Computational Linguistics and the Communication of Weather Forecasts

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Definition

The Association for Computational Linguistics (ACL) defines the term Computational Linguistics as the scientific study of language from a computational perspective.

The ACL notes that computational linguists are interested in providing computational models of various kinds of linguistic phenomena and that these models may be:

- knowledge-based (hand-crafted); or,
- data-driven (statistical or empirical).

Motivation

The ACL further notes that work in computational linguistics is in some cases:

- motivated from a scientific perspective in that one is trying to provide a computational explanation for a particular linguistic or psycholinguistic phenomenon; and, in other cases,
- the motivation may be more purely technological in that one wants to provide a working component of a speech or natural language system.

Data Base

The current paper presents an analysis of the words used in a 12-year data set (2005-2017) of précis weather forecasts for Melbourne, Australia.

Analysis Strategy

•Studying the overall frequency of occurrence, of particular words and phrases;

•Noting any significant trends over the period, in the nature of the language utilised to communicate the weather forecast information;

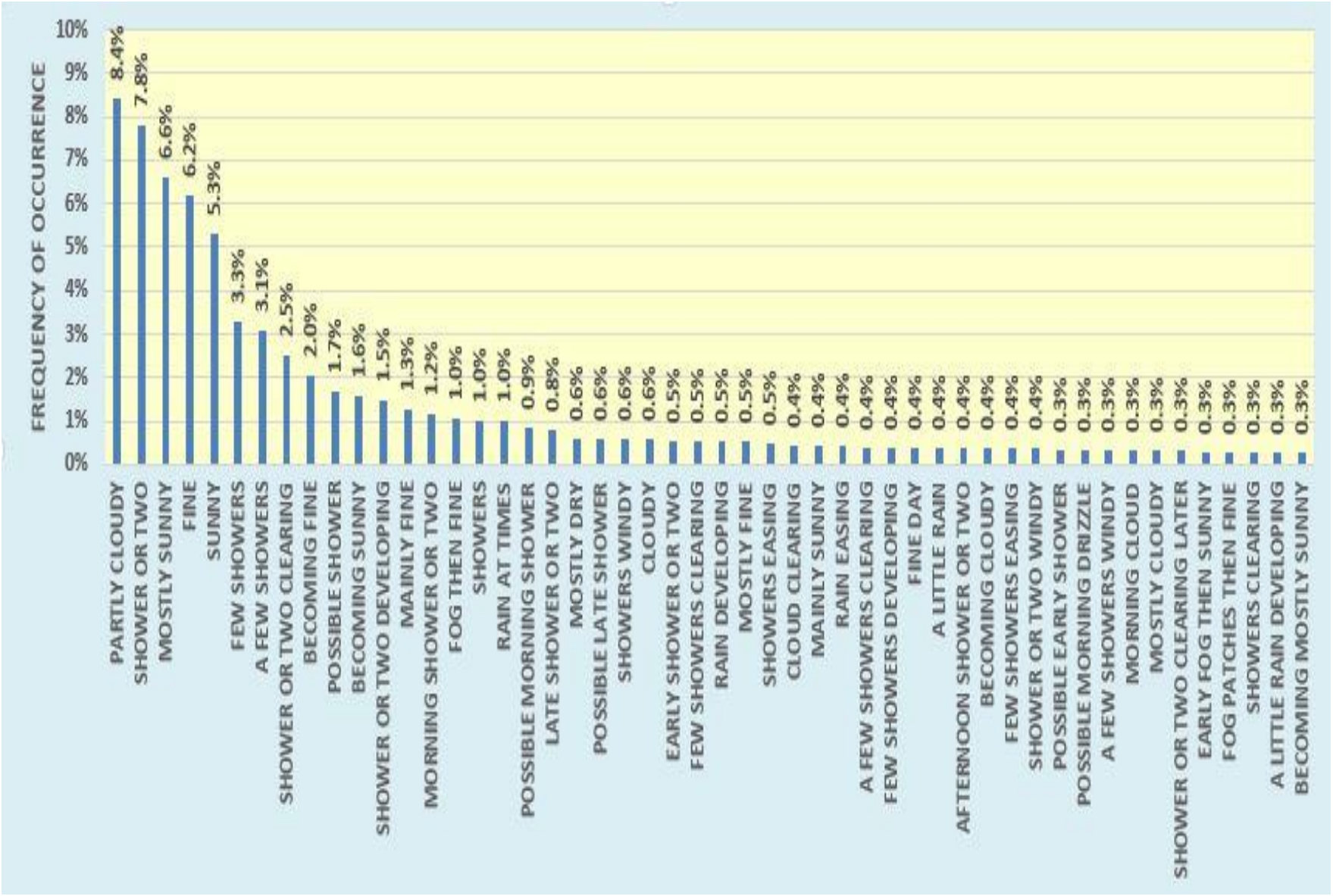
•Establishing how one might best combine textual components of weather forecasts with numerical components (for example, precipitation amount and probability) to (hopefully) enhance the accuracy of the latter.

Frequency

The ten most frequently occurring Day-1 précis weather forecasts issued by the Australian Bureau of Meteorology for Melbourne over the twelve years were:

PARTLY CLOUDY (8.4%),
SHOWER OR TWO (7.8%),
MOSTLY SUNNY (6.6%),
FINE (6.2%),
SUNNY (5.3%),
FEW SHOWERS (3.3%),
A FEW SHOWERS (3.1%),
SHOWER OR TWO CLEARING (2.5%),
BECOMING FINE (2.0%), and
POSSIBLE SHOWER (1.7%).

Frequency of Different Précis Weather Forecasts



Significant Trends

The most dramatic change in the language utilised relates to FINE which was used on 20% of occasions during the first year, but was completely absent during the last year.

By contrast, the précis PARTLY CLOUDY, which was not used at all during the first year, was used on 16% of occasions during the final year.

Blending Text and Numbers

Blending textual components of weather forecasts (e.g. A FEW SHOWERS) with numerical components (e.g. PoP 70%, 2 – 5 mm) enhances the accuracy of the numerical components.

Words + Precip Amount & Likelihood

Blending textual components of the official worded weather forecasts ...

* A FEW SHOWERS : *Predicted Words*) with numerical components ...

* Probability of Precipitation 70% : *Official PoP (Likelihood)*

* 2 to 5 mm : *Official LOW Number* to *Official HIGH Number*

Regression Relationship between Words and *Precipitation Likelihood*

Words most highly correlated with Precip Likelihood:

RAIN
SHOWERS
SHOWER
DRIZZLE
THUNDER

Words least highly correlated with Precip Likelihood:

LITTLE
CHANCE
FEW
CLEARING
LATE

VARIABLE	Coefficients	t Stat	P-value
CONSTANT	9.3914	7.99	8.5E-16
RAIN	73.6175	33.15	1.5E-215
SHOWER	35.7348	22.68	4.7E-108
SHOWERS	33.4854	14.94	1.4E-49
DRIZZLE	26.7889	6.80	6.0E-12
THUNDER	16.5787	5.47	2.4E-08
BECOMING	8.2476	3.39	3.5E-04
EASING	5.7797	2.10	1.8E-02
HEAVY	16.1928	1.31	9.6E-02
CLOUD	-2.1751	-1.18	1.2E-01
FOG	-4.7680	-1.70	4.5E-02
FINE	-3.9270	-2.39	8.4E-03
LATE	-4.3014	-2.52	5.9E-03
CLEARING	-4.8558	-2.66	4.0E-03
FEW	-6.6368	-2.68	3.7E-03
CHANCE	-13.7656	-6.33	1.3E-10
LITTLE	-24.6880	-7.65	1.3E-14

Regression Relationship Combining Words + Numbers with *Precip Likelihood (PoP)*

VARIABLE	*Coefficients*	*t Stat*	*P-value*
CONSTANT	4.2738	1.11	1.3E-01
SQRT(HIGH)	23.2366	5.76	4.7E-09
PoP	0.7085	5.19	1.2E-07
Predicted*	0.2384	1.77	3.8E-02
SQRT(LOW)	0.3642	0.10	4.6E-01
LOW	-0.3749	-0.22	4.1E-01
SQRT(Pred)	-1.1045	-0.71	2.4E-01
SQRT(PoP)	-2.2314	-2.09	1.9E-02
HIGH	-2.8180	-2.86	2.2E-03

% Variance Explained = 54.3%

***cf* 45.6% (**PoP**) 42.7% (**Pred-words**) 53.4% (**HIGH-number**) 47.2% (**LOW-number**)**

Regression Relationship between Words and *Precipitation Amount*

Words most highly correlated with Precip Amt:

RAIN
SHOWERS
SHOWER
HEAVY
THUNDER

Words least highly correlated with Precip Amt:

LITTLE
FEW
CHANCE
CLEARING
LATE

VARIABLE	Coefficients	t Stat	P-value
CONSTANT	0.1417	5.43	3.0E-08
RAIN	2.0797	42.15	0.0E+00
SHOWERS	0.9540	19.16	5.8E-79
SHOWER	0.4994	14.27	1.8E-45
HEAVY	2.5934	9.42	3.4E-21
THUNDER	0.5546	8.24	1.1E-16
DRIZZLE	0.4940	5.64	8.9E-09
EASING	0.3008	4.93	4.3E-07
BECOMING	0.0888	1.64	5.0E-02
FOG	-0.0260	-0.42	3.4E-01
CLOUD	-0.0696	-1.70	4.4E-02
FINE	-0.1144	-3.13	8.7E-04
LATE	-0.1515	-3.99	3.3E-05
CLEARING	-0.1670	-4.11	2.0E-05
CHANCE	-0.2616	-5.42	3.2E-08
FEW	-0.4505	-8.19	1.6E-16
LITTLE	-0.8675	-12.10	1.9E-33

Regression Relationship Combining Words + Numbers with *Precip Amount*

VARIABLE	Coefficients	t Stat	P-value
CONSTANT	0.0630	1.47	7.1E-02
Predicted*	0.4335	6.11	6.0E-10
HIGH	0.0766	3.77	8.5E-05
SQRT(HIGH)	0.2686	3.24	6.0E-04
PoP	0.0090	3.22	6.5E-04
SQRT(LOW)	0.1237	1.65	4.9E-02
SQRT(PoP)	-0.0430	-1.95	2.5E-02
LOW	-0.0892	-2.54	5.6E-03
SQRT(Pred)	-0.3394	-3.12	9.2E-04

% Variance Explained = 64.7%

***cf* 47.6% (**PoP**) 53.0% (**Pred-words**) 64.4% (**HIGH-number**) 59.9% (**LOW-number**)**

Concluding Remarks

The frequency distribution of various words used in the official weather forecasts has been established, and it has been shown that their usage varies over time as different words become less or more 'fashionable'.

The analysis approach described here is shown to enhance the accuracy of the numerical components of the official forecasts, albeit only slightly.

However, the approach readily achieves the identification of how the individual components of the official forecasts, and also the words utilised therein, are related to both the amount and likelihood of subsequent precipitation.

Thank You ...

Any Questions?