Developing overnight minimum temperature and daytime maximum temperature databases

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1. INTRODUCTION

Recently, the Bureau of Meteorology decided to take the minimum temperature between 6pm and 9am as representing the "overnight" minimum temperature (OMIN), and the maximum temperature between 6am and 9pm as representing the "daytime" maximum temperature (DMAX).

However, some systems for automated weather forecast verification still source the standard "minimum temperature during the 24 hours to 9am" (9amMIN) and the standard "maximum temperature during the 24 hours from 9am" (9amMAX). Such databases may include misleading OMINs and misleading DMAXs.

2. PURPOSE

Since 1990, the increasing number of automatic weather stations providing data at 1-minute intervals readily allows the establishment of OMIN and DMAX databases. The purpose of this paper is to show how to apply stratification and regression analysis to historical temperature data taken at 3-hourly intervals in order to establish reliable OMIN and DMAX databases.
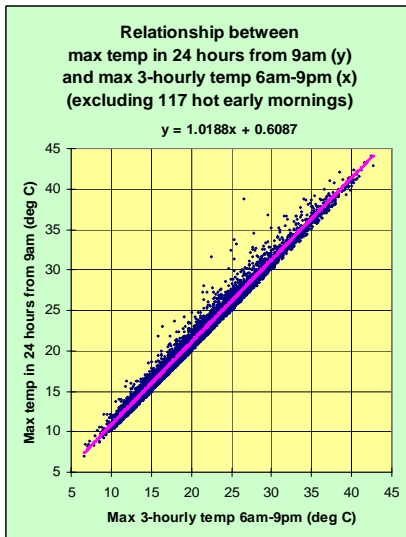
3. EXAMPLES

3.1 Maximum temperature on 12-Jan-1982

For example, in Melbourne, on 12-Jan-1982, the 6am temperature was 32.2°C, but the 9amMAX was only 24.2°C. 24.2°C provides a misleading representation of the 12-Jan-1982 DMAX, it likely to have been at, or slightly above, the 6am temperature of 32.2°C.

During the 30-year period between 1979 and 2008 (10958 days) there are 77 cases where the *current day's* 6am temperature is above the 9amMAX. During the same period, there are another 40 cases where the *current day's* 6am temperature is at, or between 0.1 °C and 0.5 °C below, the 9amMAX.

In such circumstances, it may be suggested that the *current day's* 6am temperature provides a better estimate of DMAX than does 9amMAX. The data is stratified to exclude these cases, and regression analysis is applied to the remaining data to yield the following relationship which is then solved in all these cases, in order to yield, for these cases, an improved estimate of DMAX.

Relationship between
max temp in 24 hours from 9am (y)
and max 3-hourly temp 6am-9pm (x)
(excluding 117 hot early mornings)
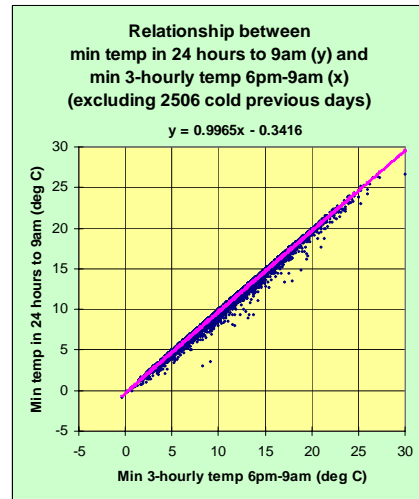
$y = 1.0188x + 0.6087$

3.2 Minimum temperature on 3-Mar-1988

The lowest temperature recorded in the 24 hours to 9am 3-Mar-1988 was 15.6°C at 9am the previous morning. However, the temperatures recorded at 3-hourly intervals between 6pm the previous evening and 9am that day were 35.4°C-29.8°C-27.3°C-27.4°C-27.7°C-27.2°C. 15.6°C provides a misleading representation of the 3-Mar-1988 OMIN, it likely to have been at, or slightly below, the lowest of the temperatures recorded at 3-hourly intervals between 6pm the previous evening and 9am that day, which was 27.2°C.

During the 30-year period between 1979 and 2008 there are 1319 cases where the 9amMIN equals the lowest of the previous day's 9am, Noon, and 3pm temperatures. During the same period, there are another 1187 cases where the where the 9amMIN is between 0.1 °C and 0.5 °C above, the 9amMIN.

In such circumstances, it may be suggested that the lowest of the temperatures recorded at 3-hourly intervals between 6pm the previous evening and 9am that day provides a better estimate of DMIN than does 9amMIN. The data is stratified to exclude these cases, and regression analysis is applied to the remaining data to yield the following relationship which is then solved in all these cases, in order to yield, for these cases, an improved estimate of DMIN.

Relationship between
min temp in 24 hours to 9am (y) and
min 3-hourly temp 6pm-9am (x)
(excluding 2506 cold previous days)

$y = 0.9965x - 0.3416$

3.3 Maximum temperature on 6-Dec-1990

On 6-Dec-1990, the temperatures recorded at 3-hourly intervals between 6am on that day and 9pm that evening were 20.4°C-25.0°C-24.5°C-25.0°C-25.6°C-22.3°C. However, the 9amMAX was 33.2°C at 9am the following morning. 33.2°C provides a misleading representation of the 6-Dec-1990 DMAX, it likely to have been at, or slightly above, the highest of the temperatures recorded at 3-hourly intervals between 6am that morning and 9pm that evening, which was 25.6°C.

During the 30-year period between 1979 and 2008 there are 77 cases where the 9amMAX equals the highest of the *next day's* Midnight, 3am, 6am, and 9am temperatures. During the same period, there are another 119 cases where the where the 9amMAX is between 0.1 °C and 0.5 °C below, the the highest of the *next day's* Midnight, 3am, 6am, and 9am temperatures.

In such circumstances, it may be suggested that the highest of the temperatures recorded at 3-hourly intervals between 6am that morning and 9pm that evening provides a better estimate of DMAX than does 9amMAX. The data is stratified to exclude these cases, and regression analysis is applied to the remaining data to yield the following relationship (which, is then solved in all these cases, in order to yield, for these cases, an improved estimate of DMAX.

Relationship between
max temp in 24 hours to 9am (y) and
max 3-hourly temp 6am-9am (x)
(excluding 196 hot next mornings)

$y = 1.0174x + 0.605$