

Zpravodaj Československého sdružení uživatelů TeXu

Vít Novotný

The Trends in the Usage of TeX for the Preparation of Theses and
Dissertations at the Masaryk University in Brno

Zpravodaj Československého sdružení uživatelů TeXu, Vol. 25 (2015), No. 1-2, 80–85

Persistent URL: <http://dml.cz/dmlcz/150229>

Terms of use:

© Československé sdružení uživatelů TeXu, 2015

Institute of Mathematics of the Czech Academy of Sciences provides access to digitized documents strictly for personal use. Each copy of any part of this document must contain these *Terms of use*.



This document has been digitized, optimized for electronic delivery
and stamped with digital signature within the project *DML-CZ*:
The Czech Digital Mathematics Library <http://dml.cz>

The Trends in the Usage of T_EX for the Preparation of Theses and Dissertations at the Masaryk University in Brno

VÍT NOVOTNÝ

This article is a statistical analysis of theses and dissertations written and defended during the period 2010–2015 at the Masaryk University in Brno (MU). The author assesses the trends in the usage of T_EX and tests the hypothesis that theses and dissertations written using T_EX received significantly better rating than those not written using T_EX.

Key words:

thesis, dissertation, statistics

Introduction

A statistical analysis of theses defended at the Masaryk University in Brno (MU) between years 2010 and 2015 was carried out by the author of this article. The sample data for the analysis were kindly provided by doc. Ing. Michal Brandejs, CSc., the head of the Computer Systems Unit at the Faculty of Informatics at MU.

Table 1 shows the distribution of theses written and defended during the years 2010–2015 across the faculties of MU and Table 2 illustrates how many of these theses were written using T_EX. Table 3 then presents the trends in the usage of T_EX by the students of bachelor's, master's and doctoral degree programmes at the Faculty of Informatics (FI) and the Faculty of Science (Sci). Other faculties of MU were not considered since the number of theses written at these faculties using T_EX was statistically insignificant (see Table 2). Theses written by students of lifelong education programmes were likewise ignored since none of them were written using T_EX.

Analysis

A thesis was considered to be written using T_EX if one or more files submitted with it satisfied one or more of the following conditions:

- The suffix was `tex`.
- The magic number was that of a DVI file.

Faculty	#	%
Arts	10 000	21.98
Education	8 219	18.07
Social Studies	5 599	12.31
Science	5 275	11.60
Law	4 824	10.60
Economics & Administration	4 591	10.09
Informatics	2 904	6.38
Sports Studies	2 062	4.53
Medicine	2 014	4.43
Total	45 488	100.00

Table 1: The distribution of theses defended during 2010–2015 across the faculties of MU

Faculty	With T_EX	Total	%
Informatics	1 716	2 904	59.09
Science	786	5 275	14.90
Economics & Administration	64	4 591	1.39
Arts	69	10 000	0.69
Medicine	8	2 014	0.40
Law	15	4 824	0.31
Education	19	8 219	0.23
Social Studies	12	5 599	0.21
Sports Studies	3	2 062	0.15
Total	2 692	45 488	5.92

Table 2: The distribution of theses written using T_EX, which were defended during 2010–2015 across the faculties of MU

Degree	Fac.	2010	2011	2012	2013	2014	R
Bachelor's	FI	58.92	59.44	49.54	53.77	59.06	-0.195
	Sci	11.55	13.00	15.90	19.79	15.16	+0.703
	All	5.08	6.19	6.00	6.08	6.24	+0.731
Master's	FI	60.61	59.91	60.08	64.50	57.96	-0.046
	Sci	19.38	13.54	13.75	13.78	17.71	-0.180
	All	6.02	4.88	5.22	6.59	6.29	+0.490
Doctoral	FI	100.00	76.67	71.88	83.87	90.91	-0.155
	Sci	18.09	10.71	12.75	10.19	8.85	-0.830
	All	8.83	8.23	8.41	9.38	7.43	-0.361
All	FI	60.83	60.53	54.92	60.57	59.34	-0.188
	Sci	14.86	12.96	14.74	16.55	15.45	+0.577
	All	5.67	5.70	5.73	6.41	6.28	+0.855

Table 3: The percentage of theses written using $\text{\TeX}$ which were defended in each year during the years 2010–2014 and the sample correlation coefficient R between the percentage and the years with remarkably strong correlations emphasized

- The MIME type was `application/postscript` and the file contained the `TeXDict` substring suggesting that the file was a PostScript document which had been created using the `dvips` utility.
- The MIME type was `application/pdf` and either the `Creator` or the `Producer` PDF header contained the `TeX` substring suggesting that the file had been created using either the `dvipdfm` utility or a $\text{\TeX}$ engine which supports PDF output.

Provided the heuristic is sound, there was a marked and steady increase in the use of $\text{\TeX}$ for the typesetting of theses at MU during the period 2010–2014 (see Table 3). This, however, does not necessarily hold true for individual faculties and degree study programmes with some of them showing barely any correlation between the years and the use of $\text{\TeX}$ others showing a strong negative correlation. A particularly striking example of the latter case is the pronounced downward trend in the use of $\text{\TeX}$ for the typesetting of doctoral theses at the Faculty of Science.

At first the null hypothesis h_1 was supposed that the grades awarded to theses written using and not using $\text{\TeX}$, respectively, have the same distribution on the significance level $\alpha = 0.05$. The one-tailed Pearson's χ^2 test (Pearson, 1900) of the goodness of fit was applied to the observations of awarded grades (see Table

	Without $\text{T}_{\text{E}}\text{X}$	E(With $\text{T}_{\text{E}}\text{X}$)	O(With $\text{T}_{\text{E}}\text{X}$)	$(E - O)^2/E$
A	15 476	987.635	1 181	37.858
B	9999	638.108	587	4.093
C	7 926	505.815	381	30.799
D	4 020	256.545	194	15.248
E	2 783	177.603	128	13.853
F	1 979	126.294	145	2.771
Total	42 183	2 692	2 692	104.623

Table 4: The contingency table of the numbers of marks awarded to theses written and defended during 2010–2015 with Pearson’s goodness-of-fit measure $(E - O)^2/E$ between the expected (E) and the observed (O) numbers of marks awarded to theses written using $\text{T}_{\text{E}}\text{X}$

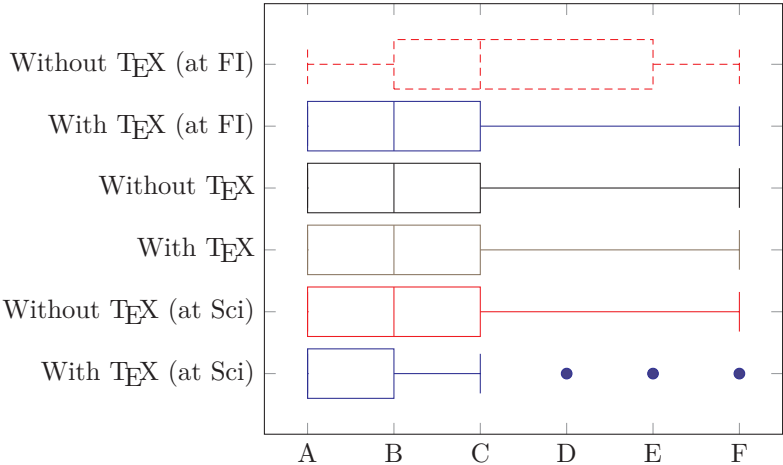


Figure 1: A box plot of the grades of theses written and defended during the period 2010–2015 at FI, Sci and all the faculties of MU with and without $\text{T}_{\text{E}}\text{X}$

4). Since

$$\sum_{A,B,\dots,F} (E - O)^2/E = 104.623 \gg 11.07 = \chi^2_{1-\alpha}(5) \quad (1)$$

the null hypothesis h_1 was refused and it was concluded that the grades are indeed differently distributed on the significance level α .

Having shown that the distribution of grades awarded to theses written using and not using T_EX is different, the author proceeded to test if this holds for individual grades. The null hypothesis h_A was supposed that the distribution of grade A being awarded to theses written using and not using T_EX is equivalent. The two-tailed Mann-Whitney U test (Mann and Whitney, 1947) was applied to the observations of grade A being and not being awarded to theses written using and not using T_EX:

$$m_1 = 15\,476 \quad (\text{Without T}_{\text{E}}\text{X (grade A)})$$

$$m_2 = 1\,181 \quad (\text{With T}_{\text{E}}\text{X (grade A)})$$

$$n_1 = 42\,183 \quad (\text{Without T}_{\text{E}}\text{X (total)})$$

$$n_2 = 2\,692 \quad (\text{With T}_{\text{E}}\text{X (total)})$$

$$U_1 = m_1(m_2 \cdot 0.5 + (n_2 - m_2)) + (n_1 - m_1)((n_2 - m_2) \cdot 0.5) \quad (2)$$

$$= 52\,699\,952.5$$

$$U_2 = m_2(m_1 \cdot 0.5 + (n_1 - m_1)) + (n_2 - m_2)((n_1 - m_1) \cdot 0.5) \quad (3)$$

$$= 60\,856\,683.5$$

$$U = \min(U_1, U_2) = U_1 = 52\,699\,952.5 \quad (4)$$

Since $n_1 n_2 \gg 20$, $U \sim N\left(\frac{n_1 n_2}{2}, \frac{n_1 n_2 (n_1 + n_2 + 1)}{12}\right)$. After normalization to

$$N(0, 1) \sim z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}} \approx -\frac{4\,078\,365.5}{651\,662.46} \approx -6.258 \quad (5)$$

the two-tailed p -value β was computed as follows:

$$\arg \min_{\beta} P(\Phi_{\beta/2}^{-1} \leq z \leq \Phi_{1-\beta/2}^{-1}) = \beta \quad (6)$$

$$\iff \Phi_{\beta/2}^{-1} = -6.258 \iff \beta/2 = 1 - \Phi(6.258) \iff \beta \approx 0$$

Since $\beta < \alpha$ the null hypothesis h_A on the significance level α was refused. Following a similar procedure for grades from B to F, the following conclusions on the significance level α could be made:

- Theses written using T_EX had been awarded grade A significantly more often than those not written using T_EX.

- Theses written using T_EX had been awarded grades C and D significantly less often than those not written using T_EX.
- No significant difference was observed in the distributions of grades B, E and F being awarded to theses written using and not using T_EX.

A box plot of the grades is shown in Figure 1.

Conclusion

The author has shown that there was a marked and steady increase in the usage of T_EX at MU the period during 2010–2014 and that the usage of T_EX correlated with statistically significantly better grades during the period 2010–2015.

Literatura

- MANN, H. B., WHITNEY, D. R. On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. *The Annals of Mathematical Statistics*, 1947, Vol. 18, No. 1, s. 50–60.
- PEARSON, C. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *Philosophical Magazine Series 5*, 1900, Vol. 50, Iss. 302, s. 157–175.

Vít Novotný
 witiko@mail.muni.cz