R/exams

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

Achim Zeileis

`https://www.R-exams.org/`

Motivation

Goals:

- Enable individualized organization of learning, feedback, and assessment.
- Foster continuing active participation.
- Encourage learning from peers and supporting each other.

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- Enable individualized organization of learning, feedback, and assessment.
- Foster continuing active participation.
- Encourage learning from peers and supporting each other.

Challenges:

- Deal with large(-ish) student groups.
- Discourage cheating without learning.

Motivation

Strategy:

- High-frequency low-stakes formative assessment in supportive environment.
- Strict summative assessment in controlled environment.
- One pool of exercises as the basis for all assessments.

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Strategy:

- High-frequency low-stakes formative assessment in supportive environment.
- Strict summative assessment in controlled environment.
- One pool of exercises as the basis for all assessments.

Technology: R/exams software & learning management systems.

- *Individualization:* Randomized dynamic exercise pools.
- *Feedback:* Support for complete correct solutions.
- *Automatic evaluation:* Rendering into different (closed) assessment formats.

Motivation

Possible formative assessments:

- *Quick quiz:* Recap of knowledge from previous session or preparation.
- *Asynchronous test:* Several days, encourage group work, support in forum.
- *Synchronous test:* In learning groups in live sessions (possibly completion of individual tests afterwards).
- *Open-ended tasks:* Upload of solutions online, discussion in live sessions.

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 (either closed/short or open-ended).
- 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 *Canvas*, *OpenOlat*, *ILIAS*.
- *Blackboard* (partially based on QTI 1.2)
- *learnr*, *Participfy*, …

R package *exams*

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- *learnr*, *Participfy*, …

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

- R, *Markdown*, LaTeX.
- *knitr*, *rmarkdown*, *pandoc*, Sweave.
- *Moodle*, *OpenOlat*, and many others.
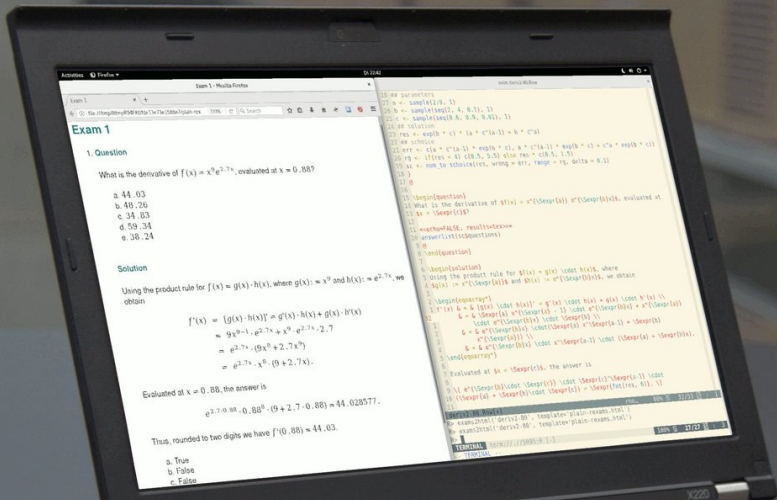
Dynamic Exercises

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 the following cities are the capital of the corresponding country?

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 the following cities are the capital of the corresponding country?

Dynamic exercises: `.Rmd`

Example: Which of the following cities are the capital of the corresponding country?

```
Question
========
Which of the following cities are the capital of the corresponding country?

Answerlist
----------
* Lagos (Nigeria)
* São Paulo (Brazil)
* Toronto (Canada)
* Auckland (New Zealand)
* Istanbul (Turkey)
* Zürich (Switzerland)
* Tokyo (Japan)
* New Delhi (India)
* Astana (Kazakhstan)
* Warsaw (Poland)
* Riyadh (Saudi Arabia)
```

Dynamic exercises: `.Rmd`

Example: Which of the following cities are the capital of the corresponding country?

```
Solution
========

Answerlist
----------
* False. The capital of Nigeria is Abuja.
* False. The capital of Brazil is Brasilia.
* False. The capital of Canada is Ottawa.
* False. The capital of New Zealand is Wellington.
* False. The capital of Turkey is Ankara.
* False. The de facto capital of Switzerland is Bern.
* True. Tokyo is the capital of Japan.
* True. New Delhi is the capital of India.
* True. Astana is the capital of Kazakhstan.
* True. Warsaw is the capital of Poland.
* True. Riyadh is the capital of Saudi Arabia.
```

Dynamic exercises: `.Rmd`

Example: Which of the following cities are the capital of the corresponding country?

```
Meta-information
================
exname: Capitals
extype: mchoice
exsolution: 00000011111
exshuffle: 5
```

Dynamic exercises: `.Rmd` vs `.Rnw`

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

Dynamic exercises: `.Rmd` vs `.Rnw`

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

```
```{r data generation, 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: `.Rmd` vs `.Rnw`

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

````
```{r data generation, echo = FALSE, results = "hide"}
## parameters
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## solution
res <- exp(b * c) * (a * c^(a-1) + b * c^a)
```


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

Dynamic exercises: `.Rmd` vs `.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 $f(x) = x^{\Sexpr{a}} e^{\Sexpr{b}x}$,
evaluated at $x = \Sexpr{c}$?
\end{question}
```

Dynamic exercises: `.Rmd` vs `.Rnw`

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

```
Solution
========
Using the product rule for $f(x) = g(x) \cdot h(x)$, where
$g(x) := x^{`r a`}$ and $h(x) := e^{`r b` x}$, we obtain
$$
\begin{aligned}
f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\
...
\end{aligned}
$$
...
```

Dynamic exercises: `.Rmd` vs `.Rnw`

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

```
Solution
========
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$g(x) := x^{`r a`}$ and $h(x) := e^{`r b` x}$, we obtain
$$
\begin{aligned}
f'(x) &= [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\
...
\end{aligned}
$$
...

Meta-information
================
extype: num
exsolution: `r fmt(res)`
exname: derivative exp
extol: 0.01
```

Dynamic exercises: `.Rmd` vs `.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
$g(x) := x^{\Sexpr{a}}$ and $h(x) := e^{\Sexpr{b}x}$, we obtain
\begin{eqnarray*}
f'(x) & = & [g(x) \cdot h(x)]' = g'(x) \cdot h(x) + g(x) \cdot h'(x) \\
...
\end{eqnarray*}
...
\end{solution}


\extype{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) Basel

(b) Bern

(c) Zurich

(d) Geneva

(e) Lausanne

Knowledge quiz: Shuffled distractors.

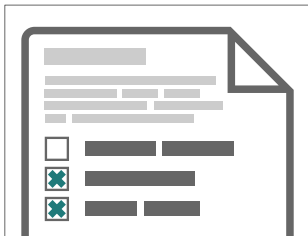# Dynamic exercises: Single choice


```
extype: schoice
exsolution: 010
```

Question
What is the derivative of $f(x) = x^9 e^{3.9x}$, evaluated at $x = 0.82$?

(a) 61.05

(b) 49.15

(c) 72.53

(d) 45.04

(e) 61.47

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 the following cities are the capital of the corresponding country?

(a) New Delhi (India)

(b) Tokyo (Japan)

(c) Lagos (Nigeria)

(d) Auckland (New Zealand)

(e) Astana (Kazakhstan)

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
```


Numeric exercises: Solving arithmetic problems.

Dynamic exercises: String


```
extype: string
exsolution: ANSWER
```
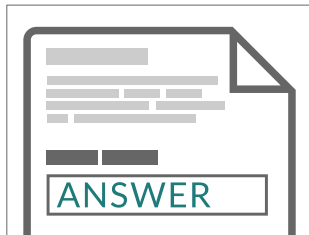
Dynamic exercises: String


```
extype: string
exsolution: ANSWER
```

Question
What is the name of the R function for extracting the fitted log-likelihood from a fitted (generalized) linear model object?

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

Dynamic exercises: String

`extype: string`
`exsolution: ANSWER`

Question
Consider the following regression results:

```
Call:
lm(formula = log(y) ~ log(x), data = d)

Residuals:
   Min    1Q Median    3Q    Max
-5.490 -1.056  0.102  1.593  5.187

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)   -0.039      0.304   -0.13     0.90
log(x)         0.217      0.308    0.70     0.48

Residual standard error: 2.24 on 53 degrees of freedom
Multiple R-squared:  0.00927,        Adjusted R-squared
F-statistic: 0.496 on 1 and 53 DF,  p-value: 0.484
```
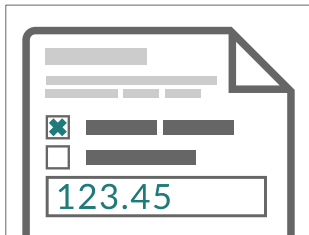
Describe how the response `y` depends on the regressor `x`.

Open-ended question: Answer in an `essay` editor and/or by `file` upload (via `exstringtype`).
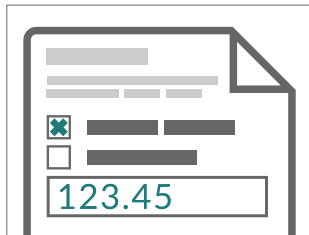
Dynamic exercises: Cloze


```
extype: cloze
exclozetype: mchoice|num
exsolution: 10|123.45
```
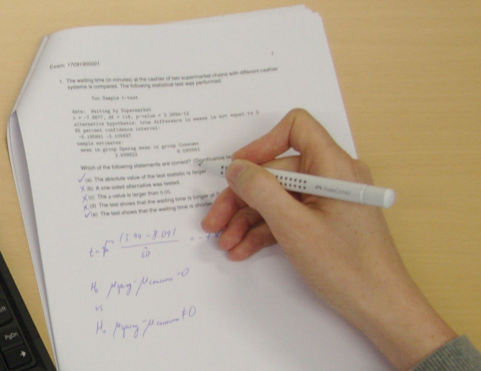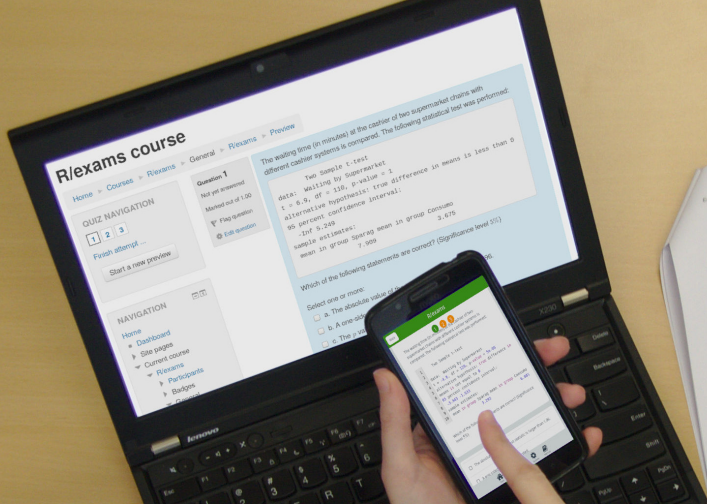
Dynamic exercises: Cloze

Question
Using the data provided in `regression.csv` estimate a linear regression of y on x and answer the following questions.
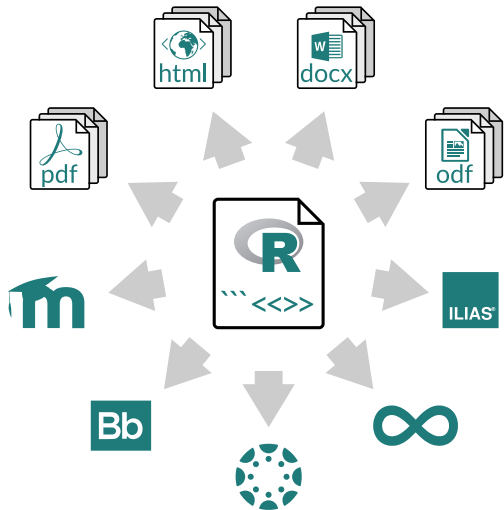
(a) x and y are not significantly correlated / y increases significantly with x / y decreases significantly with x

(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(
+    "capitals.Rmd",
+    "deriv2.Rmd",
+    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

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

Live quiz:
```
R> exams2particify(myexam, n = 1, dir = odir)
```
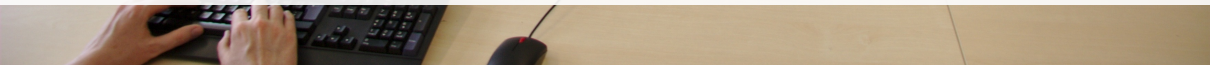
Written exam:
```
R> exams2nops(myexam, n = 3, dir = odir,
+     language = "de", date = "2023-03-29",
+     institution = "Universität Innsbruck", logo = "uibk-logo-bw.png")
```

Other: exams2pdf(), exams2html(), exams2canvas(),
exams2forms::exams2webquiz(),...
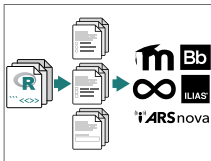
E-Learning

E-Learning

1. Scenarios

- Short quizzes conducted in-class.
- Online tests conducted over several days.
- E-exams conducted in-class or remotely.

E-Learning

1. Scenarios

- Short quizzes conducted in-class.
- Online tests conducted over several days.
- E-exams conducted in-class or remotely.

2. Create

- Draw random replications from exercise templates.
- Embed these into exchange file format.

E-Learning

1. Scenarios

- Short quizzes conducted in-class.
- Online tests conducted over several days.
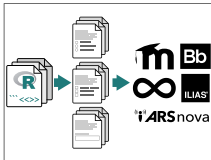- E-exams conducted in-class or remotely.

2. Create

- Draw random replications from exercise templates.
- Embed these into exchange file format.

3. Import

- Import in learning management system.
- Then handle "as usual" in the system.

E-Learning: Online test

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

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

Evaluated at $x = 0.75$, the answer is

$e^{3.3 \cdot 0.75} \cdot 0.75^2 \cdot (3 + 3.3 \cdot 0.75) = 36.591945$.

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

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

24

E-Learning: Online test

OpenOLAT - infinite learning - Mozilla Firefox

eRum-2018

[Finish test]

≡ Show description

Question   1 point   ⊙ Not answered

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.

OpenOLAT - infinite learning - Mozilla Firefox
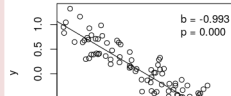
eRum-2018

[Finish test]

≡ 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

Screen 1

ars.uibk.ac.at

1 2 3

Which of the following cities are the capital of the corresponding country?

- ☐ Lagos (Nigeria)
- ☐ Istanbul (Turkey)
- ☐ Zürich (Switzerland)
- ☐ Warsaw (Poland)
- ☐ New Delhi (India)

Overview   Q&A   R/exams

Screen 2

ars.uibk.ac.at

1 **2** 3

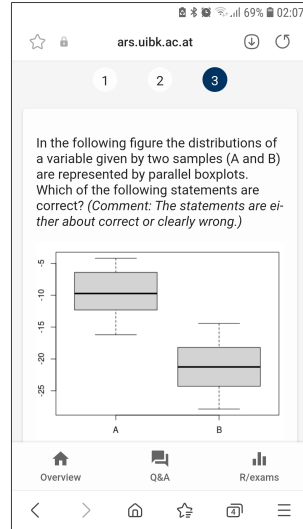What is the derivative of $f(x) = x^8 e^{3.1x}$, evaluated at $x = 0.7$?

- ○ 6.28
- ○ 7.34
- ○ 5.77
- ○ 4.34

Overview   Q&A   R/exams

Screen 3

ars.uibk.ac.at

1 2 **3**

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.)*
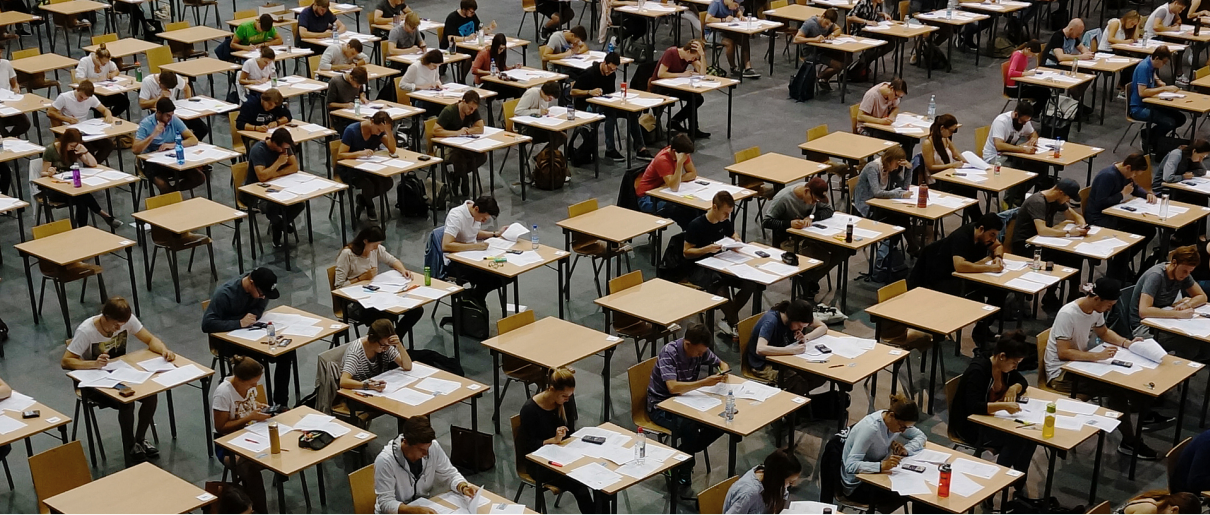
Overview   Q&A   R/exams

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

Universität Innsbruck
Exam 2023-03-29

Persönliche Daten

Nachname:

Vorname:

Unterschrift:

Matrikelnummer

```
0 □□□□□□□ 0
1 □□□□□□□ 1
2 □□□□□□□ 2
3 □□□□□□□ 3
4 □□□□□□□ 4
5 □□□□□□□ 5
6 □□□□□□□ 6
7 □□□□□□□ 7
8 □□□□□□□ 8
9 □□□□□□□ 9
```

In diesem Feld dürfen **keine** Veränderungen der Daten vorgenommen werden!

Scrambling 0 , 0

Belegart 003   Klausur-ID 23032900001

Bitte sorgsam ankreuzen: ☒ Nicht angekreuzt: □ oder ■

Dieser Beleg wird maschinell gelesen. Bitte nicht falten, nicht knicken und nicht beschmutzen. Verwenden Sie zum Markieren einen **blauen oder schwarzen Kugelschreiber.**
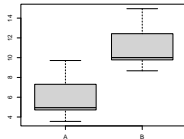**Nur deutlich erkennbare und positionsgenaue Markierungen werden ausgewertet!**

Antworten 1 - 3
```
  a b c d e
1 □ □ □ □ □
2 □ □ □ □ □
3 □ □ □ □ □
  a b c d e
```

Exam: 23032900001   1

1. Which of the following cities are the capital of the corresponding country?
   a. New Delhi (India)
   b. Tokyo (Japan)
   c. Lagos (Nigeria)
   d. Auckland (New Zealand)
   e. Astana (Kazakhstan)

2. What is the derivative of $f(x) = x^4 e^{2.3x}$, evaluated at $x = 0.89$?
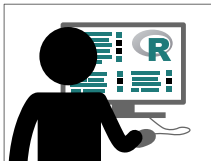   a. 19.60
   b. 27.40
   c. 30.45
   d. 31.09
   e. 34.42

3. 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.
   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.

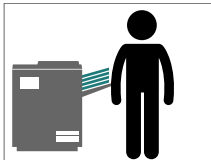29

Written exams

1. Create

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

Written exams

1. Create

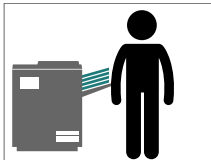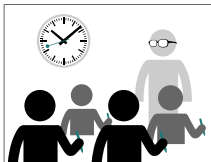- Using `exams2nops()`, create (individual) PDF files for each examinee.

2. Print

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

Written exams

1. Create

- Using `exams2nops()`, create (individual) PDF files for each examinee.
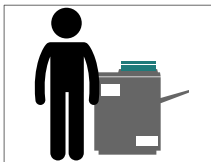
2. Print

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

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.
- Correct potential scanner problems with `nops_fix()`.
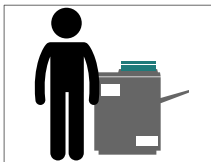
Written exams

4. Scan

- Scan exam sheets, e.g., on a photocopier.
- Using `nops_scan()`, process the scanned exam sheets.
- Correct potential scanner problems with `nops_fix()`.

5. Evaluate

- Using `nops_eval()`, obtain grades, points, etc.
- ...plus individual HTML reports for each examinee.

Written exams

A vizsga eredménye

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

Értékelés

Kérdés	Pontok	Adott válasz	Helyes válasz
1	1.0000000	__c__	__c__
2	0.5000000	abc_e	abc__
3	0.0000000	_____	ab_d_
4	1.0000000	__c__	_bc__
5	0.6666667	___d_	ab_d_
6	0.0000000	_bc_e	a_c__

Vizsgalap

+ **R University**

Exam 2015-07-29

Personal Data

Family Name: DOE

Given Name: JANE

Signature:

0 ☑ ☐ ☒
1 ☒ ☐ ☐
2 ☐ ☐ ☐

1,5,0

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

+ **Universität Innsbruck**

Klausur 2015-07-29

Persönliche Daten

Nachname: Dexter

Vorname: Ambi

Unterschrift:

0 ☐ ☐ ☒
1 ☐ ☐ ☐
2 ☐ ☐ ☐

9,9,1

In action: First-year mathematics

Structure: Mandatory.

- 2-hour lecture (VO), about 700 participants.
- 2-hour tutorial (PS), up to 40 participants per tutorial.

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Weekly schedule:

- *Learning:* Online textbook, screencasts, slides.
- *Flipped classroom:* Overview, questions & answers in lecture session.
- *Formative assessment:* Numeric online test, several days, support in forum.
- *Feedback:* Discussion of more complex exercises in tutorial session.
- *Formative assessment:* Another online test in tutorial learning groups.

In action: First-year mathematics

Structure: Mandatory.

- 2-hour lecture (VO), about 700 participants.
- 2-hour tutorial (PS), up to 40 participants per tutorial.

Weekly schedule:

- *Learning:* Online textbook, screencasts, slides.
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- *Formative assessment:* Another online test in tutorial learning groups.

Summative assessment: Written single-choice exams (mid-term & end-term).

In action: Data analytics

Structure: Elective.

- 2-hour lecture (VU), 40–60 participants.
- 1-hour tutorial (VU), 15–40 participants per tutorial.

In action: Data analytics

Structure: Elective.

- 2-hour lecture (VU), 40–60 participants.
- 1-hour tutorial (VU), 15–40 participants per tutorial.

Weekly schedule:

- *Learning:* Lecture session, online textbook/slides.
- *Formative assessment:* Quiz & numeric test, several days, support in forum.
- *Formative assessment:* Open-ended practical task, several days, file upload.
- *Feedback:* Discussion of practical tasks in tutorial session.

In action: Data analytics

Structure: Elective.

- 2-hour lecture (VU), 40–60 participants.
- 1-hour tutorial (VU), 15–40 participants per tutorial.

Weekly schedule:

- *Learning:* Lecture session, online textbook/slides.
- *Formative assessment:* Quiz & numeric test, several days, support in forum.
- *Formative assessment:* Open-ended practical task, several days, file upload.
- *Feedback:* Discussion of practical tasks in tutorial session.

Summative assessment: Online exams with open-ended theory questions and individualized practical tasks (mid-term & end-term).

In action: Do it yourself

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.).
- Connect to experienced users.
- Use exercise types creatively.
- Don't be afraid to try stuff, especially in formative assessments.
- Thorough quality control for dynamic exercises before summative assessments.

In action: Do it yourself

Installation:

1. R, Rtools on Windows, RStudio recommended for beginners.
2. R package *exams* (including dependencies).
3. LaTeX for producing PDF output.
4. Pandoc (e.g., provided along with RStudio).
5. Possibly further tools needed for scanning NOPS exams.

More details: https://www.R-exams.org/tutorials/installation/

In action: Do it yourself

First steps: https://www.R-exams.org/tutorials/first_steps/

Quality control: Stress testing.

- Generate a large number of random versions of an exercise.
- Check for errors, warnings, long computation times, …
- Especially for numeric exercises: Check solution distribution, outliers, dependency on randomized parameters.
- Especially for multiple-choice exercises: Check shuffling of correct answers.

More details: https://www.R-exams.org/tutorials/stresstest/

Resources

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

Links:

- https://www.R-exams.org/
- https://CRAN.R-project.org/package=exams
- https://stackoverflow.com/questions/tagged/r-exams
- https://R-Forge.R-project.org/forum/?group_id=1337
- @zeileis@fosstodon.org
- @AchimZeileis