ATMOS 5010: Weather Forecasting Forecasting Practicum

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Objectives

- Provide a realistic, time-constrained weather analysis and forecasting experience
- Gain experience with forecast validation including assessments of forecast accuracy
- Create an environment that simultaneously encourages individualism and teamwork
- Have fun!!!

Time Conversion

- MST=Mountain Standard Time
- MDT=Mountain Daylight Time
- Local time is MST in winter, MDT in summer
  - MDT=MST+1 (Spring Ahead, Fall Back)
- UTC=Coordinated Universal Time
  - – Also called GMT (Greenwich Mean Time)
  - – Also called “Z” or “Zulu Time”
    - MST = UTC – 7 hours
    - MDT = UTC – 6 hours

Examples

- 0000 UTC 5 March = 1700 MST 4 March = 5PM MST 5 March = 1800 MDT 5 March = 6PM MDT 5 March

- 1200 UTC 5 March = 0500 MST 5 March = 5 AM MST 5 March = 0600 MDT 6 March = 6 AM MDT 5 March

Forecast Categories

Forecast Laboratory
Salt Lake City, UT (SLC)

Alias → Your Name

I. Temperature & Dewpoint

- Max Temp [Today, 12Z-6Z]
- Min Temp [Tonight, 0Z-18Z]
- Max Temp [Tomorrow, 12Z-6Z]
- Dewpoint [Today, 0Z]
- Dewpoint [Tomorrow,12Z]

°F

II. Precipitation & Visibility Probabilities

- POP(%) [0Z-12Z]
- POP(%) [12Z-0Z]
- Amount of Precip {Nearest .01"} [0Z-0Z] ← Except for QPF
- Snow Observed(%) [0Z-0Z]
- T-Storm(s) Observed(%) [0Z-0Z]
- Visibility < 1 mile Observed(%) [0Z-0Z]

Verify 0% or 100%

III. Observed Weather

- Mean Cloud Cover [0Z-0Z] ← Octants
- Wind Direction [0Z]
- Wind Speed (kts) [0Z]
- Wind Direction [12Z]
- Wind Speed (kts) [12Z]

Submit

Few=2/8
Sct=4/8
Bkn=6/8
Ovc=8/8

Forecast Accuracy v. Forecast Value

- *Accuracy* is the correspondence between what is forecast and what is observed
  - E.g., my forecast error was 3°F

- *Value* measures the economic (or other) value to the end user

- We're focusing on accuracy, but value is critical in the real world

Source: Joliffe and Stephenson (2003): *Forecast Verification*

Measuring Forecast Accuracy

- *Absolute Error* and *Mean Absolute Error*

$$AE = \left| Forecast - Observed \right|$$

$$MAE = \frac{1}{N}\sum_{i=1}^{N}\left| Forecast - Observed \right|$$

- Example
  - You forecast a high of 54°F and 57°F is observed

$$AE = \left|54 - 57\right| = 3^\circ F$$

  - The next day you forecast a high of 63°F and 69°F is observed

$$AE = \left|63 - 69\right| = 6^\circ F$$

$$MAE = \frac{3+6}{2} = 4.5^\circ F$$

Use of AE and MAE

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Salt Lake City, UT (SLC)

Your Name

I. Temperature & Dewpoint

AE and MAE

- Max Temp [Today, 12Z-6Z]
- Min Temp [Tonight, 0Z-18Z]
- Max Temp [Tomorrow, 12Z-6Z]

AE/2 and MAE/2

- Dewpoint [Today, 0Z]
- Dewpoint [Tomorrow,12Z]

II. Precipitation & Visibility Probabilities

- POP(%) [0Z-12Z]
- POP(%) [12Z-0Z]

AE*10 and MAE*10

- Amount of Precip {Nearest .01"} [0Z-0Z]
- Snow Observed(%) [0Z-0Z]
- T-Storm(s) Observed(%) [0Z-0Z]
- Visibility < 1 mile Observed(%) [0Z-0Z]

III. Observed Weather

AE and MAE

- Mean Cloud Cover [0Z-0Z]

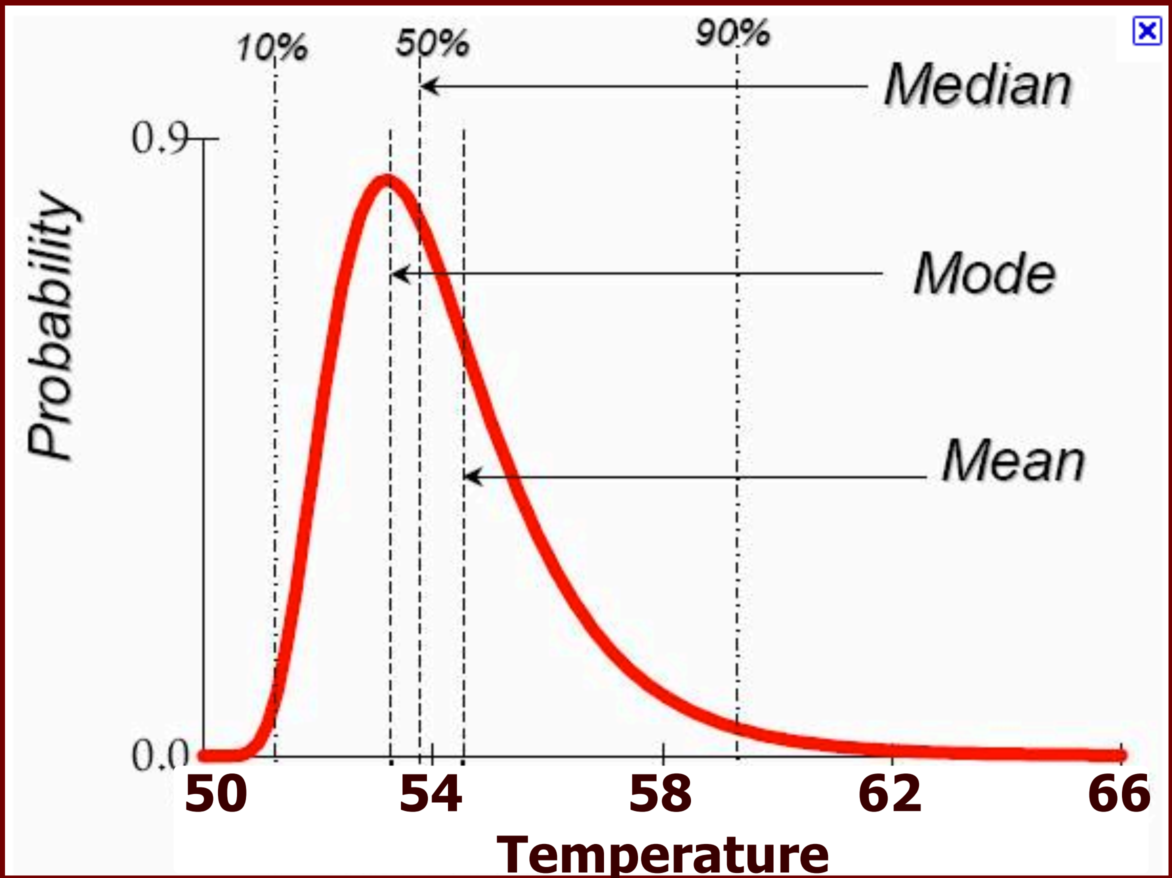
Direction – AE/10 and MAE/10
Speed – AE/2 and MAE/2

- Wind Direction [0Z]
- Wind Speed (kts) [0Z]
- Wind Direction [12Z]
- Wind Speed (kts) [12Z]

Submit

Minimizing AE and MAE

- Forecast the *median* event of the predicted probability distribution



Probability Distribution Skewed Toward Higher Temperatures

Best Deterministic Forecast if Scored with AE/MAE Is Median of Possibilities 54°F

Original Graph: heardingcats.typepad.com

Measuring Forecast Accuracy

- *Square Error and Mean Square Error (Brier Score)*

$$SE = \left(Forecast - Observed\right)^2$$

$$MSE = \frac{1}{N}\sum_{i=1}^{N}\left(Forecast - Observed\right)^2$$

- Example
  - You forecast a high of 54°F and 57°F is observed

$$SE = \left(54 - 57\right)^2 = 9^\circ F$$

  - The next day you forecast a high of 63°F and 69°F is observed

$$SE = \left(63 - 69\right)^2 = 36^\circ F$$

$$MBE = \frac{9 + 36}{2} = 22.5^\circ F$$

Strongly Penalizes Outliers!!!

Use of SE and MSE

POP, Snow, T-Storm, Visby

$=[(\text{Forecast-Observed})/10]^2$

Example
Forecast 20% POP
& Precip Occurs

$=[(20-100)/10]^2 = 64$

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Max Temp [Tomorrow, 12Z-6Z]
Dewpoint [Today, 0Z]
Dewpoint [Tomorrow,12Z]

II. Precipitation & Visibility Probabilities

POP(%) [0Z-12Z]
POP(%) [12Z-0Z]
Amount of Precip {Nearest .01"} [0Z-0Z]
Snow Observed(%) [0Z-0Z]
T-Storm(s) Observed(%) [0Z-0Z]
Visibility < 1 mile Observed(%) [0Z-0Z]

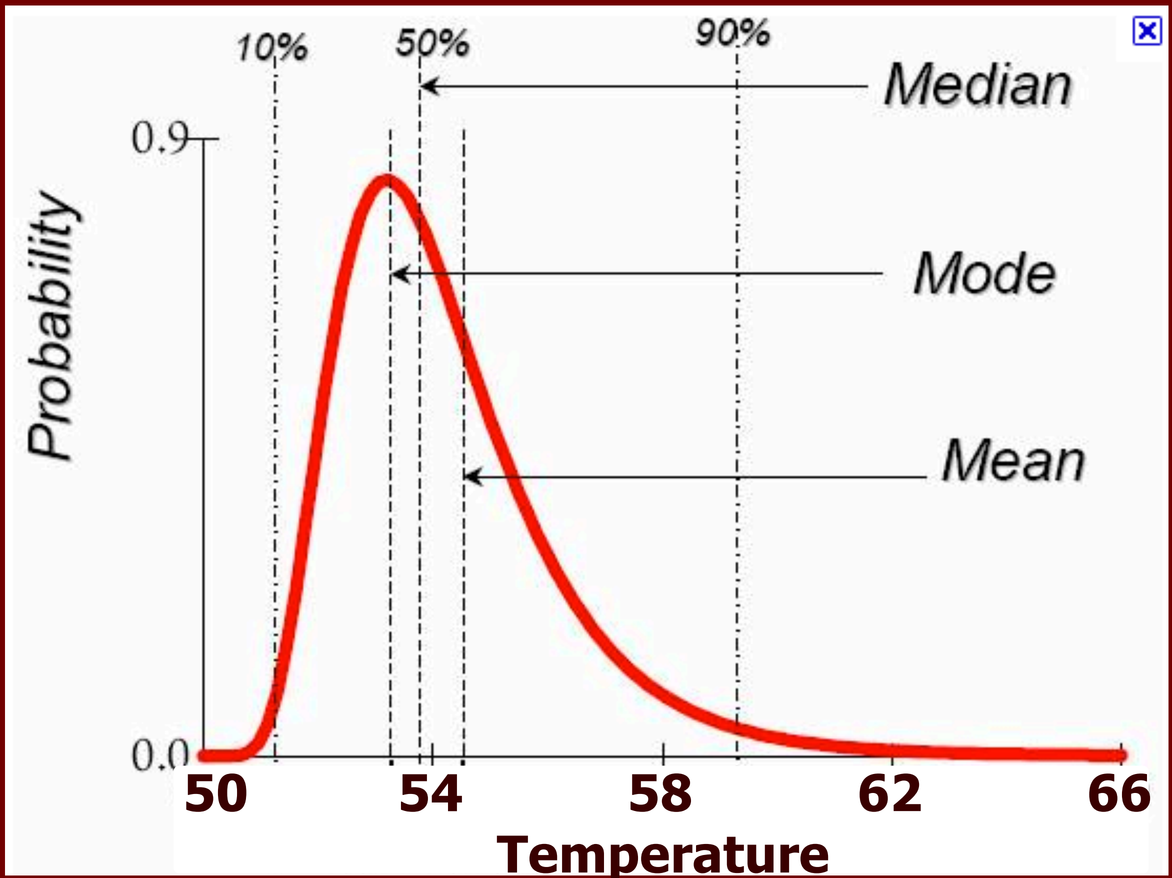
III. Observed Weather

Mean Cloud Cover [0Z-0Z]
Wind Direction [0Z]
Wind Speed (kts) [0Z]
Wind Direction [12Z]
Wind Speed (kts) [12Z]

Submit

Minimizing SE and MSE

- Forecast the *mean* event of the predicted probability distribution



Probability Distribution Skewed Toward Higher Temperatures

Best Deterministic Forecast if Scored with SE/MSE Is Mean of Possibilities 55°F

Original Graph: heardingcats.typepad.com

Minimizing SE and MSE

- For POP and other probabilities, why not go 0% or 100%?
- Suppose there is a 1/6 chance of precip (like rolling a die)
  - If you go 0% every time, you are right an average of 5/6 times and wrong 1/6 times giving a long-term average error of
    - $(0-0)^2+(0-0)^2+(0-0)^2+(0-0)^2+(0-0)^2+(0-100)^2=10{,}000$
  - If instead you go 17% each time, the long-term average error is
    - $(17-0)^2+(17-0)^2+(17-0)^2+(17-0)^2+(17-0)^2+(17-100)^2=8{,}334$
- Bottom Line: Best forecast is an accurate estimate of the mean of what is possible – don't go out on limb