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| | |
|---|---|
| **Started on** | Sunday, 14 November 2021, 1:23 PM |
| **State** | Finished |
| **Completed on** | Sunday, 14 November 2021, 3:54 PM |
| **Time taken** | 2 hours 31 mins |
| **Marks** | 24.50/27.00 |
| **Grade** | **24.50** out of 27.00 (**91**%) |

Question **1**

Correct

Mark 1.00 out of 1.00

When finding an interpolating function using quadratics splines, what is the second condition our splines must satisfy?

Select one:

- a. They must form the convolution matrix
- b. They must be accessible from the data
- c. Every coefficient must be non-zero
- d. The first derivatives of adjacent splines must agree at the knot they both touch ✔

The correct answer is: The first derivatives of adjacent splines must agree at the knot they both touch

Question **2**

Correct

Mark 1.00 out of 1.00

Which of the following is a problem with interpolating using linear splines?

Select one:

- a. The interpolating function is a step function
- b. The interpolating function is not continuous at the knots
- c. The interpolating function cannot estimate a step function
- d. The interpolating function is not differentiable at the knots ✔

The correct answer is: The interpolating function is not differentiable at the knots

Question **3**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

Lagrange created an efficient method for finding interpolating [polynomials] . The idea is that $y$ is a linear combination of Lagrange basis functions, which are [easy] to find. For example, an interpolating [quadratic] has form $y = L_0(x)y_0 + L_1(x)y_1 + L_2(x)y_2$.

difficult variables line

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

Lagrange created an efficient method for finding interpolating [polynomials]. The idea is that $y$ is a linear combination of Lagrange basis functions, which are [easy] to find. For example, an interpolating [quadratic] has form $y = L_0(x)y_0 + L_1(x)y_1 + L_2(x)y_2$.

Question **4**

Correct

Mark 1.00 out of 1.00

For each of the following statements, indicate whether they are true or false for the simple linear least squares regression method.

| | True | False | |
|---|---|---|---|
| If two people use the least squares method correctly they will both get the same answer. | ◉ ✔ | ○ ✘ | ✔ |
| The residuals are the differences between the y values in the data and the values predicted by the line. | ◉ ✔ | ○ ✘ | ✔ |
| The least squares method will always produce a line suitable for the data. | ○ ✘ | ◉ ✔ | ✔ |
| The aim is to minimize the sum of the squares of the residuals. | ◉ ✔ | ○ ✘ | ✔ |

Question **5**

Correct

Mark 1.00 out of 1.00

Given *n* data points, how many unknowns must we find to find an interpolating function using quadratic splines?

Select one:

a. $$4n$$

b. $$3n$$

c. $$n$$

The correct answer is:

$$3n$$

Question **6**

Correct

Mark 1.00 out of 1.00

Given data points

$$x_0 = 1, x_1 = 9, x_2 = 14, y_0 = 2.6, y_1 = 9.8, y_2 = 5.8$$

use linear splines to estimate the value of *f(x)* when

$$x = 4.5$$

Give your answer to 1 decimal place.

Answer: 5.8

This is covered in week 12. See the linear splines example.

The correct answer is: 5.8

Question **7**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

In [spline] interpolation, we have data points $(x_0, y_0), \ldots, (x_n, y_n)$ with $x_0 < x_1 < \ldots < x_n$ , and functions connecting the points $(x_i, y_i)$ and $(x_{i+1}, y_{i+1})$ are found for each interval $[x_i, x_{i+1}]$ . These functions are often [polynomials] . By using higher degree polynomials we can guarantee that [derivatives] of functions agree at the points they both touch.

[extrapolation] [random] [maximums]

Your answer is correct.

The correct answer is:

*Drag and drop words and phrases to make the following statement correct.*

In [spline] interpolation, we have data points $(x_0, y_0), \ldots, (x_n, y_n)$ with $x_0 < x_1 < \ldots < x_n$ , and functions connecting the points $(x_i, y_i)$ and $(x_{i+1}, y_{i+1})$ are found for each interval $[x_i, x_{i+1}]$ . These functions are often [polynomials]. By using higher degree polynomials we can guarantee that [derivatives] of functions agree at the points they both touch.

Question **8**

Correct

Mark 1.00 out of 1.00

You have the following data:

$$(2.9, 12.3), (3.2, 28), (5.1, 30.9).$$

Use inverse linear interpolation to estimate the value of $x$ when $y = 23.2$. Give your answer to one decimal place.

3.10841

One possible correct answer is: 3.1082802547771

Your answer is correct.

Question **9**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

If we have data that we believe fits a(n) [exponential] ✔ model defined by the equation $y = \alpha e^{\beta x}$ , we can use simple linear regression to estimate the parameters $\alpha$ and $\beta$. To do this we [linearize] ✔ the data by taking the [natural logs] ✔ of the $y$ values.

[logs base 10] [power equation] [reduce]

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

If we have data that we believe fits a(n) [exponential] model defined by the equation $y = \alpha e^{\beta x}$ , we can use simple linear regression to estimate the parameters $\alpha$ and $\beta$. To do this we [linearize] the data by taking the [natural logs] of the $y$ values.

Question **10**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

If we have fit a [quadratic] ✔ regression line to some data, we can find the standard error of the estimate $s_{yx}$ by calculating the sum of the squares of the residuals using

$$S_r = \sum_{i=1}^{n} (y_i - a_0 - a_1 x_i - a_2 x_i^2)^2$$

then dividing $S_r$ by [n - 3] ✔ and taking the square root. This gives us a measure of [goodness of fit] ✔ for our regression model.

[n - 2] [cubic] [probability]

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

If we have fit a [quadratic] regression line to some data, we can find the standard error of the estimate $s_{yx}$ by calculating the sum of the squares of the residuals using

$$S_r = \sum_{i=1}^{n} (y_i - a_0 - a_1 x_i - a_2 x_i^2)^2$$

then dividing $S_r$ by [n - 3] and taking the square root. This gives us a measure of [goodness of fit] for our regression model.

Question **11**

Correct

Mark 2.00 out of 2.00

You have the following data:

$$(1.1, 2.3), (2.8, 9.6), (3.1, 10.2), (4, 26), (5.4, 38).$$

a) Insert values to obtain a matrix equation that could be solved to find the best fit quadratic for this data.

| | | |
|---|---|---|
| 5 ✔ One possible correct answer is: 5 | 16.4 ✔ One possible correct answer is: 16.4 | 63.82 ✔ One possible correct answer is: 63.82 |
| 16.4 ✔ One possible correct answer is: 16.4 | 63.82 ✔ One possible correct answer is: 63.82 | 274.538 ✔ One possible correct answer is: 274.538 |
| 63.82 ✔ One possible correct answer is: 63.82 | 274.538 ✔ One possible correct answer is: 274.538 | 1261.5874 ✔ One possible correct answer is: 1261.5874 |

$$\cdot \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} =$$

| |
|---|
| 86.1 ✔ One possible correct answer is: 86.1 |
| 370.23 ✔ One possible correct answer is: 370.23 |
| 1700.149 ✔ One possible correct answer is: 1700.149 |

Your answer is correct.

Question **12**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

Interpolation is [estimating] values taken by a function $f$ of $x$ for $x$ values [inside] the range of available data. Formally, we are given data points $(x_0, y_0), \ldots, (x_n, y_n)$ with $x_0 < x_2 < \ldots < x_n$ and $x \in (x_0, x_n)$, and try to estimate $f(x)$. We often use [polynomials] to do this, using methods created by Newton and Lagrange.

[outside] [minimizing] [random variables]

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

Interpolation is [estimating] values taken by a function $f$ of $x$ for $x$ values [inside] the range of available data. Formally, we are given data points $(x_0, y_0), \ldots, (x_n, y_n)$ with $x_0 < x_2 < \ldots < x_n$ and $x \in (x_0, x_n)$, and try to estimate $f(x)$. We often use [polynomials] to do this, using methods created by Newton and Lagrange.

Question **13**

Correct

Mark 1.00 out of 1.00

When finding an interpolating function using quadratics splines, what is the first condition our splines must satisfy?

Select one:

- a. Each spline must pass through every data point
- b. Each spline must pass through the data points at the ends of the interval on which it is defined ✔
- c. Each spline must be a linear combination of the others
- d. The splines must be linearly independent

The correct answer is: Each spline must pass through the data points at the ends of the interval on which it is defined

Question **14**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

Given $n+1$ data points $(x_0, y_0), \dots, (x_n, y_n)$, there is a(n) unique ✔ polynomial of degree at most $n$ that passes through every data point. This is called the interpolating ✔ polynomial. There are however a(n) infinite ✔ number of polynomials of degree $n+1$ that pass through all these points.

finite random Runge

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

Given $n+1$ data points $(x_0, y_0), \dots, (x_n, y_n)$, there is a(n) [unique] polynomial of degree at most $n$ that passes through every data point. This is called the [interpolating] polynomial. There are however a(n) [infinite] number of polynomials of degree $n+1$ that pass through all these points.

Question **15**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

When using a sample to estimate the standard deviation of a population ✔ , we must adjust the standard deviation formula by dividing by n-1 ✔ in place of $n$. This is because the mean of the sample is derived from the sample itself, and the standard deviation of the elements of the sample with respect to the mean of the sample will tend to underestimate ✔ the standard deviation of the population.

sample n-2 overestimate

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

When using a sample to estimate the standard deviation of a [population], we must adjust the standard deviation formula by dividing by [n-1] in place of $n$. This is because the mean of the sample is derived from the sample itself, and the standard deviation of the elements of the sample with respect to the mean of the sample will tend to [underestimate] the standard deviation of the population.

Question **16**

Incorrect

Mark 0.00 out of 2.00

You have the following data:

$$(1.2, 11.9), (4.3, 15.2), (6.1, 18.9), (8.8, 11.2)$$

Find the interpolating cubic for this data and use to estimate the value of y when $x = 5.3$. Give your answer to 1 decimal place.

18.0 ✖

One possible correct answer is: 17.651693251448

This is covered in week 11. You can use any method to find the interpolating cubic (Newton's method, Lagrange's method, even the Vandermonde matrix method). Once you have calculated the interpolating cubic you just evaluate it at when $x = 5.3$ to find the corresponding value of $y$.

Question **17**

Correct

Mark 2.00 out of 2.00

You have the following data, which you believe fits a saturation-growth model $y = \frac{ax}{x+b}$, for the unknown parameters $a$ and $b$.

$$(15.3, 7.4), (32.8, 8.37), (82.8, 8.92)(111.8, 9.06)$$

a) Using this data find an estimate for $a$. Give your solution to 2 decimal places.

9.3856 ✔

One possible correct answer is: 9.385664878873

b) Using this data find an estimate for $b$. Give your solution to 2 decimal places.

4.0885 ✔

One possible correct answer is: 4.088581200875

Your answer is correct.

Question **18**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

In the general linear least squares regression model, $y = a_0 z_0 + ... + a_m z_m$ . Here the $z_i$ are [basis functions] ✔ . The model is defined by the matrix equation [Y = ZA + E] ✔ . Taking partial derivatives and setting them equal to zero is equivalent to the matrix equation $Z^T E = 0$. Combining this with the other matrix equation gives a matrix formula for finding $A$, the vector of [parameters] ✔ .

[estimates] [values] [Y = AX + B]

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

In the general linear least squares regression model, $y = a_0 z_0 + ... + a_m z_m$ . Here the $z_i$ are [basis functions]. The model is defined by the matrix equation [Y = ZA + E]. Taking partial derivatives and setting them equal to zero is equivalent to the matrix equation $Z^T E = 0$. Combining this with the other matrix equation gives a matrix formula for finding $A$, the vector of [parameters].

Question **19**

Correct

Mark 1.00 out of 1.00

*Drag and drop words and phrases to make the following statement correct.*

To calculate the coefficient of variance (cv), we divide the standard deviation by the [mean] ✔ . This gives us a [normalized] ✔ measure. This is useful because the standard deviation alone cannot be used to compare different [populations] ✔ .

[caramelized] [parameters] [variance]

Your answer is correct.

The correct answer is:
*Drag and drop words and phrases to make the following statement correct.*

To calculate the coefficient of variance (cv), we divide the standard deviation by the [mean]. This gives us a [normalized] measure. This is useful because the standard deviation alone cannot be used to compare different [populations].

Question **20**

Correct

Mark 1.00 out of 1.00

Given data points

$$x_0 = 1, x_1 = 4, x_2 = 7, y_0 = 1, y_1 = 3, y_2 = 2$$

use quadratic splines to estimate the value of *f(x)* when

$$x = 5$$

Give your answer to 2 decimal places.

Answer: 3.33

The correct answer is: 3.33

Question **21**

Partially correct

Mark 3.50 out of 4.00

You have the following data points

$$(1, 22.8), (2, 23), (4.4, 29.8), (5.8, 28.9), (8, 38.7).$$

a) Calculate the parameter $a_1$ for the best fit line. Give your solution to 2 decimal places.

2.178 ✔

One possible correct answer is: 2.1789985052317

b) Calculate $\bar{x}$.

4.24 ✔

One possible correct answer is: 4.24

c) Calculate $\bar{y}$.

28.6399 ✔

One possible correct answer is: 28.64

d) Find the parameter $a_0$ for the best fit line. Give your solution to 2 decimal places.

14.4010 ✖

One possible correct answer is: 19.401046337818

e) Use the best fit line to estimate the value of $y$ when $x$ is 6.1. Give your solution to 1 decimal place.

32.692937 ✔

One possible correct answer is: 32.692937219731

f) Calculate the sum of the squares of the residuals from the mean $S_t$. Give your solution to 2 decimal places.

168.5320 ✔

One possible correct answer is: 168.532

g) Calculate the sum of the squares of the residuals of regression $S_r$. Give your solution to 2 decimal places.

16.06311 ✔

One possible correct answer is: 16.063116591928

h) Calculate the coefficient of determination $r^2$. Give your solution to 2 decimal places.

0.904688 ✔

One possible correct answer is: 0.90468803199435

i) Calculate the standard error $s_{yx}$. Give you solution to 2 decimal places.

2.3139 ✔

One possible correct answer is: 2.3139516410914

This is covered in the week 9 class on simple linear regression.

You have correctly answered 8 part(s) of this question.

◄ Homework 11

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Homework 13 ►