

A Critical Analysis of the Method of Double Proportion

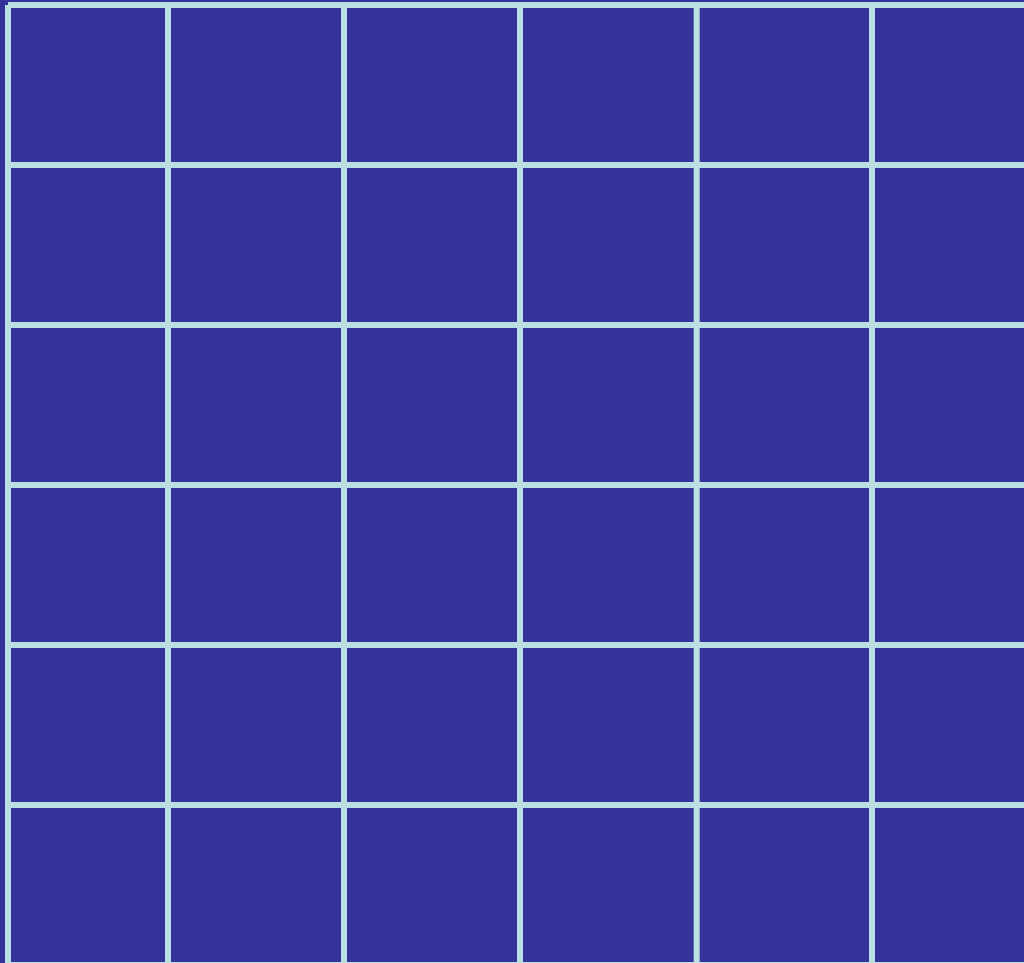
Originally Prepared by
Martin D. Paquette, 2007.

Purpose of Double Proportion

Re-establishment of Lost Corners at or near their original positions.

This study is motivated by the hypothesis that the BLM's Double Proportion method does not accomplish this as well as an alternative method is likely to do. Alternative methods are proposed and examined.

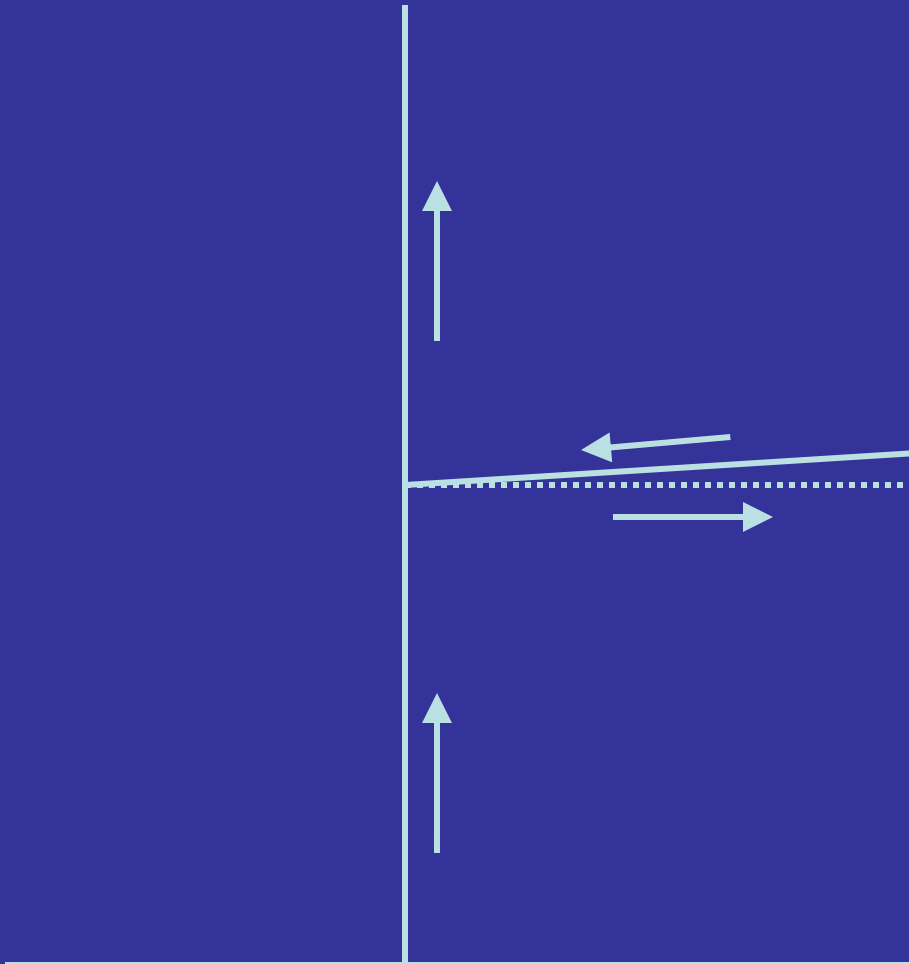
Layout of PLSS, Township Layout



Township
boundary in
place

Sections laid
in from south
to north, west
to east

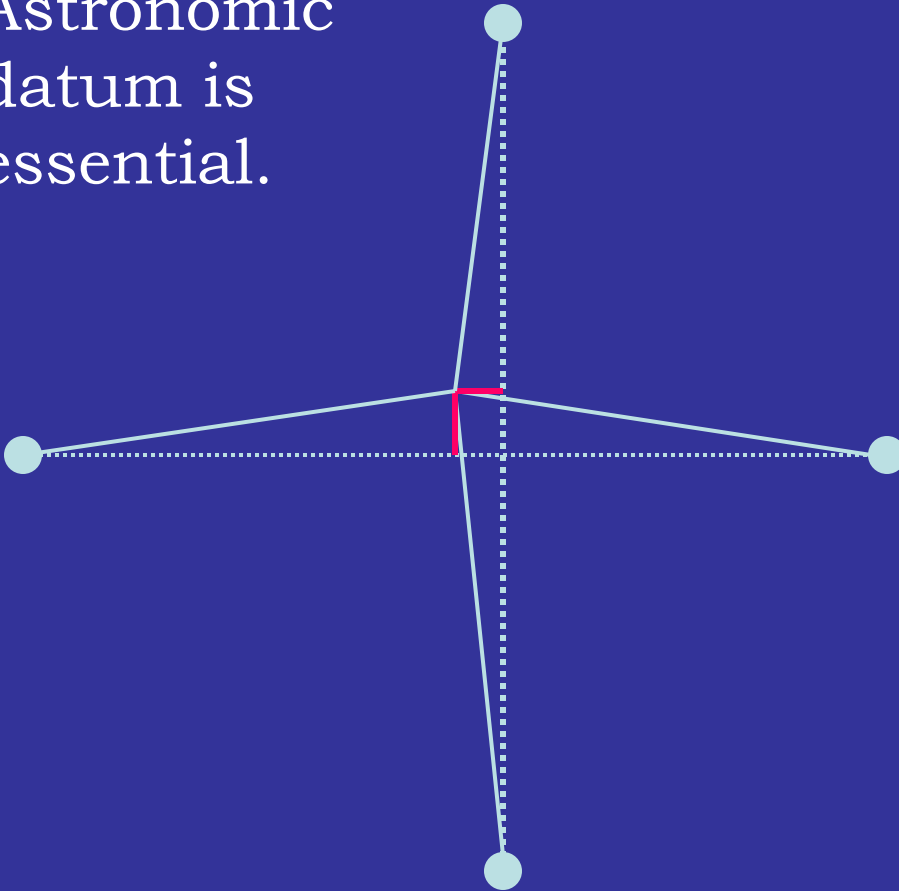
Section Layout



Meridional lines
laid in first;
Latitudinal lines
laid in “random
and true,”
subject to
falsification

Restoration Problem

Astronomic datum is essential.



TMI – “Too much information” is available but can be redundant and noticeably conflicting.

Distance as basis for proportion

BLM Manual defines distance as the only parameter for proportions

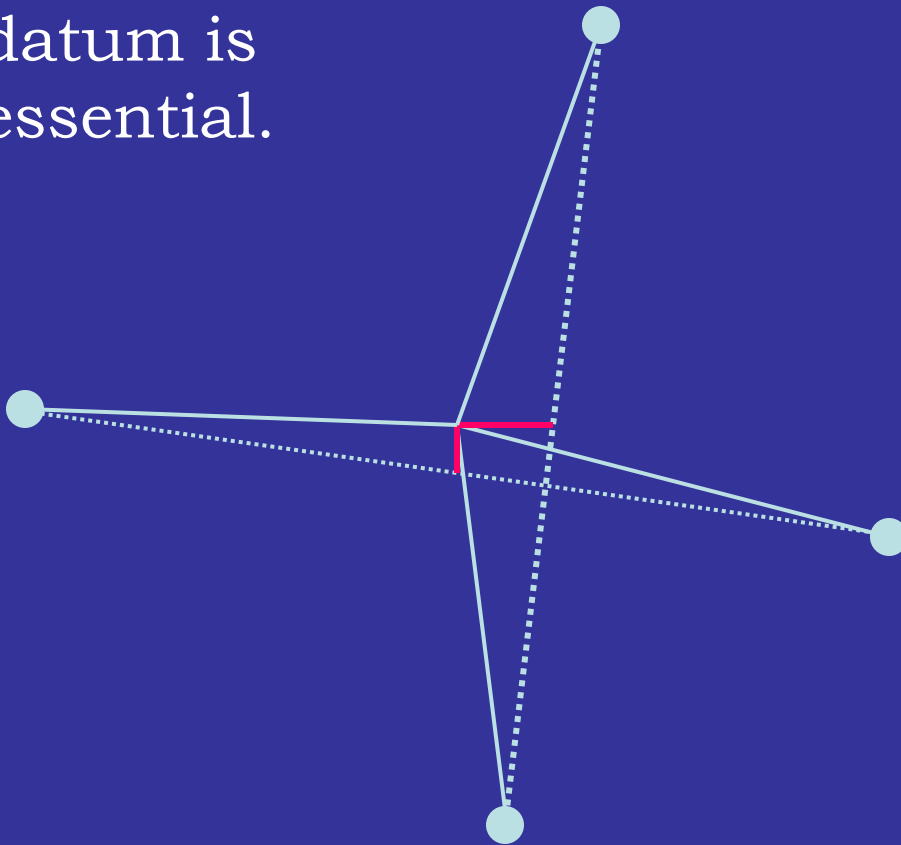
“Distances are only comparable if reduced to their cardinal equivalents.” (since 1947)

I.e., major rectangular components of land lines are used.

Perpendicular component is discarded.

When bearings are skewed in the field

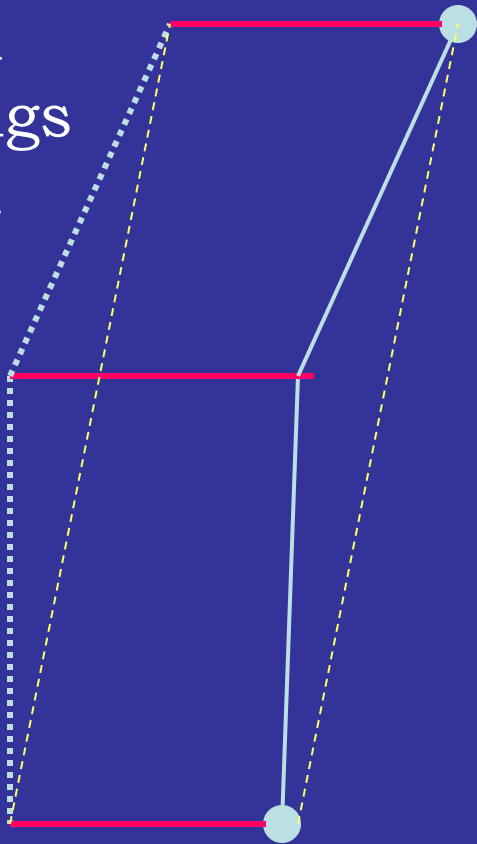
Astronomic datum is essential.



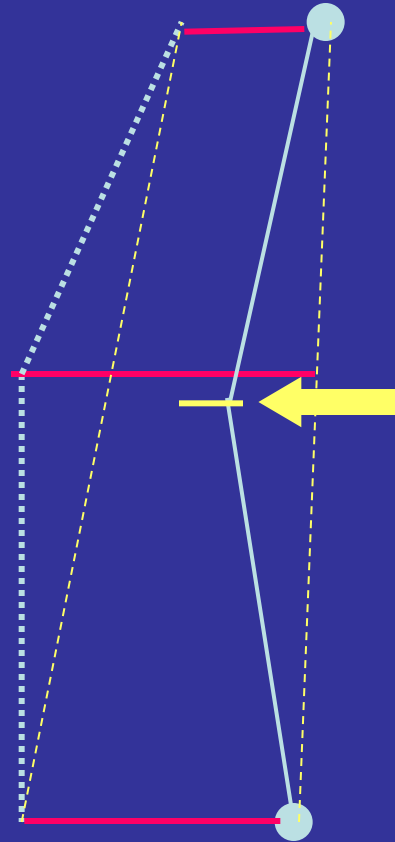
Proportioned distances are no longer in the same ratio as the record.

When bearings are skewed in the record

OK when record bearings match field



(Illustration assumes no distortion contributed by west-east line.)



Record geometry not preserved

What is the goal of corner restoration by proportion?

1. Preservation of record distance ratios?
2. Preservation of record angles?
3. Restoration of original monument position?

Protection of *bona fide* rights (honoring legitimately established land occupation) per BLM.

Bona fide rights and original corners

Original corners are without error.

“Walking in the footsteps...”

Proportion as a method of last resort.

Basis of investigation: discovering if BLM’s DP method is optimal in restoring lost corners to their original locations. Using existent *found* corners.

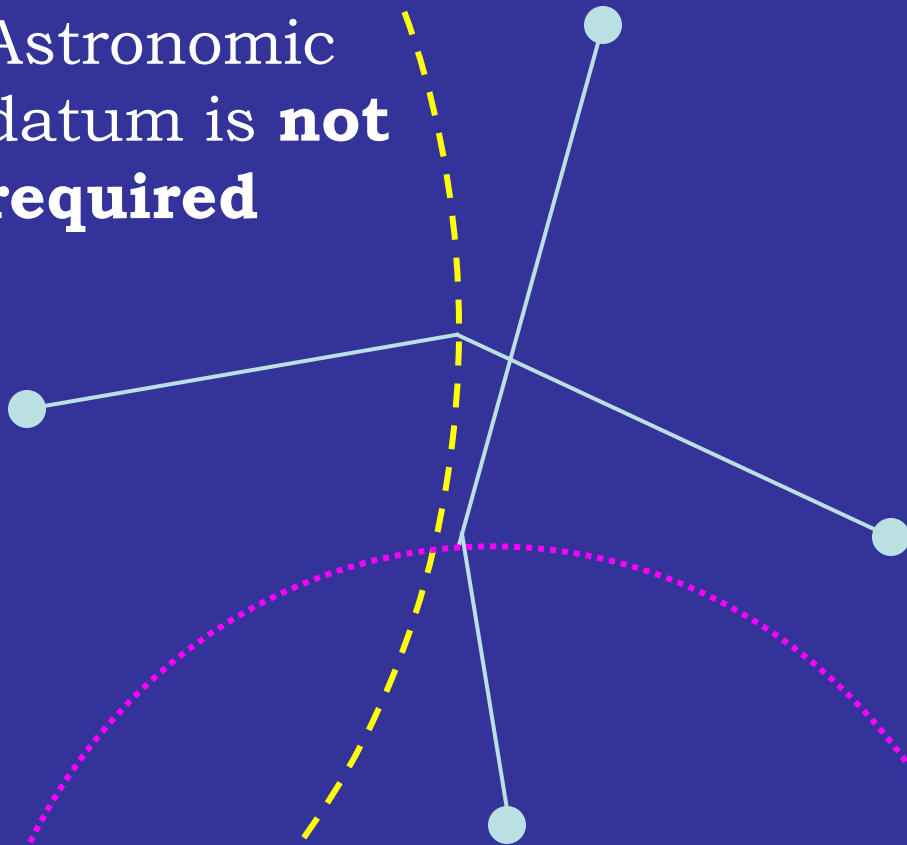
Possible Options

1. BLM Double Proportion
2. Single Proportion N-S (or E-W)
3. Methods defined by BLM (1 or 3 pt. ctrl)
4. Double distance proportion (4-way)
5. Double fixed angle (including BB int.)
6. Local Datum method (provisional basis of bearings)
7. *Skip to Slide 18 (blue banner)*

Alternate Methods

1. Double-Distance proportion

Astronomic datum is **not required**



Perpendicular bisector for equal distances

Intersection of two curves for unequal distances.

Easily computed by iterative numerical methods.

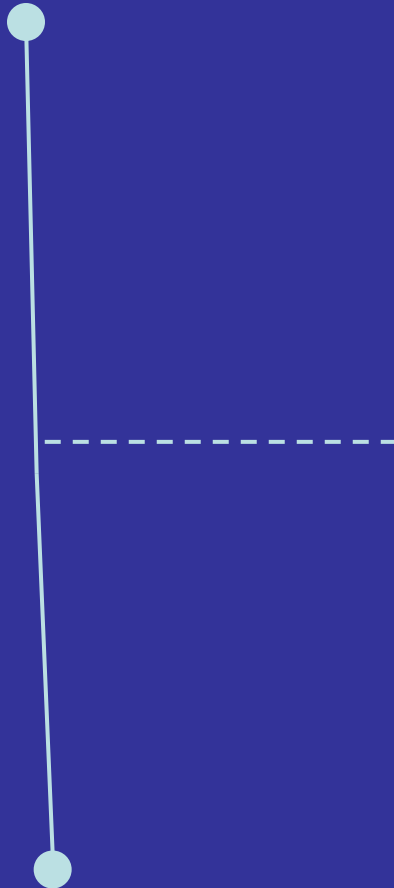
Alternate Methods

Noted: Single N-S proportion

Astronomic
datum is **not
required**



When E-W
records are
missing or
dubious.



Alternate Methods

2. Double-fixed angles

Astronomic datum is **not required**



A solution exists for which record angles are preserved. (Simple when record lines are straight)

Computed by iterative numerical methods, computer desired.

DDP method...

- Creates exact match for original distance ratios & is distance-based.
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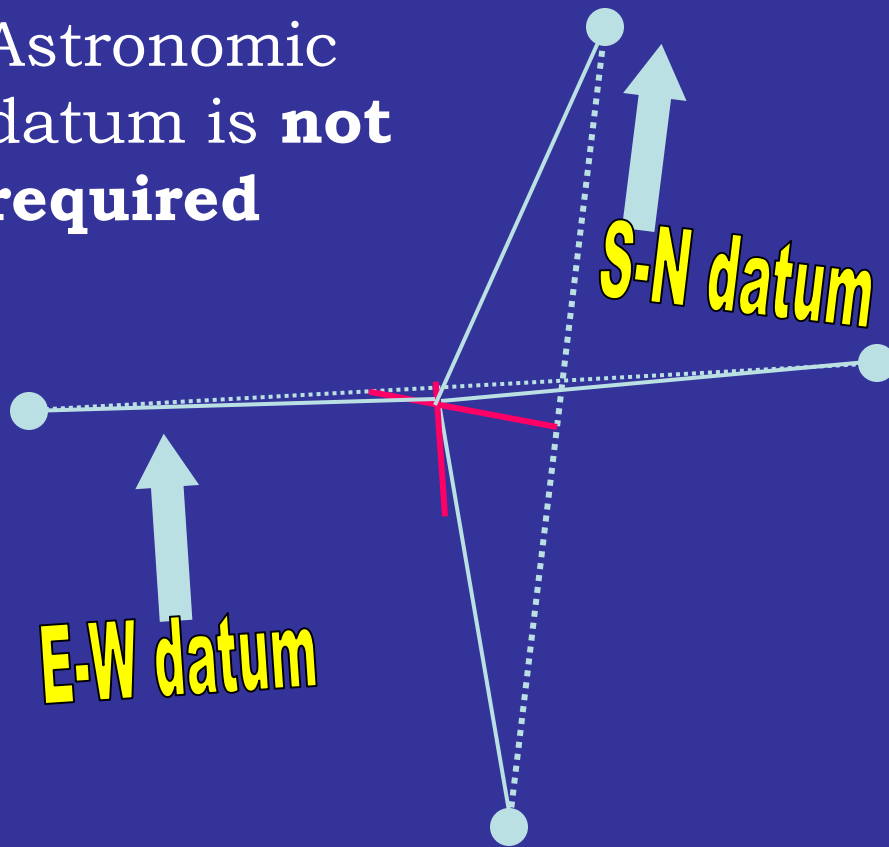
Double Fixed Angle (DFA) method...

Not distance-based.

Method has sometimes been used

Local Datum Method

Astronomic datum is **not required**



Existing corners are treated as local basis of bearings for each line. Offsets are cardinal **with respect to two local, independent assumed datums**

Local Datum method...

- Creates exact match for original distance ratios when distances are equal (i.e. 80-chain meridional lines.)
- Most common ‘misinterpretation’ of BLM method & is identical except as noted.
- Referred to as “perpendicular offsets” method or “Illinois method.”
- Advocated by Joe Webber (author of recognized Illinois reference).

Reasons for BLM method

- Easily executed with classic GLO field techniques.
- Minimal computation.
- Exactly replicates original conditions when similar geometry is found in the field.

But so do all other methods referenced!

The PLSS Datum

- Term coined since *1973 Manual*.
- All measurements are made with respect to the local astronomic meridian. This means ALL.
- East-West lines are curved parallels.
- Basis of bearings is the only critical parameter needed for BLM double proportion.

Why & how the BLM method always works...

1. “ A proportionate measurement gives equal relative weights to all parts of the line. (1973 *Manual* 5-24)
2. “In effect, the record directions are disregarded,” used only for cardinal equivalents. (5-25)
3. Temporary stakes are set for latitude and departure of solution (5-26).
4. “The PLSS datum is used in all stages of work (2-17).
5. “The method of double proportion exactly replaces a corner in its original location when the original corners are found properly located as stated in the original record.” (Jerry Wahl)

Criteria completely defined.
Criteria completely satisfied.

Unless it can be shown that another method:

More nearly replaces original positions or
protects bona fide rights.

Experiments

Calculations for restoration of existing corners by several methods

Comparison to existing corner locations

Which is closer more often?

Assumptions

- One-mile lines used for all samples.
- $\frac{1}{2}$ miles not used ($\frac{1}{4}$ corners often not original).
- Relatively high fidelity records to current positions best.
- Authentic original corners exist.

Data Chosen

Two townships in Sheboygan Co., WI

Two townships in Bellevue, WA

Sheboygan's records had much higher fidelity than Bellevue.

Findings

Both BLM and Local datum methods resulted in much closer solutions to found originals than all other methods

Sheboygan favored Local Datum method.

Bellevue favored BLM method.

Conclusions

- Legal presumption: BLM Surveyors faithfully conducted their work and kept authentic records (defensible in Local Datum method).
- Much more data are now available than in 2007 to allow testing.
- This study creates a toolbox of options for dialing-in corner search locations.

The End

