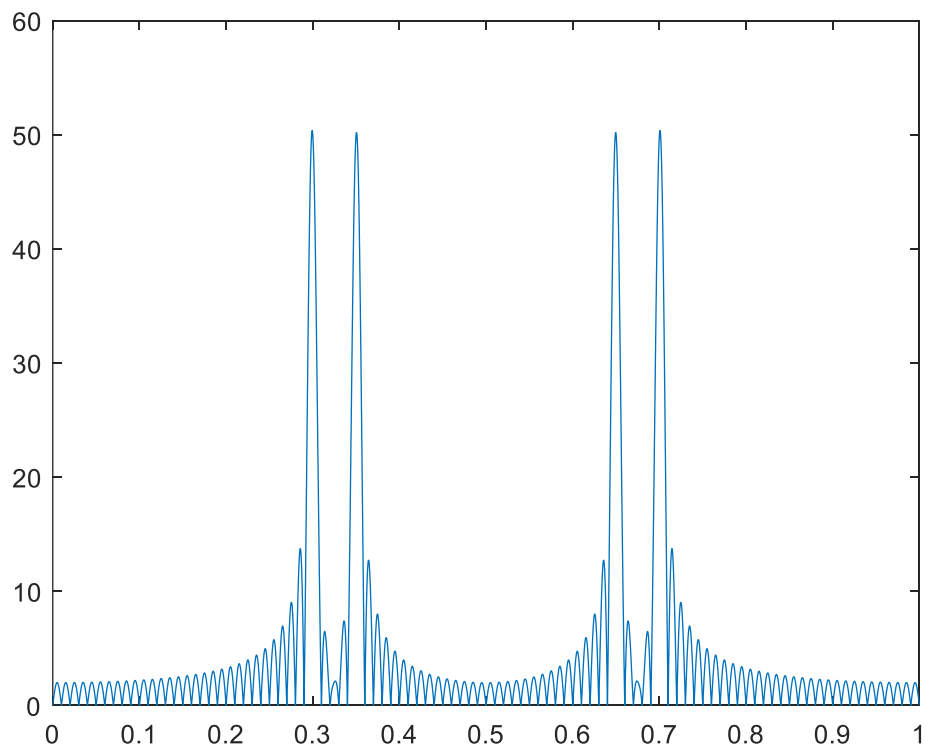


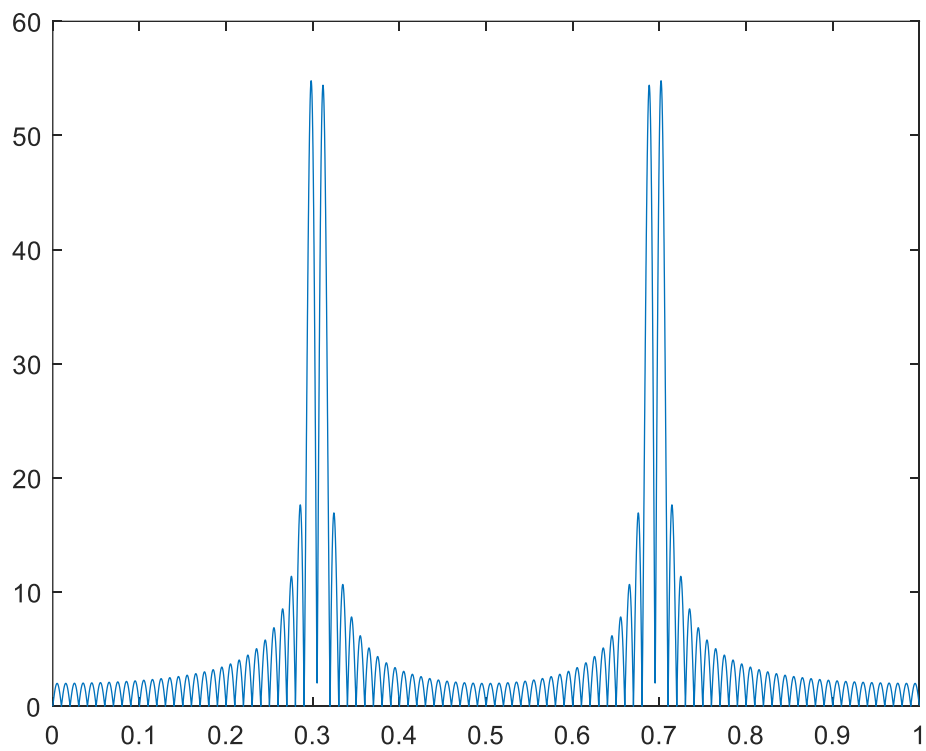
Two closely spaced sinusoids, and resolution limits

```
N = 100;  
NFFT = 10000;  
n = 0:N-1;  
k = 0:NFFT-1;  
fk = k/NFFT;  
  
f1 = 0.3;  
f2 = 0.35;  
x = cos(2*pi*f1*n) + cos(2*pi*f2*n);  
X = fft(x, NFFT);  
figure(1), plot(fk, abs(X))
```



If the absolute value of the difference between f_1 and f_2 is greater than or equal to $1/N$ then the DFT/FFT can resolve the two sinusoids and show both peaks.

```
f1 = 0.3;  
f2 = 0.31; % The difference is 0.01 = 1/N  
x = cos(2*pi*f1*n) + cos(2*pi*f2*n);  
X = fft(x, NFFT);  
figure(2), plot(fk , abs(X))
```



How small can we make the difference and still resolve the peaks?

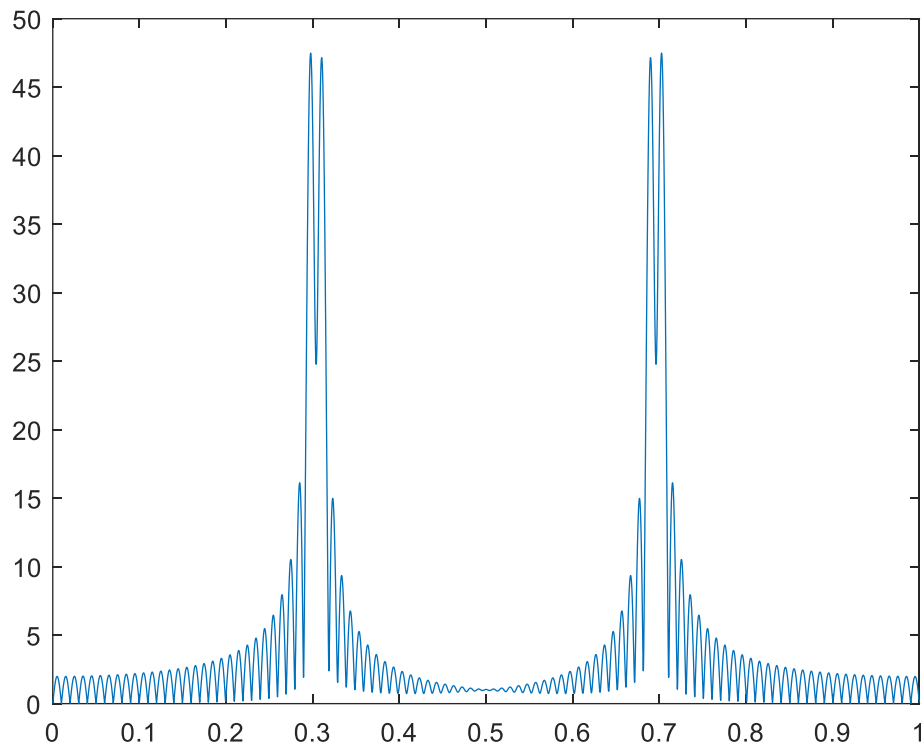
```
f1 = 0.3;
```

```
f2 = 0.308; % The difference is  $0.008 < 1/N$ , so no guaranteed to resolve
```

```
x = cos(2*pi*f1*n) + cos(2*pi*f2*n);
```

```
X = fft(x, NFFT);
```

```
figure(3), plot(fk , abs(X))
```



Clearly we could still resolve the peaks, but there is no guarantee that you always can if the difference is less than $1/N$.