**Question 1 (POLYNOMIAL) – Lecture 1**

Which **two** of the following criteria/statistics can be used to select the order of polynomial regression? Check all that apply.



AIC



RSS (No because it will always pick the largest D)



F-test – Also called Anova Testing and helpful comparing different models (http://sia.webpopix.org/polynomialRegression1.html#t-test)



Magnitude of the coefficient for the highest polynomial term

**Question 2 (CUBIC SPLINE) – Lecture 2**

Suppose *g* is a cubic spline defined on [*a*,*b*]. Which of the following statement **is not** true?



*g* is a continuous function.



The first derivative of *g* is continuous.



The second derivative of *g* is continuous.



The third derivative of *g* is continuous. (By third derivative spline is not useful and no longer continuous) – Check last 2 lectures in ISLR videos.

**Question 3 (CUBIC SPLINE) – Lecture 2-3**

A robot needs to follow a path that passes consecutively through six points (*xi*​,*yi*​) where without loss of generality, assume *xi*​'s are arranged in an increasing order and they are unique. To find a smooth path you would recommend which of the following? Circle all that apply. *(Hint: there are two correct answers.)*

1 point



Fit a linear regression model based on the 6 data points.



Fit a cubic polynomial function of *x* based on the 6 data points.



Fit a natural cubic spline function with knots at the six points *x*1​ to *x*6​.



Fit a cubic spline function with two knots {*z*1​, *z*2​}, where *z*1​ is the average of (*x*1​,*x*2​,*x*3​) and *z*2​ is the average of (*x*4​,*x*5​,*x*6​).

**Question 4 (CUBIC SPLINE)**

* **Follow the example here :** [**http://www.cs.uky.edu/~jzhang/CS321/answer6-10.pdf**](http://www.cs.uky.edu/~jzhang/CS321/answer6-10.pdf)
* **At original equation when x =1, we get a = 2**
* **At 1st derivative when x = 1, we get b = -1**
* **At 2nd Derivative when x = 1, we get c = -3**
  + **Also as per the Piazza notes: we need to calculate upto second derivative and with x = 1, at second derivate c will be = -3**
* **3rd Derivative wont apply since there wont be any x terms left. D hence NA I assume.**

(**Questions 4-7 are related to the same function *g*.**)

A cubic spline function *g* is defined between 0 and 2 as follows

* *g*(*x*) = 1 + 2x– x^3, if 0 ≤ *x* < 1;
* g(x) = a + b(x-1) +c(x-1)^2 + d(x-1)^3, if 1 ≤ x ≤ 2.

Find the value of *a*. If the value is not unique, write "NA" in the box.

1 point



Question 5

Find the value of *b*. If the value is not unique, write "NA" in the box.

1 point



Question 6

Find the value of *c*. If the value is not unique, write "NA" in the box.

1 point



Question 7

Find the value of *d*. If the value is not unique, write "NA" in the box.

1 point



Question 8 **(CUBIC POLYNOMIAL) – LECTURE 1**

**Questions 8-15 are related to the data "Boston" from R library MASS.**

library(MASS)

attach(Boston)

This question uses the variables "dis" (the weighted mean of distances to five Boston employment centers) and "nox" (nitrogen oxides concentration in parts per 10 million) from the Boston data.

**Round your answer to the 2nd digits after the decimal point.**

Use the poly() function to fit a cubic polynomial regression to predict "nox" using "dis".What's the residual sum of squares? (A number between 1.50 and 2.10)

1 point



Question 9 (Lecture 4 – end of lecture)

**Round your answer to the 2nd digits after the decimal point.**

Use the poly() function to fit a cubic polynomial regression to predict "nox" using "dis".

What's the predicted "nox" when dis=6? (A number between 0.30 and 0.60)

1 point



Question 10 ( Lecture 1)

**Round your answer to the 2nd digits after the decimal point.**

Use the poly() function to fit a cubic polynomial regression to predict "nox" using "dis".

Is the p-value for the cubic term less than 5%? (Fill in "Yes" or "No")

1 point



Question 11

**Round your answer to the 2nd digits after the decimal point.**

Next use the poly() function to fit a fourth-degree polynomial regression model.

What's the residual sum of squares? (A number between 1.50 to 2.10)

1 point



Question 12 (Lecture 4 – end of lecture)

**Round your answer to the 2nd digits after the decimal point.**

Next use the poly() function to fit a fourth-degree polynomial regression model.

What's the predicted "nox" when dis=6? (A number between 0.30 and 0.60)

1 point



13.

Question 13

**Round your answer to the 2nd digits after the decimal point.**

Next use the poly() function to fit a fourth-degree polynomial regression model.

Is the p-value for the highest polynomial term less than 5%? (Fill in "Yes" or "No")

1 point



Question 14 ( LECTURE 2 & 3) – Tried comparing models using Anova in code. Also Residual Difference Is the Lowest. Compare them using the anova function)

This question uses the variables "dis" and "nox" from the Boston data. We use the following R command to fit a cubic spline model to predict "nox" using "dis"

library(MASS)

myfit1 = lm(nox ~ bs(dis, df=3), data=Boston)

Which **two** of the following R command would return the same model as "myfit1"?

lm(nox ∼ bs(dis, df= 5, intercept=TRUE), data=Boston)

lm(nox ~ bs(dis, df= 4, intercept=TRUE), data=Boston) – Lec 3: ***Intercept not added by default so same here.***

lm(nox ∼ bs(dis, knots=quantile(dis, prob=c(0.25, 0.5, 0.75)), data=Boston)

lm(nox ∼ poly(dis, 3), data=Boston)

lm(nox ∼ bs(dis, knots=median(dis)), data=Boston)

Question 15

Suppose we use the following R command to fit a cubic spline model to predict "nox" using "dis"

myfit2 = lm(nox ∼ bs(dis, df=4), data=Boston)

Which **two** of the following R command would return the same model as "myfit2"?

1 point

lm(nox ∼ bs(dis, df= 4, intercept=TRUE), data=Boston)

lm(nox ∼ bs(dis, knots=quantile(dis, prob=c(0.25, 0.5, 0.75)), data=Boston)

lm(nox ∼ poly(dis, 3), data=Boston)

lm(nox ~ bs(dis, knots=median(dis)), data=Boston)

lm(nox ∼ bs(dis, df= 5, intercept=TRUE), data=Boston) – Lec 3: ***Intercept not added by default so same here.***

Question 16

Suppose we fit a smoothing spline on n data points (*xi*​,*yi*​) where *xi*​'s are unique and arranged in an increasing order. Which **three** of the following statements are correct?

1 point



The fitted curve is a piece-wise cubic polynomial when *x* is between *x*1​ and *xn*​, but a linear function when x < x\_1*x*<*x*1​ and another linear function when x > x\_n*x*>*xn*​.



When the tuning parameter lambda is set to be zero, the curve returned by smoothing spline passes through all the data points (*xi*​,*yi*​).



When the tuning parameter lambda is equal to infinity (or large enough), smoothing spline is equivalent to linear regression (I did not select this one)



Due to the roughness penalty, the fitted curve is no longer a piece-wise cubic polynomial function.



Instead of tuning lambda, we can tune the degree of the freedom of a smoothing spline model (i.e., the df option in smooth.spline command). But we can only try integer values for df.



The data points divide the x-coordinate into (*n*+1) intervals, and the fitted curve is a linear function within each interval.



When the tuning parameter lambda is set to be zero, smoothing spline is equivalent to cubic polynomial regression.



When the tuning parameter lambda is equal to infinity (or large enough), smoothing spline is equivalent to cubic polynomial regression.