Creating statistics e-Assessments using DEWIS with embedded R code

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E-A×M+S
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UWE BRISTOL
University of the West of England

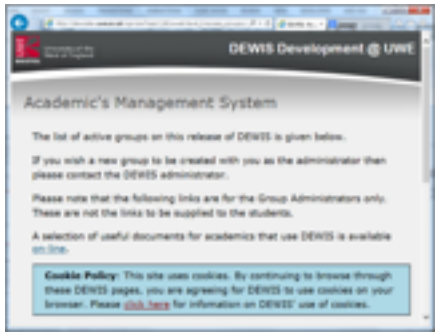
In the beginning (2013-4)….

- Level 2 research skills module delivered to 850+ Business School Students
- Short course on statistics covering a challenging amount of material together with learning to use SPSS
- Designed to provide a solid foundation for students to undertake Level 3 project work
- Electronic assessment of analysis of bespoke data

e-Assessment mechanics

Student

e-Assessment system

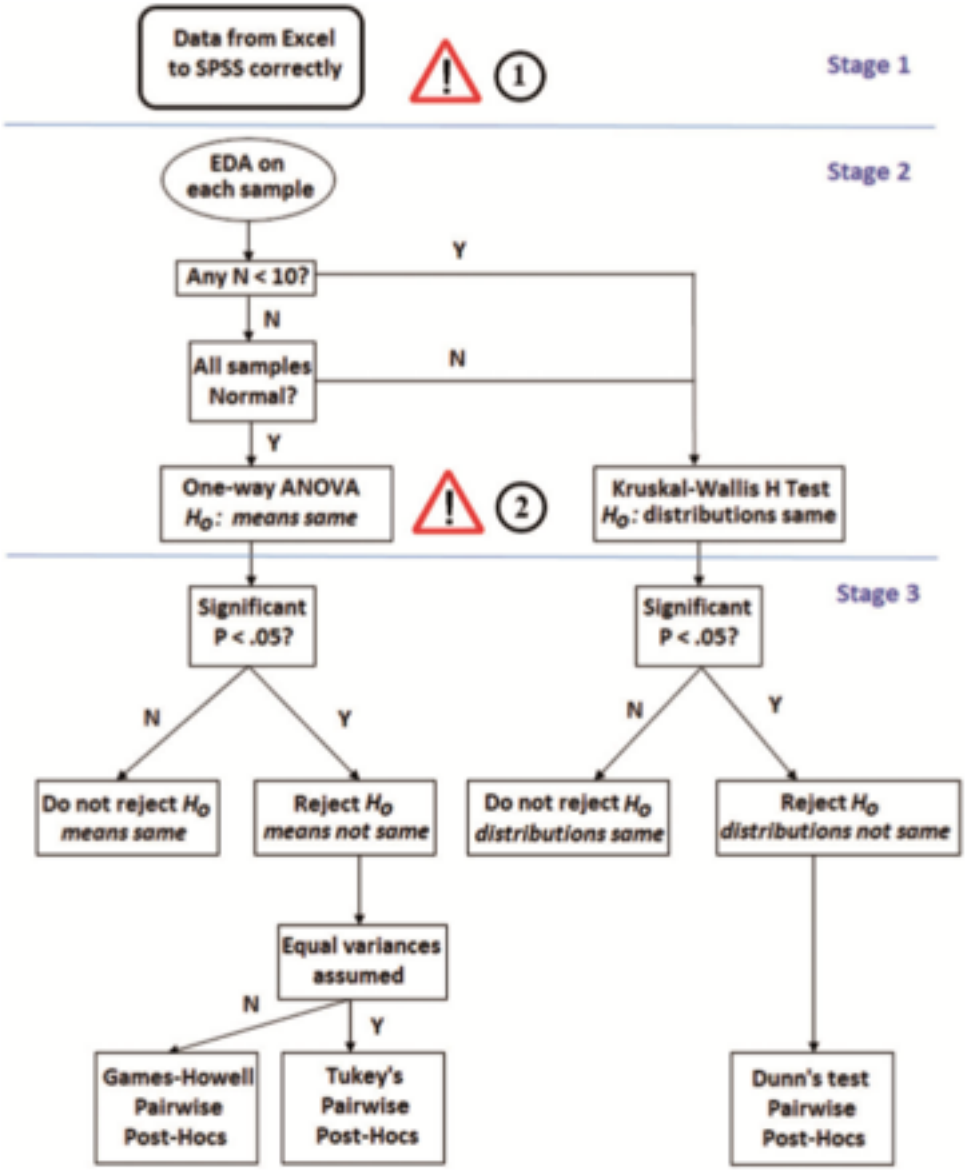


DEWIS

e-Assessment 1: One-way ANOVA

- A parametric test to evaluate the equality of 3 or more population means using sample data
- If the test assumptions not met then a non-parametric test to evaluate the equality of the population distributions is carried out
- If there is evidence of a difference then Post-Hoc tests are employed to detect where the differences lie

Staged e-Assessment



e-Assessment 2: Regression

- Manipulating the data from the supplied Excel format to that required in SPSS
- EDA of the data set
- Initial regression model that containing all of the explanatory variables
- Finding a parsimonious regression model using the *Backwards* elimination method
- Obtaining predictions from the final model

Further details

- Weir, I., Gwynllyw, R. and Henderson, K. (2015) Using technology to inspire and enhance the learning of statistics in a large cohort of diverse ability. *Edulearn15 Proceedings.*

- Gwynllyw, R., Weir, I. and Henderson, K. (2016) Using DEWIS and R for multi-staged statistics e-assessments. *Teaching Mathematics and Its Applications*.

A suite of statistics e-Assessments with supporting materials

http://www.statstutor.ac.uk

2014 Sigma Resource Development funding for a suite of e-Assessment modules that relate to the statistical activities involved in choosing and carrying out an appropriate one-sample test for location

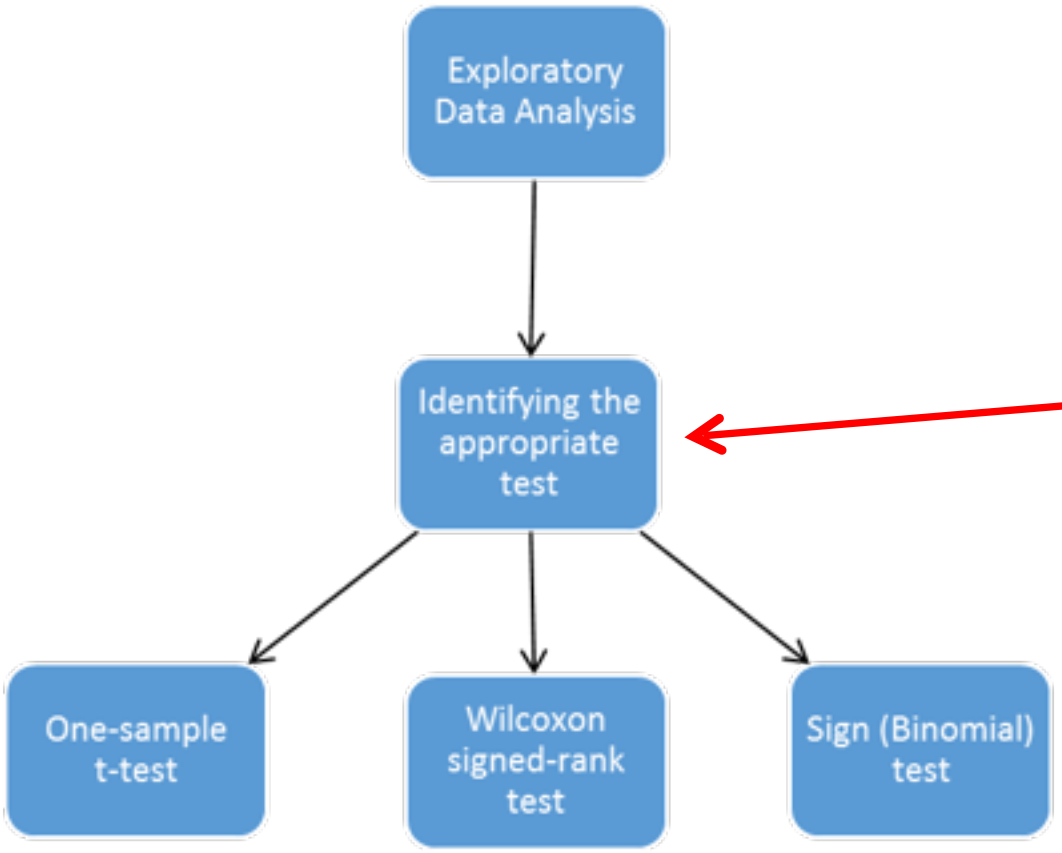
Motivation

- This resource will benefit students from a wide range of disciplines who need to master a methodical and defendable approach to carrying in depth and appropriate statistical analysis; a variety of application contexts are offered.

- Our choice of focusing on one-sample location tests is a natural one as it contains activities that are required in the extension to more complex data scenarios.

- Also to showcase in public domain to encourage academics to produce further such e-Assessments using the DEWIS platform with embedded R code.

One-sample location test analysis flow



The modules can be taken sequentially which will mimic the flow of a full statistical analysis or if desired may be accessed independently

Further details

http://www.statstutor.ac.uk

- Weir, I., Gwynllyw, R. and Henderson, K. (2016) Open access statistics resources. *EDULEARN16 Proceedings.*

Creating a UWE statistics e-Assessment community

- UWE Learning and Teaching Project
- Create a community of UWE lecturers who will be able to author and share relevant, authentic and engaging statistics e-Assessments that enrich the learning experience of students
- IW, RG + 2 other staff that teach stats as a secondary skill

Creating a UWE statistics e-Assessment community

- DEWIS-R interface to allow creation of e-Assessments solely by writing R script file
- Introduction of e-Assessments to staff modules
- Training of staff to author e-Assessments
- Extend to other UWE staff + beyond
- Community webpage
- Public question bank of statistics e-Assessments

R script file

```
#<R>

##############################################################################
################## R functions ###############################################
##############################################################################

#====================== Bespoke R functions ==========================



##############################################################################
################## Run-time function #########################################
##############################################################################

dewis_run=function(){

#====================== Data generation and calculations =============

#====================== Assign and communicate correct answers =======

}



##############################################################################
################## Install-time function #####################################
##############################################################################

# Construct the Dewis question - this occurs at install-time

dewis_install = function(){

#====================== Call run-time function and define inputs =====

#====================== Communicate Question text ====================

}
```

```
##########################################################################
################## Install-time function ##################################
##########################################################################
# Construct the Dewis question - this occurs at install-time.

dewis_install = function(){
 cat("
 <DEWIS>

#====================== Call run-time function and define inputs =====

 <R CALL='dewis_run()'/>

 <NUM_IDS=2>

 <INPUT TYPE=NUMERICAL ID=1 NAME='the mean IQ'/>

 <INPUT TYPE=DROPDOWN ID=2 NAME='the mean comparison'>
  <OPTION>higher than</OPTION>
  <OPTION>lower than</OPTION>
  <OPTION>the same as</OPTION>
 </INPUT>


#====================== Communicate Question text ====================

 <QUESTION>
 10 people had their IQs tested. Download the <DATALINK>data</DATALINK> and calculate the mean IQ (to 1 d.p.).
 <p>
 Complete the following sentence:
 <p>
 <IN_FEEDBACK>
 The mean IQ of the sample is <INPUT ID=1/> which is <INPUT ID=2/> the population average of 100.
 </IN_FEEDBACK>
 </QUESTION>

 </DEWIS>
 ")
}
```

Install-time R to DEWIS communication

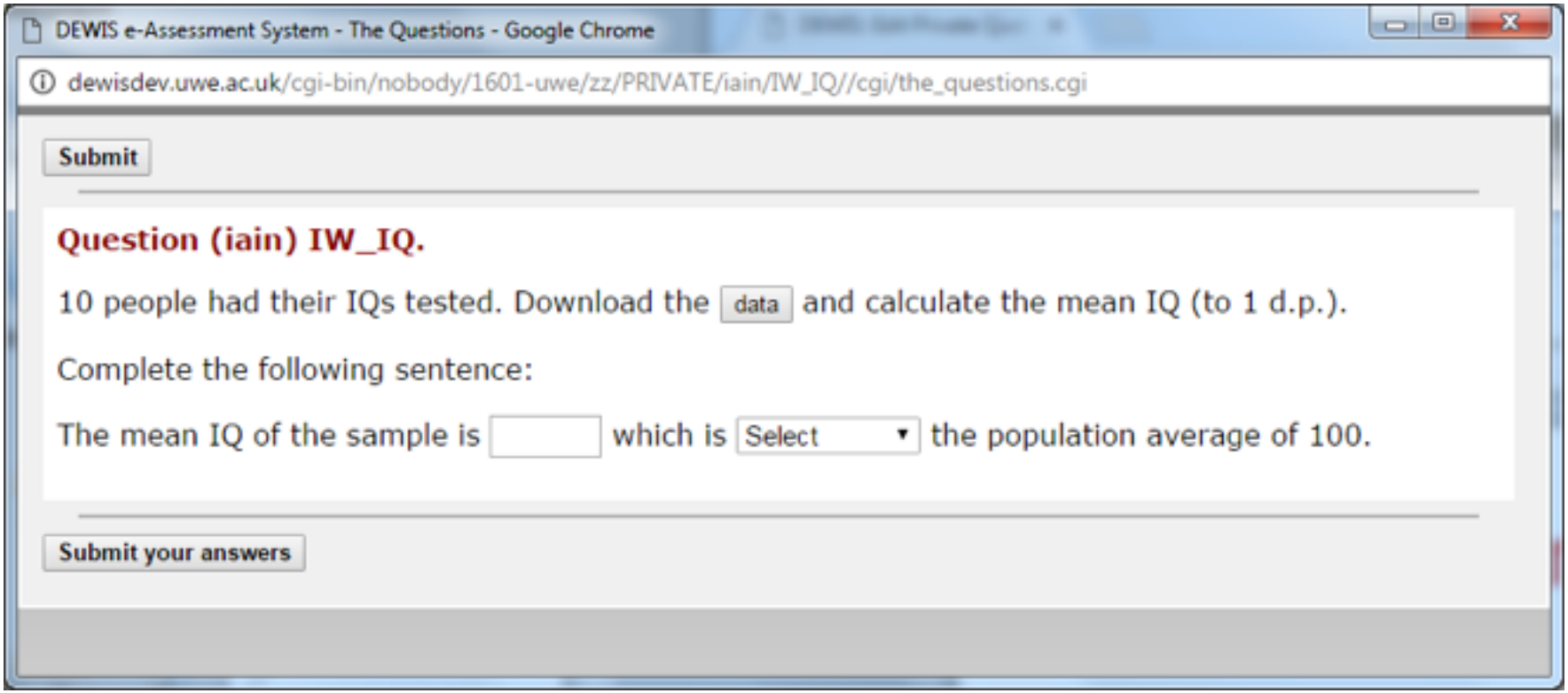
```
> dewis_install()

 <DEWIS>

#====================== Call run-time function and define inputs =====

 <R CALL='dewis_run()'/>

 <NUM_IDS=2>

 <INPUT TYPE=NUMERICAL ID=1 NAME='the mean IQ'/>

 <INPUT TYPE=DROPDOWN ID=2 NAME='the mean comparison'>
  <OPTION>higher than</OPTION>
  <OPTION>lower than</OPTION>
  <OPTION>the same as</OPTION>
 </INPUT>


#====================== Communicate Question text ====================

 <QUESTION>
 10 people had their IQs tested. Download the <DATALINK>data</DATALINK> and calculate the mean IQ (to 1 d.p.).
 <p>
 Complete the following sentence:
 <p>
 <IN_FEEDBACK>
 The mean IQ of the sample is <INPUT ID=1/> which is <INPUT ID=2/> the population average of 100.
 </IN_FEEDBACK>
 </QUESTION>

 </DEWIS>
 >
```

```
#<R>

##########################################################################
################## Run-time function ######################################
##########################################################################

dewis_run=function(){

#====================== Data generation and calculations ============

# get mean from 10 integer observations from N(100,15^2)
 IQ=round(rnorm(10,100,15))
 meanIQ=round(mean(IQ),1)
 IQdata=data.frame(IQ)

# comparison to mean of 100 1="higher"/2="lower"/3="the same"
 if (meanIQ>100){
  meanComp=1
 }else if(meanIQ<100){
  meanComp=2
 }else{
  meanComp=3
 }


#====================== Assign and communicate correct answers =======

 cat("
 <DEWIS_PARAMS>

# Assign correct answers for each input
 <CORRECT ID=1>",meanIQ,"</CORRECT>
 <CORRECT ID=2>",meanComp,"</CORRECT>

# Printing out of generated data
 <DEWIS_DATA COLS=1>
 ")
 print(IQdata)
 cat("
 </DEWIS_DATA>

 </DEWIS_PARAMS>
 ")

}
```

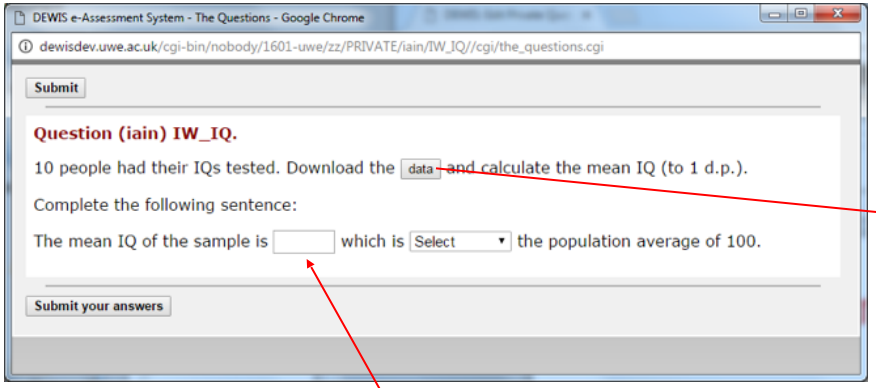
Run-time R to DEWIS communication

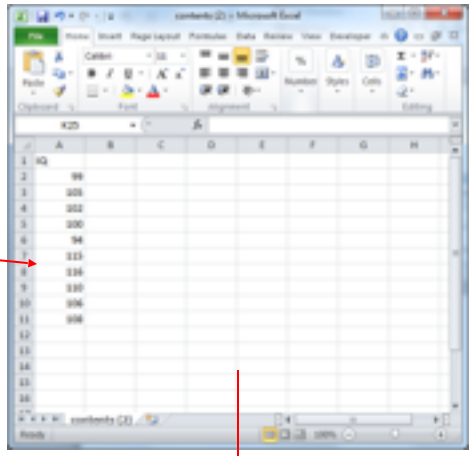
```
> dewis_run()

 <DEWIS_PARAMS>

# Assign correct answers for each input
 <CORRECT ID=1> 98.3 </CORRECT>
 <CORRECT ID=2> 2 </CORRECT>

# Printing out of generated data
 <DEWIS_DATA COLS=1>
     IQ
1    97
2   104
3    99
4   105
5   121
6   105
7    94
8    61
9   104
10   93

 </DEWIS_DATA>

 </DEWIS_PARAMS>
 >
```

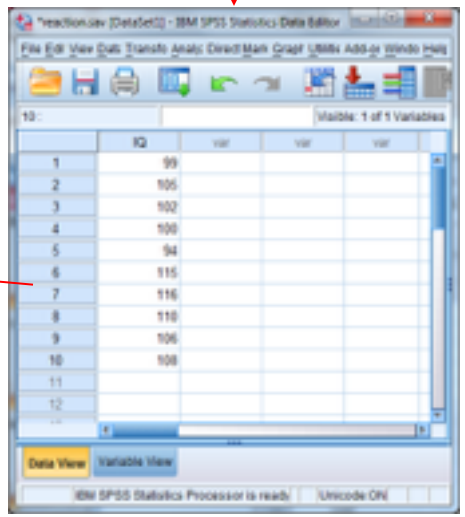
Live Demonstration 1



Student activity



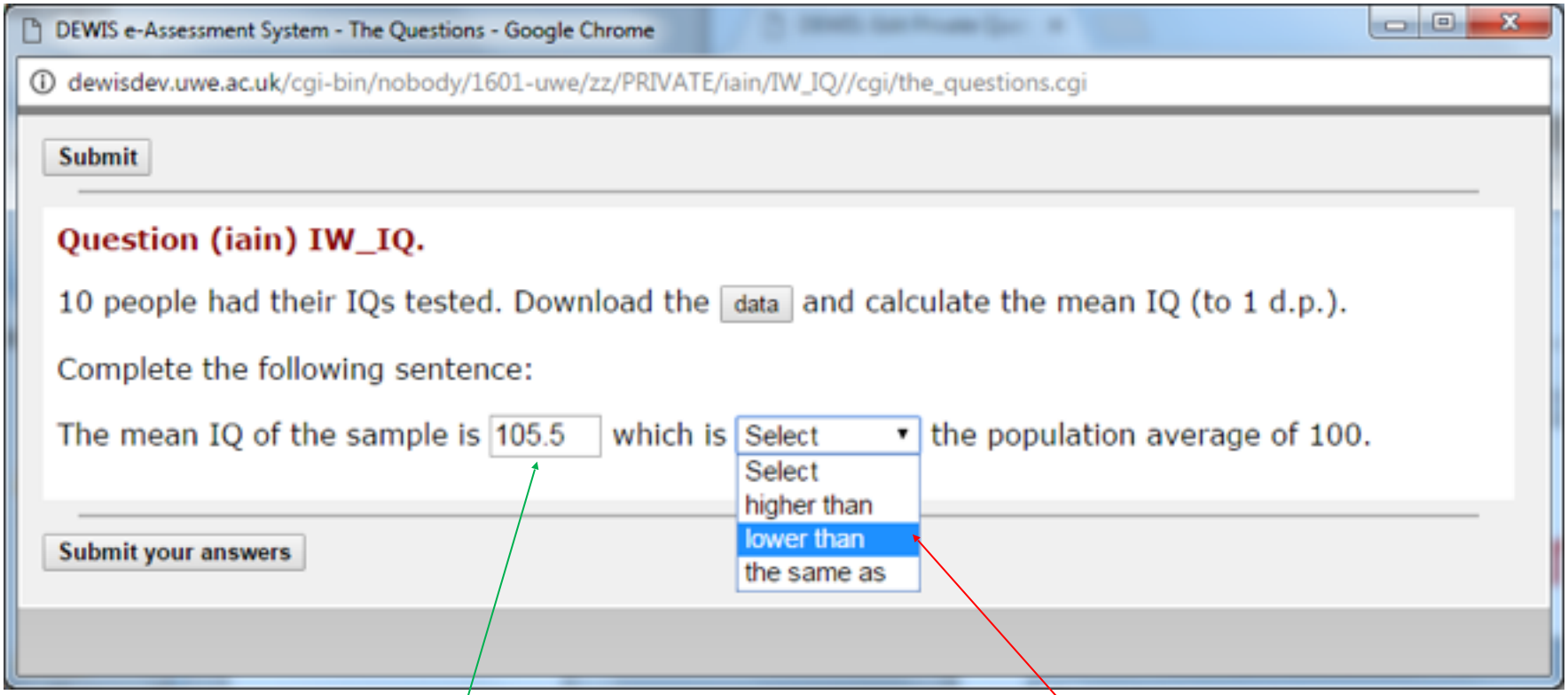




Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
IQ	10	94	116	105.50	7.028
Valid N (listwise)	10				

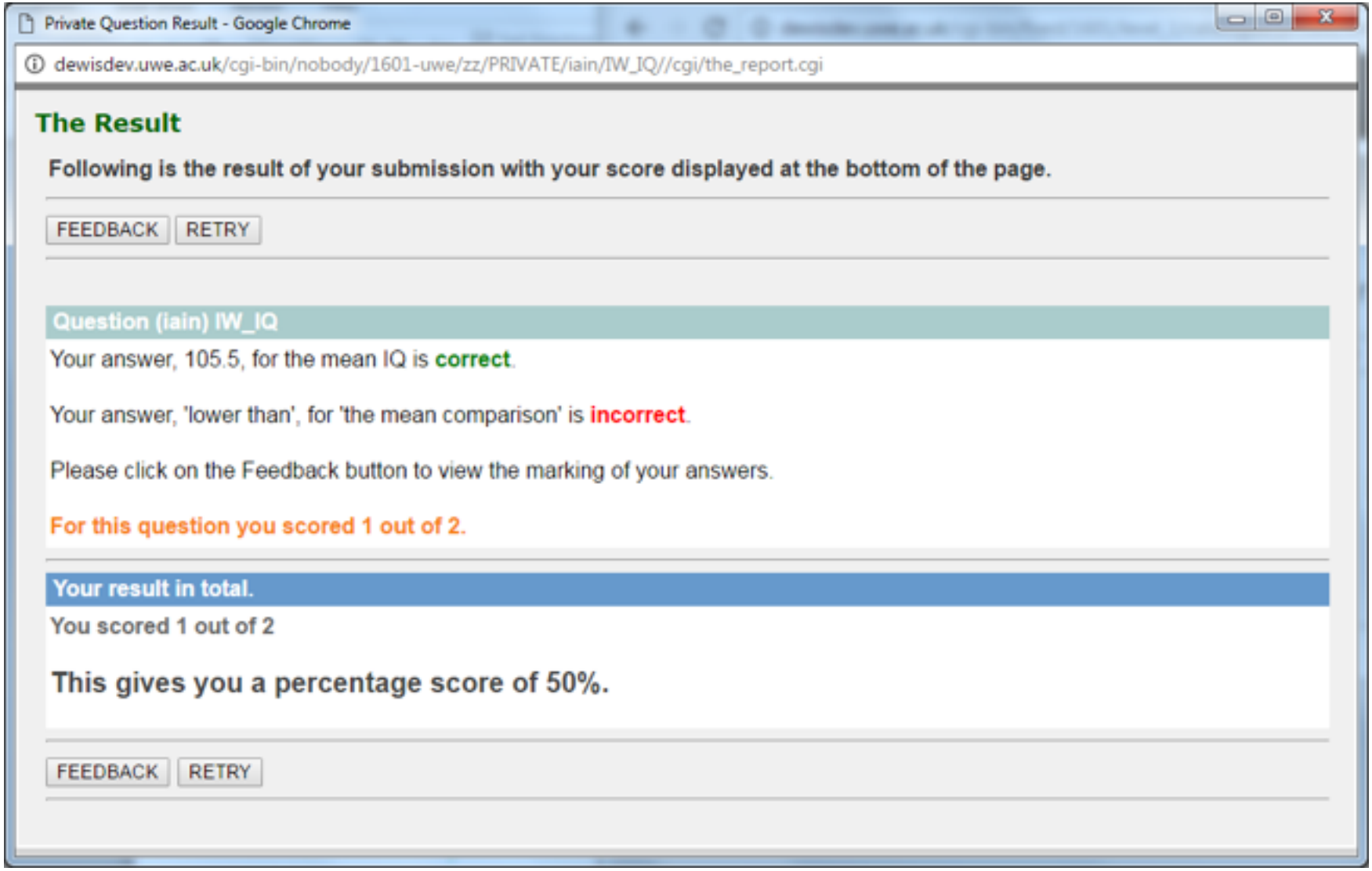
Entering answers



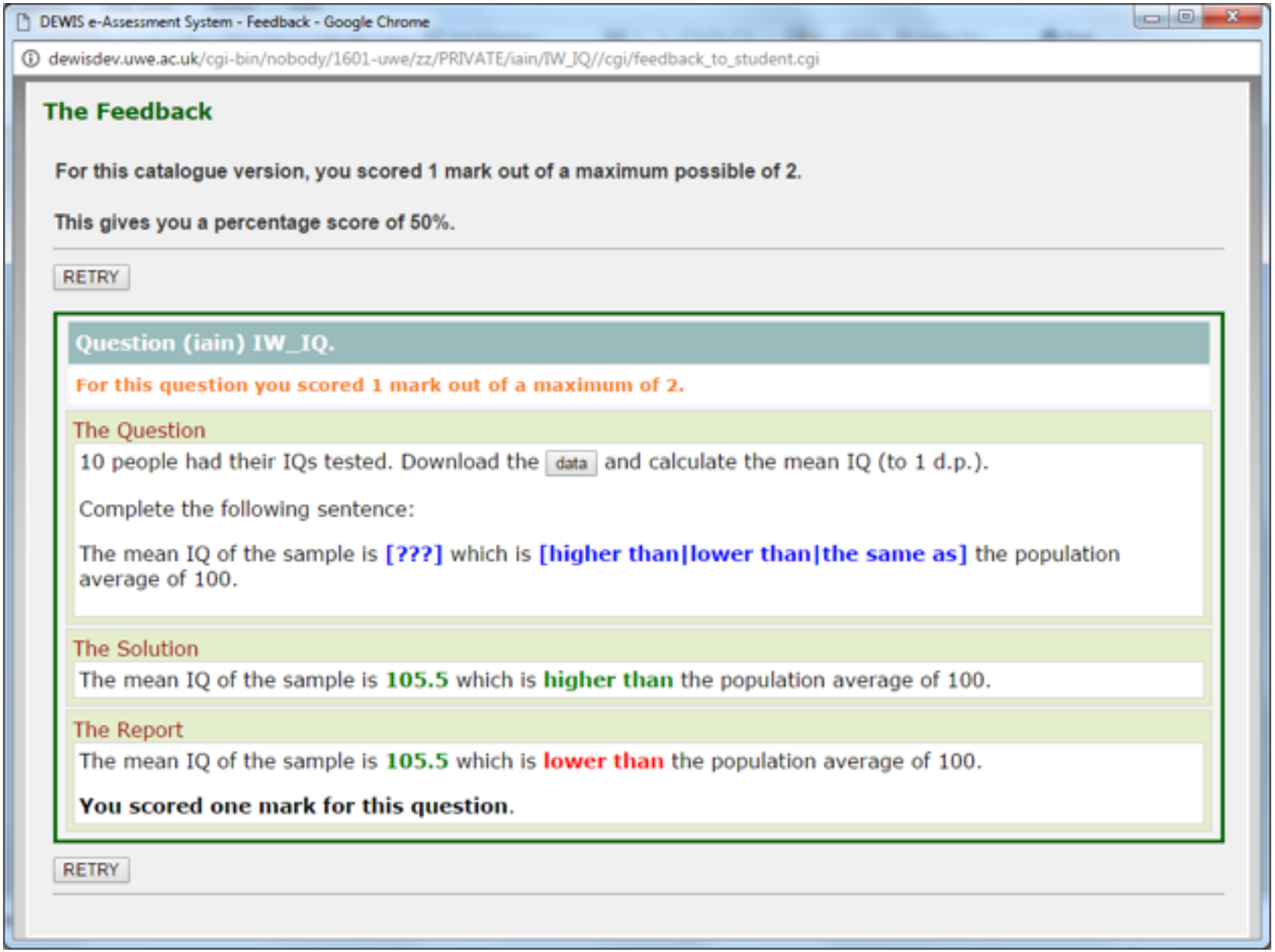
Correct

Incorrect

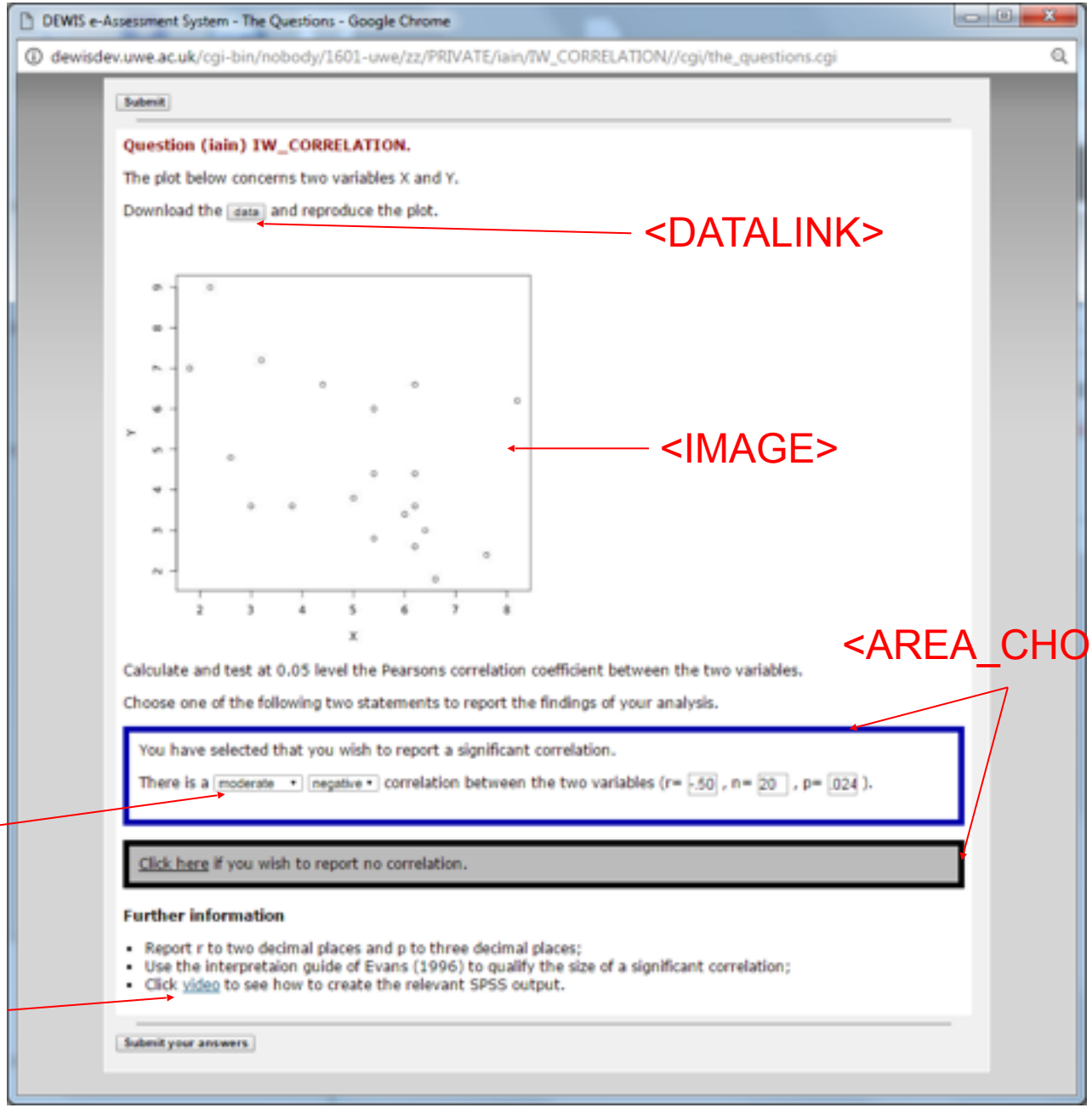
The Result


Private Question Result - Google Chrome
dewisdev.uwe.ac.uk/cgi-bin/nobody/1601-uwe/zz/PRIVATE/iain/IW_IQ//cgi/the_report.cgi
The Result
Following is the result of your submission with your score displayed at the bottom of the page.
FEEDBACK
RETRY
Question (iain) IW_IQ
Your answer, 105.5, for the mean IQ is correct.
Your answer, 'lower than', for 'the mean comparison' is incorrect.
Please click on the Feedback button to view the marking of your answers.
For this question you scored 1 out of 2.
Your result in total.
You scored 1 out of 2
This gives you a percentage score of 50%.
FEEDBACK
RETRY

Feedback: note can be made more detailed!



Live Demonstration 2



Alternative write up statement

DEWIS e-Assessment System - The Questions - Google Chrome

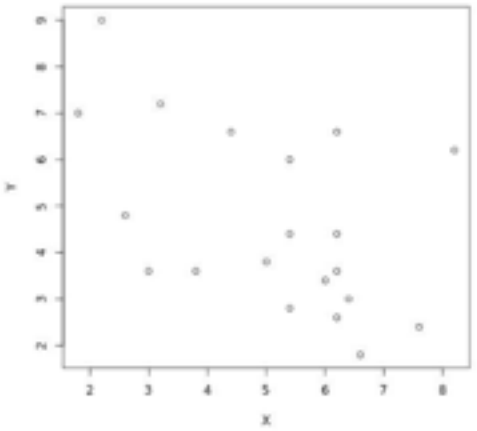
dewisdev.uwe.ac.uk/cgi-bin/nobody/1601-uwe/zz/PRIVATE/iain/IW_CORRELATION//cgi/the_questions.cgi

Submit

Question (iain) IW_CORRELATION.

The plot below concerns two variables X and Y.

Download the data and reproduce the plot.



Calculate and test at 0.05 level the Pearsons correlation coefficient between the two variables.

Choose one of the following two statements to report the findings of your analysis.

Click here if you wish to report a significant correlation.

You have selected that you wish to report no correlation.

There is no correlation between the two variables (r= , n= , p=).

Further information

- Report r to two decimal places and p to three decimal places;
- Use the interpretaion guide of Evans (1996) to qualify the size of a significant correlation;
- Click video to see how to create the relevant SPSS output.

Submit your answers