Annual surveillance report

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1. Summary

1.1 This report provides a summary of the activities and progress made to the modernised surveillance model outlined in the report to the December 2019 Board.

1.2 The Board is asked to:

- **Endorse the surveillance vision**
- **Note progress** on surveillance through 2019
- **Agree the direction of travel**

2. Introduction

2.1 A report is presented annually to the Board on the topic of surveillance, an activity and function concerning the whole of the FSA. This year the report restates the strategic vision for surveillance, highlighting the importance of data and analytics; outlines what has been delivered by each team through 2019; and describes the work being done to develop the fully integrated operating model. It is important to recognise that we were ready in delivering the minimum requirements to meet the immediate EU Exit risks, and we have delivered much across the board in the last year. We also must recognise, we are in the early stages of the journey to develop the aspiration of a fully joined up, value adding surveillance model, that leads the work of the FSA.

3. Strategic Vision for Surveillance

3.1 For us, Surveillance is an umbrella term used to describe activities relating to the development of our situational awareness. It is the ongoing systematic collection, collation, analysis and interpretation of data, followed by the dissemination of information to all those involved so that directed actions may be taken. The goal is to develop a systematic approach across the FSA to effectively identify food and feed risks. We need to identify direct impacts such as a microbiological risk through to crime, changes in consumer attitude to food to changes in business models, then to technical advancements in the production of food and how we all engage with it. The data we use may be data directly describing food, it might be indirect such as climate data, it might be about food business behaviour, it might be about consumer attitudes. Time is an important factor: Our definition of surveillance encompasses the range of

periodicities from the long-term horizon scanning to the day to day tactical, near time response.

3.2 We undertake surveillance in order to protect consumers now, and in the future, with the foresight to predict and take action in a timely manner. This is an underpinning strategic principle for the FSA.

3.3 We will use modern data and technology enabled approaches to delivery of surveillance. Taking cues from past and ongoing FSA Science Council work in horizon scanning, data usage and digital technology, the focus of surveillance is on using data, enabled by leading technology, with human input, to proactively develop situational awareness before issues arise, in order to protect the consumer and ensure that food is safe and authentic. This includes the analysis of past historical data; the ingestion of new data sources as appropriate; the spotting of anomalies and patterns that may indicate risks; and finally, the prescription of appropriate, evidenced actions whose impacts are clear and measurable. The recent developments in technology are allowing us to deliver solutions not possible before, and in the most cost-effective manner. We need to continue monitor developments in this arena and learn from others, as well as building on our own experience.

3.4 In summary, our assessment is: we are increasingly recognising the importance of surveillance to the business of the FSA; we are making significant progress in each part of the department; we are already operating at the forefront of the use of data analytical techniques. However, we need to do even more, join up more, and make material impact with the greater insight we have.

3.5 Our intended next step, for which Board endorsement is requested, is to develop an overarching integrated system that while remaining agile and decentralised, will enable additional data sharing, re-use of technical solutions across Government, a clear tie-in to actions taken by the remainder of FSA. This builds on the existing principles and culture of the FSA to be science led, evidence based, innovative and open. (Further detail is provided in the final section: Development of the Overarching Integrated System).

4. Elements of Surveillance

4.1 This section provides an update on each element/function/team that is involved with Surveillance, whether providing or consuming data, insights and action. It reflects the variety of surveillance activity across the FSA, different types for different purposes, evolving at different rates; some are primarily generators of data and analytical services, whilst some are primarily customers of those services. Although recognising the need to better join up these different activities, there are already examples where teams are starting to work in a more coordinated manner.

4.2 This paper is a useful opportunity to update the Board on the range of surveillance activities, but a number of other papers are also being presented to the Board with greater detail and so reference is made to them.

Horizon Scanning

4.3 After the publication of the Horizon Scanning Report in June 2019 (Final Report from Science Council Working Group on Food System Risks and Horizon Scanning and FSA Response; FSA 19-06-07) dedicated resource has been allocated to this area and will develop a system for horizon scanning that can be implemented across the FSA, as an integrated component of our wider surveillance system. As well as developing an overarching framework and process, there is also ongoing work specifically focused on horizon scanning and review within the developing allergens programme.

Strategic Surveillance

4.4 The FSA has developed a flexible, responsive data enabled strategic surveillance capability that has matured from a programme to a service in the last year.

4.5 Through this capability, we are developing a picture of the food system, its risks (safety, authenticity, assurance) and vulnerabilities, so that FSA, and others, can manage consumer food risks. We provide services to all FSA teams, to use data and analytics to help identify and address issues as they arise, be they strategic, global and long term, or immediate and operational, following a mature agile way of working that is centred around specific real life 'use cases' (projects) as sprints. A sprint consists of understanding a problem, finding data that might address the problem, and developing a model. At that point we decide whether we should put what we have built into operation or not.

Summary of use cases delivered in the last year (see Annex B for detail):

Title	Description
Risk Likelihood Dashboard	This dashboard helps present complex information on risky food and feed in an understandable way and flags potential and emerging food and feed safety risks in terms of commodity, country of origin and hazard. Access to this tool has been extended to other bodies like PHAs, LAs etc.
Aflatoxin risk prediction	This tool helps establish the relation between known hazards and climate, and then applies that intelligence to predict unknown hazards by looking at similar climates.
Meat establish-ments dashboard prototype	This tool offers a comprehensive view of different types of data related to FSA-approved meat establishments, and thus helps identify potential indicators of risk and geographical hotspots. A separate project is underway to extend the tool to LAs by bringing in data about the meat establishments under their purview.

Title	Description
Unregistered businesses prototype	This project analysed various data sources to match them against FHRS and identify unregistered businesses. We worked closely with 2 LAs to confirm our findings.
Signal prioritisation	This prototype helped us learn about potential and emerging food safety and fraud issues by using machine learning algorithms to extract and summarise risks with commodity, origin country, and hazard, by accessing various data sources (including various official data sources and news websites).
Pesticide risk prediction tool	Extended from the aflatoxin tool, this project investigated predicting increased pesticide residue using climate data.
Food Consumer experience	A change in food price, availability or quality could indicate where there is a vulnerability in the food chain, giving greater opportunity for food fraud. The project aimed to establish whether people discussed this on social media and whether we could develop a method to reliably identify this discussion amongst the noise.
Trade Routes and Volumes at Ports	This prototype helped compare TRACES pre-notifications and HMRC data to anticipate and monitor where the highest risk foods are entering the UK, and ensure we are not missing any. It also helps to find commodities appearing only in HMRC which could be TRACES commodities in disguise.
Non-UK RASSFs	This prototype calculates probabilities of UK RASFF alerts following a non-UK RASFF alert. (A non-UK RASFF alert is a RASFF that UK did not raise and where UK is also not listed as a country distributed to.)
Online display of FHRS scores	This prototype automatically searches food businesses websites, locates the FHRS logo and compares the information displayed online to that stored in the FHRS database.
UK food sectors most exposed to change in value of the pound	This project used trade, consumption, consumer expenditure and exchange rate data to identify the UK food industry exports and imports sectors most vulnerable to the value of the pound.

4.6 Annex C lists use cases that were delivered in 2018, so providing the full picture of what has been delivered.

4.7 We have strengthened our capability to understand food risks by accessing and analysing various sources of data, using increasingly sophisticated analytics

techniques, providing our stakeholders with critical insights and predictive models. We have collaborated with Local Authorities, Port Health Authorities, other government departments, academics and the industry to utilise their expertise and share the insights. Whilst working as far as possible in the open, we are mindful of the responsibilities we have in relation to data privacy; we take appropriate action to protect any data, and are also actively understanding the evolution of data protection and access techniques such as governance, anonymisation and data trusts.

4.8 Strategic Surveillance has achieved its primary objective for this year, which was to provide a responsive capability to help mitigate risks associated with leaving the EU and future changes in trade patterns. The capability includes the systems, better knowledge of the available data, models, algorithms, skills.

4.9 We have formed a Strategic Surveillance Steering Committee, which has representation from the various directorates within the FSA, to decide on prioritisation of projects. We regularly report to EMT, which provides strategic advice and direction.

4.10 We have shared our work with various external organisations such as OPSS, CIEH, GFSI, FDA. It has been met positively, and based on the feedback received, we appear to be in the leading pack of food safety regulators in the use of data analytics.

4.11 Strategic Surveillance sees the validation of its outputs as an important step towards confirming the relevance and benefits of its services. The methods for validating the outputs vary by use case, and examples are included in the detail in Annex D. We aim to conduct such validations for all use cases, conducting the validation in ways that minimise costs for the FSA: We leverage existing work, but where not possible, but justified, we would consider use of third parties to validate our results.

4.12 Surveillance is only of value if it is used to take action. In the past year, we have taken various measures to improve the adoption of the outputs from our projects. Annex D summarises the benefits we are already seeing or can see real potential for. A “Change Champion Network”, which is a group of individuals selected from across various teams in the FSA, has been established to encourage adoption within their respective teams. We support business users through user guides, training sessions and videos.

4.13 We have a strong pipeline of use case ideas for future projects from across the FSA. We also hope that the international relationships we have established will bear fruit in the generation of more use cases and access to more data. A strong pipeline of use-cases also highlights our progress, not only in developing predictive risk models but also contributing toward raising the bar for data literacy across the organisation. That said, there is more to do.

4.14 We have recently embarked on a project to investigate the potential for Artificial Intelligence in the identification of business establishment risk. This is

considered novel for UK government for this sector, and we are therefore engaged with experts to ensure the use of data aligns with the Data Ethics Framework and using guidance published in the Alan Turing Institute guide for responsible design and implementation of AI systems in the public sector.

4.15 In summary, we have established a predictive data analytics enabled surveillance capability, one that delivers on-going operational services as well as continues to explore new opportunities; created a future demand; created the necessary governance and management processes. We have started to see real world impact resulting from the insights we have acquired, but this is an area requiring greater management attention. Going forward we will continue to develop new and increasingly sophisticated services, to meet the current and evolving demand.

Sampling

4.16 Sampling, with its associated testing, of food and associated material eg packaging, hygiene swabs, is another critical source of data for surveillance. The challenges caused by the diversity of sampling purposes and delivery models, including the role of other government bodies such as PHE in England defining the requirement in some areas, requires cross-agency efforts. We are moving towards a co-ordinated, multi-pronged approach, as presented within the Sampling Strategy. By breaking down sampling into three core types: hypotheses answering, intelligence gathering, and official control; it allows efforts to be focused on delivering these in different ways, recognising that these various types of sampling have very distinct purposes and goals. But then, by co-ordinating, we ensure the adherence to the same high-level guiding principles and deliver our collective vision, where sampling is an essential part of our coherent surveillance system.

4.17 Greater detail on sampling was provided in the June 2019 paper: FSA Sampling Strategy: Our Future Approach to Sampling; FSA 19-06-09.

Analytics

4.18 The Analytics Unit continued to provide analytical services across its FSA customers as well as supporting Strategic Surveillance projects.

4.19 Projects worked on include work with the imports team to estimate how many consignments of high-risk food from third countries are imported into the UK but are not currently checked at UK points of entry, because they come into the UK via another EU Country and so have already been. The analysis is used to help UK DPEs to plan for the additional number of checks on transits that might have to be carried out post EU Exit.

4.20 In collaboration with SERD risk assessors the Unit is working on researching how we may better understand trends and the circumstances around the occurrence of food hypersensitivity reactions, including consequential health encounters (both hospital and primary care).

4.21 In building the evidence base for the Regulating Our Future programme the Unit led the delivery of proof of concept research on how to predict FBO compliance for new establishments based on initial operating factors. Strategic Surveillance is building on this, addressing previous limitations by:
1. Using more advanced AI deep learning techniques;
2. Adding external open sources of data (e.g. ONS);
3. Looking at the macro scale of the UK.

4.22 Finally, a conceptual framework is being developed with the aim of capturing the full range of impacts that food crime has on the UK economy.

Social Science

4.23 Social scientists monitor, measure, describe, explain and predict and evaluate social and economic phenomena; another form of surveillance. This year the focus has been on predicting trends and changes, including understanding the drivers of food choices in Generation Z (people aged 16-25), the changes in consumer risk perceptions and acceptability of new food technologies, and using open social media allowing us to track consumer views in near real time.

4.24 The benefits from the Social Science surveillance work accrue due to the ability to:
- spot trends which might lead to increased food related safety risk (the underlying hazard might be unchanged, but the risk increases if more people are engaged with the risky food);
- target campaigns;
- predict the timing of movements or new/novel foods entering the market, for example lab grown meat, and share our insights with industry; and
- understand and segment the wider interests of consumers and play this into the FSA's strategy.

4.25 The detailed findings of such studies are published on the FSA website and in the Social Science update paper presented to the FSA Board. Close working closely with Policy and Operations ensure that the insights gleaned, increasingly influence and where necessary, change what we do, how we target it, and how we do it.

NFCU Intelligence

4.26 (NFCU use the term "intelligence" rather than "surveillance" to describe the general gathering of data and its analysis).

4.27 The expansion of the National Food Crime Unit has included an increase in the size of the Unit's intelligence analysis team. We have established a number of new/enhanced intelligence sources/capabilities. For example, we are now receiving the industry generated FIIN data on a quarterly basis and reflect on the scale and nature of the non-compliances it highlights, as well as the industry testing coverage it shows is in place for various commodities and hazards.

4.28 We have secured access to national policing databases (Police National Database and the National ANPR Service) and introduced a new intelligence and case management system.

4.29 We are working on the establishment of discreet intelligence gathering through human intelligence and directed surveillance. We will continue to share intelligence bulletins with our partners.

4.30 NFCU is working with RCD on the 2-way intelligence sharing between the FSA and local authorities, and we are looking to secure direct access to their own intelligence database, IDB.

4.31 The potential insight which the various aspects of surveillance can deliver to the counter-food crime response, both as a companion dataset to the criminal intelligence gathered and received by the NFCU, and also as an aid to prioritisation of both proactive and reactive work, is recognised by NFCU. Strategic Surveillance provides effective insight tools, so NFCU can focus more on the application of a criminological perspective to those data signals. For example, NFCU has been particularly interested in tools relating to harnessing a more holistic view of what is already known by the FSA about its approved premises, in the development of accessible insight to trade movements and of the current use case exploring horizon scanning.

4.32 More detail may be found in the paper: FSA 20-01-18 National Food Crime Unit – Update on Progress.

Imports

4.33 The Imports and Exports Unit has focused on further strengthening the already strong working relationships with port health authorities, improving our ability to collate and share intelligence across the FSA, to communicate emerging risks to relevant stakeholders, and inform policy decisions regarding imported food.

4.34 The Imports Team are users of several innovative tools that have been developed through Strategic Surveillance, which enable them to easily access collated data sets across the world and provide key insights regarding potential risks from imported food, including insights that help pre-empt the likelihood of increased risk. These initiatives have greatly increased the capability for data-driven decision-making within the production of intelligence on imported food, using the intelligence produced to inform local and port health authorities to aid in the targeted inspections of imported food. Access to these tools is being extended to local authorities across the UK to ensure officers dealing with imported food, both at the border and inland can benefit from these developments. We are also planning to use these tools to target sampling activities.

4.35 The Imports Team actively collaborates with other teams across the FSA in sharing the intelligence it produces on imported food and feed, notably the

Incidents Branch and the National Food Crime Unit. As well as a year of focus on EU Exit, it has collaborated with other Government departments at the border to lead on an investigation into the risk of non-compliant food entering the UK via the parcel network. This initiative uncovered a number of high-risk food products that had effectively evaded the mandatory import controls and highlighted the need for a broader investigation to assess and mitigate the risk nationwide.

RCD

4.36 RCD's focus in relation to surveillance has been the collation and improvement of the data collected by local authorities. The Unified View is a tool that has been developed to collect data from local authorities about food businesses. This gives us the ability to, for example:

- Allow FSA Incidents Team to quickly see the emerging scale of an incident, by business and by establishment
- Provide input into the local authority balanced scorecard
- Provide input into Strategic Surveillance to e.g. facilitate the identification of unregistered businesses
- Help inform policy making

5. Development of the Overarching Integrated System

5.1 Work has commenced on the design and development of the overarching surveillance system. Given there is surveillance activity already happening across the FSA, and indeed beyond, that is potentially useful to us and the consumer, we are looking to build on it, optimise it and share its insights. We have already seen good practice and greater value where teams are joining up. We have though seen missed opportunities where "it would have been even better if…". We will develop a model that links the elements together where there will be business value in doing so.

5.2 The features of the future system that we have identified so far (but yet to be socialised or confirmed) are:

- Sharing and integration opportunities are various and could be sharing raw data, insights, technical solutions etc. There does not appear to be a case to create a big, centralised tightly coupled operation.
- Whilst there are many similarities between surveillance functions, and opportunities for integration, we recognise the differences e.g. timeliness from years for horizon scanning to hours for incident management, different needs for data accuracy balanced against timeliness or cost. This is important so needs are met, but equally we do not over-engineer solutions.
- As well as the potential business value of the outputs, we also identified potential efficiencies in, for example, re-use of data or technical solutions.
- We recognise the need to address intervention resulting from the insights, as there is no business value generated if the insight is not then acted upon (noting deciding not to act is a valid response). Whilst taking action

is not considered to be within the scope of Surveillance, ensuring its measurement and feedback is.

- Coordination, oversight and governance are important. We are considering re-using/extending existing governance arrangements e.g. EMT, Investment Board, Strategic Surveillance Steering Committee.
- As well as structure, process, technology etc, we also need to address the culture, so we think outside my narrow team's world, share freely, use something "not invented here".
- We expect there to be the need for some additional resource to coordinate the whole system.

6. Our next steps are to:

- Write up and share the use cases where a modern integrated approach has worked well. And those where the opportunity was missed. Identify good practice and gaps/blockers.
- Write up and share the proposition to include expected outcomes.
- Commence the design of a model that identifies the various functional elements that will be needed, and identify a use case that can be used to exercise how a new model might work, but building on what we already have.
- Be informed by the Science Council Working Group 4 report, on the exploitation of data.

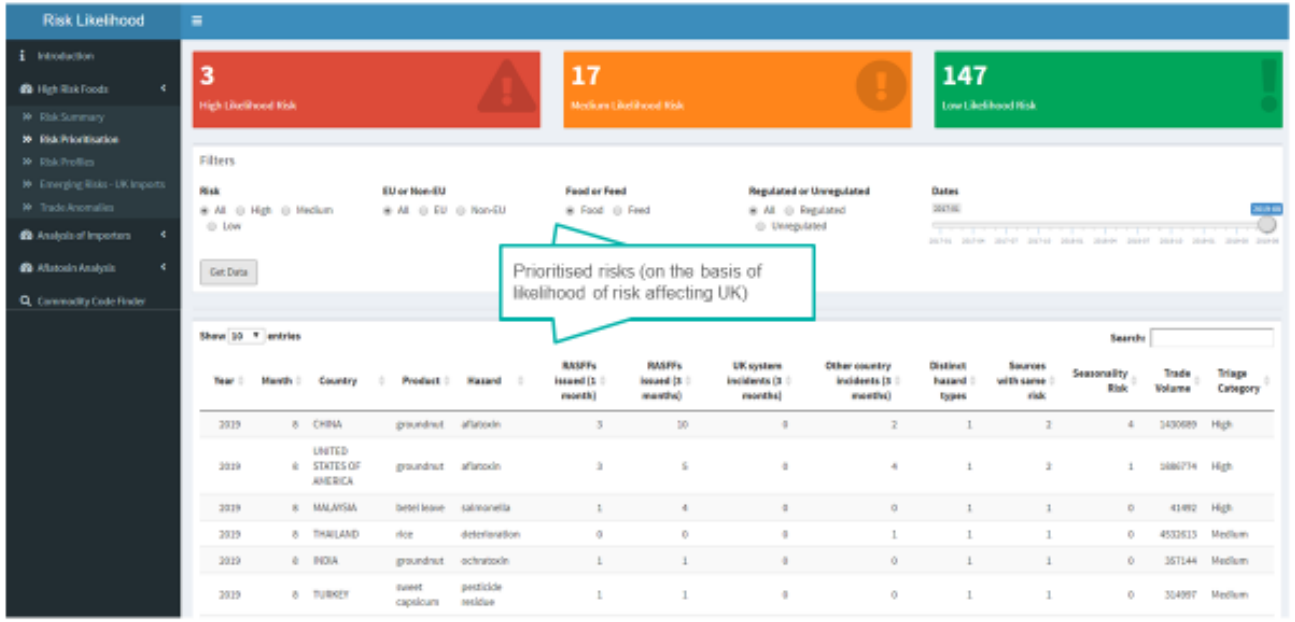
Annex A: Glossary

Acronym	Definition
ANPR	Automatic Number Plate Recognition
CIEH	Chartered Institute of Environmental Health
DPE	Designated Point of Entry
EFSA	European Food Safety Authority
EMT	Executive Management Team
FDA	USA Food and Drug Administration
FHRS	Food Hygiene Rating Scheme
FIIN	Food Industry Intelligence Network
FNAO	Food Not of Animal Origin
GFSI	Global Food Safety Initiative
HMRC	Her Majesty's Revenue and Customs
IDB	Trading Standards Intelligence Database
LA	Local Authority
PHA	Port Health Authority
PHE	Public Health England
OGD	Other Government Department
ONS	Office for National Statistics
OPSS	Office for Product Safety and Standards
RASFF	Rapid Alert System for Food and Feed – a system for reporting food safety issues in the European Union.
RCD	FSA Regulatory Compliance Division
SERD	FSA Science, Evidence and Research Division
TRACES	Trade Control and Expert System- a certification tool used by the European Union for controlling the import and export of live animals and animal products within and without its borders.

Annex B: Strategic Surveillance Use Cases Delivered in 2019

1. Risk likelihood dashboard

Risk likelihood dashboard



Data is collected from multiple sources: UK(MEMEX, TRACES, PHILIS); EU (RASFF), Non-EU (USA, Japan, Canada, Australia) etc.

** We are working with Information Governance and Legal teams to extend the dashboard to PHAs and LAs*

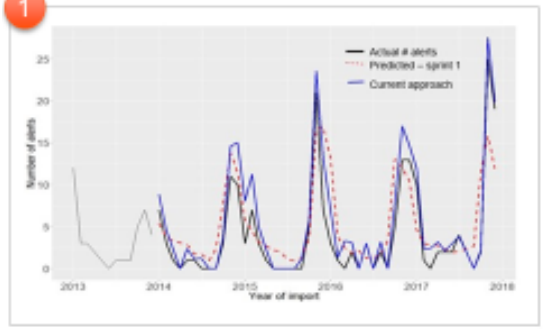
- Functionalities include: Risk Identification, Risk Prioritisation, Emerging Risks, New Risks etc.
- This use case was part of our work that won the Highly Commended prize in the Technical & Innovation category of the Office for Product Safety and Standards (BEIS) Regulatory Excellence awards 2019

2. Aflatoxin risk prediction

Aflatoxin risk prediction

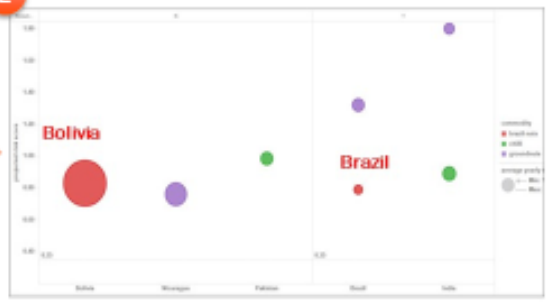
Known Risk → Unknown Risk

1



Predicting Aflatoxin risk for known risk using climate data

2



Identifying countries with similar climate conditions & trade behaviours as known

3

Country	Product	Predicted Alerts
Georgia	Hazelnuts	4
Nicaragua	Peanuts	2
India	Melon Seeds	2
India	Melon Seeds	2
South Africa	Figs	2
South Africa	Figs	2
South Africa	Figs	2
Georgia	Hazelnuts	2
Bolivia	Brazilnuts	1
Bolivia	Brazilnuts	1

Identifying risk from unregulated countries with similar inherent Aflatoxin risk

As an Example:

Risk prediction model using RASFF alerts for Figs imported from Turkey (regulated), Brazilnuts from Brazil etc.

Risk prediction model to predict RASFF alerts for unregulated commodities e.g. Melon Seeds from India, Brazilnuts from Bolivia etc.

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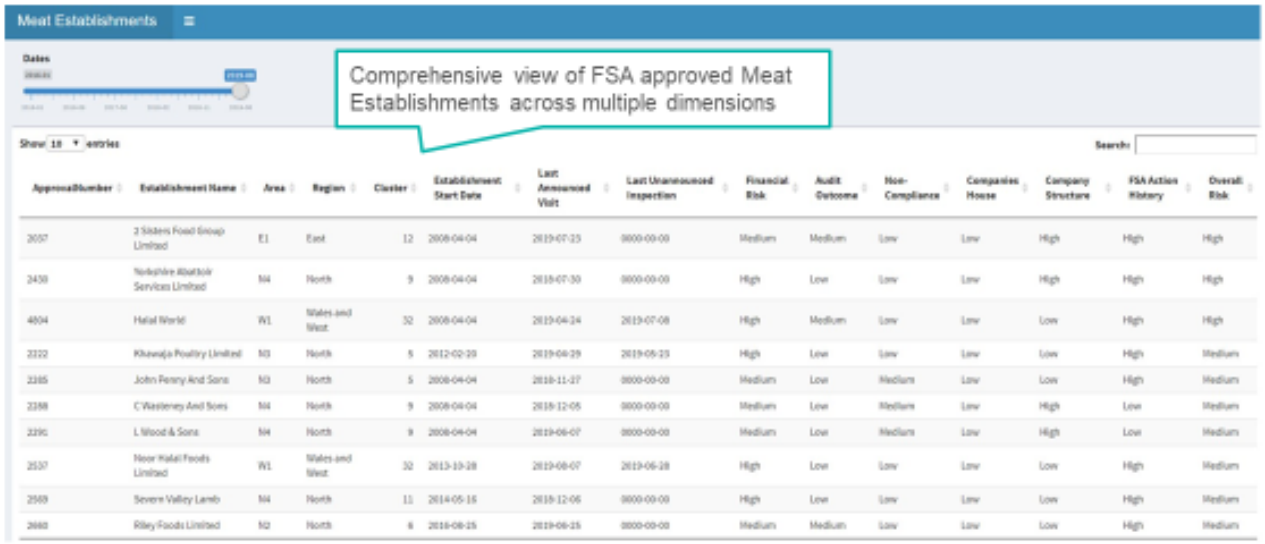
3. Meat establishments dashboard

Meat establishments dashboard



FSA approved meat Establishments are triaged across multiple dimensions / indicators to get a comprehensive view

Objective is to extend the work to 9 identified LAs in the near future

Geographical Analysis

Financial Stability & Non-compliances

Historical Non-compliances (Audits, Unannounced Inspections etc.)

Health and Safety

Indicators

Complaints

Company Structure & Operations

Legal investigations and Prosecutions

Throughput vs. Revenue

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Extension of 'Meat establishments dashboard' to LAs

- **Positive response from 9 of the 12 LAs** we reached out to:

Broadland	Dudley	Mid Devon	Newark Sherwood	North Lincolnshire
Cotswolds, Forest of Dean and West Oxfordshire	Sefton	Teignbridge	West Suffolk	

- **8 LAs have completed our initial checklist** to indicate the kind of data they hold and it's current format (whether paper or digital)
- Engaged with University of Lincoln for setting up a **Data Trust** with these LAs to facilitate collaboration and sharing of data
- **Food Standards Scotland** has also indicated interest in collaborating on this project

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4. Unregistered businesses

Unregistered businesses

Prototype to identify FBOs selling food through various online platforms (e.g. local area listings, social media, Google maps, Trip Advisor, Yelp, City Pantry, Just Eat, Deliveroo Editions etc.)

Focused on 5 types of FBOs :

- Retail Establishments / Restaurants
- Takeaways
- Mobile caterers, food vans and stalls
- Supper clubs, pop-ups
- Dark Kitchen

Explored 5 different types of FBOs* leveraging 19 data sources

Matched FBOs against FHRS data for 2 Local Authorities

Unmatched FBOs shared with the Local Authorities for verification

Local Authorities verified against their own data

Local Authorities provided feedback to improve our model

5. Signal prioritisation

Signal Prioritisation

Scan >40 competent and trusted data sources globally to identify and prioritise signals related to food safety and food fraud

Functionalities include: Trending Products, country and hazard in last 24 hours, Signal Prioritisation and Search functionality (for trends, historical data etc.)

Trending Products

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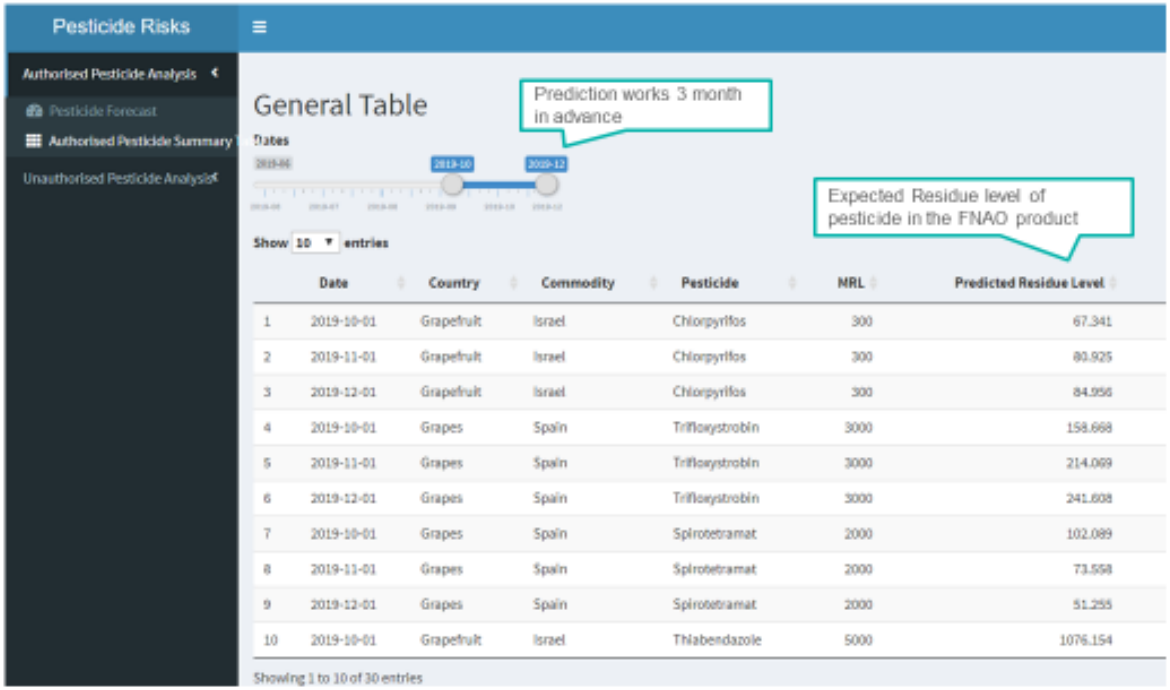
6. Pesticide risk prediction

Pesticide risk prediction



e.g. Chlorpyrifos in Grapefruit from Turkey, Neonicotinoids in Lettuce from Spain, Neonicotinoids & Acetamiprid in Okra from India

Model built by estimating effect of climate factors & trade seasonality on Residue Levels for FNAO products

Dashboard helps users analyse data, trends and patterns related to Authorised as well as Unauthorised Pesticides

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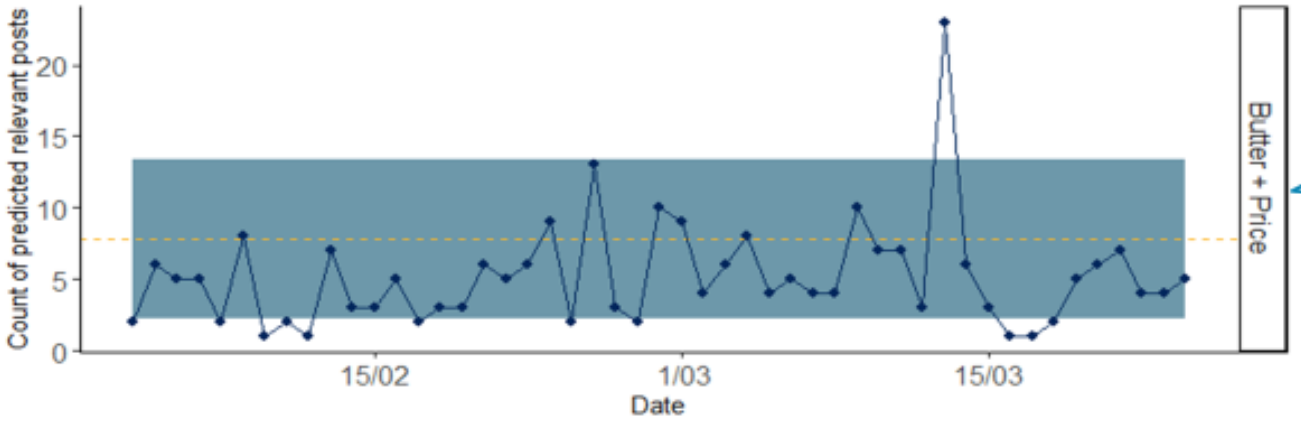
7. Food consumer experience

Food consumer experience

A change in **food price, availability or quality** could indicate where there is a vulnerability in the food chain, giving greater opportunity for food fraud. Do people discuss this on social media?



Some discussion on price, but very little on food quality and availability

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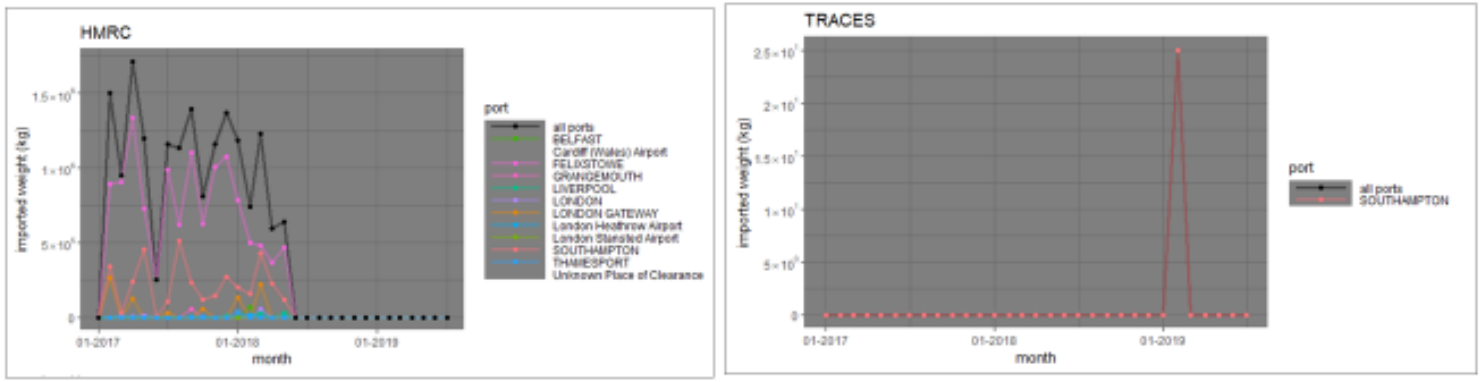
8. Trade Routes and Volumes at Ports

Trade Routes and Volumes at Ports (1/2)

Comparing TRACES pre-notifications and HMRC data to anticipate and monitor where the highest risk foods are entering the UK, and ensure we are not missing any

Significant difference in the trade data between TRACES and HMRC for “Dried vegetables and mixtures of vegetables” from China; Reasons unclear



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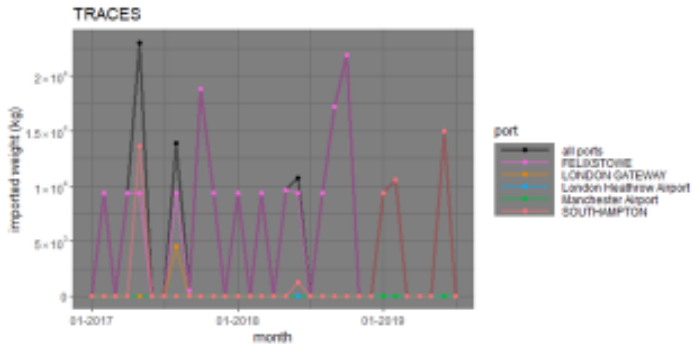
Trade Routes and Volumes at Ports (2/2)

Are there any commodities appearing only in HMRC which could be TRACES commodities in disguise?

For commodities having similar codes, we want to monitor whether fall in trade for one in TRACES corresponds to a rise in trade for another in HMRC

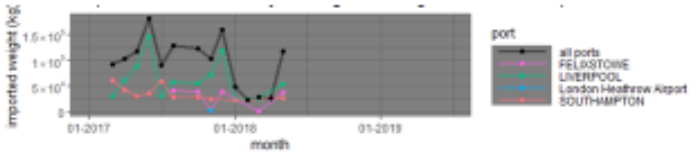
TRACES



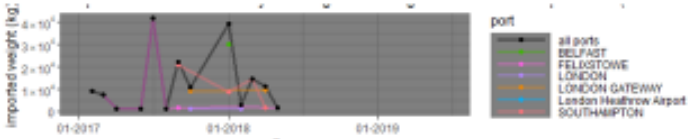
1. Rice, pre-cooked or otherwise prepared

HMRC

2. Prepared foods obtained by swelling or roasting cereals or cereal products based on rice

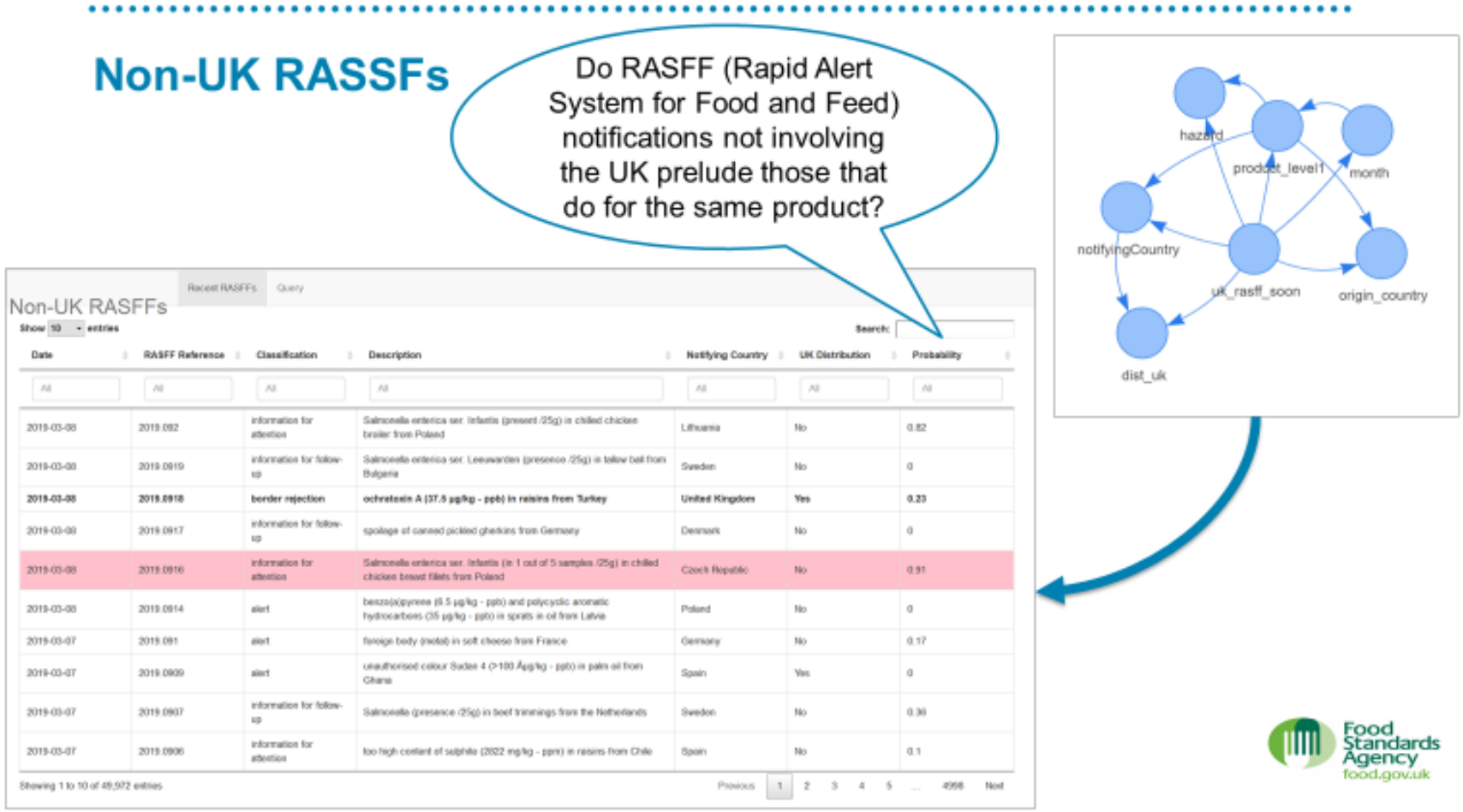


3. Prepared foods obtained by swelling or roasting cereals or cereal products based on maize



4. Prepared foods obtained by swelling or roasting cereals or cereal products (excl. based on maize or rice)

9. Non-UK RASSFs



10. Online Display of FHRS Scores

Online Display of FHRS Scores

Get website → Get images → Hygiene Rating

Automated searching of websites to find what proportion of food establishments display their hygiene rating

FSA Hygiene Ratings

R Shiny app layout

Approach	Time	Time Saved
Manual Google search	90 working days	
Shiny app	60 working days	~33%
Automated	2 days	~98%

Estimated performance of alternatives in proof-of-concept work

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11. UK food sectors most exposed to change in value of the pound

UK food sectors most exposed to change in value of the pound (1/2)

Problem Statement

- Can we predict which UK food industries are most vulnerable to a change in the value of the pound?

Solution Highlights

- Used trade, consumption, consumer expenditure and exchange rate data
- Developed a repeatable model consisting of five methods run in parallel with each other

Key Findings & Next Steps

- Model helped identify the most exposed UK food industry exports and imports (detailed on next slide)
- Make the model more robust by including different types of data and a more complete list of commodities
- Build a dashboard that stays up-to-date and provides visualisations

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UK food sectors most exposed to change in value of the pound (2/2)

*Food industries of which **imports** are vulnerable to a fluctuation in the pound:*

HS4 Code	Description
HS0201	Fresh and chilled beef
HS0210	Salted/dried/smoked meat and offal
HS1902	Pasta/noodles
HS2001	Prepared/preserved vegetables/fruit/nuts
HS2206	Other fermented beverages
HS0203	Pork
HS0305	Salted/dried/smoked fish
HS0405	Dairy:butter/fats/oils/spreads
HS0409	Natural honey
HS1602	Prepared/preserved meat/offal
HS1806	Preparations of chocolate including cocoa

The first five results are considered to be particularly vulnerable

*Food industries of which **exports** are vulnerable to a fluctuation in the pound:*

HS4 Code	Description
HS1006	Rice
HS1107	Malt
HS1604	Prepared/preserved fish/fish eggs
HS2008	Prepared/preserved fruit/nuts not in vinegar
HS2202	Soft drinks excluding fruit juice
HS2206	Other fermented beverages
HS0207	Poultry
HS0405	Dairy: butter/fats/oils/spreads
HS1602	Prepared/preserved meat/offal

The first six results are considered to be particularly vulnerable

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1. Olive oil adulteration

Understanding Olive Oil trade patterns and anomalies

Problem Statement

- Can we use open trade data to identify anomalies in olive oil trade?

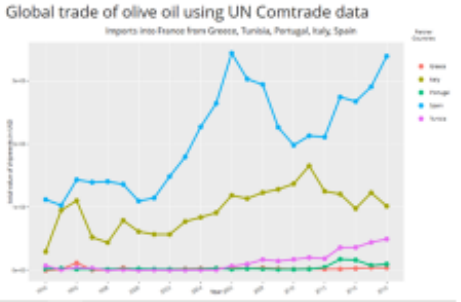
Solution Highlights

- Used openly available UN trade data to look for patterns in trade of olives and olive oil between countries
- Built a dashboard using this data for further analysis -

https://foodstandards.shinyapps.io/olivedash_shiny/

Key Findings & Next Steps

- Italy is the UKs biggest trade partner for Olive Oil
- In 2017 Italian olive production dropped by 75%, but no drop in Olive Oil trade was observed
- During that time Tunisia exported olives to Italy
- Potentially Tunisian olives are turned into Italian oil and mis-sold



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2. Vibrio infections

Predicting Vibrio infections using climate data

Problem Statement

- Naturally occurring bacteria in warm coastal water can cause disease through contaminated shellfish
- Can we predict vibrio infections ?

Solution Highlights

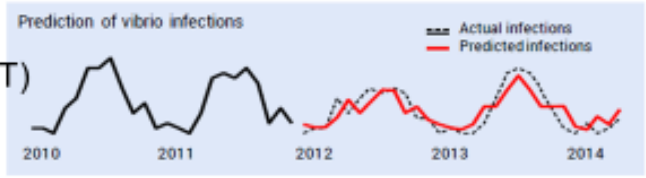
- Using Center for Disease Control and Prevention (CDC) and National Oceanic and Atmospheric Administration (NOAA) data, our model was able to predict vibrio infection rates in th US

Sea surface temperatures USA

Vibrio infections over time

Key Findings & Next Steps

- Strong correlation seen between sea surface temperatures (SST) and number of vibrio infections
- Using climate change data, the model can be applied to predict risk of infections in the UK
- For vulnerable population segments identified, survival rates could be modelled for those who are infected



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3. RASFF analysis

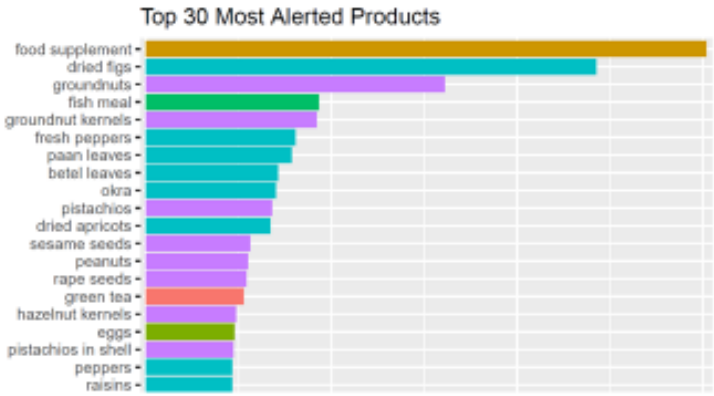
Analysing RASFF Alerts

Problem Statement

- RASFF is the European Union's Rapid Alert System for Food and Feed. Can we identify UK specific hazards?

Solution Highlights

- By linking the RASFF data to volumetric trade data from other countries, we were able to examine where the greatest import risks lie for UK consumers



Key Findings & Next Steps

- There are clear segments of RASFF which are have higher numbers of alerts
- By profiling Hazard / Commodity / Country of Origin, we identified areas for future study

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4. International trade patterns

International Trade Patterns

Problem Statement

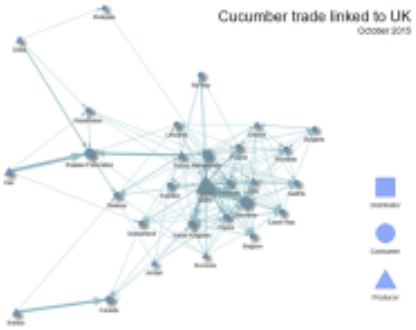
- How to better understand global patterns of trade with the UK and identify changes and anomalies?
- How to understand, detect and model trade anomalies?

Solution Highlights

- Understand the trade irregularities to identify potential sources of risk and facilitate investigations
- Characterising trade by patterns & understanding:
  -Who could replace a supplier/consumer?
  -Which countries share the same trade pattern?

Key Findings and next steps

- Demonstrated how patterns and trends are useful in establishing types of trade relationships between countries.
- Understanding the anomalies and enable further investigations



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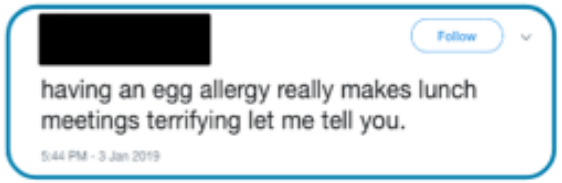
5. Allergies

Understanding allergy related discussions using social media

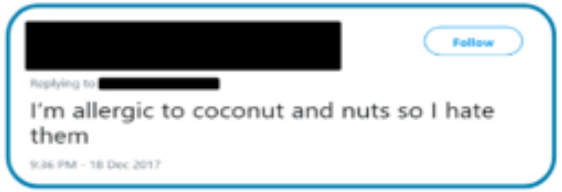
Problem Statement

- What can we understand about allergies using social media ?



Solution Highlights

- Focussed on two questions:
  - Which allergens are people talking about most ?
  - Which allergy related issues are people talking about, and is there any difference between local authorities ?
- Analysed 2 years of social media data



Key Findings & Next Steps

- Identified most discussed allergens, potential additions to list of 14
- Looked at issues by local authority, inform communication
- Inform potential research and response
- Created dashboard to interact with data

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6. EU Exit

EU Exit

Problem Statement

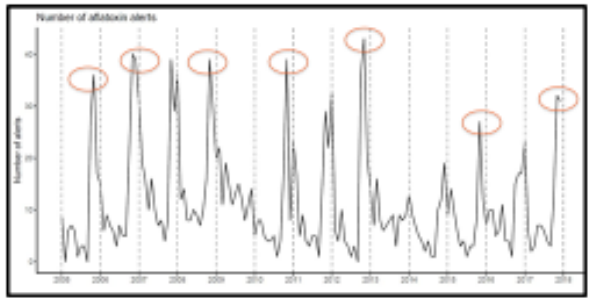
- What are the risks to public health from imported food?

Solution Highlights

- Identify ways of looking at food risk
- Predicting which foods are more likely to be risky
- Looking at how food enters the UK

Key Findings & Next Steps

- Identified key hazards
- Investigated seasonality of hazards
- Compared entry by Air and Sea



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7. Meat Mass Balance

Mass Balance in Pork

Problem Statement

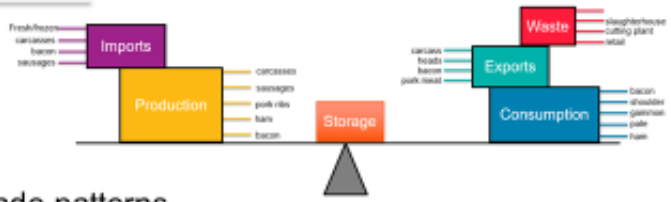
- Shortages and surpluses can be indicative of fraud and other risks ?
- 'Balancing' pork production, imports, exports, consumption and waste may reveal risks

Solution Highlights

- We analysed the pork supply chain visualising key components

Key Findings & Next Steps

- We found trends in imports and exports
- We identified potential areas of import risk and unusual trade patterns



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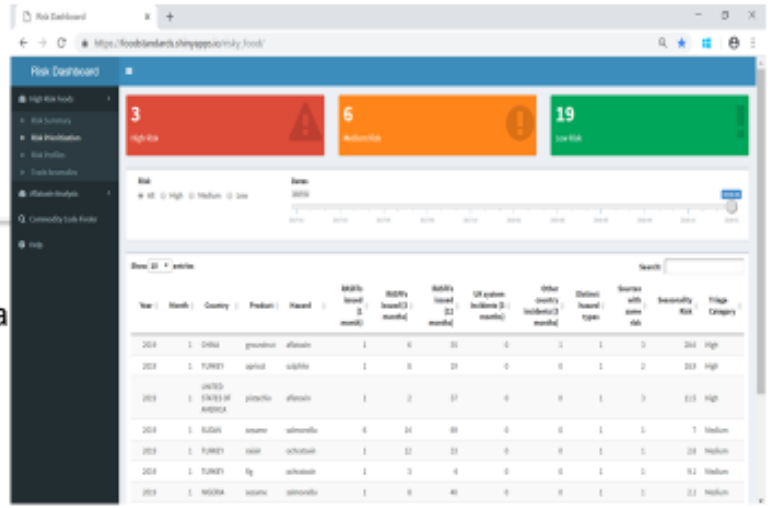
8. Risk likelihood dashboard

Data standards help us manage risks in importing food

Problem Statement

- Food imports have quality and safety risks, inconsistent data format limits usefulness in digital intelligence



Solution Highlights

- Identified, extracted and standardised food alert data across international datasets by creating reusable algorithms
- Identified global Hazard/Commodity/Country segments that extend our previous knowledge

Key Findings & Next Steps

- Improved data-driven identification of risks delivered via an interactive dashboard
- Informed future risk prevention efforts with Brazil nuts

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9. Predicting hazard levels from climate data

Predicting Hazard Levels from Climate Data

Problem Statement

- If we can relate known Hazards to climate, can we predict unknown Hazards by looking for similar climates?

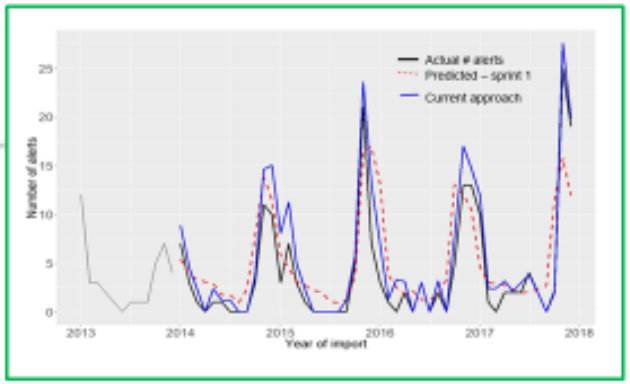
Solution Highlights

- We built a predictive model using known Aflotoxins in Figs from Turkey as an example
- We were able to model Aflotoxin incidence in Figs from countries with similar climates

Key Findings & Next Steps

- Climate risk can be quantified
- Climate data is highly correlated with some Hazards
- Known risk and climate can be used to predict unknown risk

Weather Variable	Direction
1. Relative Humidity	↓
2. Average Ground Temperatures	↑
3. Precipitation Rate	↓
4. Soil Moisture at surface level	↓
5. Max Ground Temperature	↑



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Annex D: Benefits realisation

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
1	Risk likelihood dashboard	This dashboard helps present complex information on risky food and feed in an understandable way and flags potential and emerging food and feed safety risks in terms of commodity, country of origin and hazard. Data is updated daily. Access to this tool has been extended to other bodies like Port Health Authorities (PHAs), Local Authorities (LAs) etc. Validation through: results of the sampling survey undertaken by the Imports team.	Compared to old way of procuring the same level of intelligence through individual data sources, the tool saves a substantial amount of time and effort for users. Improved precision of sampling strategies and effective utilisation of sampling budgets. The tool has been used by Imports to design a sampling survey. FSA will gain the most value out of limited sampling funds. For example, inputs from Strategic Surveillance dashboards increased the non-compliance hit ratio in sampled commodities by 60% - from 17.4% to 27.6%.	Improve FSA's collaboration with Port Health Authorities (PHAs), Local Authorities (LAs), and others. The tool is bespoke and uniquely developed to continuously meet future user requirements.
2	Aflatoxin risk prediction	This tool helps establish the relation between known hazards and climate, and then applies that intelligence to predict unknown hazards by looking at similar climates.	Prioritise annual Imports Sampling Project and effective budgeting: Data from the dashboard is annually used to find commodities with increased hazard/risk levels due to its production in certain climatic conditions.	The tool has a flexible design sustained by weather and climate data which allows expanding the model to different commodities, countries of origin and hazards.

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
		Validation through: results of the sampling survey undertaken by the Imports team.	Reputational benefit: Regulatory Excellence Award by the Office for Product Safety and Standards.	This tool will be rolled out with the Risk Likelihood dashboard.
3	Meat establishments dashboard	This prototype offers a comprehensive view of different types of data related to FSA-approved meat establishments, and thus helps identify potential indicators of risk and geographical hotspots. A separate project is underway to extend the tool to Local Authorities by bringing in data about the meat establishments under their purview. Validation through: comparison with current sources of intelligence used by the NFCU. Preliminary results showed that 8 of the 10 meat establishments identified as 'High' risk on our dashboard matched the inspectors' list of establishments that should be investigated.	A centralised access to multiple datasets providing intelligence on meat establishments behaviour saves time and money. NFCU is running a two-month trial to test and apply intelligence gathered from the dashboard to referrals and investigations in collaboration with Field Operations. If trial is successful, the dashboard could enable the NFCU to take proactive measures against meat establishments showing indications of risk, enhancing operational decision making and resource allocation. This information can be accessed in a few seconds as opposed to several hours of reactive research done by the inspector (while proactive research could take weeks or months).	Improved collaboration with Local Authorities: A separate project is underway to enhance the scope of this solution by including meat establishments that fall under the purview of LAs. 9 LAs have expressed their willingness to collaborate and provide us with an overview of the kind of data they hold.

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
4	Unregistered businesses	This project analysed various data sources to match them against FHRS and identify unregistered businesses. Validation through: businesses identified by our tool were shared with 2 local authorities for them to compare our list against their locally maintained records and confirm the registration status of each business. We await the results.	This automated prototype helps to identify unregistered businesses and discover new operating models. Promotes collaboration with the LAs. We worked with 2 LAs to confirm our findings and they took action to seek out and validate the apparently unregistered businesses.	If widely rolled out, the solution has the potential to save significant resources and time by replacing / supporting the manual processes that LAs currently use to identify unregistered businesses.
5	Signal prioritisation	This prototype helps learn about potential and emerging food safety and fraud issues by using machine learning algorithms to extract and summarise risks with commodity, origin country, and hazard, by accessing various data sources (including various official data sources and news websites).	Only deployed into live operation in November 2019, so no benefits as yet.	Predictive, daily update capability provides increased speed of response for users from RAM, Imports, NFCU, Risk Assessment.
6	Pesticide risk prediction	Extended from the aflatoxin model, this prototype helps predict increased pesticide residue using climate data.	The dashboard helps to predict the presence of pesticide residues in food.	The Imports Policy team will use the intelligence from this dashboard and nominate commodities for sampling

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
				enabling to manage sampling budget whilst collaboratively working with borders and inland authorities.
7	Food Consumer Experience	A method to evaluate whether consumer perceptions of such factors as changes in food price, availability or quality could indicate a vulnerability in the food chain, giving greater opportunity for food fraud. The project aimed to establish whether people discussed this on social media and whether we could develop a method to reliably identify this discussion amongst all the noise. Validation through: Our finding that social media conversation about food to be mainly around 'Price', rather than 'Availability' or 'Quality' was similarly seen in the 'Eurobarometer 2019' study by EFSA aimed at understanding views and perceptions of EU citizens, reporting that people's food	This prototype provides much faster insights on identifying emerging vulnerabilities associated with food fraud compared to traditional approaches like surveys. However, the project also showed that public perception is very vulnerable to sensational newspapers stories, adding additional difficulties to proper interpretation of the results.	Social media data was found to be of limited value when looking for food chain vulnerabilities. New techniques (such as Topic modelling and Event analysis) that were explored as part of this project, can be used for future social media work.

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
		choices nowadays are mostly driven by the cost of food.		
8	Trade Routes and Volumes at Ports	This prototype helps compare TRACES pre-notifications and HMRC data to anticipate and monitor where the highest risk foods are entering the UK, and ensure we are not missing any. It also helps to find commodities appearing only in HMRC which could be TRACES commodities in disguise. This tool actively identifies instances of fraud where: • controlled commodities are brought into the country through ports that are not DPEs (Designated Point of Entry) or • commodities are mis-declared/disguised or • commodity's country of origin is mis-declared / disguised.	This prototype helps the Imports team with quick access to information extracted from complex TRACES, HMRC and RASFF data and highlights patterns and anomalies that help with fraud identification by providing a full picture of the cross-UK activity surrounding commodities of interest. The user can then decide whether the unusual patterns exposed by the dashboard are worth investigating.	The Imports team will use this prototype to inform their sampling strategies and to guide PHAs and LAs by helping identify trends in high risk imported foods and supporting resource management.
9	Non-UK RASSFs	This prototype calculates probabilities of UK RASFF alerts following a non-UK RASFF alert. (A non-UK RASFF alert is a	The prototype delivers intelligence on what are the risks most likely to affect the UK in the near future. For instance, out of	This prototype should enhance our operational decision making and increase response rates to mitigate incidents. Insights for

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
		RASFF that UK did not raise and where UK is also not listed as a country distributed to.)	49,972 non-UK RASFF alerts, 3,083 records (~ 6.17%) have a probability of 0.9 or higher to affect the UK within 28 days.	this dashboard would benefit FSA teams (e.g. RAM, Incidents, Imports) and other bodies such as the PHAs by better preparing for future risks heading our way and informing their resourcing and sampling strategies.
10	Online Display of FHRS Scores	This prototype automatically searches food businesses websites, locates the FHRS logo and compares the information displayed online to that stored in the FHRS database	The prototype automatically searches websites for FHRS scores. Significantly faster compared with manually searching for same data on internet. We estimated that for 8,000 business, it will take ~90 days to search manually, but just around 2 days (saving ~98% time) with the automated option.	If changes in regulation mandate the display of the FHRS score in all online food business, we will have an automated methodology to monitor the scores and match them against our FHRS database, saving time and money in the identification of anomalies.
11	UK food sectors most exposed to change in value of the pound	This project used trade, consumption, consumer expenditure and exchange rate data to identify the UK food industry exports and imports sectors most vulnerable to the value of the pound.	Project delivered only in November 2019, so no benefits as yet.	The project helped identify food industries (for both imports and exports) that are most vulnerable to a change in the value of the pound. The model could be made more robust by including different types of data and a more complete list of commodities. This could then be used by various teams like NFCU, Imports and Exports etc.

Ref. No.	Title	Description	Realised capability/benefits to date	Potential further benefits
				as one of the inputs to guide their strategy and policy decisions.