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8000 - 6000 - 4000 - 2000 -	divorced –	marital	single –	unknown –						
# (b) barcrosstab	in each gro		response o	verlay	of each grou	ip but it is	difficult to	determine t	the proportion of y	yes/no
12000 - 10000 - 8000 - 6000 - 4000 - 2000 -	aîvorced -	married -	single -	unknown -						
# (c) non norm_cros	clearly shows the control of the con	marital  ows the proport  oar graph of n	ions of yes/r marital w/ iv(crosstak	response	e overlay				er groups	
0.0 y	es									
#show all fig, axs crosstab	c clearly sho ribution (free 1 3 bar ch =plt.subple 01.plot(k	equency) of each	ion of yes/non h group  tal side-by  tacked=Fals	y-side s <b>e,</b> ax <b>=</b> ax:	s[0])	roup in co	mparision	to other gro	oups, but gives no	indicatio
norm_cros	respond600 no 1200	plot(kind='bar el='marital'> 00 - respons 00 - ye	r', stacked							
22) Us	marital sing the	divorced divorced single	divorced - divorced - divorced	narital	21c, des	scribe :	the rel	ationsh	ip betweer	1
For each mindividuals individuals	narital group had the hig having the the fol gency 1	ghest proportion smallest propo llowing w table, beir	n of yes responds on of yes with the very sample of	oonses, fo responses variab ful to l	llowed by the s.  les mare have the second control of the second c	ital an	d resp	onse: a	f responses being th divorced/marrie ) build a representing and b) desc	g the
#continge #display crosstab_ crosstab_	ency table counts 01=pd.cro	tingency the for marital posstab (bank ['ramarried single	status vs.	. respons	se					
round(cro	osstab_01.	1608 1061  proportions div(crosstab_ married single  90.1 86.0  9.9 14.0	_01.sum(0),			for each	marital	group		
Out of those Out of those	se who are r se who are s se who are u	divorced: 2743 married: 14579 single: 6514 (86 unknown: 50 (8 tell us how each	(90.1%) responc (90.1%) responc (37.7%) respo	ponded 'N led 'No' , nded 'No'	No', 1608 (9 1061 (14%) ', 7 (12.3%)	9%) responded	onded 'Yes d 'Yes' l 'Yes'		responded 'No'.	
Explain contin	te row proposstab_01.	ifference l	proportion of the proportion o	n the i	interpre	etation	of this	s table a	ercentages and the pre	
Out of all 'unknown.	No' respons		were divorc	ed, 14579	9 (61%) wer	e married,	6514 (27%		lle, and 50 (<1%) v e, and 7 (<1%) wer	
# (a) his plt.histoplt.title	on, with y of res	overlay of sponse. W	of respo hat is t	nse, c	ć) Norm	alized	histog	gram of	Histogram duration, v kness?	
plt.xlabe #This gra Text(0.5,	el('Durati	lon') ly shows the d		on of du	ration but	does no	t separat	e between	yes/no respons	es
Histogram	•	Duration	n ution of dura	ation but c	does not se	parate bety	ween yes/r	no response:	S.	
duration_duration_plt.histoplt.legerplt.titleplt.ylabeplt.xlabe	y=bank[ba: n=bank[ba: ([duration] nd(['Responde('Histogra el('Freque: el('Duration) 0, 'Duration)	ank.response = n_y, duration_ onse = Yes','F ram of Duration ency') Lon')	'yes']['c	'duration duration 10, stack No']) sponse On	'] ked=True) verlay')				ion and respons	е
20000 - 15000 - 5000 -			Re	sponse = Yes						
# (c) non (n, bins, n_table = n_norm = ourbins =	rmalized h patches) n_table / np.column	bowever, the proposition of a plt.hist( mn_stack((n[0])	ency of yes/reportion of yes  duration w, [duration_y],n[1])) (axis=1)[:, s[0:10],bir	no respons s/no respons / respons y, durat: , None] ns[1:11];	onses is diff  se overlay ion_n], bi	ns=10, st	erpret. tacked= <b>Tr</b>	r <b>ue</b> ) #creat	ntaining the overa	
p1 = plt. p2 = plt. plt.leger plt.title plt.xlabe plt.ylabe plt.show #not sure	bbar(x = or bbar(x = or d) ['Responde('Normali el('Durational('Proportional()) e why hist	ourbins[:,0],h purbins[:,0], pnse=Yes','Res tzed Histogran Lon')	height = n height = r sponse=No'; m of Durat: showing pa	_norm[:,( n_norm[:, ]) ion with	0], width ,1], width Response	= ourbin	ns[:,1] -	ourbins[:	:,0], bottom =	n_norm[
15000 - 15000 - 5000 -			R	esponse=No						
follow adult.  #import to	Science ving ex _ch6_	xercises test data	g Pyth s, work ta sets	on ar with		-			5,16,17. Fo	or the
adult_tra adult_tra adult_tra	ain=pd.read st=pd.read ain	Income Cap_C <=50K <=50K <=50K	_ch6_train: ch6_test')	; ;						
4  18756 18757 18758 18759	Married Divorced Married Married Divorced Married	<=50K <=50K <=50K <=50K <=50K <=50K	0.00000 0.00000 0.00000 0.00000 0.00000							
adult_tes  Mar  0  1 2 Nev	ital status  Married  Married  er-married	Income Cap_Ga <=50K >50K <=50K	0.000000 0.051781 0.000000							
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14) Cromarita provid tree.	l status	CART modes and capi ecision tro	ital gain	s and	losses	Visua	lize th	e decisi	cts income ion tree (th n the decis	at is,
<pre>#save tan y=adult_t #convert mar_np=np #create</pre>	catsmodels earn.tree erget varia crain['Inc marital s o.array(ad	import Decisi	ionTreeClas  my variable  arital stat  ables for e	es tus'])	— ue of mari	tal stat		es = True)		
<pre>mar_cat_g X = pd.cd X  /opt/mini rical is y arrays. warning</pre>	conda3/endeprecated It will by warn ( p_Gains_Los	ed. Use pandas be removed af	ap_Gains_Loab/python3. s Categorio fter releas 2 3 4	.10/site- cal to re se 0.13.	-packages/	statsmode	els/tools		:152: FutureWar: L_dummies to co:	
1 2 3 4  18756 18757	0.00 0.00 0.00 0.00	0000 1.0 0.0 (0000 0.0 1.0 (0000 0.0 (0000 0.0 1.0 (0000 0.0 (00	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 							
#show the	0.00  × 6 column  e values f	0000 1.0 0.0 0 0000 0.0 1.0 0 ns for each dummy 'Married', 2	0.0 0.0 0.0 y variable		, 3: 'Sepa	rated', 4	4: 'Widow	ed'}		
<pre>X_names = y_names = y_names =  #run CART cart01 =  /opt/mini ure names be raised</pre>	= ["CapGai: = ["<=50K"  T model DecisionT  conda3/env only supp	TreeClassifier	Divorced", r(criterion lb/python3.	n='gini',	, max_leaf -packages/	_nodes=5;	).fit(X, <sub>)</sub>	) idation.py	idowed"] y:1858: FutureWeint', 'str']. A	
	tree struc	cture art01, out_fil	_e ="cart01	s valu	Married < gini = 0. amples = ue = [142] class = <	= 0.5 364 18761 71, 4490 =50K		s_names=y_	_names)	
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1	i = 0.083 bles = 934 = [8938, 4 s = <=50k	42 104]	gini = sample value = [3 class = 0.411 = 235 68, 167]	0.485 s = 549 322, 227 <=50K gir sam value		sar value cla	gini = 0.4 mples = <sup>-</sup> e = [4821 ass = <=	7632 , 2811]	gini = 0 samples = value = [190 class = >	: 1238 ), 1048
samp value =		class = : a binary split of a condition (True) rital status. The arried<=0.5). Th	>50K  all decision r ) and a right root node di ne next decis p on the righ 1 marital stat	clas nodes. For child that ivides all r sion nodes at of the tr	r our model, t does not secords into s are based ree is furthe further split	each pare atisfy the t two group on CapGa	est condit os: those w insLosses hether the	ion (False). <sup>-</sup> ho are marri and whethe eir total capi	o child nodes: the The first split in th ied (False for Mari r or not they exce tal gains and losse sses.	e decision ried <=0 ed a
CART mod that satisfi tree is defi and other numeric th 0.051. Tho	es the test oned by marion (True for Manager) (True	rt01.predict()	ib/python3. nat are all odel us s. Visua	ing the	-packages/ s. Got fea			idation.pv	7:1858: FutureWo	
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[106	37) Interpret the coefficient for Debt-to-Income Ratio  The coefficient for Debt-to-Income Ratio is -48.1262. This means that a one unit increase in Debt-to-Income Ratio will result in a decrease in Credit Score of 48, holding Request Amount constant.  38) Interpret the coefficient for Request Amount.  The coefficient for Request Amount is 0.0011. This means that a one unit increase in Request Amount will result in an increase in Credit Score of 0.0011, holding Debt-to-Income Ratio constant.  39) Find and interpret the value of s.  #Find the standard error, s np.sqrt (model01.scale)  66.00195259717188								
[106]:	np.sqrt (model01.scale)  66.00195259717188  The standard error for our model is 66.00. This means that the predicted Credit Score will typically differ from the actual credit score by 66 points.  40) Find and interpret the R^2_adjusted. Comment.  The R^2 value can be interpreted as the proportion of variability of the target variable that can be explained by the predictor variables. Our model has an R^2_adjusted value of 0.028, which means that 2.8% of the variability of Credit Score can be explained by our predictor variables, Debt-to-Income Ratio and Request Amount. An R^2 value that is equal to the R^2_adjusted tells us that all of our predictor variables belonged in the model.								
[107 [ [107]:	41) Find MAE_baseline and MAE_regression, and determine whether the regression model outperformed its baseline model.  #Calculate MAE_regression by passing the test set through the regression model from sklearn.metrics import mean_absolute_error  ypred=model01.predict(X_test) ytrue=bank_test['Credit Score'] mean_absolute_error(y_true=ytrue, y_pred=ypred)  47.79066993781932  #Calculate MAE_baseline by passing the training set through the regression model mean_absolute_error(y_true=bank_train['Credit Score'], y_pred=model01.predict(X))  48.309615690578404								
	MAE_regression = 47.79  MAE_baseline = 48.31  MAE_regression < MAE_baseline, so we can conclude that the regression model outperformed its baseline model								