Source attribution of food- and waterborne pathogens in the United States using structured expert judgment

University of Florida

Elizabeth Beshearse

Tina Nane

Arie Havelaar

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Outline of Content

- Specific aim
- Study design
- Elicitation proper
- Results

SPECIFIC AIM

Aim of Current Study

- CDC long-term aim
  - Produce updated estimates of the incidence of all domestically acquired illnesses, laboratory confirmed or not, caused by foodborne and waterborne pathogens in the United States
- Study aim
  - Produce source attribution estimates for the proportion of illnesses caused by food- and waterborne transmission using Structured Expert Judgment

STUDY DESIGN

OVERVIEW

Why Structured Expert Judgment?

- For food- and waterborne diseases, data are insufficient to perform fully data based source attribution due to issues such as underreporting and underdiagnosis

STUDY DESIGN

VARIABLES OF INTEREST

Pathogens of interest

- Selected pathogens where food or water is a known transmission pathway, but the proportion of this is unknown
  - Pathogens known to be nearly 100% food- or waterborne were excluded
- 41 pathogens in 15 panels
  - 29 Bacteria
  - 5 Viruses
  - 7 Protozoa

STUDY DESIGN

TRANSMISSION PATHWAYS AND POINT OF ATTRIBUTION

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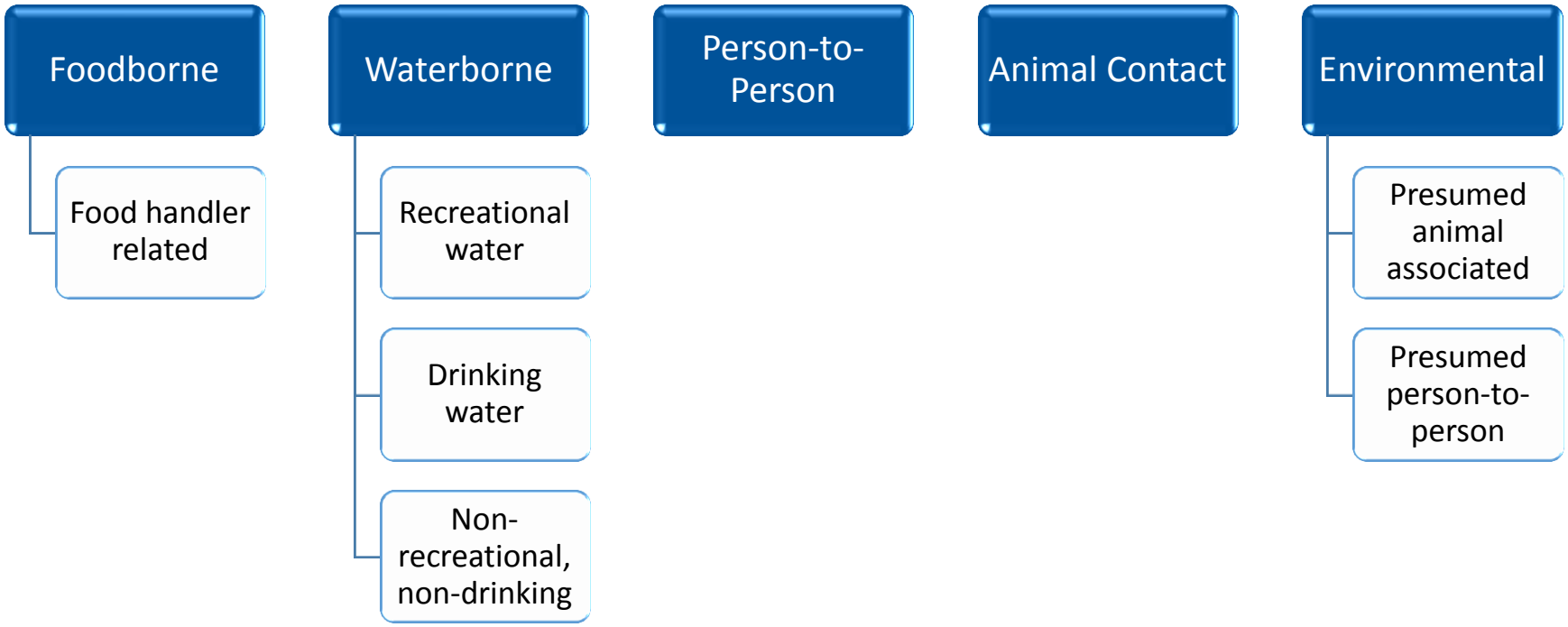
Major and Subpathways



Point of Attribution

- The place or time that determines the vehicle to which an exposure to a hazardous agent (e.g., toxin or pathogen) is attributed
- This study will use the "point of consumption," also known as, "point of exposure" for attribution
- This approach considers the direct source of human exposure to be the vehicle to which the illness is attributed
- This approach will be used in this study because it encompasses routes other than merely ingestion and is most consistent with definitions in CDC surveillance systems

STUDY DESIGN

EXPERT SELECTION

Identification of experts

- Initial list of experts identified by study team and CDC recommendations
- 182 experts received invitation to apply for participation

Application process

- Experts asked to submit
  - CV
  - Publication history
  - Questionnaire
- 57 experts applied
- 55 invited to participate
- 48 in final elicitation

STUDY DESIGN

PRE-ELICITATION EXPERT TRAINING

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Transmission pathway webinar

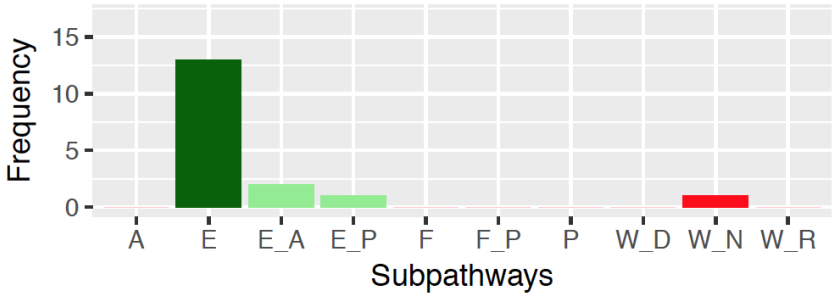
- 2 hour webinar training
- Transmission pathways and point of attribution

Knowledge review

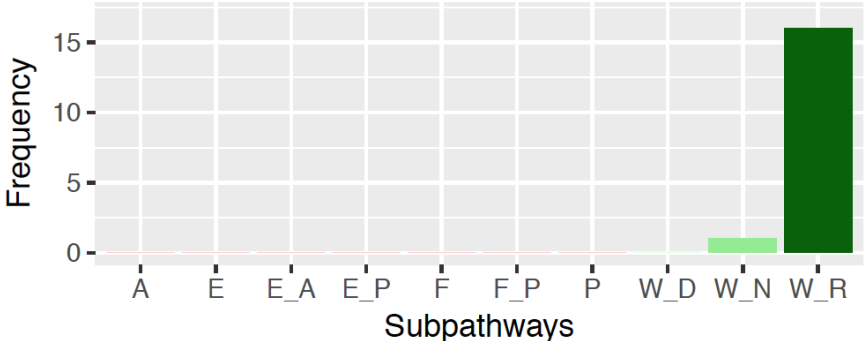
- 20 questions
- Scenarios provided to experts to respond with the associated transmission pathway as defined for the study

Knowledge Review

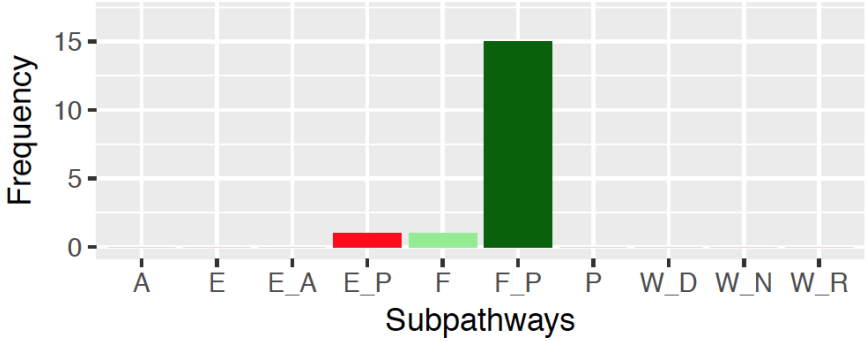
Salmonellosis among participants in a mud volleyball tournament linked to ingestion of mud



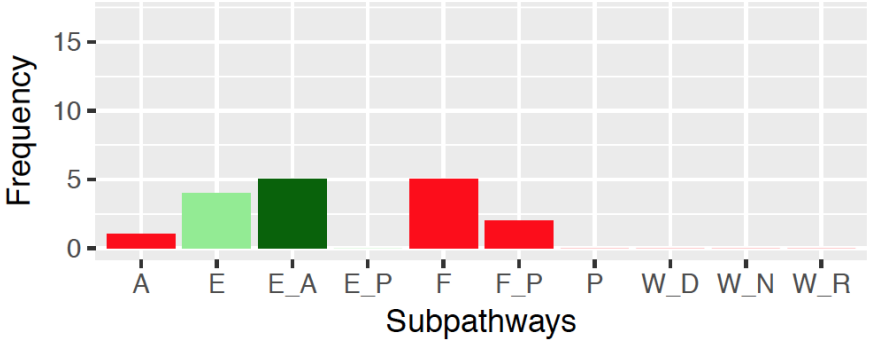
Norovirus illness from a lake after someone vomited in the lake



Norovirus outbreak due to an infected food handler preparing sandwiches



Campylobacteriosis linked to contact with contaminated packaging of chicken meat



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STUDY DESIGN

DRY RUN EXERCISE

Dry run exercise

- 6 participants
  - 2 from CDC
  - 3 from Florida Department of Health
  - 1 from Colorado Department of Health

- Items reviewed
  - Transmission pathway webinar
  - Knowledge review
  - Calibration questions
  - Elicitation instrument

STUDY DESIGN

ELICITATION PROPER

Meeting workshop

- Two day, in-person meeting of all participants at CDC in Atlanta, Georgia

- Day one
  - ½ day of training
  - Calibration questions
  - Target questions

- Day two
  - Presentation of preliminary results
  - Target questions

Calibration questions

- 14 questions related to food- and waterborne pathogens

The annual number of human cases of acute hepatitis A reported to CDC through the NNDSS passive surveillance system has declined markedly over the past decade.

What was the percent decrease from 2013 to 2014 in the annual number of cases of hepatitis A reported to CDC through the NNDSS system?

This would be calculated as follows:

(number of cases in 2013 – number of cases in 2014)/(number of cases in 2013) * 100%

Low (5^{th})	Median (50^{th})	High (95^{th})
_____	_____	_____

Target questions

Pathogen	**Norovirus**
Acronym	**NOROV**
Participant number:	**0**

	Percent of All Domestic Human Cases in a Typical Year			
	lower credible value (5th percentile)	**central value** (50th percentile)	**upper credible value** (95th percentile)	**Validation**
Major pathways				
Foodborne				****
Waterborne				****
Person to person				****
Animal Contact	0%	0%	0%	
Environmental				****
		0%		
Foodborne subpathways				
Foodhandler related				****
Waterborne subpathways				
Recreational Water				****
Drinking Water				****
Non-recreational/Non-drinking				****
		0%		
Environmental subpathways				
Presumed Person to Person				****
Presumed Animal Contact	0%	0%	0%	

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RESULTS

Experts and target variables

	# Experts	# Target variables		# Experts	# Target variables
Panel 1	14	33	**Panel 9**	9	22
Panel 2	18	44	**Panel 10**	18	11
Panel 3	17	22	**Panel 11**	14	99
Panel 4	21	22	**Panel 12**	19	22
Panel 5	22	22	**Panel 13**	20	22
Panel 6	21	11	**Panel 14**	17	11
Panel 7	21	33	**Panel 15**	16	66
Panel 8	20	11			

Panel 1

Case name : p1r 25-6-2017 Version W1.5.1

Results of scoring experts

Bayesian Updates: no Weights: item DM Optimisation: yes

Significance Level: 0.5994 Calibration Power: 1

Nr.	Id	Calibr.	Mean relati total	Mean relati realizatioo	Numb real	UnNormalize weight	Normaliz.we without DM	Normaliz.we with DM
1	exprt004	0.01911	1.755	2.46	14	0		0
2	exprt015	0.01432	1.551	2.717	14	0		0
3	exprt018	2.178E-006	2.298	3.777	14	0		0
4	exprt028	0.3547	1.186	2.018	14	0		0
5	exprt049	0.2536	1.488	2.013	14	0		0
6	exprt003	0.5994	1.01	2.082	14	1.248		0.5
7	exprt007	0.2745	1.62	2.217	14	0		0
8	exprt009	0.0003112	1.271	2.365	14	0		0
9	exprt010	1.904E-006	1.082	1.624	14	0		0
10	exprt014	0.04098	1.615	1.963	13	0		0
11	exprt027	0.0002081	1.157	2.066	14	0		0
12	exprt034	0.003589	1.349	2.424	14	0		0
13	exprt023	1.743E-006	1.657	1.889	14	0		0
14	exprt022	0.003537	1.647	3.275	14	0		0
15	PWi	0.5994	1.01	2.082	14	1.248		0.5
16	EW	0.2819	0.508	0.9929	14	0.2799		0.07883

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Panel 11

Case name : p11r 26-6-2017 Version W1.5.1

Results of scoring experts

Bayesian Updates: no Weights: item DM Optimisation: yes

Significance Level: 0.9683 Calibration Power: 1

Nr.	Id	Calibr.	Mean relati total	Mean relati realizatioo	Numb real	UnNormalize weight	Normaliz.we without DM	Normaliz.we with DM
1	exprt005	0.09093	3.681	1.341	14	0		0
2	exprt008	2.113E-006	1.971	2.017	14	0		0
3	exprt043	0.001261	1.181	1.297	14	0		0
4	exprt006	0.1853	1.307	1.55	14	0		0
5	exprt014	0.03391	3.778	1.118	14	0		0
6	exprt017	0.1435	1.1	0.9897	14	0		0
7	exprt021	0.03339	1.269	1.128	14	0		0
8	exprt030	0.09093	1.29	1.549	14	0		0
9	exprt036	1.904E-005	2.312	2.303	14	0		0
10	exprt041	0.5691	0.8942	0.935	14	0		0
11	exprt045	0.0119	1.331	0.6992	14	0		0
12	exprt012	0.04827	0.8694	1.088	14	0		0
13	exprt042	0.2225	1.602	1.489	14	0		0
14	exprt013	0.9683	0.8927	1.19	14	1.152		0.5
15	PWi	0.9683	0.8927	1.19	14	1.152		0.5
16	EW	0.2498	0.4087	0.4675	14	0.1168		0.03942

Panel 8

Case name : p8r 26-6-2017 Version W1.5.1

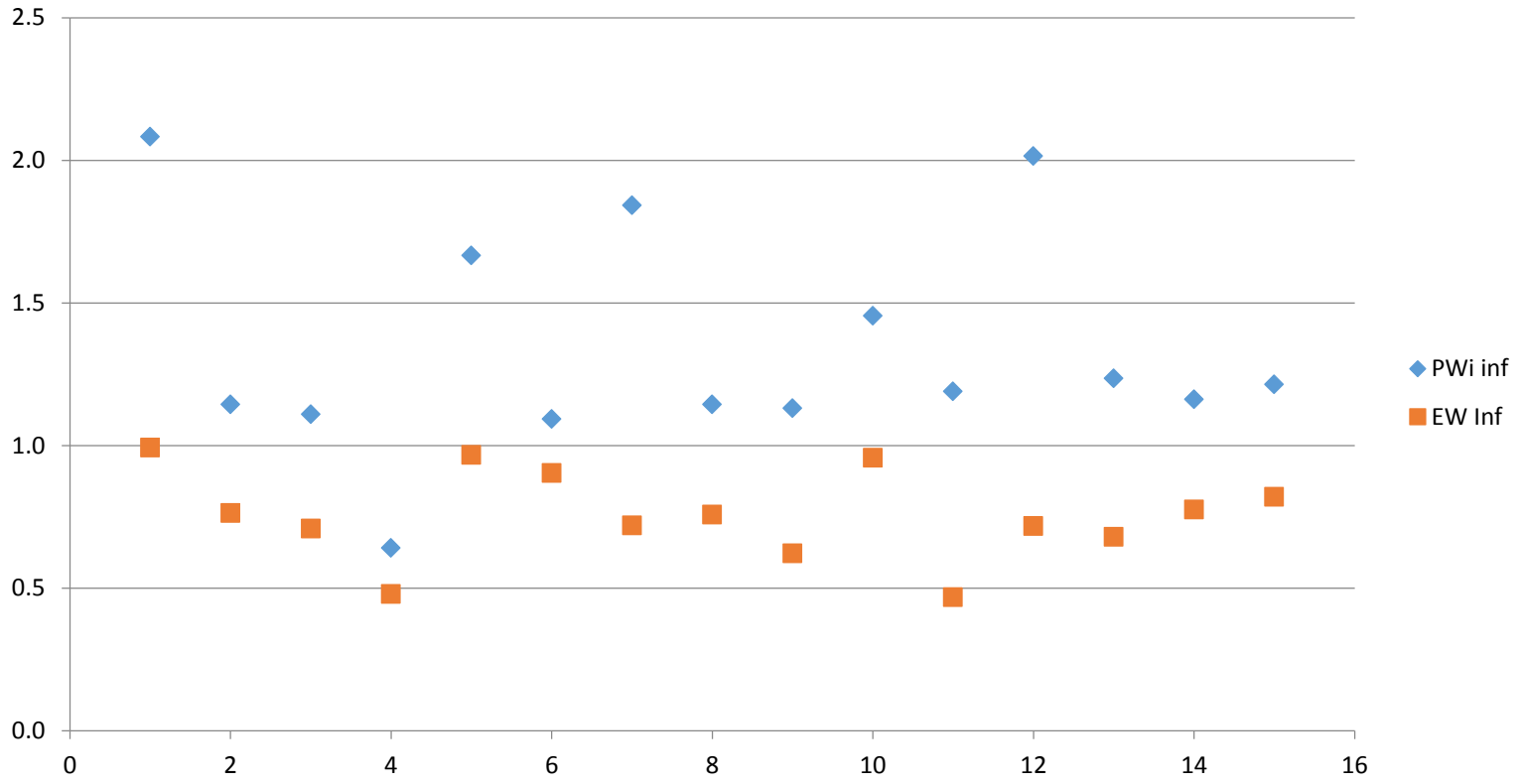
Results of scoring experts

Bayesian Updates: no Weights: item DM Optimisation: yes

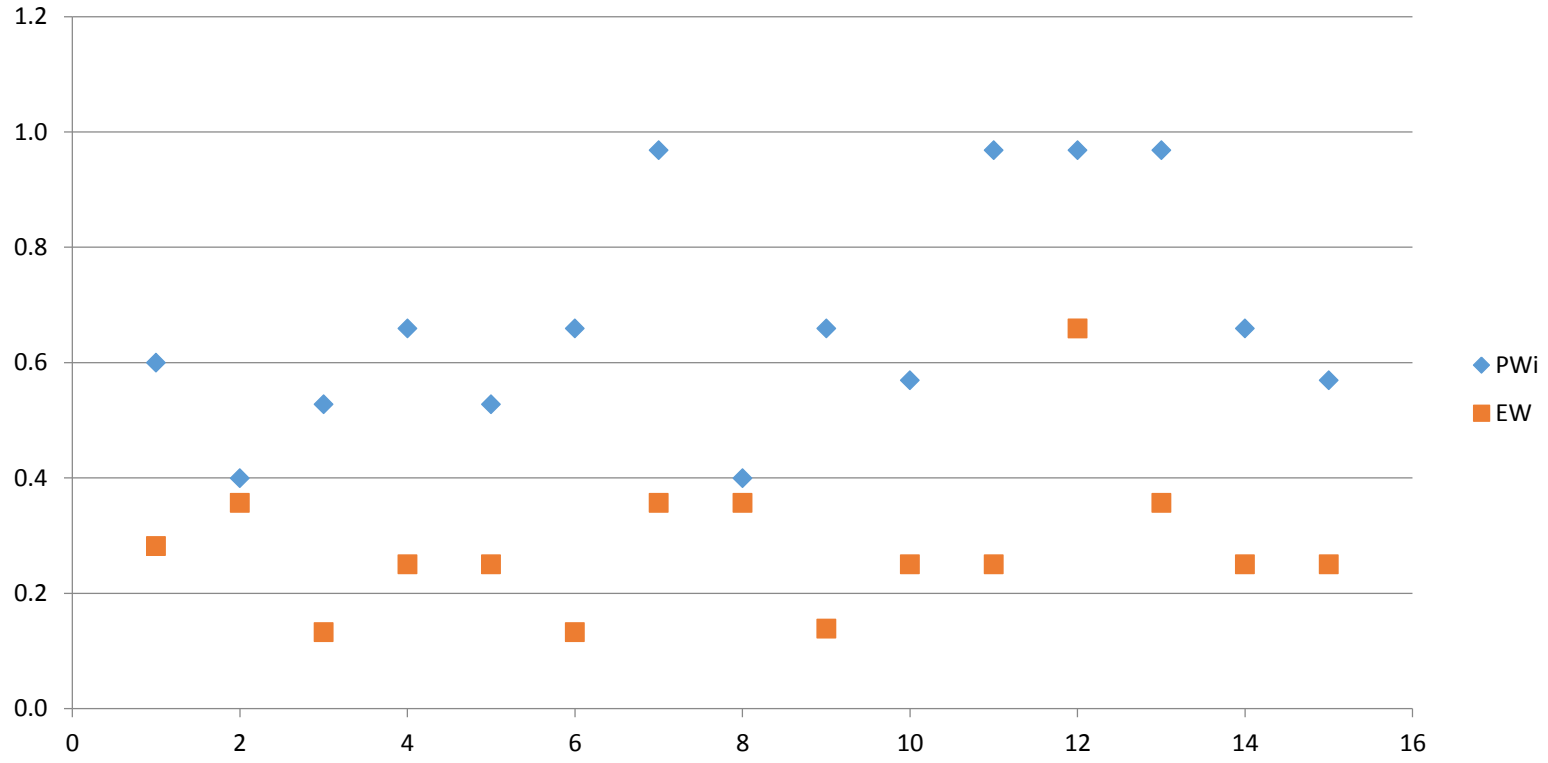
Significance Level: 0.07235 Calibration Power: 1

Nr.	Id	Calibr.	Mean relati total	Mean relati realizatioo	Numb real	UnNormalize weight	Normaliz.we without DM	Normaliz.we with DM
1	exprt001	0.0007204	2.179	2.153	14	0		0
2	exprt011	0.006782	1.874	2.459	14	0		0
3	exprt026	0.09093	1.745	1.745	14	0.1586		0.02815
4	exprt029	0.03339	1.614	1.653	14	0		0
5	exprt033	0.2426	1.749	1.726	14	0.4188		0.07432
6	exprt043	0.001261	1.807	2.182	14	0		0
7	exprt003	0.5691	1.515	1.791	14	1.019		0.1809
8	exprt009	0.0001566	1.748	2.069	14	0		0
9	exprt024	0.009843	1.682	1.998	14	0		0
10	exprt025	0.009843	1.853	1.674	14	0		0
11	exprt037	0.0002755	1.871	2.056	14	0		0
12	exprt039	0.07235	1.726	2.082	14	0.1506		0.02673
13	exprt041	0.5691	1.484	1.806	14	1.028		0.1824
14	exprt046	1.23E-005	1.738	1.828	14	0		0
15	exprt047	0.5691	1.083	1.131	14	0.6438		0.1142
16	exprt049	0.2225	1.561	1.717	14	0.3821		0.0678
17	exprt050	0.5691	1.073	1.27	14	0.7227		0.1282
18	exprt016	0.07235	1.617	1.752	14	0.1268		0.02249
19	exprt042	0.2225	1.79	2.373	14	0.5281		0.09371
20	PWi	0.3992	0.9465	1.144	14	0.4567		0.08105
21	EW	0.3565	0.6269	0.7578	14	0.2702		0.04858

Information



Statistical accuracy



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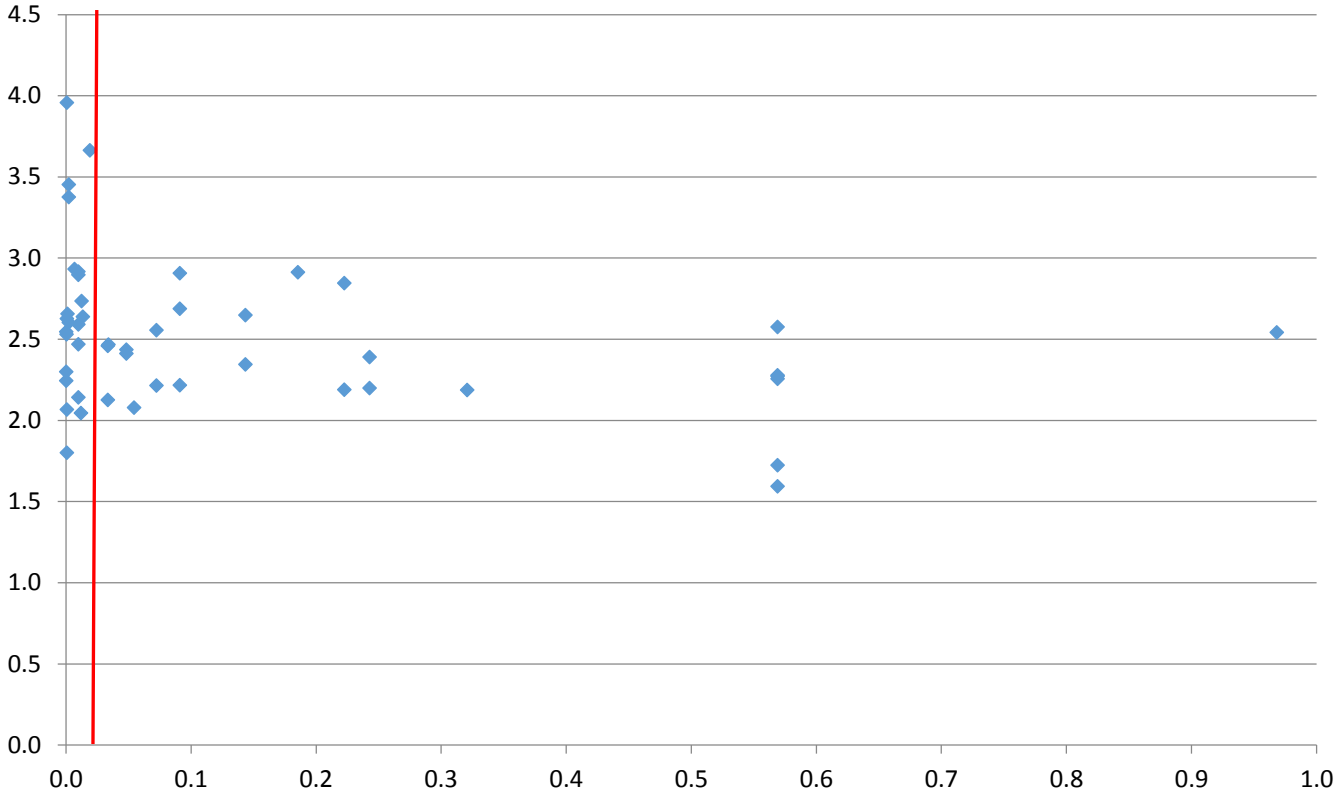
Experts' performance

23 out of 48 experts with SA > 0.05



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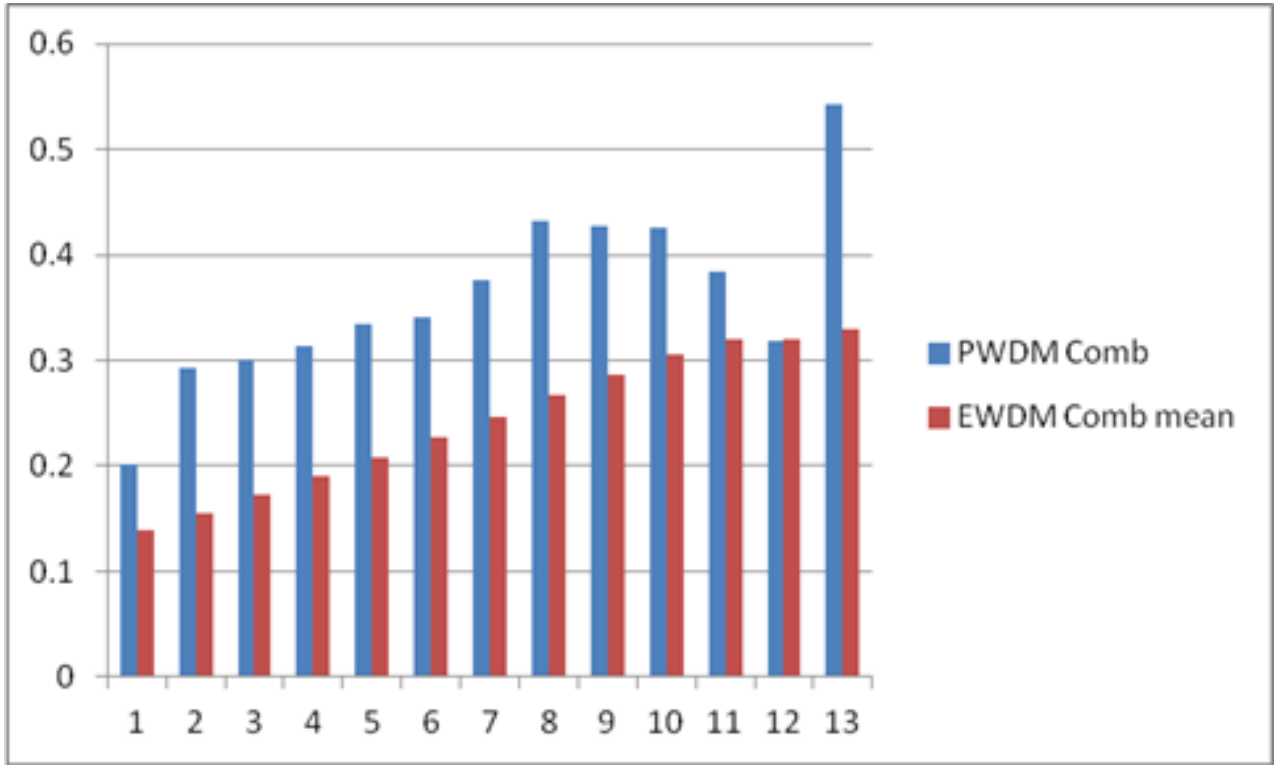
Cross validation Panel 6



THANK YOU!

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