



**THE DICHOTOMOUS METHOD OF WEATHER FORECAST VERIFICATION
AT THE CENTRAL FORECAST OFFICE (CFO), NIGERIAN
METEOROLOGICAL AGENCY, (NIMET), ABUJA, NIGERIA.**



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Introduction; Aim; Objectives; Requirements for verification; Mode of Verification:

- The **dichotomous method** used at CFO is simple and effective enough to serve the purpose.
- Both daily validations and monthly verifications are carried out using ground (primary) reports from **48 weather stations** spread across **Abuja** and the **36 states** of Nigeria, and from Satellite based information.
- **Aim:** *To evaluate the **skill performance of the forecasting techniques** at the CFO, using standard **contingencies and standard ratios**, by **comparing forecast and observation**, in order to **verify** the **closeness** between **the forecast** and **the observed**.*
- **Objective:** the above aim helps us to achieve the following;
- **Personnel evaluation;** helps *to know* the **performance rate of staff** in the area of **model interpretation**, and make **improvements**.
- **Model evaluation;** helps to **guard** against **model related forecast errors**, esp. during **transitional periods**, due to **model adjustment**.
- **Requirements for verification:**
- **Daily weather forecast bulletin:** *details of forecast issued* for the **48 cities** or **LGA** in which the **representative stations** are located.
- **Observation reports from ground stations:** As **accessible as possible**, **a.m.** and **p.m.** reports of weather conditions of the day in view. **Best verification tool** but has both **spatial** and **temporal challenges**. As, **all stations** are **not 24/7**. **Report** not a **true representation** of area.
- **Satellite based observations:** spatially and temporally useful to verify weather phenomena. Sources; **PUMA**, **EUMETSAT** website etc.. However, **not a perfect substitute** to **verify temperature**.
- **Modes of verification and meteorological parameters to verify:** **2 modes;**
- **Daily weather forecast validation:** Weather **phenomenon**, **minimum** temperature and **maximum** temperature, with a bias of **+2°C**.
- **Monthly weather forecast verification:** Weather **phenomenon** only.

Daily Weather Forecast Validation:

- **Tool:** Microsoft word, **tabular representation.**
- **Row** representation: each **row** represents a weather **station** which is representative of a city or an area. There are a total of **48 stations/cities represented** by the rows.
- **Column** representation: **a.m.** weather forecast, **p.m.** weather forecast, **a.m.** weather observed, **p.m.** weather observed, minimum temperature forecast, maximum temperature forecast, minimum temperature observed, maximum temperature observed, **a.m.** contingency, **p.m.** contingency, minimum temperature contingency and maximum temperature contingency. Column of contingencies are scored “1s” and “0s” for “hits” and “misses” respectively
- **Accuracy of forecast:** measurements of forecast accuracy in daily weather validation is simply measured in percentage as follows;

Accuracy = (Sum of validated hits ÷ Sum of validated stations) × 100

S/N	STATION	FORECAST				OBSERVATION				WEATHER			TEMPERATURE	
		WEATHER		MAX/MIN TEMP		WEATHER		MAX/MIN TEMP		BINARY VERIFICATION			BINARY VERIFICATION	
		AM	PM			AM	PM			AM	PM	OP	MAX	MIN
1	ABUJA	TS	TS	31	23	TS	PC	24	24	1	0	1	0	1
2	AKURE	C	TS	27	22	RA	TS	27	22	0	1	1	1	1
3	BENIN	RA	RA	30	22	RA	RA	-	-	1	1	2	-	-
4	CALABAR	RA	RA	30	24	RA	RA	29	23	1	1	2	1	1
5	ENUGU	RA	TS	30	22	RA	PC	27	22	1	0	1	0	1
6	GOMBE	C	TS	32	22	TS	TS	-	19	0	1	1	-	0
7	IBADAN	C	RA	28	23	C	RA	-	22	1	1	2	-	1
8	ILORIN	C	TS	30	22	TS	TS	26	23	0	1	1	0	1
9	JOS	TS	TS	25	18	TS	TS	-	16	1	1	2	-	1
10	KADUNA	TS	TS	28	22	TS	TS	27	18	1	1	2	1	0
44	SHAKI	C	RA	29	21	C	PC	27	21	1	0	1	1	1
45	UMUAHIA	RA	RA	32	22	RA	PC	-	22	1	0	1	-	1
46	YELWA	C	TS	32	22	TS	PC	26	21	0	0	0	0	1
47	YENEGOA	C	RA	30	22	RA	C	-	25	0	0	0	-	0
48	DAMATURU	C	TS	33	23	TS	TS	-	22	0	1	1	-	1

Accuracy of Forecast:

Parameter	A.M.	P.M.	OVERALL
Weather phenomenon	58%	58%	58%
Min. Temperature.	80%	-	80%
Max. Temperature.	-	65%	65%

- **Tool:** Microsoft excel spread sheet.
- **Row** representation: each *row* represents a *representative* weather *station*. A total of **48 stations** are **represented** by the rows.
- **Column** representation: **a.m.** forecast, **p.m.** forecast, **a.m.** observation, **p.m.** observation, **a.m.** contingency and **p.m.** contingency. “**YES**” and “**NO**” represent “**event**” and “**non-event**” respectively. An “**event**” in this context means *rain, thunderstorm* or *deep convective cloud* like *cumulonimbus (CB)*. Also, that a “*non-event*” translates to *clear/sunny sky, partly cloudy sky* with intervals of sunshine or *cloudy sky* without CB. **Combinations** of “**YES**” and “**NO**”, when the *forecast* and the *observed* are *compared*, result in *more contingency outcomes* even as follows;

Contingency Table:

		Observation	
		YES	NO
Forecast	YES	Hit	False alarm (FA)
	NO	Miss	Correct non-even (CN)

Below is the “IF” and “AND” formula for contingency outcomes:

=IF(AND(B5="YES",D5="YES"),"HIT",IF(AND(B5="YES",D5="NO"),"FA",IF(AND(B5="NO",D5="NO"),"CN",IF(AND(B5="NO",D5="YES"),"MISS","NNA"))))

Where column B5 is the forecast and column D5 is the observed

Monthly Weather Forecast Verification:

		FORECAST		OBSERVED		MORNING	AFTERNOON
S/N	STATIONS	MORNING	AFTERNOON	MORNING	AFTERNOON	RESULT	RESULT
1	ABUJA	YES	YES	YES	NO	HIT	FA
2	AKURE	NO	YES	NO	YES	CN	HIT
3	BENIN	NO	NO	NO	NO	CN	CN
4	CALABAR	NO	NO	NO	NO	CN	CN
5	ENUGU	NO	YES	NO	NO	CN	FA
6	GOMBE	NO	YES	YES	YES	MISS	HIT
7	IBADAN	NO	NO	NO	NO	CN	CN
8	ILORIN	NO	YES	YES	YES	MISS	HIT
9	JOS	YES	YES	YES	YES	HIT	HIT
10	KADUNA	YES	YES	YES	YES	HIT	HIT
44	SHAKI	NO	NO	NO	NO	CN	CN
45	UMUAHIA	NO	NO	NO	NO	CN	CN
46	YELWA	NO	YES	YES	NO	MISS	FA
47	YENEGOA	NO	NO	NO	NO	CN	CN
48	DAMATURU	NO	YES	YES	YES	MISS	HIT

Hits	25	Accuracy.	0.688	POFD	0.281
Misses	14	Bias	1.051	CSI	0.455
CN	41	POD	0.641	ETS	37.67
FA	16	FAR	0.390	TSS/PSS	0.360

Forecast Accuracy and other verification ratios:

Finally, relevant *standard ratios* are *computed* to further *probe (verify)* the forecasting *skill performance* of the forecasts issued for a particular month. Please, note that daily computations for these ratios are done firstly, after which their monthly averages are done. Below are given the ratios and their formulae;

Accuracy = (Hits + CNs)/(Hits+Misses+CNs+FA s)

Bias = (Hits+FA s)/(Hits+Misses)

Probability of Detection, POD = Hits/(Hits+Misses)

False Alarm Ratio, FAR = FA s/(Hits+FA s)

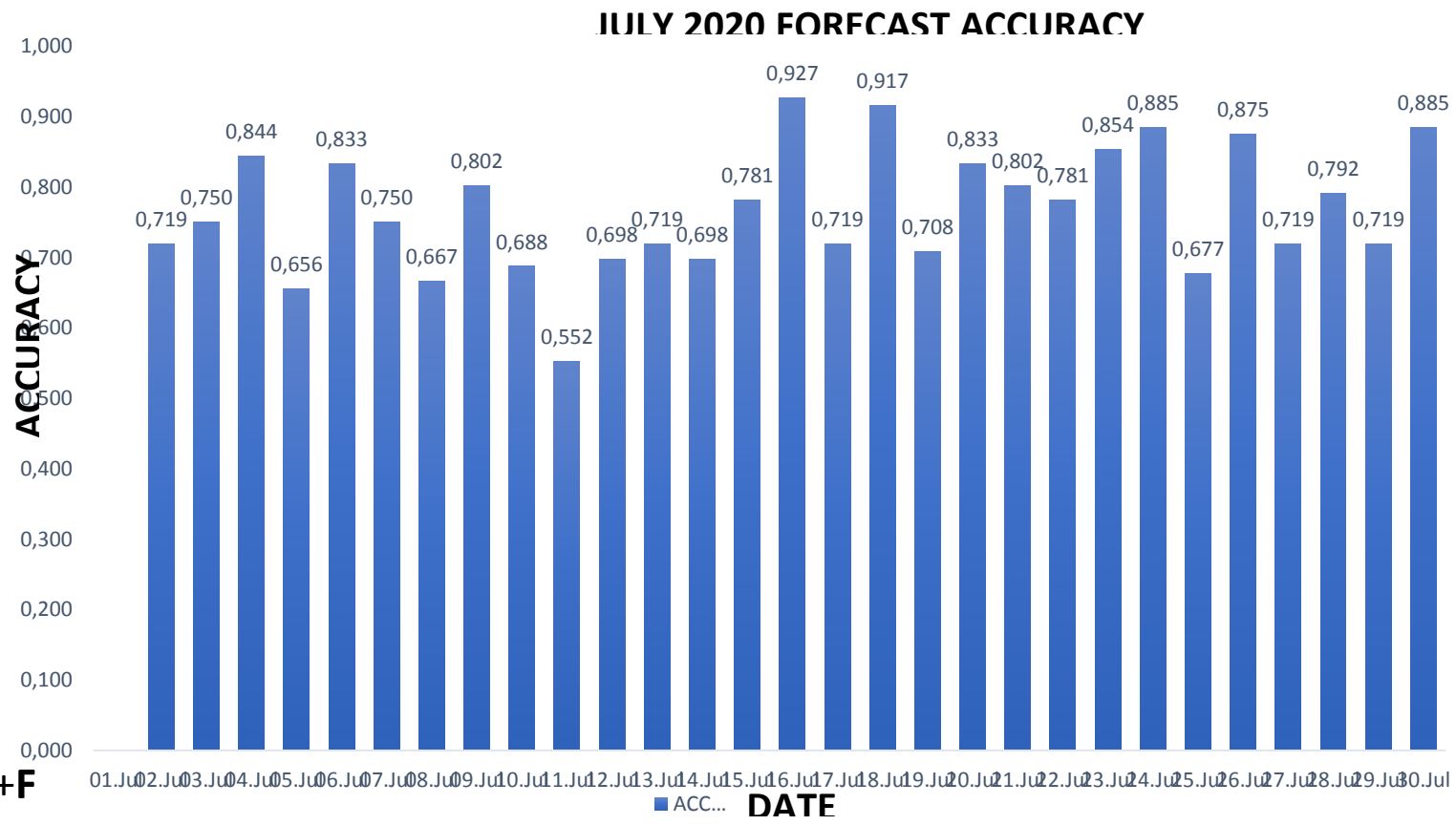
Probability of False Detection, POFD= FA s/(CNs+FA s)

Critical Success Index, CSI = Hits/(Hits+Misses+FA s)

ETS = Hits-
 $\{[(Hits+Misses) \times (Hits+FA s)] / (Hits+Misses+CNs+FA s)\} \div Hits+Misses+FA s-$
 $\{[(Hits+Misses) \times (Hits+FA s)] / (Hits+Misses+CNs+FA s)\}$

TSS/PSS = [Hits/(Hits+Misses)] - [FA s/(FA s+CNs)]

- **Forecast Accuracy and other verification ratios: These are represented in graphical as shown below**



THANK YOU