Q1 → 20, Q2 → 10, Q3 → 0

```
format long e;
for n=[16,20,25]
    D=diag(diag(10*rand(n)));
    M=rand(n);
    [Q,R]=qr(M);
    A=Q'*D*Q;


    x=rand(n,1);
    RQ(A,x)
end
```

```
ans =
     4.613836802601556e-01
ans =
     1.128396441267035e+00
ans =
     6.515892326463449e-01
```

```
for n=[10,12,15]
    A=rand(n);
    B=myinv(A);
    norm(B-inv(A))
    norm(eye(n)-B*A)
end
```

```
ans =
     1.260055426804661e-14
ans =
     1.078918416808271e-14
ans =
     5.723755704359015e-14
ans =
     7.666028007019713e-14
ans =
     1.159311210361099e-12
ans =
     5.870961521844348e-14
```

```

```

```
Error using MA423ms210123041>gepp
Too many input arguments.
```

```
n=8
[L,U,p]=gepp(hilb(n));
[L_,u_,P_]=lu(hilb(n));
```

```
function G=cholesky(A)
    n=size(A,1);
    G=zeros(n,n);
    if(n==1)
        G=[sqrt(A(1,1))];
        return
    end
```

```
    G(1,1)=sqrt(A(1,1));
    G(1,2:n)=A(1,2:n)/G(1,1);
    G(2:n,2:n)=cholesky(A(2:n,2:n)-G(1,2:n).'*G(1,2:n));
end

function b=rofs(L,b)
    n=size(L,1);
    b(1)=b(1)/L(1,1);
    for i=2:n
        b(i)=b(i)-dot(b(1:i-1),L(i,1:i-1));
        b(i)=b(i)/L(i,i);
    end
end

function c=RQ(A,x)
    c=norm(rofs(cholesky(A).',x),2)/norm(x,2);
end

function b=cofs(U,b)
    n=size(U,1);
    b(n)=b(n)/U(n,n);
    for i=n-1:-1:1
        b(i)=b(i)-dot(b(i+1:n),U(i,i+1:n));
        b(i)=b(i)/U(i,i);
    end
end

function [L,U,p]=gepp(A)
    n=size(A,1);
    p=[1:n].';
    for k=1:n
        [nul,ind]=max(A(k:n,k));

        ind=ind+(k-1);
        if(ind~=k)
            A([k,ind],:)=A([ind,k],:);
            p([k,ind])=p([ind,k]);
        end
        if(A(k,k)~=0)
            A(k+1:n,k)=A(k+1:n,k)/A(k,k);
            A(k+1:n,k+1:n)=A(k+1:n,k+1:n)-A(k+1:n,k)*A(k,k+1:n);
        end
    end
    L=tril(A,-1)+eye(n);
    U=triu(A);
end

function B=myinv(A)
    n=size(A,1);
    [L,U,p]=gepp(A);
```

$$C = \frac{\|(G^T)^{-1}x\|_2^2}{\|x\|_2^2}$$

```
    B=zeros(n,n);
    for i=1:n
        e=zeros(n,1);
        e(i)=1;
        pe=e(p);
        y=rofs(L,pe);
        B(:,i)=cofs(U,y);
    end
end
```