Geodesy 1B (GED209)
Lecture No: 8

Types of Conditions in Triangulation Networks

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CONTENTS

- What is meant by conditions?
- Types of conditions
- Different methods to compute internal conditions
- Examples

What is a condition in control survey?

- A condition means .....

- Please follow the board

External Conditions

- **Scale**

The computed length of a side must equal its known length or differ by a value within tolerance.

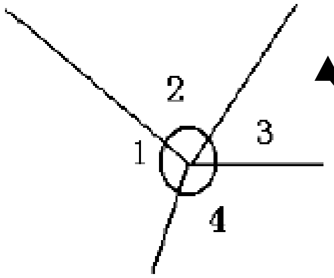
- **Orientation**

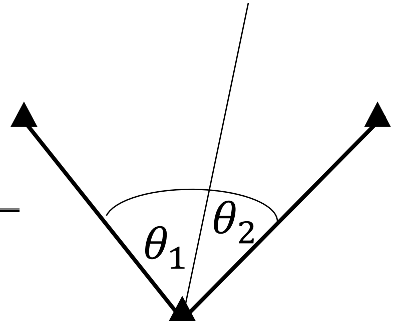
The computed azimuth of a side must equal its known azimuth or differ by a value within tolerance.

- **Position**

The computed coordinates of a point must equal its known coordinates or differ by a value within tolerance.

Internal (Geometric) Conditions



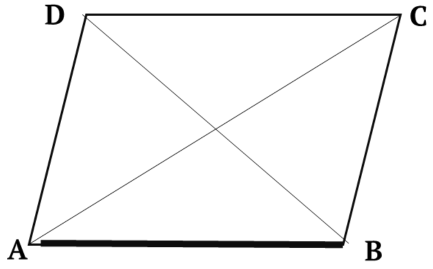


- **Local condition**

The sum of angles taken at certain station should equal a pre-specified value.

- **Side condition**

The length of a side should equal specific value whatever the route used in calculation.



- **Angle / Triangle condition**

The sum of the internal angles of a polygon should equals $(n - 2) \times 180° + \varepsilon$

How to calculate the number of different types of internal conditions?

(1) By Law

(1) By Law

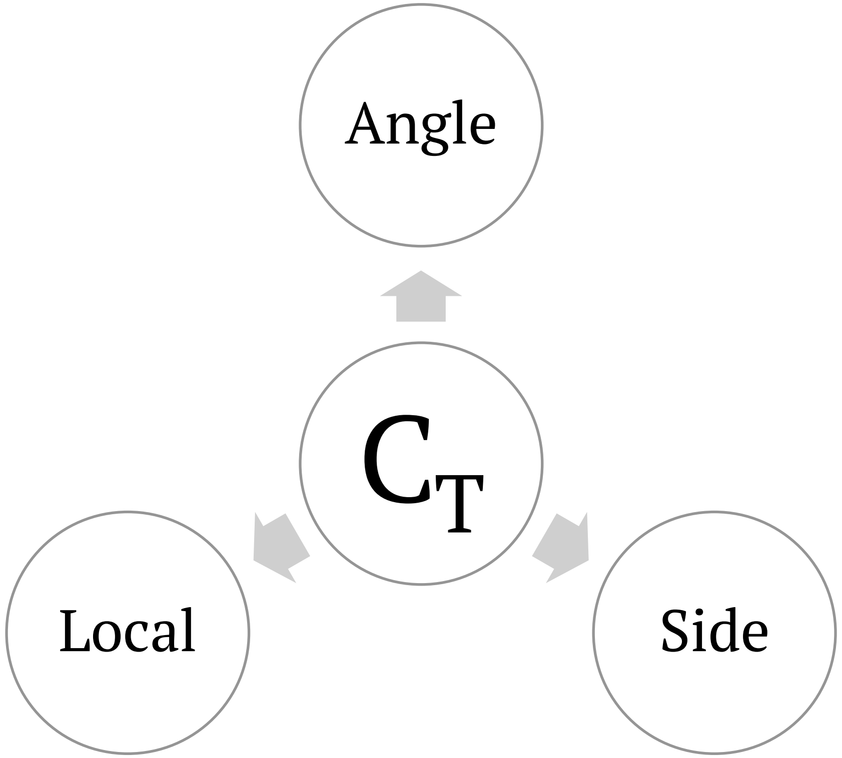
- The total number of geometric conditions C_T in a figure is:

$$C_T = O_T - O_{nec.}$$

Where:

O_T .... Total number of observations

$O_{nec.}$ .... Number of necessary observations



(1) By Law

(1) Angle Conditions

- The total number of geometric conditions C_A in a figure is:

$$C_A = (L - L') - (S - S') + 1$$

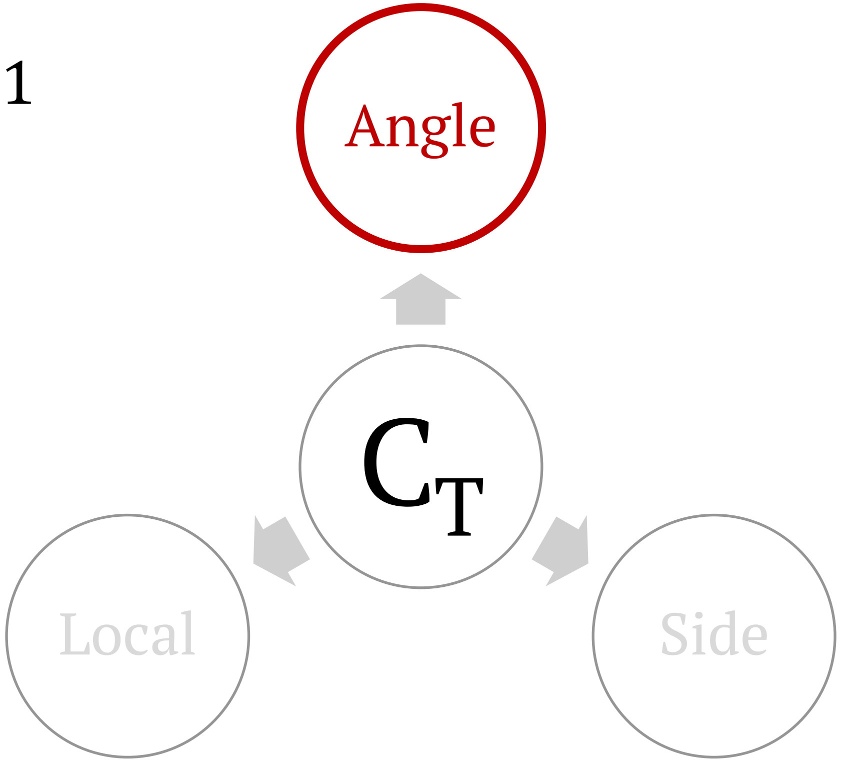
Where:

L .... Total number of lines.

L' .... Number of lines observed in one direction.

S .... Total number of stations.

S' .... Number of unoccupied stations.



(1) By Law

(2) Side Conditions

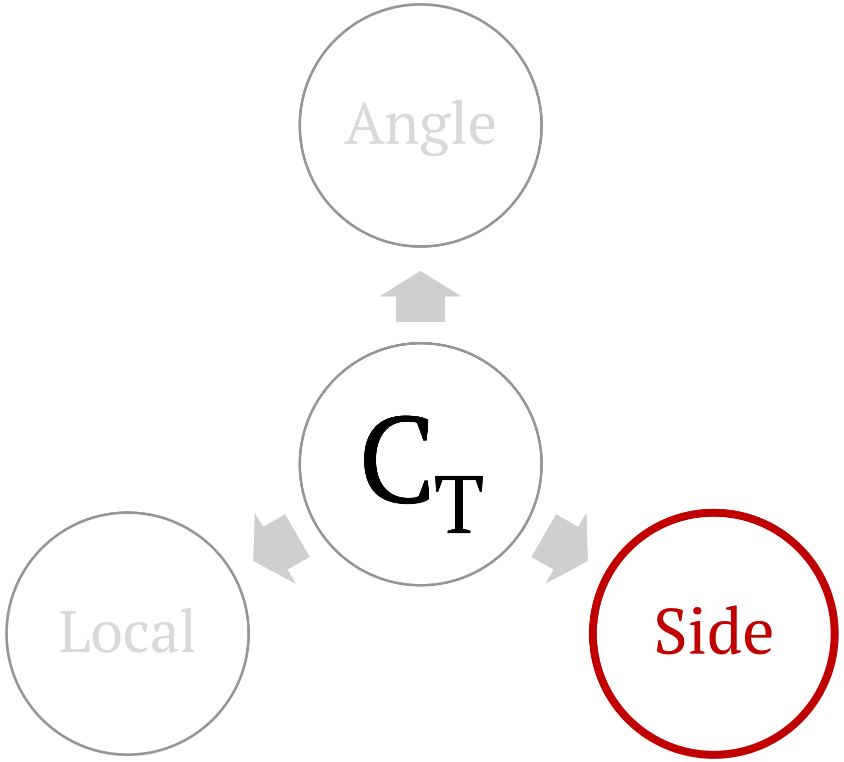
- The total number of side conditions C_S in a figure is:

$$C_S = L - 2S + 3$$

Where:

L .... Total number of lines.

S .... Total number of stations.



(1) By Law

(3) Local Conditions

- The total number of Local conditions C_{Local} in a figure is:

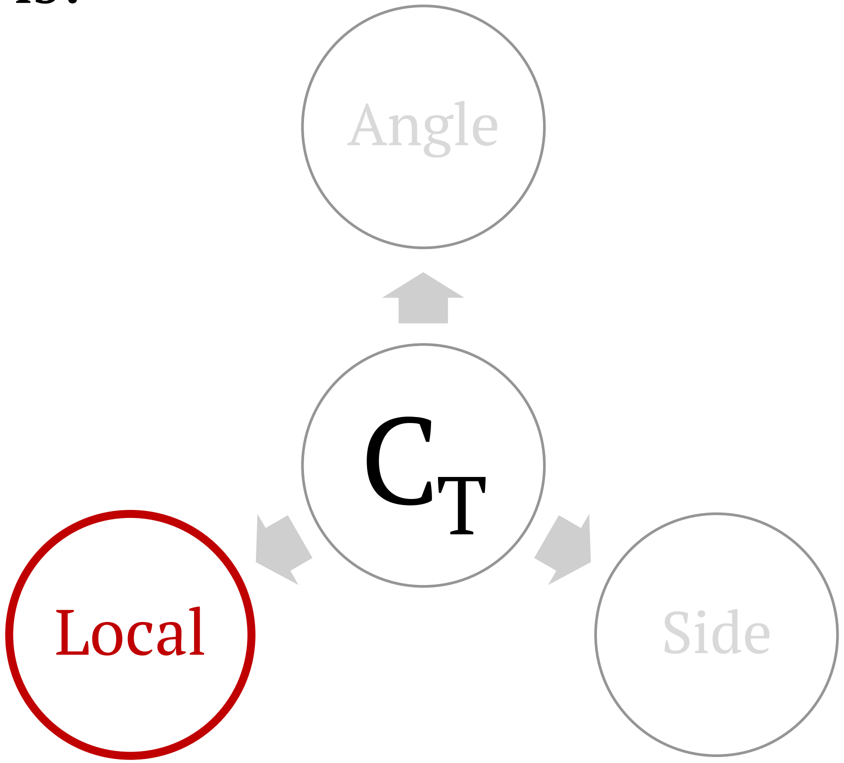
$$C_{Local} = C_T - C_A - C_S$$

Where:

C_T .... Total number of conditions.

C_A .... Total number of angle conditions.

C_S .... Total number of side conditions.



(1) By Law – Example

Calculate the number of different types of internal conditions in the following braced quadrilateral.

Known points = 2 (baseline)

New points = 2 (C, D)

Total number of observation O_T = 8

Number of necessary observations O_{nec} = 2 × *new points* = 2 × 2 = 4

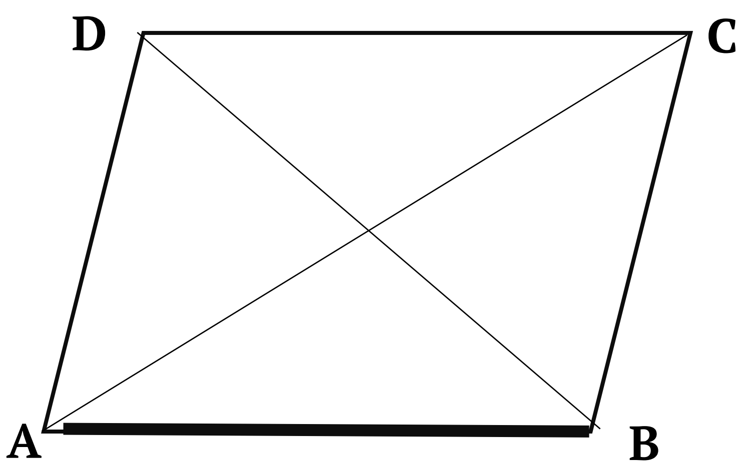
Total number of conditions $C_T = O_T - O_{nec}$ = 8 – 4 = 4

Number of triangle conditions $C_A = (L - L') - (S - S') + 1$

$=$ (6 – 0) - (4-0) + 1 = **3**

Number of side conditions $C_S = L - 2S + 3$ = 6 – 8 +3 = **1**

Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 4 – 3 -1 = **0**



(2) Point By Point

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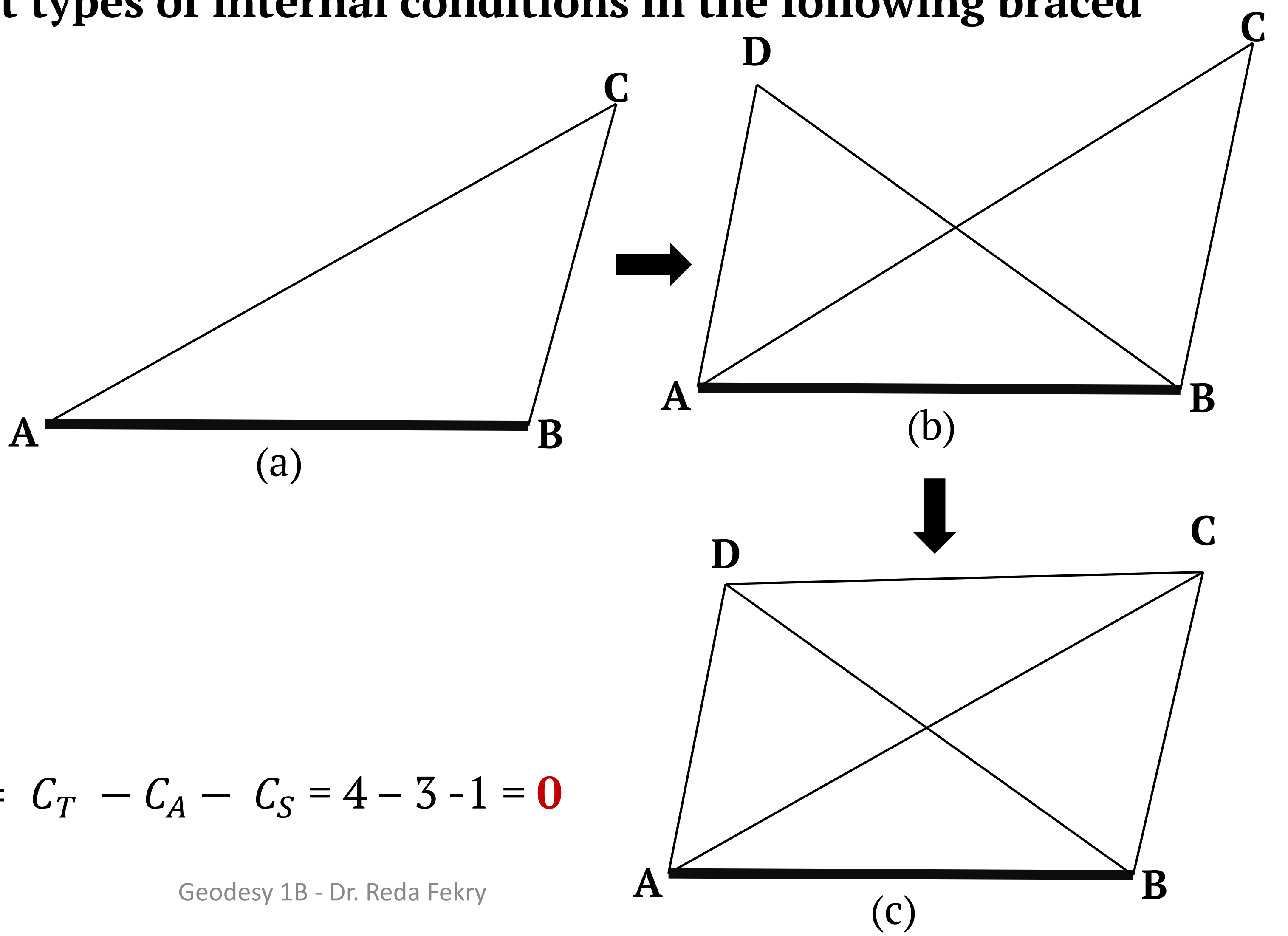
Calculate the number of different types of internal conditions in the following braced quadrilateral.

Point	C_A	C_S
A	-	-
B	-	-
C	2 -1 = 1	2 - 2 = 0
D	3 -1 = 2	3 - 2 = 1
Total	3	1



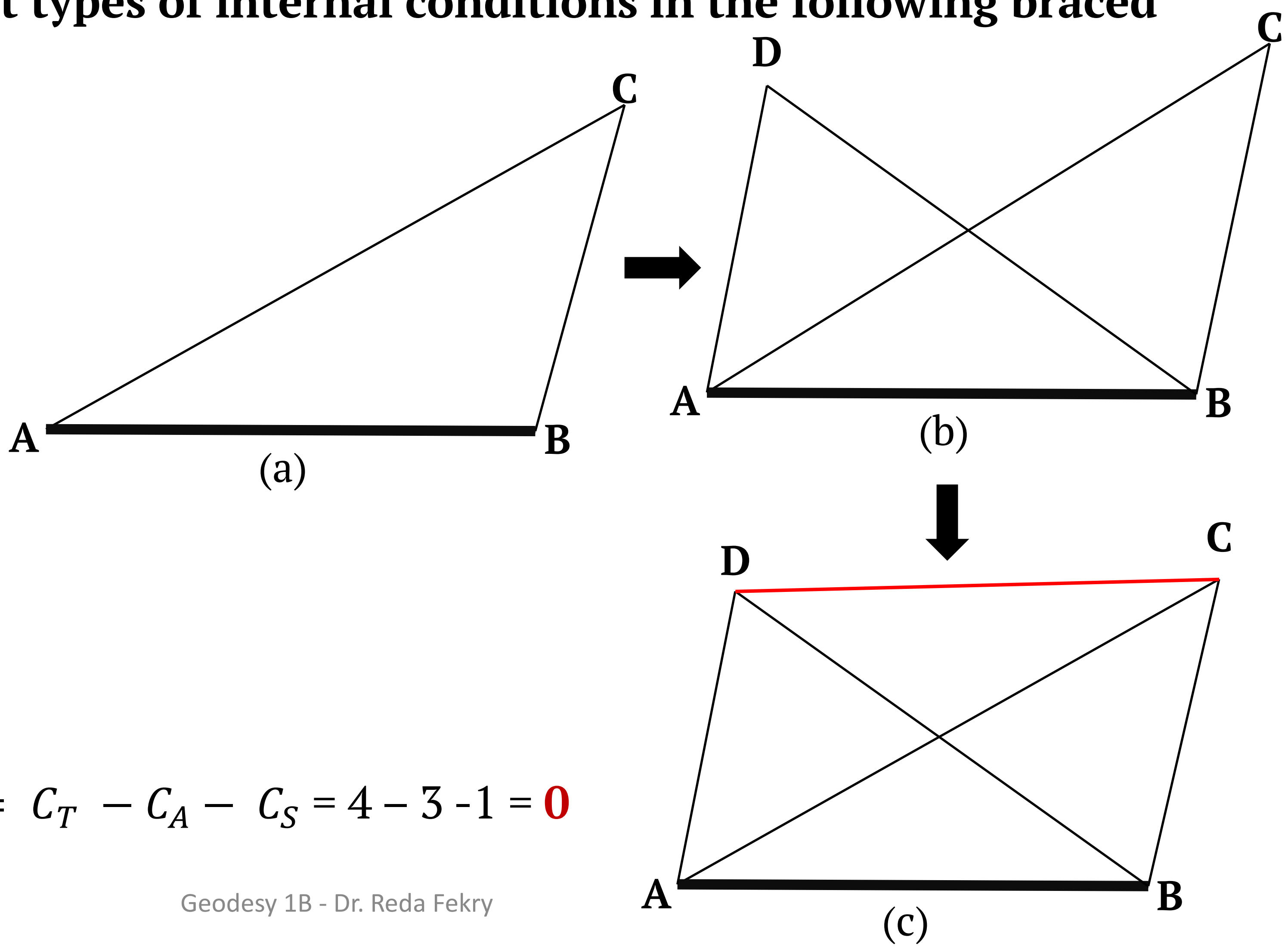
Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 4 – 3 -1 = **0**

(3) Triangle By Triangle

(3) Triangle By Triangle

Calculate the number of different types of internal conditions in the following braced quadrilateral.

Triangle	C_A	C_S
ABC	1	0
ABD	1	0
CD	1	1
Total	3	1



Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 4 – 3 -1 = **0**

Which method should be used?

Numerical Examples

(1) Calculate the number of different types of geometric conditions in the following figure:

Known points = 2 (baseline)

New points = 3 (C, D, E)

Total number of observation O_T = 12

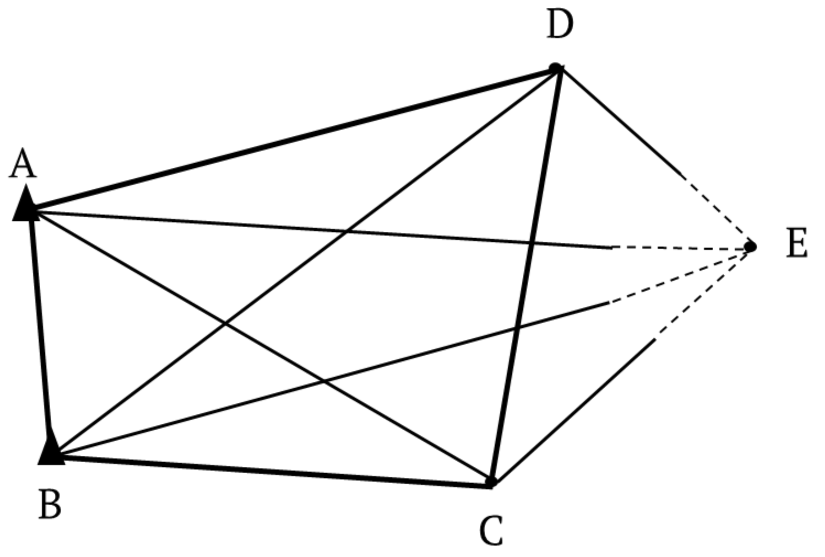
Number of necessary observations O_{nec} = 2 $\times$ $\boldsymbol{new\ points}$ = 2 $\times$ 3 = 6

Total number of conditions $C_T = O_T - O_{nec}$ = 12 – 6 = 6

Number of triangle conditions $C_A = (L - L') - (S - S') + 1$ = (10-4) –(5-1) + 1 = **3**

Number of side conditions $C_S = L - 2S + 3$ = 10 – 10 +3 = **3**

Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 6 – 3 -3 = **0**

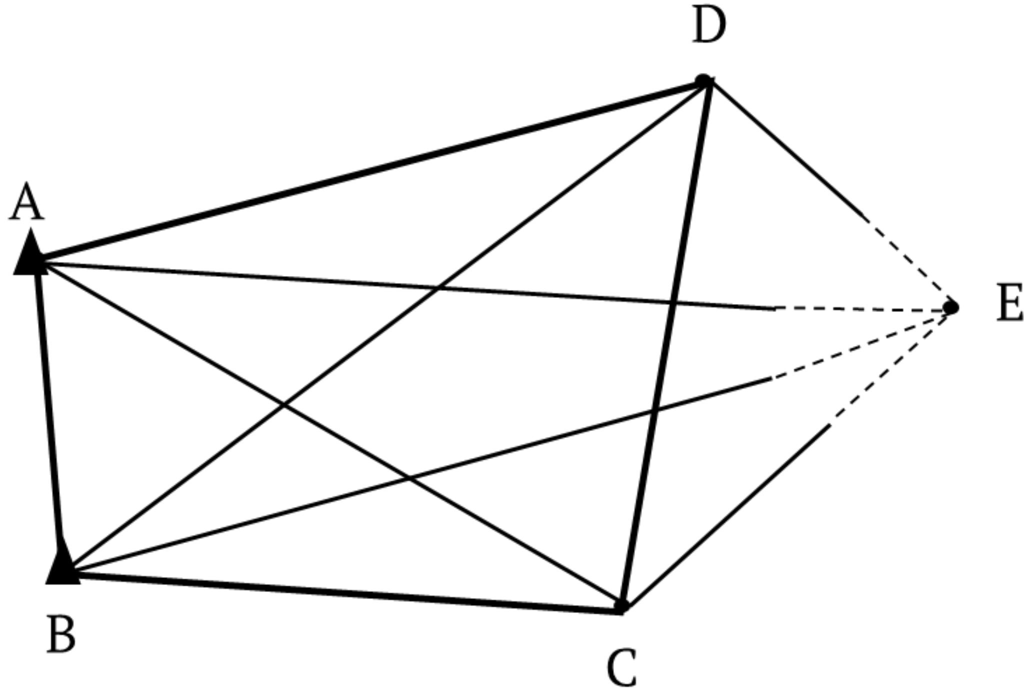


Numerical Examples

(1) **Calculate the number of different types of geometric conditions in the following figure:**

Point by point

Point	C_A	C_S
A	-	-
B	-	-
C	2 -1 = 1	2 - 2 = 0
D	3 -1 = 2	3 - 2 = 1
E	0	4 -2 = 2
Total	**3**	**3**



Number of local conditions $C_{Local} = C_T - C_A - C_S = 6 - 3 - 3 = \mathbf{0}$

Numerical Examples

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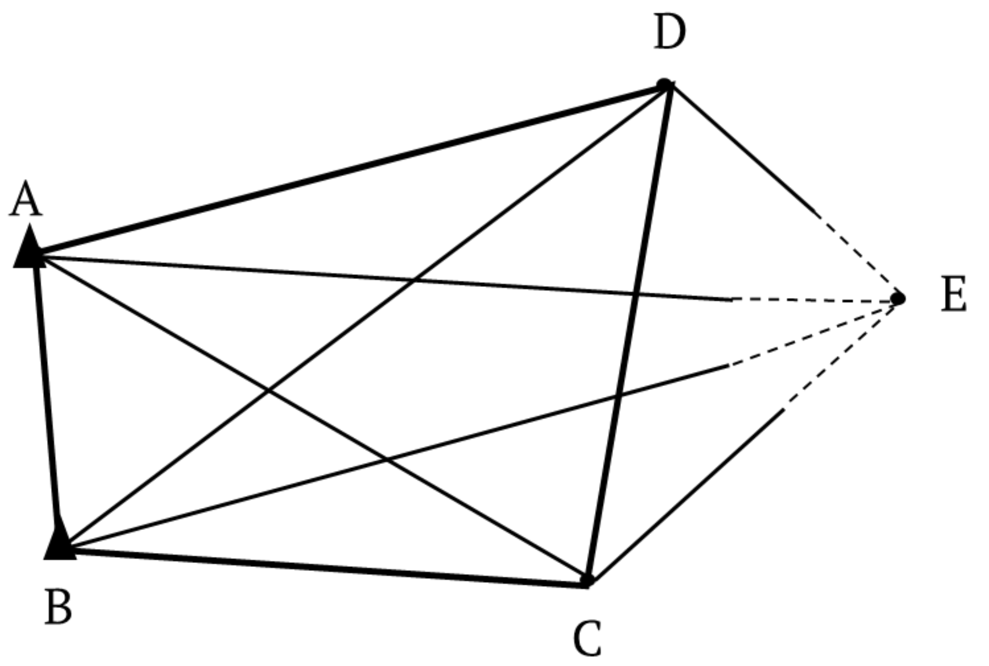
(1) **Calculate the number of different types of geometric conditions in the following figure:**

Triangle by triangle

Triangle	C_A	C_S
ABC	1	0
ACD	1	0
CDE	0	0
BD	1	1
EA	0	1
EB	0	1
Total	**3**	**3**



Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 6 – 3 -3 = **0**

Numerical Examples

(2) Calculate the number of different types of geometric conditions in the following figure:

Known points = 2 (baseline)

New points = 3 (C, D, E)

Total number of observation O_T = 13

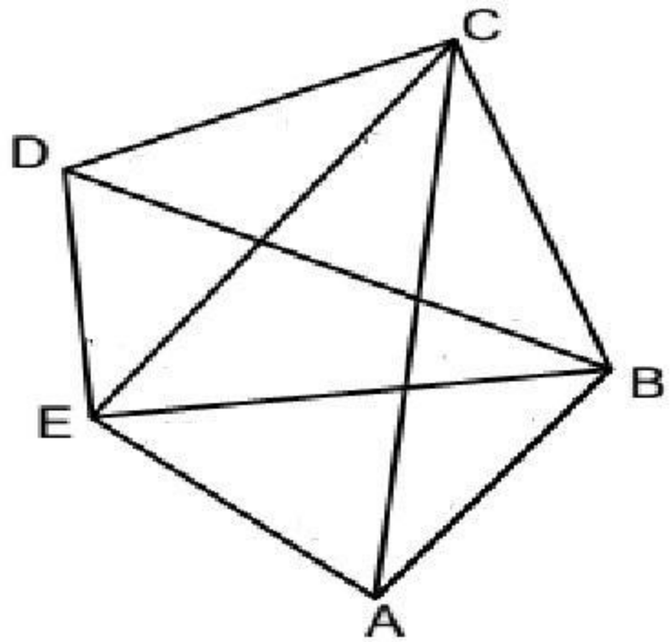
Number of necessary observations O_{nec} = 2 × $\boldsymbol{new\ points} = 2 \times 3 = 6$

Total number of conditions $C_T = O_T - O_{nec}$ = 13 – 6 = 7

Number of triangle conditions $C_A = (L - L') - (S - S') + 1$ = (9-0) –(5-0) + 1 = **5**

Number of side conditions $C_S = L - 2S + 3$ = 9 – 10 +3 = **2**

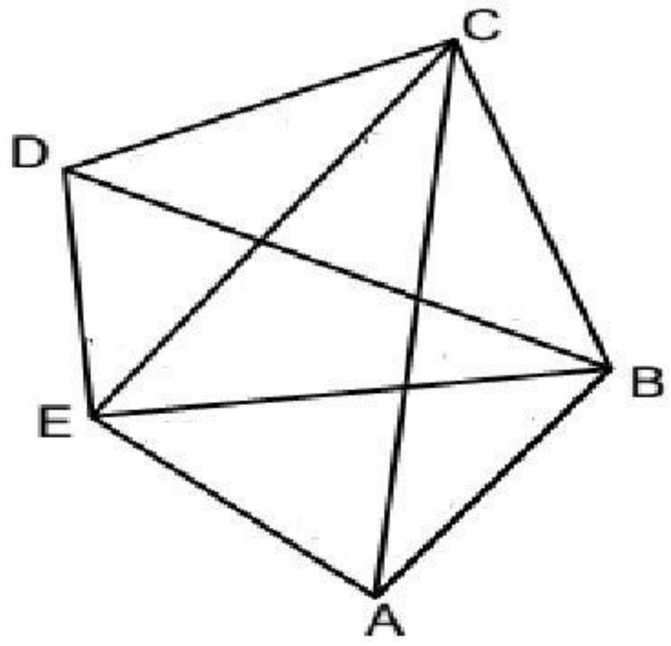
Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 7 – 5 -2 = **0**



(2) Calculate the number of different types of geometric conditions in the following figure:

Point by point

Point	**C_A**	**C_S**
A	-	-
B	-	-
C	2 -1 = 1	2 - 2 = 0
D	2 -1 = 1	2 - 2 = 0
E	4 -1 = 3	4 -2 = 2
Total	**5**	**2**



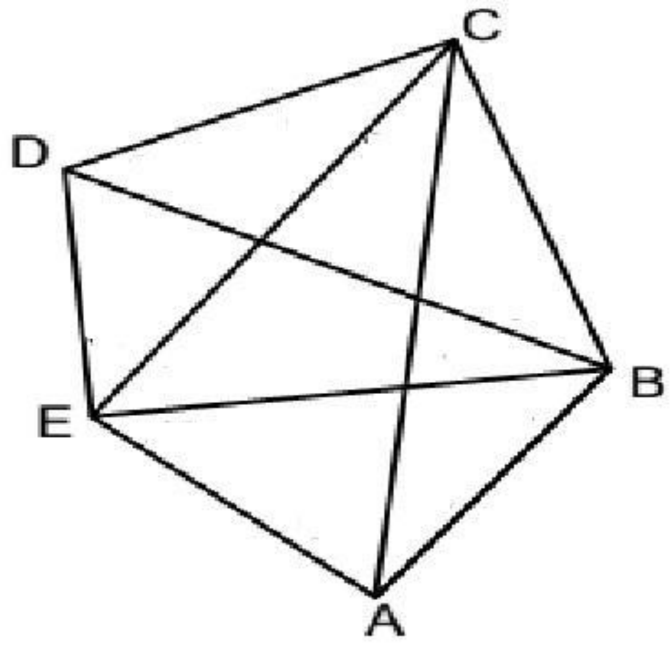
Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 7 – 5 -2 = **0**

Numerical Examples

(2) Calculate the number of different types of geometric conditions in the following figure:

Triangle by triangle

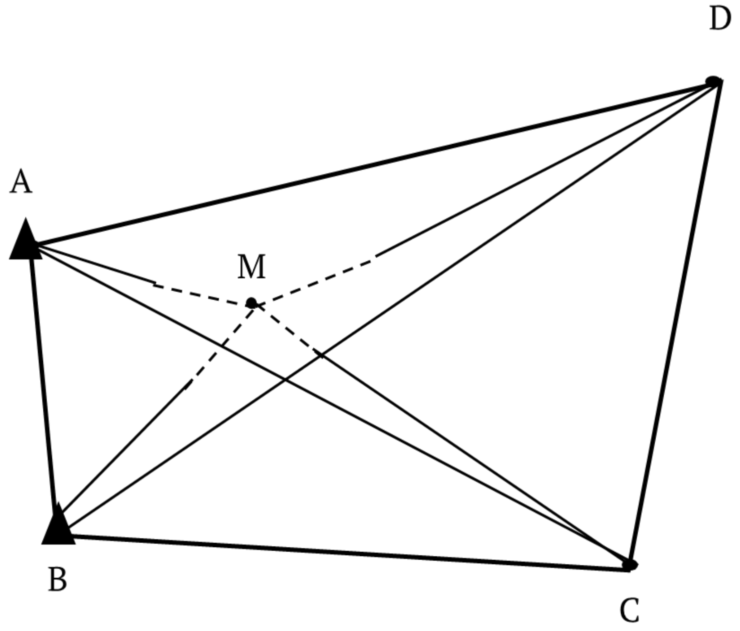
Triangle	C_A	C_S
ABC	1	0
ABE	1	0
EBD	1	0
EC	1	1
ED	1	1
Total	**5**	**2**



Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 7 – 5 -2 = **0**

Numerical Examples

(3) Calculate the number of different types of geometric conditions in the following figure:



Known points = 2 (baseline)

New points = 3 (C, D, M)

Total number of observation O_T **= 12**

Number of necessary observations O_{nec} **= 2** $\times$ ***new points*** **= 2 × 3 = 6**

Total number of conditions $C_T = O_T - O_{nec}$ **= 12 – 6 = 6**

Number of triangle conditions $C_A = (L - L') - (S - S') + 1$ = (10-4) –(5-1) + 1 = **3**

Number of side conditions $C_S = L - 2S + 3$ = 10 – 10 +3 = **3**

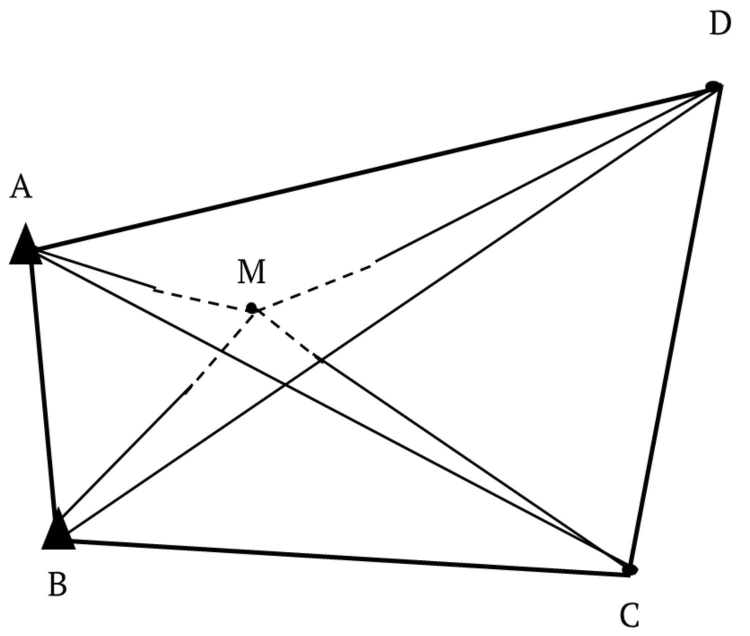
Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 6 – 3 -3 = **0**

Numerical Examples

(3) Calculate the number of different types of geometric conditions in the following figure:

Point by point

Point	C_A	C_S
A	-	-
B	-	-
C	2 -1 = 1	2 - 2 = 0
D	3 -1 = 2	3 - 2 = 1
M	0	4 -2 = 2
Total	**3**	**3**



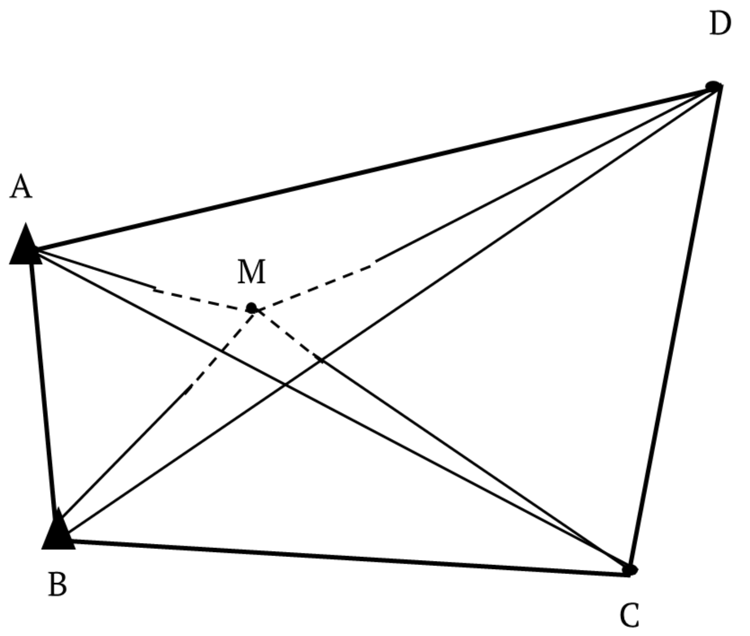
Number of local conditions $C_{Local} = C_T - C_A - C_S = 6 - 3 - 3 = \mathbf{0}$

Numerical Examples

(3) Calculate the number of different types of geometric conditions in the following figure:

Triangle by triangle

Triangle	**C_A**	**C_S**
ABC	1	0
ABD	1	0
ABM	0	0
CD	1	1
MD	0	1
MC	0	1
Total	**3**	**3**



Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 6 – 3 -3 = **0**

Numerical Examples

(4) Calculate the number of different types of geometric conditions in the following figure:

Known points = 2 (baseline)

New points = 1 (M)

Total number of observation O_T = 12

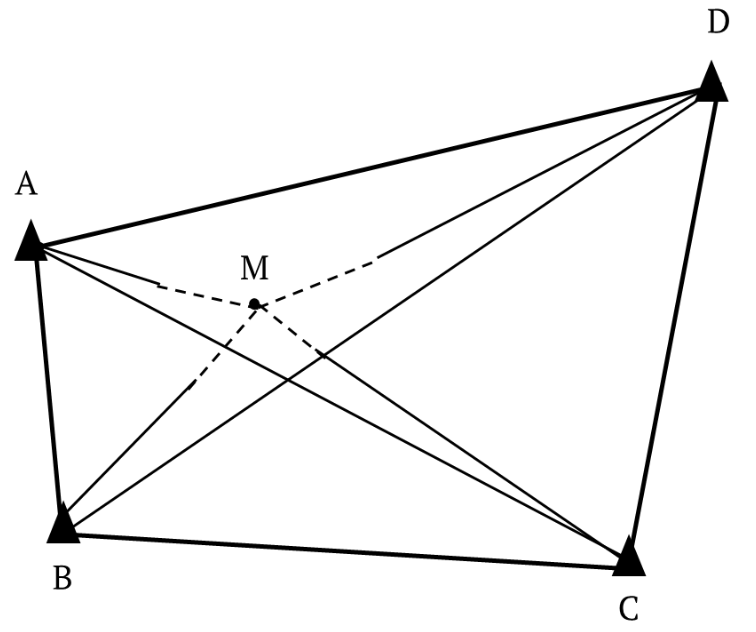
Number of necessary observations O_{nec} = 2 $\times$ *new points* = 2 $\times$ 1 = 2

Total number of conditions $C_T = O_T - O_{nec}$ = 12 – 2 = 10

Number of triangle conditions $C_A = (L - L') - (S - S') + 1$ = (10-4) –(5-1) + 1 = **3**

Number of side conditions $C_S = L - 2S + 3$ = 10 – 10 +3 = **3**

Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 10 – 3 -3 = **4**

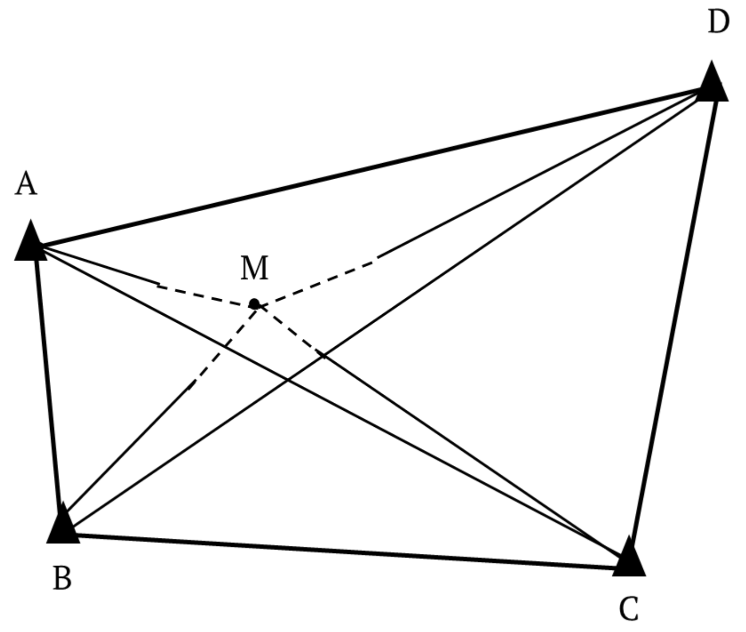


Numerical Examples

(4) Calculate the number of different types of geometric conditions in the following figure:

Point by point

Point	C_A	C_S
A	-	-
B	-	-
C	2-1 = 1	2-2 = 0
D	3 -1 = 2	3-2 = 1
M	-	4 -2 = 2
Total	**3**	**3**



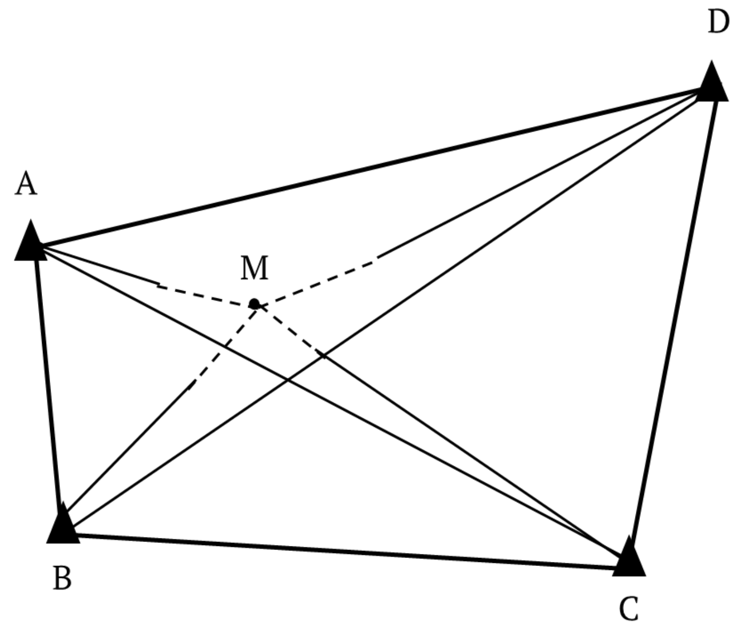
Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 10 – 3 -3 = **4**

Numerical Examples

(4) Calculate the number of different types of geometric conditions in the following figure:

Triangle by triangle

Triangle	C_A	C_S
ABC	1	0
ABD	1	0
ABM	0	0
CD	1	1
MD	0	1
MC	0	1
Total	**3**	**3**



Number of local conditions $C_{Local} = C_T - C_A - C_S$ = 10 – 3 -3 = **4**

End of Presentation

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THANK YOU