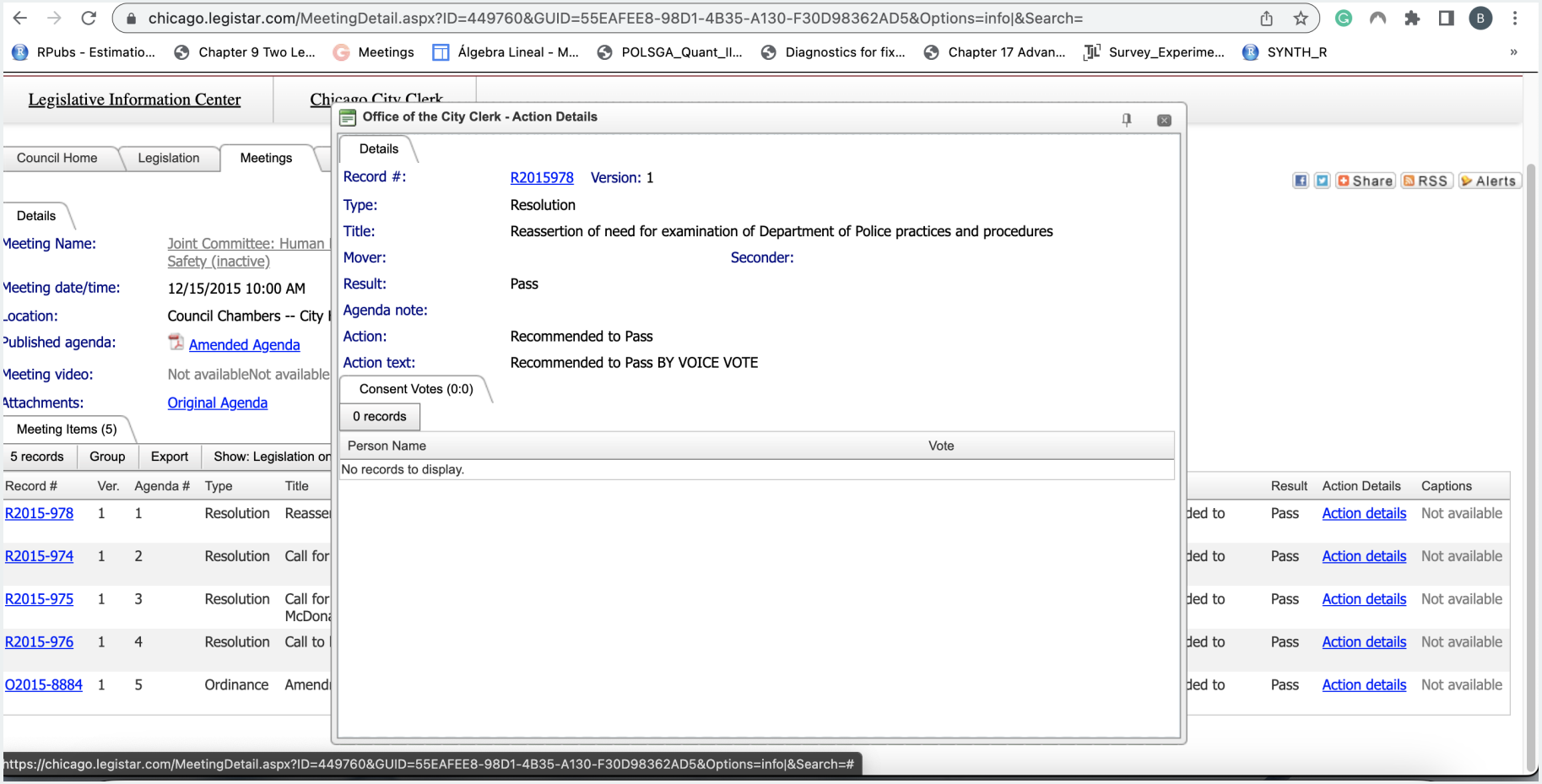
Legislative Information Center
Chicago City Clerk
Council Home
Legislation
Meetings
Legislative Bodies
Council Members
Share
RSS
Alerts
Details
Meeting Name: Joint Committee: Human Relations; Public Safety (inactive)
Agenda status: Final
Meeting date/time: 12/15/2015 10:00 AM
Minutes status: Final
Location: Council Chambers -- City Hall -- Chicago, Illinois
Published agenda: Amended Agenda
Published summary: Summary
Meeting Extra1: Notice
Meeting video: Not availableNot available
Attachments: Original Agenda
Meeting Items (5)
5 records
Group
Export
Show: Legislation only
Record # | Ver. | Agenda # | Type | Title | Action | Result | Action Details | Captions
R2015-978 | 1 | 1 | Resolution | Reassertion of need for examination of Department of Police practices and procedures | Recommended to Pass | Pass | Action details | Not available
R2015-974 | 1 | 2 | Resolution | Call for public hearing(s) concerning Laquan McDonald case | Recommended to Pass | Pass | Action details | Not available
R2015-975 | 1 | 3 | Resolution | Call for appointment of special prosecutor to represent Cook County in case against Jason Van Dyke on murder of Laquan McDonald | Recommended to Pass | Pass | Action details | Not available
R2015-976 | 1 | 4 | Resolution | Call to hold hearing(s) and engage communities and leaders on police task force accountability | Recommended to Pass | Pass | Action details | Not available
O2015-8884 | 1 | 5 | Ordinance | Amendment of Municipal Code Chapter 2-84-050 to establish and monitor police training programs | Recommended to Pass | Pass | Action details | Not available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Álgebra Lineal - M...
POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
SYNTH_R
Legislative Information Center
Chicago City Clerk
Council Home
Legislation
Meetings
Details
Meeting Name:
Joint Committee: Human
Safety (inactive)
Meeting date/time:
12/15/2015 10:00 AM
Location:
Council Chambers -- City
Published agenda:
Amended Agenda
Meeting video:
Not availableNot available
Attachments:
Original Agenda
Meeting Items (5)
5 records
Group
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Agenda #
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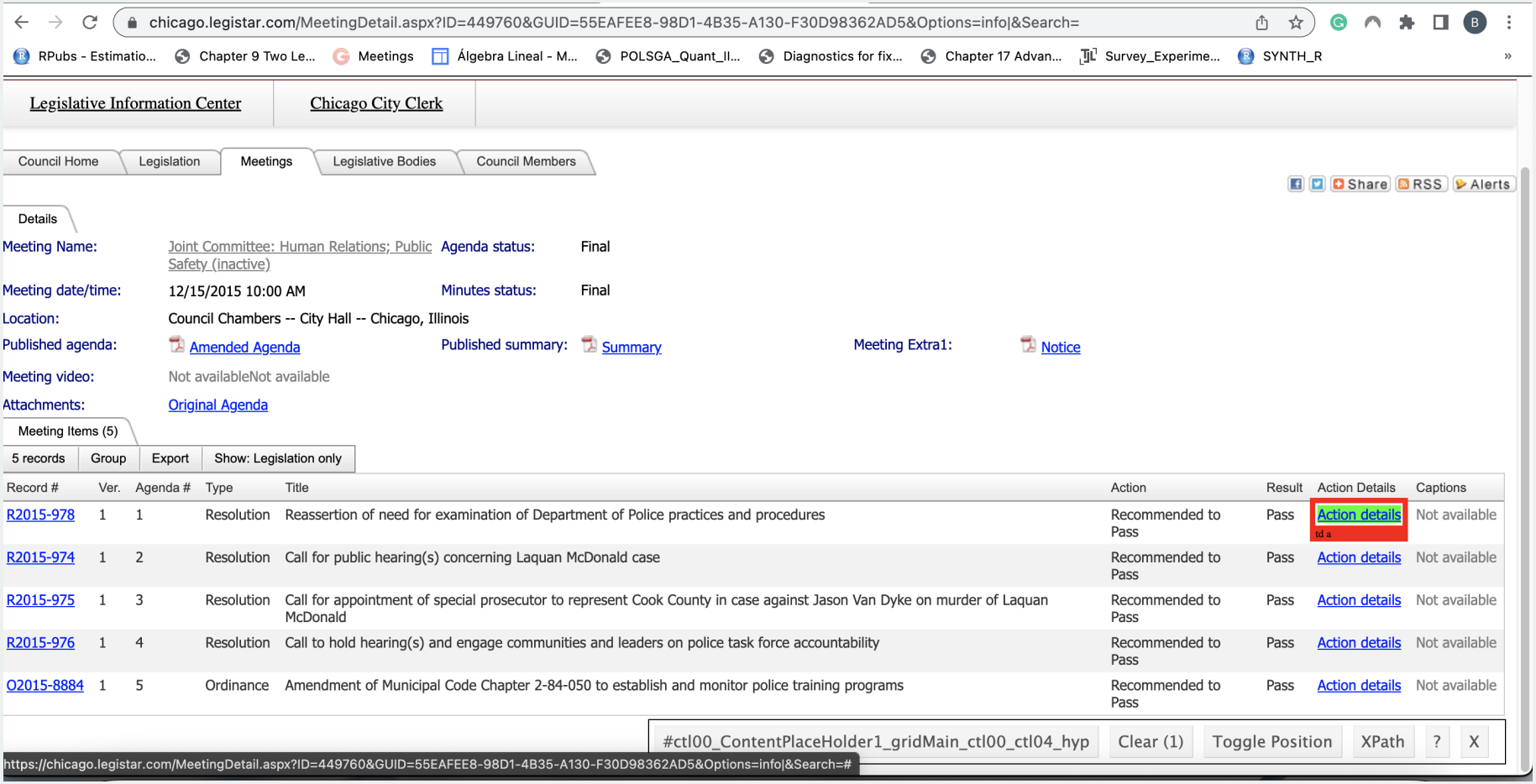
R2015-978 1 1 Resolution Reasse
R2015-974 1 2 Resolution Call for
R2015-975 1 3 Resolution Call for McDona
R2015-976 1 4 Resolution Call to
O2015-8884 1 5 Ordinance Amend
Result
Action Details
Captions
ded to Pass Action details Not available
Office of the City Clerk - Action Details
Details
Record #: R2015978 Version: 1
Type: Resolution
Title: Reassertion of need for examination of Department of Police practices and procedures
Mover:
Seconder:
Result: Pass
Agenda note:
Action: Recommended to Pass
Action text: Recommended to Pass BY VOICE VOTE
Consent Votes (0:0)
0 records
Person Name
Vote
No records to display.
Share
RSS
Alerts
https://chicago.legistar.com/MeetingDetail.aspx?ID=449760&GUID=55EAFEE8-98D1-4B35-A130-F30D98362AD5&Options=info|&Search=#


chicago.legistar.com/MeetingDetail.aspx?ID=449760&GUID=55EAFEE8-98D1-4B35-A130-F30D98362AD5&Options=info|&Search=
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O2015-8884 1 5 Ordinance Amendment of Municipal Code Chapter 2-84-050 to establish and monitor police training programs Recommended to Pass Pass Action details Not available
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Clear (1)
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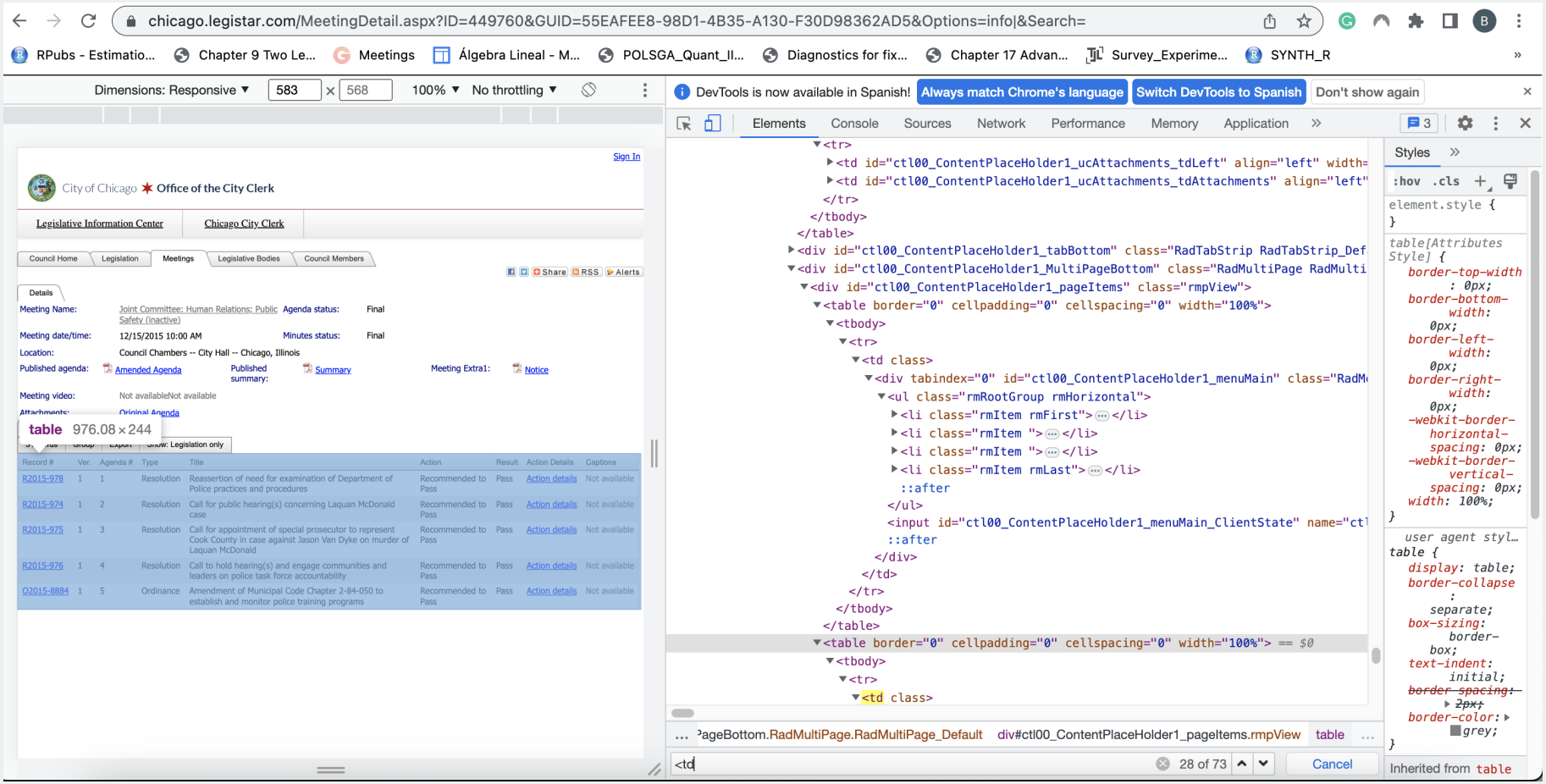
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SYNTH_R
Dimensions: Responsive
583
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No throttling
DevTools is now available in Spanish!
Always match Chrome's language
Switch DevTools to Spanish
Don't show again
Elements
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Sign In
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Notice
Meeting video:
Not availableNot available
Original Agenda
table 976.08 × 244
Record #
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Agenda #
Type
Title
Action
Result
Action Details
Captions
R2015-978
Resolution
Reassertion of need for examination of Department of Police practices and procedures
Recommended to Pass
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Action details
Not available
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Pass
Action details
Not available
O2015-8884
Ordinance
Amendment of Municipal Code Chapter 2-84-050 to establish and monitor police training programs
Recommended to Pass
Pass
Action details
Not available
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</tbody>
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div#ctl00_ContentPlaceHolder1_pageItems.rmpView
table
<td
28 of 73
Cancel
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}
table[Attributes Style] {
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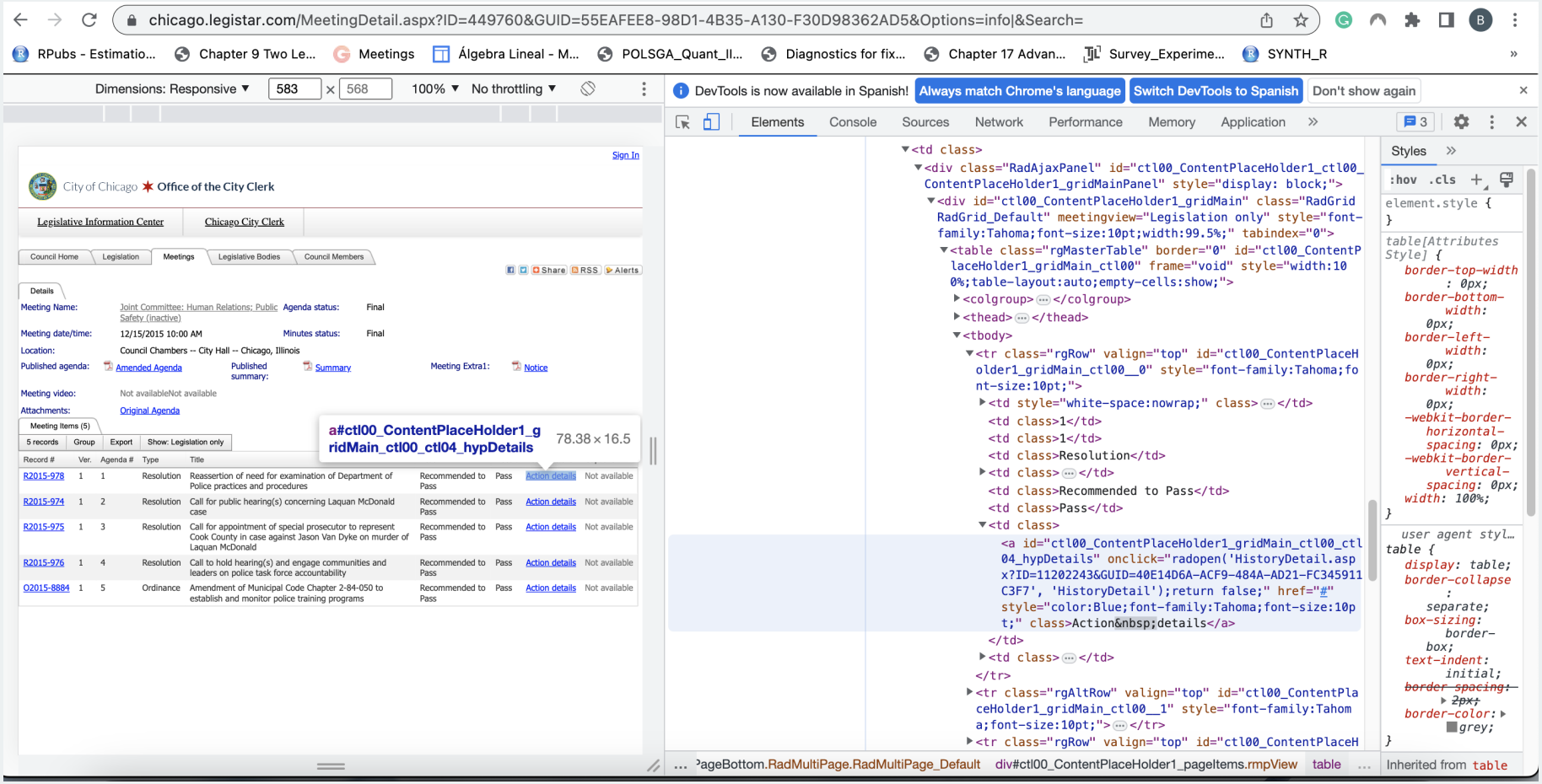
border-bottom-width: 0px;
border-left-width: 0px;
border-right-width: 0px;
-webkit-border-horizontal-spacing: 0px;
-webkit-border-vertical-spacing: 0px;
width: 100%;
}
user agent styl…
table {
display: table;
border-collapse: separate;
box-sizing: border-box;
text-indent: initial;
border-spacing: 2px;
border-color: grey;
}
Inherited from table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Minutes status:
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Published summary:
Summary
Meeting Extra1:
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Meeting video:
Not availableNot available
Attachments:
Original Agenda
Meeting Items (5)
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a#ctl00_ContentPlaceHolder1_gridMain_ctl00_ctl04_hypDetails
78.38 × 16.5
Record #
Ver.
Agenda #
Type
Title
R2015-978 1 1 Resolution Reassertion of need for examination of Department of Police practices and procedures Recommended to Pass Pass Action details Not available
R2015-974 1 2 Resolution Call for public hearing(s) concerning Laquan McDonald case Recommended to Pass Pass Action details Not available
R2015-975 1 3 Resolution Call for appointment of special prosecutor to represent Cook County in case against Jason Van Dyke on murder of Laquan McDonald Recommended to Pass Pass Action details Not available
R2015-976 1 4 Resolution Call to hold hearing(s) and engage communities and leaders on police task force accountability Recommended to Pass Pass Action details Not available
O2015-8884 1 5 Ordinance Amendment of Municipal Code Chapter 2-84-050 to establish and monitor police training programs Recommended to Pass Pass Action details Not available
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<td style="white-space:nowrap;" class></td>
<td class>1</td>
<td class>1</td>
<td class>Resolution</td>
<td class></td>
<td class>Recommended to Pass</td>
<td class>Pass</td>
<td class>
Action details
</td>
<td class></td>
</tr>
<tr class="rgAltRow" valign="top" id="ctl00_ContentPlaceHolder1_gridMain_ctl00__1" style="font-family:Tahoma;font-size:10pt;"></tr>
<tr class="rgRow" valign="top" id="ctl00_ContentPlaceH
Styles
:hov .cls
element.style {
}
table[Attributes Style] {
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border-bottom-width: 0px;
border-left-width: 0px;
border-right-width: 0px;
-webkit-border-horizontal-spacing: 0px;
-webkit-border-vertical-spacing: 0px;
width: 100%;
}
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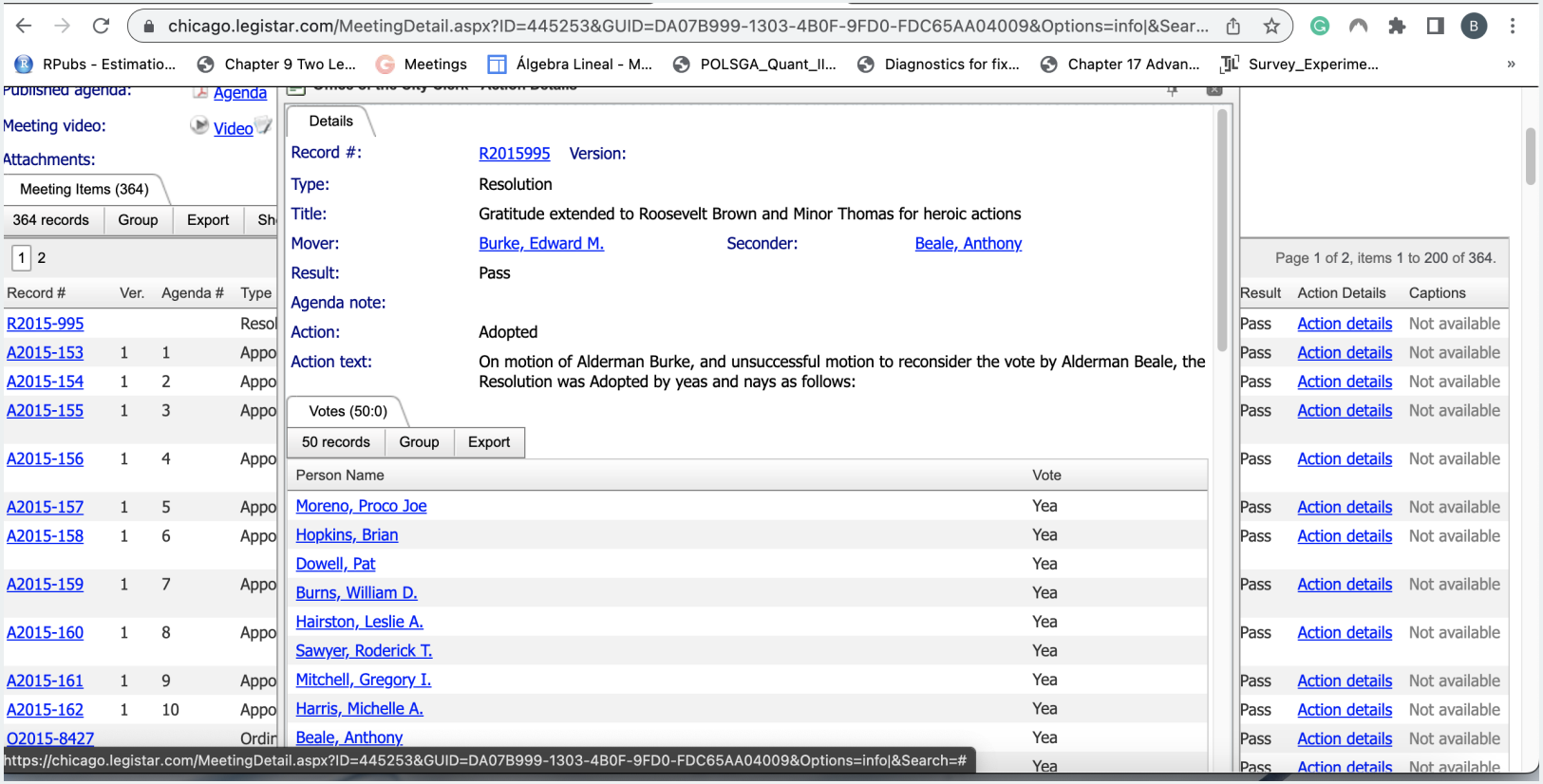
table {
display: table;
border-collapse: separate;
box-sizing: border-box;
text-indent: initial;
border-spacing: 2px;
border-color: grey;
}
pageBottom.RadMultiPage.RadMultiPage_Default
div#ctl00_ContentPlaceHolder1_pageItems.rmpView
table
Inherited from table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RPubs - Estimatio...
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POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
Published agenda:
Agenda
Meeting video:
Video
Attachments:
Meeting Items (364)
364 records
Group
Export
Details
Record #: R2015995 Version:
Type: Resolution
Title: Gratitude extended to Roosevelt Brown and Minor Thomas for heroic actions
Mover: Burke, Edward M.
Seconder: Beale, Anthony
Result: Pass
Agenda note:
Action: Adopted
Action text: On motion of Alderman Burke, and unsuccessful motion to reconsider the vote by Alderman Beale, the Resolution was Adopted by yeas and nays as follows:
Votes (50:0)
50 records
Group
Export
Person Name
Vote
Moreno, Proco Joe
Yea
Hopkins, Brian
Yea
Dowell, Pat
Yea
Burns, William D.
Yea
Hairston, Leslie A.
Yea
Sawyer, Roderick T.
Yea
Mitchell, Gregory I.
Yea
Harris, Michelle A.
Yea
Beale, Anthony
Yea
Page 1 of 2, items 1 to 200 of 364.
Record #
Ver.
Agenda #
Type
Result
Action Details
Captions
R2015-995
A2015-153
A2015-154
A2015-155
A2015-156
A2015-157
A2015-158
A2015-159
A2015-160
A2015-161
A2015-162
O2015-8427
Action details
Not available
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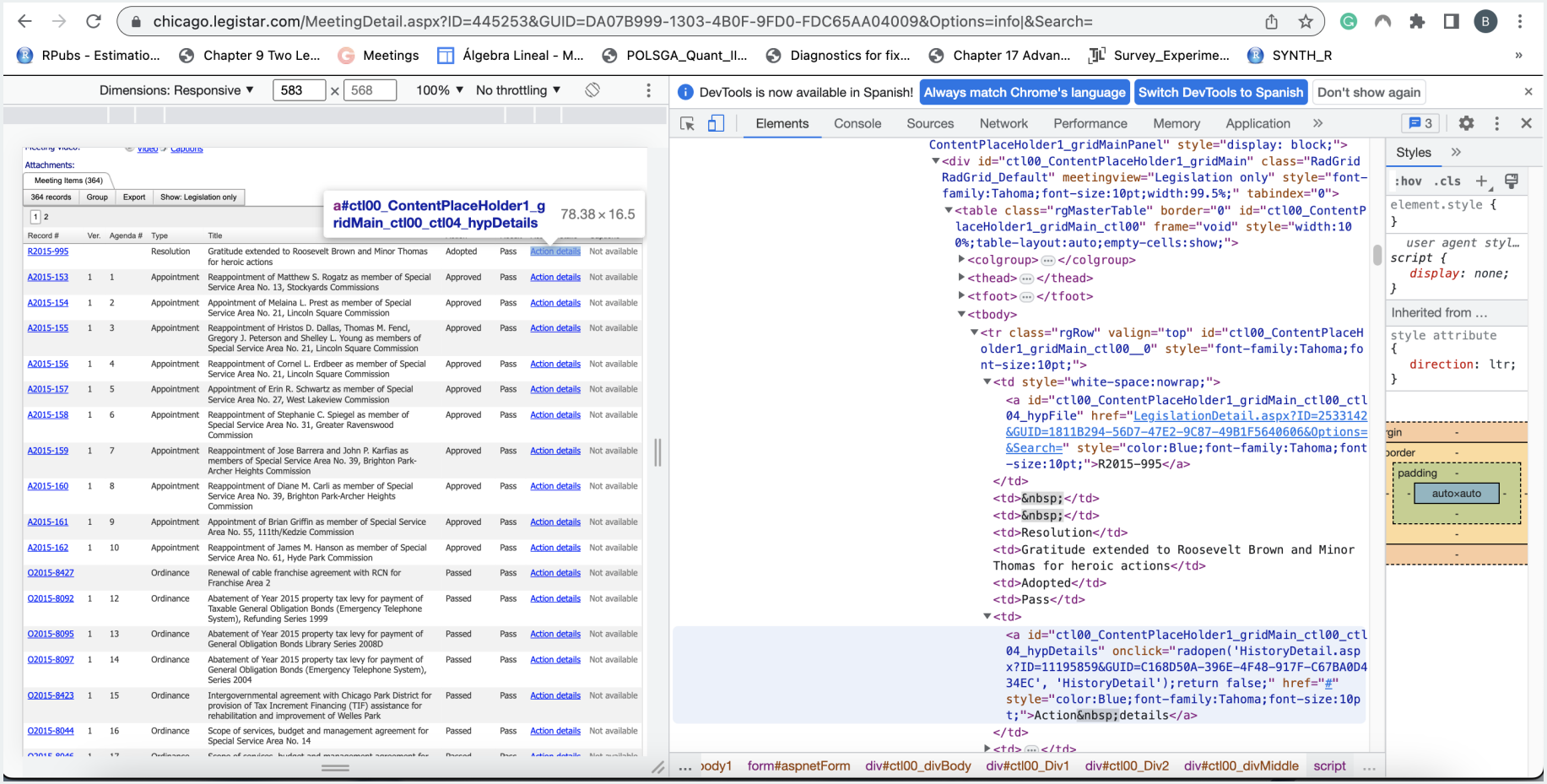
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RPubs - Estimatio...
Chapter 9 Two Le...
Meetings
Álgebra Lineal - M...
POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
SYNTH_R
Dimensions: Responsive
583
568
100%
No throttling
DevTools is now available in Spanish!
Always match Chrome's language
Switch DevTools to Spanish
Don't show again
Elements
Console
Sources
Network
Performance
Memory
Application
Styles
Attachments:
Meeting Items (364)
364 records
Group
Export
Show: Legislation only
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Record #
Ver.
Agenda #
Type
Title
R2015-995
Resolution
Gratitude extended to Roosevelt Brown and Minor Thomas for heroic actions
Adopted
Pass
Action details
Not available
A2015-153
Appointment
Reappointment of Matthew S. Rogatz as member of Special Service Area No. 13, Stockyards Commissions
A2015-154
Appointment of Melaina L. Prest as member of Special Service Area No. 21, Lincoln Square Commission
A2015-155
Reappointment of Hristos D. Dallas, Thomas M. Fencl, Gregory J. Peterson and Shelley L. Young as members of Special Service Area No. 21, Lincoln Square Commission
A2015-156
Reappointment of Cornel L. Erdbeer as member of Special Service Area No. 21, Lincoln Square Commission
A2015-157
Appointment of Erin R. Schwartz as member of Special Service Area No. 27, West Lakeview Commission
A2015-158
Reappointment of Stephanie C. Spiegel as member of Special Service Area No. 31, Greater Ravenswood Commission
A2015-159
Reappointment of Jose Barrera and John P. Karfias as members of Special Service Area No. 39, Brighton Park-Archer Heights Commission
A2015-160
Reappointment of Diane M. Carli as member of Special Service Area No. 39, Brighton Park-Archer Heights Commission
A2015-161
Appointment of Brian Griffin as member of Special Service Area No. 55, 111th/Kedzie Commission
A2015-162
Reappointment of James M. Hanson as member of Special Service Area No. 61, Hyde Park Commission
O2015-8427
Ordinance
Renewal of cable franchise agreement with RCN for Franchise Area 2
O2015-8092
Abatement of Year 2015 property tax levy for payment of Taxable General Obligation Bonds (Emergency Telephone System), Refunding Series 1999
O2015-8095
Abatement of Year 2015 property tax levy for payment of General Obligation Bonds Library Series 2008D
O2015-8097
Abatement of Year 2015 property tax levy for payment of General Obligation Bonds (Emergency Telephone System), Series 2004
O2015-8423
Intergovernmental agreement with Chicago Park District for provision of Tax Increment Financing (TIF) assistance for rehabilitation and improvement of Welles Park
O2015-8044
Scope of services, budget and management agreement for Special Service Area No. 14
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R2015-995
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<td>Gratitude extended to Roosevelt Brown and Minor Thomas for heroic actions</td>
<td>Adopted</td>
<td>Pass</td>
<td>
Action details
</td>
element.style {
}
user agent styl…
script {
display: none;
}
Inherited from …
style attribute
{
direction: ltr;
}
padding
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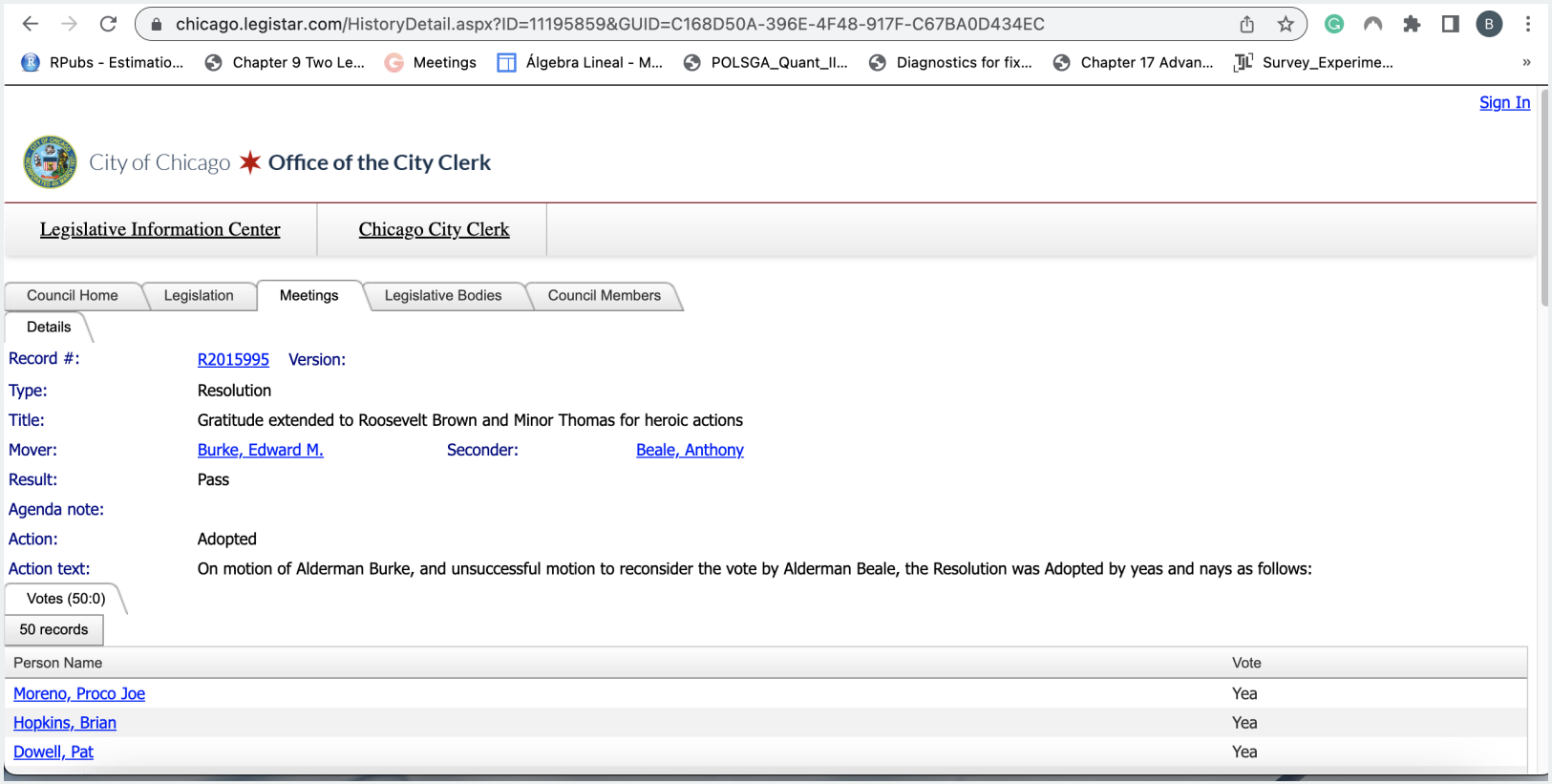
div#ctl00_Div1
div#ctl00_Div2
div#ctl00_divMiddle
script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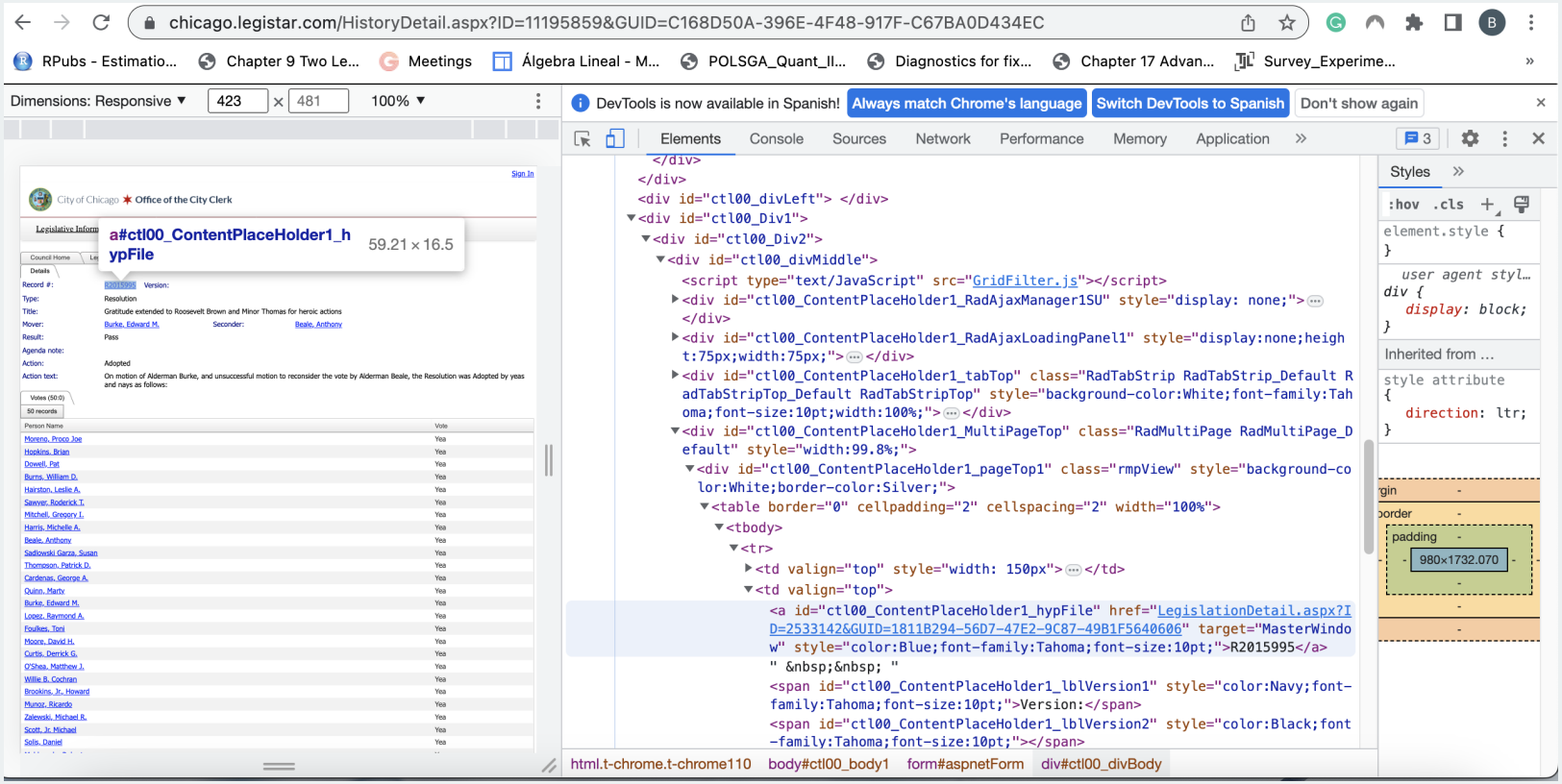
RPubs - Estimatio...
Chapter 9 Two Le...
Meetings
Álgebra Lineal - M...
POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
Sign In
City of Chicago
Office of the City Clerk
Legislative Information Center
Chicago City Clerk
Council Home
Legislation
Meetings
Legislative Bodies
Council Members
Details
Record #: R2015995 Version:
Type: Resolution
Title: Gratitude extended to Roosevelt Brown and Minor Thomas for heroic actions
Mover: Burke, Edward M. Seconder: Beale, Anthony
Result: Pass
Agenda note:
Action: Adopted
Action text: On motion of Alderman Burke, and unsuccessful motion to reconsider the vote by Alderman Beale, the Resolution was Adopted by yeas and nays as follows:
Votes (50:0)
50 records
Person Name
Vote
Moreno, Proco Joe
Yea
Hopkins, Brian
Yea
Dowell, Pat
Yea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RPubs - Estimatio...
Chapter 9 Two Le...
Meetings
Álgebra Lineal - M...
POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
Dimensions: Responsive
423
481
100%
DevTools is now available in Spanish!
Always match Chrome's language
Switch DevTools to Spanish
Don't show again
Elements
Console
Sources
Network
Performance
Memory
Application
Styles
City of Chicago
Office of the City Clerk
Legislative Inform
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Details
Record #:
R2015995
Version:
Type:
Resolution
Title:
Gratitude extended to Roosevelt Brown and Minor Thomas for heroic actions
Mover:
Burke, Edward M.
Seconder:
Beale, Anthony
Result:
Pass
Agenda note:
Action:
Adopted
Action text:
On motion of Alderman Burke, and unsuccessful motion to reconsider the vote by Alderman Beale, the Resolution was Adopted by yeas and nays as follows:
Votes (50:0)
50 records
Person Name
Vote
Moreno, Proco Joe
Hopkins, Brian
Dowell, Pat
Burns, William D.
Hairston, Leslie A.
Sawyer, Roderick T.
Mitchell, Gregory I.
Harris, Michelle A.
Beale, Anthony
Sadlowski Garza, Susan
Thompson, Patrick D.
Cardenas, George A.
Quinn, Marty
Burke, Edward M.
Lopez, Raymond A.
Foulkes, Toni
Moore, David H.
Curtis, Derrick G.
O'Shea, Matthew J.
Willie B. Cochran
Brookins, Jr., Howard
Munoz, Ricardo
Zalewski, Michael R.
Scott, Jr, Michael
Solis, Daniel
Yea

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R2015995
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Version:

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}
Inherited from …
style attribute
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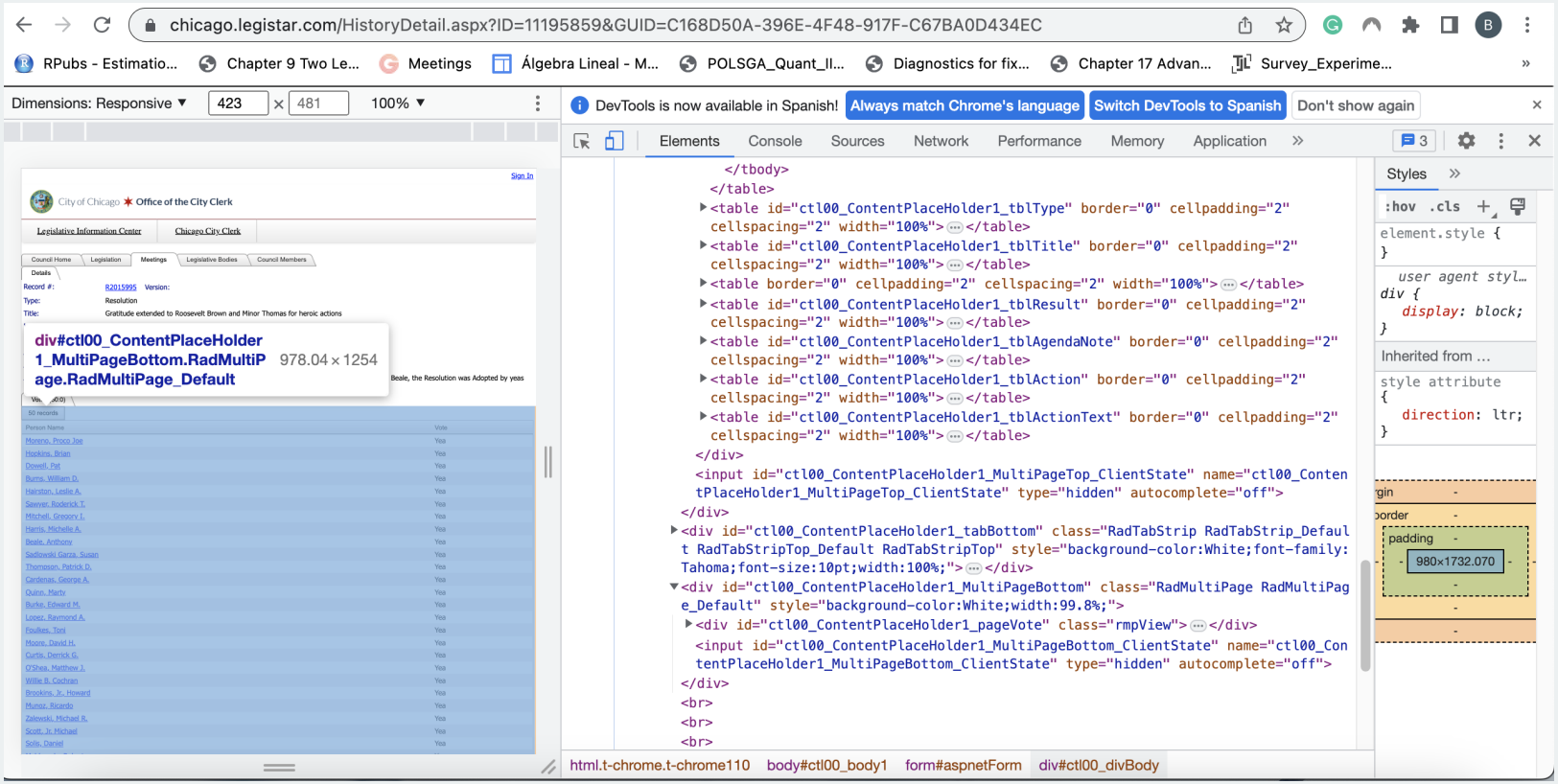
div#ctl00_divBody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POLSGA_Quant_II...
Diagnostics for fix...
Chapter 17 Advan...
Survey_Experime...
Dimensions: Responsive
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DevTools is now available in Spanish!
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Switch DevTools to Spanish
Don't show again
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Sources
Network
Performance
Memory
Application
City of Chicago ✱ Office of the City Clerk
Legislative Information Center
Chicago City Clerk
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Styles
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element.style {
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div {
display: block;
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Inherited from ...
style attribute
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html.t-chrome.t-chrome110
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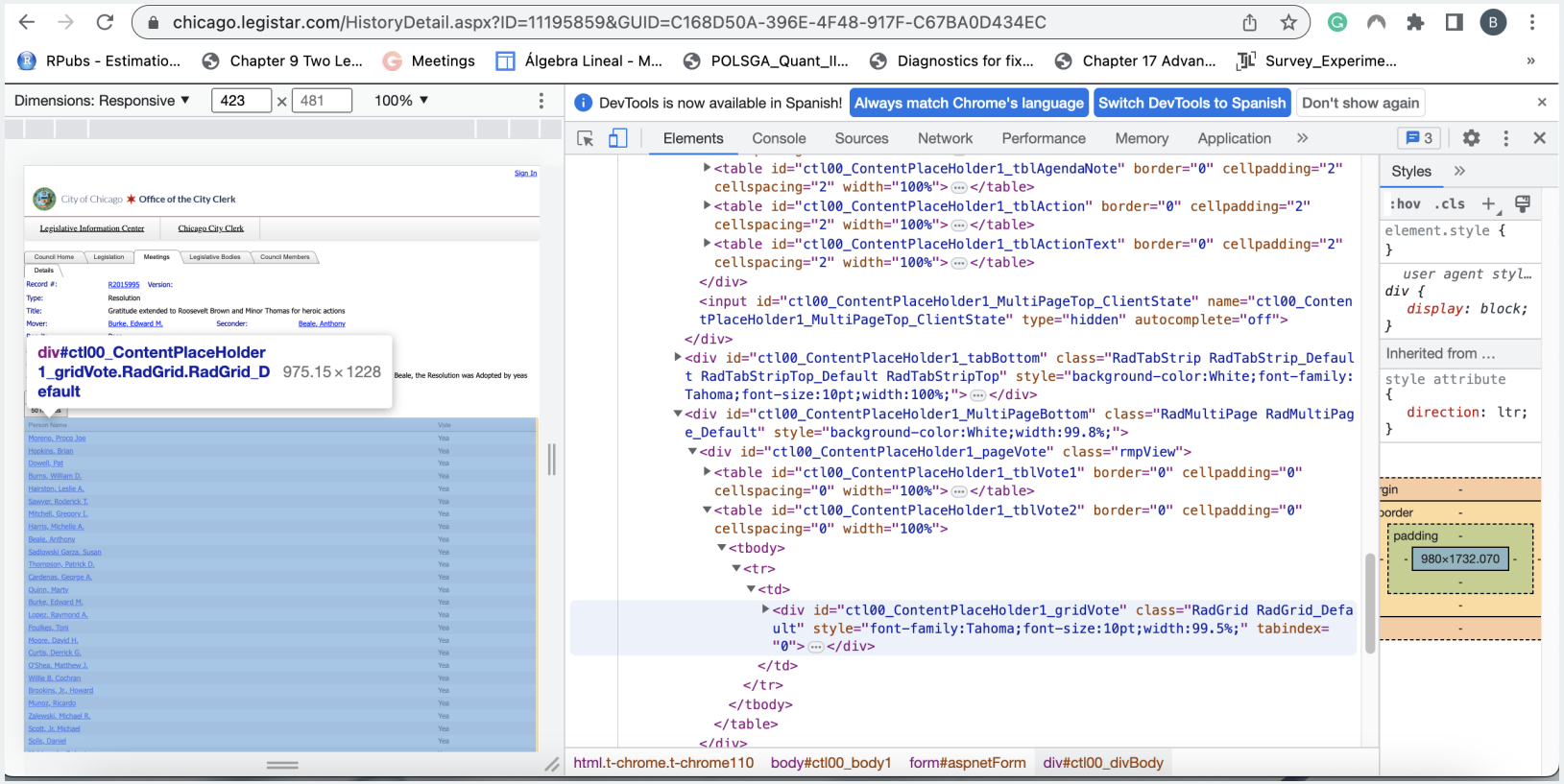
form#aspnetForm
div#ctl00_divBody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Álgebra Lineal - M...
POLSGA_Quant_II...
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Dimensions: Responsive
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City of Chicago ★ Office of the City Clerk
Legislative Information Center
Chicago City Clerk
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Styles
:hov .cls
element.style {
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user agent styl…
div {
display: block;
}
Inherited from …
style attribute
{
direction: ltr;
}
padding
980×1732.070
html.t-chrome.t-chrome110
body#ctl00_body1
form#aspnetForm
div#ctl00_divBody

Data Collection: New York

- Steps to collect data with API:
    1. Sign up for an app token/key.
    2. Identify the API endpoint.
    3. Filter the dataset (select columns and rows).
    4. Download selected data.

- Client: nyc.
- Explore Legistar Help.
- Example:
    - `"https://webapi.legistar.com/v1/nyc/events?token=XXXX"`

Principal Component Analysis

- Datasets have different types of information (and columns have different names).
- The New York dataset contains rows with different EventItems (not only votes). It is preferable to filter them.
- Original data: long format. PCA: wide format.
- Many votes are unanimous (or the minority is less than 10Methodological decisions:
    - Number of authorities.
    - Number of votes (the important thing is plenary, over the committees).
    - Management of missing values.
    - Substantive interpretation.