MONTANA EARLY WARNING SYSTEM FOR DROPOUTS

PRESENTED BY
ERIC MEREDITH
DATA ANALYST
OPI
WHAT IS THE MONTANA EWS?

• A statistical model that can use readily available school, student, and other live data to identify students who are at risk of dropping out of school **before** they drop out.

• The EWS allows educators to intervene early on during the process before a student has reached the point of no return.
HOW IS THE EWS DEVELOPED?

• Compare data from dropouts to the data from high school graduates from the school years 2007-2015

• Model is found using Logistic Regression

\[ \pi(x) = \frac{e^{\alpha + \beta x_1 + \beta x_2 + \cdots + \beta x_n}}{1 + e^{\alpha + \beta x_1 + \beta x_2 + \cdots + \beta x_n}} \]

• \( \pi(x) \) is the percent chance a student will drop out of school

• Separate model is developed for each grades 6, 7, 8 and for each year of high school.
WHAT DATA IS AVAILABLE FOR THE MODEL?

• Data stored by the State.
  • Student Data
    • SIS (AIM) Data
    • Testing Data
  • School data
    • School Demographics
    • Location
  • Census Information
    • Unemployment Rates
    • Populations

• Data stored by the Schools
  • Attendance
  • Transcripts
  • Grades
  • Discipline
EWS MODEL DATASET

• Data from all Graduates and Dropouts from 2007-2016 school years at 13 school system’s in Montana.

  • 13 school system’s in Montana were sampled to give a good representation of schools across the state. (roughly 11,000 students per year, or about 1/6th of the statewide students in 6-12th grades)

• Data current for each student at the end of the enrollment (whether a dropout or graduate)

  • Previous term data is usually from the 3rd quarter of the year.

  • This creates an assumption in the model that on average a student’s data is the same at the end of the year as it is throughout the school year.
EWS HISTORY

• Pilot Year 2012-2013 (10 School Systems involved)
  • For the 2012-2013 school year EWS Results were sent to each school once a month
  • EWS was changed and updated many times during the school year.

• 2nd Year of EWS 2013-2014
  • Model was updated during the previous summer and remained unchanged throughout the 2013-2014 school year.

• 3rd Year of EWS 2014-2015
  • New model uses less variables that OPI does not collect (9 total)

• 4th Year of EWS 2015-2016
  • Available to all schools in GEMS

• 5th Year of EWS 2016 – 2017
  • New updated model completed before start of the new school year
  • Updates to current reports

• 6th Year of EWS 2017-2018
  • Updated Models and Intervention Report
SCHOOL SYSTEMS CURRENTLY IN EWS

- Arlee
- Belgrade
- Bozeman
- Browning
- Butte
- Columbus
- Corvallis
- Cut Bank
- Frenchtown
- Great Falls
- Havre
- Hays-Lodge Pole
- Heart Butte
- Huntley Project
- Lame Deer
- Laurel
- Lewistown
- Libby
- Livingston
- Missoula
- Park City
- Red Lodge
- St. Ignatius
- Townsend
- Wolf Point
## VARIABLES IN THE EWS MODEL

### Collected by OPI
- Moved this school year (Y or N)
- Moved from out of state (Y or N)
- Repeated a grade in K-8 (Y or N)
- Age Difference (July 15 cutoff date)*
- Number of School systems attended since 2007
- Gender

### Not Collected by OPI
- Attendance Rate
- # of Previous Term F’s
- # of Previous Term A’s
- # of Behavior Events in last 120 days
- # of Out of School Suspension Events in last 3 years
- On Track (Y or N)
- # of Credits per year
- # of Absences in last 90 days
- # of Absences in last 60 days

About 300 Variables have been analyzed.
TWO PARTS TO A GOOD EWS MODEL

1

• The Model should assign a high dropout percentage to students who end up dropping out.
  • Low dropout percentage to those that eventually graduate.
    • Can be evaluated by:
      • R squared
      • C-statistic
      • ROC Curves
      • Model AIC

2

• Model should be efficient in identifying dropouts above the cut-off threshold for targeting a student as At-Risk
  • A high percentage of At-Risk students end up being dropouts.
    • Can be evaluated by:
      • Confusion Matrix
WHEN IS A STUDENT CONSIDERED AT RISK?

- At what dropout percentage should we be concerned about a student?
  - Depends on school
  - Depends on how many incorrect conclusions you will accept.

- We want to be able to identify as many dropouts as we possibly can.

- We want as many of the students as possible to be in one of the “True” boxes.
  - Small number of students in the “False” boxes.
**EWS MODEL EXAMPLES**

Looking at Beginning of the Year EWS Results from 2009-2010

Only including students that had **all** data elements needed for the EWS. (4167 students total)

Must look at 2009-2010 to include 6\textsuperscript{th}, 7\textsuperscript{th}, 8\textsuperscript{th}, 9\textsuperscript{th}, 10\textsuperscript{th}, 11\textsuperscript{th}, and 12\textsuperscript{th} grade students and allow time for them to graduate.

512 Dropouts from group of students that were in school 2009-2010 in the Pilot Schools

<table>
<thead>
<tr>
<th>Marked as At Risk when &gt;15%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>True Negative</strong></td>
<td><strong>False Negative</strong></td>
</tr>
<tr>
<td>Model: Graduate Student: Graduate 3132 75.2%</td>
<td>Model: Graduate Student: Dropout 131 3.1%</td>
</tr>
<tr>
<td><strong>False Positive</strong></td>
<td><strong>True Positive</strong></td>
</tr>
<tr>
<td>Model: Dropout Student: Graduate 523 12.6%</td>
<td>Model: Dropout Student: Dropout 381 9.1%</td>
</tr>
</tbody>
</table>

- Dropouts found – 74.4%
- Graduates found – 85.7%
- Accuracy – 84.3%
EWS MODEL DIAGNOSTICS

- ROC Curve and c-statistic
  - Graph of Sensitivity (True Positive Rate, % of Graduates correct) vs 1-Specificity (False Positive Rate, % of Dropouts correct)
  - Probability the model will assign a higher score to a randomly chosen dropout than to a randomly chosen graduate.
EWS MODEL DIAGNOSTICS

% Dropouts Identified

% Identified Students Dropout

True positive rate

Positive predictive value

Cutoff

Cutoff
FULL MODEL DIAGNOSTICS

- **R-squared**
  - Measure of the fit of the model to data
  - Works a little different with logistic regression but similar to the r squared used with linear regression

- **C-statistic**
  - Probability a higher dropout value is assigned to a dropout than to a graduate.

<table>
<thead>
<tr>
<th>Year</th>
<th>R squared</th>
<th>c-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Grade</td>
<td>0.449</td>
<td>0.861</td>
</tr>
<tr>
<td>7th Grade</td>
<td>0.501</td>
<td>0.885</td>
</tr>
<tr>
<td>8th Grade</td>
<td>0.522</td>
<td>0.895</td>
</tr>
<tr>
<td>1st Year HS</td>
<td>0.567</td>
<td>0.910</td>
</tr>
<tr>
<td>2nd Year HS</td>
<td>0.661</td>
<td>0.943</td>
</tr>
<tr>
<td>3rd Year HS</td>
<td>0.708</td>
<td>0.968</td>
</tr>
<tr>
<td>4th Year HS</td>
<td>0.777</td>
<td>0.987</td>
</tr>
<tr>
<td>5+ Years HS</td>
<td>0.728</td>
<td>0.941</td>
</tr>
</tbody>
</table>
GEMS EWS RESULTS

• [http://gems.opi.mt.gov/StudentCharacteristics/Pages/EarlyWarningSystemOverview.aspx](http://gems.opi.mt.gov/StudentCharacteristics/Pages/EarlyWarningSystemOverview.aspx)

• EWS Results only available in GEMS Secure
  • Must get a login and access rights to the page.

• 3 Reports in GEMS
  • School Report
  • Student Summary Report
  • Student Detail Report
SCHOOL LEVEL REPORT

• Available for every school/district you have access to
  • School or district wide results to see numbers of students being identified.

• Can compare results by Grade

• Can compare to Statewide average results

• Will display results for the last 2 EWS runs
## STUDENT SUMMARY REPORT

Lists EWS results for every student in your district/school in an excel file (other formats available)

Names, School, and Data provided in the report is fictitious

<table>
<thead>
<tr>
<th>SC</th>
<th>School Name</th>
<th>Last Name</th>
<th>First Name</th>
<th>StateID</th>
<th>HS Years</th>
<th>Grade</th>
<th>Dropout Prob.</th>
<th>Change</th>
<th>Est. Attendance</th>
<th>Grades</th>
<th>Behavior</th>
<th>Age</th>
<th>Off Track</th>
<th>Mobility</th>
<th>Previous Dropout</th>
<th>Previous Prob.</th>
<th>Behavior Odds</th>
<th>Attendance Odds</th>
<th>Grades Odds</th>
<th>Mobility Odds</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Anderson</td>
<td>Joel</td>
<td>DJHDFIEF</td>
<td>4</td>
<td>12</td>
<td>99.8%</td>
<td></td>
<td>Attendance</td>
<td>Grades</td>
<td>Off Track</td>
<td>Mobility</td>
<td>Prev Dropout</td>
<td>Behavior Odds</td>
<td>Attendance Odds</td>
<td>Grades Odds</td>
<td>Mobility Odds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Smith</td>
<td>Maria</td>
<td>JDUEDJIE</td>
<td>4</td>
<td>12</td>
<td>0.1%</td>
<td></td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.0%</td>
<td>1.00</td>
<td>2.80</td>
<td>0.78</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Lackey</td>
<td>Edin</td>
<td>BGDFWFD</td>
<td>3</td>
<td>11</td>
<td>9.6%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td>Mobility</td>
<td></td>
<td></td>
<td>3.0%</td>
<td>1.22</td>
<td>3.23</td>
<td>0.57</td>
<td>3.19</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Underman</td>
<td>Hal</td>
<td>IKJHVEGXI</td>
<td>3</td>
<td>11</td>
<td>6.1%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td>Mobility</td>
<td></td>
<td></td>
<td>3.8%</td>
<td>1.06</td>
<td>1.49</td>
<td>0.28</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Grossman</td>
<td>Keith</td>
<td>JSUDEHDB</td>
<td>2</td>
<td>10</td>
<td>3.9%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td>Mobility</td>
<td></td>
<td></td>
<td>1.8%</td>
<td>1.00</td>
<td>0.83</td>
<td>0.21</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Player</td>
<td>Joe</td>
<td>IJUJHHUUS</td>
<td>2</td>
<td>10</td>
<td>0.4%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td>Mobility</td>
<td></td>
<td></td>
<td>0.2%</td>
<td>1.00</td>
<td>0.83</td>
<td>0.21</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Stein</td>
<td>Thomas</td>
<td>ODJEHDDY</td>
<td>1</td>
<td>09</td>
<td>70.2%</td>
<td>1</td>
<td>Attendance</td>
<td>Grades</td>
<td>Off Track</td>
<td>Mobility</td>
<td></td>
<td></td>
<td>59.8%</td>
<td>2.92</td>
<td>2.95</td>
<td>6.14</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Caligher</td>
<td>Mary</td>
<td>DYSYDHEGD</td>
<td>1</td>
<td>09</td>
<td>1.8%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.1%</td>
<td>1.00</td>
<td>2.40</td>
<td>0.12</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Thompson</td>
<td>Jess</td>
<td>UDJEHGDB</td>
<td>N/A</td>
<td>08</td>
<td>81.6%</td>
<td>1</td>
<td>Attendance</td>
<td>Behavior</td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>69.0%</td>
<td>1.32</td>
<td>2.28</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Banby</td>
<td>Shane</td>
<td>MSJHEDYDG</td>
<td>N/A</td>
<td>08</td>
<td>8.3%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.4%</td>
<td>1.00</td>
<td>2.37</td>
<td>0.35</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Smith</td>
<td>Jane</td>
<td>NSDHREYRG</td>
<td>N/A</td>
<td>07</td>
<td>76.5%</td>
<td>1</td>
<td>Attendance</td>
<td>Grades</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97.8%</td>
<td>1.00</td>
<td>3.59</td>
<td>8.46</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Anderson</td>
<td>Mike</td>
<td>MKNJBHGC</td>
<td>N/A</td>
<td>07</td>
<td>13.7%</td>
<td>1</td>
<td>Attendance</td>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.0%</td>
<td>1.00</td>
<td>1.39</td>
<td>1.06</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Abbott</td>
<td>Megan</td>
<td>HYGJFTDE</td>
<td>N/A</td>
<td>06</td>
<td>50.2%</td>
<td>1</td>
<td>Attendance</td>
<td>Behavior</td>
<td>Mobility</td>
<td></td>
<td></td>
<td></td>
<td>14.5%</td>
<td>1.85</td>
<td>1.39</td>
<td>0.62</td>
<td>4.92</td>
<td></td>
</tr>
<tr>
<td>ABCD</td>
<td>Early Warning System School</td>
<td>Cornrow</td>
<td>Mike</td>
<td>KDHSTGDXC</td>
<td>N/A</td>
<td>06</td>
<td>18.3%</td>
<td>1</td>
<td>Attendance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.6%</td>
<td>1.23</td>
<td>1.35</td>
<td>1.05</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>
STUDENT LEVEL REPORT

- Available for every student enrolled in your school
- Displays all data used by the EWS Model
- Graphically displays the following
  - Dropout Probability
  - Grades Risk Factor
  - Attendance Risk Factor
  - Behavior Risk Factor
  - Mobility Risk Factor
- Will display results for up to the last 12 EWS results
- Attendance Risk Factor Example
  - Based on grades alone, the odds of this student dropping out is 11.18 times the odds of an average student, with all other factors held constant
  - Above 1.25 all risk factors are flagged

* All names and data in report are fictitious *
At-Risk Tiers

TIER 3
Tertiary Prevention
EWS: Extreme Risk – 11.0% of Students

TIER 2
Secondary Prevention
EWS: At-Risk – 13.6% of Students

TIER 1
Primary Prevention
EWS: Low Risk – 75.4% of Students
Tier I
Core
(All Students)

Tier II
Supplemental
Reg. Ed. In addition to core instruction (10-15% of all students)

Tier III
Intensive
(5-10% of all students)

All Students K-12
- Universal screenings (e.g., PALS, MAP, AIMSweb)
- Balanced assessment (formative, summative, and benchmark)

Meets benchmark
Continue Core Instruction

Does not meet benchmark (25% or below)
Implement Tier I Interventions

Extreme academic or behavioral deficit or Above 15% Dropout Probability in GEMS

Individual student intervention team meeting to determine individualized interventions

Meets benchmark
Implement small group and individualized Tier II Interventions

Does not meet benchmark or Above 40% Dropout Probability in GEMS

Insufficient progress
Referral for Specially Designed Instruction

Phase 1
Implement intensive scientific or evidence-based individualized intervention focused on targeted skills

Phase 2
Significantly increased intervention minutes or initiate second intensive intervention

Meets benchmark

Does not meet Benchmark
RESOURCES

• Teacher Learning Hub Course (Using the Montana Early Warning System)
  • http://learninghub.mrooms.net/
    • Found in Self Paced courses in “Other” Section

• Montana Early Warning System Manual
  • http://gems.opi.mt.gov/StudentCharacteristics/Pages/EarlyWarningSystemOverview.aspx

• Infinite Campus EWS Extract Manual