

# Marketing Campaign Analytics



# Overview



- Portuguese banking institution
- Campaigns through phone calls
- Participants: 45,211
- Attributes: 17

Data source:

<https://archive.ics.uci.edu/ml/datasets/Bank+Marketing>

# **Business questions**

1. How to improve the effectiveness of the bank marketing campaign of the term deposit?
2. How to target customers who are new and who have been previously contacted?



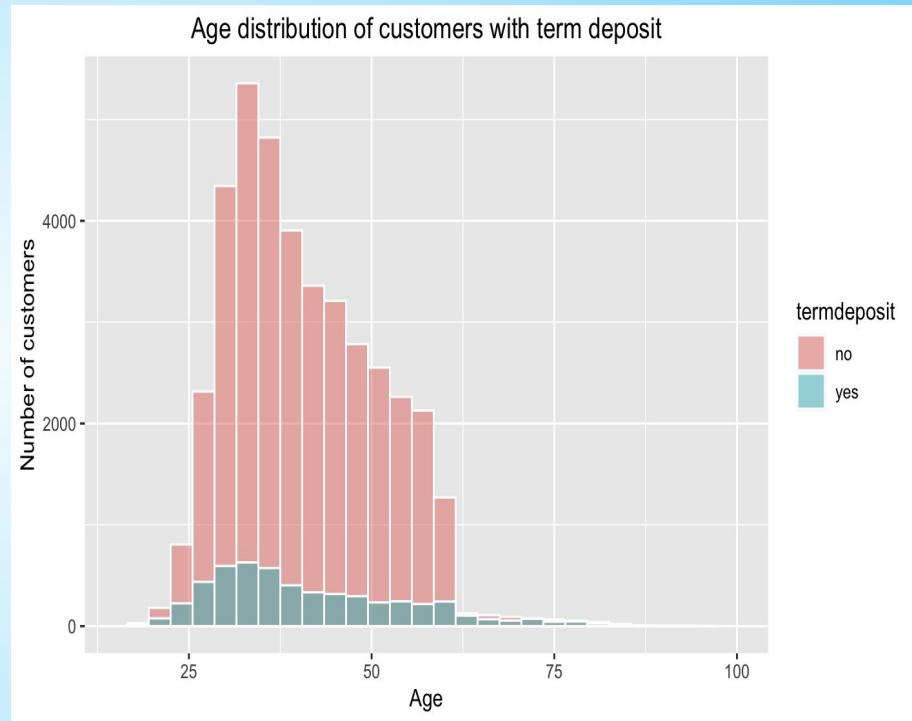
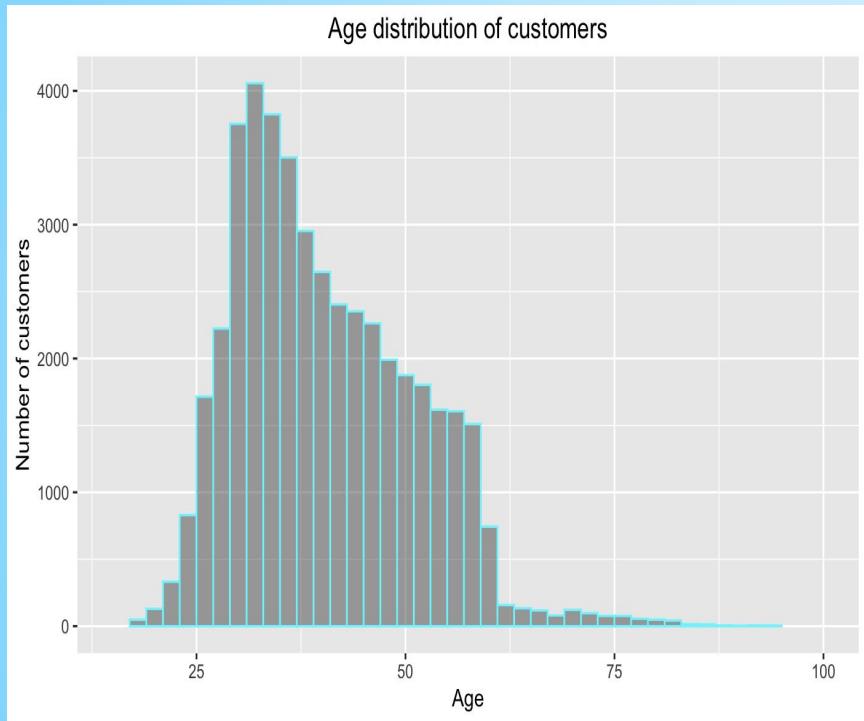
# Data Attributes



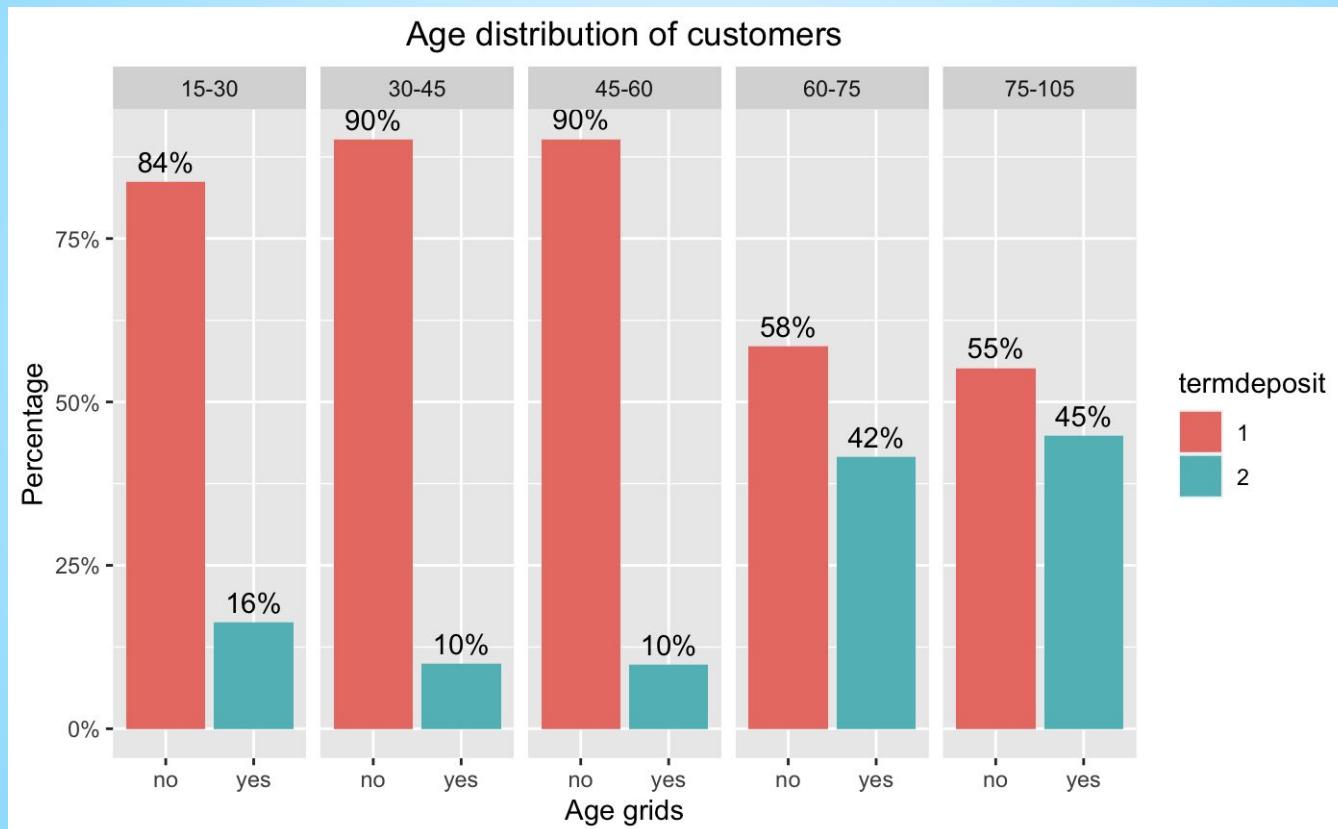


# Exploratory Data Analysis

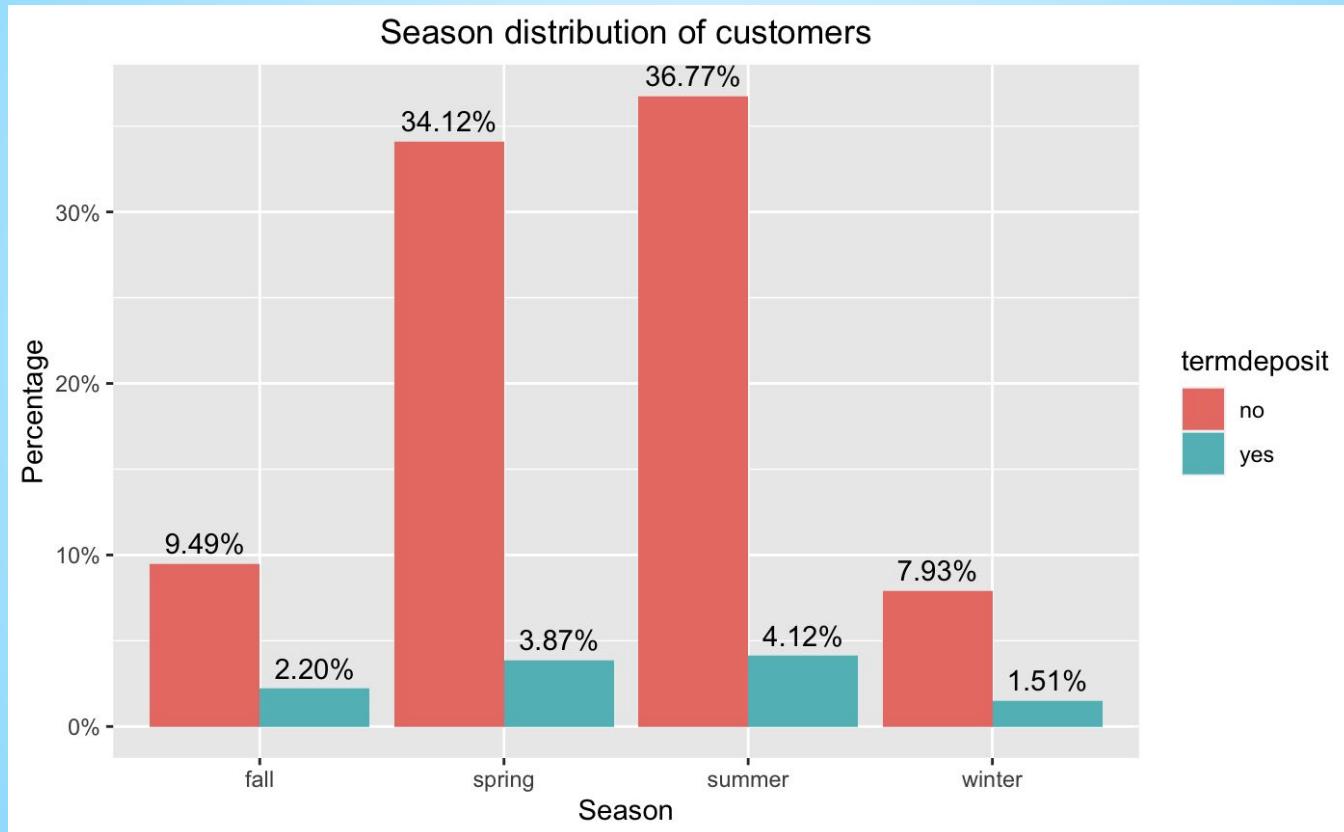
# Age distribution across customers



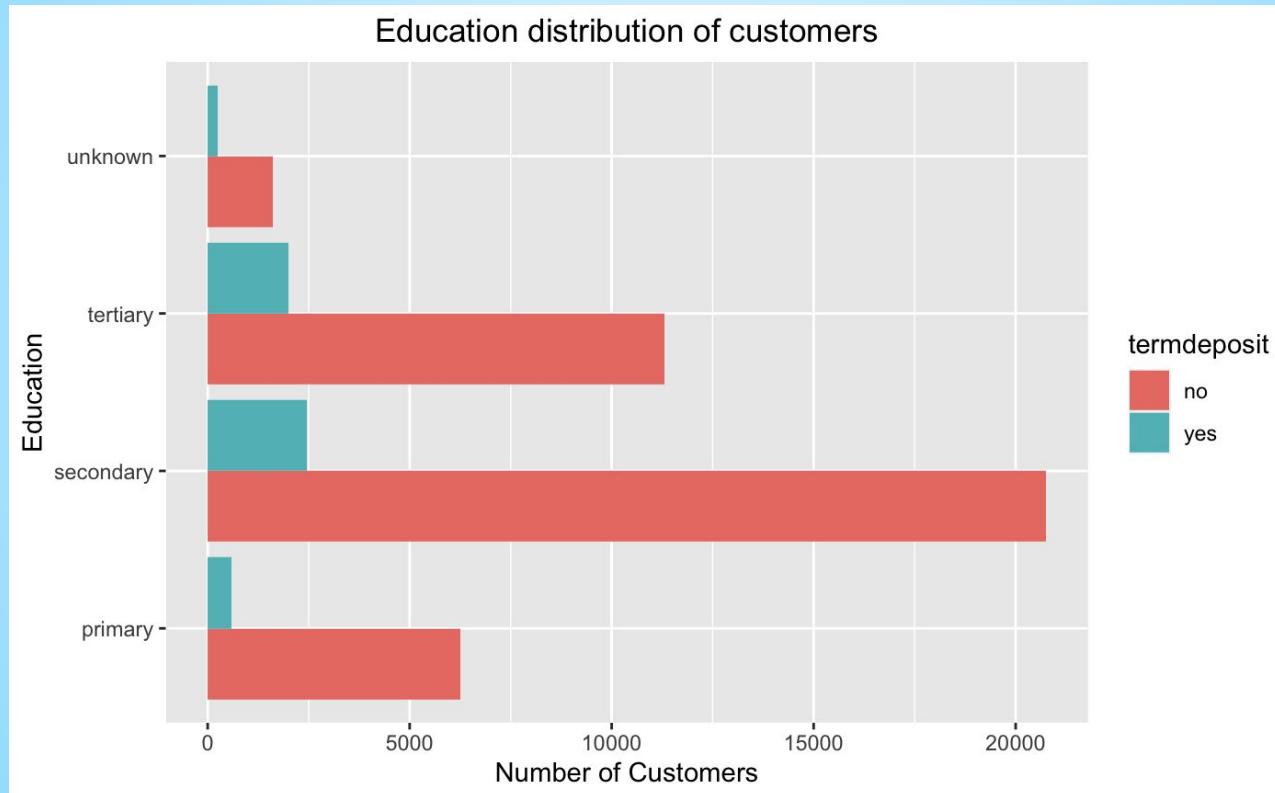
# Age distribution across customers



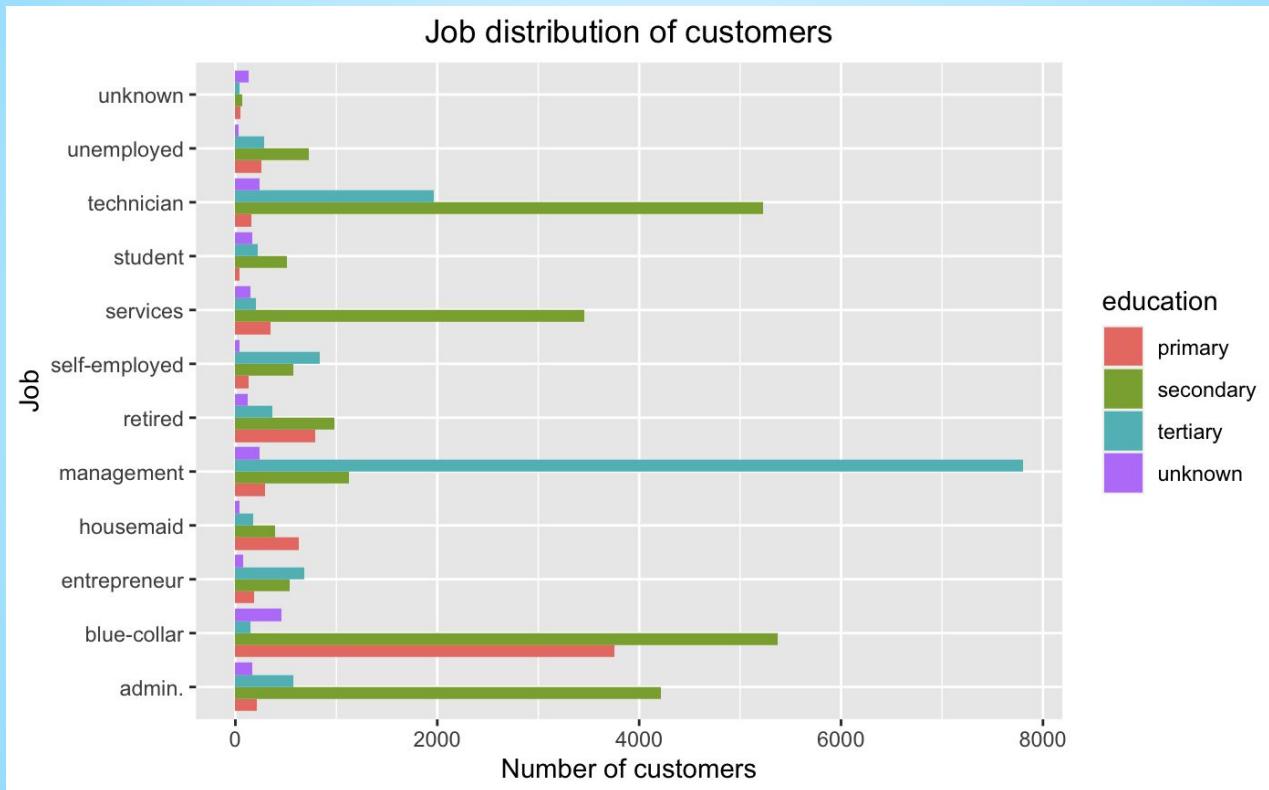
# Season distribution across customers



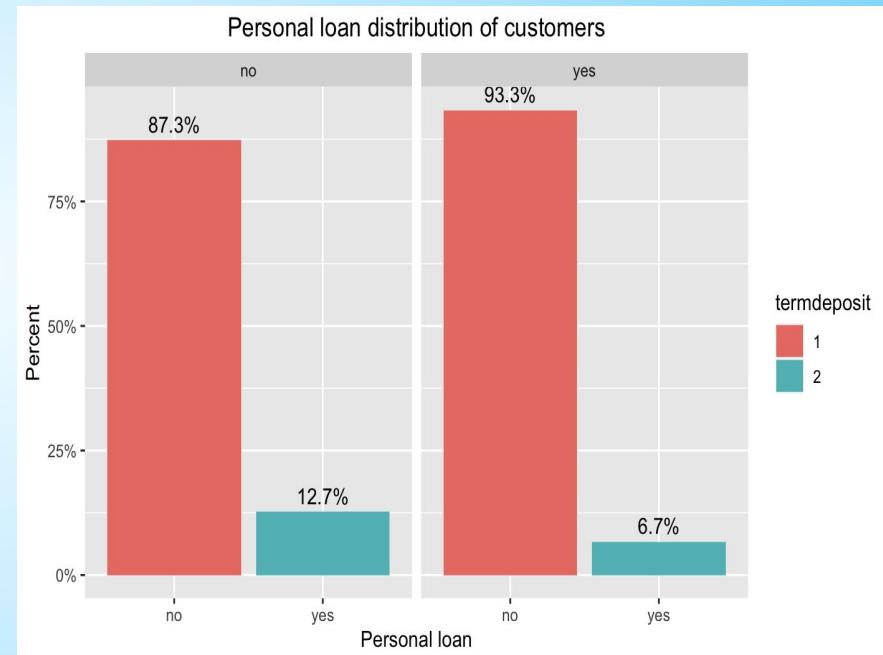
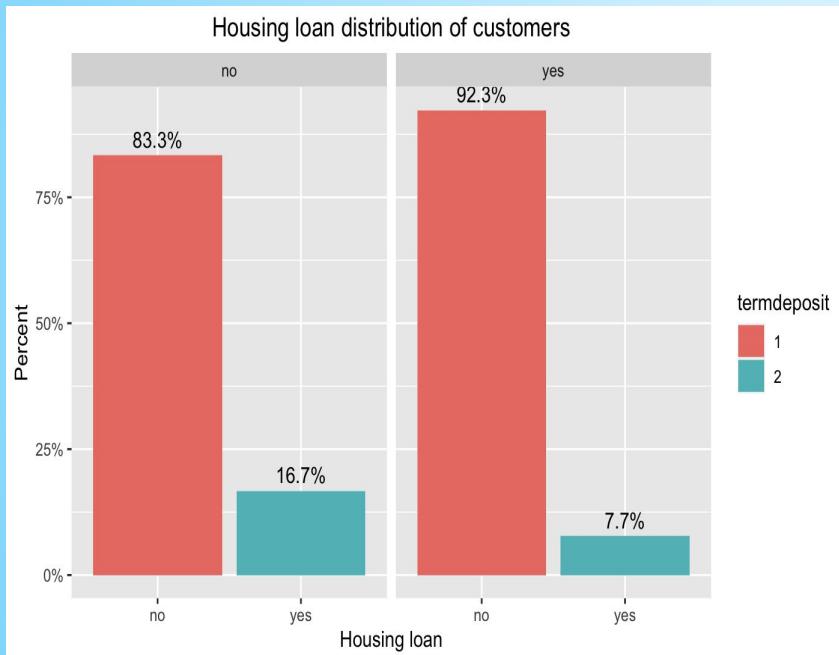
# Education distribution across customers



# Job distribution across customers

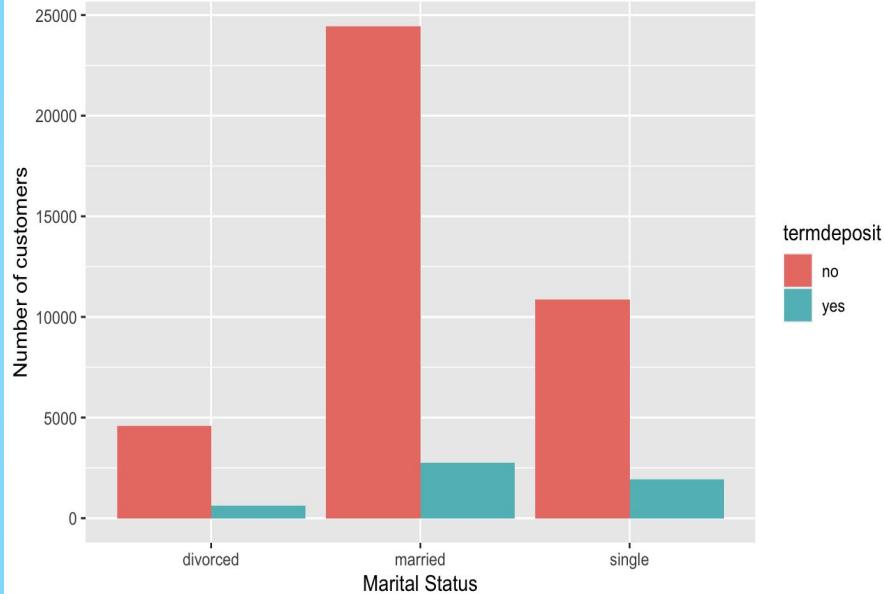


# Loan distribution across customers

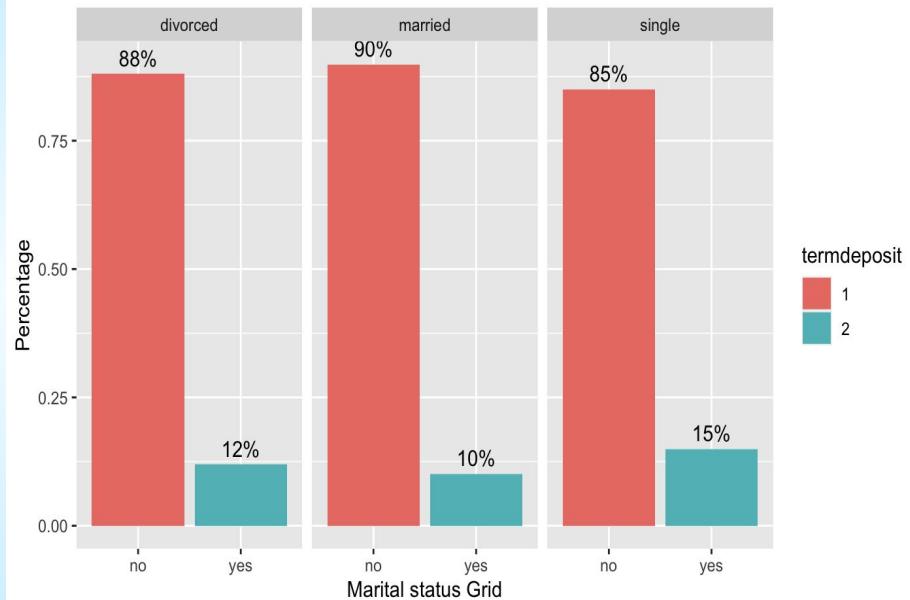


# Marital Status distribution across customers

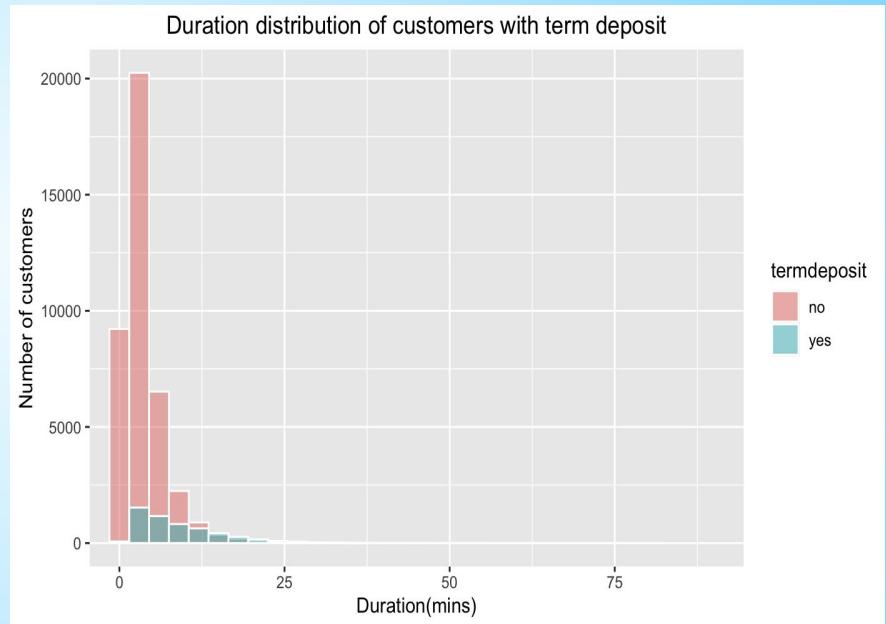
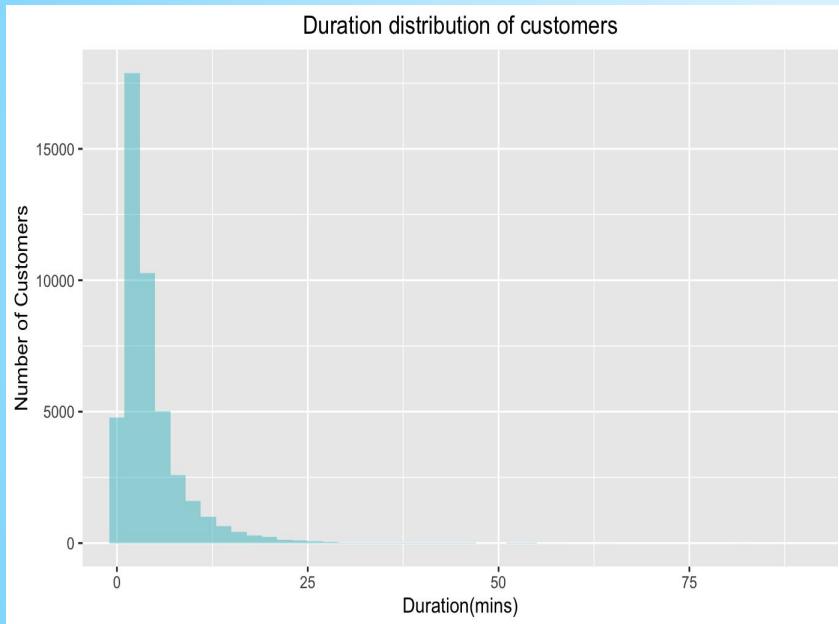
Count distribution of customers wrt marital status



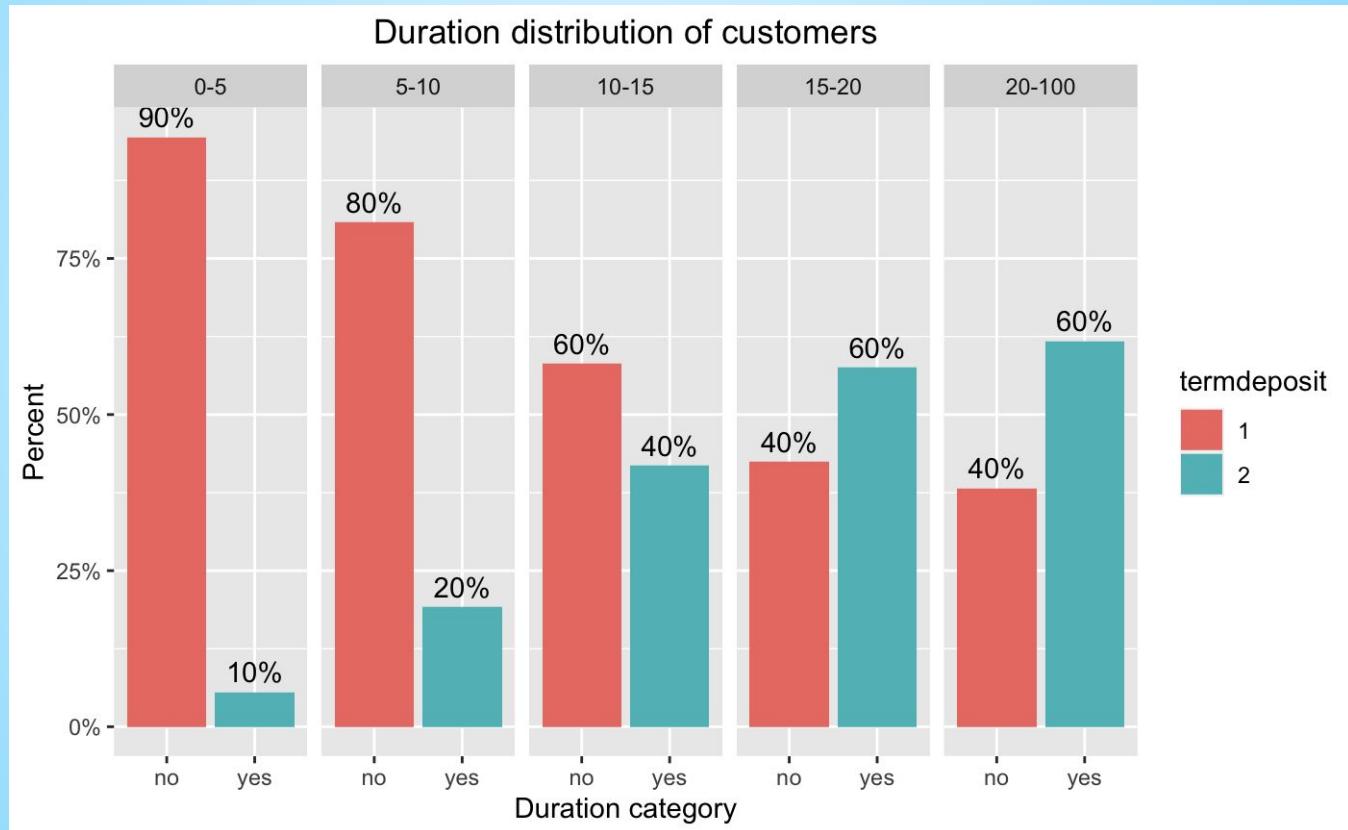
Percentage distribution of customers wrt marital status



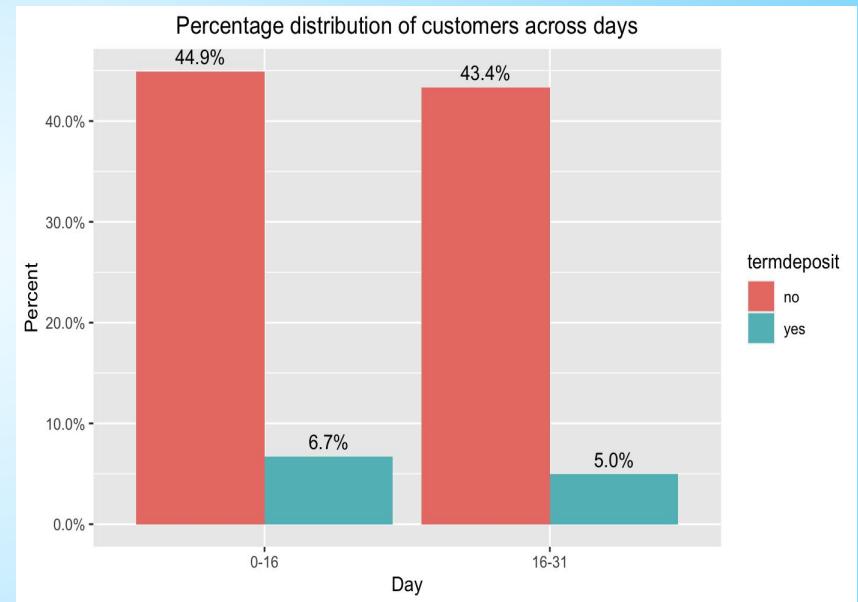
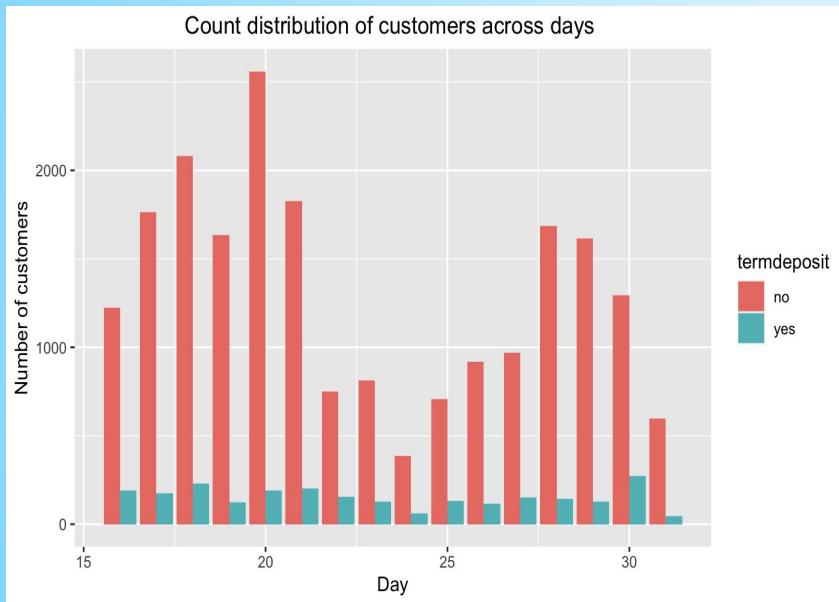
# Duration distribution across customers



# Duration distribution across customers



# Day-wise distribution across customers





# Modelling

# Logistic Regression Model

## Newly Contacted Customers

Coefficients:		Estimate	Std. Error	z value	Pr(> z )
(Intercept)	-1.180440	0.160327	-7.363	1.80e-13	***
age	0.001629	0.002276	0.716	0.474223	.
jobbluecollar	-0.119267	0.074962	-1.591	0.111605	.
jobentrepreneur	-0.205482	0.124008	-1.657	0.097520	.
jobhousemaid	-0.263997	0.137244	-1.924	0.054410	.
jobmanagement	-0.159437	0.077262	-2.064	0.039058	*
jobretired	0.567988	0.098369	5.774	7.74e-09	***
jobsselfemployed	-0.152181	0.114668	-1.327	0.184462	.
jobservices	-0.145860	0.086699	-1.682	0.092497	.
jobstudent	0.395055	0.116634	3.387	0.000706	***
jobtechnician	-0.112467	0.072047	-1.561	0.118519	.
jobunemployed	-0.047294	0.115228	-0.410	0.681486	.
jobunknowm	-0.382280	0.258805	-1.477	0.139650	.
maritalmarried	-0.309388	0.058387	-5.299	1.17e-07	***
maritalsingle	0.092379	0.066607	1.387	0.165465	.
educationsecondary	0.112493	0.064202	1.752	0.079744	.
educationtertiary	0.325352	0.075306	4.320	1.56e-05	***
educationunknown	0.206147	0.105942	1.946	0.051672	.
default	-0.182790	0.154909	-1.180	0.238005	.
balance	0.054150	0.014913	3.631	0.000282	***
housing	-0.641129	0.044136	-14.526	< 2e-16	***
loan	-0.417781	0.059277	-7.048	1.82e-12	***
contacttelephone	-0.155454	0.074163	-2.096	0.036073	*
contactunknowm	-1.140722	0.053488	-21.327	< 2e-16	***
day	-0.011490	0.002287	-5.025	5.05e-07	***
campaign	-0.071030	0.008978	-7.911	2.55e-15	***
seasonspring	0.226272	0.064049	3.533	0.000411	***
seasonsummer	-0.402997	0.060178	-6.697	2.13e-11	***
seasonwinter	-0.203555	0.076889	-2.647	0.008112	**

## Previously Contacted Customers

Coefficients:		Estimate	Std. Error	z value	Pr(> z )
(Intercept)	-1.8752037	0.2745531	-6.830	8.49e-12	***
age	0.0064542	0.0037755	1.709	0.087359	.
jobbluecollar	-0.3788189	0.1256763	-3.014	0.002576	**
jobentrepreneur	-0.5443625	0.2499845	-2.178	0.029437	*
jobhousemaid	-0.2661587	0.2428645	-1.096	0.273116	.
jobmanagement	0.0661759	0.1205887	0.549	0.583161	.
jobretired	0.1522516	0.1671308	0.911	0.362310	.
jobsselfemployed	-0.1691363	0.1919950	-0.881	0.378350	.
jobservices	-0.0910757	0.1422405	-0.640	0.521981	.
jobstudent	0.3289640	0.1740716	1.890	0.058782	.
jobtechnician	-0.1656216	0.1151009	-1.439	0.150172	.
jobunemployed	0.3944386	0.1917051	2.058	0.039635	*
jobunknowm	0.5634087	0.4207184	1.339	0.180519	.
maritalmarried	0.1483437	0.1052719	1.409	0.158791	.
maritalsingle	0.2395274	0.1200598	1.995	0.046036	*
educationsecondary	0.1447215	0.1172351	1.234	0.217033	.
educationtertiary	0.2946455	0.1339530	2.200	0.027834	*
educationunknown	0.1709527	0.1834759	0.932	0.351469	.
default	-0.3196407	0.4830193	-0.662	0.508128	.
balance	0.0543143	0.0282089	1.925	0.054176	.
housing	-0.8567476	0.0710085	-12.065	< 2e-16	***
loan	-0.4914457	0.1114766	-4.409	1.04e-05	***
contacttelephone	-0.2646790	0.1233793	-2.145	0.031933	*
contactunknowm	-0.9808552	0.3569744	-2.748	0.006002	**
day	0.0071074	0.0038290	1.856	0.063426	.
campaign	-0.1357625	0.0237054	-5.727	1.02e-08	***
pdays	0.0010631	0.0002912	3.651	0.000261	***
previous	0.0112594	0.0063336	1.778	0.075448	.
poutcomether	0.3556767	0.0805325	4.417	1.00e-05	***
poutcomesuccess	2.1675921	0.0750314	28.889	< 2e-16	***
poutcomeunknowm	0.9968855	0.9490270	1.050	0.293521	.
seasonspring	-0.2607501	0.0855358	-3.048	0.002300	**
seasonsummer	0.4682113	0.0946446	4.947	7.53e-07	***
seasonwinter	-0.3714226	0.0975038	-3.809	0.000139	***

```

## Call:
## glm(formula = termdeposit ~ ., family = "binomial", data = train)
##
## Deviance Residuals:
##      Min      1Q   Median      3Q     Max 
## -3.2236 -0.3829 -0.2566 -0.1558  3.1975 
## 
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)    
## (Intercept) -1.520e+00 1.794e-01 -8.473 < 2e-16 ***
## jobbluecollar -3.925e-01 8.465e-02 -4.637 3.53e-06 ***
## jobentrepreneur -5.640e-01 1.504e-01 -3.750 0.000177 ***
## jobhousemaid -6.194e-01 1.597e-01 -3.879 0.000105 *** 
## jobmanagement -2.013e-01 8.578e-02 -2.347 0.018928 *  
## jobretired -3.282e-01 1.266e-01 -2.592 0.009549 ** 
## jobselfemployed -3.660e-01 1.293e-01 -2.831 0.004635 ** 
## jobservices -2.656e-01 9.615e-02 -2.763 0.005734 ** 
## jobstudent 3.216e-01 1.300e-01 2.474 0.013364 *  
## jobtechnician -2.713e-01 8.022e-02 -3.382 0.000719 *** 
## jobunemployed -1.338e-01 1.300e-01 -1.029 0.303316 
## jobunknown -2.432e-01 2.557e-01 -0.951 0.341528 
## maritalmarried -2.381e-01 6.801e-02 -3.502 0.000462 *** 
## maritalsingle -1.587e-02 7.723e-02 -0.205 0.837198 
## educationsecondary 1.359e-01 7.548e-02 1.800 0.071825 . 
## educationtertiary 3.971e-01 8.784e-02 4.520 6.17e-06 *** 
## educationunknown 1.951e-01 1.214e-01 1.607 0.108075 
## default -1.461e-01 1.911e-01 -0.764 0.444616 
## balance 4.051e-02 1.838e-02 2.204 0.027538 *  
## housing -8.479e-01 5.075e-02 -16.709 < 2e-16 *** 
## loan 5.108e-01 6.920e-02 -7.381 1.57e-13 *** 
## contacttelephone -2.130e-01 8.930e-02 -2.385 0.017090 * 
## contactunknown -1.131e+00 6.816e-02 -16.595 < 2e-16 *** 
## day -4.448e-03 2.595e-03 -1.714 0.086560 . 
## campaign -9.814e-02 1.188e-02 -8.260 < 2e-16 *** 
## pdays 7.382e-05 3.709e-04 0.199 0.842250 
## previous 3.108e-02 1.097e-02 2.832 0.004622 ** 
## poutcomeother 2.243e-01 1.061e-01 2.113 0.034599 *  
## poutcomesuccess 2.393e+00 9.630e-02 24.849 < 2e-16 *** 
## poutcomeunknown -1.370e-01 1.134e-01 -1.208 0.227057 
## seasonspring 3.281e-02 6.870e-02 0.478 0.632992 
## seasonsummer -2.495e-01 6.654e-02 -3.750 0.000177 *** 
## seasonwinter -3.198e-01 8.101e-02 -3.947 7.91e-05 *** 
## duration_bin5-10 1.445e+00 4.943e-02 29.226 < 2e-16 *** 
## duration_bin10-15 2.876e+00 6.565e-02 43.808 < 2e-16 *** 
## duration_bin15-20 3.806e+00 1.006e-01 37.847 < 2e-16 *** 
## duration_bin20-100 4.028e+00 1.194e-01 33.742 < 2e-16 *** 
## age_bin30-45 -3.611e-01 6.201e-02 -5.824 5.73e-09 *** 
## age_bin45-60 -3.568e-01 7.518e-02 -4.746 2.07e-06 *** 
## age_bin60-75 9.364e-01 1.406e-01 6.659 2.75e-11 *** 
## age_bin75-105 1.090e+00 2.268e-01 4.807 1.54e-06 *** 
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

# Logistic Regression Model



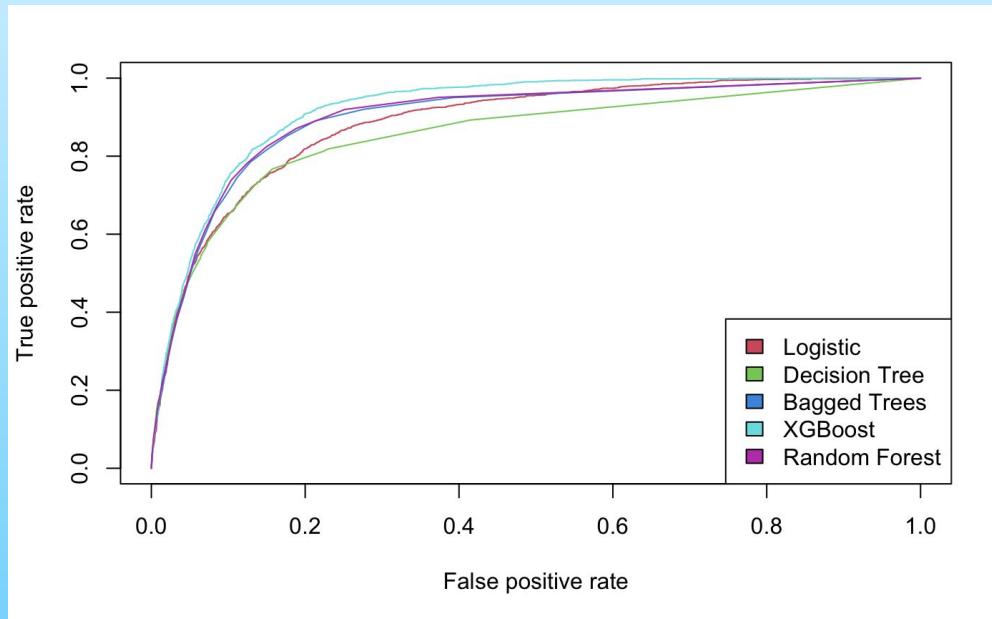
Job student, Balance, Previous outcome success, tertiary and secondary education



Married marital status, Housing loan, Personal loan, Number of times contacted in current campaign, Age less than 60, Season of Summer & Winter, Contact type-telephone

# Model Comparison

Models	Logit	Decision Tree	Bagging	XGBoost	Random Forest
AUC Score	0.8816	0.8543	0.8963	<u>0.9212</u>	0.8995



# Solving Imbalance using SMOTE Technique

SMOTE generates new examples of the minority class and undersamples the majority class examples.

Imbalanced Target Variable

Yes	No
3713	27832

**SMOTE**

Balanced Target Variable

Yes	No
14852	15594

perc.over = x : minority class turns into  $(1+x)/100$  times

perc.under = y : majority turns into  $y/100 * (x/100)$  times of minority

# Comparing model results between imbalanced and balanced data



Imbalanced Data

Prediction	Actual	
	Yes	No
Yes	652	408
No	963	11665

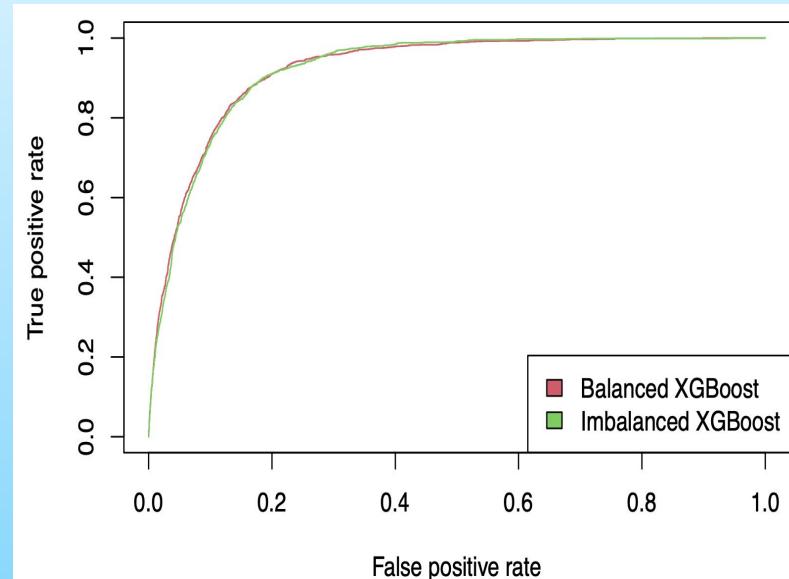
AUC : 0.9218

Balanced Data

Prediction	Actual	
	Yes	No
Yes	965	769
No	591	11113

AUC : 0.9227

ROC curve comparison



# Customer Segment Analysis

Age

**Less than 40**

Customers below the age of 40

Age

**40 and above**

Customers from the age of 40 and above

Season

**Winter + Spring**

Customers contacted from December to May

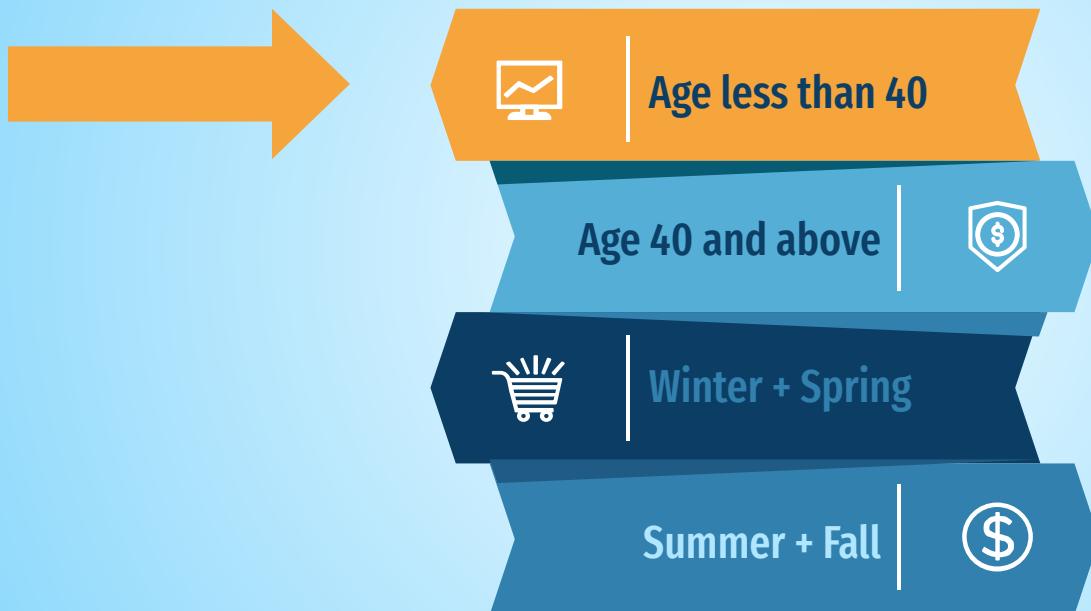
Season

**Summer + Fall**

Customers contacted from June to November



# Segment Analysis



```

## Call:
## glm(formula = deposit ~ ., family = binomial(link = "logit"),
##      data = train_age)
##
## Deviance Residuals:
##    Min      1Q   Median      3Q     Max
## -2.5672 -0.4008 -0.2691 -0.1609  3.1771
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept) -3.514e+00 4.943e-01 -7.109 1.17e-12 ***
## default      1.319e-03 2.409e-01  0.005 0.995630
## balance     2.617e-05 1.023e-05  2.559 0.010501 *
## housing     -8.865e-01 6.802e-02 -13.033 < 2e-16 ***
## loan        -5.779e-01 9.595e-02 -6.022 1.72e-09 ***
## day         -8.705e-03 3.551e-03 -2.451 0.014239 *
## campaign    -6.188e-02 1.471e-02 -4.206 2.60e-05 ***
## pdays       -9.301e-04 4.933e-04 -1.886 0.059352 .
## previous    2.336e-02 1.542e-02  1.515 0.129693
## spring      3.776e-01 1.010e-01  3.740 0.000184 ***
## summer     3.775e-02 9.747e-02  0.387 0.698503
## fall        3.380e-01 1.143e-01  2.958 0.003093 **
## age_bin_15_30 3.470e-01 6.578e-02  5.275 1.32e-07 ***
## job_admin.   2.138e-01 4.650e-01  0.460 0.645720
## job_bluecollar -8.893e-02 4.651e-01 -0.191 0.848369
## job_entrepreneur -1.421e-02 4.992e-01 -0.028 0.977292
## job_housemaid -1.022e-02 5.250e-01 -0.019 0.984472
## job_management 1.166e-01 4.634e-01  0.252 0.801349
## job_retired    -8.470e-01 1.204e+00 -0.703 0.481862
## job_selfemployed -2.121e-02 4.820e-01 -0.044 0.964891
## job_services   3.846e-02 4.684e-01  0.082 0.934557
## job_student    6.839e-01 4.692e-01  1.458 0.144931
## job_technician 5.020e-02 4.626e-01  0.109 0.913589
## job_unemployed 9.799e-02 4.853e-01  0.202 0.839986
## marital_divorced -8.553e-02 1.248e-01 -0.685 0.493043
## marital_married -2.566e-01 6.539e-02 -3.924 8.72e-05 ***
## education_primary -3.887e-01 2.025e-01 -1.919 0.054943 .
## education_secondary -8.749e-02 1.637e-01 -0.535 0.592942
## education_tertiary 1.326e-01 1.690e-01  0.785 0.432710
## contact_cellular 1.067e+00 9.245e-02 11.541 < 2e-16 ***
## contact_telephone 7.338e-01 1.785e-01  4.111 3.94e-05 ***
## poutcome_failure 5.097e-01 1.534e-01  3.323 0.000892 ***
## poutcome_other   6.754e-01 1.767e-01  3.822 0.000132 ***
## poutcome_success 2.702e+00 1.459e-01 18.516 < 2e-16 ***
## duration_bin_5_10 1.426e+00 6.724e-02 21.215 < 2e-16 ***
## duration_bin_10_15 2.865e+00 9.089e-02 31.518 < 2e-16 ***
## duration_bin_15_20 3.690e+00 1.368e-01 26.977 < 2e-16 ***
## duration_bin_20_100 4.221e+00 1.695e-01 24.900 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 12033.6 on 16362 degrees of freedom
## Residual deviance: 8419.8 on 16325 degrees of freedom
## AIC: 8495.8
##
## Number of Fisher Scoring iterations: 6

```

## Logistic Regression Model



Positive Significance:

Previously contacted customers, spring, fall, age between 15-30, Contact by cellular, contact duration

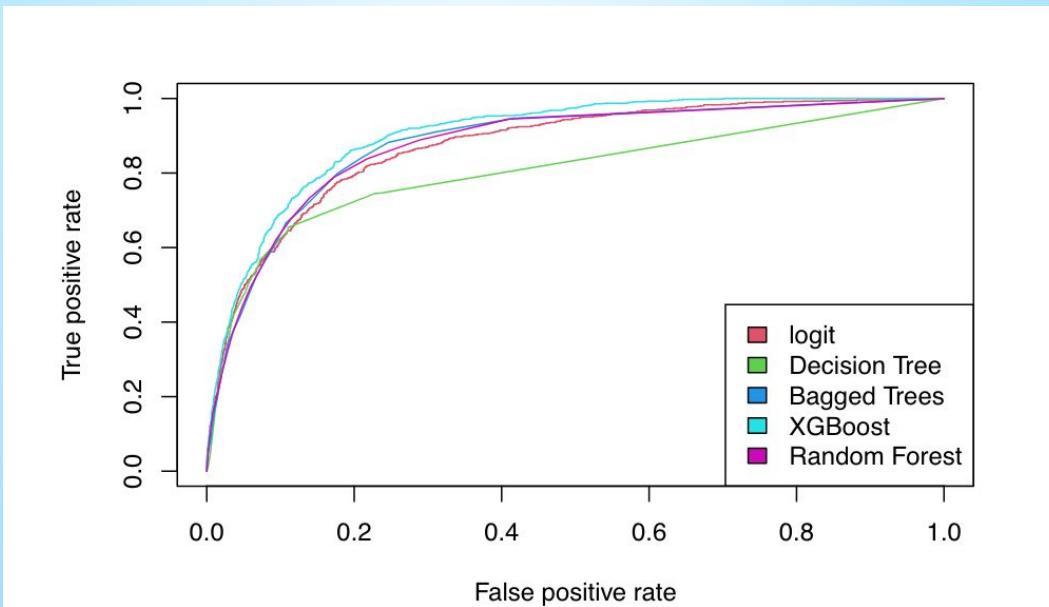


Negative Significance:

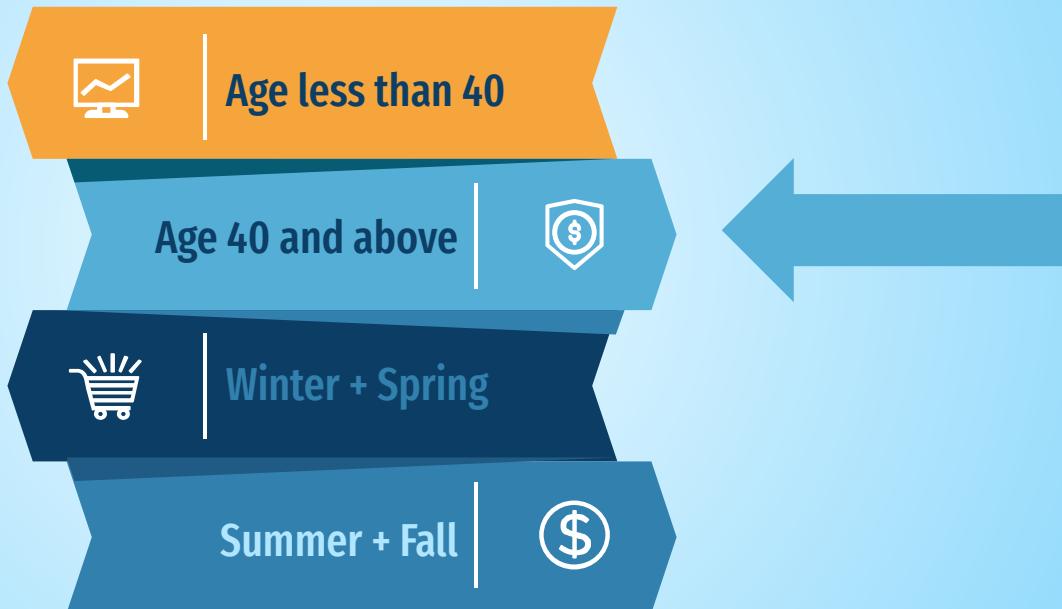
Housing loan, personal loan, campaign, married marital status.

# Model Comparison

Models	Logit	Decision tree	Bagging	XGboost	Random Forest
AUC Score	0.874	0.809	0.869	<u>0.908</u>	0.867



# Segment Analysis (Cntd.)



Deviance Residuals:

	Min	1Q	Median	3Q	Max
	-3.2450	-0.3527	-0.2427	-0.1539	3.3245

Coefficients:

	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	-3.692e+00	3.522e-01	-10.484	< 2e-16 ***
default	-5.710e-02	2.818e-01	-0.203	0.83941
balance	1.270e-05	7.560e-06	1.679	0.09308 .
housing	-7.728e-01	7.847e-02	-9.848	< 2e-16 ***
loan	-5.646e-01	1.054e-01	-5.357	8.47e-08 ***
day	-3.685e-03	3.891e-03	-0.947	0.34363
campaign	-1.190e-01	1.856e-02	-6.411	1.44e-10 ***
pdays	8.979e-04	5.665e-04	1.585	0.11298
previous	2.495e-03	7.337e-03	0.340	0.73383
spring	2.915e-01	8.918e-02	3.269	0.00108 **
fall	2.287e-01	9.565e-02	2.391	0.01681 *
winter	9.203e-02	1.086e-01	0.848	0.39662
age_bin_50_60	-4.491e-03	7.371e-02	-0.061	0.95142
age_bin_60_70	1.295e+00	1.491e-01	8.687	< 2e-16 ***
age_bin_70_105	1.553e+00	1.862e-01	8.319	< 2e-16 ***
job_admin.	4.778e-01	3.374e-01	1.416	0.15675
job_bluecollar	9.572e-02	3.346e-01	0.286	0.77485
job_entrepreneur	3.916e-02	3.667e-01	0.107	0.91495
job_housemaid	-2.469e-01	3.671e-01	-0.672	0.50130
job_management	2.690e-01	3.317e-01	0.811	0.41740
job_retired	2.027e-01	3.350e-01	0.605	0.54520
job_selfemployed	-2.851e-01	3.749e-01	-0.760	0.44700
job_services	9.756e-02	3.483e-01	0.280	0.77939
job_student	7.375e-01	1.051e+00	0.702	0.48281
job_technician	2.881e-01	3.334e-01	0.864	0.38748
job_unemployed	3.164e-01	3.607e-01	0.877	0.38035
marital_married	-1.638e-01	8.448e-02	-1.939	0.05256 .
marital_single	2.750e-02	1.207e-01	0.228	0.81983
education_primary	-2.258e-01	1.554e-01	-1.453	0.14633
education_secondary	-4.185e-02	1.420e-01	-0.295	0.76824
education_tertiary	1.260e-01	1.522e-01	0.828	0.40792
contact_cellular	1.028e+00	1.005e-01	10.223	< 2e-16 ***
contact_telephone	8.480e-01	1.415e-01	5.991	2.09e-09 ***
poutcome_failure	-7.515e-03	1.660e-01	-0.045	0.96388
poutcome_other	2.877e-01	1.883e-01	1.528	0.12661
poutcome_success	2.805e+00	1.552e-01	18.077	< 2e-16 ***
duration_bin_5_10	1.469e+00	7.448e-02	19.722	< 2e-16 ***
duration_bin_10_15	2.861e+00	9.857e-02	29.021	< 2e-16 ***
duration_bin_15_20	3.637e+00	1.446e-01	25.158	< 2e-16 ***
duration_bin_20_100	4.110e+00	1.715e-01	23.972	< 2e-16 ***

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 10682.5 on 15281 degrees of freedom  
 Residual deviance: 7048.7 on 15242 degrees of freedom  
 AIC: 7128.7

Number of Fisher Scoring iterations: 6

## Logistic Regression Model



Positive Significance:

Spring, Fall, Age 60-70 and 70-105,  
 Contact\_cellular, Success of previous  
 campaign

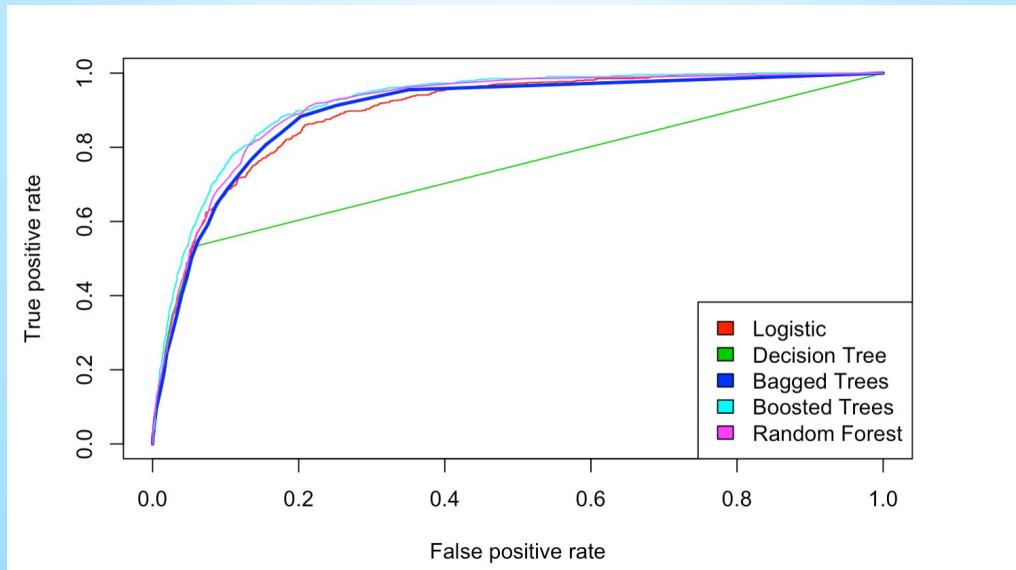


Negative Significance:

Housing loan, Personal loan, Number of  
 times contacted in current campaign, Age  
 between 40 to 50

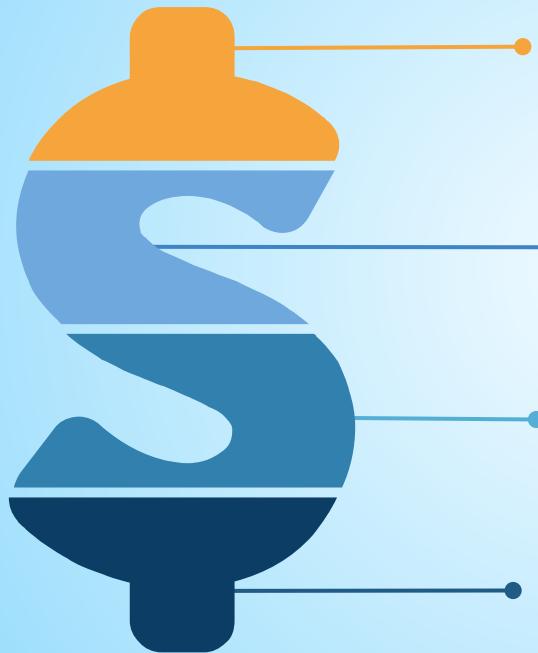
# Model Comparison

Models	Logit	Decision Tree	Bagging	XGboost	Random Forest
AUC Score	<b>0.895</b>	<b>0.741</b>	<b>0.896</b>	<b><u>0.919</u></b>	<b>0.911</b>



# Key Observations - Age

**Target those:**



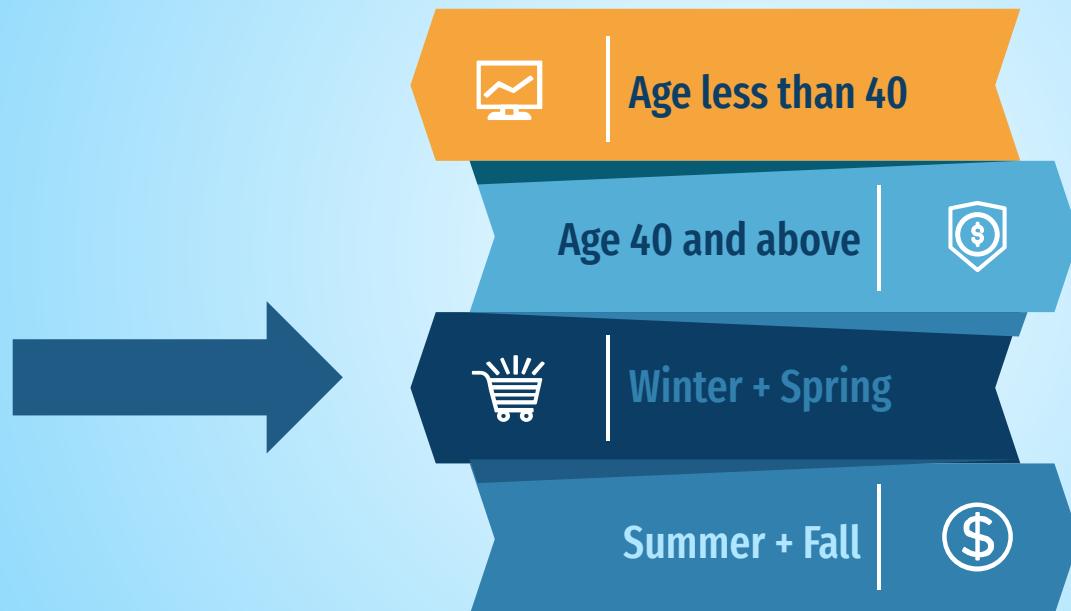
Who have age between 15 to 30 and above 60

Who have a successful previous outcome

During season spring and fall

Contact by cellular

# Segment Analysis (Cntd.)



```

Call:
glm(formula = deposit ~ ., family = binomial(link = "logit"),
     data = train)

Deviance Residuals:
    Min      1Q  Median      3Q     Max 
-3.0512 -0.3525 -0.2155 -0.1253  3.6474 

Coefficients:
            Estimate Std. Error z value Pr(>|z|)    
(Intercept) -2.669e+00 2.878e-01 -9.273 < 2e-16 ***
jobblue-collar -2.997e-01 1.199e-01 -2.499 0.012469 *  
jobentrepreneur -5.413e-01 2.501e-01 -2.165 0.030420 *  
jobhousemaid -5.791e-01 3.035e-01 -1.908 0.056362 .  
jobmanagement -8.727e-02 1.287e-01 -0.678 0.497621  
jobretired -1.454e-01 2.057e-01 -0.707 0.479586  
jobsself-employed -4.334e-01 2.150e-01 -2.016 0.043801 *  
jobservices -2.280e-01 1.399e-01 -1.629 0.103219  
jobstudent 2.722e-01 1.852e-01 1.470 0.141540  
jobtechnician -1.253e-01 1.197e-01 -1.047 0.295311  
jobunemployed -2.618e-01 1.885e-01 -1.389 0.164861  
jobunknowm 3.632e-01 4.515e-01 0.804 0.421190  
maritalmarried -2.547e-02 1.107e-01 -0.230 0.818020  
maritalsingle 2.030e-01 1.213e-01 1.673 0.094284 .  
educationsecondary 2.207e-01 1.134e-01 1.947 0.051570 .  
educationtertiary 5.215e-01 1.340e-01 3.892 9.93e-05 *** 
educationunknown 1.412e-02 1.911e-01 0.074 0.941094  
default 1.069e-01 3.246e-01 0.329 0.741859  
balance 9.544e-06 1.091e-05 0.875 0.381499  
housing -1.008e+00 8.005e-02 -12.596 < 2e-16 *** 
loan -3.257e-01 1.115e-01 -2.922 0.003477 **  
contacttelephone -7.670e-01 1.527e-01 -5.024 5.07e-07 *** 
contactunknowm -1.563e+00 1.109e-01 -14.100 < 2e-16 *** 
day 3.650e-02 4.554e-03 8.016 1.09e-15 *** 
monthdec 8.215e-01 2.206e-01 3.723 0.000197 *** 
monthfeb 1.048e-01 1.188e-01 0.882 0.377739  
monthjan -1.549e+00 1.501e-01 -10.319 < 2e-16 *** 
monthmar 1.714e+00 1.515e-01 11.315 < 2e-16 *** 
monthmay -2.312e-01 9.364e-02 -2.469 0.013549 *  
campaign -5.641e-02 2.010e-02 -2.806 0.005014 ** 
pdays -5.351e-04 5.914e-04 -0.905 0.365513  
previous 4.433e-03 7.333e-03 0.605 0.545480  
poutcomeother 4.543e-02 1.539e-01 0.295 0.767863  
poutcomesuccess 2.288e+00 1.439e-01 15.907 < 2e-16 *** 
poutcomeunknown 1.772e-01 1.728e-01 1.025 0.305380  
age_bin30-45 -1.792e-01 8.773e-02 -2.043 0.041046 *  
age_bin45-60 -8.292e-02 1.127e-01 -0.736 0.461834  
age_bin60-75 1.084e+00 2.290e-01 4.734 2.20e-06 *** 
age_bin75-105 1.473e+00 3.483e-01 4.231 2.33e-05 *** 
duration_bin5-10 1.431e+00 7.636e-02 18.733 < 2e-16 *** 
duration_bin10-15 3.025e+00 1.021e-01 29.634 < 2e-16 *** 
duration_bin15-20 3.840e+00 1.500e-01 25.598 < 2e-16 *** 
duration_bin20-100 4.308e+00 1.886e-01 22.834 < 2e-16 *** 
--- 
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 10617.1  on 15007  degrees of freedom
Residual deviance: 6780.1  on 14965  degrees of freedom
AIC: 6866.1

Number of Fisher Scoring iterations: 6

```

## Logistic Regression Model



Positive Significance:

Tertiary education,, Months of December and March, Successful previous outcome, Ages over 60

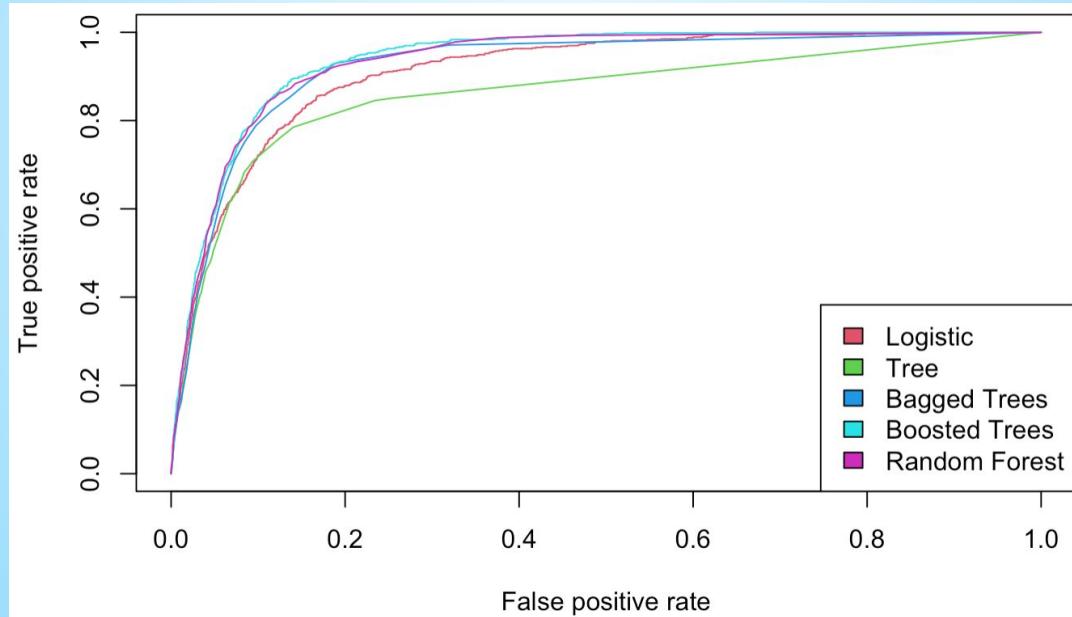


Negative Significance:

Number of times contacted in current campaign, Personal Loan and housing loan, Married marital status, Month of January and May, Jobs, Ages less than 45

# Model Comparison for Winter + Spring

Models	Logit	Decision Tree	Bagging	XGBoost	Random Forest
AUC Score	<b>0.9099</b>	0.8611	0.9229	<u>0.9376</u>	0.9131



# Segment Analysis (Cntd.)



```

## Call:
## glm(formula = termdeposit ~ ., family = "binomial", data = train_season)
##
## Deviance Residuals:
##    Min      1Q   Median      3Q     Max 
## -2.9156 -0.3324 -0.2300 -0.1722  3.3351 
## 
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)    
## (Intercept) -2.1381657  0.2568754 -8.324 < 2e-16 ***
## jobbluecollar -0.1162120  0.1246065 -0.933 0.351010    
## jobentrepreneur -0.1947134  0.1926640 -1.011 0.312190    
## jobhousemaid -0.4214684  0.2005245 -2.102 0.035568 *  
## jobmanagement -0.27820209 0.1235980 -2.249 0.024487 *  
## jobretired -0.2891715  0.1717921 -1.683 0.092324 .  
## jobselfemployed -0.1789410  0.1840179 -0.972 0.330846    
## jobservices 0.0013606  0.1396138  0.010 0.992224    
## jobstudent 0.3583314  0.1957620  1.830 0.067184 .  
## jobtechnician -0.2478059  0.1159571 -2.137 0.032594 *  
## jobunemployed -0.0639533  0.1919936 -0.333 0.739058    
## jobunknown -0.6813525  0.3748914 -1.817 0.069146 
## maritalmarried -0.3430842  0.0941938 -3.642 0.000270 *** 
## maritalsingle -0.1193528  0.1102149 -1.083 0.278848    
## educationsecondary 0.2705803  0.1079211  2.507 0.012169 *  
## educationtertiary 0.3714343  0.1250919  2.969 0.002985 ** 
## educationunknown 0.2907989  0.1731246  1.680 0.093014 .  
## default 0.1043607  0.2336123  0.447 0.655073    
## balance 0.0368481  0.0255297  1.443 0.148923 
## housing -0.2261621  0.0687227 -3.291 0.000999 *** 
## loan -0.4533761  0.0944750 -4.799 1.60e-06 *** 
## contacttelephone 0.1501330  0.1146430  1.310 0.190342    
## contactunknown -1.9355526  0.1365727 -14.172 < 2e-16 *** 
## day -0.0124173  0.0041118 -3.020 0.002529 ** 
## monthjul -0.3033716  0.0911679 -3.328 0.000876 *** 
## monthjun 1.1307307  0.1231909  9.179 < 2e-16 *** 
## monthnov -0.4174025  0.1048696 -3.980 6.89e-05 *** 
## monthoct 1.4454173  0.1337291 10.809 < 2e-16 *** 
## monthsep 1.3604375  0.1467392  9.271 < 2e-16 *** 
## campaign -0.0768108  0.0143802 -5.341 9.22e-08 *** 
## pdays 0.0021739  0.0004718  4.608 4.07e-06 *** 
## previous 0.0343079  0.0179927  1.907 0.056551 .  
## poutcomeother 0.2460706  0.1698128  1.449 0.147318 
## poutcomesuccess 2.1290925  0.1439389 14.792 < 2e-16 *** 
## poutcomeunknown -0.1721792  0.1579598 -1.090 0.275705 
## duration_bins_10 1.6439254  0.0714706 23.001 < 2e-16 *** 
## duration_bin10_15 3.0386697  0.0947825 32.059 < 2e-16 *** 
## duration_bin15_20 3.8935175  0.1317635 29.549 < 2e-16 *** 
## duration_bin20_100 4.0477771  0.1561470 25.923 < 2e-16 *** 
## age_bin30_45 -0.3211048  0.0943045 -3.405 0.000662 *** 
## age_bin45_60 -0.3415761  0.1104479 -3.093 0.001984 ** 
## age_bin60_75 0.5606697  0.1975890  2.838 0.004546 ** 
## age_bin75_105 0.3635657  0.3215364  1.131 0.258175 
## 
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 
## 
## (Dispersion parameter for binomial family taken to be 1)
## 
## Null deviance: 12146.1 on 16615 degrees of freedom
## Residual deviance: 7910.6 on 16573 degrees of freedom
## AIC: 7996.6 
## 
## Number of Fisher Scoring iterations: 6

```

## Logistic Regression Model



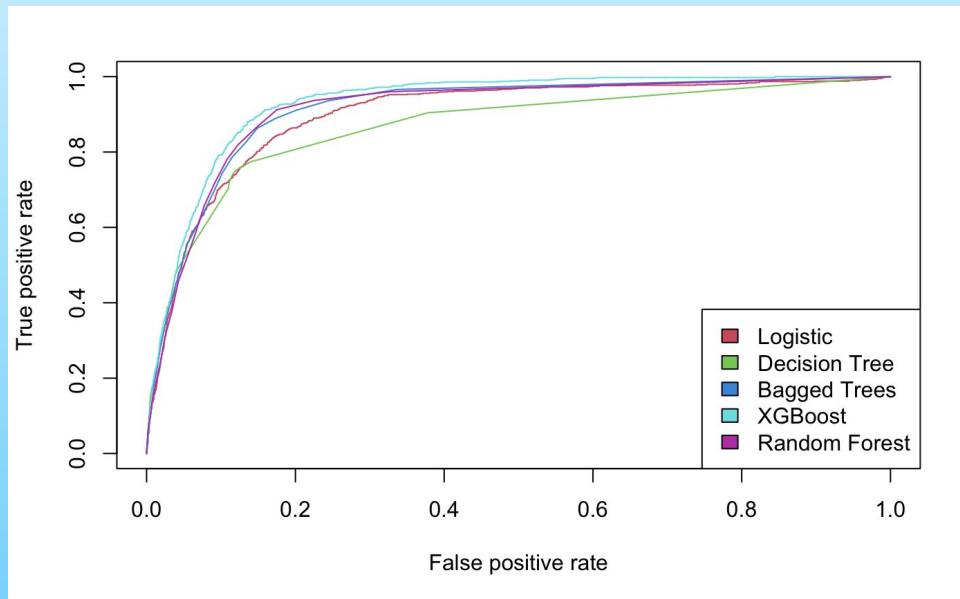
Job student, Secondary and tertiary education, Months of June, October, September, age more than 60, success of previous campaign



Married marital status, Housing loan, Personal loan, Number of times contacted in current campaign, Age less than 60, Months of July, November, Other jobs

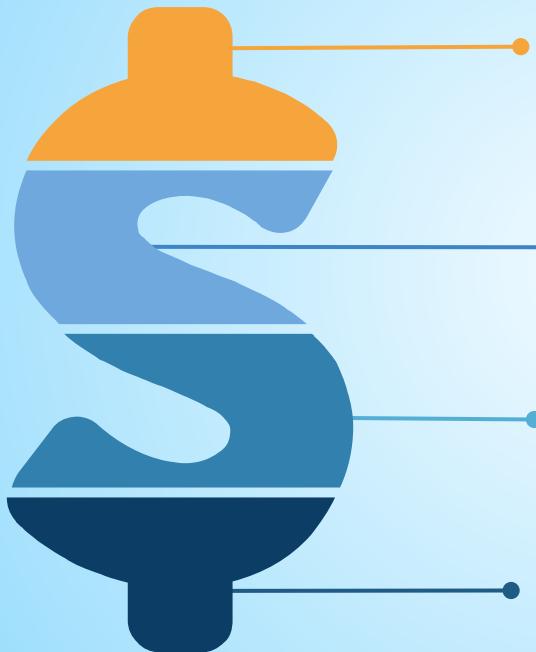
# Model Comparison for Summer + Fall

Models	Logit	Decision Tree	Bagging	XGBoost	Random Forest
AUC Score	0.8984	0.8675	0.9132	<u>0.9307</u>	0.9121



# Key Observations-Seasons

**Target those:**



Months of September,  
October, December & March

Students majority in the age  
category 18-30 and more  
than 60

Customers having secondary  
and tertiary education

Customers with successful  
previous outcome

# Final Insights

## Campaign Strategy:

In order to maximise subscription to term deposit, target:

- Non-married individuals
  - Customers having success in the previous campaign
  - Customers in the age group 15-30 and above 60
  - Customers having secondary and tertiary level of education
  - Focus on the months of October, September, December and March
  - Individuals without housing and personal loan
  - Reduced repeat contact of customers in a campaign
- Longer call duration leads to better success. However higher duration alone cannot determine the success of the marketing campaign.



