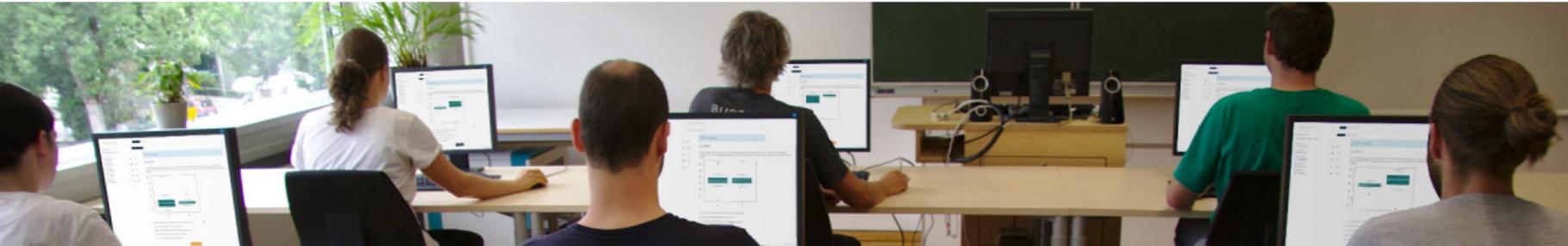




R/exams



R/exams: A One-for-All Exams Generator

Written Exams, Online Tests, and Live Quizzes with R

Achim Zeileis

<http://www.R-exams.org/>



R/exams



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R/exams

Solution

Using the product rule for $f(x) = g(x) \cdot h(x)$, where $g(x) := x^9$ and $h(x) := e^{2.7x}$, we obtain

$$\begin{aligned}f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\&= 9x^{9-1} \cdot e^{2.7x} + x^9 \cdot e^{2.7x} \cdot 2.7 \\&= e^{2.7x} \cdot (9x^8 + 2.7x^9) \\&= e^{2.7x} \cdot x^8 \cdot (9 + 2.7x).\end{aligned}$$

Evaluated at $x = 0.88$, the answer is

```
6 \begin{solution}
5 Using the product rule for $f(x) = g(x) \cdotdot h(x)$, where
4 $g(x) := x^9(\text{\Sexpr{a}})$ and $h(x) := e^{2.7x}(\text{\Sexpr{b}})$, we obtain
3
2 \begin{eqnarray*}
1 f'(x) &= g(x) \cdotdot h(x)' = g'(x) \cdotdot h(x) + g(x) \cdotdot h'(x) \\
32 &= 6 \cdotdot \text{\Sexpr{a}} \cdotdot x^{9-(\text{\Sexpr{a}}-1)} \cdotdot e^{2.7x}(\text{\Sexpr{b}}) x + x^9(\text{\Sexpr{a}}) \\
1 &\quad \cdotdot e^{2.7x}(\text{\Sexpr{b}}) \cdotdot (\text{\Sexpr{a}}) x^{9-(\text{\Sexpr{a}}-1)} + (\text{\Sexpr{b}}) \\
2 &\quad x^{9-(\text{\Sexpr{a}})} \\
3 &= 6 e^{2.7x}(\text{\Sexpr{b}}) \cdotdot x^{9-(\text{\Sexpr{a}}-1)} \cdotdot (\text{\Sexpr{a}}) + (\text{\Sexpr{b}}) x^{9-(\text{\Sexpr{a}}-1)} \\
4 &= 6 e^{2.7x}(\text{\Sexpr{b}}) \cdotdot x^{9-(\text{\Sexpr{a}}-1)} \cdotdot (\text{\Sexpr{a}}) + (\text{\Sexpr{b}}) x^{9-(\text{\Sexpr{a}}-1)} \\
5 \end{eqnarray*}
6
7 Evaluated at $x = \text{\Sexpr{c}}$, the answer is
8
9 \text{\Sexpr{b}} \cdotdot \text{\Sexpr{c}} \cdotdot \text{\Sexpr{c}} \cdotdot \text{\Sexpr{c}} \cdotdot \text{\Sexpr{c}} \cdotdot \text{\Sexpr{c}} \cdotdot \text{\Sexpr{c}} = \text{\Sexpr{fat(res, 6)}}.\end{solution}
```

R/exams: A One-for-All Exams Generator

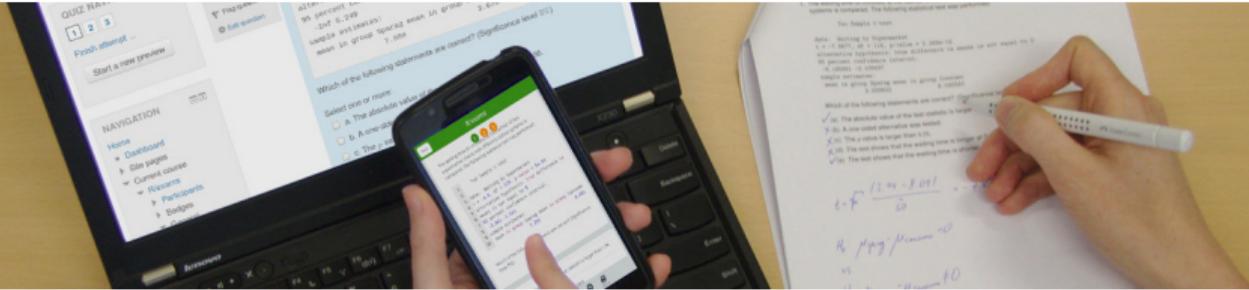
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R/exams



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Motivation and challenges

Motivation:

- Many of us teach large lecture courses, also as support for other fields.
- For example, statistics, probability, or mathematics in curricula such as business and economics, social sciences, psychology, etc.
- At WU Wien and Universität Innsbruck: Some courses are attended by more than 1,000 students per semester.
- Several lecturers teach lectures and tutorials in parallel.

Strategy:

- Individualized organization of learning, feedback, and assessment.
- The same pool of exercises at the core of all parts of the course.

Motivation and challenges

	Learning	Feedback	Assessment
Synchronous	Lecture	Live quiz (+ Tutorial)	Written exam
	Live stream		
Asynchronous	Textbook	Self test	Online test
	Screencast	(+ Forum)	

Motivation and challenges

	Learning	Feedback	Assessment
Synchronous	Lecture	Live quiz (+ Tutorial)	Written exam
	Live stream		
Asynchronous	Textbook	Self test	Online test
	Screencast	(+ Forum)	

Learning:

- *Standard*: Textbook along with presentation slides.
- *Streaming*: Videos streamed simultaneously or (pre-)recorded.

Motivation and challenges

	Learning	Feedback	Assessment
Synchronous	Lecture	Live quiz (+ Tutorial)	Written exam
	Live stream		
Asynchronous	Textbook	Self test	Online test
	Screencast	(+ Forum)	

Feedback & assessment:

- *Scalability*: Randomized dynamic exercises required.
- *Feedback*: Support for complete correct solutions.
- *Flexibility*: Automatic rendering into different assessment formats.

R package *exams*

Exercises:

- Each exercise is a single file (either .Rmd or .Rnw).
- Contains question and (optionally) the corresponding solution.
- Dynamic templates if R code is used for randomization.

Answer types:

- Single choice and multiple choice.
- Numeric values.
- Text strings (typically short).
- Combinations of the above (cloze).

R package *exams*

Output:

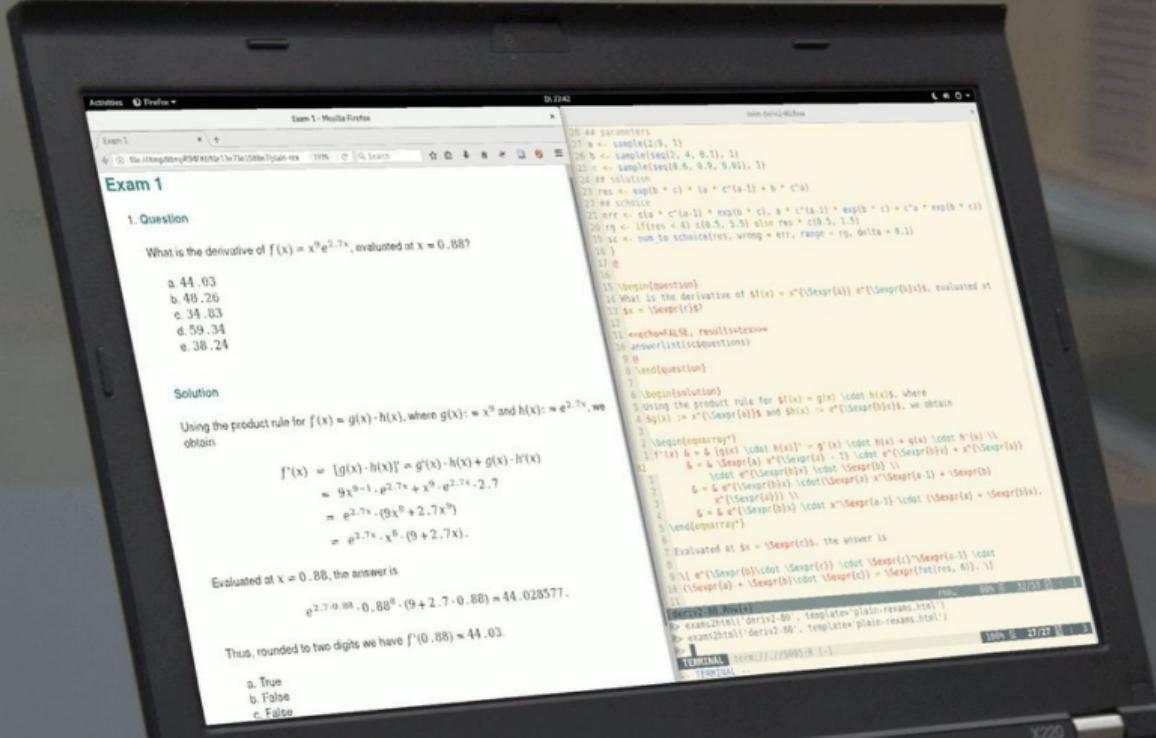
- PDF – fully customizable vs. standardized with automatic scanning/evaluation.
- HTML – fully customizable vs. embedded into exchange formats below.
- *Moodle XML*.
- QTI XML standard (version 1.2 or 2.1), e.g., for *OLAT/OpenOLAT*.
- *ARSnova, TCEexam, LOPS*, ...

Infrastructure: Standing on the shoulders of lots of open-source software...

R package exams

Type	Software	Purpose
Statistical computing	R	Random data generation, computations
Writing/reporting	\LaTeX , Markdown	Text formatting, mathematical notation
Reproducible research	<code>knitr</code> , <code>rmarkdown</code> , <code>Sweave</code>	Dynamically tie everything together
Document conversion	<code>TtH/TtM</code> , <code>pandoc</code>	Conversion to HTML and beyond
Image manipulation	<code>ImageMagick</code> , <code>magick</code> , <code>png</code>	Embedding graphics
Web technologies	<code>base64enc</code> , <code>RCurl</code> , ...	Embedding supplementary files
Learning management	<code>Moodle</code> , <code>OpenOLAT</code> , <code>ARSnova</code> , ...	E-learning infrastructure

Dynamic Exercises



Dynamic exercises

Text file:

- ① Random data generation (optional).
- ② Question.
- ③ Solution (optional).
- ④ Metainformation.

Examples:



Multiple-choice knowledge quiz with shuffled answer alternatives.

Which of these institutions already hosted a useR! or eRum conference?



Dynamic numeric arithmetic exercise.

What is the derivative of $f(x) = x^a e^{b \cdot x}$, evaluated at $x = c$?

Dynamic exercises: .Rmd

Example: Which of these institutions already hosted a useR! or eRum conference?

Dynamic exercises: .Rmd

Example: Which of these institutions already hosted a useR! or eRum conference?

Question

=====

Which of these institutions already hosted a useR! or eRum conference?

Answerlist

- * Uniwersytet Ekonomiczny w Poznaniu
- * Agrocampus Ouest
- * Technische Universität Dortmund
- * Universität Wien
- * ETH Zürich
- * Københavns Universitet

Dynamic exercises: .Rmd

Example: Which of these institutions already hosted a useR! or eRum conference?

Solution

=====

The list of useR!/DSC and eRum hosts can be found at

<<https://www.R-project.org/conferences.html>> and <<https://erum.io/>>, respectively.

Answerlist

=====

- * True. eRum 2016 was hosted in Poznan.
- * True. useR! 2009 was hosted at Agrocampus Ouest, Rennes.
- * True. useR! 2008 was hosted at TU Dortmund.
- * False. Universität Wien did not host an R conference yet (only TU Wien and WU Wien).
- * False. ETH Zürich did not host an R conference yet.
- * False. Københavns Universitet hosted DSC but not useR! or eRum.

Dynamic exercises: .Rmd

Example: Which of these institutions already hosted a useR! or eRum conference?

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- * False. ETH Zürich did not host an R conference yet.
- * False. Københavns Universitet hosted DSC but not useR! or eRum.

Meta-information

=====

exname: R conferences

extype: mchoice

exsolution: 111000

exshuffle: 5

Dynamic exercises: .Rnw

Example: What is the derivative of $f(x) = x^a e^{b \cdot x}$, evaluated at $x = c$?

Dynamic exercises: .Rnw

Example: What is the derivative of $f(x) = x^a e^{b \cdot x}$, evaluated at $x = c$?

```
<<echo=FALSE, results=hide>>=
## parameters
a <- sample(2:9, 1)
b <- sample(seq(2, 4, 0.1), 1)
c <- sample(seq(0.5, 0.8, 0.01), 1)
## solution
res <- exp(b * c) * (a * c^(a-1) + b * c^a)
@
```

Dynamic exercises: .Rnw

Example: What is the derivative of $f(x) = x^a e^{b \cdot x}$, evaluated at $x = c$?

```
<<echo=FALSE, results=hide>>=
## parameters
a <- sample(2:9, 1)
b <- sample(seq(2, 4, 0.1), 1)
c <- sample(seq(0.5, 0.8, 0.01), 1)
## solution
res <- exp(b * c) * (a * c^(a-1) + b * c^a)
@

\begin{question}
What is the derivative of  $f(x) = x^{\text{\$Expr{a}}}\ e^{\text{\$Expr{b}}x}$ ,
evaluated at  $x = \text{\$Expr{c}}$ ?
\end{question}
```

Dynamic exercises: .Rnw

Example: What is the derivative of $f(x) = x^a e^{b \cdot x}$, evaluated at $x = c$?

```
\begin{solution}
Using the product rule for  $f(x) = g(x) \cdot h(x)$ , where
 $g(x) := x^{\text{\{a\}}}$  and  $h(x) := e^{\text{\{b\}}x}$ , we obtain
\begin{eqnarray*}
f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\
&= \text{\{a\}} x^{\text{\{a\}} - 1} \cdot e^{\text{\{b\}}x} +
\end{eqnarray*}
...
\end{solution}
Evaluated at  $x = \text{\{c\}}$ , the answer is
\[
e^{\text{\{b\}} \cdot \text{\{c\}}} \cdot \text{\{c\}}^{\text{\{a\}} - 1} \cdot
(\text{\{a\}} + \text{\{b\}} \cdot \text{\{c\}}) = \text{\{fmt(res, 6)\}}.
\]
Thus, rounded to two digits we have  $f'(\text{\{c\}}) = \text{\{fmt(res)\}}$ .
\end{solution}
```

Dynamic exercises: .Rnw

Example: What is the derivative of $f(x) = x^a e^{bx}$, evaluated at $x = c$?

```
\begin{solution}
Using the product rule for  $f(x) = g(x) \cdot h(x)$ , where
 $g(x) := x^{\text{\Sexpr{a}}}$  and  $h(x) := e^{\text{\Sexpr{b}}x}$ , we obtain
\begin{eqnarray*}
f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\
&= \text{\Sexpr{a}} x^{\text{\Sexpr{a}} - 1} \cdot e^{\text{\Sexpr{b}}x} +
\end{eqnarray*}
```

```
\end{eqnarray*}
```

Evaluated at $x = \text{\Sexpr{c}}$, the answer is

```
\[ e^{\text{\Sexpr{b}} \cdot \text{\Sexpr{c}}} \cdot \dots \cdot \text{\Sexpr{c}}^{\text{\Sexpr{a}} - 1} \cdot \text{\Sexpr{a}} \cdot e^{\text{\Sexpr{b}} \cdot \text{\Sexpr{c}}} = \text{\Sexpr{fmt(res, 6)}}. \]
```

Thus, rounded to two digits we have $f'(\text{\Sexpr{c}}) = \text{\Sexpr{fmt(res)}}$.

```
\end{solution}
```

```
\ex{num}
\exsolution{\Sexpr{fmt(res)}}
\exname{derivative exp}
\extol{0.01}
```

Dynamic exercises: Single choice



extype: schoice

exsolution: 010

Dynamic exercises: Single choice



extype: schoice

exsolution: 010

Question

What is the seat of the federal authorities in Switzerland (i.e., the de facto capital)?

- (a) Bern
- (b) Lausanne
- (c) Zurich
- (d) St. Gallen
- (e) Basel

Knowledge quiz: Shuffled distractors.

Dynamic exercises: Single choice



extype: schoice
exsolution: 010

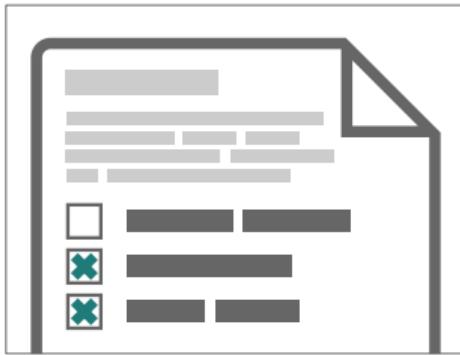
Question

What is the derivative of $f(x) = x^3 e^{3.3x}$, evaluated at $x = 0.85$?

- (a) 45.97
- (b) 35.82
- (c) 56.45
- (d) 69.32
- (e) 39.31

Numeric exercises: Distractors are random numbers and/or typical arithmetic mistakes.

Dynamic exercises: Multiple choice



extype: mchoice

exsolution: 011

Dynamic exercises: Multiple choice



extype: mchoice
exsolution: 011

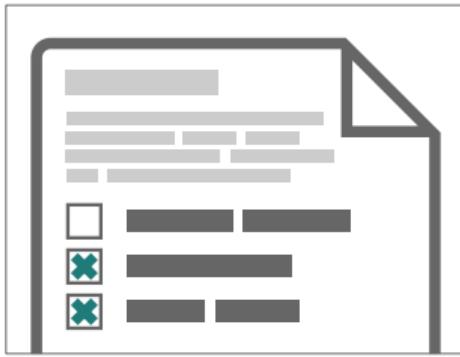
Question

Which of these institutions already hosted a useR! or eRum conference?

- (a) Agrocampus Ouest
- (b) Universität Wien
- (c) ETH Zürich
- (d) Technische Universität Dortmund
- (e) Uniwersytet Ekonomiczny w Poznaniu

Knowledge quiz: Shuffled true/false statements.

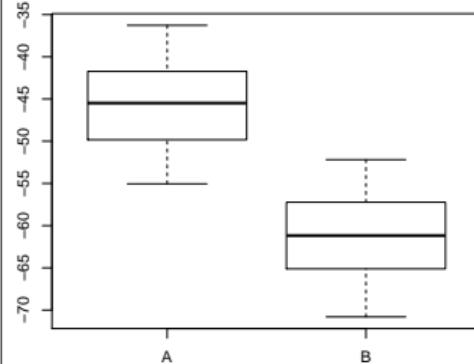
Dynamic exercises: Multiple choice



extype: mchoice
exsolution: 011

Question

In the following figure the distributions of a variable given by two samples (A and B) are represented by parallel boxplots. Which of the following statements are correct? (*Comment: The statements are either about correct or clearly wrong.*)



- (a) The location of both distributions is about the same.
- (b) Both distributions contain no outliers

Interpretations: Statements that are approximately correct or clearly wrong.

Dynamic exercises: Numeric



extype: num
exsolution: 123.45

Dynamic exercises: Numeric



```
extype: num  
exsolution: 123.45
```

Question
Given the following information:

$$\begin{array}{rcl} \text{orange} & + & \text{pineapple} & + & \text{orange} & = & 585 \\ \text{banana} & + & \text{orange} & + & \text{banana} & = & 144 \\ \text{orange} & + & \text{banana} & + & \text{orange} & = & 177 \end{array}$$

Compute:

$$\text{banana} + \text{orange} + \text{pineapple} = ?$$

Numeric exercises: Solving arithmetic problems.

Dynamic exercises: String



extype: string

exsolution: ANSWER

Dynamic exercises: String



Question

What is the name of the R function for Poisson regression?

Knowledge quiz: Sample a word/phrase from a given vocabulary or list of question/answer pairs.

```
extype: string
```

```
exsolution: ANSWER
```

Dynamic exercises: Cloze



extype: cloze

exclozetype: mchoice|num

exsolution: 10|123.45

Dynamic exercises: Cloze



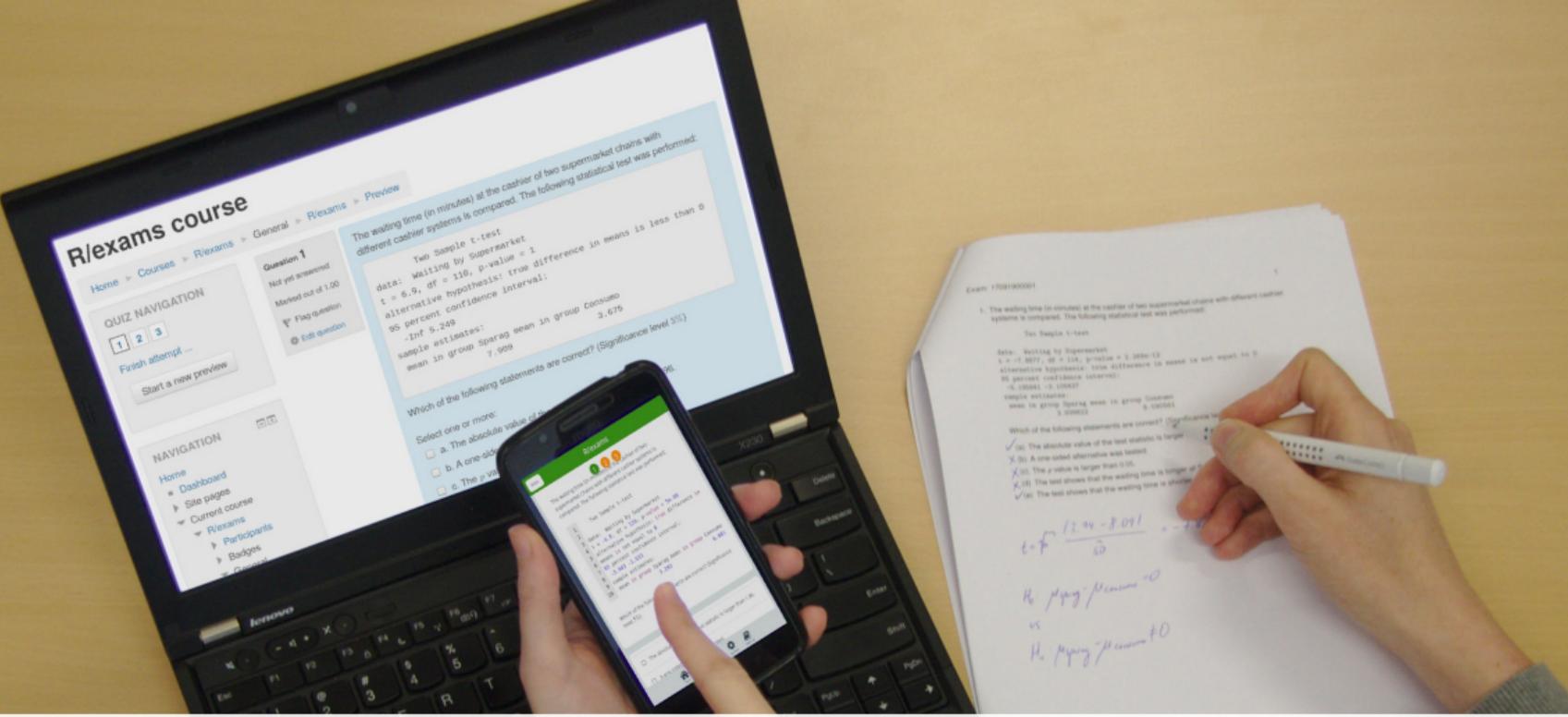
Question

Using the data provided in `regression.csv` estimate a linear regression of y on x and answer the following questions.

- (a) x and y are not significantly correlated / y increases significantly with x / y decreases significantly with x
- (b) Estimated slope with respect to x :

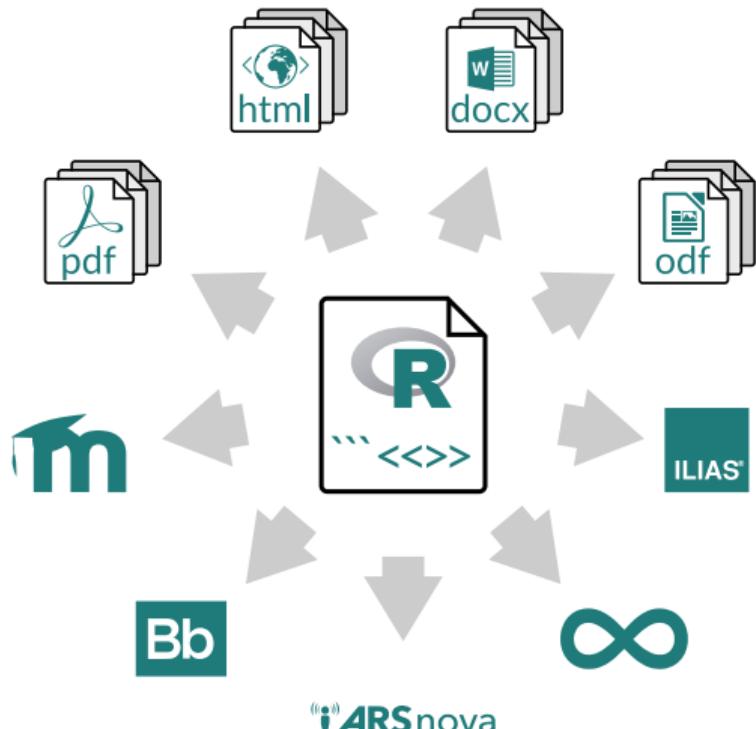
Exercises with sub-tasks: Several questions based on same problem setting.

```
extype: cloze  
exclozetype: mchoice|num  
exsolution: 10|123.45
```



One-for-All

One-for-all



- The *same* exercise can be exported into different formats.
- Multiple standalone documents vs. combined exercise pool.
- Multiple-choice and single-choice supported in all output formats.

One-for-All

Idea: An exam is simply a list of exercise templates.

```
R> myexam <- list(  
+   "deriv2.Rnw",  
+   "fruit2.Rnw",  
+   c("ttest.Rnw", "boxplots.Rnw")  
+ )
```

Draw random exams:

- First randomly select one exercise from each list element.
- Generate random numbers/input for each selected exercise.
- Combine all exercises in output file(s) (PDF, HTML, ...).

One-for-All

Written exam:

```
R> exams2nops(myexam, n = 3, dir = odir,  
+   language = "hu", institution = "eRum 2018")
```

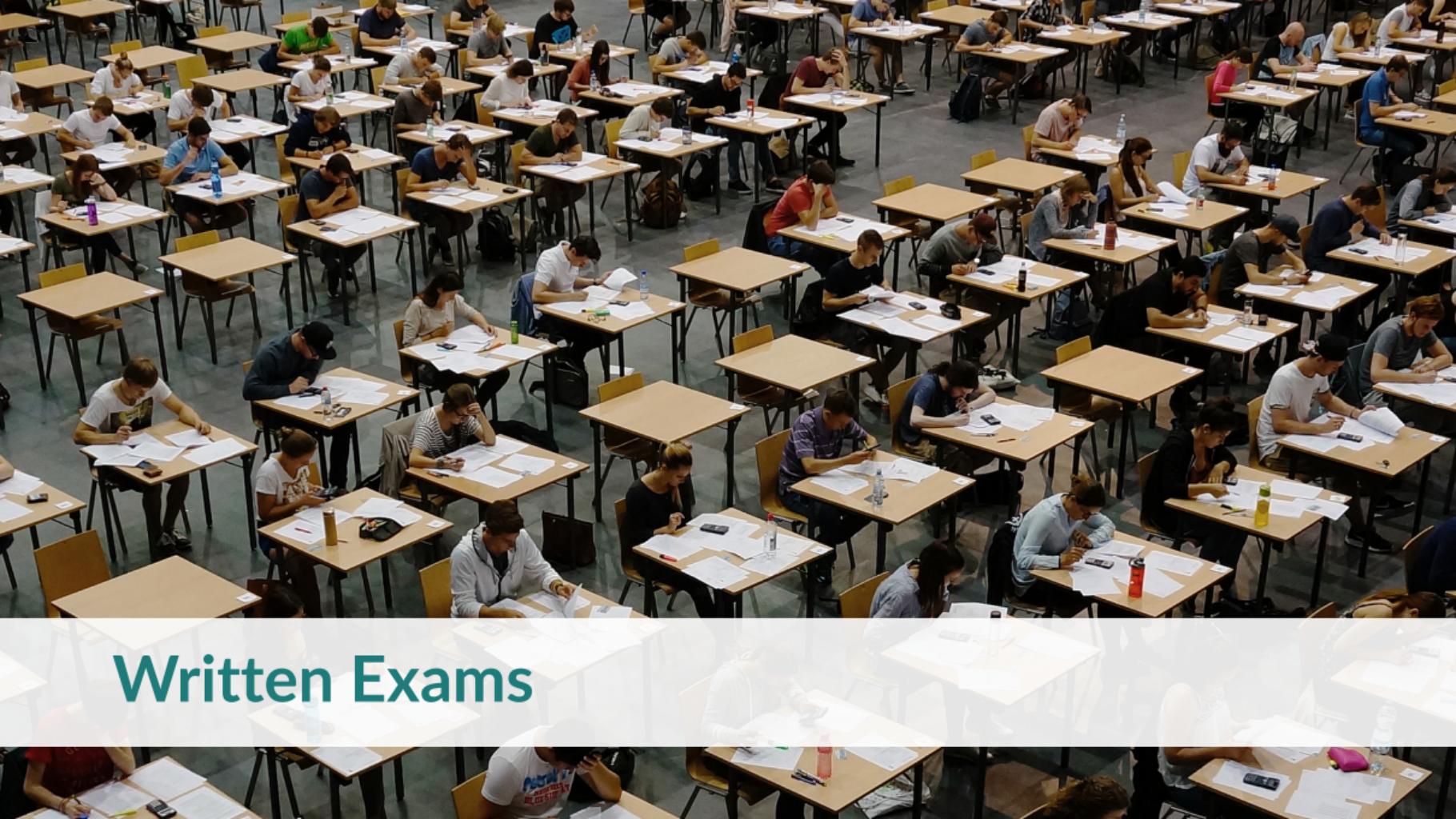
Online test:

```
R> exams2moodle(myexam, n = 10, dir = odir)
```

Live quiz:

```
R> exams2arsnova(myexam, n = 1, dir = odir)
```

Other: `exams2pdf()`, `exams2html()`, `exams2qti12()`, `exams2qti21()`, ...

An aerial view of a large lecture hall or classroom. Numerous students are seated at individual wooden desks, each with a white sheet of paper and a pen. Many students are looking down at their papers, while others are looking up or to the side. The room has a polished green floor and rows of desks. A few water bottles and backpacks are visible on the desks.

Written Exams

Written Exams

Flexible: Roll your own.

- Combination with user-specified template in `exams2pdf()` and `exams2pandoc()`.
- Customizable but typically has to be evaluated “by hand”.

Standardized: “NOPS” format.

- `exams2nops()` intended for single- and multiple-choice questions.
- Can be scanned and evaluated automatically within R.
- Limited support for open-ended questions that have to be marked by a person.

Written exams

+

eRum 2018
Exam 2018-05-16

+

R

Személyes adatok

Vezetéknév: _____

Keresztnév: _____

Aláírás: _____

Előnevezés: _____

Regisztrációs szám

0 1 2 3 4 5 6 7 8 9

1 2 3 4 5 6 7 8 9

2 3 4 5 6 7 8 9

3 4 5 6 7 8 9

4 5 6 7 8 9

5 6 7 8 9

6 7 8 9

7 8 9

8 9

9

Er a blokk adminisztrációra célokat szolgál,
kérjük ide ne írjon, tartalmát ne módosítsa!

Választás Variáns
0 0

Típus Dokumentum ID
005 18051600001

A választást jelölje eggyel több x-el: Jelölések cella: vagy

A vizsgálap szkennerrelése automatikusan történik, ezért kérjük, hogy ne hajtsa össze és a körökhez használjon kék vagy fekete tollat.

Kizárdag az egyértelműen és pontosan megjelölt válaszok kerülnek feldolgozásra!

Válaszok 1 - 3

1 a b c d e

2 a b c d e

3 a b c d e

+

+

Exam: 18051600001

1. What is the derivative of $f(x) = x^x e^{1/x}$, evaluated at $x = 0.83$?
(a) 49.35
(b) 87.17
(c) 71.00
(d) 72.46
(e) 55.20

2. Given the following information:

A series of fruit addition problems. The first row shows three pineapples plus three bananas equals 282. The second row shows two pineapples plus two oranges plus one banana equals 137. The third row shows one pineapple plus two bananas plus one orange equals 106.

Compute:
A row of fruit symbols: a banana, an orange, and a pineapple, followed by a question mark.

(a) 106
(b) 313
(c) 161
(d) 232
(e) 454

3. The waiting time (in minutes) at the cashier of two supermarket chains with different cashier systems is compared. The following statistical test was performed:

Two Sample t-test

data: Waiting by Supermarket
 $t = -3.3$, $df = 90$, $p\text{-value} = 1$
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
-3.227 - Inf
sample estimates:
mean in group Sparag 6.192
mean in group Consumo 4.045

Which of the following statements are correct? (Significance level 5%)
(a) The absolute value of the test statistic is larger than 1.96.
(b) A one-sided alternative was tested.
(c) The p value is larger than 0.05.
(d) The test shows that the waiting time is longer at Sparag than at Consumo.
(e) The test shows that the waiting time is shorter at Sparag than at Consumo.

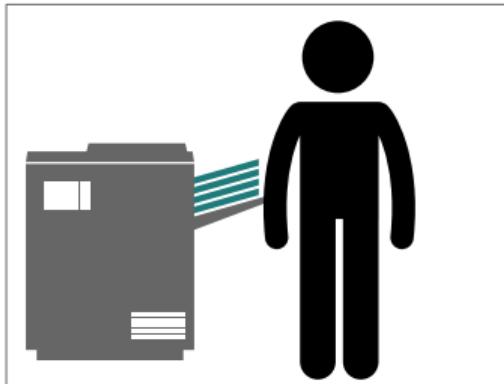
Written exams



1. Create

- As illustrated above.
- Using `exams2nops()`, create (individual) PDF files for each examinee.

Written exams



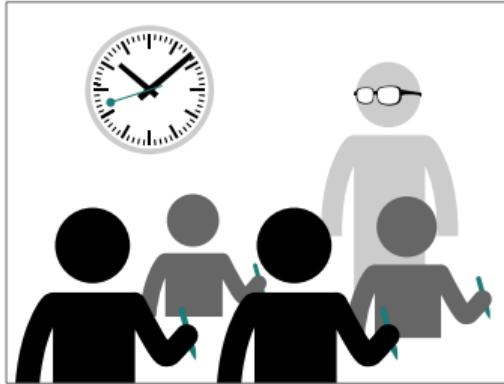
1. Create

- As illustrated above.
- Using `exams2nops()`, create (individual) PDF files for each examinee.

2. Print

- Print the PDF exams, e.g., on a standard printer.
- ...or for large exams at a print shop.

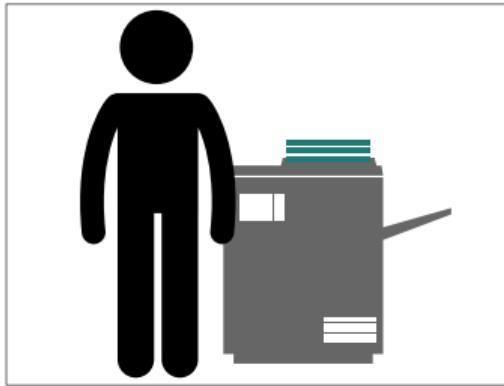
Written exams



3. Exam

- Conduct the exam as usual.
- Collect the completed exams sheets.

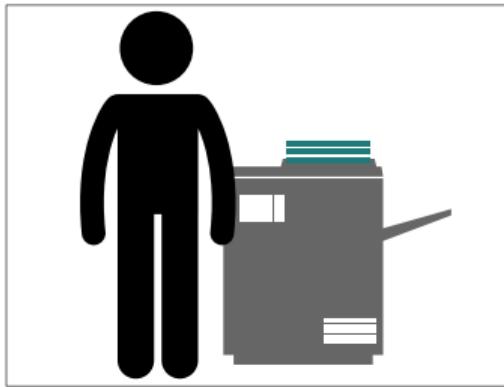
Written exams



4. Scan

- Scan exam sheets, e.g., on a photocopier.
- Using `nops_scan()`, process the scanned exam sheets to machine-readable content.

Written exams



4. Scan

- Scan exam sheets, e.g., on a photocopier.
- Using `nops_scan()`, process the scanned exam sheets to machine-readable content.

5. Evaluate

- Using `nops_eval()`, evaluate the exam to obtain marks, points, etc. and individual HTML reports for each examinee.
- Required files: Correct answers (1.), scans (4.), and a participant list in CSV format.

Written exams

A vizsga eredménye

Név: Jane Doe
Regisztrációs szám: 1501090
Érdemjegy: 5
Pontok: 3.16666666666667

Értékelés

Kérdés	Pontok	Adott válasz	Helyes válasz
1	1.000000	_c__	_c__
2	0.500000	abc_e	abc__
3	0.000000	_____	ab_d__
4	1.000000	_c__	_bc__
5	0.6666667	_d__	ab_d__
6	0.000000	_bc_e	a_c__

Vizsgalap



Exam 2015-07-29

Personal Data

Family Name: DOE

Given Name: JANE

Signature:

Registration

1,5,0

0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A vizsga eredménye

Név: Ambi Dexter
Regisztrációs szám: 9901071
Érdemjegy: 5
Pontok: 1.5

Értékelés

Kérdés	Pontok	Adott válasz	Helyes válasz
1	0.0	a_c__	_d__
2	0.0	a_cde	ab_d__
3	0.0	_b__	__e
4	0.0	_____	a_cd__
5	0.0	_____	_bc__
6	1.5	abc__	a__

Vizsgalap



Klausur 2015-07-29

Persönliche Daten

Nachname: Dexter

Vorname: Ambi

Unterschrift:

Matrikula

9.9.1

0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



E-Learning



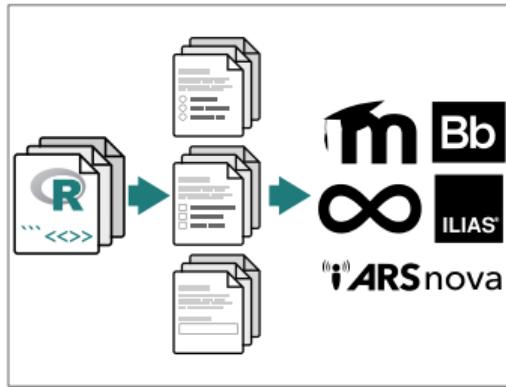
E-Learning



1. Goal

- Online tests with flexible exercise types.
- Possibly: Dynamic supplements and/or complete correct solution.
- Random variations of similar exercises to reduce the risk of cheating.
- Use university's learning management system, e.g., Moodle, ...

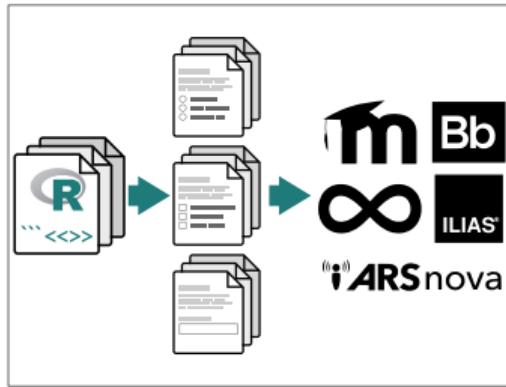
E-Learning



2. Create

- Draw random replications from exercise templates, e.g., via `exams2moodle()`, ...
- Automatically embed these into exchange file format (typically via HTML/XML).

E-Learning



2. Create

- Draw random replications from exercise templates, e.g., via `exams2moodle()`, ...
- Automatically embed these into exchange file format (typically via HTML/XML).



3. Import

- Import in learning management system.
- From there handling “as usual” in the system.

E-Learning: Online test

Preview question: R01 Q1 : deriv - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Edit questions Preview question: R01 Q1 +

138.232.212.178/question/p... 110% DuckDuckGo Search Images OpenStreetMap Maps | EO Wikipedia

Preview question: R01 Q1 : deriv

Question 1
Incorrect
Mark 0.00 out of 1.00

What is the derivative of $f(x) = x^3 e^{3.3x}$, evaluated at $x = 0.75$?
Answer: 51.83594 ✘

Check

Using the product rule for $f(x) = g(x) \cdot h(x)$, where $g(x) := x^3$ and $h(x) := e^{3.3x}$, we obtain

$$\begin{aligned} f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\ &= 3x^{3-1} \cdot e^{3.3x} + x^3 \cdot e^{3.3x} \cdot 3 \cdot 3 \\ &= e^{3.3x} \cdot (3x^2 + 3 \cdot 3x^3) \\ &= e^{3.3x} \cdot x^2 \cdot (3 + 3 \cdot 3x). \end{aligned}$$

Evaluated at $x = 0.75$, the answer is
 $e^{3.3 \cdot 0.75} \cdot 0.75^2 \cdot (3 + 3 \cdot 3 \cdot 0.75) = 36.591945$.

Thus, rounded to two digits we have $f'(0.75) = 36.59$.
The correct answer is: 36.59

Start again Save Fill in correct responses Submit and finish Close preview

Preview question: R01 Q6 : lm - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Edit questions Preview question: R01 Q6 +

138.232.212.178/question/p... 110% DuckDuckGo Search Images OpenStreetMap Maps | EO Wikipedia

Preview question: R01 Q6 : lm

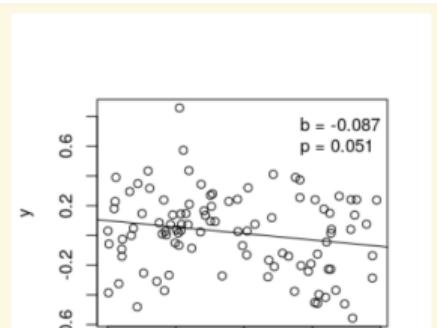
Question 1
Correct
Mark 2.00 out of 2.00

Using the data provided in [regression.csv](#) estimate a linear regression of y on X and answer the following questions.

a. x and y are not significantly correlated ✓

b. Estimated slope with respect to X : -0.08 ✓

Check



b = -0.087
p = 0.051

31

E-Learning: Online test

OpenOLAT - infinite learning - Mozilla Firefox

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OpenOLAT - infinite learn +

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eRum-2018

Show description

Question 1 point

The waiting time (in minutes) at the cashier of two supermarket chains with different cashier systems is compared. The following statistical test was performed:

```
Two Sample t-test

data: Waiting by Supermarket
t = -0.50168, df = 135, p-value = 0.3084
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
 -Inf 0.5862572
sample estimates:
 mean in group Sparag mean in group Consumo
 7.608248          7.862992
```

Which of the following statements are correct? (Significance level 5%)

a. The absolute value of the test statistic is larger than 1.96.

b. A one-sided alternative was tested.

c. The p value is larger than 0.05 .

d. The test shows that the waiting time is longer at Sparag than at Consumo.

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eRum-2018

Show description

Question 2 points Completed

Using the data provided in `regression.csv` estimate a linear regression of `y` on `x` and answer the following questions.

a.1. `x` and `y` are not significantly correlated

a.2. `y` increases significantly with `x`

a.3. `y` decreases significantly with `x`

b. Estimated slope with respect to `x`: -0.08

b = -0.993
p = 0.000

E-Learning: Live quiz

R/exams/1

1 2 3 4

Which of these institutions already hosted a userR! or eRum conference?

Universität Wien

ETH Zürich

Københavns Universitet

Start Questions Feedback System Manual

Back Forward Home Bookmarks Tabs

R/exams/2

1 2 3 4

What is the derivative of $f(x) = x^9 e^{2x}$, evaluated at $x = 0.7$?

2.43

3.70

2.10

Start Questions Feedback System Manual

Back Forward Home Bookmarks Tabs

R/exams/3

1 2 3 4

Given the following information:

Orange	+	Pineapple	+	Pineapple	=	470
Banana	+	Pineapple	+	Pineapple	=	502
Banana	+	Orange	+	Banana	=	166

Compute:

Banana	+	Orange	+	Pineapple	=	?
--------	---	--------	---	-----------	---	---

Start Questions Feedback System Manual

Back Forward Home Bookmarks Tabs

What Else?



What else?

Under development:

- Many volunteers: Internationalization for “NOPS” exams.
- Nikolaus Umlauf: Exercise “stress tester”.
- Stefan Coors, Nikolaus Umlauf: Graphical exams manager based on shiny that can be used on a local machine or on a server.
- Achim Zeileis: Reports for lecturers based on IRT models.
- Niels Smits: Better management of exercise categories.
- Mirko Birbaumer, Andreas Melillo, Achim Zeileis: Ilias interface based on QTI 1.2.

NOPS internationalization

Please mark the boxes carefully: Not marked: or

This document is scanned automatically. Please keep clean and dry.
please use a **blue or black pen**.

Only clearly marked and positionally accurate crosses will be evaluated.

Answers 1 - 15					Answers 16 - 21				
a	b	c	d	e	a	b	c	d	e
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Merci de cocher soigneusement: Non coché: ou

Cet examen sera corrigé par un système automatisé. Ne pas plier
bille bleu ou noir.

Seul les marques lisibles et bien positionnées seront évaluées

Réponses 1 - 15					Réponses 16 - 21				
a	b	c	d	e	a	b	c	d	e
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A válaszát jelölje egyértelmű x-el: Jelöletlen cella: vagy
A vizsgalap szkennelése automatikusan történik, ezért kérjük, hogy
kék vagy fekete tollat.

Kizárálag az egyértelműen és pontosan megjelölt válaszok kezelése!

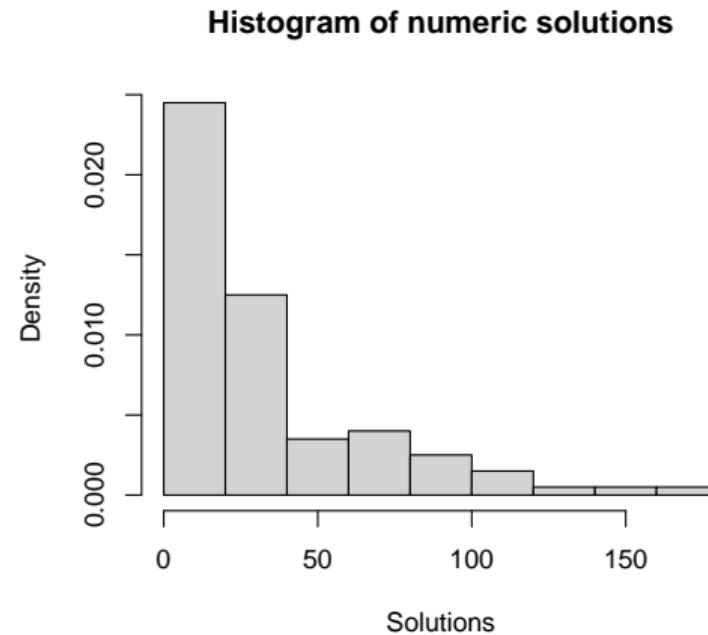
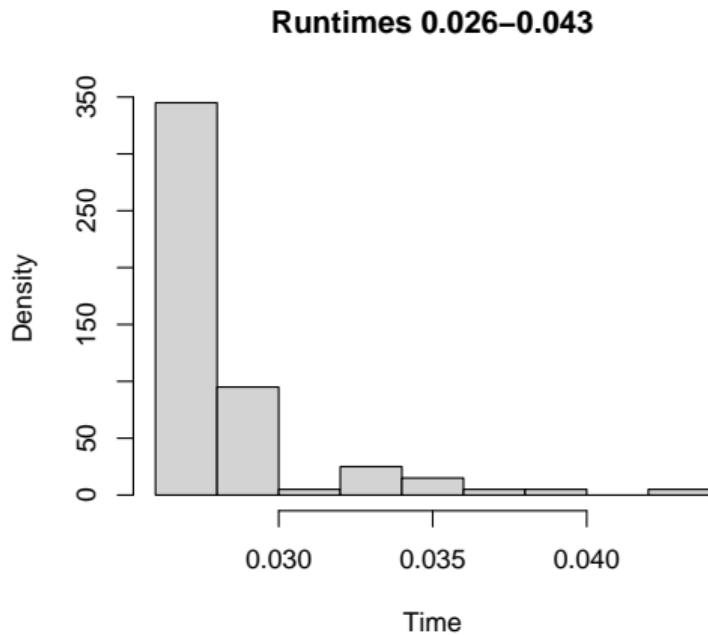
Válaszok 1 - 15					Válaszok 16 - 21				
a	b	c	d	e	a	b	c	d	e
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

da Jensen, Messner
de Zeileis
en Zeileis
es Kogelnik
fi Nordhausen
fr Allignol
gsw Stauffer
hr Juraić
hu Daróczsi, Tóth
it Zambella
nl Smits
pt Calvão, Dellinger,
Petutschnig (pt-PT/pt-BR)
ro Gatu
sk Fabsic
sr Kecojevic
tr Er

More contributions welcome ...

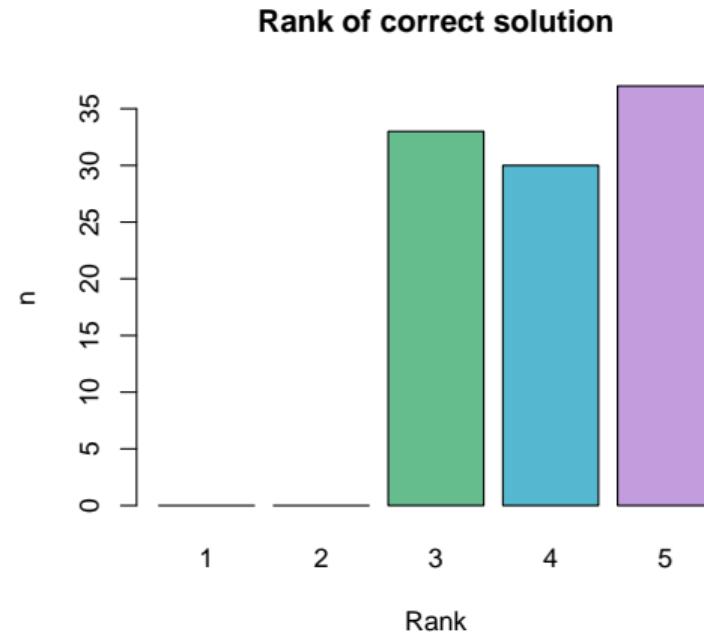
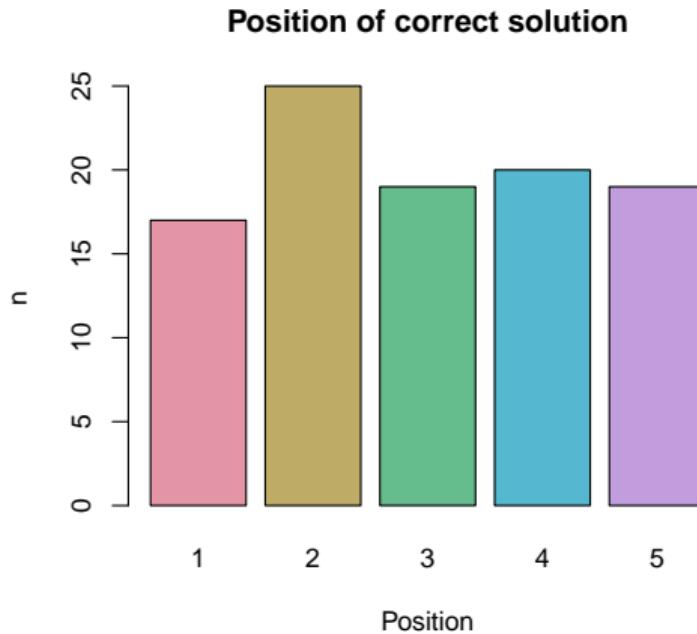
Stress tester

```
R> s <- stresstest_exercise("deriv2.Rnw")
R> plot(s)
```



Stress tester

```
R> s <- stresstest_exercise("deriv2.Rnw")
R> plot(s)
```



Graphical exams manager

The screenshot shows the R-exams graphical exams manager interface. The top navigation bar includes links for 'Create/Edit Exercises', 'Import/Export Exercises', 'Define Exams', and 'Generate Exams'. The main area is titled 'Create Exercises' and contains a preview window showing R code for generating exercises. The left sidebar has several dropdown menus and buttons:

- 'Load a template, Markup?' dropdown set to 'LaTeX'.
- 'Type?' dropdown set to 'num'.
- 'Load template' button.
- 'Load exams package exercises.' dropdown set to 'boxplots.Rnw'.
- 'Load exercise' button.
- 'Select exercise to be modified.' dropdown.
- 'Encoding?' dropdown set to 'UTF-8'.

The preview window displays the following R code:

```
1 ##<echo=FALSE, results='hide'>##
2 ## convenience functions
3 SK <- function(x) diff(diff(fivenum(x)[2:4]))/diff(fivenum(x)[c(2, 4)])
4 trob <- function(a, b)
5   (median(a) - median(b))/sqrt(var(a)/length(a) + var(b)/length(b))
6
7 ## DATA GENERATION
8 ## dgp for one sample
9 dgp <- function(location = 0, scale = 1, skewed = FALSE, outlier = NULL,
10   n = 10, amount = 0.1)
11 {
12   ## basic intervals from which equal amounts of observations are drawn
13   qq <- if (skewed) c(0, 2, 2.2, 6, 10) else c(0, 3, 5, 7, 10)
14   sim <- function(x) {
15     rval <- NULL
16     for(i in 1:length(x)-1) rval <- c(rval, runif(n, min = x[i], max = x[i+1]))
17     rval <- jitter(rval, amount = amount)
18     rval <- rval/4
19     rval
20   }
21   ## draw under restrictions about IQR and SK
22   rval <- sim(qq)
23   if (skewed) {
24     while(IQR(rval) > 1.15 | IQR(rval) < 0.85 | abs(SK(rval)) < 0.7) rval <- sim(qq)
25   } else {
26     while(IQR(rval) > 1.15 | IQR(rval) < 0.85 | abs(SK(rval)) > 0.15) rval <- sim(qq)
27   }
28 }
```

At the bottom right of the preview window is a 'Show preview' button.

The footer of the interface includes the copyright notice '© 2018 R-exams.org' and a 'show help' link.

Graphical exams manager

Load a template, Markup? **LaTeX**

Type? **num**

Load template

Load exams package exercises. **boxplots.Rnw**

Load exercise

Select exercise to be modified.

Encoding? **UTF-8**

Create Exercises Preview

Question

In the following figure the distributions of a variable given by two samples (A und B) are represented by parallel boxplots. Which of the following statements are correct? (Comment: The statements are either about correct or clearly wrong.)

a. The location of both distributions is about the same.
b. Both distributions contain no outliers.
c. The spread in sample A is clearly bigger than in B.
d. The skewness of both samples is similar.
e. Distribution B is left-skewed.

Solution

a. True. Both distributions have a similar location.
b. True. Both distributions have no observations which deviate more than 1.5 times the Interquartile range from the box.

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show help

Examining exams

Report: Exercise difficulty, student performance, unidimensionality, fairness.

Methods: Psychometrics, especially item response theory.

Example: End-term exam from first-year mathematics course for business and economics students at Universität Innsbruck.

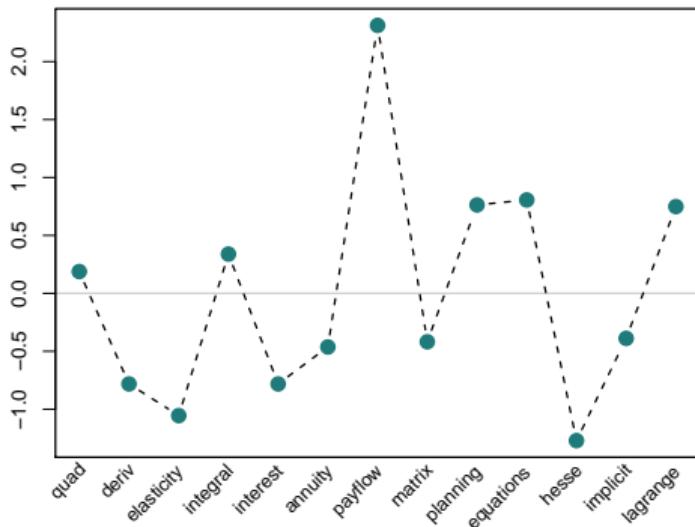
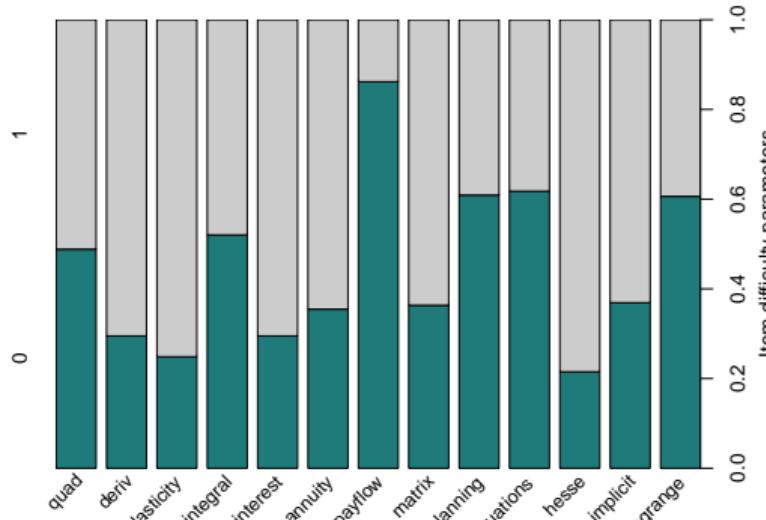
- 729 students (out of 941 registered).
- 13 single-choice exercises on the basics of analysis, linear algebra, financial mathematics.
- Two groups with partially different pools of exercise templates.

```
R> library("psychotools")
R> data("MathExam14W", package = "psychotools")
R> mex <- subset(MathExam14W, nsolved > 0 & nsolved < 13)
```

Examining exams

Item difficulty: Raw proportions vs. Rasch model.

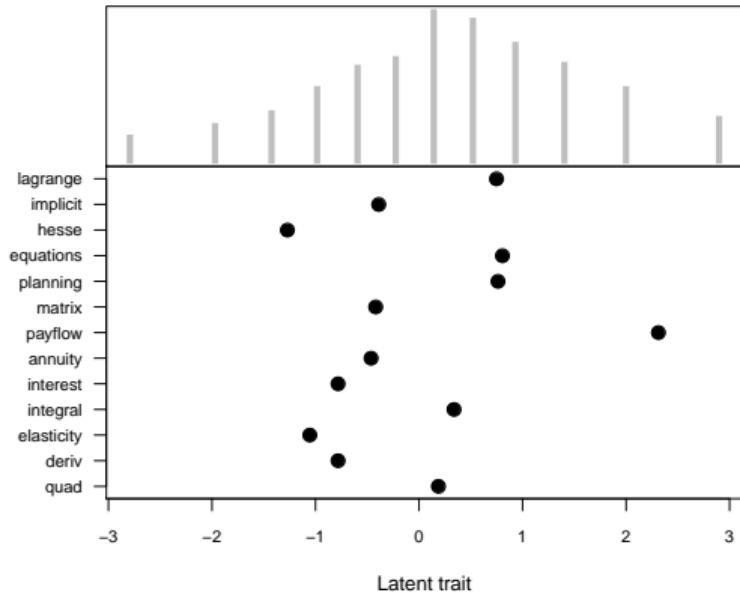
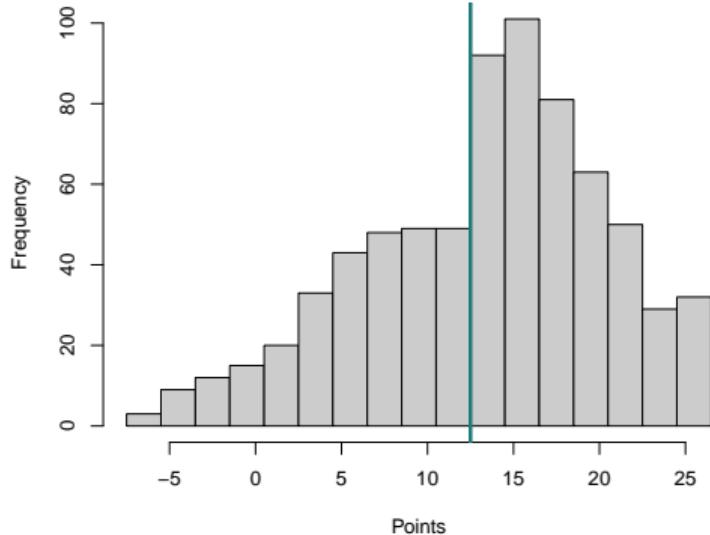
```
R> plot(mex$solved, ...)  
R> mr <- raschmodel(mex$solved)  
R> plot(mr, ...)
```



Examining exams

Student performance: Points and person-item map.

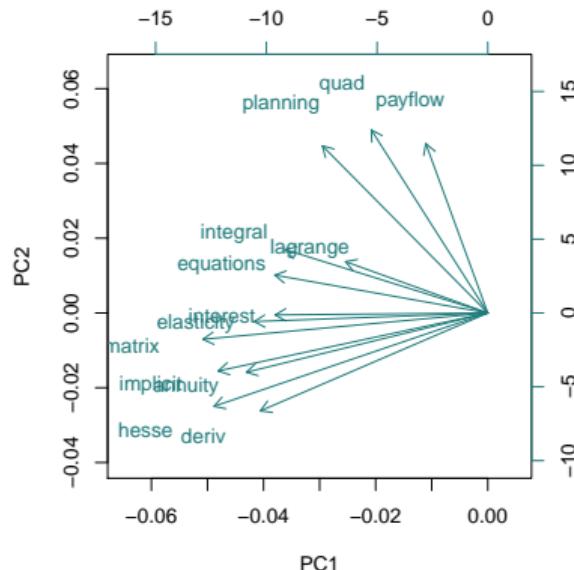
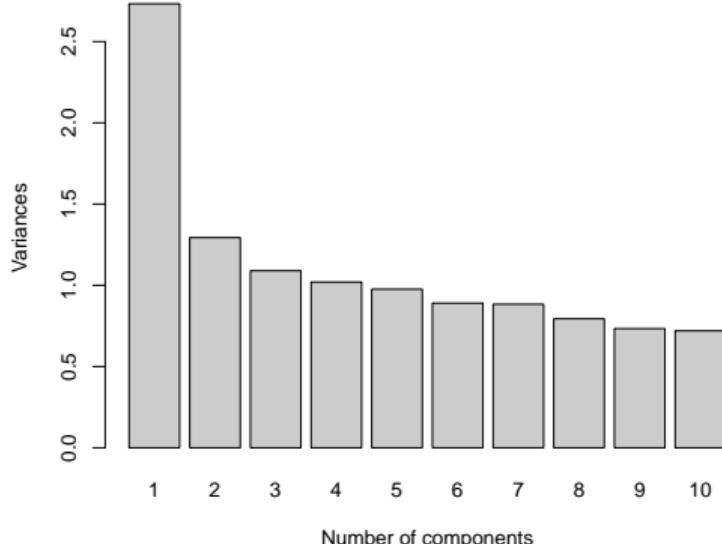
```
R> hist(MathExam14W$points, ...)  
R> piplot(mr)
```



Examining exams

Unidimensionality: Principal component analysis.

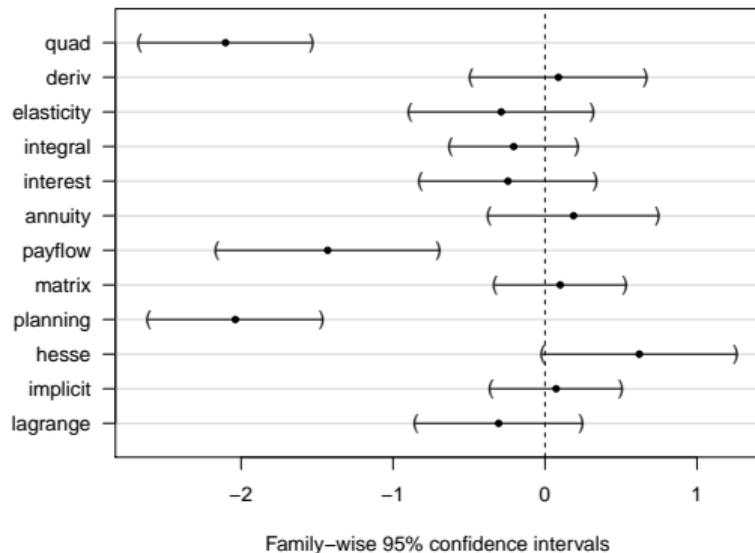
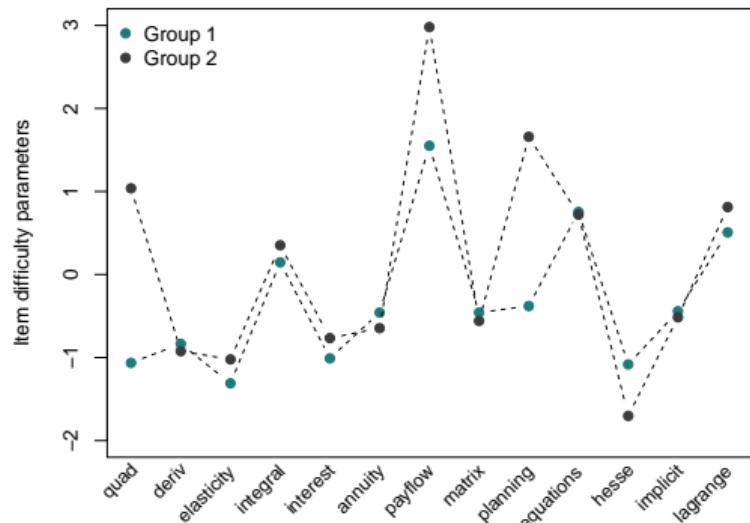
```
R> pr <- prcomp(mex$solved, scale = TRUE)
R> plot(pr, ...)
R> biplot(pr, ...)
```



Examining exams

Fairness: Differential item functioning.

```
R> ma <- anchortest(solved ~ group, data = mex, adjust = "single-step")
R> plot(ma$final_tests, ...)
```



Recommendations

If you want to try  R/exams:

- Start with simple exercises before moving to more complex tasks.
- Focus on content of exercises.
- Don't worry about layout/formatting too much.
- Try to build a team (with lecturers, assistants, etc.).
- Use exercise types creatively.
- Don't be afraid to try stuff, especially in formative assessments.
- Thorough quality control for dynamic exercises before summative assessments.

Resources

Contributors: Zeileis, Grün, Leisch, Umlauf, Smits, Birbaumer, Ernst, Keller, Krimm, Stauffer.

Links:

Web	http://www.R-exams.org/
CRAN	https://CRAN.R-project.org/package=exams
Forum	http://R-Forge.R-project.org/forum/?group_id=1337
StackOverflow	https://stackoverflow.com/questions/tagged/exams
Twitter	@AchimZeileis

References:

- Zeileis A, Umlauf N, Leisch F (2014). “Flexible Generation of E-Learning Exams in R: Moodle Quizzes, OLAT Assessments, and Beyond.” *Journal of Statistical Software*, **58**(1), 1–36. <doi:10.18637/jss.v058.i01>
- Grün B, Zeileis A (2009). “Automatic Generation of Exams in R.” *Journal of Statistical Software*, **29**(10), 1–14. <doi:10.18637/jss.v029.i10>