MiniQuiz Lec 11 [ALL CORRECT]

Q1 [CORRECT]

Let's assume $y = 0.5e^{0.1x} + 2$

Now let's assume that we don't know this function, but we know only some points on this function.

If we only know 2 points with equal interval between 0 and 40, then we can use linear interpolation to predict when x = 22, y =

If we only know 3 points with equal interval between 0 and 40, then we can use quadratic interpolation to predict when x = 22, y =

If we only know 4 points with equal interval between 0 and 40, then we can use cubic interpolation to predict when x = 22, y =

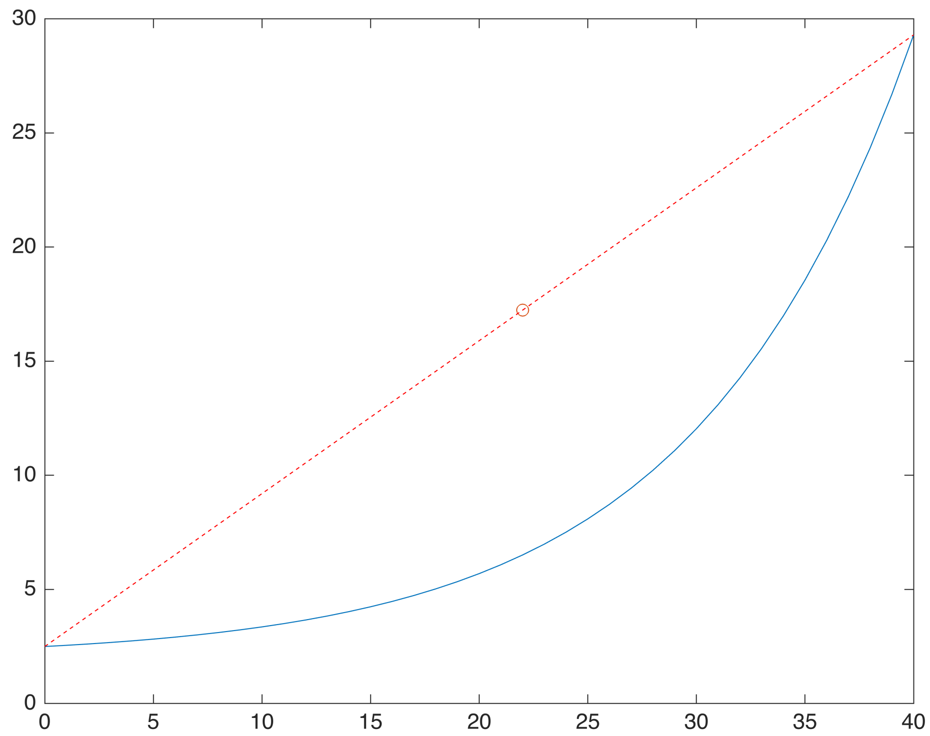
```
xtest = 22;
xx = 0:1:40;
yy = 0.5 * exp(0.1.*xx) + 2;
```

Linear Interpolation

```
xx1 = linspace(0, 40, 2);
y1 = 0.5 * exp(0.1.*xx1) + 2;
p1 = polyfit(xx1, y1, 1);
ypred1 = polyval(p1, xtest)
```

```
ypred1 =
17.2395
```

```
plot(xx, yy, '-', xtest, ypred1, 'o', xx1, y1, 'r--');
```

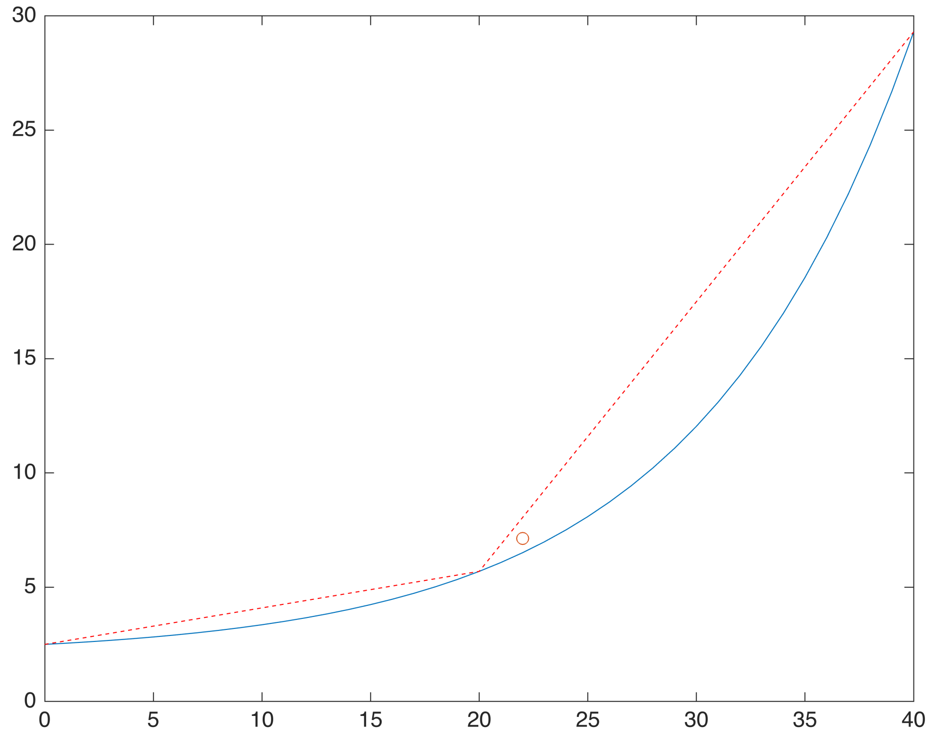


Quadratic Interpolation

```
xx2 = linspace(0, 40, 3);
y2 = 0.5 * exp(0.1.*xx2) + 2;
p2 = polyfit(xx2, y2, 2);
ypred2 = polyval(p2, xtest)
```

```
ypred2 =
7.1365
```

```
plot(xx, yy, '-', xtest, ypred2, 'o', xx2, y2, 'r--');
```

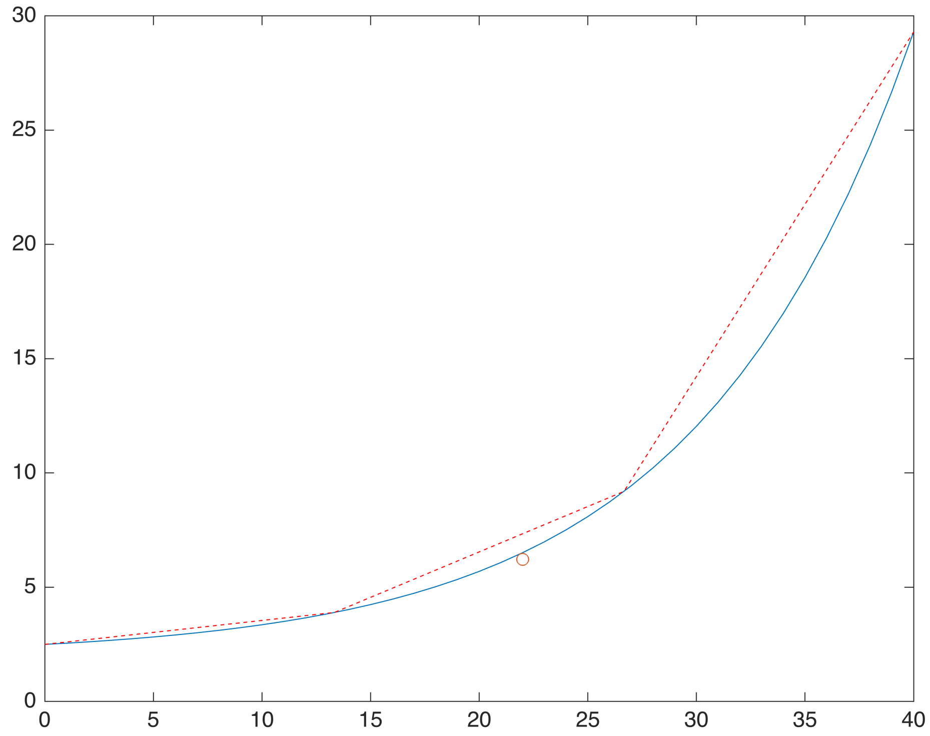


Cubic Interpolation

```
xx3 = linspace(0, 40, 4);
y3 = 0.5 * exp(0.1.*xx3) + 2;
p3 = polyfit(xx3, y3, 3);
ypred3 = polyval(p3, xtest)
```

```
ypred3 =
6.2153
```

```
plot(xx, yy, '-', xtest, ypred3, 'o', xx3, y3, 'r--');
```



Q2 [CORRECT]

Suppose, we focus on the Runge's function $\frac{1}{1+25x^2}$ from x = 0 to 1.

When x = 0.6, y = ____ (true value)

If we perform quadratic polynomial interpolation with 3 points with equal interval between 0 and 1, when x = 0.6, y = ____

|Relative error| = ____ %

If we perform cubic polynomial interpolation with 4 points with equal interval between 0 and 1, when x = 0.6, y = ____

|Relative error| = ____ %

If we perform a 4th-order polynomial interpolation with 5 points with equal interval between 0 and 1, when x = 0.6, y = ____

|Relative error| = ____ %

Assume that we have 5 data points from this Runge's function at x = 0.00, 0.25, 0.50, 0.75, 1.00

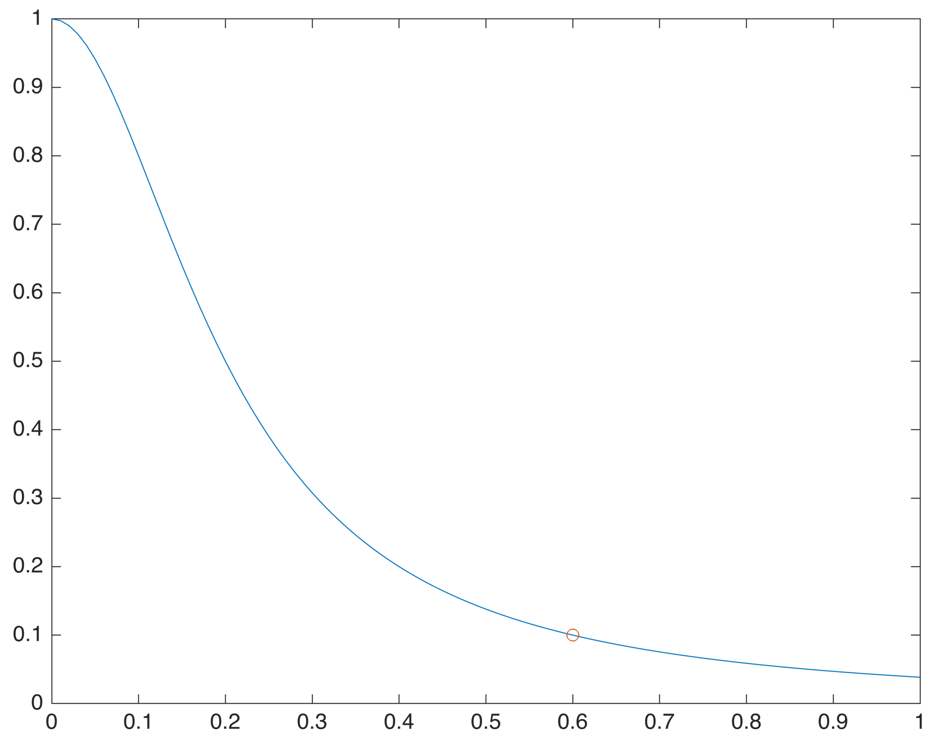
a) When y = 0.5, find the correct value of x analytically. x = ____

b) Now assume that we don't know the Runge's function. Using quadratic interpolation and the quadratic formula to determine the value of x numerically. (use the first three points to fit quadratic polynomial) x = ____

```
xtest = 0.6;
xx = 0:0.01:1;
yy = 1 ./ (1 + 25.*xx.^2);
ytrue = 1 ./ (1 + 25.*xtest.^2)
```

```
ytrue =
0.1000
```

```
plot(xx, yy, '-', xtest, ytrue, 'o')
```

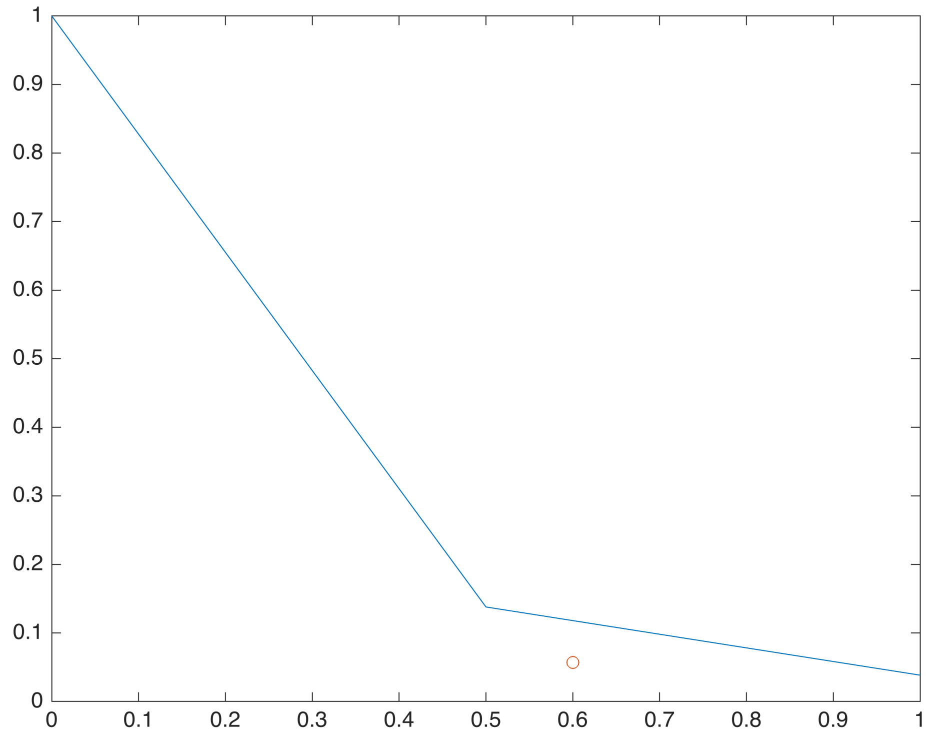


Quadratic

```
xx2 = linspace(0, 1, 3);
yy2 = 1 ./ (1 + 25.*xx2.^2);
p2 = polyfit(xx2, yy2, 2);
ypred2 = polyval(p2, xtest)
```

```
ypred2 =
0.0570
```

```
plot(xx2, yy2, '-', xtest, ypred2, 'o')
```




```
errq = abs((ytrue - ypred2) / ytrue) * 100
```

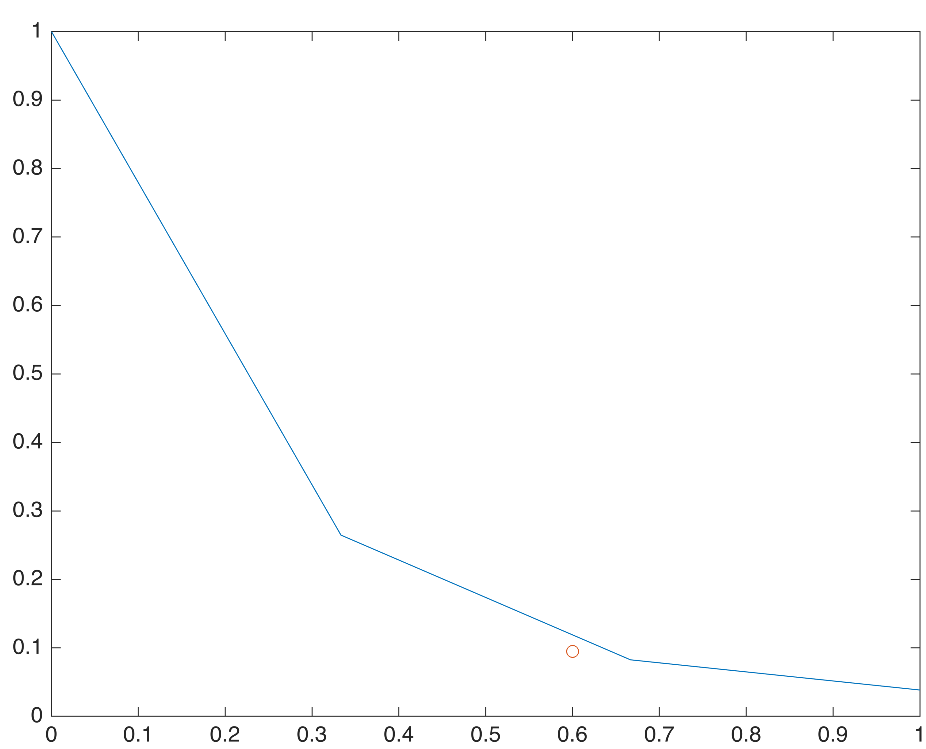
```
errq =
42.9708
```

Cubic

```
xx3 = linspace(0, 1, 4);
yy3 = 1 ./ (1 + 25.*xx3.^2);
p3 = polyfit(xx3, yy3, 3);
ypred3 = polyval(p3, xtest)
```

```
ypred3 =
0.0947
```

```
plot(xx3, yy3, '-', xtest, ypred3, 'o')
```




```
errc = abs((ytrue - ypred3) / ytrue) * 100
```

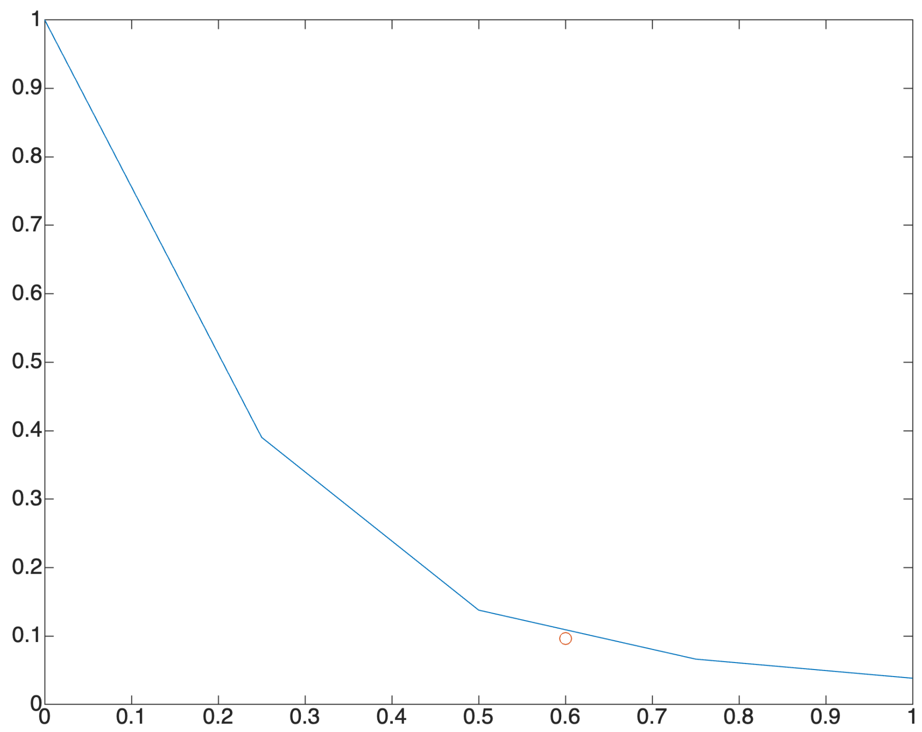
```
errc =
5.3302
```

4th-order

```
xx4 = linspace(0, 1, 5);
yy4 = 1 ./ (1 + 25.*xx4.^2);
p4 = polyfit(xx4, yy4, 4);
ypred4 = polyval(p4, xtest)
```

```
ypred4 =
0.0962
```

```
plot(xx4, yy4, '-', xtest, ypred4, 'o')
```




```
err4th = abs((ytrue - ypred4) / ytrue) * 100
```

```
err4th =
3.8120
```

Inverse

a)

```
xxinv = [0.00, 0.25, 0.50, 0.75, 1.00];
ytest = 0.5;
xinvtrue = sqrt(((1/ytest)-1) * (1/25)) % 0.2000
```

```
xinvtrue =
0.2000
```

b)

```
xxinv2 = [0.00, 0.25, 0.50];
yyinv2 = 1 ./ (1 + 25.*xxinv2.^2);
pinv2 = polyfit(xxinv2, yyinv2, 2)
```

```
pinv2 = 1×3
    2.8595   -3.1539    1.0000
```

```
c = pinv2(3) - ytest;
b = pinv2(2);
a = pinv2(1);
x1 = (-b + sqrt(b^2 - (4*a*c))) / (2*a)
```

```
x1 =
0.9110
```

```
x2 = (-b - sqrt(b^2 - (4*a*c))) / (2*a)
```

```
x2 =
0.1919
```

```
% ans = x2 = 0.1919
```