

SAMPLING METHODS – SAMPLING SUNFLOWERS

SAMPLING SUNFLOWERS

(Source: The Practice of Statistics, 4th edition)

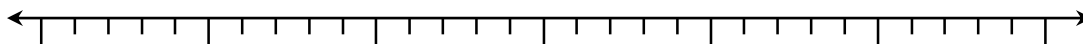
A British farmer grows sunflowers for making sunflower oil. Her field is arranged in a grid pattern, with 10 rows and 10 columns as shown in the figure to the right. Irrigation ditches run from east to west along the north and south end of the field, as shown. The farmer would like to estimate the number of healthy plants in the field so she can predict how much money she'll make from selling them. It would take too much time to count the plants in all 100 squares, so she'll accept an estimate based on a sample of 10 squares.

Sunflower Field										
	A	B	C	D	E	F	G	H	I	J
---IRRIGATION DITCH---										
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2										
3										
4										
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10										
---IRRIGATION DITCH---										

SIMPLE RANDOM SAMPLING

1. Explain carefully how to take a simple random sample (SRS) of 10 grid squares using technology or a table of random digits.
2. Obtain a simple random sample (SRS) of 10 grid squares and shade these squares in the diagram of the field above.
3. In order to be able to see how sampling works (for the purposes of this activity), we will pretend we have information for the entire field. Use the “True Field Yield” table at the end of this handout to find the number of healthy plants for each square in your sample. Calculate the sample mean number of healthy plants.
4. Based on your sample, what is your estimate for the mean number of healthy plants per square in the entire field?

- Combine your sample mean with the rest of the class to produce a dotplot. Record the dotplot below.



- The true total number of healthy plants in the field is 10246. What is the true mean number of healthy plants per square? Is this number a **parameter** or a **statistic**?
- Mr. Tyson will run a Fathom simulation to simulate taking an SRS of 10 squares and calculating the sample mean for many different random samples. Describe the resulting distribution of sample means, including a rough sketch.
- Based on the simulation, does simple random sampling appear to be a **biased** or **unbiased** sampling method for estimating the population mean? Explain.

STRATIFIED RANDOM SAMPLING

- Use technology or a table of random digits to randomly select one square from each horizontal row. Shade the selected squares in the diagram to the right. Calculate the mean number of healthy plants using this sample.

Sunflower field										
	A	B	C	D	E	F	G	H	I	J
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---IRRIGATION DITCH---										

10. The rows form subgroups (called **strata**) within our population. If we let a random process select some of the individuals (squares) in each **stratum**, and then combine these “subsamples” into one larger sample, we have obtained a **stratified random sample**. Why is this NOT a simple random sample?

11. Mr. Tyson will run a Fathom simulation to simulate taking a stratified random sample when stratifying by the *rows*. Describe the resulting distribution of sample means, including a rough sketch.

12. Use technology or a table of random digits to randomly select one square from each vertical column. Shade the selected squares in the diagram to the right. Calculate the mean number of healthy plants using this sample.

13. Mr. Tyson will run a Fathom simulation to simulate taking a stratified random sample when stratifying by the *columns*. Describe the resulting distribution of sample means, including a rough sketch.

Sunflower field										
	A	B	C	D	E	F	G	H	I	J
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---IRRIGATION DITCH---										

14. When is stratified random sampling most effective? What effect does effective stratification have when trying to estimate the population mean with sample means?

CLUSTER SAMPLING

15. The farmer is very busy. To save time, she decides to divide the field into 10 regions as shown to the right. These regions are called **clusters**. Use technology or a table of random digits to randomly select one of the clusters. Then, use all 10 squares within that cluster to form your sample. Shade the selected squares in the diagram to the right and compute the mean number of healthy plants per square.

Sunflower Field										
	A	B	C	D	E	F	G	H	I	J
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---IRRIGATION DITCH---										

16. Mr. Tyson will run a Fathom simulation to simulate taking a cluster sample. Describe the resulting distribution of sample means, including a rough sketch.

17. Now obtain a cluster sample using a different set of clusters, arranged horizontally. Shade the selected squares in the diagram to the right. Once again, compute the mean number of healthy plants per square.

Sunflower Field										
	A	B	C	D	E	F	G	H	I	J
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---IRRIGATION DITCH---										

18. Mr. Tyson will run a Fathom simulation to simulate taking a cluster sample using this new set of clusters. Describe the resulting distribution of sample means, including a rough sketch.

19. When is cluster sampling most effective? When is it least effective? What is an advantage to cluster sampling as compared to simple random sampling? a disadvantage?

THE TRUE FIELD YIELDS

True Field Yield										
	A	B	C	D	E	F	G	H	I	J
---IRRIGATION DITCH---										
1	106	104	106	105	105	105	108	108	107	106
2	103	102	103	104	103	103	103	104	103	105
3	101	99	102	101	100	100	102	101	102	101
4	98	99	99	99	100	99	98	101	99	101
5	98	100	100	100	99	99	99	98	100	98
6	97	98	98	98	99	99	99	99	97	98
7	103	102	102	104	101	102	102	102	104	102
8	104	103	103	103	102	102	103	104	102	102
9	106	106	104	106	102	107	104	103	106	106
10	107	108	109	110	106	107	109	107	106	107
---IRRIGATION DITCH---										