Logistic regression

Venugopal Gopalakrishna-Remani (Venu), Ph.D.,
BVSc & A.H, MBA, PGDPM, ACUE

The University of Texas at

TYLER™

Your Success. Our Passion.

What is logistic regression?

Estimate (guess) the probability of an event given some previous data.

Works with binary data, event happens (1) or the event does not happen (0).

Outcome & independent Variables

- Two possible outcomes, "0" and "1" ("dead" vs. "alive" or "win" vs. "loss")

Prediction is based on what?

- Is the independent variable
- Predict a student pass or fail in an exam based on the number of hours spent studying.
- Number of hours studied become independent variable
- We can also consider his/her IQ and that becomes another dependent variable and so on

When should you use logistic regression?

- To predict the likelihood of an event to occur
- To understand the relationship between the dependent variable and one or more independent variables by estimating probabilities using a logistic regression equation.

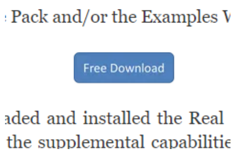
Logistic regression

- With 14 points, 4 rebounds and 5 assists, will Dr.V will make it to the awesome team?
- WE WILL SOLVE THIS AT THIS ONLINE WORKSHOP:
- Pic Credit: https://www.shutterstock.com/image-photo/back-view-basketball-player-holding-against-

PROCESS 1: INSTALLING SOFTWARE

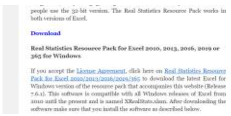
- Go to Real Statistics .com (https://www.real-statistics.com/)
- Click on Free Download

- Download Real Statistics resource pack
- Click on the download and install it
- Go to Excel Home > Options > Add ins >Browse
- Browse >downloads> XrealStats.Xlam
- Once added in> addins



Pack and/or the Examples V

aded and installed the Real
the supplemental capabilitie

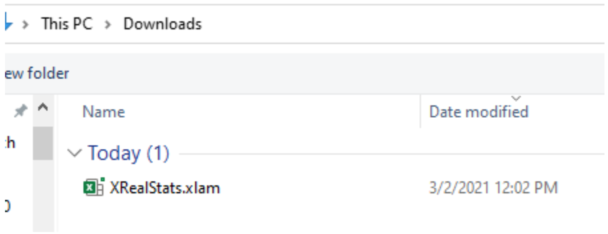


people use the 32-bit version. The Real Statistics Resource Pack works in both versions of Excel.

Download

Real Statistics Resource Pack for Excel 2010, 2013, 2016, 2019 or 365 for Windows

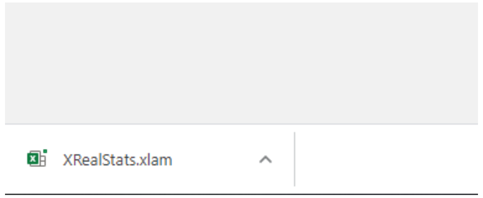
If you accept the License Agreement, click here on Real Statistics Resource Pack for Excel 2010/2013/2016/2019/365 to download the latest Excel for Windows version of the resource pack that accompanies this website (Release 7.6.1). This software is compatible with all Windows releases of Excel from 2010 until the present and is named XRealStats.xlam. After downloading the software make sure that you install the software as described below.



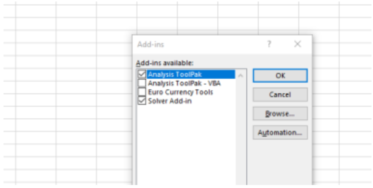
This PC > Downloads

ew folder

Name	Date modified
Today (1)	
XRealStats.xlam	3/2/2021 12:02 PM



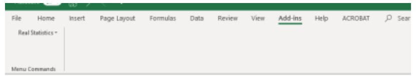
XRealStats.xlam



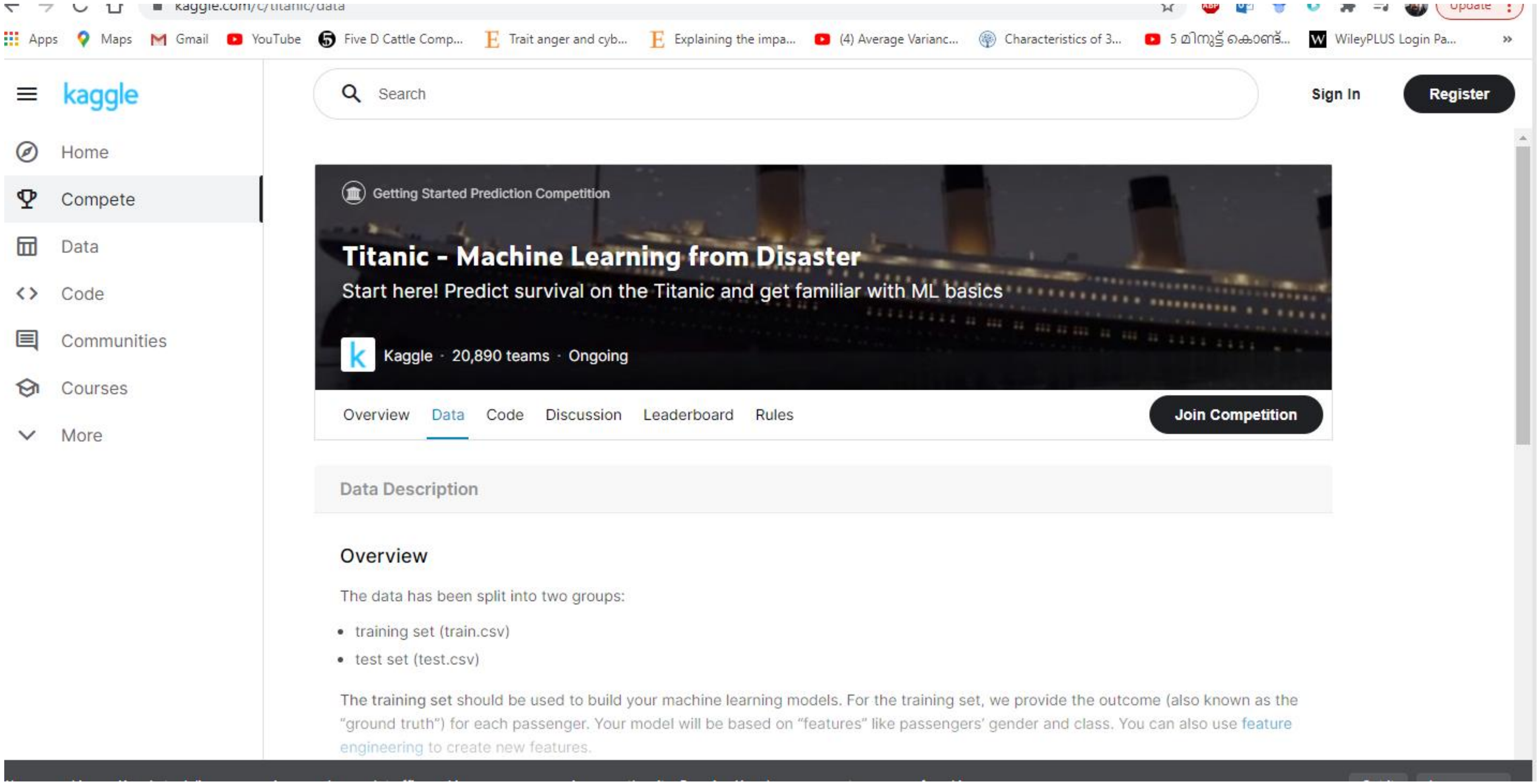
Add-ins

Add-ins available:

☑ Analysis ToolPak
□ Analysis ToolPak - VBA
□ Euro Currency Tools
☑ Solver Add-in



Data set



Titanic - Machine Learning from Disaster

Start here! Predict survival on the Titanic and get familiar with ML basics

Data Description

Overview

The data has been split into two groups:

- training set (train.csv)
- test set (test.csv)

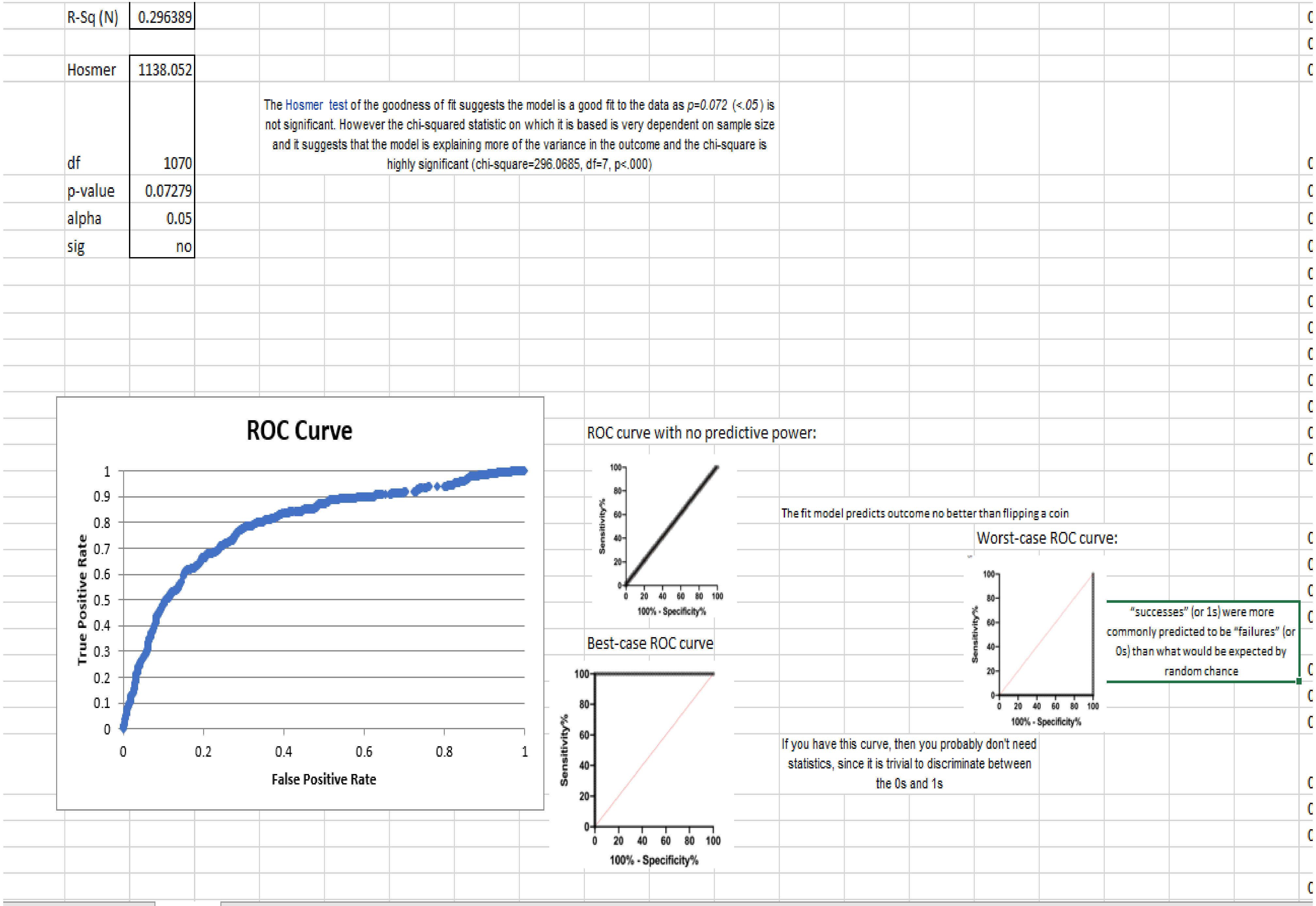
The training set should be used to build your machine learning models. For the training set, we provide the outcome (also known as the "ground truth") for each passenger. Your model will be based on "features" like passengers' gender and class. You can also use feature engineering to create new features.

Sample Size

- **Sample Size**:
- Equation is $10k/q$ where k = the number of independent variables and q = the smaller of the percentage of cases with y = 0 or y = 1, with a minimum of 100.
- For Example 1, k = 2 and q = 200/500 = .40, and so $10k/q$ = 50. A minimum sample of size 100 is recommended.

Process

- Excel
- > Add-ins
- >Real Statistics> Data Analytic tools
- >Reg>Logit and Probit regression
- >Select Input Range to Fill
- > Select Output Range –New
- >OK



R-Sq (N)	0.296389
Hosmer	1138.052
df	1070
p-value	0.07279
alpha	0.05
sig	no

The Hosmer test of the goodness of fit suggests the model is a good fit to the data as *p=0.072 (<.05)* is not significant. However the chi-squared statistic on which it is based is very dependent on sample size and it suggests that the model is explaining more of the variance in the outcome and the chi-square is highly significant (chi-square=296.0685, df=7, p<.000)

ROC curve with no predictive power:

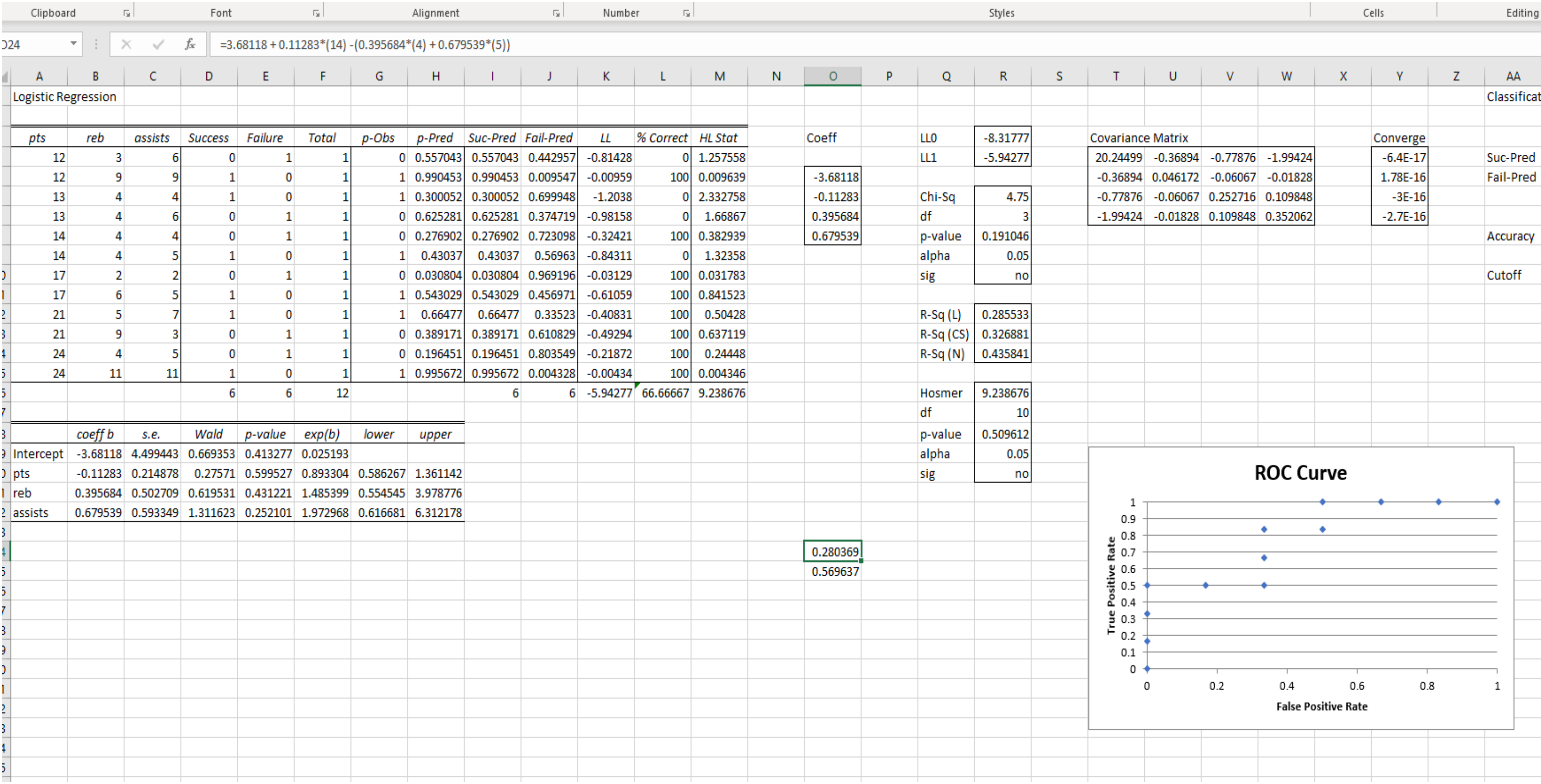
The fit model predicts outcome no better than flipping a coin

Best-case ROC curve

If you have this curve, then you probably don't need statistics, since it is trivial to discriminate between the 0s and 1s

Worst-case ROC curve:

"successes" (or 1s) were more commonly predicted to be "failures" (or 0s) than what would be expected by random chance



=3.68118 + 0.11283*(14) -(0.395684*(4) + 0.679539*(5))

Logistic Regression

pts	reb	assists	Success	Failure	Total	p-Obs	p-Pred	Suc-Pred	Fail-Pred	LL	% Correct	HL Stat
12	3	6	0	1	1	0	0.557043	0.557043	0.442957	-0.81428	0	1.257558
12	9	9	1	0	1	1	0.990453	0.990453	0.009547	-0.00959	100	0.009639
13	4	4	1	0	1	1	0.300052	0.300052	0.699948	-1.2038	0	2.332758
13	4	6	0	1	1	0	0.625281	0.625281	0.374719	-0.98158	0	1.66867
14	4	4	0	1	1	0	0.276902	0.276902	0.723098	-0.32421	100	0.382939
14	4	5	1	0	1	1	0.43037	0.43037	0.56963	-0.84311	0	1.32358
17	2	2	0	1	1	0	0.030804	0.030804	0.969196	-0.03129	100	0.031783
17	6	5	1	0	1	1	0.543029	0.543029	0.456971	-0.61059	100	0.841523
21	5	7	1	0	1	1	0.66477	0.66477	0.33523	-0.40831	100	0.50428
21	9	3	0	1	1	0	0.389171	0.389171	0.610829	-0.49294	100	0.637119
24	4	5	0	1	1	0	0.196451	0.196451	0.803549	-0.21872	100	0.24448
24	11	11	1	0	1	1	0.995672	0.995672	0.004328	-0.00434	100	0.004346
			6	6	12			6	6	-5.94277	66.66667	9.238676

	coeff b	s.e.	Wald	p-value	exp(b)	lower	upper
Intercept	-3.68118	4.499443	0.669353	0.413277	0.025193		
pts	-0.11283	0.214878	0.27571	0.599527	0.893304	0.586267	1.361142
reb	0.395684	0.502709	0.619531	0.431221	1.485399	0.554545	3.978776
assists	0.679539	0.593349	1.311623	0.252101	1.972968	0.616681	6.312178

Coeff
-3.68118
-0.11283
0.395684
0.679539

0.280369
0.569637

LL0	-8.31777
LL1	-5.94277
Chi-Sq	4.75
df	3
p-value	0.191046
alpha	0.05
sig	no
R-Sq (L)	0.285533
R-Sq (CS)	0.326881
R-Sq (N)	0.435841
Hosmer	9.238676
df	10
p-value	0.509612
alpha	0.05
sig	no

Covariance Matrix

20.24499	-0.36894	-0.77876	-1.99424
-0.36894	0.046172	-0.06067	-0.01828
-0.77876	-0.06067	0.252716	0.109848
-1.99424	-0.01828	0.109848	0.352062

Converge
-6.4E-17
1.78E-16
-3E-16
-2.7E-16

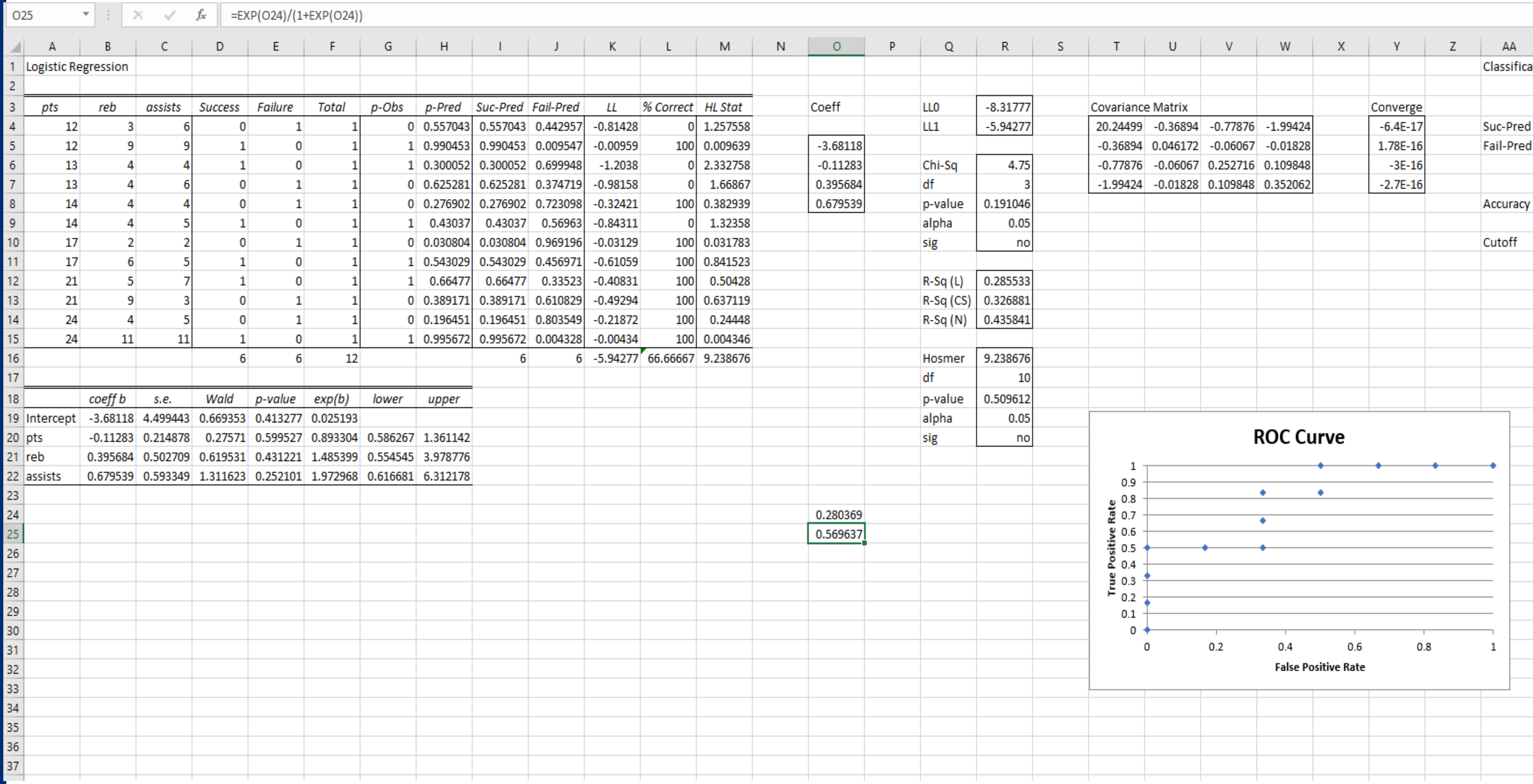
Classificat

Suc-Pred

Fail-Pred

Accuracy

Cutoff



O25 =EXP(O24)/(1+EXP(O24))

Logistic Regression

pts	reb	assists	Success	Failure	Total	p-Obs	p-Pred	Suc-Pred	Fail-Pred	LL	% Correct	HL Stat
12	3	6	0	1	1	0	0.557043	0.557043	0.442957	-0.81428	0	1.257558
12	9	9	1	0	1	1	0.990453	0.990453	0.009547	-0.00959	100	0.009639
13	4	4	1	0	1	1	0.300052	0.300052	0.699948	-1.2038	0	2.332758
13	4	6	0	1	1	0	0.625281	0.625281	0.374719	-0.98158	0	1.66867
14	4	4	0	1	1	0	0.276902	0.276902	0.723098	-0.32421	100	0.382939
14	4	5	1	0	1	1	0.43037	0.43037	0.56963	-0.84311	0	1.32358
17	2	2	0	1	1	0	0.030804	0.030804	0.969196	-0.03129	100	0.031783
17	6	5	1	0	1	1	0.543029	0.543029	0.456971	-0.61059	100	0.841523
21	5	7	1	0	1	1	0.66477	0.66477	0.33523	-0.40831	100	0.50428
21	9	3	0	1	1	0	0.389171	0.389171	0.610829	-0.49294	100	0.637119
24	4	5	0	1	1	0	0.196451	0.196451	0.803549	-0.21872	100	0.24448
24	11	11	1	0	1	1	0.995672	0.995672	0.004328	-0.00434	100	0.004346
			6	6	12			6	6	-5.94277	66.66667	9.238676

	coeff b	s.e.	Wald	p-value	exp(b)	lower	upper
Intercept	-3.68118	4.499443	0.669353	0.413277	0.025193		
pts	-0.11283	0.214878	0.27571	0.599527	0.893304	0.586267	1.361142
reb	0.395684	0.502709	0.619531	0.431221	1.485399	0.554545	3.978776
assists	0.679539	0.593349	1.311623	0.252101	1.972968	0.616681	6.312178

Coeff
-3.68118
-0.11283
0.395684
0.679539

0.280369
0.569637

LL0	-8.31777
LL1	-5.94277
Chi-Sq	4.75
df	3
p-value	0.191046
alpha	0.05
sig	no
R-Sq (L)	0.285533
R-Sq (CS)	0.326881
R-Sq (N)	0.435841
Hosmer	9.238676
df	10
p-value	0.509612
alpha	0.05
sig	no

Covariance Matrix

20.24499	-0.36894	-0.77876	-1.99424
-0.36894	0.046172	-0.06067	-0.01828
-0.77876	-0.06067	0.252716	0.109848
-1.99424	-0.01828	0.109848	0.352062

Converge
-6.4E-17
1.78E-16
-3E-16
-2.7E-16

Classifica

Suc-Pred

Fail-Pred

Accuracy

Cutoff

References

- You can download the realstats from https://www.real-statistics.com/free-download/real-statistics-resource-pack/
- Basketball data from https://www.statology.org/logistic-regression-excel/

Photo credits

- Pic Credit: https://www.shutterstock.com/image-photo/back-view-basketball-player-holding-against-