Using Data and Predictive Models for New Product Development – to Assess Safety, Shelf Life and Health Benefits

4th April 2019
Sandrine Pigat
Head of Food & Nutrition at Creme Global

IST Spring Conference 2019 (SC19)
‘Nutritional Science over Gut Feel’
About Us

Creme Global is an independent data science technology company. Various industry and government partners funded the projects described here.
Content

- Data Science Challenges
- Predictive Modelling Case studies
  - Probabilistic Exposure Modelling
  - New Product Development and Health Impact
  - Product Stability and Shelf Life - Predictive Modelling
  - Modelling Industry Reformulation Efforts and Population Impacts
Data Science Challenges
Data Science Challenges

Collect the Data
- Traditional Data, Big Data, IOT

Gathering Data

Understanding

Analysing and Visualising the Data

Insight

Structuring, Validating and Sharing

Foresight

Developing Predictive Models
- Traditional Methods, Machine Learning, AI
Data Structure

Well Structured Data

Unstructured Data

Messy Data
Alternative Data Sources

Market Research
- Kantar Worldpanel
- Nielsen
- Mintel
- Euromonitor International
- NPD Group

Crowd Sourced
- QS
- CodeCheck
- Data Donors
- Quantified Self

Online Data Gathering
- Foodbook
- Food4me.org
- MyFood24
Industry Applications of Predictive Modelling

R&D
- Consumer Product Design
- Safety By Design
- Food Product Design
- Chemical Product Design

Health
- Nutrition
- Health Economics
- Health Outcomes

Safety
- Toxicology
- Chemical Exposure
- Microbial Food Safety
- Chemical Food Safety

Strategy
- Operational Performance
- Business Intelligence
- Business Analytics
- Investment Decisions
- Nutrition
- Health Outcomes

Predictive Modelling

Health Economics

Operational Performance

Business Intelligence

Investment Decisions

Nutrition

Health Outcomes

Health

Strategy

Predictive Modelling

Consumer Product Design

Safety By Design

Food Product Design

Chemical Product Design

Toxicology

Chemical Exposure

Microbial Food Safety

Chemical Food Safety

Operational Performance

Business Intelligence

Business Analytics

Investment Decisions

Nutrition

Health Outcomes

Health

Strategy
Predictive Modelling: Case Studies
Probabilistic Exposure Modelling
Exposure Assessments

Distribution of Subjects

Exposure (mg/kg/day)  Reference Intake

Contaminants, additives, chemicals etc.

Determine consumer safety
Data

What do people eat?

What is the concentration in these foods?

Population Exposure
From Worst Case to Probabilistic Exposure Modelling
**Diary Day 1**

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>x1</td>
<td>40 g</td>
</tr>
<tr>
<td>x2</td>
<td>500 g</td>
</tr>
<tr>
<td>x3</td>
<td>100 g</td>
</tr>
<tr>
<td>x4</td>
<td>200 g</td>
</tr>
</tbody>
</table>
Diary Day 1

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>AMOUNT</th>
<th>SUBSTANCE CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>x1</td>
<td>40 g</td>
<td>0.6 %</td>
</tr>
<tr>
<td>x2</td>
<td>500 g</td>
<td>0.02 %</td>
</tr>
<tr>
<td>x3</td>
<td>100 g</td>
<td>1.5 %</td>
</tr>
<tr>
<td>x4</td>
<td>200 g</td>
<td>0.007 %</td>
</tr>
</tbody>
</table>
Population Exposure

Lower

Higher
Population Exposure

Lower

Mean

Higher
Population Exposure

Lower  Median  Consumer Exposure  Higher
Population Exposure

Lower

95th Percentile Consumer Exposure

Higher
From Worst Case to Probabilistic Exposure Modelling

Health Based Threshold: Acceptable Daily Intake, Tolerable Daily Intake
New Product Development and Health Impact
New Product Development - Impact on Potassium Intakes and Health Outcomes

Population:
consumers 45 years and older, drinking milk

Food/Food Group:
new product, high in potassium

Baseline:
food and nutritional intakes

Scenario:
replacement with new product Impact on population intakes

Impact on Health Parameter:
blood pressure

New Product Development - Impact on Potassium Intakes and Health Outcomes

Nutrient Intake before and after Scenario
New Products and Predicting Health Outcomes

Impact on SBP in Product Consumers

Baseline
Conservative
Optimistic

Normotensive
Prehypertensive
Hypertensive
Product Stability and Shelf Life
- Predictive Modelling
Microbial Stability Calculator

Probability of product being stable is 89.83%
Recommended Classification: **STABLE**

<table>
<thead>
<tr>
<th>Carbonated</th>
<th>Not Carbonated</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ Volume</td>
<td>3.6</td>
</tr>
<tr>
<td>SHMP (ppm)</td>
<td>0</td>
</tr>
<tr>
<td>Sorbic Acid (ppm)</td>
<td>175</td>
</tr>
<tr>
<td>Benzoic Acid (ppm)</td>
<td>175</td>
</tr>
</tbody>
</table>
Development of MSC

1. Data validation and visualisation

2. Statistical analysis

3. Sensitivity and specificity analysis

4. Software
Public Health Nutrition
Modelling Industry Reformulation Efforts and Population Impacts
FDI Creme Global Reformulation
Project Overview and Methodology

Estimate the impact of reformulation and the introduction of new products on the nutrient intakes of the Irish population.

**Surveys Used:**
The National Teens’ Food Survey (2005 – 2006)
National Pre-school Nutrition Survey (2010 – 2011)

**Nutrients:**
Sodium
Fat
Saturated Fat
Sugar
Energy
Phase 1
Reformulated Products Only

Directly replaced survey foods – no scope for product choice changing between years.
Phase 2

Phase 2 uses similar principles to Phase 1 but in addition, Phase 2 takes account of new products and discontinued products.

- Consumers’ movement away from products popular in 2005 to products popular in 2017.
- Composition of the products changing.
- More data, giving a more holistic view of the market.

**Consumer Basket**

- 2005
- 2017
Data Collection Portal

15 Companies
1,780 Food Products
23,305 Concentration data points collected
Key Results

Direct reformulation of products on the market in both 2005 and 2017

These figures show the percentage reduction in nutrients from 235 products that were on the market in 2005 and remained on the market in 2017.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fat</td>
<td>0.3%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>10.1%</td>
</tr>
<tr>
<td>Energy</td>
<td>1.6%</td>
</tr>
<tr>
<td>Sodium</td>
<td>28.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>8.0%</td>
</tr>
</tbody>
</table>
Sugar Intake Reductions

![Sugar intake reduction (g/d) chart showing reductions for Adults, Teenagers, Children, and Pre-Schoolers.]
Associating market share with concentration values

2005
Associating market share with concentration values

2017

New product enters the market

Product 1  Product 2  Product 3  Product 4

Product 4

New product
Challenges

- Expertise, understand methodologies, opportunities and limitations
- Data availability
- Up-to-date data
- Data quality, acceptability
- Uncertainties

Opportunities

- Using data and models to faster inform product development, consumer health and safety
- Use of technologies and tools
- Use of multidisciplinary capabilities
Thank You.

Sandrine Pigat
Head of Food & Nutrition
sandrine.pigat@cremeglobal.com