July 26

Predictive Modeling

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iPad on ebay
Sold or not sold

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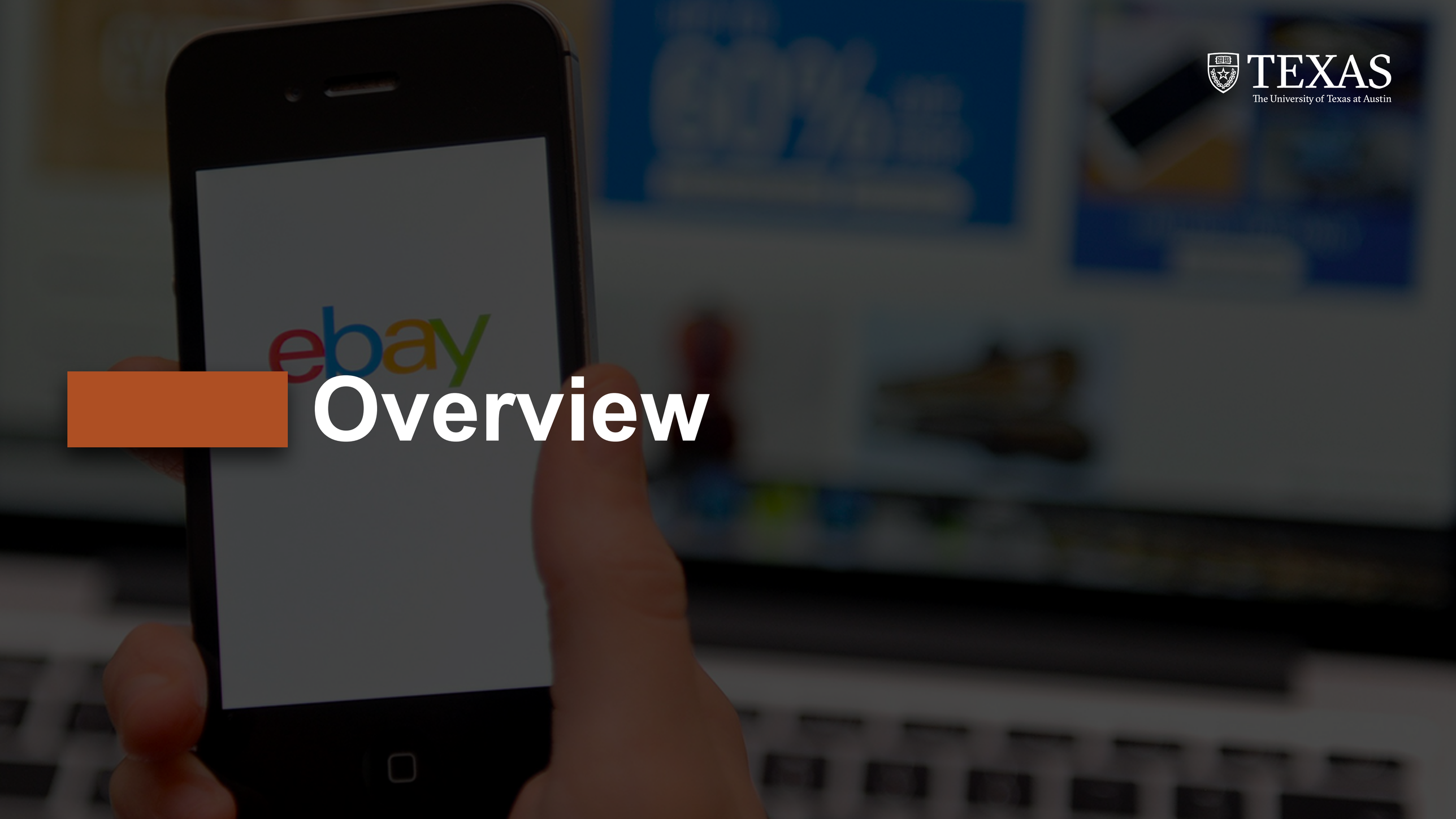
Outline



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Overview

Market Size

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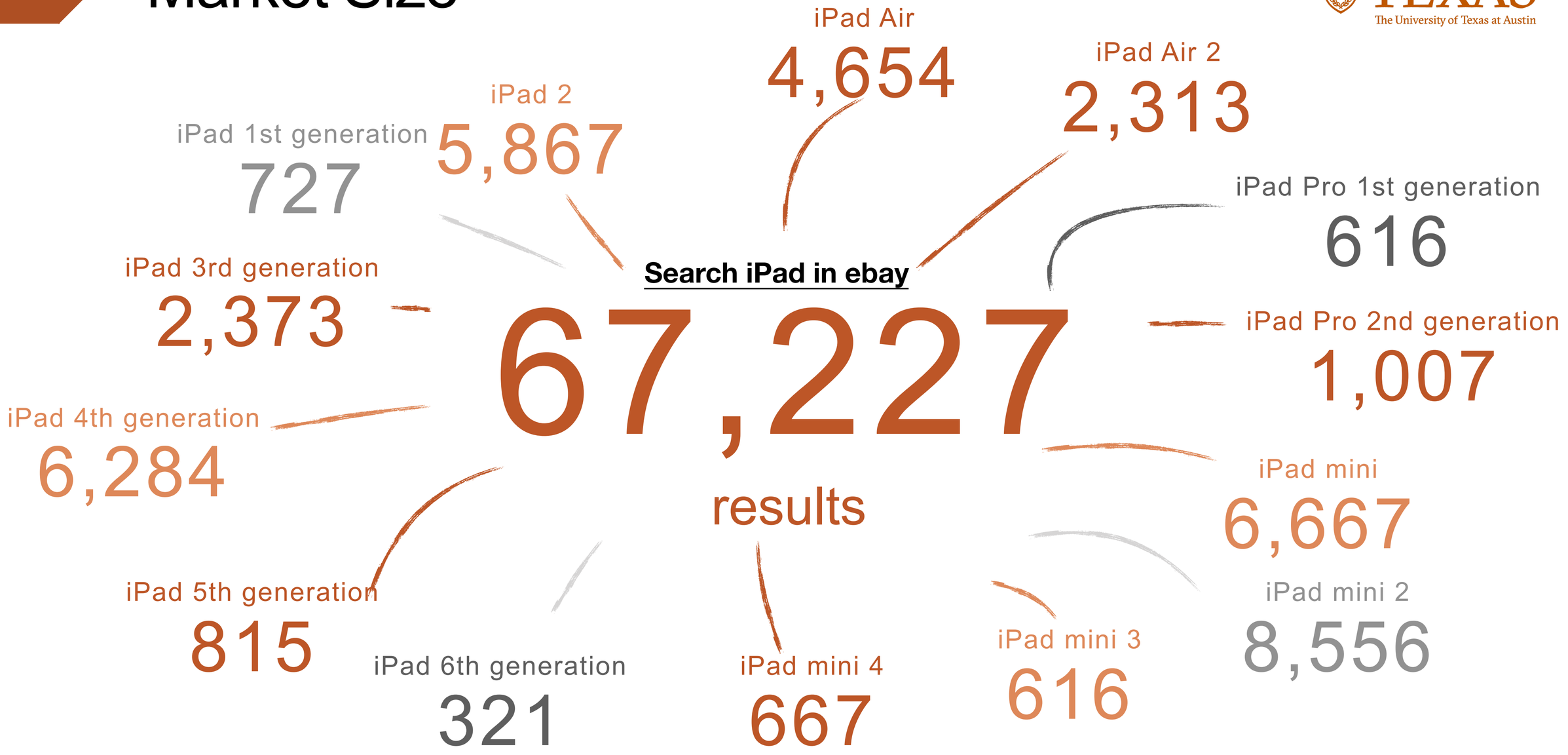

Features

iPad Air

4,654

Colors

Storage 128GB / 64GB / 32GB / 16GB

Network AT&T verizon T-Mobile

Bid Biddable / Unbiddable

Condition Used/ New/ Manufacturer refurbished/ Seller refurbished

Start Price USD$ 0 ~ USD$ 1000

Overview

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67,227+

iPad

Problem Sets

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“Predict

the probability of “sold” or “not sold”
within iPads on ebay


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Dataset

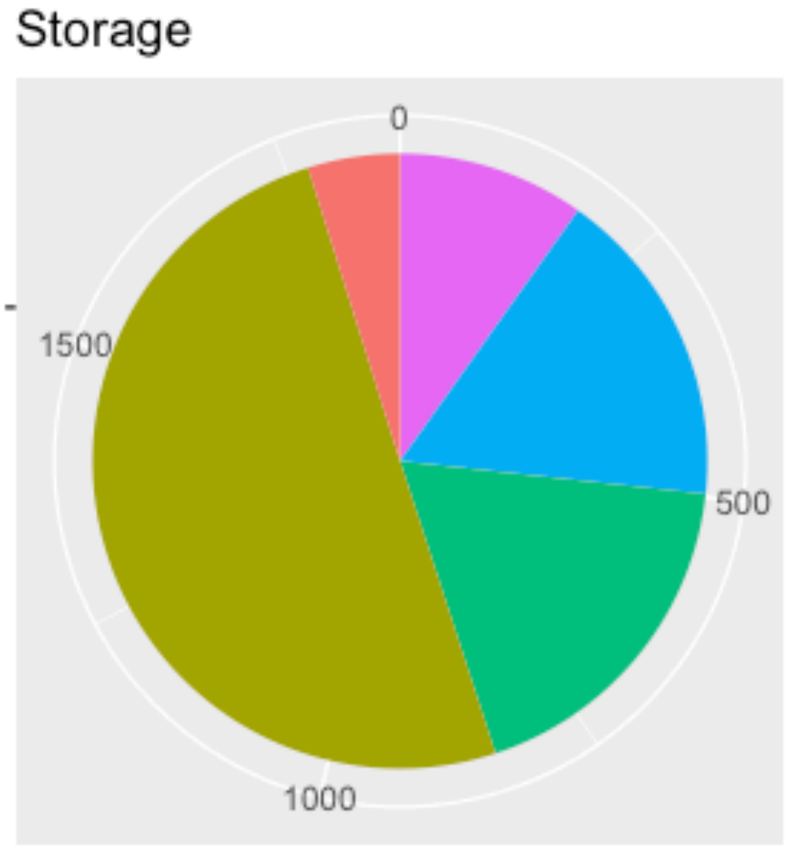
Summary

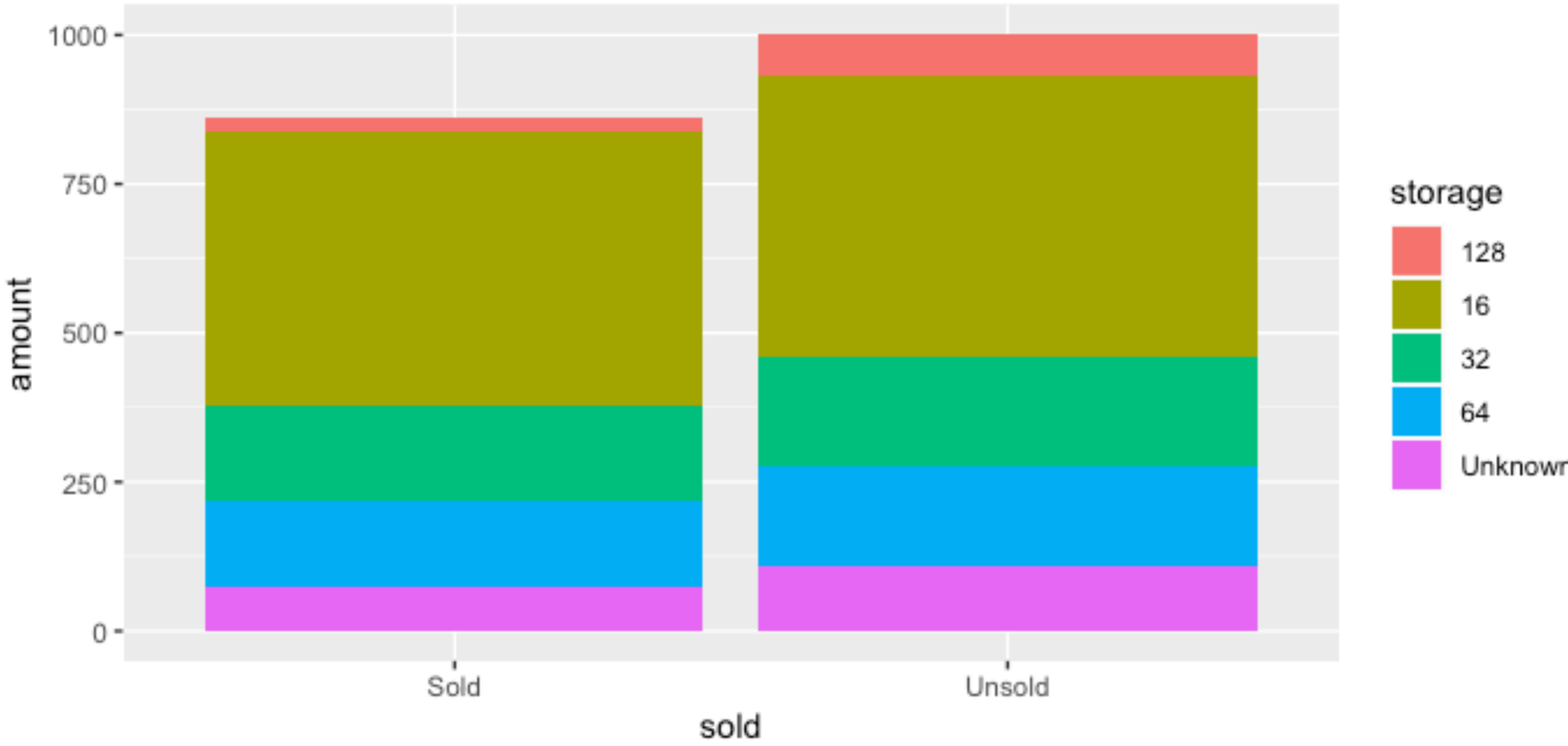
- 1,861 observations
- raw data includes 9 variables:

"description" "biddable" "startprice" "condition" "cellular" "carrier" "color" "storage" “productline"

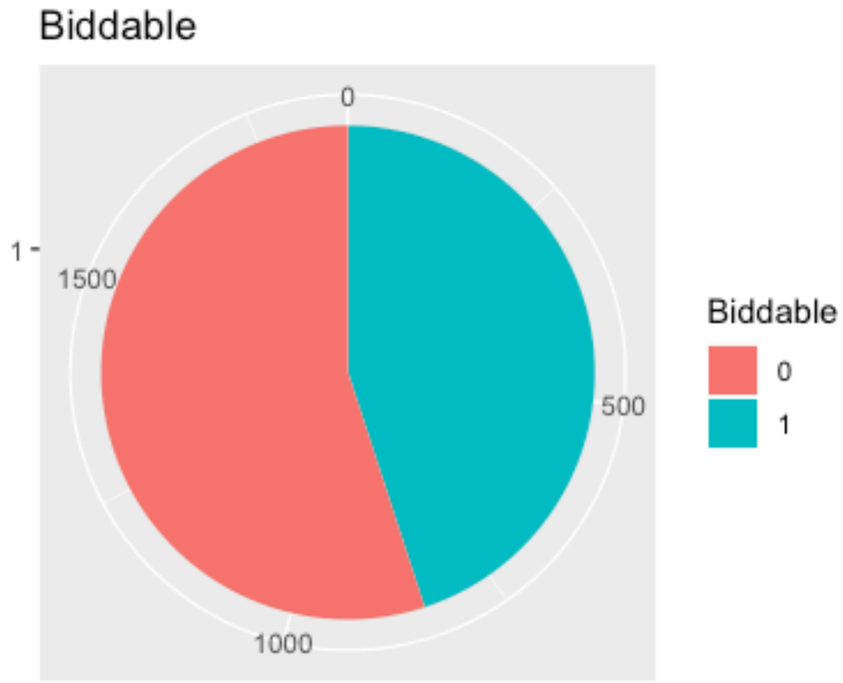
- Turned “description” into word counts “count_des”
- With only “startprice” and “count_des” are continuous data and the others are categorical data

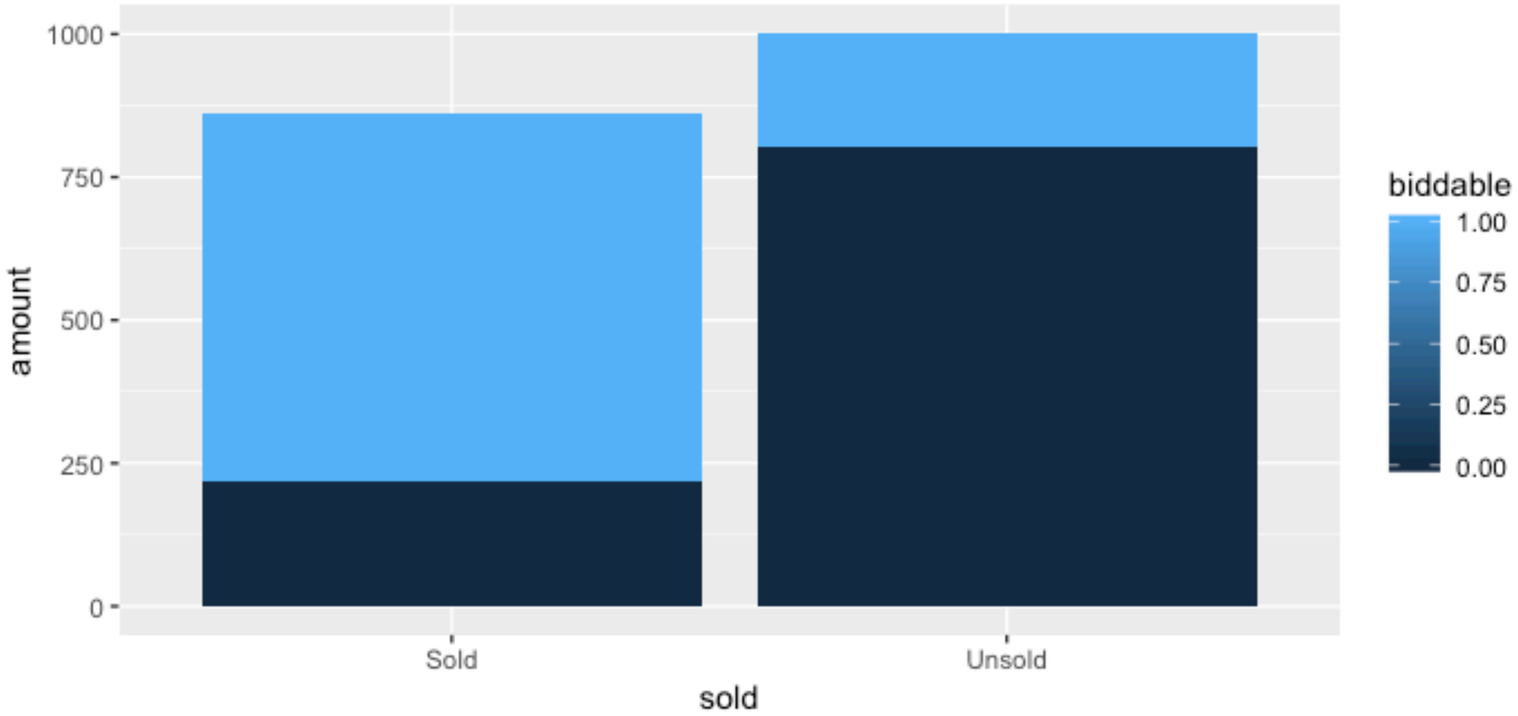
Storage


Storage
0
500
1000
1500

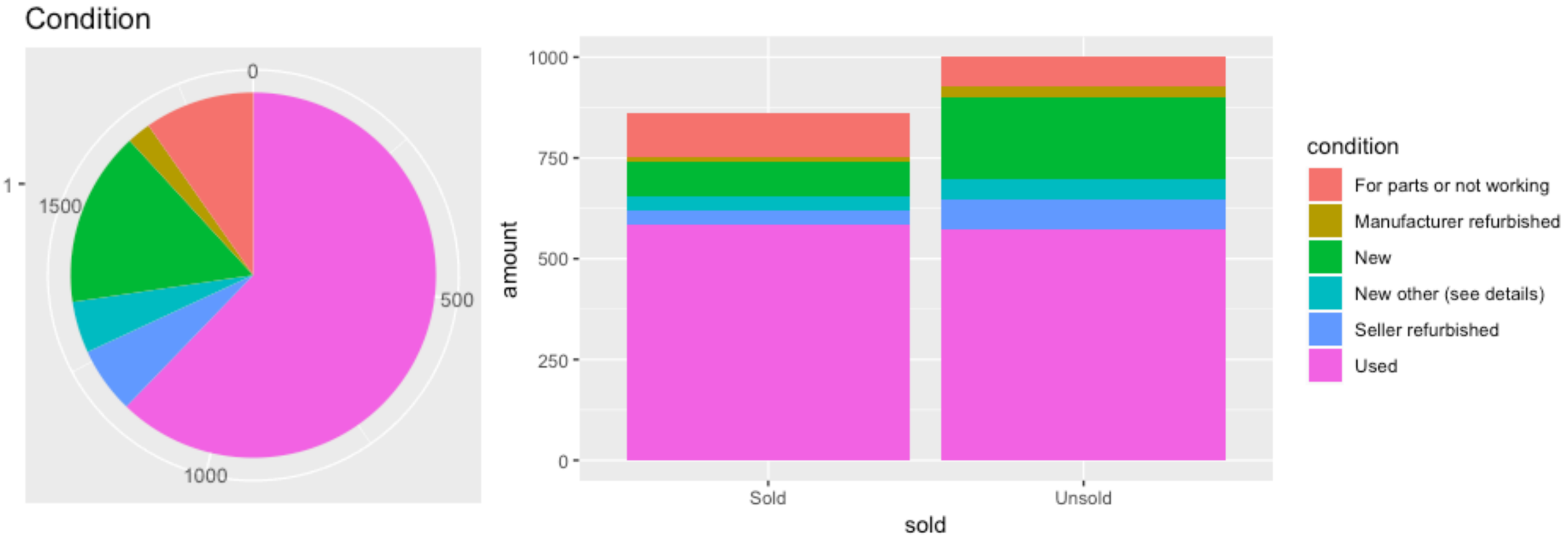

1000
750
500
250
0
amount
Sold
Unsold
sold
storage
128
16
32
64
Unknown

Biddable

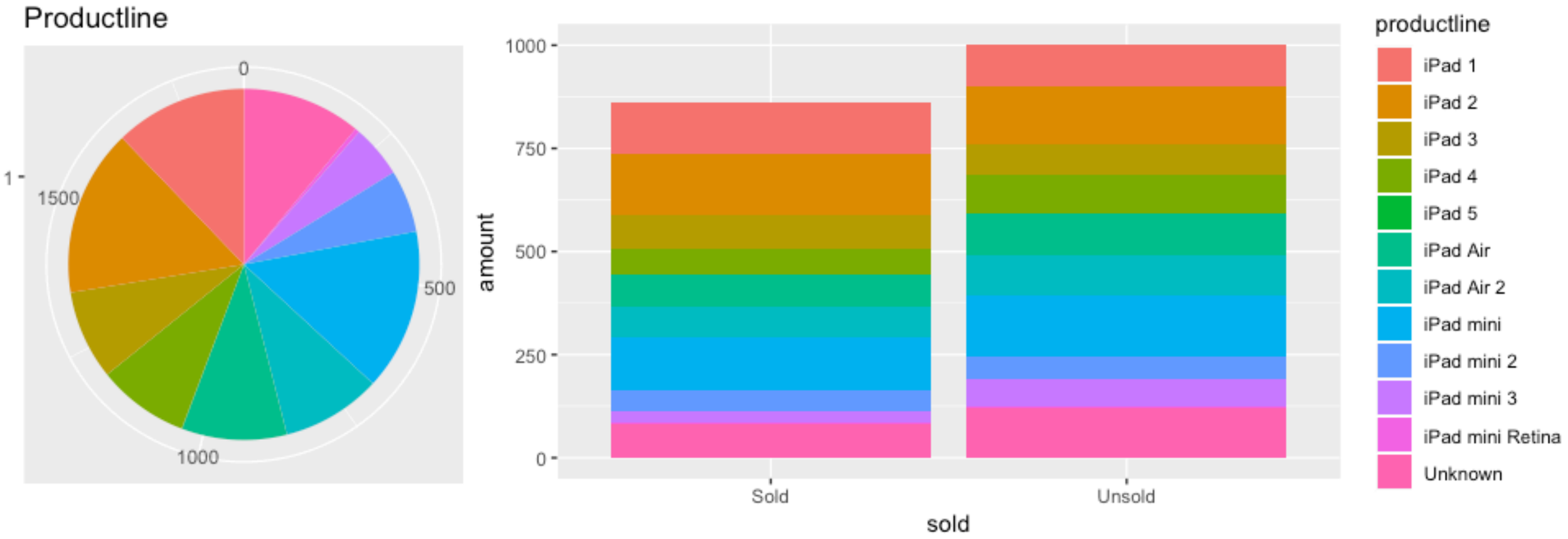

Biddable
0
1
1500
500
1000
Biddable
0
1


1000
750
500
250
0
amount
Sold
Unsold
sold
biddable
1.00
0.75
0.50
0.25
0.00

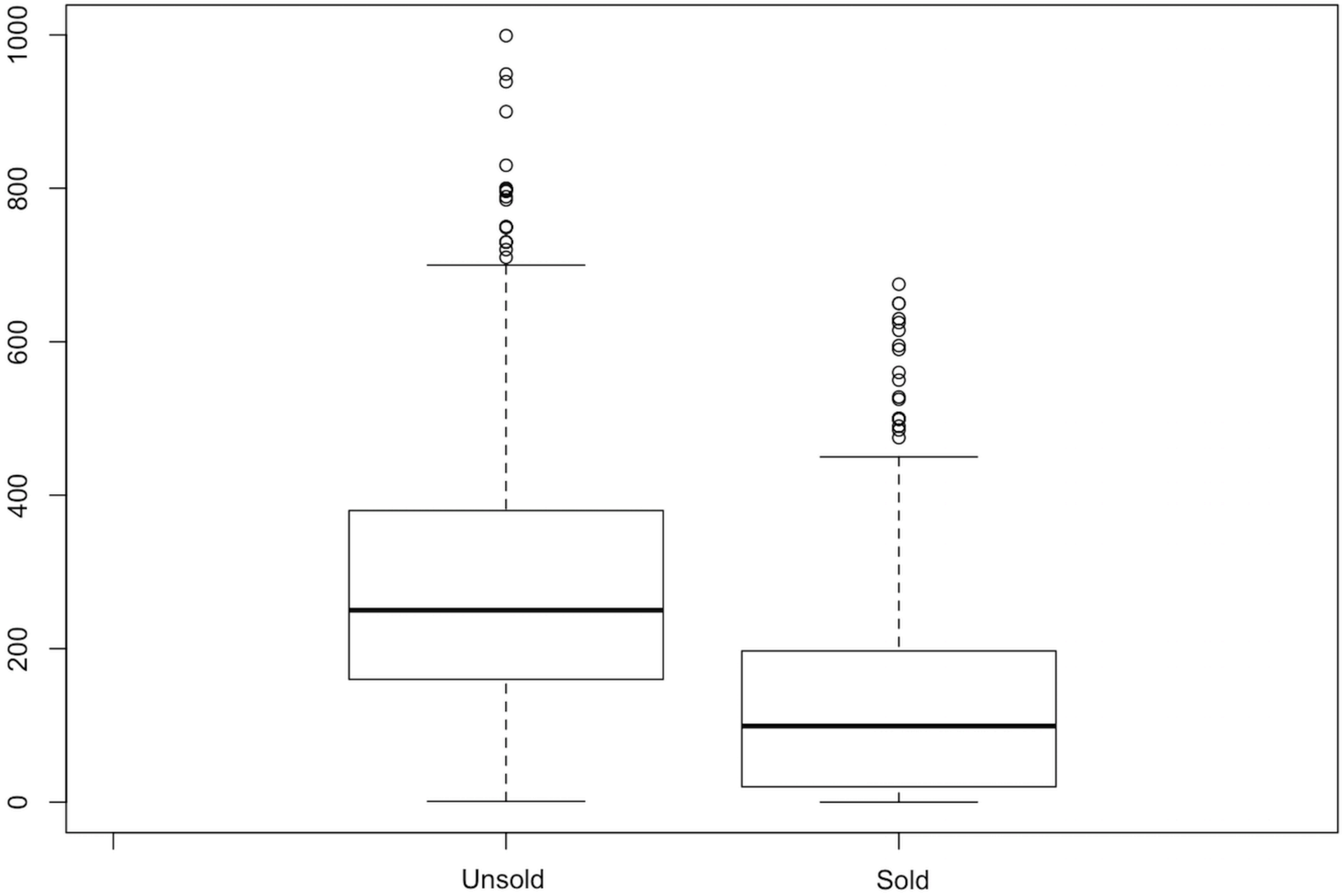
Condition


Condition
0
500
1000
1500
1
amount
1000
750
500
250
0
Sold
Unsold
sold
condition
For parts or not working
Manufacturer refurbished
New
New other (see details)
Seller refurbished
Used

Product line



StartPrice vs Sold



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Methodology

Logistic Regression/ Classification Tree

Logistic Regression

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```
glm1=glm(sold~biddable, data = trainingset, family = binomial)

glm2=glm(sold~startprice, data = trainingset, family = binomial)

glm3=glm(sold~productline, data = trainingset, family = binomial)

glm4=glm(sold~biddable + startprice, data = trainingset, family = binomial)

glm5=glm(sold~biddable + productline, data = trainingset, family = binomial)

glm6=glm(sold~startprice + productline, data = trainingset, family = binomial)

glm7=glm(sold~biddable + startprice + productline, data = trainingset, family = binomial)

glm8=glm(sold~biddable + startprice + productline + storage, data = trainingset, family = binomial)

glm9=glm(sold~biddable+ startprice + cellular + carrier + color + storage + productline + description, data =

trainingset, family = binomial)
```

4 influencial variables:
biddable, startprice, productline, storage

Logistic Regression

MODELS	1	2	3	4	5	6
Beta 0	-1.23	1.32	0.33	0.00073	-0.88	1.38
biddable	2.44			1.92	2.42	
startprice		-0.0074		-0.00497		-0.0129
product line			***		***	***
cellular						
carrier						
color						
storage						
count_des						

Logistic Regression

glm7=glm(sold~biddable + startprice + productline, data = trainingset, family = binomial)

```
Call:
glm(formula = sold ~ biddable + startprice + productline, family = binomial,
    data = trainingset)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.2896  -0.7441  -0.2645   0.6482   3.1842

Coefficients:
                           Estimate Std. Error z value Pr(>|z|)
(Intercept)               0.2635006  0.2055179   1.282 0.199797
biddable                  1.6396826  0.1412771  11.606  < 2e-16 ***
startprice               -0.0089966  0.0007982 -11.271  < 2e-16 ***
productlineiPad 2         0.1448676  0.2406609   0.602 0.547203
productlineiPad 3         0.7323803  0.2937604   2.493 0.012663 *
productlineiPad 4         0.7675379  0.3202247   2.397 0.016536 *
productlineiPad Air       1.3637772  0.3374355   4.042 5.31e-05 ***
productlineiPad Air 2     2.7280599  0.4094992   6.662 2.70e-11 ***
productlineiPad mini      0.2249164  0.2487482   0.904 0.365893
productlineiPad mini 2    1.1483337  0.3546347   3.238 0.001203 **
productlineiPad mini 3    1.5013492  0.4376725   3.430 0.000603 ***
productlineiPad mini Retina 1.8865622  0.9540091   1.978 0.047984 *
productlineUnknown        0.0263242  0.2647703   0.099 0.920803
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 2074.0  on 1499  degrees of freedom
Residual deviance: 1415.9  on 1487  degrees of freedom
AIC: 1441.9

Number of Fisher Scoring iterations: 5
```

Logistic Regression

glm8=glm(sold~biddable + startprice + productline + storage, data = trainingset, family = binomial)

```
Call:
glm(formula = sold ~ biddable + startprice + productline + storage,
    family = binomial, data = trainingset)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.4827  -0.7263  -0.2792   0.6441   3.3433

Coefficients:
                           Estimate Std. Error z value Pr(>|z|)
(Intercept)               1.3791136  0.5081351   2.714 0.006646 **
biddable                  1.5513750  0.1444379  10.741  < 2e-16 ***
startprice               -0.0100076  0.0008848 -11.311  < 2e-16 ***
productlineiPad 2         0.2475337  0.2451132   1.010 0.312555
productlineiPad 3         0.8433340  0.3008385   2.803 0.005059 **
productlineiPad 4         0.9383415  0.3315663   2.830 0.004654 **
productlineiPad Air       1.5112818  0.3467771   4.358 1.31e-05 ***
productlineiPad Air 2     2.9012330  0.4285660   6.770 1.29e-11 ***
productlineiPad mini      0.3895729  0.2628067   1.482 0.138246
productlineiPad mini 2    1.3458761  0.3671422   3.666 0.000247 ***
productlineiPad mini 3    1.7692305  0.4621306   3.828 0.000129 ***
productlineiPad mini Retina 2.1692066  0.9635338   2.251 0.024366 *
productlineUnknown        0.2903007  0.3221693   0.901 0.367545
storage16                -1.1193861  0.4427570  -2.528 0.011464 *
storage32                -1.0797054  0.4561020  -2.367 0.017921 *
storage64                -0.6449558  0.4432720  -1.455 0.145672
storageUnknown           -1.2999701  0.5230980  -2.485 0.012950 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 2074.0  on 1499  degrees of freedom
Residual deviance: 1405.3  on 1483  degrees of freedom
AIC: 1439.3

Number of Fisher Scoring iterations: 5
```

Logistic Regression

glm9=glm(sold~biddable+ startprice + cellular + carrier + color + storage + productline + description, data =trainingset, family = binomial)

```
Call:
glm(formula = sold ~ biddable + startprice + cellular + carrier +
    color + storage + productline + description, family = binomial,
    data = trainingset)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.5175  -0.7314  -0.2733   0.6392   3.3937

Coefficients:
                          Estimate Std. Error z value Pr(>|z|)
(Intercept)              14.62540  624.18948   0.023 0.981306
biddable                  1.56568    0.14844  10.548  < 2e-16 ***
startprice               -0.01001    0.00090 -11.125  < 2e-16 ***
cellular1               -13.19550  624.18921  -0.021 0.983134
cellularUnknown         -13.67902  624.18916  -0.022 0.982516
carrierNone             -13.20298  624.18923  -0.021 0.983124
carrierOther             13.02137  619.73923   0.021 0.983237
carrierSprint             1.14213    0.60379   1.892 0.058546 .
carrierT-Mobile          -0.36619    0.83610  -0.438 0.661406
carrierUnknown           -0.11816    0.35466  -0.333 0.739009
carrierVerizon            0.36805    0.31790   1.158 0.246965
colorGold                -0.57651    0.50306  -1.146 0.251789
colorSpace Gray          -0.05564    0.27440  -0.203 0.839328
colorUnknown             -0.06181    0.18243  -0.339 0.734751
colorWhite               -0.06461    0.20181  -0.320 0.748838
storage16                -1.05150    0.45008  -2.336 0.019477 *
storage32                -1.01166    0.46349  -2.183 0.029059 *
storage64                -0.58933    0.45009  -1.309 0.190415
storageUnknown           -0.75254    0.59103  -1.273 0.202925
productlineiPad 2         0.21401    0.25498   0.839 0.401275
productlineiPad 3         0.85772    0.31126   2.756 0.005857 **
productlineiPad 4         0.92105    0.33574   2.743 0.006082 **
productlineiPad Air       1.51175    0.36812   4.107 4.01e-05 ***
productlineiPad Air 2     2.95805    0.44685   6.620 3.60e-11 ***
productlineiPad mini      0.34853    0.27090   1.287 0.198241
productlineiPad mini 2    1.37229    0.38037   3.608 0.000309 ***
productlineiPad mini 3    1.92651    0.48550   3.968 7.24e-05 ***
productlineiPad mini Retina 2.26517  0.98345   2.303 0.021263 *
productlineUnknown        0.43937    0.34493   1.274 0.202725
description              -0.01370    0.00937  -1.462 0.143749
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 2074.0  on 1499  degrees of freedom
Residual deviance: 1390.3  on 1470  degrees of freedom
AIC: 1450.3

Number of Fisher Scoring iterations: 13
```

k-fold Cross Validation and AIC

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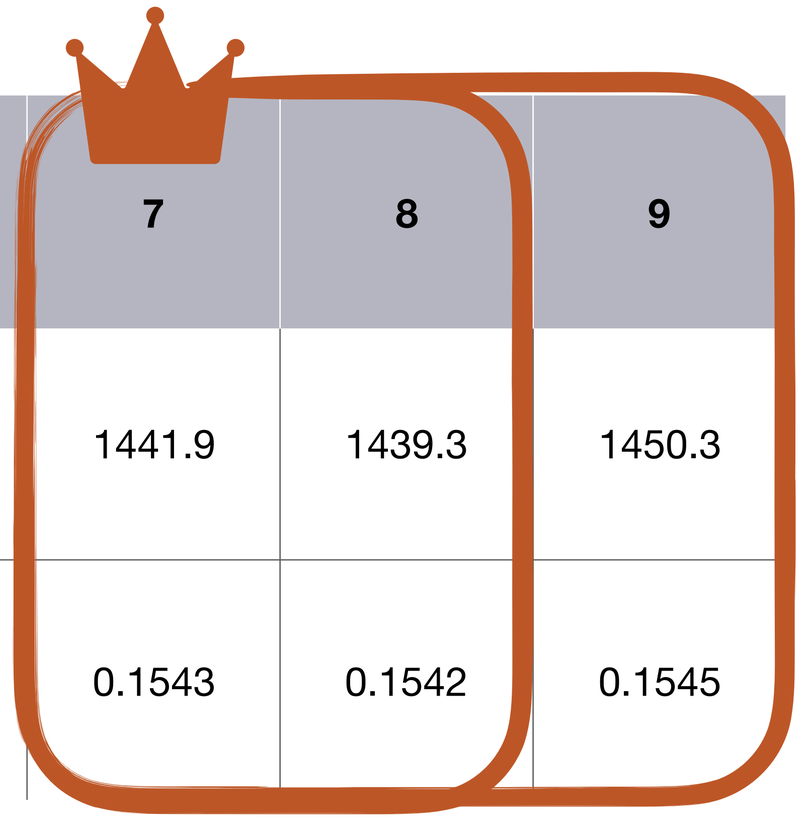
MODEL	1	2	3	4	5	6	7	8	9
AIC	1614.5	1707.5	2065.5	1490.4	1622.6	1576.9	1441.9	1439.3	1450.3
Cross Validation Error	0.1764	0.1908	0.2479	0.1602	0.1776	0.1698	0.1543	0.1542	0.1545



k-fold Cross Validation and AIC

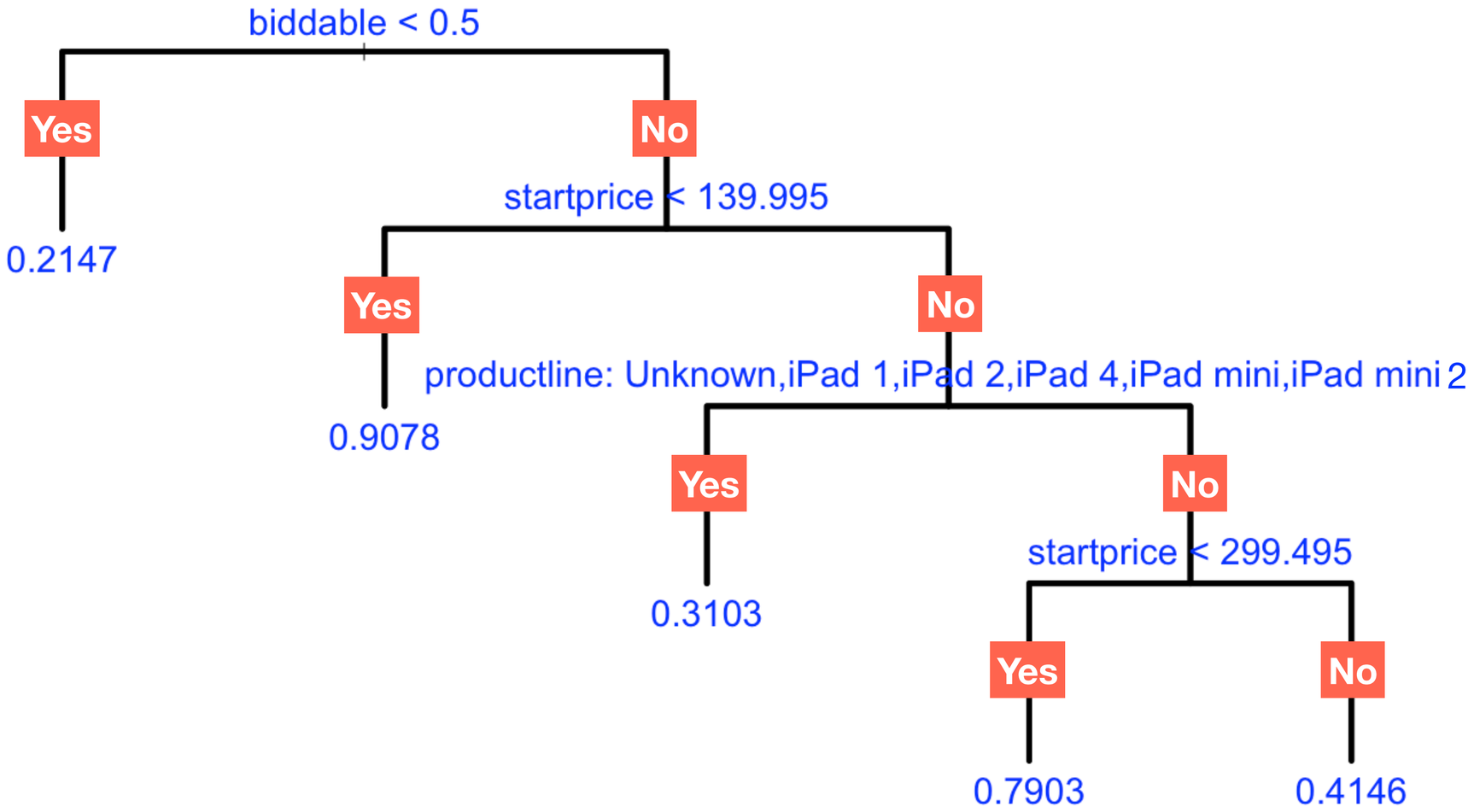
- glm7=glm(sold~biddable + startprice + productline, data = trainingset, family = binomial)

$$\begin{cases} Y = 0 \text{ , not sold} \\ Y = 1, \text{ sold} \end{cases}$$

- Predict SOLD if $Y > 0.5$
- Accuracy: 81.111% = (171+121) / (171+33+35+121)

glm.pred	0	1
0	171	33
1	35	121

Classification Tree



Classification Tree

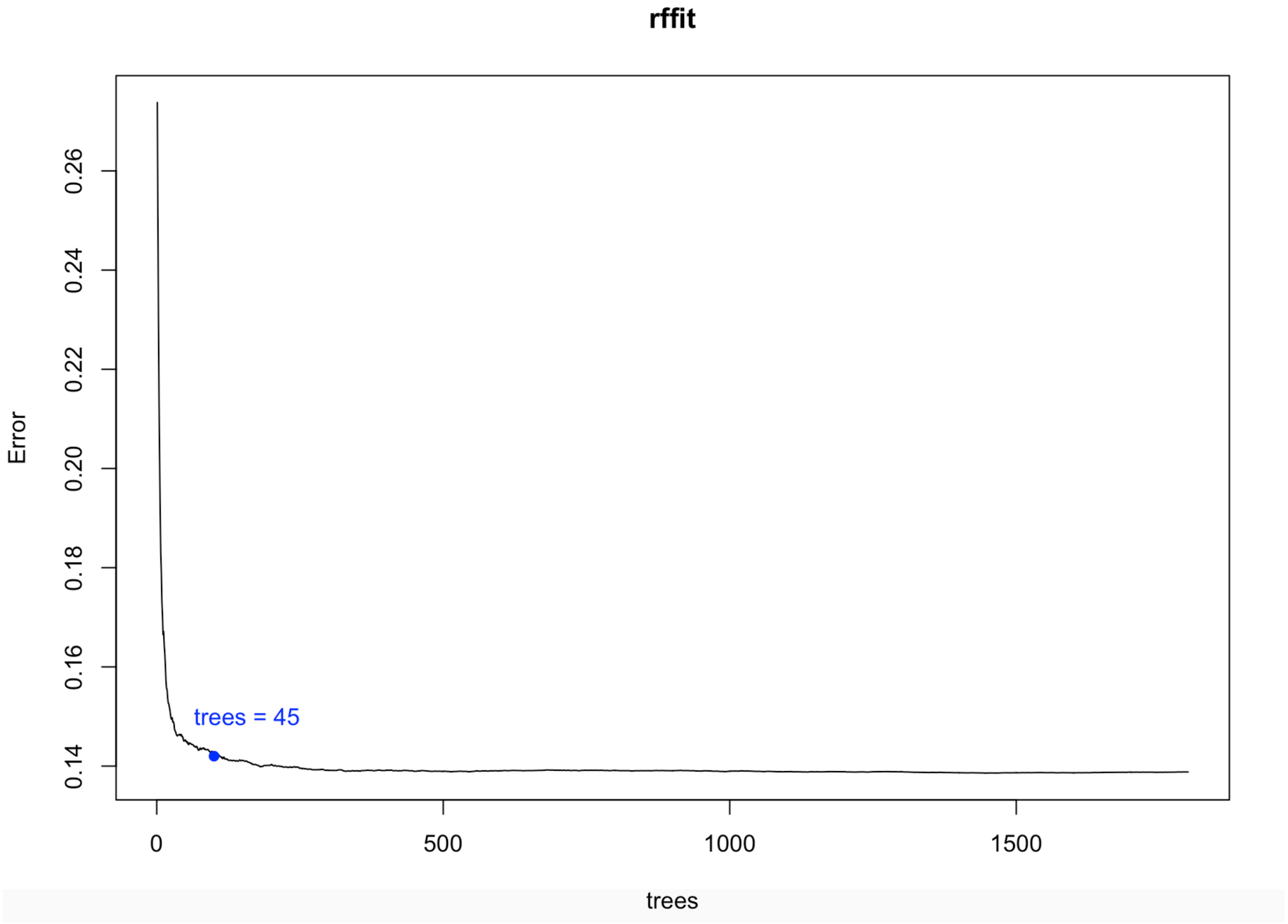
- Variables actually used in tree construction:

  [1] "biddable" "startprice" “productline”

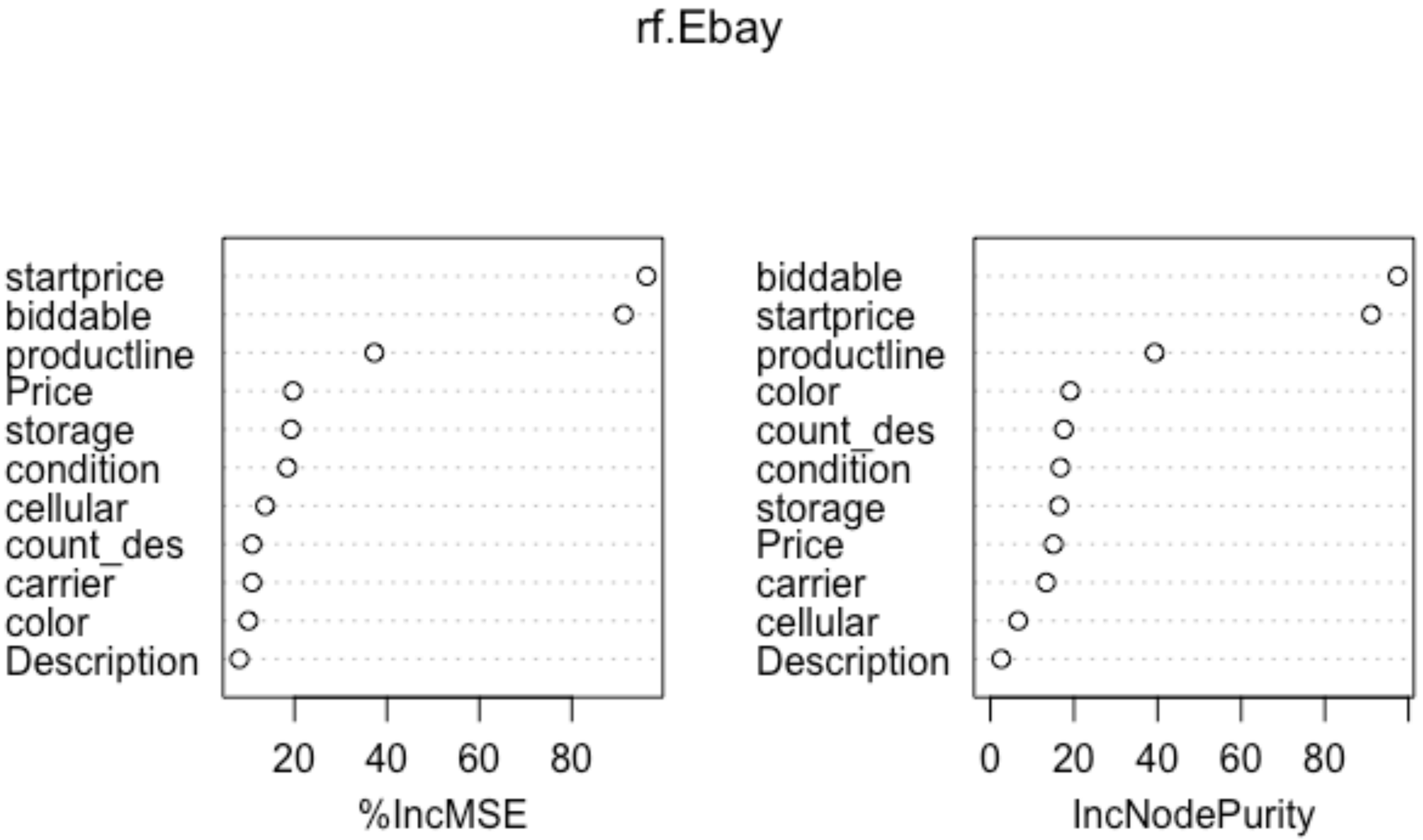
- Residual mean deviance: 0.1499

- Accuracy: 80.06% = (175+114) / (175+50+22+114)

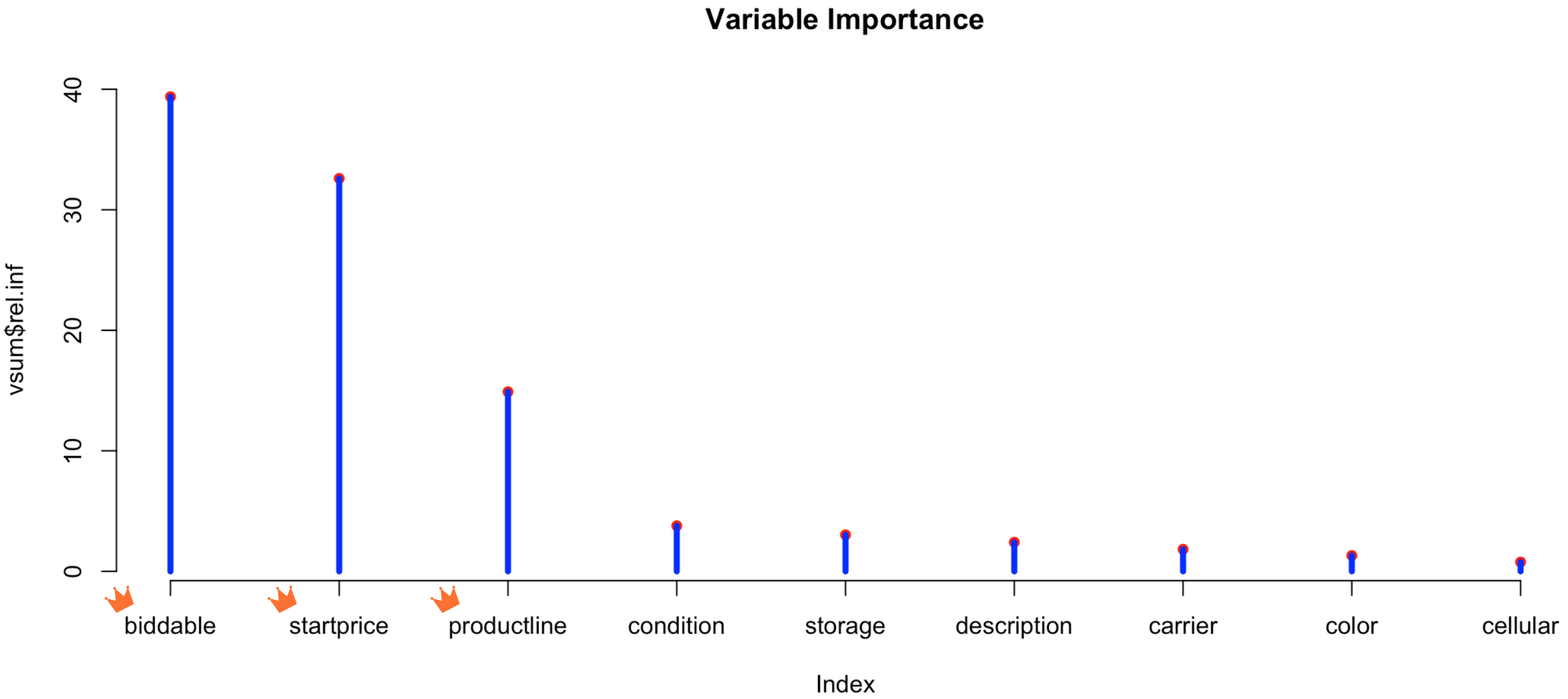
tree.pred	0	1
0	175	50
1	22	114


rffit
Error
0.14
0.16
0.18
0.20
0.22
0.24
0.26
trees = 45
0
500
1000
1500
trees

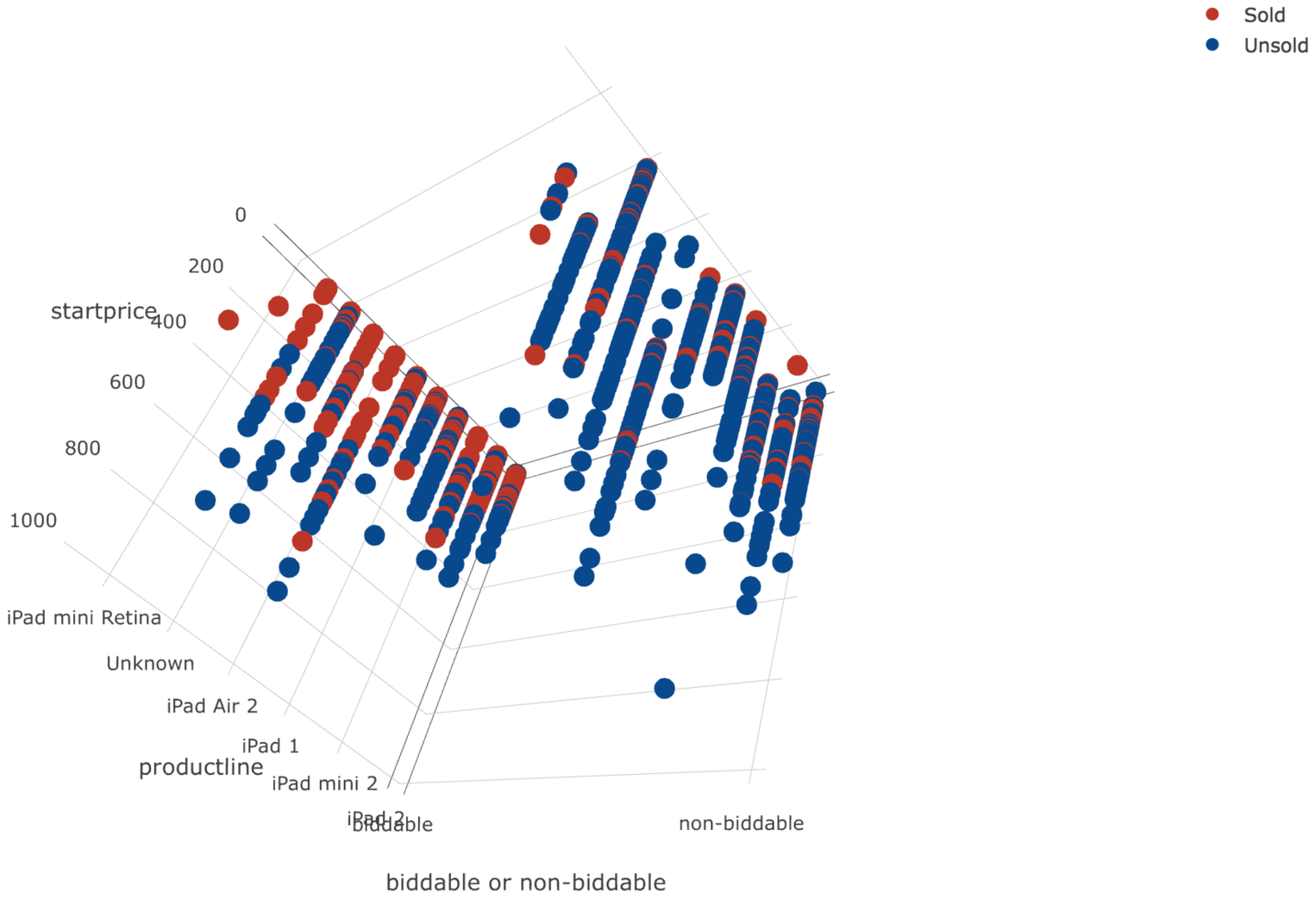
Random Forests

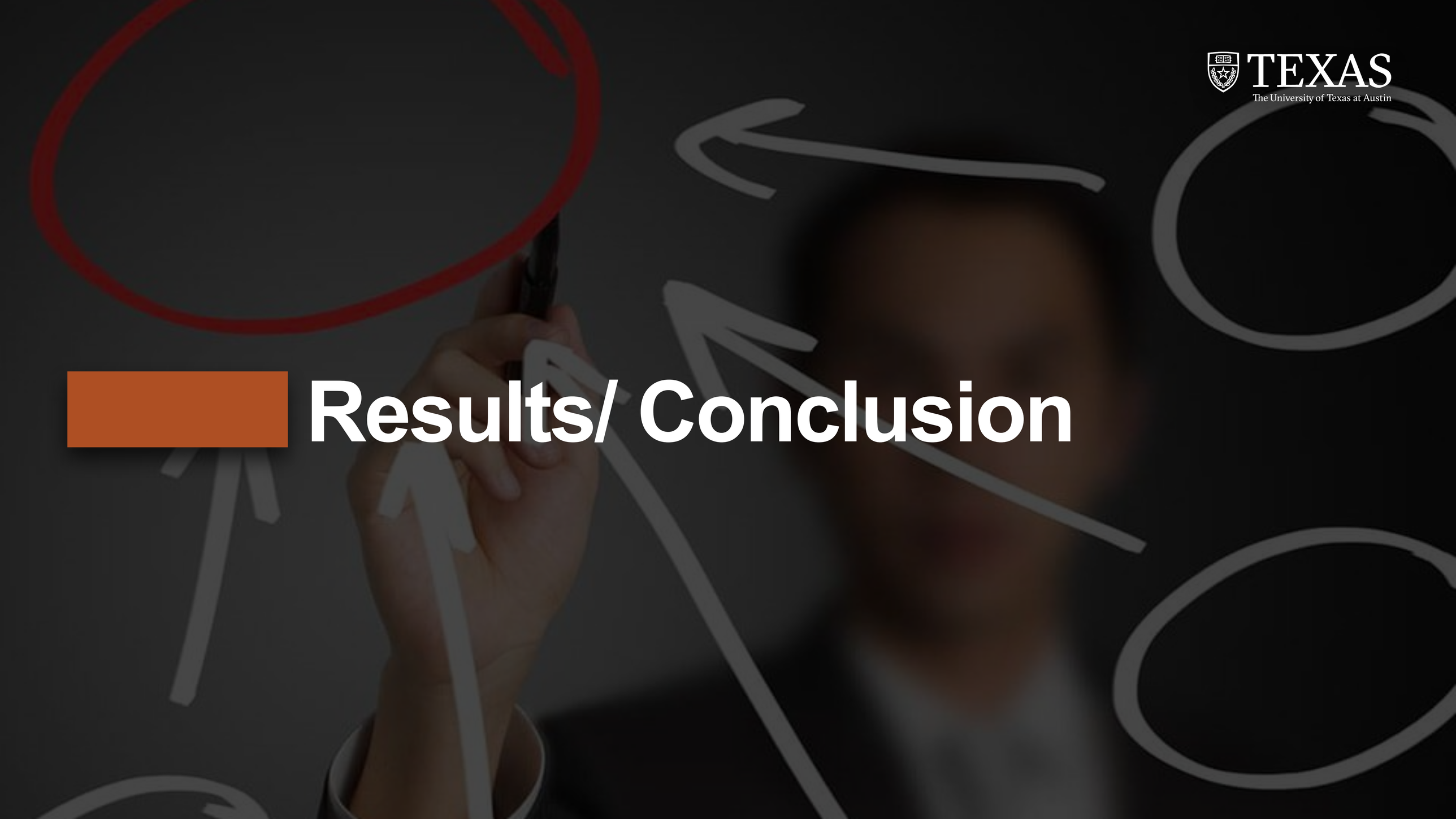


Boosting


Variable Importance
vsum$rel.inf
0
10
20
30
40
biddable
startprice
productline
condition
storage
description
carrier
color
cellular
Index

3D Presentation





Results/ Conclusion

Results

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	Logistic Model (glm7)	Classification Tree (5 nodes)	Random Forest (45 trees)
Variables Used	**Biddable, StartPrice, Product line**	**Biddable, StartPrice, Product line**	**Unknown**
Accuracy	**81.11%**	**80.03%**	**86.00%**

Conclusion

3 significant variables

Set as biddable, lower your start price and then...

Higher chance to ... SELL!!!!

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FAQ