An= b AER BEIR BEIR .. Ax = 201+ 22 22 + ... + xnan that is lineare combination of columns So if b E Column space of A, then a solution exists. If, a,,..., an form a basis of R, then b can be written as a unique linear combination of a; . So solution will then be unique If b & Column Space, No solution exists. Let the rank of A be a, So there are a linearly independent columns, Let. a, ..., an be independent in anti, ..., an con be expressed in terms of If b can be expressed as linear combination of {a,,..., a } => b can be expressed as a linear combination of {a,,...an } · o Rank 7 a,, a,, an, b} must be 91, · . Rank {a, , a, ... , an} = Rank { a, , a, ... , an, b} for solution to exist

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Here Rank E... 3 de notes max number of L.I. vec tors
                                                       ... Rank (A | b) = Rank (A) for

(A augmented with b) Solution to exist,
Now suppose solution exists and the above rank z n

i. n \le n and n \le m

Covel: For n < n

i. a_1, a_2, \dots, a_n are L.
                                                                                         so b cambe supresented uniquely in terms of { an, ..., an }
     However considering {a,,..., an}
                                               Let b= 21, a1 + .... + 22 an + 0. an+1 + .... + 0. an
                                                                                                              This is possible since, ou, ..., our are L.I,
                                                                                                                                                                                                              So 2, -- 2, are unique
                                                                                                                                            29+1 = --- = x, 20
                                             Con sider Ax=0, °° a,, --, an are not LI,
                                                                                                                                                                                                                                      Ihis will have infinite sets of
             solutions with dimension of solutionset = n-n
                                                                                                                                                                                                                                                                                                                                                                               [ By Renk Nullity
Theorem ]
                  A x = b A(x + x + y) = b

x = \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix} Where A y = 0

So Solution

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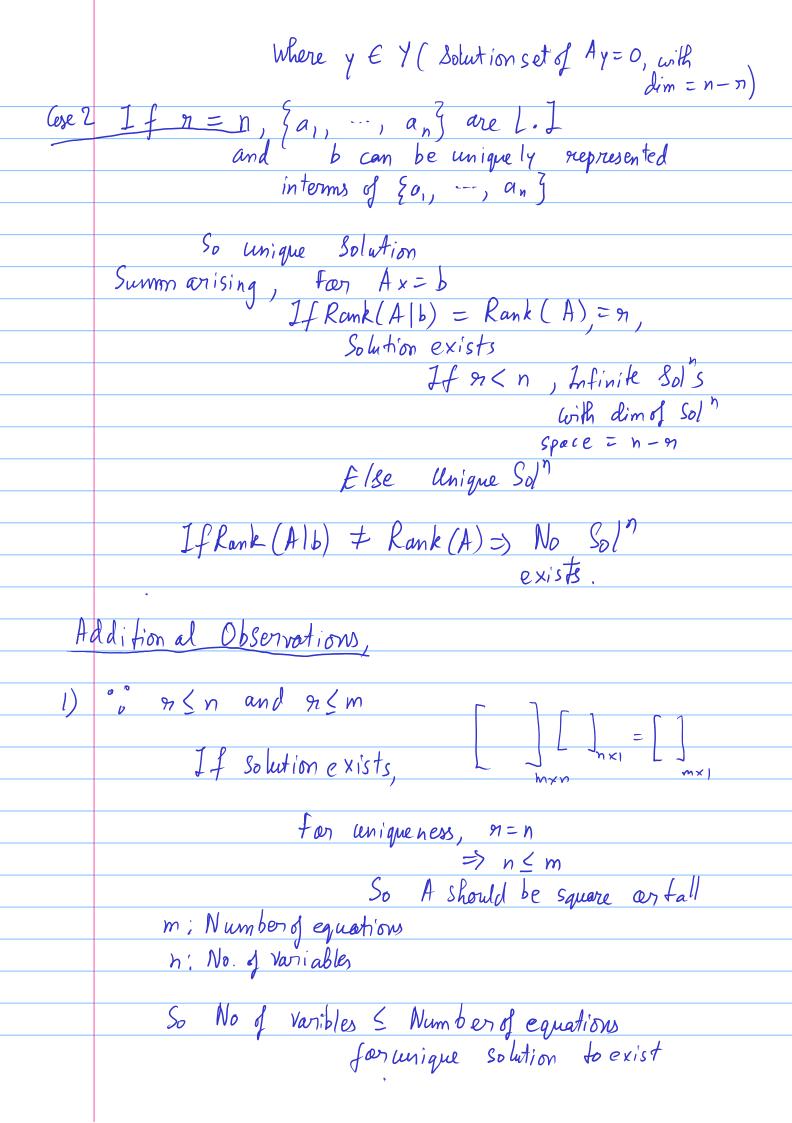
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                                                                                                                                                                                                                                                   = at &
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2) Also >> If n>m (Wide matrix) => Solution Cannot be unique, In this case if nows erelt, i.e Rank(A)=m, then Span(a,, an) = Rm, db & Column Space (A) So solution exists, But not unique Solution Space has dimension n-m