Food service measurement methods
Recap: Food service

• Meals or food prepared for consumption out of the home
• Can contain many different subsectors – prioritise those which are the largest / likely to serve the most food

• ‘Food waste’ contains food and inedible parts

• Level 2 reporting: total amount (fresh mass) food waste
• Level 3 reporting:
  • Share of food waste which was edible parts
  • Destination of waste
Defining food waste in food service

- Three main stages where food waste can arise

**Inventory**
Stocked food (pre-prepared or unprepared) disposed without being served

Photo by Bilge Seyma Kütükoğlu from Pexels

**Preparation**
Food removed during preparation

Photo by Toa Heftiba on Unsplash

**Consumer**
Food leftover by consumers in plates/bowls/cups/disposable containers

In some settings (e.g. canteens/buffets), ‘serving’ waste could be counted separately
Overview of section

- Level of ambition for measuring food-service food waste
- Measurement methods: primary data
- Three ‘frameworks’ for quantification:
  1) Building an estimate from sub-sector studies
  2) Businesses measure and report food waste via a voluntary agreement
  3) Businesses mandated to measure and report food waste
Ambition level for measuring food-service food waste

- Measuring FS food waste to an accuracy required for tracking is problematic
  - Multiple sub-sectors
  - Expensive to acquire primary data
  - Scaling to obtain a national estimate can present problems
Measurement methods

<table>
<thead>
<tr>
<th>Sector</th>
<th>Methods of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing (if included)</td>
<td>Mass balance</td>
</tr>
<tr>
<td>Retail</td>
<td>Direct measurement (for food-only waste streams)</td>
</tr>
<tr>
<td>Food service</td>
<td>Waste composition analysis (for waste streams in which food is mixed with non-food)</td>
</tr>
<tr>
<td>Household</td>
<td>Volumetric assessment</td>
</tr>
<tr>
<td></td>
<td>Counting/scanning</td>
</tr>
<tr>
<td></td>
<td>Diaries (for material going down sewer, home composted or fed to animals)</td>
</tr>
</tbody>
</table>
How to measure / obtain primary data?

- Weighing food-only collections
- Assessment of volume of waste bins
- Scanning / counting
- Smart bins
- Waste compositional analysis for mixed waste streams
How to measure / obtain primary data?

- Weighing food-only collections
- Assessment of volume of waste bins
- Scanning / counting
- Smart bins
- Waste compositional analysis for mixed waste streams

Requires food waste to be in separate bin

Can analyse food waste in mixed bin

Photo by Sebastian Coman on Unsplash
Weighing and assessing volume

• **Weighing**
  • Weighing receptacles filled with waste
  • Requires food waste to be separated from non-food
  • May be received by waste contractors if businesses charged by weight disposed

• **Assessing volume**
  • Estimate amount via number of bins filled and how full they are
  • Requires food waste to be separated from non-food
  • Less accurate than weighing...
    ... but may be lower cost
Scanning / counting

• Counting or scanning items as they become waste

• **Scanning**: relevant for packaged items (e.g. using barcode)

• **Counting**: appropriate for discrete items (e.g. 10 mangos)
  • Need to know average weight of item

• Not applicable to mixed/semi-prepared waste, e.g. vegetable skins or leftovers

• May have minor role in Food Service, e.g. for inventory/stock room
Smart technologies – digital bin
Weighing / waste compositional analysis

- Scales for weighing
- Interface for inputting information about food
  - (Camera + Artificial intelligence to automatically identify food)
- Database to record food waste, provide info
# Summary of measurement methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Accuracy of measurement</th>
<th>Coverage of all FW in sector</th>
<th>Measurement causes behaviour change?</th>
<th>Detailed information possible?</th>
<th>Cost?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighing</td>
<td>High</td>
<td>Only covers segregated streams (food waste only)</td>
<td>Low</td>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>Volumetric analysis</td>
<td>Lower: estimating volume</td>
<td>Only covers segregated streams (food waste only)</td>
<td>Low</td>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>Direct weighing (digital bin)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
<td>High</td>
</tr>
<tr>
<td>Waste compositional analysis</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Yes</td>
<td>High</td>
</tr>
<tr>
<td>Scanning / counting</td>
<td>High</td>
<td>Only scannable / countable items</td>
<td>Low</td>
<td>Yes</td>
<td>High</td>
</tr>
</tbody>
</table>
Do restaurants and other food service in your country normally separate their food waste?

How could they be encouraged to do so?
Food service scaling
Three key steps

Measure food waste at a sampling unit

What do you measure? What is the granularity of measurement?

Normalise measurement with a relevant factor

What metric would be more comparable across businesses of different sizes?

Scaling data by a representative factor for a national estimate

How can this be scaled to form a nationally-representative estimate?
Sampling units in food service

What is the granularity of measurement?

What might be a suitable sampling unit?

- **An individual meal**: measure waste from each individual meal
- **A kitchen/premise**: measure waste each day/week within a kitchen, or premise with multiple kitchens
- **A business (possibly with multiple sites)**: e.g., where existing data provided to government for all sites owned by a business (e.g. chain businesses)
## Sampling units

<table>
<thead>
<tr>
<th>Sampling unit</th>
<th>Pros</th>
<th>Cons / points to consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual meal</td>
<td>Quickly build up large dataset (good for statistics)</td>
<td>Costly – many measurements</td>
</tr>
<tr>
<td></td>
<td>High resolution</td>
<td>Primarily captures plate waste – difficult to apportion serving/prep waste to individual meals</td>
</tr>
<tr>
<td></td>
<td>Observe variation within customers at same site</td>
<td>Likely to miss drink waste unless captured separately</td>
</tr>
</tbody>
</table>

### Example: grams/meal waste each day, 'per meal' sampling unit (one restaurant)

![Example chart showing grams/meal waste each day, 'per meal' sampling unit (one restaurant)](chart.png)

- **Day 1**
- **Day 2**
## Sampling units

<table>
<thead>
<tr>
<th>Kitchen/premise</th>
<th>Natural unit for measurement and scaling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Can capture waste for all stages of food service</td>
</tr>
<tr>
<td></td>
<td>Can be normalised through POS data</td>
</tr>
<tr>
<td></td>
<td>May capture drink waste even if disposed in different area to food waste</td>
</tr>
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</table>

- **Pros**
  - Quickly build up large dataset (good for statistics)
  - High resolution
  - Observe variation within customers at same site

- **Cons**
  - Does not capture variation between customers of same site
  - If multiple kitchens at same site, need to understand flow of food between them

---

**Example:**

- **Kitchen/premise:** kg waste each day, 'per kitchen/premise' sampling unit (3 restaurants)
- **Business Sampling units:** kg waste each day normalised by number of customers that day
Likely to miss drink waste unless captured separately.

Observe variation within customers at same site.

Does not capture variation between customers of same site. If multiple kitchens at same site, need to understand flow of food between them.

Natural unit for measurement and scaling.

Can capture waste for all stages of food service.

Can be normalised through POS data.

May capture drink waste even if disposed in different area to food waste.

<table>
<thead>
<tr>
<th>Sampling units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Allows data for a large entity to be reported quickly.</td>
</tr>
<tr>
<td>May capture drink waste even if disposed in different area to food waste.</td>
</tr>
</tbody>
</table>

Example: kg waste each day, 'per business' sampling unit (not disaggregated)

Example: kg waste each day, 'per business' sampling unit
## Sampling units

<table>
<thead>
<tr>
<th>Sampling unit</th>
<th>Pros</th>
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<td></td>
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<tr>
<td></td>
<td>May capture drink waste even if disposed in different area to food waste</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>Allows data for a large entity to be reported quickly</td>
<td>Requires additional data for normalisation, comparison and scaling</td>
</tr>
<tr>
<td></td>
<td>May capture drink waste even if disposed in different area to food waste</td>
<td>May lose nuance on where waste arises</td>
</tr>
</tbody>
</table>
Normalising and scaling in food service

Normalise measurement with a relevant factor

What metric would be more comparable across businesses of different sizes?

How would we compare food waste generated in the two scenes below?
What metric would be more comparable across businesses of different sizes?

- Normalising an important step ahead of scaling
- Normalising data = dividing by relevant quantity
- Normalising data is also useful for analysis and communicating data
Options for normalising food-waste data?

- Weight of food waste:
  - As % of food served / entering kitchen
  - per meal / portion / guest (cover)
  - per kitchen / premise
  - per unit of turnover or value of sales (e.g., kg FW / US$ turnover)
  - per employee

Normalising and scaling in food service

Scaling data by a representative factor for a national estimate

• Scaling necessary to obtain a national estimate
  • From sample => population

• Close relationship between normalisation data and scaling data
  • Need to be able to access that for both the entity in the sample AND for the nation/region being studied
Example: scaling from sample to nation

- Sub-sector = **restaurants**.
- 50 restaurants sampled: 3 days’ worth of **food waste** measured via waste comp = 300 kg
- Have data for sample and nation on total **food served** in restaurants:
  - 2,000 kg in sample over 3 days
  - 1 million tonnes in country per year
- Can normalise sample data... \( \frac{300 \text{ kg}}{2,000 \text{ kg}} = 15\% \)
- ... and apply to nation  \( 15\% \times 1 \text{ mil. tonnes} = 150,000 \text{ tonnes} \)

More details in Appendix C of *Food Loss and Waste Reporting and Accounting Standard*
Example 2: scaling from sample to nation

- Sub-sector = **sports events (football matches)**.
- 10 sports events sampled: 10 days’ worth of **food waste** measured by direct weighing = 10,000 kg (10 tonnes)
- Have data for number of attendees to those football matches: 200,000
- Can normalise sample data... \( \frac{10 \text{ tonnes}}{200,000 \text{ people}} = 50g \text{ per person} \)
- Have data on annual attendees of football matches: 6 million people (30 weeks of 200k attendees)
- ... use this to scale \( 50g \times 6 \text{ mil. attendees} = 300 \text{ tonnes} \)

More details in Appendix C of *Food Loss and Waste Reporting and Accounting Standard*
Normalising and scaling in food service

- Sampling unit, normalising and scaling are connected
- **Normalising** by something you can’t **scale by** not that helpful
- Some **sampling units** are more suited to **normalisation** than others, or some data more available than others
## Methods for normalisation and scaling

<table>
<thead>
<tr>
<th>Normalisation factor</th>
<th>Accuracy of normalisation factor</th>
<th>Obtaining data from sampling unit</th>
<th>Obtaining data for whole country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of food served (mass)</td>
<td>High: Likely to be lower levels of variation when normalising using the amounts of food</td>
<td>Might be recorded by kitchen / business</td>
<td>May be collected as national statistics or by trade body</td>
</tr>
<tr>
<td>Meals/covers served</td>
<td>High: likely to be lower level of variation when normalising using meals</td>
<td>Likely to be recorded by POS system</td>
<td>May be collected as national statistics or by trade body</td>
</tr>
<tr>
<td>Number of kitchens/sites</td>
<td>Intermediate: kitchens and sites can vary in size, particularly if multiple kitchens in a single site</td>
<td>Easy if sampling unit is kitchen/site, care needed for multiple kitchens on one site</td>
<td>Could be available through national statistics (e.g. licensing/food safety databases), care needed where multiple kitchens</td>
</tr>
<tr>
<td>Value of sales / turnover</td>
<td>Intermediate: need to be aware of (a) cost of food varying within subsector (e.g., different types of restaurant) and (b) inflation can cause problems when making comparisons over time</td>
<td>Probably recorded by POS but may be commercially sensitive</td>
<td>Data likely to be available</td>
</tr>
<tr>
<td>Employees</td>
<td>Intermediate: similar to turnover</td>
<td>Likely to be recorded by POS, business or sites</td>
<td>Could be available as part of national statistics</td>
</tr>
<tr>
<td>Businesses</td>
<td>Poor: businesses vary in size enormously; so will their level of FW</td>
<td>Easy if sampling unit is business</td>
<td>Could be available as part of national statistics</td>
</tr>
</tbody>
</table>
Possible data sources

Governmental / national statistics
Likely to be the main source of information

Trade bodies / representative organisation
Could be useful, especially for data on customers/meals served

Private market research
If you have no idea what data is available or where to start, these could be useful

Examples include:
- Euromonitor international
- Mintel
- GlobalData
- Statista

Downsides:
- Often for specific subsectors only
- Often very expensive to access
Possible data sources

• National datasets
  • Schools/educational institutions (Education department?)
  • Hospitals/care homes (Health department?)
  • Prisons/military (Defence department?)
  • Markets, restaurants, cafés, canteens etc. (Licensing procedure? Food safety databases? Does this miss informal economy?)

What sorts of national data do you have available to you?
Generating new food-service data

- **Use surveys to generate new information on eating-out habits**
  - May already be covered in dietary, health and nutrition surveys [e.g.]
  - Could include questions as part of a food waste diary or other food-based survey:
    - E.g. ‘in a typical week, how many meals do you/your family eat at the following food service locations:
      - Restaurants
      - Fast food establishments
      - Pubs/bars
      - Hotels
      - Informal/street food vendors
      - Etc.
Generating new food service data

- Use assumptions or proxy data from similar countries

- Fewer assumptions is better...
  ... sensitivity testing your assumptions is advisable
Food service sampling
How long to measure for?

- Shorter duration of measurement is cheaper...
- But only gives a snapshot:
  - Less accurate
  - Less useful for the business for developing strategy
  - Requires more kitchens / premises / businesses to be sampled
- A week would be a minimum, given variation through the week
- Seasonality likely to be very important in some setting (e.g., where tourism influences demand)
  - Need multiple sampling throughout the year
Table 3. Aspects covered in previous food waste quantification studies.

<table>
<thead>
<tr>
<th>Kitchen type</th>
<th>Country</th>
<th>Units (n)</th>
<th>Duration</th>
<th>Waste (%)</th>
<th>Waste/portion (g)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>UK</td>
<td>1</td>
<td>28 days</td>
<td>&gt;40</td>
<td>-</td>
<td>Barton et al. (2000)</td>
</tr>
<tr>
<td>Schools &amp; restaurants</td>
<td>Sweden</td>
<td>4</td>
<td>2 days</td>
<td>20</td>
<td>92.5</td>
<td>Engström &amp; Carlsson-Kanyama (2014)</td>
</tr>
<tr>
<td>Catering</td>
<td>Egypt</td>
<td>-</td>
<td>-</td>
<td>23-51</td>
<td>126,131,166</td>
<td>El-Mobaidh et al. (2006)</td>
</tr>
<tr>
<td>Hospital</td>
<td>UK</td>
<td>3</td>
<td>2 days</td>
<td>19-66</td>
<td>-</td>
<td>Sonnino &amp; McWilliam (2011)</td>
</tr>
<tr>
<td>University</td>
<td>Portugal</td>
<td>1</td>
<td>4 weeks</td>
<td>24</td>
<td>280</td>
<td>Ferreira et al. (2013)</td>
</tr>
<tr>
<td>Food service sector</td>
<td>Finland</td>
<td>72</td>
<td>1 day – 1 week</td>
<td>8-27</td>
<td>-</td>
<td>Katajajuuri et al. (2014)</td>
</tr>
<tr>
<td>Preschool</td>
<td>USA</td>
<td>1</td>
<td>5 days</td>
<td>43.3</td>
<td>210</td>
<td>Byker et al. (2014)</td>
</tr>
<tr>
<td>Schools</td>
<td>Portugal</td>
<td>21</td>
<td>1 month</td>
<td>27.3</td>
<td>49.5</td>
<td>Martins et al. (2014)</td>
</tr>
<tr>
<td>Hospital</td>
<td>Portugal</td>
<td>1</td>
<td>8 weeks</td>
<td>35</td>
<td>953</td>
<td>Dias-Ferreira et al. (2015)</td>
</tr>
<tr>
<td>Schools</td>
<td>Italy</td>
<td>3</td>
<td>92+33 days</td>
<td>15.31</td>
<td>-</td>
<td>Falasconi et al. (2015)</td>
</tr>
<tr>
<td>Schools &amp; restaurants</td>
<td>Switzerland</td>
<td>2</td>
<td>5 days</td>
<td>7.69 &amp; 10.73</td>
<td>86 &amp; 91</td>
<td>Betz et al. (2015)</td>
</tr>
<tr>
<td>Food service sector</td>
<td>Finland</td>
<td>51</td>
<td>5 days</td>
<td>19-27</td>
<td>58-189</td>
<td>Silvennoinen et al. (2015)</td>
</tr>
<tr>
<td>Hotel</td>
<td>Malaysia</td>
<td>1</td>
<td>1 week</td>
<td>-</td>
<td>1100</td>
<td>Papargyropoulou et al. (2016)</td>
</tr>
<tr>
<td>University</td>
<td>South Africa</td>
<td>9</td>
<td>21 days</td>
<td>-</td>
<td>555</td>
<td>Painter et al. (2016)</td>
</tr>
<tr>
<td>Preschools</td>
<td>Sweden</td>
<td>4</td>
<td>2 weeks</td>
<td>-</td>
<td>145</td>
<td>Hansson (2016)</td>
</tr>
<tr>
<td>Schools</td>
<td>China</td>
<td>6</td>
<td>1 day/unit</td>
<td>21</td>
<td>130</td>
<td>Liu et al. (2016)</td>
</tr>
<tr>
<td>Public sector</td>
<td>Sweden</td>
<td>30</td>
<td>3 months</td>
<td>23 (13-34)</td>
<td>75 (33-131)</td>
<td>Eriksson et al. (2017)</td>
</tr>
<tr>
<td>Hotel</td>
<td>Slovenia</td>
<td>1</td>
<td>63 days</td>
<td>-</td>
<td>15.2</td>
<td>Juvan et al. (2017)</td>
</tr>
<tr>
<td>Schools</td>
<td>Italy</td>
<td>4-5</td>
<td>5-10 days</td>
<td>27</td>
<td>-</td>
<td>Boschini et al. (2018)</td>
</tr>
<tr>
<td>Schools</td>
<td>Italy</td>
<td>1</td>
<td>12 days</td>
<td>-</td>
<td>151</td>
<td>Lagorio et al. (2018)</td>
</tr>
<tr>
<td>University</td>
<td>Qatar</td>
<td>3</td>
<td>40 days</td>
<td>~50</td>
<td>980, 757</td>
<td>Abdelaal et al. (2019)</td>
</tr>
<tr>
<td>University</td>
<td>China</td>
<td>6</td>
<td>2-3 days</td>
<td>-</td>
<td>73.7</td>
<td>Wu et al. (2019)</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Saudi Arabia</td>
<td>1</td>
<td>3 weeks</td>
<td>-</td>
<td>412</td>
<td>Alharbi et al. (2020)</td>
</tr>
<tr>
<td>Schools</td>
<td>Italy</td>
<td>78</td>
<td>740 days</td>
<td>-</td>
<td>160</td>
<td>Boschini et al. (2020)</td>
</tr>
<tr>
<td>Catering</td>
<td>Germany</td>
<td>239</td>
<td>4 years</td>
<td>-</td>
<td>74-280</td>
<td>Leverenz et al. (2020)</td>
</tr>
</tbody>
</table>

Christopher Malefors, Thesis: [https://susfood-db-era.net/main/sites/default/files/2021-04/malefors_c_210216.pdf](https://susfood-db-era.net/main/sites/default/files/2021-04/malefors_c_210216.pdf)
How many sampling units to sample?

Sample size \( \approx \left( 2 \times \frac{\text{Standard Deviation}}{\text{Desired 95\% confidence interval}} \right)^2 \)

- Use **normalised** values for st. dev. and mean, i.e. those used for scaling
- Resulting sample size will be the number of sampling units
- For priority sub-sectors, aim for ±10\%, for others ±20\%
### Variation in food waste for example 1

<table>
<thead>
<tr>
<th>Sector</th>
<th>Kitchens (n)</th>
<th>Mean (%)</th>
<th>Std. Dev. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canteens</td>
<td>5</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>Care homes</td>
<td>8</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td>Hospitals</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hotels</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Preschools</td>
<td>148</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Primary schools</td>
<td>226</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Restaurants</td>
<td>9</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Secondary schools</td>
<td>35</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>431</td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

\[
\frac{\text{Standard Deviation}}{\text{Mean}} = \frac{6\%}{19\%} = 0.32
\]

- Analysis of existing data
- Data presented as **food waste as percentage of food served**
- Standard deviation between different kitchens
- Sampling unit = kitchen

Christopher Malefors, Thesis: [https://susfood-db-era.net/main/sites/default/files/2021-04/malefors_c_210216.pdf](https://susfood-db-era.net/main/sites/default/files/2021-04/malefors_c_210216.pdf)
Example calculation 1

- For primary schools
- Sampling unit = kitchen
- Data expressed as % of food served
- Priority sector

Sample size \( \approx \left( 2 \times \frac{\text{Standard Deviation}}{\text{Mean}} \times \frac{\text{Desired 95% confidence interval}}{\text{Mean}} \right)^2 \)

\[ \approx \left( 2 \times \frac{0.32}{0.1} \right)^2 \approx 41 \text{ kitchens} \]

- Need to be randomly selected to ensure representative
## Variation in food waste for example 2

<table>
<thead>
<tr>
<th>Sector</th>
<th>Kitchens (n)</th>
<th>Mean (g)</th>
<th>Std. Dev. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canteens</td>
<td>230</td>
<td>84</td>
<td>74</td>
</tr>
<tr>
<td>Care homes</td>
<td>49</td>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td>Hospitals</td>
<td>16</td>
<td>110</td>
<td>33</td>
</tr>
<tr>
<td>Hotels</td>
<td>83</td>
<td>140</td>
<td>82</td>
</tr>
<tr>
<td>Preschools</td>
<td>193</td>
<td>95</td>
<td>56</td>
</tr>
<tr>
<td><strong>Primary schools</strong></td>
<td><strong>322</strong></td>
<td><strong>66</strong></td>
<td><strong>29</strong></td>
</tr>
<tr>
<td>Restaurants</td>
<td>15</td>
<td>230</td>
<td>94</td>
</tr>
<tr>
<td>Secondary schools</td>
<td>46</td>
<td>89</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>954</strong></td>
<td><strong>91</strong></td>
<td><strong>69</strong></td>
</tr>
</tbody>
</table>

\[
\frac{\text{Standard Deviation}}{\text{Mean}} = \frac{29 \text{ grams}}{66 \text{ grams}} = 0.44
\]

- Analysis of existing data
- Data presented as **weight of food waste per portion**
- Standard deviation between different kitchens
- Sampling unit = **still the kitchen**

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Example calculation 2

- For primary schools
- Sampling unit = kitchen
- Data expressed as food waste per meal
- Priority sector

Sample size $\approx \left( 2 \times \frac{\text{Standard Deviation}}{\text{Mean}} \right)^2$

\[
\approx \left( 2 \times \frac{0.32}{0.44} \right)^2 \approx 41 \text{ kitchens}
\]

- Sample size sensitive to how data is normalised

Standard deviation / mean $\approx 0.44$

Desired 95% CI / mean $= 0.1$ (10%)
Sample sizes

- **Ideal case:**
  - Work with existing data, including mean and standard deviation, in order to calculate sample size *for each subsector included*
  - Greater precision needed in high-priority subsectors (±10%), less precision needed for lower priority (±20%)

- If no data is available, or subsectors lack information: start with approximately 30 establishments per subsector

- But... ... depends on how you plan on collecting data