
The lecture will start soon at
10:15
https://unsplash.com/photos/gm3bxHin8VA

Aalto University
School of Business

MySQL for Data Analytics

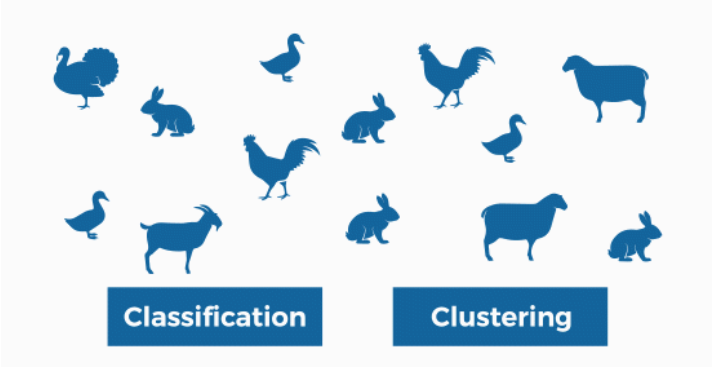
Lecturer: Yong Liu
Contact me at: Yong.liu@aalto.fi

Content

- **Association analysis**
- **Connecting database to R**
- **Commands for Root Users**
- **Text mining**
- **Close of the course**

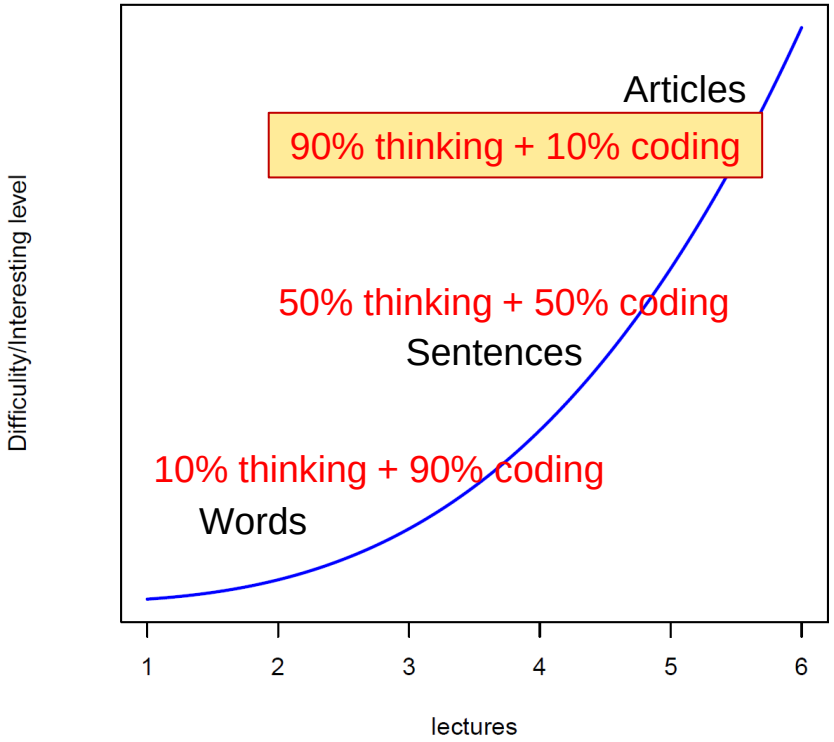
Principles Behind Common Analytic Tasks

- **Prediction** – e.g. daily revenue of next 7 days
- **Optimization** – e.g. logistic planning
- **Recommendation** – e.g. **association analysis**
- **Classification**
- **Clustering**



https://blog.bismart.com/en/classification-vs.-clustering-a-practical-explanation
IS2020 A Competency Model for Undergraduate Programs in Information Systems

Allocating your resources properly



- The first few lectures demand more memorization work, and very limited critical thinking.
- The last few lectures demand more critical thinking, in addition to some memorization work.

Advices:

- **Keep pace with the lectures**. Otherwise, you will find the course tremendously difficult in the last few lectures, if you do not get familiar with basic MySQL vocabulary.

MySQL as a language: Words → Sentences → Articles

Association Analysis

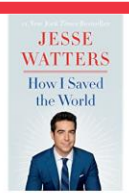
- **Association analysis (AA)** discovers the probability of the co-occurrence of items in a collection.
- **Association rules**: the relationships between co-occurring items.
- Applications of AA: Market-basket analysis & network analysis

https://docs.oracle.com/cd/E18283_01/datamine.112/e16808/market_basket.htm

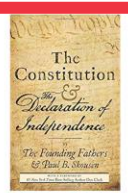
Association Analysis – Example I

Customers who viewed this item also viewed

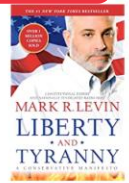
Page 1 of 9



How I Saved the World
› Jesse Watters
3,301
Hardcover
#1 Best Seller in Journalist Biographies
$17.64
+ $35.48 shipping
In Stock.

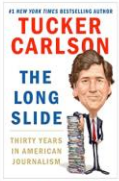


The Constitution and the Declaration of Independence: The…
The Founding Fathers
5,232
Paperback
#1 Best Seller in Political Reference
$6.95
+ $35.48 shipping
In Stock.

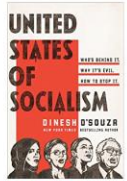


Liberty and Tyranny: A Conservative Manifesto
› Mark R. Levin
4,643
Paperback
96 offers from $3.37

SUMMARY OF AMERICAN MARXISM By Mark R. Levin
Alex John
27
Paperback
$8.99
+ $35.48 shipping
In Stock.



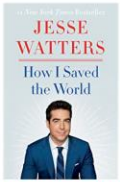
The Long Slide: Thirty Years in American Journalism
› Tucker Carlson
41
Hardcover
$17.23
+ $35.48 shipping
In Stock.



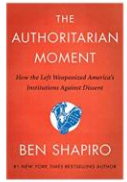
United States of Socialism: Who's Behind It. Why It's Evil. How to Stop It.
› Dinesh D'Souza
4,841
Hardcover
$14.99
+ $35.48 shipping
In Stock.

Customers who bought this item also bought

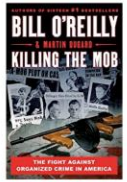
Page



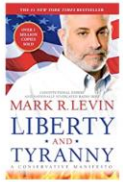
How I Saved the World
› Jesse Watters
3,301
Hardcover
#1 Best Seller in Journalist Biographies
$17.64
+ $35.48 shipping
In Stock.



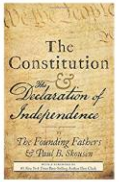
The Authoritarian Moment: How the Left Weaponized America's…
› Ben Shapiro
1,486
Hardcover
#1 Best Seller in Fascism
$17.44
+ $35.48 shipping
In Stock.



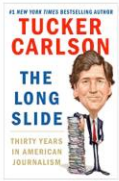
Killing the Mob: The Fight Against Organized Crime in America (Bill…
› Bill O'Reilly
6,919
Hardcover
#1 Best Seller in Organized Crime True Accounts
$17.98
+ $35.48 shipping
In Stock.



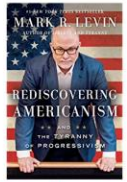
Liberty and Tyranny: A Conservative Manifesto
› Mark R. Levin
4,643
Paperback
96 offers from $3.37



The Constitution and the Declaration of Independence: The…
The Founding Fathers
5,232
Paperback
#1 Best Seller in Political Reference
$6.95
+ $35.48 shipping
In Stock.



The Long Slide: Thirty Years in American Journalism
› Tucker Carlson
41
Hardcover
$17.23
+ $35.48 shipping
In Stock.



Rediscovering Americanism: And the Tyranny of Progressivism
› Mark R. Levin
2,659
Paperback
40 offers from $6.03

Market Basket Example

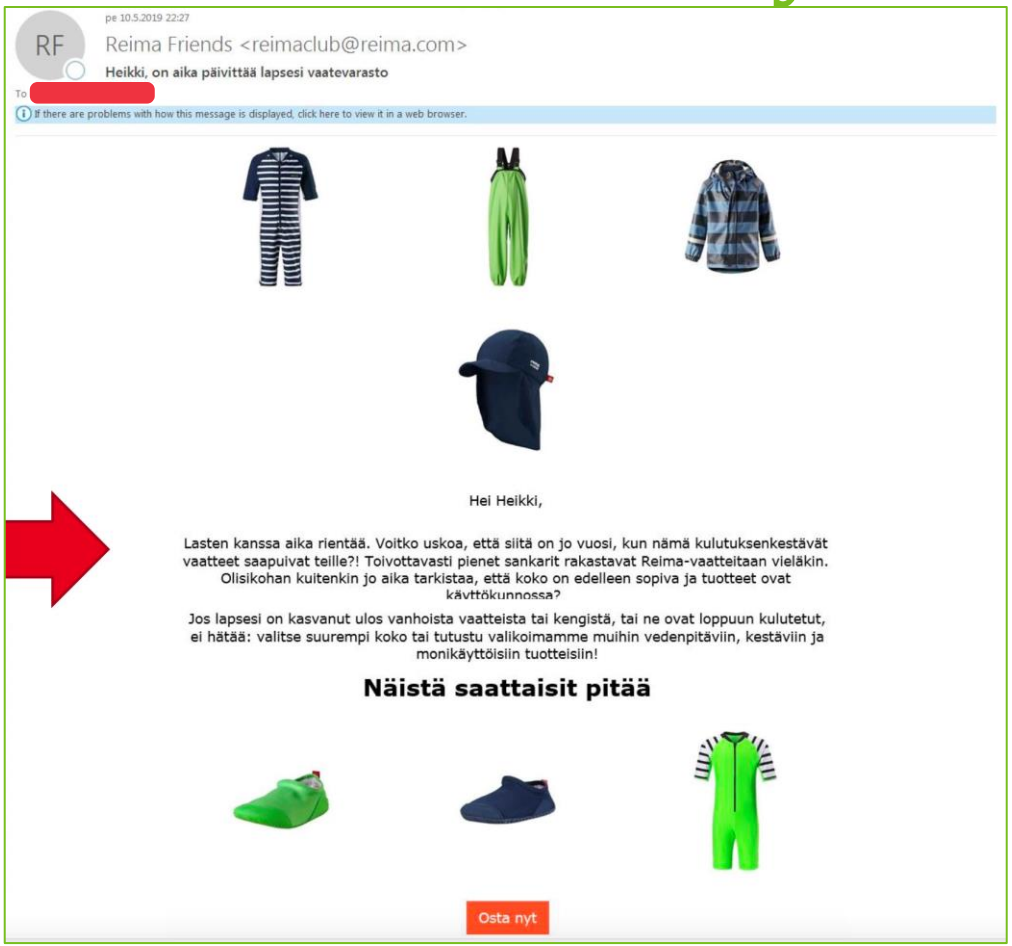
Example II

- Where should detergents be placed in the Store to maximize their sales?
- Are window cleaning products purchased when detergents and orange juice are bought together?
- Is soda typically purchased with bananas? Does the brand of soda make a difference?
- How are the demographics of the neighborhood affecting what customers are buying?

Image source: deepclimate.org

https://www.analyticsvidhya.com/blog/2014/08/effective-cross-selling-market-basket-analysis/

Association Analysis – Example III



Translation of the Finnish words:

With children the time is rushing. Can you believe it's been a year since these wear-resistant clothes arrived for you ?! Hopefully the little heroes will settle their Reima clothes even more. However, it would be time to check that the size is still suitable and the products are in good condition.

If your child has grown out of old clothes or shoes, or they are worn out, no worries: choose a larger size or check out our range of other waterproof, durable and multi-purpose products!

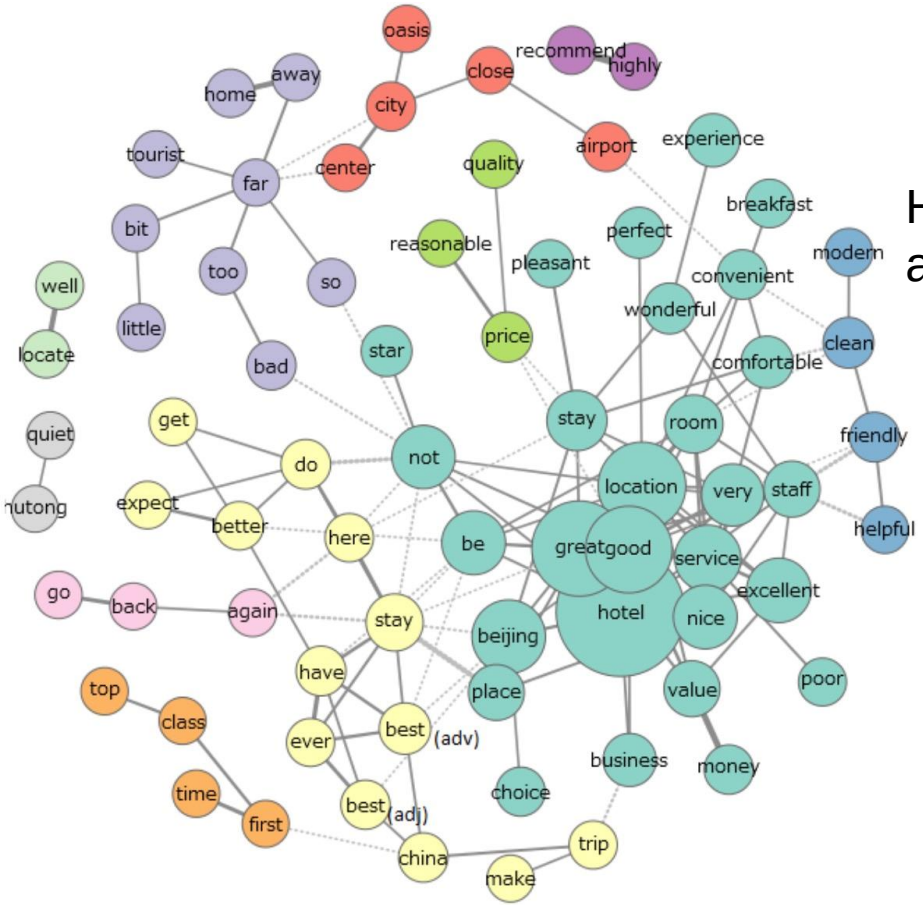
These you might like.

Market-basket analysis

- Valuable for direct marketing, sales promotions, and for discovering business trends. Market-basket analysis can also be used effectively for store layout, catalog design, and cross-sell.
- In e-commerce, association rules may be used for Web page personalization.

Example: An association model might find that a user who visits pages A and B is 70% likely to also visit page C in the same session. Based on this rule, a dynamic link could be created for users who are likely to be interested in page C.

Association Analysis – Example IV



Words association

How do consumers evaluate different attributes of your products or services?

Association rules

$$Rule:\ X \Rightarrow Y$$

$$Support = \frac{frq(X,Y)}{N}$$

$$Confidence = \frac{frq(X,Y)}{frq(X)}$$

$$Lift = \frac{Support}{Supp(X) \times Supp(Y)}$$

Rule	Support	Confidence	Lift
$A \Rightarrow D$	2/5	2/3	10/9
$C \Rightarrow A$	2/5	2/4	5/6
$A \Rightarrow C$	2/5	2/3	5/6
$B \& C \Rightarrow D$	1/5	1/3	5/9

An example of Association Rules

1. Assume there are 100 customers.
2. 10 of them bought milk, 8 bought butter and 6 bought both of them.
3. bought milk => bought butter.
4. support = P(Milk & Butter) = 6/100 = 0.06.
5. confidence = support/P(Butter) = 0.06/0.08 = 0.75.
6. lift = confidence/P(Milk) = 0.75/0.10 = 7.5.

Please note the rule A $\Rightarrow$ D differs from the rule D $\Rightarrow$ A

https://findanyanswer.com/what-is-the-formula-for-support-confidence-and-lift
https://www.saedsayad.com/association_rules.htm

How Lift is Calculated:

Lift is the ratio of the observed co-occurrence of two items to the expected co-occurrence if they were independent. The formula for calculating Lift is:

$$\text{Lift}(A, B) = \frac{\text{Support}(A \cap B)}{\text{Support}(A) \times \text{Support}(B)}$$

Where:

- **Support(A)** is the probability (or proportion) that item A appears in the dataset.
- **Support(B)** is the probability that item B appears in the dataset.
- **Support(A ∩ B)** is the probability that both items A and B appear together in the dataset.

Example:

Let's say you're analyzing customer purchases:

- **Support(A)**: 20% of customers buy bread.
- **Support(B)**: 30% of customers buy butter.
- **Support(A ∩ B)**: 10% of customers buy both bread and butter together.

The Lift for bread and butter would be:

$$\text{Lift}(A, B) = \frac{0.10}{0.20 \times 0.30} = \frac{0.10}{0.06} = 1.67$$

Interpreting Lift:

- **Lift > 1**: There is a positive association, meaning that the occurrence of A increases the likelihood of B (and vice versa).
- **Lift = 1**: A and B are independent (no association).
- **Lift < 1**: A and B have a negative association, meaning they occur together less often than expected by chance.

Open AI

Core Function of Association Analysis

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product d
3	Product c
3	Product b
3	Product e

Raw data

```
SELECT   a.uid as Product1, b.uid as Product2,
         COUNT(*) as Frequency
FROM EXAMPLE1 as a JOIN EXAMPLE1 as b
         ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid
```

example1 (3×10)

Product1	Product2	Frequency
Product b	Product a	2
Product c	Product a	2
Product d	Product a	1
Product c	Product b	3
Product d	Product b	2
Product d	Product c	2
Product e	Product a	1
Product e	Product b	2
Product e	Product c	2
Product e	Product d	1

Co-occurrence frequency

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product d
3	Product c
3	Product b
3	Product e

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product d
3	Product c
3	Product b
3	Product e

```
SELECT   a.uid as Person1, b.uid as Person2,
         COUNT(*) as Frequency
FROM EXAMPLE1 as a JOIN EXAMPLE1 as b
         ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid
```

example1 (3×10)

Product1	Product2	Frequency
Product b	Product a	2
Product c	Product a	2
Product d	Product a	1
Product c	Product b	3
Product d	Product b	2
Product d	Product c	2
Product e	Product a	1
Product e	Product b	2
Product e	Product c	2
Product e	Product d	1

Compute the confidence level

```
SELECT tb1.Product1, tb1.Product2, tb1.Frequency,
tb1.Frequency/tb2.overall_frequency from

(SELECT   a.uid as Product1, b.uid as Product2,
COUNT(*) as Frequency
FROM EXAMPLE1 as a JOIN EXAMPLE1 as b
ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid)  AS tb1

Join

(SELECT uid AS focused_product, COUNT(*) AS
overall_frequency
FROM EXAMPLE1 GROUP BY uid) AS tb2

ON tb1.Product2 = tb2.focused_product;
```

Product1	Product2	Frequency	tb1.Frequency/tb2.overall_frequency
Product b	Product a	2	1.0000
Product c	Product a	2	1.0000
Product d	Product a	1	0.5000
Product c	Product b	3	1.0000
Product d	Product b	2	0.6667
Product d	Product c	2	0.6667
Product e	Product a	1	0.5000
Product e	Product b	2	0.6667
Product e	Product c	2	0.6667
Product e	Product d	1	0.5000

$$Rule:\ X \Rightarrow Y$$

$$Support = \frac{frq(X,Y)}{N}$$

$$Confidence = \frac{frq(X,Y)}{frq(X)}$$

$$Lift = \frac{Support}{Supp(X) \times Supp(Y)}$$

Apply the code to real-life data

Core Function of Association Analysis

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product d
3	Product c
3	Product b
3	Product e

Raw data

```
SELECT  a.uid as Person1, b.uid as Person2,
        COUNT(*) as Frequency
FROM EXAMPLE1 as a JOIN EXAMPLE1 as b
        ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid
```

example1 (3×10)

Product1	Product2	Frequency
Product b	Product a	2
Product c	Product a	2
Product d	Product a	1
Product c	Product b	3
Product d	Product b	2
Product d	Product c	2
Product e	Product a	1
Product e	Product b	2
Product e	Product c	2
Product e	Product d	1

Co-occurrence frequency

Can this function be applied directly to hotel data to detect the most associated Hotels (if Null values in user_id do not matter)?
The results will be used as a basis for a hotel recommendation system.

"Sample solution"

id	hotel_id	user_id	username	overall_rating	review_date	checkin_year
646,693	199,923	(NULL)	(NULL)	5	2002-08-11	2,002
646,694	228,670	(NULL)	(NULL)	4	2002-08-11	2,002
809,978	228,670	(NULL)	(NULL)	3	2002-11-23	2,002
833,841	249,056	(NULL)	(NULL)	5	2003-01-05	2,003
841,271	206,760	(NULL)	(NULL)	5	2003-01-20	2,003
853,633	206,761	E4ED74B155D08686D9C032A5286D...	TC1968	4	2003-02-05	2,003
860,530	267,464	(NULL)	(NULL)	5	2003-02-23	2,003
908,091	267,464	(NULL)	(NULL)	5	2003-03-04	2,003
987,116	263,808	(NULL)	(NULL)	4	2003-05-02	2,003
1,070,394	228,682	CC9AB0C275A231756D0D1C0E443...	Helga88	4	2003-06-04	2,003
1,108,965	232,283	C164F53CD27D809BC7210E34703B...	Maura C	5	2003-06-25	2,003
1,137,703	228,670	(NULL)	(NULL)	4	2003-07-14	2,003
1,138,665	596,136	8571D7E8520AA15C3EF73567142A...	Nils S H	4	2003-07-15	2,003
1,153,472	263,808	(NULL)	(NULL)	4	2003-07-29	2,003
1,216,222	206,760	307FFC64E94BB40C7FB0E6674526F...	european1	4	2003-08-05	2,003
1,230,492	228,673	(NULL)	(NULL)	3	2003-08-16	2,003

Business data

Submit your answer to Presemo:
https://presemo.aalto.fi/drm/

Uniqueness of the data [?]:
A user may visit the same hotel multiple times

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product b
3	Product c
3	Product d
3	Product e

Table: EXAMPLE1

```
SELECT   a.uid as Person1, b.uid as Person2,  COUNT(*) as Frequency
FROM EXAMPLE1 as a JOIN EXAMPLE1 as b
         ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid;
```

Code

Person1	Person2	Frequency
Product b	Product a	2
Product c	Product a	2
Product d	Product a	1
Product e	Product a	1
Product c	Product b	3
Product d	Product b	2
Product e	Product b	2
Product d	Product c	2
Product e	Product c	2
Product e	Product d	1

Output

id	uid
1	Product a
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product b
3	Product c
3	Product d
3	Product e

Table: EXAMPLE2

```
SELECT   a.uid as Person1, b.uid as Person2,  COUNT(*) as Frequency
FROM EXAMPLE2 as a JOIN EXAMPLE2 as b
         ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid
```

Code

Person1	Person2	Frequency
Product b	Product a	3
Product c	Product a	3
Product d	Product a	2
Product e	Product a	1
Product c	Product b	3
Product d	Product b	2
Product e	Product b	2
Product d	Product c	2
Product e	Product c	2
Product e	Product d	1

Output

id	hotel_id	user_id	username	overall_rating	review_date	checkin_year
646,693	199,923	(NULL)	(NULL)	5	2002-08-11	2,002
646,694	228,670	(NULL)	(NULL)	4	2002-08-11	2,002
809,978	228,670	(NULL)	(NULL)	3	2002-11-23	2,002
833,841	249,056	(NULL)	(NULL)	5	2003-01-05	2,003
841,271	206,760	(NULL)	(NULL)	5	2003-01-20	2,003
853,633	206,761	E4ED74B155D08686D9C032A5286D...	TC1968	4	2003-02-05	2,003
860,530	267,464	(NULL)	(NULL)	5	2003-02-23	2,003
908,091	267,464	(NULL)	(NULL)	5	2003-03-04	2,003
987,116	263,808	(NULL)	(NULL)	4	2003-05-02	2,003
1,070,394	228,682	CC9AB0C275A231756D0D1C0E443...	Helga88	4	2003-06-04	2,003
1,108,965	232,283	C164F53CD27D809BC7210E34703B...	Maura C	5	2003-06-25	2,003
1,137,703	228,670	(NULL)	(NULL)	4	2003-07-14	2,003
1,138,665	596,136	8571D7E8520AA15C3EF73567142A...	Nils S H	4	2003-07-15	2,003
1,153,472	263,808	(NULL)	(NULL)	4	2003-07-29	2,003
1,216,222	206,760	307FFC64E94BB40C7FB0E6674526F...	european1	4	2003-08-05	2,003
1,230,492	228,673	(NULL)	(NULL)	3	2003-08-16	2,003

Uniqueness of the data [?]: A user may visit the same hotel multiple times

What would be the solution to the make the data ready for the association analysis?

Reflections

1. Understanding the nature of your data is very important before any analysis.
2. Code that generates no error message does not necessarily generate the right results.
3. A good understanding of your data – albeit take time and yields no direct output - is very important!

Association of more than two products

id	uid
1	Product a
1	Product b
1	Product c
1	Product d
2	Product a
2	Product b
2	Product c
2	Product e
3	Product d
3	Product c
3	Product b
3	Product e

Raw data

```
SELECT   a.uid as Person1, b.uid as Person2,
         COUNT(*) as Frequency
FROM EXAMPLE1 as a
JOIN EXAMPLE1 as b
         ON a.id = b.id AND a.uid > b.uid
GROUP BY a.uid, b.uid
```

example1 (3×10)

Product1	Product2	Frequency
Product b	Product a	2
Product c	Product a	2
Product d	Product a	1
Product c	Product b	3
Product d	Product b	2
Product d	Product c	2
Product e	Product a	1
Product e	Product b	2
Product e	Product c	2
Product e	Product d	1

Co-occurrence frequency of **two** products

Solution for three-products co-occurrence frequency?
Submit your answer to Presemo

Product1	Product2	Product3	Frequency
Product c	Product b	Product a	2
Product d	Product b	Product a	1
Product d	Product c	Product a	1
Product d	Product c	Product b	2
Product e	Product b	Product a	1
Product e	Product c	Product a	1
Product e	Product c	Product b	2
Product e	Product d	Product c	1
Product e	Product d	Product b	1

Co-occurrence frequency of **three** products

Solution for three-products co-occurrence frequency

```
SELECT   a.uid as Product1, b.uid as Product2, c.uid as Product3, COUNT(*) as Frequency
FROM EXAMPLE1 a
JOIN EXAMPLE1 b ON a.id = b.id AND a.uid > b.uid
JOIN EXAMPLE1 c ON a.id = c.id AND b.uid > c.uid
GROUP BY a.uid, b.uid, c.uid;
```

Product1	Product2	Product3	Frequency
Product c	Product b	Product a	2
Product d	Product b	Product a	1
Product d	Product c	Product a	1
Product d	Product c	Product b	2
Product e	Product b	Product a	1
Product e	Product c	Product a	1
Product e	Product c	Product b	2
Product e	Product d	Product c	1
Product e	Product d	Product b	1

Co-occurrence frequency
of **three** products

Analytic mind

Can you generate the solution?

Data preparation:

1. What kinds of data would you need?
2. Any necessary manipulation to the data before analysis?

Analysis → Prediction:

1. What customers bought before predict what they will buy now?!
2. Does the sequence of purchase matter and how?
3. How to code?

Submit your answer to Presemo:
https://presemo.aalto.fi/drm/

Analytics?

1. **What kinds of data would you need?**

- User ID
- Products purchased associated with User ID
- You also need to consider the year

2. **Any necessary manipulation of the data before analysis?**

- Product return
- Merge multiple orders into records for individual customers
- Consider which year to merge
- Summer clothes vs. winter clothes

review (5×56,709)

id	user_id	hotel_id	review_date	new_product_id
853,633	E4ED74B155D08686D9C032A5286D...	206,761	2003-02-05	2,003
1,070,394	CC9AB0C275A231756D0D1C0E443...	228,682	2003-06-04	2,003
1,108,965	C164F53CD27D809BC7210E34703B...	232,283	2003-06-25	2,003
1,138,665	8571D7E8520AA15C3EF73567142A...	596,136	2003-07-15	2,003
1,216,222	307FFC64E94BB40C7FB0E6674526F...	206,760	2003-08-05	2,003
1,383,626	DD49C7A0F9B575384874F75C9B21...	262,286	2003-10-09	2,003
1,496,549	BAA10872C4E4380C336DF0F9EF52...	199,923	2003-11-22	2,003
1,541,745	8854F4A62CB84DC2DB48465E2907...	202,626	2004-01-06	2,004
1,644,481	2B40B65CFF95534211587D0C3DC0...	206,763	2004-02-09	2,004
1,715,016	023696A80B035229F9873306B3D8...	293,333	2004-03-08	2,004
1,754,696	07A70590205F70B4329E58749BFAB...	199,923	2004-03-29	2,004
1,777,602	E2C4BE6FA54491536BB6DAB1AB10...	228,677	2004-04-12	2,004
1,777,683	E2C4BE6FA54491536BB6DAB1AB10...	228,682	2004-04-12	2,004
1,785,803	DCB34C13526F81DF5975E7E5CB16...	228,682	2004-04-13	2,004
1,869,142	2A8F276D2471783E1053D68A370C...	238,453	2004-05-03	2,004
2,078,376	454C2DAAA0BD0F6526D90EF10986...	206,765	2004-05-18	2,004
2,078,379	454C2DAAA0BD0F6526D90EF10986...	237,708	2004-05-18	2,004
2,128,683	3C9DF04638A7A8228333A3355273...	267,464	2004-05-28	2,004
2,268,991	6325AD565B1B895111151F30A963...	199,923	2004-07-05	2,004
2,498,342	EC710E4F8F1F7B9365224C9C66CC7...	228,674	2004-08-26	2,004

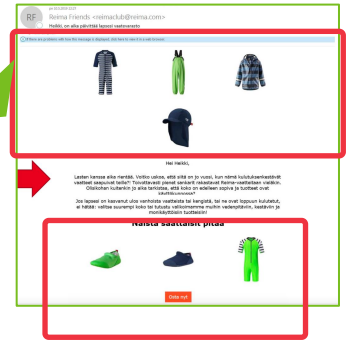
Raw data

review (2×15)

checkin_year	COUNT(*)
2,002	3
2,003	19
2,004	75
2,005	117
2,006	313
2,007	534
2,008	710
2,009	1,314
2,010	1,997
2,011	3,696
2,012	6,250
2,013	8,982
2,014	12,813
2,015	18,091
2,016	2,203

Manipulation I

Predictors



Outcomes

Data Preparation/Manipulation:

If time variable matters now, how to add that factor/variable into the association analysis?

Other considerations:

1. Association analysis AND/OR Prediction?
2. Association based on this year's sale data?
3. Association based on last year's sale data?
4. Association based on an integration of this year and last year's sale data?
5. An integration of association and prediction analysis?

Combine product ID with year as a solution

review (5×56,709)

id	user_id	hotel_id	review_date	new_product_id
853,633	E4ED74B155D08686D9C032A5286D...	206,761	2003-02-05	2,003
1,070,394	CC9AB0C275A231756D0D1C0E443...	228,682	2003-06-04	2,003
1,108,965	C164F53CD27D809BC7210E34703B...	232,283	2003-06-25	2,003
1,138,665	8571D7E8520AA15C3EF73567142A...	596,136	2003-07-15	2,003
1,216,222	307FFC64E94BB40C7FB0E6674526F...	206,760	2003-08-05	2,003
1,383,626	DD49C7A0F9B575384874F75C9B21...	262,286	2003-10-09	2,003
1,496,549	BAA10872C4E4380C336DF0F9EF52...	199,923	2003-11-22	2,003
1,541,745	8854F4A62CB84DC2DB48465E2907...	202,626	2004-01-06	2,004
1,644,481	2B40B65CFF95534211587D0C3DC0...	206,763	2004-02-09	2,004
1,715,016	023696A80B035229F9873306B3D8...	293,333	2004-03-08	2,004
1,754,696	07A70590205F70B4329E58749BFAB...	199,923	2004-03-29	2,004
1,777,602	E2C4BE6FA54491536BB6DAB1AB10...	228,677	2004-04-12	2,004
1,777,683	E2C4BE6FA54491536BB6DAB1AB10...	228,682	2004-04-12	2,004
1,785,803	DCB34C13526F81DF5975E7E5CB16...	228,682	2004-04-13	2,004
1,869,142	2A8F276D2471783E1053D68A370C...	238,453	2004-05-03	2,004
2,078,376	454C2DAAA0BD0F6526D90EF10986...	206,765	2004-05-18	2,004
2,078,379	454C2DAAA0BD0F6526D90EF10986...	237,708	2004-05-18	2,004
2,128,683	3C9DF04638A7A8228333A3355273...	267,464	2004-05-28	2,004
2,268,991	6325AD565B1B895111151F30A963...	199,923	2004-07-05	2,004
2,498,342	EC710E4F8F1F7B9365224C9C66CC7...	228,674	2004-08-26	2,004

Raw data

review (2×15)

checkin_year	COUNT(*)
2,002	3
2,003	19
2,004	75
2,005	117
2,006	313
2,007	534
2,008	710
2,009	1,314
2,010	1,997
2,011	3,696
2,012	6,250
2,013	8,982
2,014	12,813
2,015	18,091
2,016	2,203

Manipulation I

Data Preparation/Manipulation:
If time variable matters now, how to add that fact/variable into the association analysis?

```
SELECT id, hotel_id, review_date, checkin_year,
CONCAT(hotel_id, '_',checkin_year)
AS new_product_id FROM review
WHERE user_id IS NOT null
```

review (6×56,709)

id	user_id	hotel_id	review_date	checkin_year	new_product_id
853,633	E4ED74B155D08686D9C032A5286D...	206,761	2003-02-05	2,003	206761_2003
1,070,394	CC9AB0C275A231756D0D1C0E443...	228,682	2003-06-04	2,003	228682_2003
1,108,965	C164F53CD27D809BC7210E34703B...	232,283	2003-06-25	2,003	232283_2003
1,138,665	8571D7E8520AA15C3EF73567142A...	596,136	2003-07-15	2,003	596136_2003
1,216,222	307FFC64E94BB40C7FB0E6674526F...	206,760	2003-08-05	2,003	206760_2003
1,383,626	DD49C7A0F9B575384874F75C9B21...	262,286	2003-10-09	2,003	262286_2003
1,496,549	BAA10872C4E4380C336DF0F9EF52...	199,923	2003-11-22	2,003	199923_2003
1,541,745	8854F4A62CB84DC2DB48465E2907...	202,626	2004-01-06	2,004	202626_2004
1,644,481	2B40B65CFF95534211587D0C3DC0...	206,763	2004-02-09	2,004	206763_2004
1,715,016	023696A80B035229F9873306B3D8...	293,333	2004-03-08	2,004	293333_2004
1,754,696	07A70590205F70B4329E58749BFAB...	199,923	2004-03-29	2,004	199923_2004
1,777,602	E2C4BE6FA54491536BB6DAB1AB10...	228,677	2004-04-12	2,004	228677_2004
1,777,683	E2C4BE6FA54491536BB6DAB1AB10...	228,682	2004-04-12	2,004	228682_2004
1,785,803	DCB34C13526F81DF5975E7E5CB16...	228,682	2004-04-13	2,004	228682_2004
1,869,142	2A8F276D2471783E1053D68A370C...	238,453	2004-05-03	2,004	238453_2004
2,078,376	454C2DAAA0BD0F6526D90EF10986...	206,765	2004-05-18	2,004	206765_2004

Question: would this be a proper solution? Why? https://presemo.aalto.fi/drm/

Answer: NO

- The same product (product_id/hotel_is) would be labeled as different products in the new generated variable!

review (5×56,709)

id	user_id	hotel_id	review_date	new_product_id
853,633	E4ED74B155D08686D9C032A5286D...	206,761	2003-02-05	2,003
1,070,394	CC9AB0C275A231756D0D1C0E443...	228,682	2003-06-04	2,003
1,108,965	C164F53CD27D809BC7210E34703B...	232,283	2003-06-25	2,003
1,138,665	8571D7E8520AA15C3EF73567142A...	596,136	2003-07-15	2,003
1,216,222	307FFC64E94BB40C7FB0E6674526F...	206,760	2003-08-05	2,003
1,383,626	DD49C7A0F9B575384874F75C9B21...	262,286	2003-10-09	2,003
1,496,549	BAA10872C4E4380C336DF0F9EF52...	199,923	2003-11-22	2,003
1,541,745	8854F4A62CB84DC2DB48465E2907...	202,626	2004-01-06	2,004
1,644,481	2B40B65CFF95534211587D0C3DC0...	206,763	2004-02-09	2,004
1,715,016	023696A80B035229F9873306B3D8...	293,333	2004-03-08	2,004
1,754,696	07A70590205F70B4329E58749BFAB...	199,923	2004-03-29	2,004
1,777,602	E2C4BE6FA54491536BB6DAB1AB10...	228,677	2004-04-12	2,004
1,777,683	E2C4BE6FA54491536BB6DAB1AB10...	228,682	2004-04-12	2,004
1,785,803	DCB34C13526F81DF5975E7E5CB16...	228,682	2004-04-13	2,004
1,869,142	2A8F276D2471783E1053D68A370C...	238,453	2004-05-03	2,004
2,078,376	454C2DAAA0BD0F6526D90EF10986...	206,765	2004-05-18	2,004
2,078,379	454C2DAAA0BD0F6526D90EF10986...	237,708	2004-05-18	2,004
2,128,683	3C9DF04638A7A8228333A3355273...	267,464	2004-05-28	2,004
2,268,991	6325AD565B1B895111151F30A963...	199,923	2004-07-05	2,004
2,498,342	EC710E4F8F1F7B9365224C9C66CC7...	228,674	2004-08-26	2,004

Raw data

review (2×15)

checkin_year	COUNT(*)
2,002	3
2,003	19
2,004	75
2,005	117
2,006	313
2,007	534
2,008	710
2,009	1,314
2,010	1,997
2,011	3,696
2,012	6,250
2,013	8,982
2,014	12,813
2,015	18,091
2,016	2,203

Manipulation I

Question: would this be a completed solution? Are we ready to run the code for association analysis?

Answer: NO

- There can be multiple values for the same products for the same users in the category of predictor or outcome variable. For instance, a user repeatedly visited the same hotels in the past.

Data Preparation/Manipulation:
If time variable matters now, how to add that fact/variable into the association analysis?

```
(SELECT id, user_id, hotel_id, review_date, checkin_year,
CONCAT(hotel_id, '_','Predictor') AS new_product_id
FROM review
WHERE user_id IS NOT NULL AND checkin_year < 2015
LIMIT 15)
union
(SELECT id, user_id, hotel_id, review_date, checkin_year,
CONCAT(hotel_id, '_','Outcome') AS new_product_id
FROM review
WHERE user_id IS NOT NULL AND checkin_year >=
2015 LIMIT 10)
```

Result #1 (6×15)

id	user_id	hotel_id	review_date	checkin_year	new_product_id
314,109,325	000A1DFEFDAE9CAB77EB...	228,682	2015-09-27	2,015	228682_Outcome
275,334,075	000ECDFA5D2DDBDF7479...	228,686	2015-05-28	2,015	228686_Outcome
275,341,210	000ECDFA5D2DDBDF7479...	228,673	2015-05-28	2,015	228673_Outcome
147,423,657	0004FF72BDDF25A752B70...	267,464	2012-12-13	2,012	267464_Predictor
312,100,406	0008D1BACA977284D9DD...	232,150	2015-09-20	2,015	232150_Outcome
225,432,633	00017FF6229848D7515CB...	232,143	2014-08-30	2,014	232143_Predictor
227,105,065	00017FF6229848D7515CB...	1,840,189	2014-09-05	2,014	1840189_Predictor
294,869,698	00044C8B32E2D18B687E6...	2,151,632	2015-08-01	2,015	2151632_Outcome
106,676,859	000491C9528EBE3302CA4...	232,307	2011-05-03	2,011	232307_Predictor
256,942,638	000859B4AFE2A75400EDD...	281,329	2015-02-28	2,015	281329_Outcome
293,192,416	0002576AD91EE9065846B...	578,920	2015-07-27	2,015	578920_Outcome
335,151,566	0003911E45A14147EF812...	578,920	2015-12-26	2,015	578920_Outcome
336,762,288	0003976319D8996F54F4A...	293,333	2016-01-02	2,016	293333_Outcome

Connect R to MySQL: Building Connection

```
#install R package to obtain the relevant functions
install.packages("RMySQL")
#activate the package and relevant functions
library(RMySQL)
#Connect R to MySQL (template):
mydb = dbConnect(MySQL(), user='user', password='password',
dbname='database_name', host='host / database url')
#An example of the connection
mydb = dbConnect(MySQL(), user='100080', password='P100080',
dbname='D100080', host='johnson.org.aalto.fi')
```

Connect R to MySQL: Fetch Data

```
#Show the list of the tables in our database connection.
dbListTables(mydb)
#Retrieve data from the database.
rs = dbSendQuery(mydb, "select * from payments")
#Save the retrieved data to a R dataframe.
df = fetch(rs, n=-1)
#This function saves retrieved MySQL data as a data frame object. The n in the function specifies the number of records to retrieve, using n=-1 retrieves all pending records.
View(df) #This function helps you to see the data.
```

Connect R to MySQL: Descriptive Statistics

```
plot(attitude)  #plot an embedded dataset termed as attitude
install.packages("skimr")
#install a package to get function for descriptive statistics
library(skimr) #activate the package
skim(attitude)
skim(df) #activate the package
cor(attitude) #correlation analysis
```

Other functions for root users

Task: create a new database and a new user account (including both ID and password), and grant permission to the user to use the database

```
create database newdatabase2;
- create USER 'user' identified BY 'password’;
- create USER 'newtest6' identified BY 'newtest6' password expire;
grant all ON newdatabase2.* TO 'newtest5';
```

Other functions for root users

Importing large file: MySQL only allows to import relatively small size file in default. For importing large file, you need to change settings.

```
ERROR 1153 (08S01) at line 96: Got a packet bigger than 'max_allowed_packet' bytes
```

```
Set global max_allowed_packet = 2*1024*1024*10 ;
Set global wait_timeout=1000;
Set global interactive_timeout=1000;
```

When your code connects to MySQL, runs a query and then spends 3 seconds processing that query before disconnecting, that's 3 seconds of the wait_timeout. When you run a command and spend 10 seconds reading the output, that's 10 seconds of interactive_timeout

Text mining using MySQL

- Your company received a huge amount of customer reviews on the products of the company from e.g., product review website or Facebook.
- You are supposed to compute associations between words, customers emotion expressed in the review, and how an emotion is associated with a particular product attribute.
- You have found and download the list of positive and negative emotion words.

Using MySQL for an analytic project

1. Code is a treasure!
2. The code can be copied and reused to do association or emotion analysis on any textual data, if imported into MySQL.

Summary of the MySQL skills (1)

- **1. Skills of Managing MySQL data file**
  - **Nature of .sql file (a summary MySQL commands).**
  - **Import .sql file**
  - **Import .csv file**
  - **Export .sql file (drop versus not drop)**
  - **Export to be .csv file (ctrl + End)**

Summary of the MySQL skills (2)

- **2. Skills of managing MySQL account**
  - **Remote server account**
  - **Local user account**

Summary of the MySQL skills (3)

- **3. Skills of operating MySQL database**
  - **Creating a new database**
    - **Create database [if not exists] *DatabaseName;***
  - **Removing an existing database**
    - **Drop database [if exists] *DatabaseName;***
  - **Activate a database (default database)**
    - **Use *DatabaseName***
  - **Show the names of the all the databases**
    - **Show databases**

Summary of the MySQL skills (4)

- **4. Skills of operating MySQL tables (2)**
  - **Show columns information of a table**
    - **Show columns from *TableName;***
    - **Describe *TableName*;**
    - **Desc *TableName*;**

COLUMNS (6×8)

Field	Type	Null	Key	Default	Extra
employeeNumber	int(11)	NO	PRI	(NULL)	
lastName	varchar(50)	NO		(NULL)	
firstName	varchar(50)	NO		(NULL)	
extension	varchar(10)	NO		(NULL)	
email	varchar(100)	NO		(NULL)	
officeCode	varchar(10)	NO	MUL	(NULL)	
reportsTo	int(11)	YES	MUL	(NULL)	
jobTitle	varchar(50)	NO		(NULL)	

Summary of the MySQL skills (5)

- **5. Skills of operating MySQL tables (3)**
  - **Copy the structure and indexes, but not the data:**
    - **create table new_table like old_table;**
  - **Copy the structure, indexed and the data**
    - **Create table new_table like old_table;**
    - **Insert new_table select * from old_table;**
  - **Copy the data and the structure, but not the indexes:**
    - **create table new_table as select * from old_table;**

Summary of the MySQL skills (6)

- **6. Skills of adding comment to MySQL query**
  - **From a “#” character to the end of the line.**
  - **From a “-- ” sequence to the end of the line.**
  - **From a /* sequence to the following */ sequence.**

Summary of the MySQL skills (7)

- **7. Skills of creating a table**

```
create table TableName (Variable1     datatype [constraint],
                        Variable2     datatype [constraint],
                        Variable3     datatype [constraint],
                        ......
                        );
```

Summary of the MySQL skills (8)

- **8. Skills of operating datatype**
  - **Numeric Types (integer, decimal and float)**
  - **Date and Time Types (year, date, datatime)**
  - **String Types (Char, Varchar)**

Summary of the MySQL skills (9)

- **9. Skills of operating key in a table**
  - **Primary key, unique key and Foreign key**
  - **Adding key**
  - **Removing key**
  - **Set not null and auto_increment function**
  - **Entity-relationship diagram (ERD)**

Summary of the MySQL skills (10)

- **Skills of using select commands**
  - **Select for calculation and other function**
    - **Select 5+5; Select curtime(), curdate();**
  - **Select reserved word using `**
  - **Select all columns and rows using ***
  - **Select … where…**
    - **=, <, <=, >, >=, !=**
    - **And / or / not**
    - **()**
    - **Between… and …**
    - **Not between … and …**
    - **+ ; - ; * ; / ;**

Summary of the MySQL skills (11)

- **Skills of using select commands**
  - **Select … limit x, y**
  - **Select … order by desc | asc**

Summary of the MySQL skills (12)

- **Select…like [binary]…**
- **Select… IN…**
- **Select … REGEXP…**
- **Select…Distinct…**
- **Select … LEFT(*str*,*len*) …**
- **Select … LENGTH(*str*) …**

Summary of the MySQL skills (13)

- **Select … TRIM …**
- **Select … SUBSTRING(str, pos, len) …**
- **SUBSTRING_INDEX(*str,delim,count*)**
- **Select… REPLACE(*str,from_str,to_str*) …**
- **Select…Group by…**
- **Count() + group by**

Summary of the MySQL skills (14)

- **Count(Distinct)**+ Group by
- **group_concat()**+ Group by
- Select…Group by + **having**
- **As [alias]**
- **= '' != '' is null is not null**

Summary of the MySQL skills (15)

- **DATE(*expr*)**
- **STR_TO_DATE()**
- **DAYNAME(date)**
- **DAYOFMONTH(date)**
- **DATE_ADD(date, INTERVAL expr unit)**
- **DATEDIFF(expr1,expr2)**

Summary of the MySQL skills (15)

- **Alter Table** table_name **Add** column_name **datatype**
- **Alter Table** table_name **Drop** column_name

- **Delete from** table_name **[where** conditions**]**

Summary of the MySQL skills (16)

Sub-Queries

- **The result of a select command represents one column (or a list of values). E.g.:**

```
Select attributes
        from table_1
        Where attributes IN| NOT IN
        (Select ONE_column
                from table_2
                Where attributes )
```

Summary of the MySQL skills (17)

- **Update** table_name

  Set column_name1 = value|expression,

  column_name2 = value|expression,

  …

  column_nameN = value|expression

  Where conditions;

Summary of the MySQL skills (I)

- **If**
- **Case when**
- **Join**
- **Table and view**
- **Association analysis**

Bonus of sending your feedback

- **Method:** Webropol-survey, link of which will be sent to your email address.
- **Bonus**: One additional points (the full mark is 100 points)

Reflection

- **Programming???**

- **R? Python?**
- **Stata Matlab?**
- **SPSS is not recommended – you cannot remember what you have done to your data**

http://stanfordphd.com/Statistical_Software.html

Finally

- **Statistics Explained - A Guide for Social Science Students**
- **R, Stata, Matlab, Python?**
- **Econometrics**

Bonus Research Survey

- **3** bonus points (3/100)
- **10** minutes to complete
- Please **recall** the way of your course attendance
- The link to the survey will be sent to you on October 5, three days before the assignment deadline.

Q4. How many lecture sessions have you taken onsite or online?
(We have seven lectures in total; the sum of onsite and online sessions can be less than or equal 7, but not over 7)

	0	1	2	3	4	5	6	7
Onsite	○	○	○	○	○	○	○	○
Online	○	○	○	○	○	○	○	○

Q5. How many lecture videos have you watched after the class?

	0	1	2	3	4	5	6	7
Watched video	○	○	○	○	○	○	○	○

Q6. How many hands-on sessions have you attended?

	0	1	2	3	4	5
Attended hands-on sessions	○	○	○	○	○	○