Stats1 Chapter 1: Data Collection

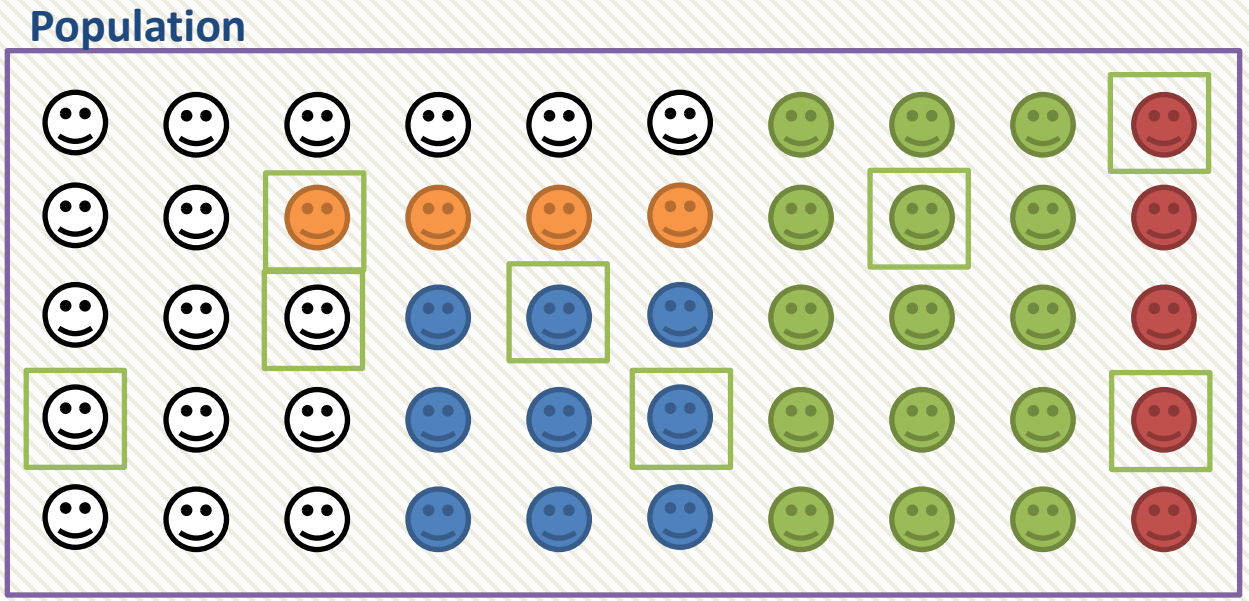
1.2 Sampling

Types of Sampling

I recommend laying out your notes like this for next bit of the chapter. Use a full page.

	Type	How to carry out	Advantages	Disadvantages
Random Sampling	Simple Random Sampling			
	Systematic Sampling			
	Stratified Sampling			
Non-Random	Quota Sampling			
	Opportunity Sampling			

Random Sampling



Ordinarily, we would want each thing in our sampling frame to have an **equal chance of being chosen**, in order to **avoid bias**.

This is known as **random sampling**.
There are a few ways of doing this…

Simple Random Sampling

Type	How to carry out	Advantages	Disadvantages
Simple Random Sampling	**What is it :** ? **Method:** ?	?	?

Edexcel S3 June 2004 Q1a

There are 64 girls and 56 boys in a school. Explain briefly how you could take a random sample of 15 pupils using a simple random sample. **(3)**

?

Simple Random Sampling

Type	How to carry out	Advantages	Disadvantages
Simple Random Sampling	**What is it :** Every sample has an equal chance of being selected. **Method:** In sampling frame each item has identifying number. Use random number generator, or 'lottery sampling' (names in a hat).	• Bias free. • Easy and cheap to implement. • Each number has a known equal chance of being selected.	• Not suitable when population size is large. • Sampling frame needed.

Edexcel S3 June 2004 Q1a

There are 64 girls and 56 boys in a school. Explain briefly how you could take a random sample of 15 pupils using a simple random sample. **(3)**

Allocate a number between 1 and N (or equiv) to each pupil. — M1 — Mark for allocating identifier to each sampling unit.

Use random number tables, computer or calculator to select 15 different numbers between 1 and 120 (or equiv). — B1 — Mark for one (bias-free) method to select such a number.

Pupils corresponding to these numbers become the sample. — B1 — Mark for explicitly mentioning how that number is actually used.

Systematic Sampling

Type	How to carry out	Advantages	Disadvantages
Systematic Sampling	**What is it :** ?	?	?

Edexcel S3 June 2009 Q1a

A telephone directory contains 50 000 names. A researcher wishes to select a systematic sample of 100 names from the directory. Explain in detail how the researcher should obtain such a sample. **(2)**

?

Systematic Sampling

Type	How to carry out	Advantages	Disadvantages
Systematic Sampling	**What is it :** Required elements are chosen at regular intervals in ordered list. i.e. Take every k^{th} elements where: $k = \frac{pop\ size\ (N)}{samp\ size\ (n)}$ starting at random item between 1 and k.	• Simple and quick to use. • Suitable for large samples/ populations.	• Sampling frame again needed. • Can introduce bias if sampling frame not random.

Edexcel S3 June 2009 Q1a

A telephone directory contains 50 000 names. A researcher wishes to select a systematic sample of 100 names from the directory. Explain in detail how the researcher should obtain such a sample. **(2)**

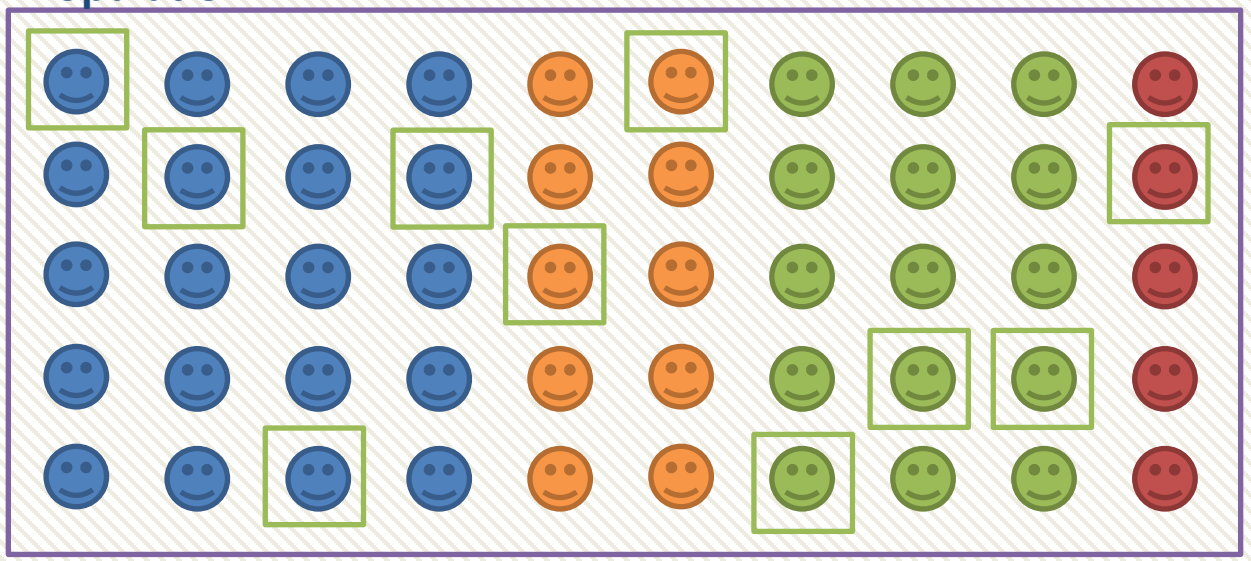
Randomly select a number between 00 and 499 (001 and 500)	B1
select every 500th person	B1

We need a random first item.

Stratified Sampling

We want to sample 20% of the population. If the population were divided into distinct groups (e.g. age ranges), known as '**strata**', we could randomly sample 20% from each group, ensuring each group is equally represented.

Population



Type	How to carry out	Advantages	Disadvantages
Stratified Sampling	**What is it :** ?	?	?

Stratified Sampling

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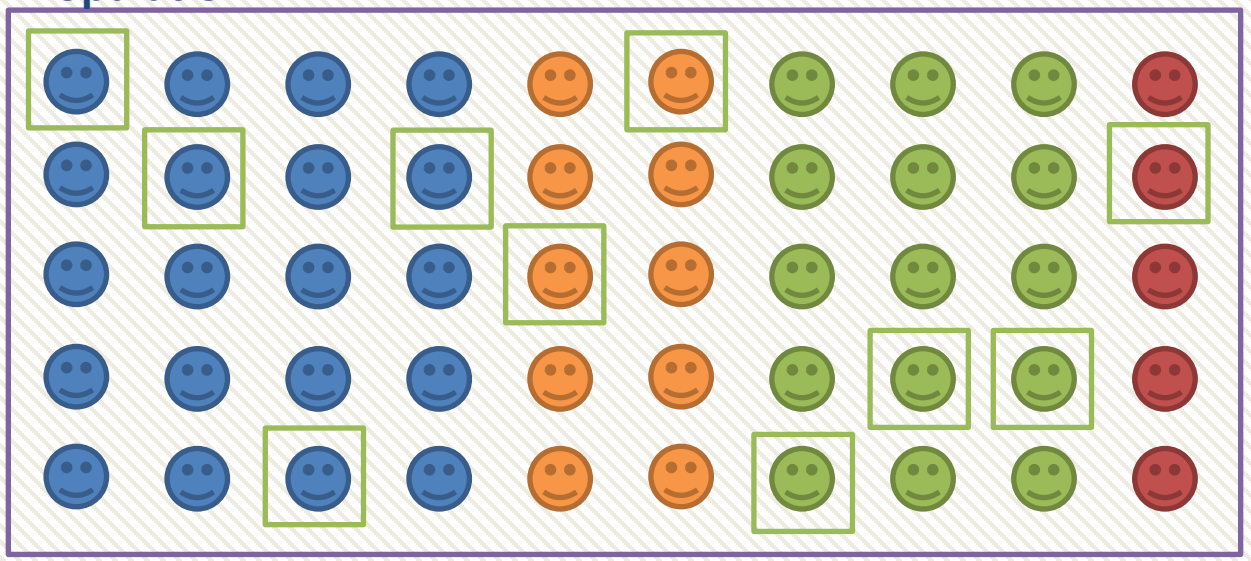

Type	How to carry out	Advantages	Disadvantages
Stratified Sampling	**What is it :** Population divided into groups (strata) and a simple random sample carried out in each group. Same proportion $\frac{samp\ size\ (n)}{pop\ size\ (N)}$ sampled from each strata. Used when sample is large and population naturally divides into groups.	• Reflects population structure. • Guarantees proportional representation of groups within population.	• Population must be clearly classified into distinct strata. • Selection within each stratum suffers from same disadvantages as simple random sampling.

Example Question

Edexcel S3 Jan 2006 Q1

A school has 15 classes and a sixth form. In each class there are 30 students. In the sixth form there are 150 students. There are equal numbers of boys and girls in each class. There are equal numbers of boys and girls in the sixth form. The head teacher wishes to obtain the opinions of the students about school uniforms. Explain how the head teacher would take a stratified sample of size 40. **(7)**

?

You would certainly want to know your mark scheme on this one!

Example Question

Edexcel S3 Jan 2006 Q1

A school has 15 classes and a sixth form. In each class there are 30 students. In the sixth form there are 150 students. There are equal numbers of boys and girls in each class. There are equal numbers of boys and girls in the sixth form. The head teacher wishes to obtain the opinions of the students about school uniforms. Explain how the head teacher would take a stratified sample of size 40. **(7)**

Total in School = $(15 \times 30) + 150 = 600$		B1
random sample of $\frac{30}{600} \times 40$	(Use of $\frac{40}{their 600}$)	M1
= 2 from each of the 15 classes		A1
random sample of $\frac{150}{600} \times 40$	Either	
= 10 from sixth form;		A1
Label the boys in each class from 1 – 15 and the girls from 1 – 15.		B1
use random numbers to select 1 girl and 1 boy		B1
Label the boys in the sixth form from 1 – 75 and the girls from 1 – 75. use random numbers to select 5 different boys and 5 different girls.		B1

You would certainly want to know your mark scheme on this one!

Exercise 1.2

Pearson Statistics & Mechanics Year 1/AS
Pages 2-3

Homework Exercise

1 a The head teacher of an infant school wishes to take a stratified sample of 20% of the pupils at the school. The school has the following numbers of pupils.

Year 1	Year 2	Year 3
40	60	80

Work out how many pupils in each age group will be in the sample.

b Describe one benefit to the head teacher of using a stratified sample.

Problem-solving

When describing advantages or disadvantages of a particular sampling method, always refer to the context of the question.

2 A survey is carried out on 100 members of the adult population of a city suburb. The population of the suburb is 2000. An alphabetical list of the inhabitants of the suburb is available.

a Explain one limitation of using a systematic sample in this situation.

b Describe a sampling method that would be free of bias for this survey.

3 A gym wants to take a sample of its members. Each member has a 5-digit membership number, and the gym selects every member with a membership number ending 000.

a Is this a systematic sample? Give a reason for your answer.

b Suggest one way of improving the reliability of this sample.

Homework Exercise

4 A head of sixth form wants to get the opinion of year 12 and year 13 students about the facilities available in the common room. The table shows the numbers of students in each year.

	Year 12	Year 13
Male	70	50
Female	85	75

a Suggest a suitable sampling method that might be used to take a sample of 40 students.

b How many students from each gender in each of the two years should the head of sixth form ask?

5 A factory manager wants to get information about the ways their workers travel to work. There are 480 workers in the factory, and each has a clocking-in number. The numbers go from 1 to 480. Explain how the manager could take a systematic sample of size 30 from these workers.

6 The director of a sports club wants to take a sample of members. The members each have a unique membership number. There are 121 members who play cricket, 145 members who play hockey and 104 members who play squash. No members play more than one sport.

a Explain how the director could take a simple random sample of 30 members and state one disadvantage of this sampling method.

The director decides to take a stratified sample of 30 members.

b State one advantage of this method of sampling.

c Work out the number of members who play each sport that the director should select for the sample.

Homework Answers

1 **a** Year 1: 8, Year 2: 12, Year 3: 16

b ANY ONE FROM: sample accurately reflects the population structure of the school; guarantees proportional representation of different year groups in the sample.

2 **a** Patterns in the sample data might occur when taking every 20th person.

b A simple random sample using the alphabetical list as the sampling frame.

3 **a** No: A systematic sample requires the first selected person to be chosen at random.

b Take a simple random sample using the list of members as the sampling frame.

4 **a** Stratified sampling.

b Male Y12: 10, Male Y13: 7, Female Y12: 12, Female Y13: 11

5 $k = \frac{480}{30} = 16$

Randomly select a number between 1 and 16. Starting with the worker with this clocking-in number, select the workers that have every 16th clocking-in number after this.

6 **a** Any method in which every member of the population has an equal chance of being selected, e.g. lottery. Disadvantage: the sample may not accurately reflect the proportions of members at the club who play each sport.

b The sample will have proportional representation of the members who play the different sports.

c Cricket: 10, Hockey: 12, Squash: 8