

Deliverables

Hand in via MMS, by **21:00 on Nov 25th 2019**

- a single .PDF file containing your written work within one file!
- a single .ZIP file containing your “pie menu work” e.g. mockups or code, video, images

GENERAL RULES**Weighting & Mark Descriptors**

This practical is weighted at 60% of the coursework. The general mark descriptors apply and can be reviewed here: https://info.cs.st-andrews.ac.uk/student-handbook/learning-teaching/feedback.html#Mark_Descriptors

Lateness

Lateness penalties follow the default School policy (Scheme B, 1 mark per 8-hour period or part thereof). You can review the policy on lateness penalties here: <https://www.st-andrews.ac.uk/media/teaching-and-learning/policies/penalties.pdf>

GOOD ACADEMIC PRACTICE

Apart from the final stage of creating an “aggregated heuristic evaluation” you are expected to work on the practical on your own and to follow the Good Academic Practice policy: <https://www.st-andrews.ac.uk/students/rules/academicpractice/>.

The University views plagiarism very seriously. Ensure that any images you choose to use as material in your report are correctly attributed to their proper sources. Ensure that all text that you include in your report, that is not your own, is correctly cited as a quotation and carries an accompanying reference (including page numbers) to the original source.

Please make sure to carefully read the practical instructions outlined below.

When you submit please make sure to download what you submit to check it's the correct work submitted.

Aims and Objectives:

1. To understand Analysis of Variance, how to determine, apply and interpret a F-Distribution value from an ANOVA.
2. To understand how to design an experiment for comparing two menu styles, along with the factors influencing each, and the threats to validity
3. To implement and test the two menu styles using your design

Resources

1. ANOVA Excel spreadsheet (this is the basis for starting but needs to be extended) from lectures
2. Video demonstrating linear menus, basic pie menus, and marking menus
3. PhD thesis describing evaluation of marking menus
4. Access to InVision to create mock-ups <http://bit.ly/invision-edu-demo>
5. Access to Mockups 3 for Desktop License Name: HCI 2019 License Key: eJzzzU/OLi0odswsqvEozU3MU3DOzy0oLUktUvDMA5KJySWZ+XkKCkYGhpY1hqbmpkbGBiYGIFATUmMIAK3qFBM=

Learning Outcomes

By the end of this practical you should have familiarity with: ANOVA, new interaction techniques and how to design experiments for them and reading related research. By the end of this practical you should have familiarity with factors influencing choice of menu styles and how to design experiments for them

Summary of what you are asked to submit

1. A table, as described in the question
2. A description of four factors and 300 words and details of two possible threats
3. A one page report on your pie/linear menu prototype/system and how you analysed the participant data the results you found in a short (less than 1 page) report
4. A short video of your pie/linear menu in operation.

Optional to submit

1. If you developed code, you can submit your code and program (along with interactions on how to use or install it if it's a web-plugin)
2. Sketch/images/mockups used to create a "prototype".

Question 1

Complete a one-way ANOVA on the following error rate data which has come from 3 different "between-subjects experiments" on 2 mobile keyboards QWERTY and QuickPath, 2 tablet pens SurePen and QuickPen and 3 speech recognition systems Siri, Alexa and Google Home.

- Report on the following 13 items per experiment, in **precisely the table format provided (TABLE for Results): Sums** of SS_{total} and SS_{error} and SS_{effect} , Number of Participants n , Number of Groups m , **Degrees of Freedom** df_{effect} and df_{error} , Mean Squares $error$ and Mean Squares $effect$, at what significance level can you reject each null hypothesis 0.05 or 0.01 or 0.001?, **F-Distribution value** (reported correctly) and how you interpret this!
- Give the **precise wording** for how you would separately report the outcome of each of the three experiments (wording as shown on slides, slide title -> "Reporting").

Keyboard QWERTY	Keyboard QuickPath
8	13
10	15
12	17
14	19
16	21

Mouse SurePen	Mouse QuickPen
5	7
4	9
7	11
9	12
10	16

SR Siri	SR Alexa	SR Google Home
30	30	41
27	44	60
32	36	48
34	39	50
36	30	47
38	46	52
41	41	45

hint: employ and extend the spreadsheet given previously for ANOVA

You must use this table format for your results!

Results	Table 1	Table 2	Table 3
SS_{error}			
SS_{total}			
SS_{effect}			

Results	Table 1	Table 2	Table 3
<i>n</i> Participants			
<i>m</i> Groups			
df_{error}			
df_{effect}			
MS_{error}			
MS_{effect}			
α Confidence Level			
F-ratio			
Critical value			
Significant?			
Table 1 Reporting	“The Qwerty Keyboard resulted in fewer average errors than.. <for you to complete> ”		
Table 2 Reporting	“<for you to complete> ”		
Table 3 Reporting	“<for you to complete> ”		

Question 2

Watch the included video, which demonstrates a comparison of **three** types of menu: linear menus, pie menus, and marking menus. Additionally, you may wish to look at the experimental design and evaluation in the **included thesis** for additional information.

To answer this question,

- first, briefly describe **four factors** to consider when deciding on whether to implement a linear menu or a pie menu, including how this factor would influence your decision.
- describe in less than **300 words** an experiment to empirically compare the two menu styles using a between-subjects design. Ensure you describe your hypothesis, independent and dependent variables, your setup, participants, apparatus, material and study procedure. Note any possible skill transfer effects, asymmetrical skill transfer, balancing and counterbalancing.
- finally, describe **two possible threats** to the experimental validity of what you propose.

You can read the related research papers and similar work to inform your answer but be judicious in how far away you read from each of the concepts in the videos shown.

Question 3 - “I’m so Over, Overleaf” or “The power of Menu Navigation”

Based on the module pre-requisites we assume everyone can code. However it’s up to **you** to decide if you can achieve the required functionality (and ability to record timing and error data) with a prototyping tool (e.g. Invision) or if you need to write code to realise a pie-menu and linear menu. **You have the freedom to decide but don’t wait too long to decide on which approach you will take!**

Question 3 - “I’m so Over, Overleaf” or “The power of Menu Navigation” (continued)

Assume you are given a Latex document with eight sections e.g. `\section{Introduction}` `\section{Related Work}` etc. You are asked to design a pie and linear menu which will jump the user to the relevant section of the document.

To answer this question, you can decide to use a **prototyping tool** or a **programming language** of your choice to create a suitable basic pie menu and linear menu.

What might your solution look like?

- You might decide to develop a web-plugin, for a suitable web-browser, which allows for a pie-menu or linear menu to appear and you collect the timing data required and your plugin actually is functional and navigates the user around the overleaf document OR
- You might decide to build a stand-alone application which draws in an OverLeaf browser window on top of which you can pop up a pie or linear menu
- You might decide to use a prototyping tool, along with screen shots of a web-browser with suitable sections of a OverLeaf document shown. As the user clicks in your prototype, you collect the timing data required, and show them what the UI would look like based on their clicks.

We don’t mind which approach you take. What is important is that your solution allows you to effectively compare the “time it takes to select a menu item” and the “error rates in menu selection” based on the “experiment to empirically compare the two menu styles” you provided in question 2. **Whatever approach you take, it needs to allow you to empirically compare these two menus as stated in your experimental design.**

You will need to:

- Have/Implement a basic pie menu and linear menu within the prototype/application.
- Instrument your application to collect data for measuring your dependent variables.
- Implement test conditions as described in your Question 2 design.
- Run the experiment with at least 6 participants (3 per condition) from your classmates or elsewhere.
- Record a video of your linear and pie menu in operation
- **Analyse the participant data and present your results in a short (<1 page) report.**

You are free to use any prototyping systems or libraries you find for assisting in implementing the pie menu, or you may also implement this from scratch, but make this clear in your report!

For additional credit, you may want to consider the following extensions:

- automatically parse the latex document to build the menu for any document offered (this is quite challenging so be careful how much time you spend exploring such an extension)
- conduct a study that uses a within-subjects comparison, and use the appropriate statistical methods to test your hypothesis. What additional threats does this pose to internal validity, and how can you minimise these threats?
- implement a multi-level pie menu i.e. when you select, for example, `\section{Introduction}` any of the `\subsections{}` in the document populate the menu for further selection
- implement a marking menu as shown in the video.
- perform an empirical comparison between your marking menu and your pie menu.