Success Indicators in the USMA Advanced Core Mathematics Program

Dr. Pamela E. Harris, MAJ Jarrod Shingleton, MAJ James Starling, and MAJ Christopher Thoma

Department of Mathematical Sciences
United States Military Academy
West Point, NY 10996

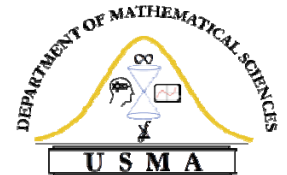**Conference on Applied Statistics in Defense**
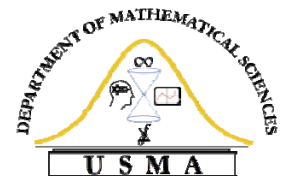
- Core Math Program
  - MA103, MA104, MA205, MA206
- Advanced Math Program
  - MA153, MA255, MA206
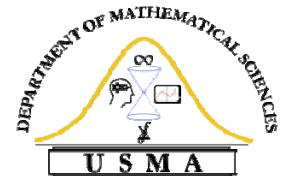 - Special selection process required for the Advanced Math track

- Reduce the amount of summer testing
  - Instructors don't have to grade as much
  - Kill fewer trees
  - Students don't have to take as many tests during Cadet Basic Training
- Predict the success of cadets in the advanced mathematics program

- Class Rank
- SAT Math Score
- ACT Math Score
- CEER Score (combination of SAT/ACT Scores and class rank)
- AP Calculus AB/BC scores
- Scores in both MA153 and MA255 (for regression training)

- All data used to determine if a cadet is going to be successful in the advanced math track must be collected before the cadet takes any math classes at USMA
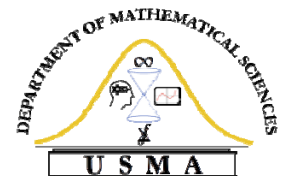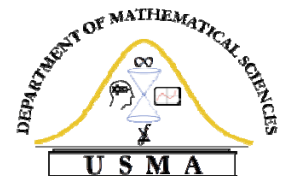
- Not all cadets take both the ACT or SAT tests
- Many cadets do not take the AB/BC test
- High school rank is a wishy-washy number at best
- Lots and lots of missing data

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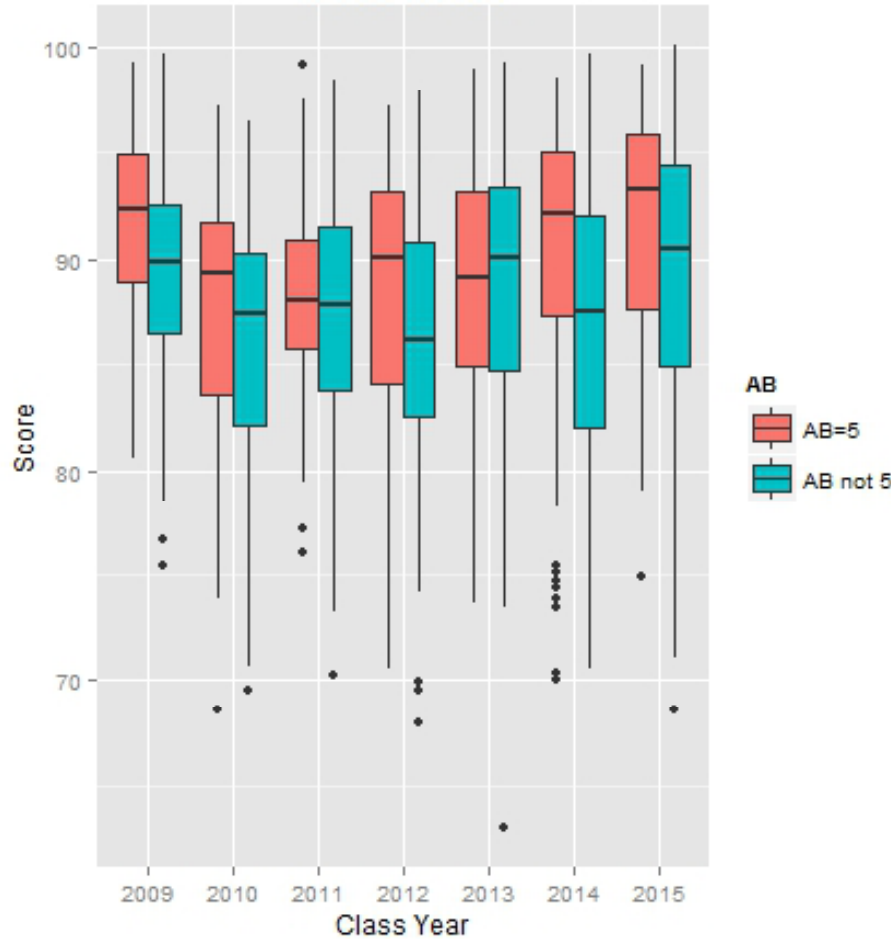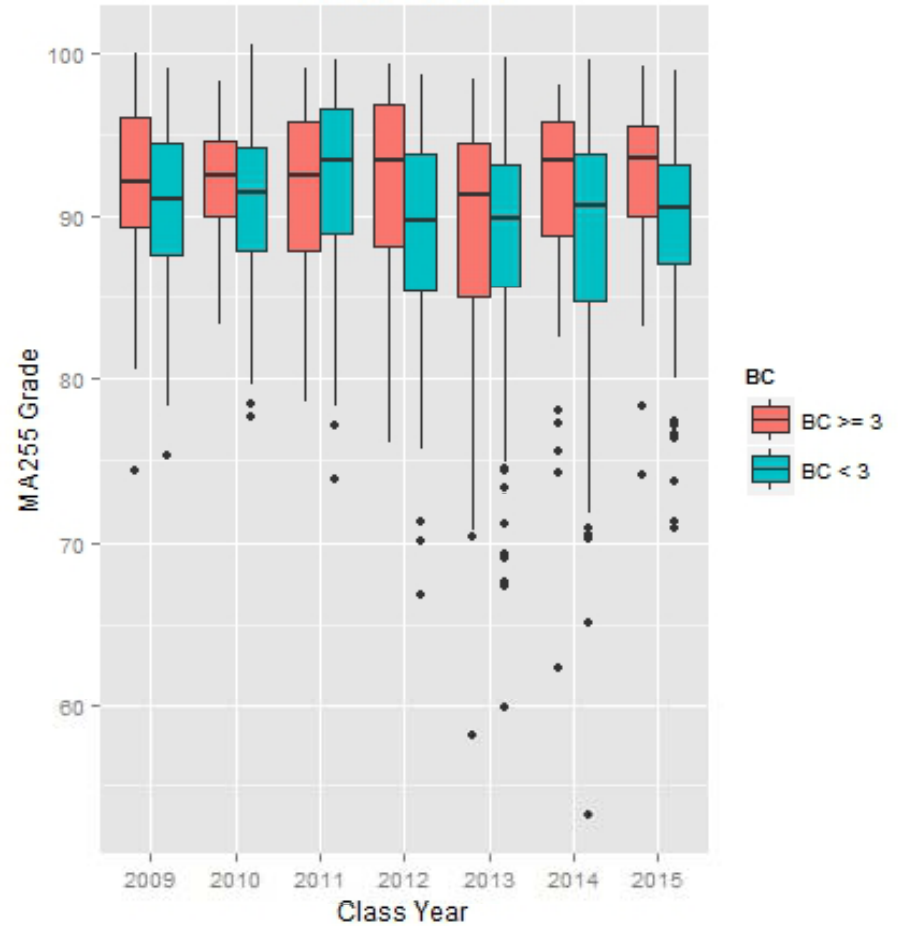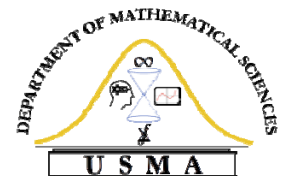
MA153 Grades

MA255 Grades

CEER< 654.5

HSP>=0.5666

SATM< 715

AB< 4.5

ACTM< 33.5

BC< 4.5

74.66

HSP>=0.1055   ACTM< 28.5

SATM< 675

ACTM< 31.5

CEER< 649.5

90.21 89.18

CEER< 737.5

HSP>=0.1325   HSP>=0.03955

CEER>=618.5

86.11 84.28 87.76

87.57

88.95

CEER>=714.5

80.01

86.94 90.1

91.21 93.29

SATM< 715

84.25

HSP>=0.1959

82.47 87.07

87.3

75.22 81.54
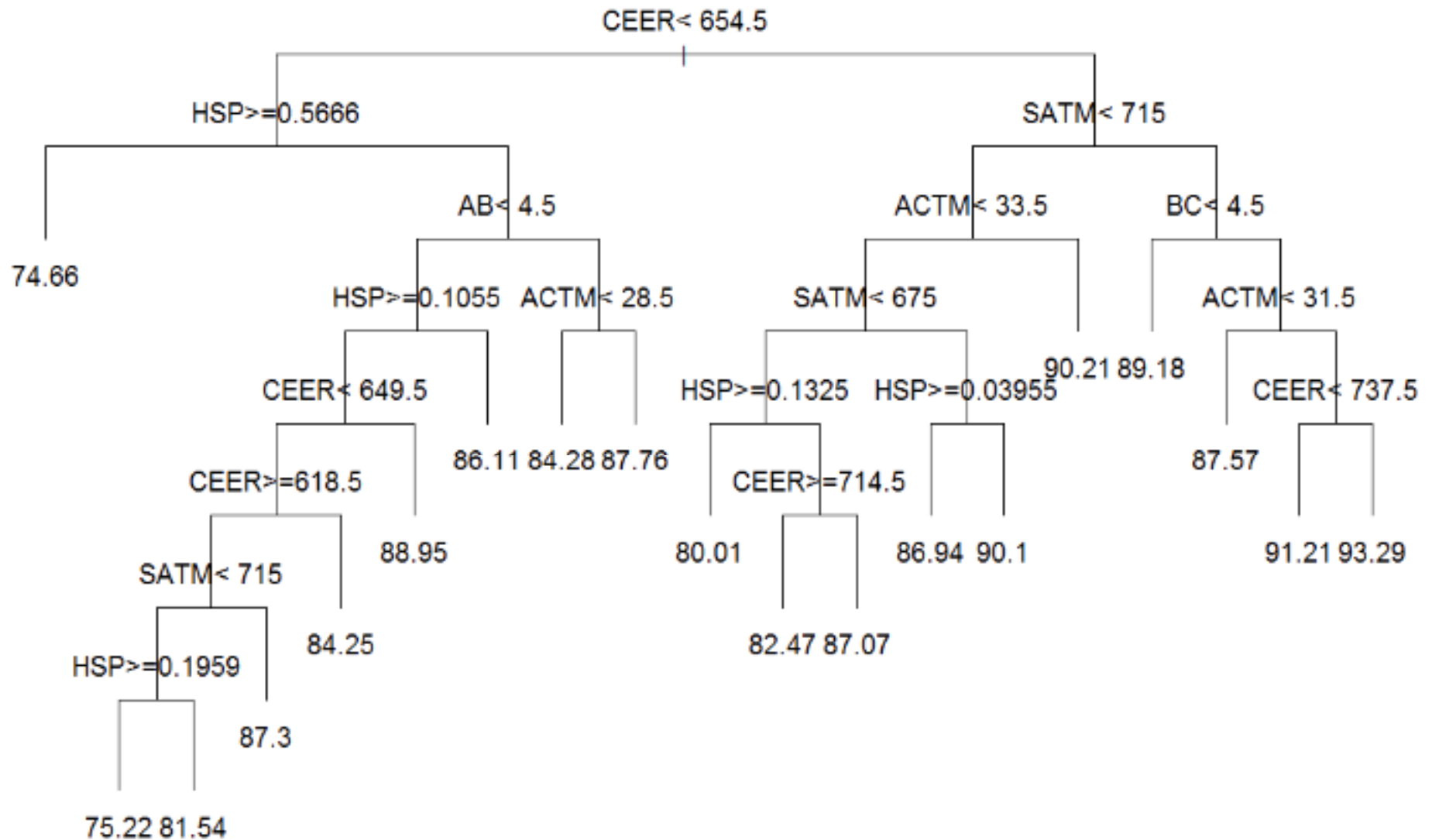
Had to decide on a threshold for "failure." First guess: scoring below 80% in the class

True Predicted	Under 80%	Over 80%
Under 80%	9	8
Over 80%	146	1226

88.9% correct prediction rate
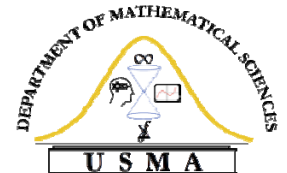
We perfectly predicted everyone that would score over an 80%!

True / Predicted	Under 80%	Over 80%
Under 80%	2	6
Over 80%	35	261

86.5% correct prediction rate
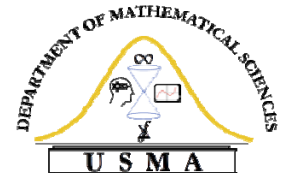
Correct prediction of success on new data: 86.5%

However, if we were just to say that everyone that everyone was in the program was going to pass, we would be correct 87% of the time, a better prediction rate than our model.

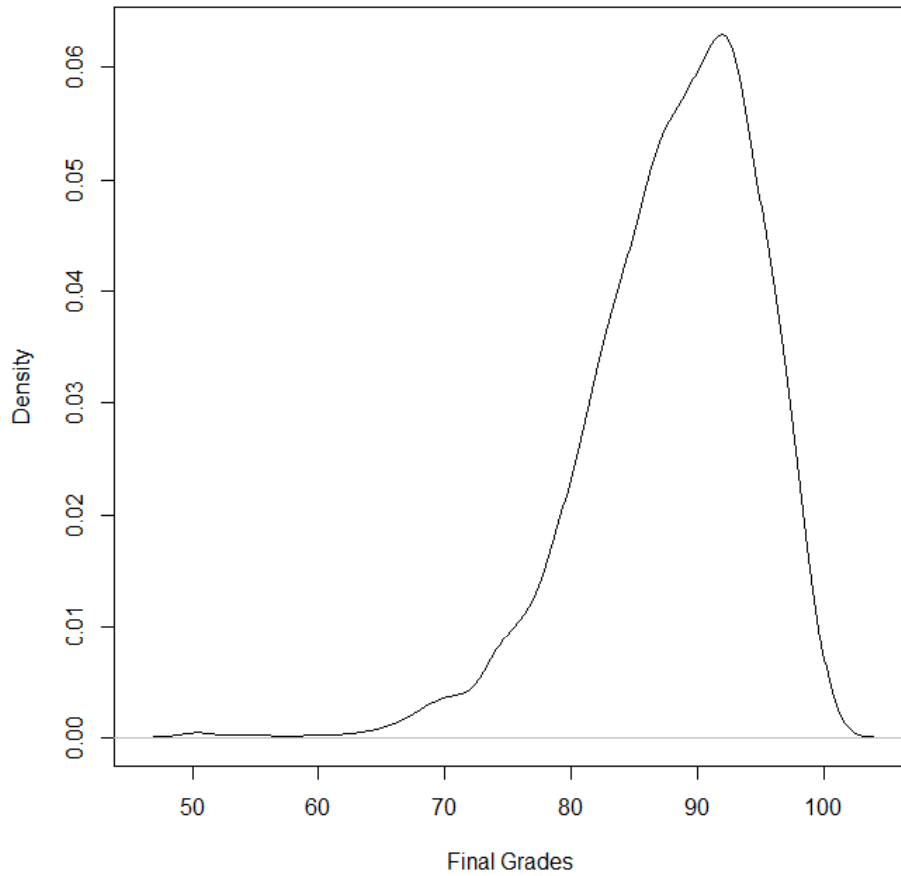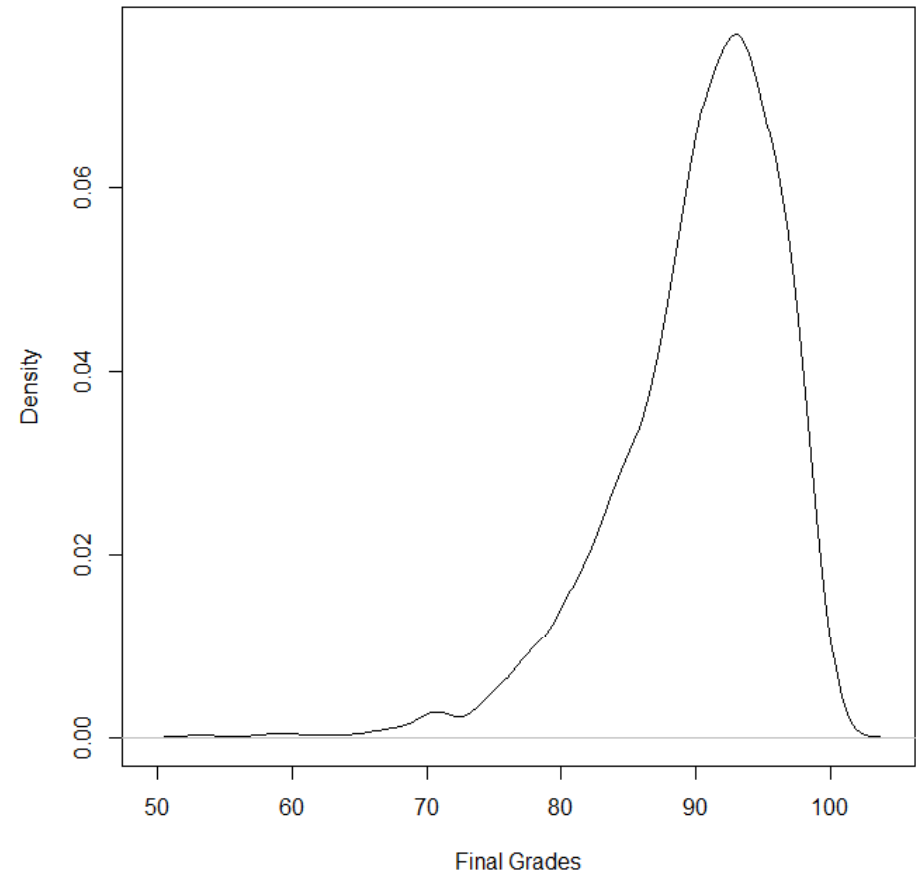Why is this prediction so terrible?
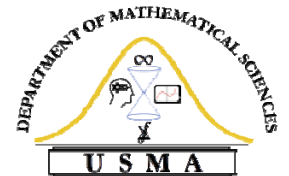
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WEST POINT *Density Plots of Grades*

Density Plot of MA153

Density Plot of MA255

Using the mean score: 88%

Off of the training set: 67% correct

Predicted \ True	Under 80%	Over 80%
Under 80%	462	303
Over 80%	155	469

Off of the test set: 59.5% correct

Predicted \ True	Under 80%	Over 80%
Under 80%	84	82
Over 80%	41	97

USMA
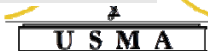
Using 88% as the threshold seems to yield better results, but there are problems associated with both false positives and false negatives.

The following cadets should, without need for retesting, be immediately offered a seat in the Advanced Core Mathematics Program:

1. Those cadets with an AP score of 4 or 5 on the AB Calculus exam.
2. Those cadets with an AP score of 3, 4 or 5 on the BC Calculus exam.
3. Those cadets with a CEER score greater than 654.5, assuming they have taken at least a single variable calculus course.
4. Those cadets with a SAT-Math score greater than 715, assuming they have taken at least a single variable calculus course.
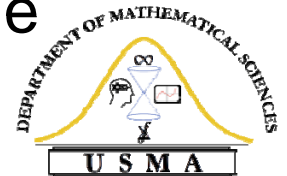
The Advanced Core Mathematics Program leadership went with the following steps from the recommendations of this study:

• Those cadets with an AP score of 5 on the AB Calculus exam or an AP score of 5 on the BC Calculus exam were given the choice of enrolling in the Advanced Core Mathematics Program

The model is not currently being used for predictions, but could be used as a tool to inform leadership about potential of a student.
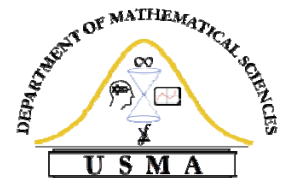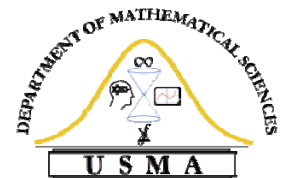
Impute the missing data to fit a different type of regression for predictive reasons.

Use Bayesian methods for something somehow.

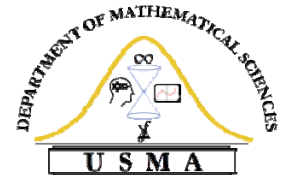| Score	Total # of Cadets	# with MA153 Final Grade <80	% with MA153 Final Grade <80	# With MA255 Final Grade <80	% with MA255 Final Grade <80
5	436	40	9.2	27	6.3
4	265	41	15.5	21	8.2
3	75	15	20.0	7	9.6
2	11	2	18.2	2	18.2
1	3	1	33.3	0	0.0

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WEST POINT.

Score	Total # of Cadets	# with MA153 Final Grade <80	% with MA153 Final Grade <80	# With MA255 Final Grade <80	% with MA255 Final Grade <80
5	208	5	2.4	4	2.0
4	79	7	8.9	8	10.0
3	66	9	13.6	4	6.3
2	5	1	20.0	0	0.0
1	6	1	16.7	0	0.0

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