

Year 12 Mathematics IAS 2.8

Design a Questionnaire

Robert Lakeland & Carl Nugent

Contents

•	Achievement Standard	2
•	Conducting a Survey with a Questionnaire	3
•	Survey Ethics	6
•	Sampling Methodology	7
•	Sampling Variation	12
•	Types of Survey	18
•	Response Variables	21
•	Constructing Your Questionnaire	28
•	Pilot Survey	29
•	Desk Reviews	31
•	Practice Internal Assessment	32
•	Answers	41
•	Order Form	47

NCEA 2 Internal Achievement Standard 2.8 – Design a Questionnaire

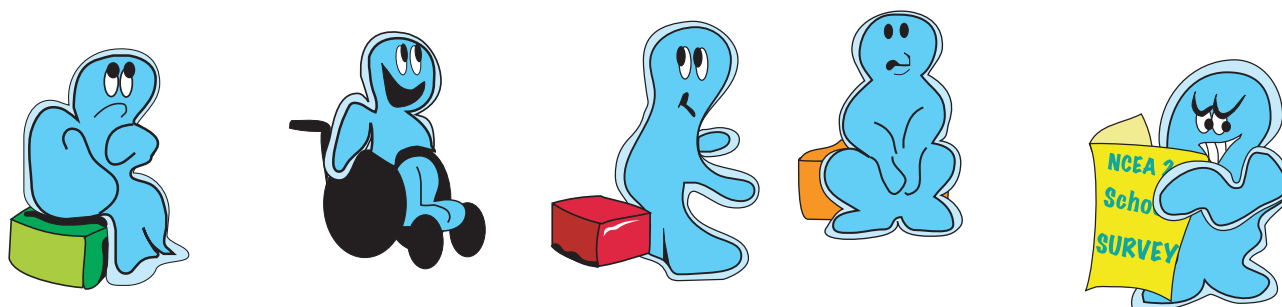
This achievement standard involves designing a questionnaire.

Achievement	Achievement with Merit	Achievement with Excellence
<ul style="list-style-type: none"> Design a questionnaire. 	<ul style="list-style-type: none"> Design a questionnaire, with justification. 	<ul style="list-style-type: none"> Design a questionnaire, with statistical insight.

- ◆ This achievement standard is derived from Level 7 of The New Zealand Curriculum, Learning Media and is related to the achievement objective
 - ❖ carry out investigations of phenomena, using the statistical enquiry cycle
 - ❖ conducting surveys
 - ❖ evaluating the choice of measures for variables and data collection methods used
 - ❖ using relevant contextual knowledge in the Statistics strand of the Mathematics and Statistics Learning Area.
- ◆ Design a questionnaire involves showing evidence of using each component of the questionnaire design process.

Design a questionnaire, with justification involves linking components of the questionnaire design process to the context and explaining relevant decisions made in the design process.

Design a questionnaire, with statistical insight involves integrating statistical and contextual knowledge relevant to the purpose of the survey throughout the design process.
- ◆ The components of the questionnaire design process involve
 - ❖ clarifying the specific information needs of the survey and the groups who will use the data
 - ❖ posing survey questions, considering sources of variation by
 - determining relevant variables
 - determining appropriate measures for each variable
 - using an appropriate range of question types
 - ❖ checking the survey questions by
 - carrying out a desk review
 - conducting a pilot survey(s) including collecting and recording data
 - ❖ refining the questionnaire based on the results of the pilot survey
 - ❖ documenting the design process including the draft and final questionnaire.



Conducting a Survey with a Questionnaire

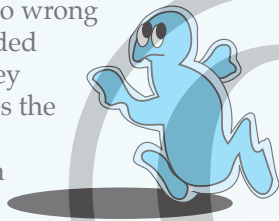


Starting the Design

Questionnaires are a set of questions to a person (called a respondent) who with his/her answers provides information (data) to the person(s) who set the questionnaire (called the researcher).

At first glance it seems a simple task to write up a set of questions to collect information, but there are many things that can go wrong and which should be avoided in order to develop a survey questionnaire that provides the required data.

In this booklet we focus on these statistical holes or pitfalls.



We expect any sampling process to give information about the population. We also expect that a representative sample will give us a good snapshot or glance at the population and will reflect the characteristics of the population. With a questionnaire we have another source of variation in that the questions may not give us accurate information. Anything that means the information gathered is not accurately describing the respondents is a problem and this can lead to a non-sampling variation (see page 12).

Many people have an interest in the survey and each group that has an interest in the questionnaire has different requirements.

- The group that initiated the survey wants answers to their question(s).
- The person who administers the survey wants it to be as simple as possible.
- Respondents want a questionnaire that they can answer without much effort or thought.
- The researcher wants responses that are easy to collate, analyse and present in a conclusion.

Who is the Survey for?

Was it requested by a business wanting to introduce a new product or information about a competitor's product? Is it a survey of behaviour or of attitudes?

The group or person that requested the survey must have an idea as to what they would like to know. It could be that they are interested in the homework done by different year levels at high school. The definition of what the survey should answer becomes the **survey objective**.





Samples

Any subset of a population is a sample but a poor sample (e.g. a cluster sample) may vary considerably from the characteristics of the population. A representative sample should have similar characteristics to that of the population.



Survey Definitions

- ❖ A Survey is an investigation about the characteristics of a population by collecting data from a sample of that population.
- ❖ A Researcher is the person or persons that designs the questionnaire and analyses the results.
- ❖ The Interviewer is the person who collects the answers from the respondents.
- ❖ The Respondents are individuals or businesses, for example, from whom data and associated information are collected for use in compiling statistics.
- ❖ The Survey Objective is what the person or persons who initiated the survey want to know.
- ❖ The Research Objectives are precisely defined objectives that the researcher believes will provide answers to the survey objective.



Example

Identify the sample frame and explain the best way to select a random sample of 30 from it.

The school board wants to know the after school commitments of the 350 students in Year 10.



The best sample frame is a list of every student in Year 10 at school on a particular day and to take a simple random sample of 30 students from the list.

If Year 10 were having an assembly this could also be our sample frame and you could systematically choose every 10th student as they left until you reached 30.

Males and females may have different commitments after school. To avoid over sampling one particular gender the sample frame could be divided into male and female students and each gender sampled in the same proportion. This would then give you a random - stratified or systematic - stratified sample.

If this school divided the students for English purely randomly then the English classes could be our sample frame and a cluster sample of one class could be our sample.



Achievement – Identify the sample frame and explain the best way to select a random sample of 30 from the sample frame.

7. The local council wants to borrow five million dollars to build a new museum. You have been asked to seek the opinion of local residents who are ratepayers.

8. The school board of trustees is considering eliminating uniform for Year 13 and wants the opinion of parents of students in the present Year 13.

9. The Principal wants to establish a quorum of 50 students to be composed of ten students from Years 9 to 11 and 15 from each of the Years 12 and 13.



Example

Explain why the following sampling method is unlikely to give a random sample of the population.

The business owners association would like to know the opinion of shoppers in Main street to a Christmas parade.

The interviewer uses their calculator to randomly select a side of the street, then a shopping block and finally one corner for them to use. The interviewer then stands on this random corner in Main street and approaches every ninth person.



The type of shopper will depend upon the time of day (if during working hours very few workers will be there).

The blocks will have different types of shoppers on them. For example, if near the banks you will get a lot of people not shopping but just visiting a bank. You should attempt to use a stratified sample where different corners are used for a set period of time (so the number interviewed reflects how busy each is) and at random times. The definition of who is a shopper makes this very hard as any discretion makes this a person in the street sample. Every ninth person should be approached and then filtered with the question "Hi, are you in Main street to shop?".

10. A mall manager wants to survey 100 shoppers about the present parking facilities.



Non-sampling Errors cont...

Questionnaire layout

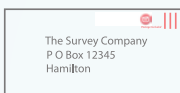
If the questionnaire is long or perceived as difficult or time consuming to complete then this will affect whether it will be completed (Non-reponse rate).

Keep the questions limited to what you need for the research objective. Questions that you believe may be interesting should not be included.

- all questions should be numbered.
- the questionnaire should appear uncluttered with plenty of white space.
- the answers should have a consistency of form and layout.
- make a clear break between questions.
- boxes for ticks etc. should be close to the answer they represent so there is no doubt which box belongs to which answer.

Aim to make the questionnaire look professional. The object is to make your questionnaire appear simple and straightforward. Your name and address must be on the questionnaire along with a clear statement on confidentiality.

Always include a self-addressed postage-paid envelope for self-administered questionnaires.



Data collection

If a question is asked face to face or over a phone there may be different answers. In a face to face interview the respondent may be more concerned with being a good person and giving expected results than in an impersonal phone interview. If there are other people present then this may affect the honesty of answers.

It is important for the interviewer to build rapport with the respondent. It has been demonstrated that an interviewer who is the same ethnic origin as the respondent gets more reliable results.

Self-administered surveys (questionnaires) are generally acceptable as being more anonymous but may be taken less seriously than when the interviewer is present. When the interviewer is present the respondent may be more cooperative in order to please the interviewer.

Coding errors

If the results of the survey are to be analysed the answers will need to be coded. This means each answer must be placed in a category so it can be entered into a computer (see page 30).

Sometimes the questions have limited answers (closed-ended questions) and are therefore self coded. Other questions allow for any response (open questions) and this response will need to be coded



Questions that include lists should not imply some sort of rank order in the list.

Lists with numerical data such as years should go from earliest to latest.

11. What year did you first attend this school?
- Before 2009
 - 2009
 - 2010
 - 2011
 - 2012
-

Lists with words should always be in alphabetical order unless there is a good reason for changing this.

12. Which is your favourite sport to play?
- Badminton
 - Basketball
 - Netball
 - Soccer
 - Touch rugby
 - Other (specify)
-

Make sure list instructions are clear.

13. How did you travel to school today?
Select the best answer.
- Bike
 - Bus
 - Car
 - Walk
-

It is sometimes clearer to have the space for an answer after the item.

13. How did you travel to school today?
Select the best answer.
- Bike
 - Bus
 - Car
 - Walk
-

If a list goes across the page make sure the place for the answer is clearly placed next to the item.

13. How did you travel to school today?
Select the best answer.
- Bike Bus Car Walk
-

13. How did you travel to school today?
Select the best answer.
- Bike Bus Car Walk
-

so it can be summarised. If you ask an open-ended question about the respondent's favourite sport and get 25 different answers it is difficult to analyse.



Merit – Explain what is wrong with these questions and rewrite them to remove the cause.

21. Are you confident that you will never smoke no cigarettes again?

22. Do you have butter in your sandwiches?

Handwriting practice lines for questions 21 and 22.

23. In the last year were you the victim of a crime?

24. When you drink alcohol how many drinks do you usually consume?

Handwriting practice lines for questions 23 and 24.

25. Have you donated money to charity in the last three months?

26. Do you support throwing students who smoke marijuana out of school?

Handwriting practice lines for questions 25 and 26.

27. When you leave school will you continue to study?

28. When did you last go to Australia?

Handwriting practice lines for questions 27 and 28.

Response Variables



Open-ended Responses

An open-ended question asks the respondent to give the answer in his or her own words, whereas a closed-ended question asks the respondent to pick an answer from a given number of options.

By not suggesting answers to the respondent the researcher is allowing answers to come up that they may not have considered.

Among the advantages of open-ended questions are:

- they let the respondent have a degree of control. They can express their answer spontaneously using their own words
- they are less likely to control the response and hence bias the survey
- they are good for likes and dislikes or where possible responses are not known
- they give the researcher quotes they can use in a final report.

The disadvantages include:

- the respondents have to think more about their answers and this makes completing the questionnaire more arduous and slower
- the wide range of answers means these have to be coded into a computer for analysis
- poor handwriting can be difficult to understand
- the coding can lead to errors as the interviewer or researcher forces the answer to an existing but inappropriate category.

In some surveys the questions appear open-ended but the interviewer immediately codes the response.

Open-ended questions are sometimes put in pilot surveys and once the range of likely answers is found, they are changed to closed-ended questions for the final questionnaire.

Measured data

If you need to know numeric data it is best entered directly.

For example "How long does it take for you to get to school each morning?" or "What year were you born in?"

Do not use categories for numeric data as that requires the respondent to think more and unless the categories have been selected carefully can result on most of the data in one or two categories.



The response to a question is a variable. It could be

- a phrase or sentence for an open-ended question.
- continuous as in a numeric variable
- dichotomous, one of two possible answers
- one of five multiple choice answers
- a scale from one to five or one to ten.



Numeric data allows you to find the mean and calculate relationships.

In what month and year were you born?

Month _____ Year _____



What year were you born?
Select the best answer


Before 1959

1960 to 1979

1980 to 1989

1990 to 1999

After 2000



Constructing Your Questionnaire



Screening Questions

The questionnaire should start and explain about the survey and how all information will be kept confidential. The questions should start with a **screening question** to determine whether the respondent is a member of the research population. If it is a stratified sample it may be that the quota for this type of respondent is already satisfied.

The following could be screening questions. They will depend upon the definition of your research population.

1. *What year were you born in?* _____
2. *What sex are you?*
 Male Female
3. *What is the year level of your form class?*
 Year 9
 Year 10
 Year 11
 Year 12
 Year 13

If the respondent is not in the research population then the survey should be stopped at the point this is established.

Main Questionnaire

Keep a copy of your research objectives in front of you. If a question is not going to help you answer the research objectives do not ask it as you want to keep the questionnaire as short as possible.

Start with general factual questions relating to behaviour. These are questions where the respondent is likely to know the answer.

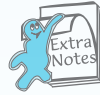
Follow questions about behaviour with questions about opinions and values. These are harder for the respondent and should be asked when the respondent has answered sufficient questions that they will feel committed to complete the questionnaire.

It is acceptable to ask more than one question for the same objective. Asking more than one question about the same objective can be useful in cross-checking responses.

If the questionnaire is going to be a face to face interview then you can include instructions for the interviewer to ask follow up questions or when to skip irrelevant questions.

The final stage should be to ask for any demographic data that you need the answers for.

The last thing in the questionnaire is to thank the respondent for taking part. Do not leave this to the interviewer to remember.





Question sequence

- **Screening question to check if the respondent is in the sample frame.**
- **Questions should flow logically from the previous question. If you have five questions on sport they should follow each other.**
- **General questions to define what categories the respondent fits in.**
 - **Demographic questions, sex, age etc.**
 - **Factual questions (e.g. What school do you attend?).**
 - **Behavioural questions (e.g. How much TV did you watch last night?).**
- **Questions about attitudes and opinions**
 - **Opinions and attitudes are usually recorded on scale questions.**
 - **Flow from least sensitive to more sensitive.**



The researcher must ensure that the answer to a question is not influenced by previous questions.

Authors' note: We suggest a Year 12 student questionnaire is not an appropriate place to ask sensitive questions.

Desk Reviews



Desk Research

After identifying your research objectives and prior to writing any questions you should complete the first of two desk reviews.

The first review is called a desk research. You need to find out if a similar survey has been conducted already. You would like to know what questions they asked and what conclusion they came to. It could be the survey was done on a different population but it will still be helpful to you if you look at their approach, questions and results.

A previous survey will help you design and evaluate your survey. It may be possible to use a similar question and to compare your results to the original survey. Libraries and online searches are good starting places to find similar surveys.

Desk Check

A desk check or desk evaluation is completed after the pilot survey and before any of the respondents from the sample frame are interviewed. The aim of the desk check is to try and identify any problems.

Look at the results of your pilot survey. Fix any errors it has shown and amend multiple choice lists where the pilot survey has shown an item is missing. Now put together your final questionnaire and complete the desk check.

The questionnaire must be simple, consistent and accurate. As part of the desk evaluation

- check each question against the research objectives
 - Record the number of each question next to its objective.
 - Remove any questions that do not relate to one of your research objectives.
- check the whole questionnaire for consistency
 - Have you used the same straightforward language throughout the questionnaire?
 - Are multiple choice responses in alphabetical order?
 - Have you included non responses where appropriate?
 - Have you varied the sort of questions? Open ended questions, multiple choice questions and scale questions.
- checks against what is known about the respondents
 - Is the language you have used appropriate to your respondents?



The Achievement Standard includes:

checking the survey questions by

- carrying out a desk review.

It does not require you to complete both a desk research and a desk check but the first can make your questionnaire easier and the second can and does remove errors.

You are required to document the design process and this is best done by keeping a diary detailing what you did and why at each step towards producing the questionnaire.



Lined writing area for notes.

Answers given here are guides only as there are many alternative correct answers.

Page 5

1. What proportion of students by year level are smoking and to what extent? See Page 6 re honesty of answers.
2. What is the proportion of students who intend to play competitive sport this summer? What hours is each student training for? What are the barriers to students playing competitive sport this summer?
3. What do teenagers do for recreation? What do teenagers see as barriers to using council facilities for recreation?
4. Proportion of employees looking to change to another job. What is one thing about the job the present employees would like to tell prospective employees? How much sick leave does each employee take?
5. Identify what about the mall present customers like and dislike compared to what non-customers like or dislike about the mall. How do customers get to the mall?
6. Opinions of people that have tried and disliked the new cereal compared to the opinion of the people who like the new cereal. What factors affect a customer's buying decision re cereal?

Page 10

7. Get a copy of the resident electoral roll from the council, this is your sample frame. Use your calculator to select a random starting page and a random position on that page. Now generate a random number under 50 and systematically select every resident at intervals of this random number. This is the better option. A similar result is possible using a simple random procedure.
The phone book is not the population as it will include people who are electors to other councils and there may be more than one ratepayer per phone line. The phone book could be used if you asked a filtering question to determine eligibility first but this sample frame may still not be representative.
8. Get a copy of all students in Year 13 still present at the school and their home phone numbers from the school. This is your sample frame. To get home phone numbers you will need to be working on the instructions of the school. Make sure the students are numbered and any twins are counted only once. Using simple random numbers select each home phone number.
9. You will need a stratified random sample. Get a copy of the school roll. Your sample frame is all students present on the nominated day. Using either a simple random procedure or

Page 10 cont... Q9 cont...

- systematic sampling select a sample of 10 from each junior level and 15 from each of the senior levels.
10. Your sample frame is all the shoppers that use the present parking facilities on a nominated day. This will be different from the population as some people will only go on particular days and times. A systematic sample starting at a random time of every n th (random number 5 to 20) shopper arriving in the parking area on the nominated day.

Page 11

11. People tend to live near others with similar income and political views. Even though they go to three streets they could be similar and not be representative of the population. Also many people are out during the day so those houses will not be sampled whereas unemployed and retired residents are more likely to be over represented in the sample.
12. The population for the council is rate payers but the sample frame is existing users of the pool. As they are already using the pool they are likely to support an upgrade. Also the people that use the pool are likely to exclude the full time employed if the survey is done during working hours.
13. The maths class is unlikely to have students randomly placed in it (possibly a streamed class) so does not meet the criteria for a cluster sample. Also the history class next may have some students from the maths class in it. The sample frame of maths and history students is unlikely to be representative of the population. In addition there may be Year 11 and Year 13 students in either class.
14. The population the canteen is wanting opinions from are its student customers, but the cluster approached may be predominantly not customers, but students who bring their own lunch.
15. Students who have left school are no longer in the sample frame as only school students are approached. In Year 12 there will be some fifteen and seventeen year old students. There may also be international students and only the opinion of local students was requested.
16. The interviewer (council member) may have a predetermined opinion and attempt to influence the opinions of their form class. Asking a whole class means that students will be influenced in their opinions by their classmates. The council makeup may be in proportion to different form levels so it may be a form of stratified sample.