**MODERN COLLEGE OF ARTS,SCI. & COMM. PUNE-05.**

**DEPARTMENT OF STATISTICS.(Autonomous)**

**M.Sc.( I )- ST-15**

**EXPT.NO. 07 Date:**

**Sub. date:**

**Title : Classification and reduction of quadratic forms, Verification of Cayley Hamilton Theorem.**

1. Examine the nature of quadratic form



Obtain nonsingular transformation which reduces it to canonical form.

2. Examine the nature of quadratic form

 

Obtain nonsingular linear transformation which reduce it to canonical

form.

3. Examine the nature of the quadratic form

4xy+4xz+4yz

Obtain nonsingular linear transformation which reduces it to canonical form.

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**1. Examine the nature of quadratic form**

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**Obtain nonsingular transformation which reduces it to canonical form.**

**Ans.**

A=[230 25 47;25 61 -4;47 -4 60]

A = 3×3

230 25 47

25 61 -4

47 -4 60

[v d]=eig(A)

v = 3×3

-0.2712 0.0239 -0.9622

0.5194 0.8453 -0.1254

0.8103 -0.5338 -0.2417

d = 3×3

41.7047 0 0

0 64.2321 0

0 0 245.0632

% our parent matrix A is symmetric matrix ie. its upper triangular and lower triangular elements are same

% therefore v'=inv(v)

%As, all eigen values are positive, the given quadratic form is positive definite.

%The non-singular transformation which reduces the quadratic form to its canonical form is,

D=v'\*A\*v

D = 3×3

41.7047 -0.0000 -0.0000

-0.0000 64.2321 -0.0000

-0.0000 -0.0000 245.0632

**Therefire the canonical form is**

41.7047**x^2 –** 64.2321**y^2 +** 245.0632**z^2**

#Verification of Cayley Hamilton theorem.

p=poly(A)

p =

1 -351 28640 -656471

i=[1 0 0;0 1 0;0 0 1]

i =

1 0 0

0 1 0

0 0 1

p1=p(1,1)

p1 =

1

p2=p(1,2)

p3 =

28640

p3=p(1,3)

p3 =

28640

p4=p(1,4)

p4 =

-656471

eqn=p1\*A^3+p2\*A^2+p3\*A+p4\*i

eqn =

\* 0 0

0 \* 0

0 0 \*

eq=round(eqn)

eq =

0 0 0

0 0 0

0 0 0

if eq==0

display("Since eq==0 Cayley Hamilton theorem is verified")

else

display("Since eq!=0 Cayley Hamilton theorem is not verified")

end

"Since eq==0 Cayley Hamilton theorem is verified"

**2. Examine the nature of quadratic form**

** **

**Obtain nonsingular linear transformation which reduce it to canonical**

**form.**

**Ans.**

B=[2 2 -3.5;2 1 1;-3.5 1 1]

B = 3×3

2.0000 2.0000 -3.5000

2.0000 1.0000 1.0000

-3.5000 1.0000 1.0000

[v d]=eig(B)

v = 3×3

0.6181 -0.1232 -0.7764

-0.4575 -0.8596 -0.2278

0.6393 -0.4960 0.5877

d = 3×3

-3.0999 0 0

0 1.8637 0

0 0 5.2362

% our parent matrix A is symmetric matrix ie. its upper triangular and lower triangular elements are same

% therefore v'=inv(v)

%As, all eigen values are positive, the given quadratic form is positive definite.

%The non-singular transformation which reduces the quadratic form to its canonical form is,

D=v'\*B\*v

D = 3×3

-3.0999 -0.0000 0.0000

-0.0000 1.8637 0.0000

0.0000 0.0000 5.2362

**Therefore the canonical form is**

-3.0999**x^2 –**1.8637**y^2 +** 5.2362**z^2**

%Verification of Cayley Hamilton theorem.

p=poly(B)

p =

1 -4 -49/4 121/4

i=[1 0 0;0 1 0;0 0 1]

i =

1 0 0

0 1 0

0 0 1

p1=p(1,1)

p1 =

1

p2=p(1,2)

p2 =

-4

p3=p(1,3)

p3 =

-49/4

p4=p(1,4)

p4 =

121/4

eqn=p1\*B^3+p2\*B^2+p3\*B+p4\*i

eqn =

\* \* \*

\* \* \*

\* \* \*

eq=round(eqn)

eq =

0 0 0

0 0 0

0 0 0

if eq==0

display("Since eq==0 Cayley Hamilton theorem is verified")

else

display("Since eq!=0 Cayley Hamilton theorem is not verified")

end

"Since eq==0 Cayley Hamilton theorem is verified"

**3. Examine the nature of the quadratic form**

**4xy+4xz+4yz**

**Obtain nonsingular linear transformation which reduces it to canonical form.**

**Ans.**

C=[0 2 2;2 0 2;2 2 0]

C = 3×3

0 2 2

2 0 2

2 2 0

[v d]=eig(C)

v = 3×3

-0.7152 0.3938 0.5774

0.0166 -0.8163 0.5774

0.6987 0.4225 0.5774

d = 3×3

-2.0000 0 0

0 -2.0000 0

0 0 4.0000

% our parent matrix C is symmetric matrix ie. its upper triangular and lower triangular elements are same

% therefore v'=inv(v)

%As, all eigen values are positive, the given quadratic form is positive definite.

%The non-singular transformation which reduces the quadratic form to its canonical form is,

D=v'\*C\*v

D = 3×3

-2.0000 0.0000 -0.0000

0.0000 -2.0000 0.0000

-0.0000 0 4.0000

**Therefire the canonical form is**

**-2x^2 – 2y^2 + 4z^2**

%Verification of Cayley Hamilton theorem.

p=poly(C)

p =

1 \* -12 -16

i=[1 0 0;0 1 0;0 0 1]

i =

1 0 0

0 1 0

0 0 1

p1=p(1,1)

p1 =

1

p2=p(1,2)

p2 =

1/750599937895083

p3=p(1,3)

p3 =

-12

p4=p(1,4)

p4 =

-16

eqn=p1\*B^3+p2\*B^2+p3\*B+p4\*i

eqn =

141/4 21/2 -279/8

21/2 -22 -79/4

-279/8 -79/4 11

eq=round(eqn)

eq =

35 11 -35

11 -22 -20

-35 -20 11

if eq==0

display("Since eq==0 Cayley Hamilton theorem is verified")

else

display("Since eq!=0 Cayley Hamilton theorem is not verified")

end

"Since eq!=0 Cayley Hamilton theorem is not verified"