

Seasonal Forecast Verification ROC & Reliability Exercise

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WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

lectures

- 1** *Introduction*
- 2** *Forecast Attributes*
- 3** **ROC & Reliability - Exercise**
- 4** *Significance & Robustness*
- 5**



The Exercise

identify the forecasts of El Niño, Neutral, and La Niña years

Year	December NIÑO3 NCEP Forecasts											
	Observed		BoM		COLA		LDEO1		NCEP		UO	
1981	0.36	N	-0.41		-0.84	L	0.46		0.13		-0.42	
1982	3.31	E	1.74	E	2.11	E	2.76	E	1.49	E	2.14	E
1983	-0.65	N	-0.45		0.36		2.62	E	0.66		-1.42	L
1984	-1.38	L	-1.34		-1.07		-0.12		-0.17		-1.28	
1985	-0.79	L	-0.15		-0.61		0.86		0.18		0.12	
1986	0.77	E	0.09		1.24		1.33		0.38		0.69	
1987	1.11	E	0.24		-0.17		0.53		0.94		0.70	
1988	-2.02	L	-1.66		-1.56		-1.01		-0.76		-1.97	
1989	-0.37	N	-0.76		0.04		0.15		0.04		0.12	
1990	0.00	N	0.53		-0.27		1.34		0.23		0.00	
1991	1.44	E	0.47		2.32		1.16		1.04		0.80	
1992	-0.08	N	-0.79		-0.79		-0.52		-0.33		-1.18	
1993	0.23	N	-0.02		-0.65		-0.24		-0.21		-0.16	
1994	0.98	E	0.33		0.03		0.42		-0.30		0.41	
1995	-0.89	L	-0.39		-1.02		-0.35		0.13		-0.20	
1996	-0.88	L	0.28		-0.63		-0.82		0.35		0.11	
1997	3.68	E	3.02		2.61		-0.23		3.09		2.50	
1998	-1.22	L	-0.50		-0.19		-0.50		-0.75		-0.80	

The Exercise

identify the forecasts of El Niño, Neutral, and La Niña years

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1981	0.36	N	-0.41		-0.84	L	0.46		0.13		-0.42	
1982	3.31	E	1.74	E	2.11	E	2.76	E	1.49	E	2.14	E
1983	-0.65	N	-0.45		0.36		2.62	E	0.66		-1.42	L
1984	-1.38	L	-1.34	L	-1.07	L	-0.12		-0.17		-1.28	L
1985	-0.79	L	-0.15		-0.61		0.86	E	0.18		0.12	
1986	0.77	E	0.09		1.24	E	1.33	E	0.38		0.69	
1987	1.11	E	0.24		-0.17		0.53		0.94	E	0.70	E
1988	-2.02	L	-1.66	L	-1.56	L	-1.01	L	-0.76	L	-1.97	L
1989	-0.37	N	-0.76	L	0.04		0.15		0.04		0.12	
1990	0.00	N	0.53		-0.27		1.34	E	0.23		0.00	
1991	1.44	E	0.47		2.32	E	1.16	E	1.04	E	0.80	E
1992	-0.08	N	-0.79	L	-0.79	L	-0.52		-0.33		-1.18	L
1993	0.23	N	-0.02		-0.65		-0.24		-0.21		-0.16	
1994	0.98	E	0.33		0.03		0.42		-0.30		0.41	
1995	-0.89	L	-0.39		-1.02	L	-0.35		0.13		-0.20	
1996	-0.88	L	0.28		-0.63		-0.82	L	0.35		0.11	
1997	3.68	E	3.02	E	2.61	E	-0.23		3.09	E	2.50	E
1998	-1.22	L	-0.50		-0.19		-0.50		-0.75	L	-0.80	L



The Exercise

calculate forecast probabilities for El Niño, neutral, and La Niña events

Year	December NIÑO3 Forecasts				
	Observed	El Niño	Neutral	La Niña	
1981	0.36	N	0 %	80 %	20 %
1982	3.31	E	100 %	0 %	0 %
1983	-0.65	N	20 %	60 %	20 %
1984	-1.38	L			
1985	-0.79	L			
1986	0.77	E			
1987	1.11	E			
1988	-2.02	L			
1989	-0.37	N			
1990	0.00	N			
1991	1.44	E			
1992	-0.08	N			
1993	0.23	N			
1994	0.98	E			
1995	-0.89	L			
1996	-0.88	L			
1997	3.68	E			
1998	-1.22	L			

The Exercise

calculate forecast probabilities for El Niño, neutral, and La Niña events

Year	December NIÑO3 Forecasts				
	Observed		El Niño	Neutral	La Niña
1981	0.36	N	0 %	80 %	20 %
1982	3.31	E	100 %	0 %	0 %
1983	-0.65	N	20 %	60 %	20 %
1984	-1.38	L	0%	40%	60%
1985	-0.79	L	20%	80%	0%
1986	0.77	E	40%	60%	0%
1987	1.11	E	40%	60%	0%
1988	-2.02	L	0%	0%	100%
1989	-0.37	N	0%	80%	20%
1990	0.00	N	20%	80%	0%
1991	1.44	E	80%	20%	0%
1992	-0.08	N	0%	40%	60%
1993	0.23	N	0%	100%	0%
1994	0.98	E	0%	100%	0%
1995	-0.89	L	0%	80%	20%
1996	-0.88	L	0%	80%	20%
1997	3.68	E	80%	20%	0%
1998	-1.22	L	0%	60%	40%



The Exercise

calculate forecast biases

Event	Bias
El Niño	
Neutral	
La Niña	20 % - 33 %

The frequency of La Niña forecasts is $18 / (18 * 5) = 0,20$

The observed frequency of La Niña events is $6 / 18 = 0,33$

The Exercise

calculate forecast biases

Event	Bias
El Niño	$22-33 = -11\%$
Neutral	$58-33 = 25\%$
La Niña	$20-33 = -12\%$

The Exercise

calculate forecast probabilities for El Niño, neutral, and La Niña events

Year	December NIÑO3 Forecasts				
	Observed		El Niño	Neutral	La Niña
1981	0.36	N	0 %	80 %	20 %
1982	3.31	E	100 %	0 %	0 %
1983	-0.65	N	20 %	60 %	20 %
1984	-1.38	L	0%	40%	60%
1985	-0.79	L	20%	80%	0%
1986	0.77	E	40%	60%	0%
1987	1.11	E	40%	60%	0%
1988	-2.02	L	0%	0%	100%
1989	-0.37	N	0%	80%	20%
1990	0.00	N	20%	80%	0%
1991	1.44	E	80%	20%	0%
1992	-0.08	N	0%	40%	60%
1993	0.23	N	0%	100%	0%
1994	0.98	E	0%	100%	0%
1995	-0.89	L	0%	80%	20%
1996	-0.88	L	0%	80%	20%
1997	3.68	E	80%	20%	0%
1998	-1.22	L	0%	60%	40%



The Exercise

calculate the Hit Rate and False Alarm Rate

Year	December NIÑO3 Forecasts				
	Observed	El Niño	Neutral	La Niña	
1981	0.36	N	0%	80%	20%
1982	3.31	E	100%	0%	0%
1983	-0.65	N	20%	60%	20%
1984	-1.38	L	0%	40%	60%
1985	-0.79	L	20%	80%	0%
1986	0.77	E	40%	60%	0%
1987	1.11	E	40%	60%	0%
1988	-2.02	L	0%	0%	100%
1989	-0.37	N	0%	80%	20%
1990	0.00	N	20%	80%	0%
1991	1.44	E	80%	20%	0%
1992	-0.08	N	0%	40%	60%
1993	0.23	N	0%	100%	0%
1994	0.98	E	0%	100%	0%
1995	-0.89	L	0%	80%	20%
1996	-0.88	L	0%	80%	20%
1997	3.68	E	80%	20%	0%
1998	-1.22	L	0%	60%	40%

Warning	El Niño	
	Hit Rate	False-alarm rate
≥ 0%	1,00	1,00
≥ 20%	0,83	0,25
≥ 40%	0,83	0,00
≥ 60%	0,50	0,00
≥ 80%	0,50	0,00
≥ 100%	0,17	0,00

The Exercise

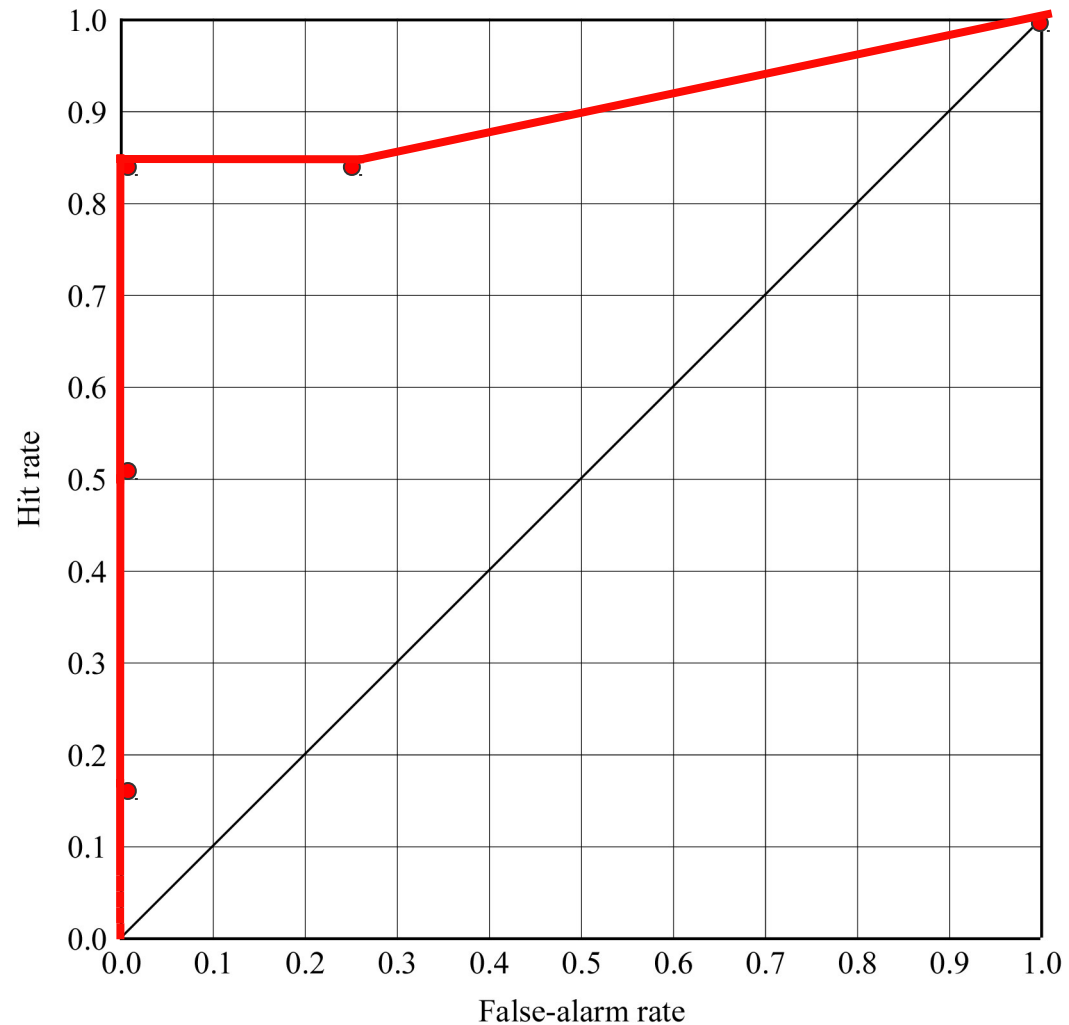
calculate the Hit Rate and False Alarm Rate

Warning	El Niño		Neutral		La Niña	
	Hit Rate	False-alarm rate	Hit Rate	False-alarm rate	Hit Rate	False-alarm rate
≥ 0%	1.00	1.00	1.00	1.00	1.00	1.00
≥ 20%	0.83	0.25	1.00	0.83	0.83	0.33
≥ 40%	0.83	0.00	1.00	0.67	0.50	0.08
≥ 60%	0.50	0.00	0.83	0.58	0.33	0.08
≥ 80%	0.50	0.00	0.67	0.33	0.17	0.00
≥ 100%	0.17	0.00	0.17	0.08	0.17	0.00

The Exercise

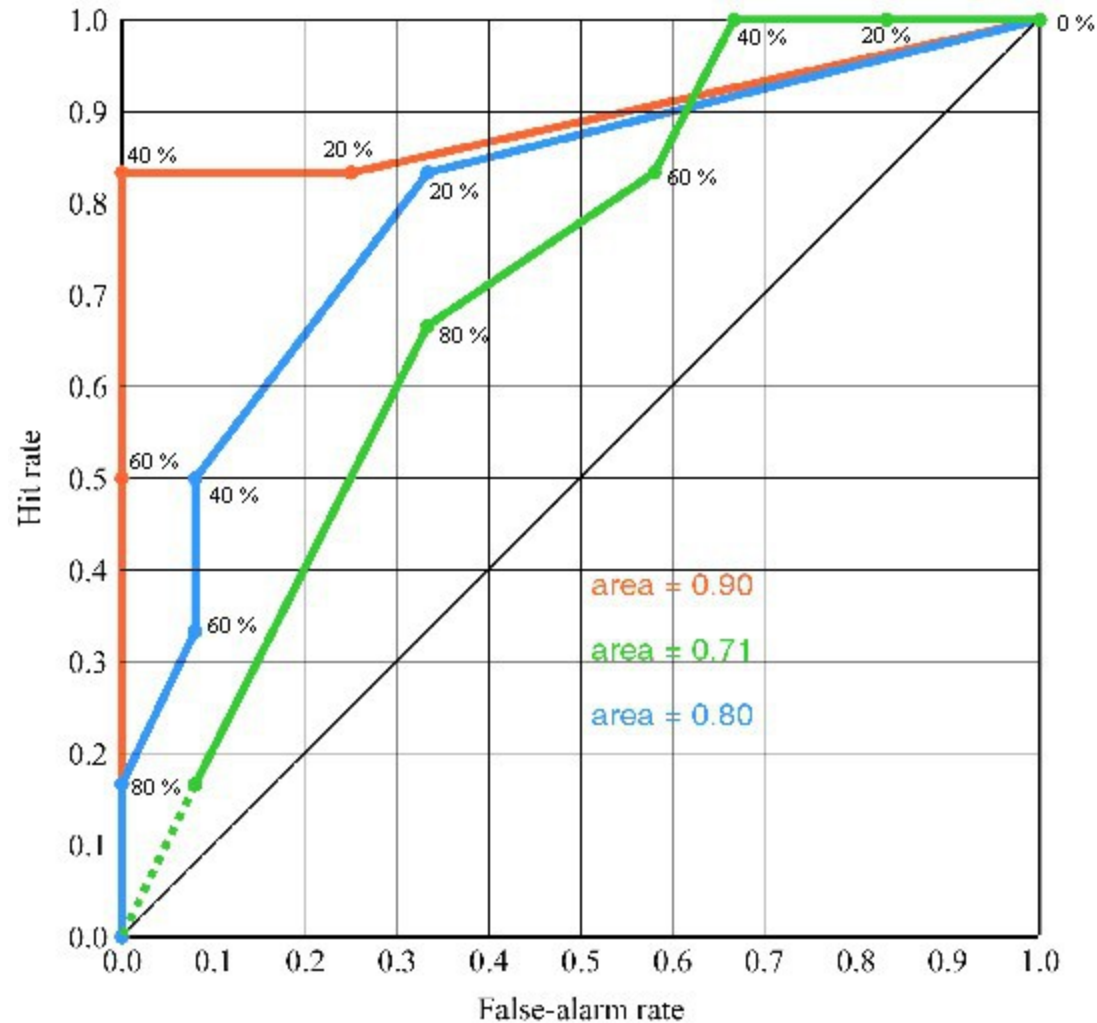
ROC diagram

Warning	El Niño	
	Hit Rate	False-alarm rate
$\geq 0\%$	1,00	1,00
$\geq 20\%$	0,83	0,25
$\geq 40\%$	0,83	0,00
$\geq 60\%$	0,50	0,00
$\geq 80\%$	0,50	0,00
$\geq 100\%$	0,17	0,00



The Exercise

ROC diagram



The Exercise

- ***Brier skill scores***

Event	Area
El Niño	0.52
Neutral	-0.22
La Niña	0.18

- ***Differences between the ROC areas and Brier skill scores***

- The ROC areas indicate more optimistic estimates of forecast skill, most notably for the neutral conditions.
- The Brier skill score indicates negative skill for forecasts of neutral conditions. The Brier skill scores for this category are weak because of the large forecast bias, but the ROC ignores the bias.

The Exercise

calculate the observed relative frequency upon the forecast probability

Year	December NIÑO3 Forecasts		
	Observed		La Niña
1981	0.36	N	20 %
1982	3.31	E	0 %
1983	-0.65	N	20 %
1984	-1.38	L	60%
1985	-0.79	L	0%
1986	0.77	E	0%
1987	1.11	E	0%
1988	-2.02	L	100%
1989	-0.37	N	20%
1990	0.00	N	0%
1991	1.44	E	0%
1992	-0.08	N	60%
1993	0.23	N	0%
1994	0.98	E	0%
1995	-0.89	L	20%
1996	-0.88	L	20%
1997	3.68	E	0%
1998	-1.22	L	40%

Forecast	La Niña
0%	1/9
20%	2/5
40%	1/1
60%	1/2
80%	
100%	1/1

The Exercise

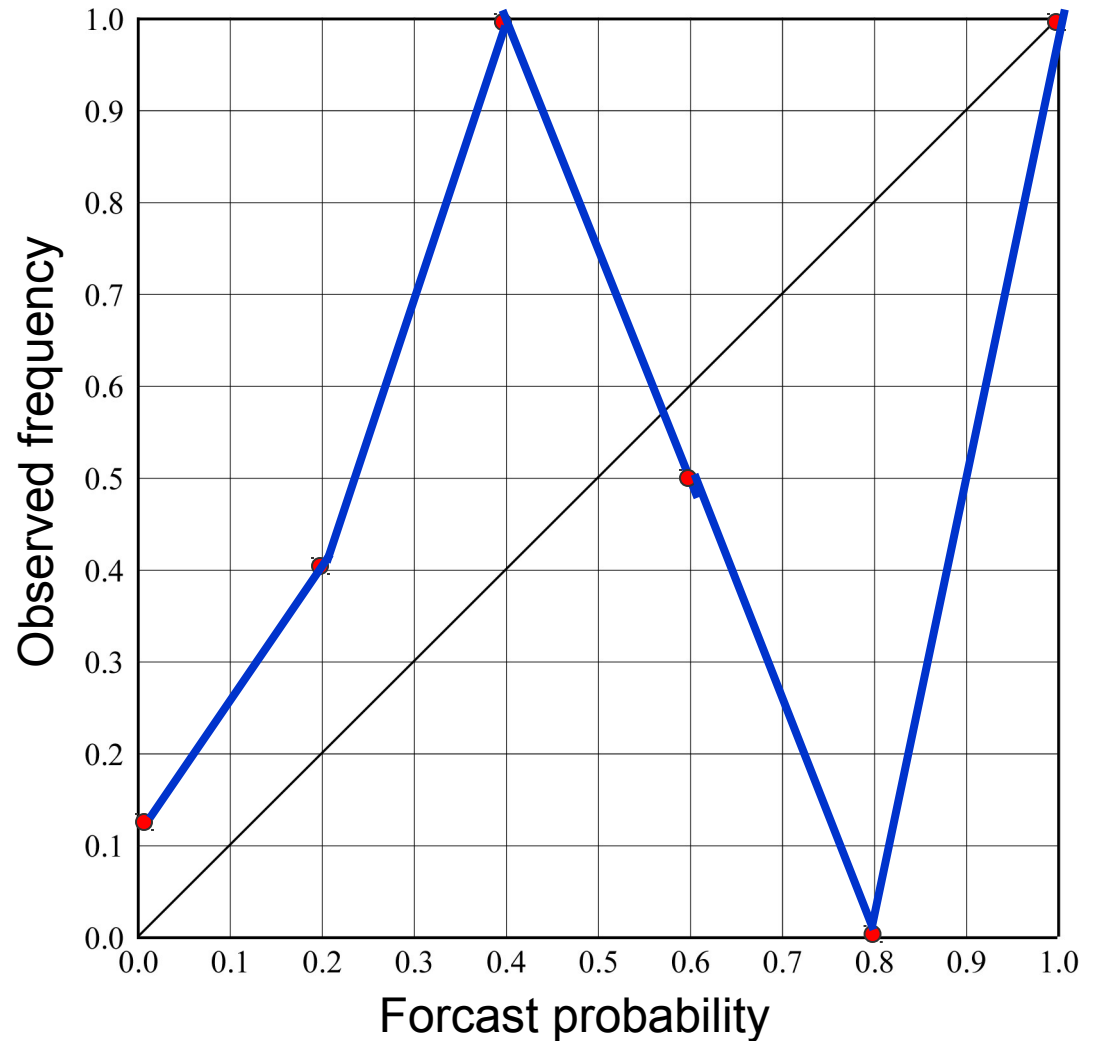
calculate the observed relative frequency upon the forecast probability

Forecast	El Niño	Neutral	La Niña
0%	10%	0%	11%
20%	0%	0%	40%
40%	100%	50%	100%
60%	x	25%	50%
80%	100%	50%	x
100%	100%	50%	100%

The Exercise

Reliability diagram

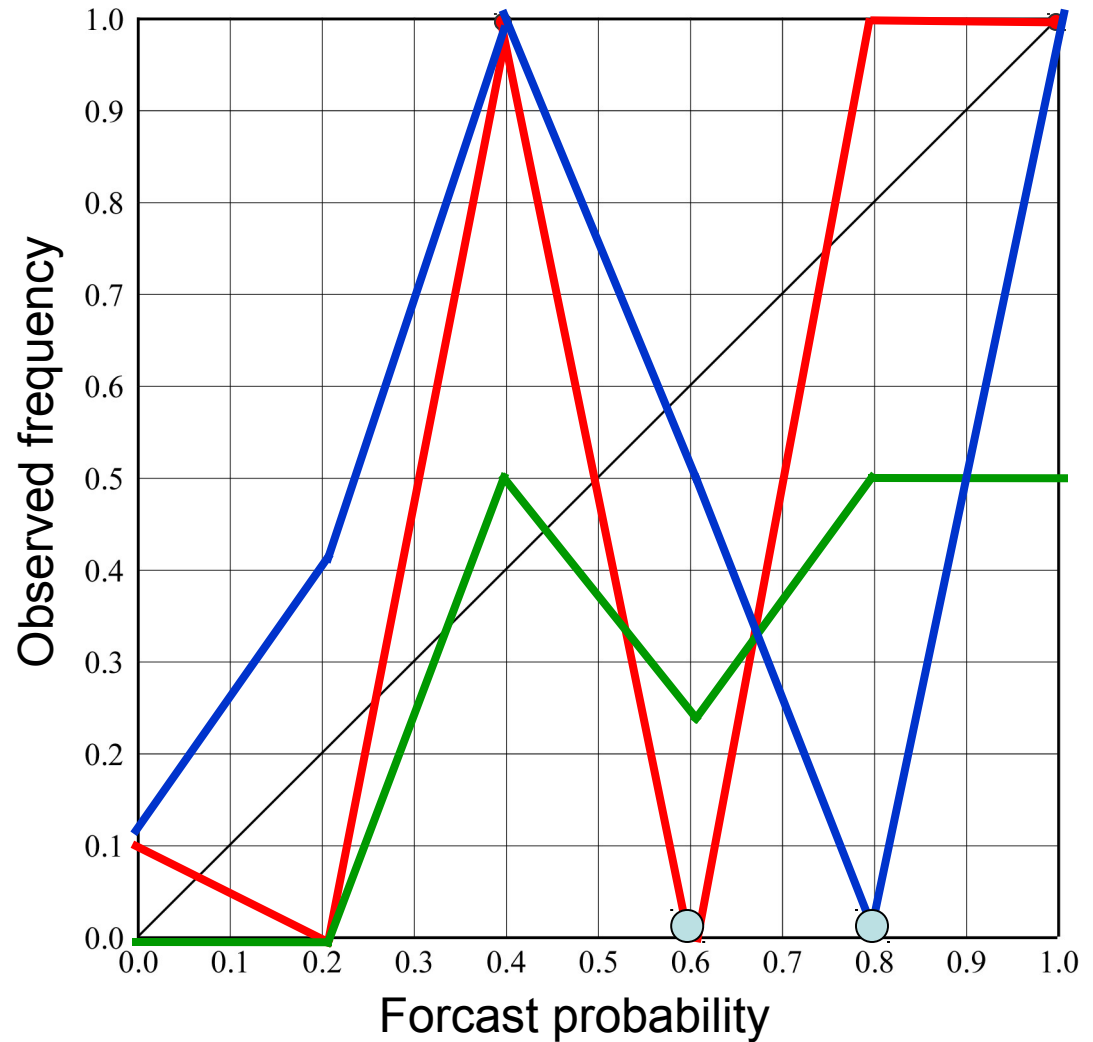
Forecast	La Niña
0%	11%
20%	40%
40%	100%
60%	50%
80%	x
100%	100%



The Exercise

Reliability diagram

El Niño
Neutral
La Niña



Thank you Merci



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