LATEX SYSTEM IN DISTANCE LEARNING OF THE PROBABILITY THEORY

Halyna Hubal
Ph.D. in Physical and Mathematical Sciences, Associate Professor, Associate Professor of Department of Physics and Higher Mathematics
Lutsk National Technical University, Ukraine

Summary. Article discusses the main issues for writing interactive mathematical tests in the LaTeX system. The LaTeX system is convenient to use for writing interactive mathematical tests in distance learning. We use the eqExam package, the AcroTeX eDucation Bundle package, the turnthepage package in order to write interactive mathematical tests, for example tests on the probability theory. For this, we create (tasks) of the “True/False” type, the “Short Answer” type, the “Essay” type (“Specifying a Definition”, “Justification of a Theoretical Hypothesis”) and the “Multiple Choice” type.

Keywords. LaTeX, test, eqExam package, turnthepage package, distance learning.

Introduction.
Scientists and educators use the LaTeX system to write texts with a great number of mathematical formulas in structural documents [1]-[6].
The LaTeX system is convenient to use for writing interactive mathematical tests in distance learning [1], [6]-[9].
In this article, we consider how to write interactive mathematical tests in the LaTeX system using LaTeX packages such as eqExam package and additional packages to this package: hyperref, AcroTeX eDucation Bundle, everyshi and generating pdf files. We also used the turnthepage package.

Main part and results.
Let us consider how to write interactive mathematical tests in the LaTeX system, for example tests on the probability theory. For this, it is necessary to install LaTeX packages and generate pdf files using Adobe Distiller, pdftex or dvipdfm. In order to generate interactive mathematical tests in the LaTeX system, we use the eqExam package and additional packages to this package such as hyperref, AcroTeX eDucation Bundle and everyshi.
The eqExam package generates questions (tasks) of the “True/False” type, the “Short Answer” type, the “Essay” type (“Specifying a Definition”, “Justification of a Theoretical Hypothesis”) and the “Multiple Choice” type.
When creating interactive mathematical tests using the eqExam package, the questions (tasks) are printed in a special format and the answers are entered according to the options.
The eqExam package is published in three modes:
- the “Answers at the end of the document” mode which is set by default;
- the “Test” mode in which answers do not appear in the document;
- the “Key-Answer” in which answers appear in the document. This mode is set by the answerkey option.
The hyperref package generates hyperlinks from standard cross-reference commands in the LaTeX system. AcroTeX eDucation Bundle is a collection of technical packages for creating online interactive tests.

Let us give the example of the LaTeX document with the eqExam package added.

\documentclass[12pt]{article}
% In the preamble of the LaTeX document, we add the eqExam package with some options
\usepackage[forpaper, pointsonboth, useforms, nosolutions, online]{eqexam}
% We generate the title of the test
\title{T1}{Test 1}
% We generate the beginning of the test
\begin{exam}{P1}
% Question (task) of the “True/False” type. The assessment of the question (task) is 2 points
\begin{parts}
\item \textbf{F} The number of arrangements of \(n\) objects out of \(k\) can be calculated by the formula \(A_n^k=\frac{n!}{(n-k)!}\), and the number of combinations of \(n\) objects out of \(k\) can be calculated by the formula \(C_n^k=\frac{n!}{k!(n-k)!}\).
\item \textbf{T} The number of arrangements of \(n\) objects out of \(k\) can be calculated by the formula \(A_n^k=\frac{n!}{(n-k)!}\) and the number of combinations of \(n\) objects out of \(k\) can be calculated by the formula \(C_n^k=\frac{n!}{k!(n-k)!}\).
\end{parts}
% Question (task) of the “Short Answer” type. When answering this question (task), you must enter a word or a phrase in the underlined place. The assessment of the question (task) is 3 points
\begin{solution}
The summation rule. If some object \(a\) can be chosen in \(m\) ways, and some object \(b\) can be chosen in \(n\) ways, neither choice \(a\) coinciding with either choice \(b\), then one of the objects \(a\) or \(b\) can be chosen in \(m+n\) ways.
The multiplication rule.
If some object \((a)\) can be chosen in \((m)\) ways, and for any choice of the object \((a)\), the object \((b)\) can be chosen in \((n)\) ways, then the choice of the pair \((a;b)\) can be made in \((mn)\) ways.
\end{solution}
\end{problem}

% Question (task) of the “Essay” type is an open-ended question (task) that requires a detailed answer. 15 inches of vertical space are allowed for the answer. The assessment of the question (task) is 4 points
\begin{problem}[4]
Which event is called probable, impossible?
\begin{solution}[15in]
The event is called probable in the given trial if it definitely occurs in this trial.
The event is called impossible in the given trial if it never occurs in this trial.
\end{solution}
\end{problem}

% Question (task) of the “Multiple Choice” type is a question (task) that has several answer options of which one or more are correct. The assessment of the question (task) is 5 points
\begin{problem}[5]
In a batch of 50 details, the number of defective ones cannot exceed two, all the values (0; 1; 2) of the number of the defective details being equally possible.
Knowing that five details chosen randomly turned out to be suitable, find the probability that all the remained details are also suitable.
% We generate the table with four columns
\begin{answers}{4}
\TextChoices
\Ans0 \(0\) \eAns \Ans0 \(\frac{1}{3}\) \eAns \Ans0 \(1\) \eAns \Ans0 \(\frac{490}{1327}\) \eAns \\end{answers}
\begin{solution}
\frac{490}{1327}
\end{solution}
\end{problem}
\end{exam}
\end{document}

The given code generates Test 1 in Fig. 1.
When creating tests, it is advisable to remind students to go to the next page so that students do not skip the page. For this, the turnthepage package is used. With this package every odd page (except the last one if it is odd) generates the message to turn the page.
Note that this package is also suitable for use for other types of documents.
The turnthepage package can be added to the preamble of a LaTeX document by the command
\usepackage[<option>]{turnthepage}
Option generates the text that appears in the lower right corner of the odd page:
- “/...”;
- “turn the page”.
The test can be submitted in electronic form. To do this, in the preamble of the LaTeX document, we use the email option and the \submitinfo command with two options: the first one has a script eqAttach.asp, and the second one has an e-mail of a recipient.

Main Concepts of Probability Theory

Test 1

Surname: __________

Semester 2

H.M. Hubal

Instructions. (14 points) Take the test. Points are subtracted from the total number of points for incorrect answers.

(2pts) 1. True or False.

(a) _________ The number of arrangements of \( n \) objects out of \( k \) can be calculated by the formula

\[
A_n^k = \frac{n!}{k!(n-k)!},
\]

and the number of combinations of \( n \) objects out of \( k \) can be calculated by the formula

\[
C_n^k = \frac{n!}{(n-k)!}.
\]

(b) _________ The number of arrangements of \( n \) objects out of \( k \) can be calculated by the formula

\[
A_n^k = \frac{n!}{k!(n-k)!},
\]

and the number of combinations of \( n \) objects out of \( k \) can be calculated by the formula

\[
C_n^k = \frac{n!}{k!(n-k)!}.
\]

(3pts) 2. The main principles of combinatorics are

______________________

(4pts) 3. Which event is called probable, impossible?

______________________

(5pts) 4. In a batch of 50 details, the number of defective ones cannot exceed two, all the values (0; 1; 2) of the number of the defective details being equally possible. Knowing that five details chosen randomly turned out to be suitable, find the probability that all the remained details are also suitable.

\[
\begin{array}{cccc}
\square & 0 & \square & \frac{1}{3} \\
\square & 1 & \square & \frac{490}{1327}
\end{array}
\]

Fig. 1. Test Mode
Conclusions.

Thus, in this article, we considered peculiarities of writing interactive mathematical tests, for example tests on the probability theory, in the LaTeX system. We used LaTeX packages such as eqExam package and additional packages to this package: hyperref, AcroTeX eDucation Bundle, everyshi and generated pdf files. We also used the turnthepage package. We created questions (tasks) of the “True/False” type, the “Short Answer” type, the “Essay” type (“Specifying a Definition”, “Justification of a Theoretical Hypothesis”) and the “Multiple Choice” type.

References: