Making the Transition from High School to College

New Hampshire Community Technical College System
Research Relating to the MaTHSC Project

June 2007

Making the Transition from High School to College

New Hampshire Community Technical College System
Research Relating to the *MaTHSC* Project
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Introduction

This report is based on the completion of six research Tasks – all of which have at their core a focus on the issue of math preparedness. The six Tasks are approached in a linear fashion, beginning with measuring the need for remediation at the NHCTC System Colleges, and progressing to an exploration of strategies for enhancing math preparedness at the secondary school level.

The titles of the six Tasks are:

I.   GATHERING DATA ON TRENDS IN THE NEED FOR MATH REMEDIATION IN THE NHCTC SYSTEM

II.   ESTABLISHING PREREQUISITE NHCTCS MATH COMPETENCIES

III.   IDENTIFYING AND SHARING BEST PRACTICES IN MATH REMEDIATION FOR ENTERING STUDENTS IN THE NHCTC SYSTEM

IV.   DEMYSTIFYING NHCTC MATH REQUIREMENTS

V.   MEASURING THE IMPACT OF RUNNING START MATH COURSES

VI.   RAISING MATH ASPIRATIONS AT CAREER TECHNICAL EDUCATION CENTERS

Prior to the beginning of the formal data gathering process, in the opinion of many stakeholders, the expectation was that the research would confirm a rapidly growing need for remediation among entering students. In fact, the formal investigatory process established that while the need for remediation, throughout the NHCTC System, is great, the three-year trend analysis showed a rate that remained essentially level.

Learning Center personnel have suggested that entering students at System Colleges, who experience the greatest difficulty in achieving the institutionally established math placement cut-score, are those students who chose not to take a math course in either the junior or senior year of high school. These students often complain that they successfully completed the required three units of high school mathematics and, therefore, cannot understand the requirement to enroll in a developmental math course, despite performing poorly on the math placement exam. This pattern suggests that the timing of math course enrollment, may be as important as course content to math preparedness at the time of postsecondary engagement.

The Steering Committee members hope that the readers of this report both find the information provided to be instructive and of value in stimulating new strategies to help address the systemic issue of a lack of math preparedness among prospective college students.

NHCTC-MaTHSC Grant – TASK I

GATHERING DATA ON TRENDS IN THE NEED FOR MATH REMEDIATION IN THE NHCTC SYSTEM

Prepared by: Matt Wood and Bob Condon

Overview of the Study

All seven NHCTC campuses utilize math placement tests to determine entering student preparedness to enroll in the first college mathematics course for degree- credit. Six of the seven colleges employ either the Accuplacer Arithmetic or Elementary Algebra exams for this purpose. Instead of Accuplacer, NHTI administers one of four self-developed placement tests. These tests are scaled in difficulty to the requirements of specific majors.

The seven campuses all employ a different cut-score for determining eligibility to enroll in the **threshold math course** (**Table-A**). For these purposes, *threshold math course* is defined as being: *that math course carrying degree-credit and requiring the lowest math placement test score for enrollment.* Three of the six Accuplacer campuses utilize an Arithmetic cut-score, with the balance relying on an Elementary Algebra score for this purpose. NHTI utilizes a campus-established cut-score of 50% for one of their four proprietary placement exams for this determination.

Table-A ~ Math Placement Test and Cut-Score Summary

Campus	Placement Exam	Cut Score	Exam Used
Berlin	**Accuplacer**	**54**	**Arithmetic**
Claremont	**Accuplacer**	**62**	**Elementary Algebra**
Laconia	**Accuplacer**	**70**	**Arithmetic**
Manchester	**Accuplacer**	**56**	**Elementary Algebra**
Nashua*	**Accuplacer**	**43**	**Arithmetic**
NHTI	**Self Designed**	**50%**	**Based on Major**
Stratham	**Accuplacer**	**57**	**Elementary Algebra**

Note: Campuses with shaded background, use the Elementary Algebra Exam of Accuplacer, others use the Arithmetic Exam

The Data

A survey was conducted for the three-year period 2004-06, to establish the number and percentage of test-takers who achieved the institutionally established threshold math course cut-score, and those who did not. Students who failed to achieve the cut-score, in most instances, are required to enroll in a developmental math course and show proficiency prior to advancing to a degree-credit carrying course.

In a minority of instances, students failing to achieve the required cut-score may sign a waiver and enroll directly in the threshold math course. Anecdotal evidence suggests that students exercising this option do not fair well and advisors have been increasingly forceful in attempting to discourage the use of this alternative.

The data sets used in this survey include, with the exception of those for NHTI, <u>all</u> students who took Accuplacer exams from February 1 – September 30 for each of the study years. This calendar period was chosen as it captures a high percentage of those students who are planning a fall semester entrance date. These individuals may or may not have ultimately enrolled in a System College
.
At the time of this study, the campus respondents indicated the only means available to them to compare the Accuplacer testing database to Banner registration records, was by a manual analysis of hardcopy rosters. However, NHTI enters all test results into Banner and, therefore, the NHTI findings reflect <u>only</u> those students tested who actually enrolled.

There already exists a somewhat natural and unavoidable division of the data to be analyzed, given the circumstance where six institutions are using Accuplacer and NHTI is using its own proprietary exams. Therefore, being able to view the longitudinal remediation results from two perspectives, e.g., tested/possibly enrolled Vs tested/enrolled, is being approached as providing additional breadth and variety to the analysis.

The Findings

Surveys:

The surveys for all seven campuses are provided, in alphabetical order by city, as Attachments I-VII.

As mentioned earlier, we have seven campuses utilizing a total of six placement tests, and seven cut-scores, to determine the need for math remediation. The summary data that appears below is of four types:

Table-B – Accuplacer Institutions – Actual placement score results, based on individual campus cut-scores, for all tested prospective students

- **Table-C** – NHTI – Actual placement test results for students who both tested and enrolled

- **Table-D** – Accuplacer Institutions – In an effort to provide a uniformly comparable analysis of remediation trends, a common cut-score of **62** on the **Elementary Algebra** exam was employed for all schools. This cut-score represents the highest used within the six Accuplacer institutions. The maximum score for this exam is 120.
  - Note: As NHCTC-Berlin uses a branching profile different from its five colleague Accuplacer institutions (branching from Arithmetic to Elementary Algebra only for specific majors), Berlin's results could not be used in the summary analysis. Please see Attachment-I for Berlin's individual campus results.

- **Table-E** – Analysis of the percentage of individual student enrollments in both developmental and degree-credit math courses for the NHCTC-System

Note: One additional finding involved utilizing NHTI's database to determine if there was a significant correlation in the performance of test-takers, based on high school attended. In looking at 5415 entering students, for the seven-year period 2000-2006, the placement test scores were regressed against high schools attended and no significant correlation was found. Only those high schools contributing twenty or more scores to the sample were included in the analysis.

Data Summary:

Table-B ~ Accuplacer Users:
Percentage of Test-Takers Scoring Above Individual Campus Cut-Scores

Campus	2004	2005	2006
Berlin	75	68	73
Claremont	23	20	24
Laconia	61	64	67
Manchester	32	31	30
Nashua	64	65	68
Stratham	36	35	40

NOTE: Campuses with shaded background, use the Elementary Algebra Exam of Accuplacer, others use the Arithmetic Exam

Table-C ~ NHTI:
Four Major-Specific Proprietary Math Placement Exams
Percentage of Test-Takers Deemed to be Ready for Degree-Credit Coursework

NHTI All Exams	2004		2005		2006	
	Tested	Degree Credit	Tested	Degree Credit	Tested	Degree Credit
	858	263	972	322	934	328
% Degree-Credit	31%		33%		35%	

Table-D ~ Accuplacer Users:
Percentage of Test-Takers Scoring 62 ≥ On the Elementary Algebra Exam

Campus	2004	2005	2006
Claremont	23	20	24
Laconia	27	33	40
Manchester	27	25	26
Nashua	21	11	26
Stratham	30	28	33
Average	25%	23%	29%

Table-E ~ NHCTC System:
Enrollment Trends in Developmental Math Courses – _Seats_

Institution	AY-2003-04		AY-2004-05		AY-2005-06	
	DEVELOP	DEGREE	DEVELOP	DEGREE	DEVELOP	DEGREE
Berlin	180	356	108	311	81	303
Claremont	87	165	59	153	78	206
Concord	590	1410	840	1420	922	1464
Laconia	53	442	95	448	84	415
Manchester	300	705	307	687	326	721
Nashua	156	807	475	479	429	428
Stratham	453	805	476	974	301	770
Totals	1819	4690	2360	4472	2221	4307
	6509		6832		6528	
Percents	28%	72%	35%	65%	34%	66%

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Campus: <u>Berlin 12-20-06</u>   Prepared by: <u>Kathy Sosny</u>

<u>Study Parameters</u>

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

    o **What is your Accuplacer cut-score? <u>54</u>**

    o **Which Test: Arithmetic <u>X</u>   Elementary Algebra <u>   </u>**

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:

<u>Part I</u>

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

    o **2004 ~ #   <u>54</u>   % <u>25</u>**
    o **2005 ~ #   <u>62</u>   % <u>32</u>**
    o **2006 ~ #   <u>65</u>   % <u>27</u>**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**

    o **2004 ~ #   <u>162</u>   % <u>75</u>**
    o **2005 ~ #   <u>130</u>   % <u>68</u>**
    o **2006 ~ #   <u>177</u>   % <u>73</u>**

Part II

[NHCTC-Berlin's Accuplacer Math testing was often limited to the Arithmetic exam only. Branching to the Elementary Algebra exam was made an option only for students applying for certain majors. Therefore, the student totals in Parts I and II of the Survey are not equal.]

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3) :**

    - **2004 ~ #   31   % 70**
    - **2005 ~ #   54   % 69**
    - **2006 ~ #   63   % 55**

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

    - **2004 ~ #   13   % 30**
    - **2005 ~ #   24   % 31**
    - **2006 ~ #   51   % 45**

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400

Attachment II

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Campus: Claremont 2-13-07 Prepared by: Diana Gauthier and Bob Condon

Study Parameters

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

    o **What is your Accuplacer cut-score? __62__**

    o **Which Test: Arithmetic ____   Elementary Algebra __X__**

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:
Part I

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

    o **2004 ~ # _279/364_   % _77__**
    o **2005 ~ # _380/476_   % _80_**
    o **2006 ~ # _287/378_   % _76__**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**
    o **2004 ~ # _85/364__   % _23__**
    o **2005 ~ # _96/476__   % _20_**
    o **2006 ~ # _91/378__   % _24_**

Part II

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3) :**

    o **2004 ~ #__279/364__ %__77__**
    o **2005 ~ #__380/476__ %__80__**
    o **2006 ~ #__287/378__ %__76__**

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

    o **2004 ~ #__85/364__ %__23__**
    o **2005 ~ #__96/476__ %__20__**
    o **2006 ~ #__91/378__ %__24__**

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400.

Attachment III

NH Technical Institute

Students with math assessment test taken April 01 to September 30
and registered in Fall 2003 to 2006

Assessment Test April 01 to September 30

	Number of students	Percent
Assessment Test April 01 to September 30 2003	716	19.5
Assessment Test April 01 to September 30 2004	916	24.9
Assessment Test April 01 to September 30 2005	1037	28.2
Assessment Test April 01 to September 30 2006	1007	27.4
Total	3676	100.0

Assessment Test April 01 to September 30 2003

MT		Frequency	Percent
M103	MT Score <= 19	92	46.5
	MT Score => 20	106	53.5
	Total	198	100.0
M108	MT Score <= 19	2	9.5
	MT Score => 20	19	90.5
	Total	21	100.0
M120	MT Score <= 19	15	23.1
	MT Score => 20	50	76.9
	Total	65	100.0
M123	MT Score <= 19	185	62.1
	MT Score => 20	113	37.9
	Total	298	100.0
M133	MT Score <= 19	20	28.6
	MT Score => 20	50	71.4
	Total	70	100.0
MTWV	MT Waived	64	100.0
Total 2003		**716**	

Assessment Test April 01 to September 30 2004

MT		Frequency	Percent
M103	MT Score <= 19	140	51.1
	MT Score => 20	134	48.9
	Total	274	100.0
M108	MT Score <= 19	7	29.2
	MT Score => 20	17	70.8
	Total	24	100.0
M120	MT Score <= 19	30	30.9
	MT Score => 20	67	69.1
	Total	97	100.0
M123	MT Score <= 19	247	63.0
	MT Score => 20	145	37.0
	Total	392	100.0
M133	MT Score <= 19	20	28.2
	MT Score => 20	51	71.8
	Total	71	100.0
MTWV	MT Waived	58	100.0
Total 2004		**916**	

Assessment Test April 01 to September 30 2005

MT		Frequency	Percent
M103	MT Score <= 19	114	45.4
	MT Score => 20	137	54.6
	Total	251	100.0
M108	MT Score <= 19	9	17.0
	MT Score => 20	44	83.0
	Total	53	100.0
M120	MT Score <= 19	21	17.9
	MT Score => 20	96	82.1
	Total	117	100.0
M123	MT Score <= 19	299	63.9
	MT Score => 20	169	36.1
	Total	468	100.0
M133	MT Score <= 19	26	31.3
	MT Score => 20	57	68.7
	Total	83	100.0
MTWV	MT Waived	65	100.0
Total 2005		**1037**	

Assessment Test April 01 to September 30 2006

MT		Frequency	Percent
M103	MT Score <= 19	119	49.4
	MT Score => 20	122	50.6
	Total	241	100.0
M108	MT Score <= 19	6	15.8
	MT Score => 20	32	84.2
	Total	38	100.0
M120	MT Score <= 19	24	25.8
	MT Score => 20	69	74.2
	Total	93	100.0
M123	MT Score <= 19	275	59.7
	MT Score => 20	186	40.3
	Total	461	100.0
M133	MT Score <= 19	28	27.7
	MT Score => 20	73	72.3
	Total	101	100.0
MTWV	MT Waived	73	100.0
Total 2006		**1007**	

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Campus: Laconia   1-5-07   Prepared by: Julie Morin

Study Parameters

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

  o **What is your Accuplacer cut-score? 70**

  o **Which Test: Arithmetic _X_   Elementary Algebra _____**

- -

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:

Part I

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

  o **2004 ~ # 141   % 39**
  o **2005 ~ # 141   % 36**
  o **2006 ~ # 135   % 33**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**

  o **2004 ~ # 218   % 61**
  o **2005 ~ # 246   % 64**
  o **2006 ~ # 277   % 67**

Part II

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3) :**

  - **2004 ~ # 263__   % 73__**
  - **2005 ~ # 259__   % 67__**
  - **2006 ~ # 249__   % 60__**

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

  - **2004 ~ #   96__   % 27__**
  - **2005 ~ # 128__   % 33__**
  - **2006 ~ # 163__   % 40__**

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400.

Attachment V

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Campus: <u>Manchester 12-20-06</u>   Prepared by: <u>Shirley Wang</u>

<u>Study Parameters</u>

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

  - **What is your Accuplacer cut-score? <u> 56 </u>**

  - **Which Test: Arithmetic <u>   </u>   Elementary Algebra <u> X </u>**

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:

Part I

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

  - **2004 ~ # <u> 413 </u>   % <u> 413/611 =68% </u>**
  - **2005 ~ # <u> 446 </u>   % <u> 446/643 =69% </u>**
  - **2006 ~ # <u> 486 </u>   % <u> 486/699 =70% </u>**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**

  - **2004 ~ # <u> 198 </u>   % <u> 198/611=32% </u>**
  - **2005 ~ # <u> 197 </u>   % <u> 197/643=31% </u>**
  - **2006 ~ # <u> 213 </u>   % <u> 213/699=30% </u>**

Part II

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3) :**

    - 2004 ~ #__448__ %___448/611 = 73%__
    - 2005 ~ #__482__ %___482/643 = 75%__
    - 2006 ~ #__517__ %___517/699 = 74%__

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

    - 2004 ~ #____163__ %___163/611 =27%__
    - 2005 ~ #___161__ %___161/643 =25%__
    - 2006 ~ #___182__ %___182/699 =26%__

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400.

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Attachment VI

NHCTC-MaTHSC Grant
Determining Trends in Math Remediation
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Campus: Nashua 12-20-06   Prepared by: Pat Goodman

Study Parameters

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

    o **What is your Accuplacer cut-score? __43*__**

    *[*A cut-score of 43 in Arithmetic qualifies the test-taker to take MTHN 104 – Topics in Mathematics. All other math courses, carrying degree credit, require a cut-score of 80 in Elementary Algebra.]*

    o **Which Test: Arithmetic __X__   Elementary Algebra _____**

- -

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:

Part I

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

    o **2004 ~ #___224___ %___35___**
    o **2005 ~ #___193___ %___35___**
    o **2006 ~ #___205___ %___32___**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**

    o **2004 ~ #___408___ %___65___**
    o **2005 ~ #___362___ %___65___**
    o **2006 ~ #___426___ %___68___**

Part II

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3):**

    o **2004 ~ #   497   %   79**
    o **2005 ~ #   493   %   89**
    o **2006 ~ #   469   %   74**

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

    o **2004 ~ #   135   %   21**
    o **2005 ~ #   62   %   11**
    o **2006 ~ #   162   %   26**

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400.

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Attachment VII

NHCTC-MaTHSC Grant
Determining Trends in Math Remediation
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Campus: STRATHAM 1-3-07   Prepared by: Sarah Bedingfield

Study Parameters

- **Years – 2004, 2005 and 2006**

- **Calendar Period – February 1 – September 30**

    o **What is your Accuplacer cut-score? 57**

    o **Which Test: Arithmetic __   Elementary Algebra X**

- -

Utilizing the Accuplacer database for all Math test-takers (see note #1), determine the following:

Part I

- **Number and Percentage of test-takers scoring below the cut-score required for enrolling in your *Threshold Math Course* (see note #2):**

    o **2004 ~ # 296/459   %   64**
    o **2005 ~ # 267/409   % _65**
    o **2006 ~ # 316/524   % _60**

- **Number and Percentage of test-takers scoring equal to or greater than your cut-score:**

    o **2004 ~ # 163/459   %   36**
    o **2005 ~ # 142/409   % _35**
    o **2006 ~ # 208/524   %   40**

Part II

- **Number and Percentage of test-takers scoring below 62 in Elementary Algebra (see note #3) :**

  - **2004 ~ # 320/459   % 70**
  - **2005 ~ # 295/409   % 72**
  - **2006 ~ # 350/524   % 67**

- **Number and Percentage of test-takers scoring equal to or greater than 62 in Elementary Algebra:**

  - **2004 ~ # 139/459   %   30**
  - **2005 ~ # 114/409   % 28**
  - **2006 ~ # 174/524   % 33**

Notes:

#1 – Please include all test-takers during this period, whether or not they enrolled at your institution. Utilizing this parameter will allow you to complete the survey utilizing only the Accuplacer database without having to cross-reference registration records.

#2 - For the purpose of this analysis, *Threshold Math Course* is defined as being that math course which carries graduation credit (non-remedial) and requires the lowest math placement test score for registration, as established by each campus. Higher math placement test scores are, in some instances, required for enrollment in specific courses and majors.

#3 – For the purposes of this analysis, students whose scores were lower on the Arithmetic test than the requirement to branch from the Arithmetic to the Elementary Algebra test, are presumed to have an Elementary Algebra score of less than 62.

If you have questions, please contact Bob Condon – rcondon@nhctc.edu – 603-913-3400.

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Establishing Prerequisite NHCTCS Math Competencies

Prepared by: Julie Morin

Overview of the Study

The purpose of this study is to identify and document core math competencies entering students will need to enroll in a threshold, college-level, math course for graduation credit at any NHCTC campus. For the purpose of this analysis, a threshold math course is defined as being that math course which carries graduation credit and requires the lowest math placement test score for registration, as established by each campus.

In an effort to establish one list of entry-level math competencies for the System, the following four steps were taken:
1. Programs for each campus were reviewed and categorized by the first math course that earns graduation credit,
2. For each of these first math courses, course descriptions were reviewed to identify the prerequisite competencies needed at each campus,
3. Campus competencies were compared and one master list was compiled, and
4. At least one math faculty member from each campus reviewed the master list to determine if this list would enable an entering student to enroll in a math course for graduation credit at his/her campus.

The Data

For each campus, math requirements vary by program; however, within a campus many programs share the same first course for degree credit. While each campus offers between 15 and 30 different degree programs, most programs utilize 2 to 5 different first math courses. Appendix B contains campus-by-campus matrices that display mathematics requirements by program.

The following table is a summary of the most common first courses for degree credit at each campus. In addition the prerequisite courses that do not count toward graduation credit are shown. Students who do not successfully pass a campus' placement test would be required to pass at least one of these prerequisite courses prior to enrolling in a first course for graduation credit.

Campus	Typical first math courses For graduation credit	Prerequisite courses that do not count toward graduation credit
Berlin	MAT112 – Algebra and Trigonometry I MAT212 – College Mathematics	PRE012 Introductory Mathematics PRE013 – Introduction to Algebra
Claremont	MTHC110 – Algebra and Trigonometry MTHC106 – Statistics	ISVC012 – Developmental Math ISCC016 – Algebra I
Concord	MT 120 – Contemporary College Mathematics MT 123 – Intermediate Algebra MT 129 - Math for Allied Health MT 133 – Elementary Functions	MT 103 – Algebra I – Part I MT 104 – Algebra I – Part II MT 108 – Introductory Technical Mathematics I MT 109 – Introductory Technical Mathematics II MT 111 – Pre-Algebra MT 113 Accelerated Introductory Mathematics MT 115 – Practical Mathematics in Electronic Technology
Laconia	LMAT1230 – Introductory Algebra LMAT1320 – Tech Math I LMAT 2100 – Intermediate Algebra	LMAT 0850 – Fundamentals of Mathematics
Manchester	MATH111 Numerical Geometry MATH131 College Algebra I MATH132 Business Math MATH141 Technical Mathematics MATH171 Pre-Calculus	MATH070 Developmental Mathematics MATH080 Developmental Algebra
Nashua	MTHN104 – Topics in Math MTHN106 – Statistics MTHN110 – Algebra and Trigonometry MTHN115 – Finite Mathematics	MTHN097 – Mathematics I MTHN099 – Algebra I
Stratham	MATH131 College Algebra I MATH141 Technical Mathematics MATH151 Intermediate Algebra MATH171 Pre-Calculus	MATH070 Developmental Mathematics MATH080 Developmental Algebra

For each course listed in the table above, course descriptions are shown in Appendix A.

Competencies required for enrollment in a math course for graduation credit were determined by reviewing the course descriptions of the first courses for graduation credit and the prerequisite courses at each campus. The competency lists for the three largest campuses are shown in Appendix C. Campuses not listed have slightly fewer requirements; therefore, by using the three lists shown an incoming student would also be prepared to enter a graduation credit-bearing course at one of the other campuses.

Please note that there are a few programs that have higher entrance requirements such as Engineering Technology in Concord, Computer Aided Drafting in Stratham, or the Computer Gaming program in Laconia. The competency lists in this report do not address these particular programs. They do address most programs at most campuses.

The Findings

Upon review of the course descriptions, the following similarities were evident. Most first math courses for graduation credit have some aspects of elementary algebra. Most of the non-credit bearing courses at each campus cover pre-algebra and elementary algebra topics. The lists of required math competencies by campus shown in Appendix C are very similar. The list for NHTI in Concord encompasses all of the competencies from the other campuses. If a student demonstrates these skills, he/she should be able to enter a course for graduation credit at any of the seven campuses in the system. Therefore, this list was selected and is shown below.

Prerequisite NHCTCS Math Competencies

- ❑ Perform operations with signed numbers
- ❑ Simplify algebraic expressions
- ❑ Solve and graph linear equations and linear inequalities
- ❑ Solve formulas for specific variables
- ❑ Apply the rules of exponents (including rewriting expressions with negative exponents using positive exponents)
- ❑ Evaluate square roots
- ❑ Translate and solve word problems
- ❑ Graph straight lines
- ❑ Find the slope of a line given two points
- ❑ Simplify polynomials (adding, subtracting, multiplying and dividing)
- ❑ Factor polynomials
- ❑ Solve systems of linear equations in 2 variables
- ❑ Simplify rational expressions (including adding, subtracting, multiplying and dividing)
- ❑ Solve quadratic equations

Summary

While the NHCTC system is comprised of seven distinct colleges with their own degree programs, the entry-level math competency requirements are similar for most programs. Potential students who are undecided about a campus or a program but want to ensure that they are prepared to take a math course for degree credit should refer to the competency list shown in this report. Students that can demonstrate these competencies will be able to enroll in a variety of programs at any campus. Potential students who are certain of the campus and program in which they would like to enroll should refer to that specific program information to identify the specific math requirements.

Appendix A
Campus Mathematics Requirements by Program including Course Descriptions

Berlin

First course for graduation credit	**MAT112 – Algebra and Trigonometry I** (3 credits) Covers selected topics from algebra including exponents, radicals, multiplication of polynomials, solving linear equations and systems of equations. Right triangle trigonometry and vectors are also covered. (Prerequisite: PRE013 or competence demonstrated on college placement exam.	**MAT212 - College Mathematics** (3 Credits) Covers a variety of topics which will provide a foundation for further course work in mathematics, as well as other academic areas, including set theory, logic, algebra and probability.
Programs	- Automotive Service Management - Environmental Science - Surveying Technology - Applied Engineering Technology - Forest Information Technology - General Studies - Geographic Information Systems - Information Technology - Mobile Equipment Technology	- Accounting - Business Administration - Criminal Justice - Culinary Arts - Early Childhood Education - Human Services - Liberal Arts - Nursing - Office Management - Teacher Preparation

First course for graduation credit	**MAT214 – Statistics (4 credits)** An introductory statistics course. Topics covered include methods of obtaining, analyzing and presenting data, elementary probability, probability distributions, confidence intervals, hypothesis testing, linear regression and correlation. (Prerequisite: MAT212)
Programs	Teacher Preparation

Claremont

First course for graduation credit	**MTHC110 – Algebra and Trigonometry (4 credits)** Students will begin the course with a review of linear equations and analytic geometry. Covered next will be the solution of simultaneous linear equations with applications. Polynomials and quadratics in particular will be discussed with the emphasis on roots of equations. Completing the square will be included with quadratics and conic sections will also be investigated. The course will finish with an introduction to trigonometry, inverse trig functions and some vector analysis if time permits. Much use will be made of the graphing calculator. Applications will be integrated throughout the course and particular attention will be paid to the process of problem solving. (Prerequisite: Satisfactory placement test score, IVSC016 or equivalent, or permission of instructor.)	**MTHC106 – Statistics (4 credits)** This course begins with a discussion of the difference between descriptive and inferential statistics. Next, the different types of data and the rudiments of statistical distributions are examined. This leads quite naturally into probability theory and probability distributions. After which much time is spent on the normal distribution and applications. Linear regression analysis is also included. The course is meant to be as experiential as possible with students doing statistics projects during the semester. (Prerequisite: Accuplacer score of 64 ISOC016 or ISC012, or permission of instructor.)
Programs	- Computer Science – Networking Option - Computer Science – Internet/Website Design Option - Restaurant Management	- Accounting - Adventure Recreation & Leisure Studies - Business Computer Management - Clinical Laboratory Technician - Criminal Justice - Early Childhood Education - Human Services - Nursing - Occupational Therapy Assistant - Physical Therapy Assistant - Respiratory Therapy - Liberal Arts - Teacher Education

Concord

First course for graduation credit	**MT 120 Contemporary College Mathematics** A course in mathematical problem solving. Students will use basic math skills and technology as they become actively involved in solving applied problems from the topics of measurement, algebra, geometry, data analysis, finance, probability, statistics and topics related to the students' major field. Career and life skills will be emphasized. (Prerequisite: NHTI's MT 103 with a grade of "C" or higher or the high school equivalent with a grade of "C" or higher)	**MT 123 Intermediate Algebra** Topics include: real numbers, linear equations and inequalities, graphs of linear equations, systems of linear equations, exponents, polynomials, quadratic (and higher degree) equations, rational expressions, roots and radicals, exponential and logarithmic functions, sequences and series. A graphing calculator* will be required. (Prerequisite: High school algebra I with a grade of "C" or higher or NHTI's MT 103 **and** MT 104, both with grades of "C" or higher)
Programs	• Addiction Counseling • Criminal Justice • Early Childhood Education • Education – Associate of Science • General Studies • Health Science • Hotel Administration • Human Services • Radiologic Technology • Real Estate • Travel & Tourism	• Accounting • Animation and Graphic Game Prog. • Business Administration • Education - Associate of Arts • Information Technology • Liberal Arts • Marketing • Paralegal Studies • Radiation Therapy • Sports Management • Visual Arts

First course for graduation credit	**MT 129 Math for Allied Health** This course is designed for students in the allied health fields. Topics covered will include: basic arithmetic operations; basic topics from geometry; conversion of units; dosage calculations; linear functions, statistics and probability as they relate to the study of health data; inductive and deductive reasoning for the purpose of drawing valid conclusions. (Prerequisite: High school Algebra I with a grade of "C" or better OR NHTI's MT 103 and MT 104 with grades of "C" or better)	**MT 133 Elementary Functions** Topics will include: algebraic concepts and operations; linear, quadratic and trigonometric functions; vectors; systems of linear equations; exponential and logarithmic functions; and ratios, proportion and variation. A graphic calculator* will be required. Prerequisite: prior knowledge of algebra I, algebra II and geometry is assumed)
Programs	• Dental Hygiene • Nursing • Paramedic Emergency Medicine	• Architectural Engineering Technology • Broadband Networking & Comm. Technology • Computer Engineering Technology • Electronic Engineering Technology • Manufacturing Engineering Technology • Mechanical Engineering Technology

Laconia

First course for graduation credit	**LMAT1230 Introductory Algebra (3 Credits)** Designed to give students a solid foundation in algebraic skills. Algebra topics include properties of real numbers, solving and graphing linear equations and inequalities, polynomials, factoring, functions and problem solving. Other topics covered include metric and American systems of measurement, dimensional analysis, percentages and scientific notation. (Prerequisite: LMAT0850 or competence demonstrated on math placement exam)	**LMAT1320 Tech Math I (3 Credits)** This introductory course is intended for the technical student and includes metric conversions, tolerance, signed numbers, order of operations, algebraic operations, linear equations, variation, dimensional analysis, function notation, fractional and negative exponents, scientific notation, radicals and logarithmic expressions. Should be followed by LMAT1330. (Prerequisite: LMAT0850 or competence demonstrated on math placement exam)
Programs	- Accounting - Computer Technologies - Business Management - Early Childhood Education - Energy Services Technology - Fine Arts - Fire Science - General Studies - Graphic Design & Printing Technology - Human Services - Liberal Arts - Lodging & Conference Management - Nursing - Office Technology Management - Restaurant Management	- Automotive Service Education Program (ASEP) - Electrical Power and Control Technologies - Electrical Systems Installation Maintenance - Marine Technology

First course for graduation credit	**LMAT2100 Intermediate Algebra (3 Credits)** For the student who has a background in basic algebra, the course includes a study of linear, radical and quadratic functions, the solutions of their equations and their graphs, an introduction to exponential and logarithmic functions, systems of equations in 2 and 3 variables and rational exponents. (Prerequisite: LMAT1230 or equivalent with a grade of C- or better)
Programs	- Computer Technology-Gaming - Teacher Preparation

Manchester

First course for graduation credit	**MATH111 Numerical Geometry** An applied course in Euclidean geometry stressing calculator manipulation and problem solving. The topics include linear, area, and solid measures involving US and SI units, solutions of linear equations, proportional relationships, congruent and similar figures, properties of polygons, circles and ellipses. Also introductory right triangle trigonometry. Prerequisites: satisfactory placement test scores as defined by mathematics faculty or successful completion (grade of C or better) of one year of college preparatory algebra, or successful completion (grade of C or better) of MATH080.	**MATH131 College Algebra I** MATH131 is the first college-level algebra course offered at the college. The course helps students further develop a knowledge foundation of basic algebra concepts that are required to solve problems in all programs of study available at the college. The algebra topics offered are signed numbers; polynomial operations; solutions of linear equations and inequalities involving numerical and literal terms; factoring polynomials; word problems; formula manipulation; graphing linear equations; systems of linear equations and solutions of equations by factoring or the quadratic formula; and an introduction to functions and their related notions. Prerequisites: satisfactory placement test scores as defined by mathematics faculty; successful completion (grade of C or better) MATH080; or permission of the instructor.
Programs	- Automotive Technology - Building Construction Technology - Heating Ventilation and Air Conditioning - Welding	- Accounting - Early Childhood Education - Exercise Science - Graphic Design - Human Services - Interior Design - Liberal Arts - Management - Marketing - Medical Assistant - Nursing

First course for graduation credit	**MATH 132 – Business Math** This course is designed to help the student learn the mathematics needed to perform personal and business operations effectively and efficiently. Students will use mathematics in applications involving interest, personal finance, loans, taxes, depreciation, insurance, investments, retailing and accounting practices, and financial statements. Prerequisite: successful completion of MATH080 or its equivalent, with a C or better, or permission of the instructor, or appropriate results of placement test.	**MATH141 Technical Mathematics** This course covers the essentials of numerical algebra, geometry and trigonometry by using different problem-solving strategies. A short review of elementary algebra topics will be followed by an introduction of geometric principles and trigonometric functions. The solution of applied problems will require the integration of these topics. The trigonometric topics include trigonometric ratios in solving right triangles and vectors applications, Laws of Sines and Cosines in solving oblique triangles and selected analytic geometry applications (or trigonometric applications in analytic geometry). Prerequisite: satisfactory placement test scores as defined by mathematics faculty or successful completion (grade of C or better) of MATH131; or permission of the instructor.
Programs	• Administrative Professional	• Computer Technologies

First course for graduation credit	**MATH 202 – Probability and Statistics** Topics include basic measures of central tendency and variability; frequency distributions; probability; the binomial distribution; the normal distribution; sampling of distributions; estimation of parameters; confidence levels and hypothesis testing; non-parametric tests; simple regression and correlation analysis. Prerequisite: satisfactory placement scores as defined by mathematics faculty; or successful completion (grade of C or better) of MATH131 or permission of the instructor.
Programs	• Liberal Arts • Teacher Preparation

Nashua

First course for graduation credit	**MTHN106 – Statistics** An introductory course in modern statistics concerned with the organization and presentation of date in descriptive statistics from which meaningful decisions can be made. Pre- requisite: Placement Test of MTHN099 or Permission of Instructor.	**MTHN110 – Algebra and Trigonometry** This course starts with algebra topics, which include linear, quadratic, and radical equations. Trigonometry topics include trigonometric functions, their graphs, identities, inverse trigonometric functions, Laws of Sines and Cosines, vectors are studied in detail. Applications to problem solving are emphasized. Prerequisite: Placement Test or MTHN099 or Permission of Instructor.
Programs	• Business Administration • Nursing • Paralegal Studies	• Automotive Technology • Aviation Technology • Collision Repair Technology • Computer Aided Drafting and Design Technology • Computer Engineering Technology • Computer Science • Electronic Engineering Technology • General Studies • Honda Automotive Technology • Liberal Arts • Machine Tool Technology • Restaurant Management • Teacher Education • Telecommunications Technology

First course for graduation credit	**MTHN104 – Topics in Math** This course is designed to give students basic mathematical concepts and methods that will assist them in using mathematics in both their personal and professional lives. The course provides exposure to problem solving, sets, systems of numeration, geometry, financial mathematics and statistics. Prerequisite: Placement Test or mastery of MTHN097	**MTHN115 – Finite Mathematics** Topics will include linear models, matrix theory, linear programming, combinatorics, and mathematics of finance. Prerequisite: MTHN099 or Placement Test or permission of Instructor.
Programs	• Early Childhood Education • Human Services • General Studies • Liberal Arts	• Speech Language Pathology Assistant

Stratham

First course for graduation credit	**MATH131 College Algebra I** MATH131 is the first college-level algebra course offered at the college. The course helps students further develop a knowledge foundation of basic algebra concepts that are required to solve problems in all programs of study available at the college. The algebra topics offered are signed numbers; polynomial operations; solutions of linear equations and inequalities involving numerical and literal terms; factoring polynomials; word problems; formula manipulation; graphing linear equations; systems of linear equations and solutions of equations by factoring or the quadratic formula; and an introduction to functions and their related notions. Prerequisites: satisfactory placement test scores as defined by mathematics faculty; successful completion (grade of C or better) MATH080; or permission of the instructor.	**MATH141 Technical Mathematics** This course covers the essentials of numerical algebra, geometry and trigonometry by using different problem-solving strategies. A short review of elementary algebra topics will be followed by an introduction of geometric principles and trigonometric functions. The solution of applied problems will require the integration of these topics. The trigonometric topics include trigonometric ratios in solving right triangles and vectors applications, Laws of Sines and Cosines in solving oblique triangles and selected analytic geometry applications (or trigonometric applications in analytic geometry). Prerequisite: satisfactory placement test scores as defined by mathematics faculty or successful completion (grade of C or better) of MATH131; or permission of the instructor.
Programs	- Accounting - Automotive - Business Management - Criminal Justice - Early Childhood Education - Hospitality Management - Liberal Arts/Business - Liberal Arts/Teacher Prep. - Marketing - Nursing - Surgical Technology	- Computer Technologies - Information Systems Technology

First course for graduation credit	**MATH151 Intermediate Algebra** This course prepares the student for higher level mathematics by covering further topics in algebra including exponents; polynomials; factoring; rational expressions; and solving linear, higher degree and rational equations (including the quadratic formula). Quadratic functions, composite and inverse functions are introduced. Solving systems of linear equations of three and more variables by matrices and solving systems of inequalities by graphing. Solving of exponential and logarithmic equations. Prerequisite: satisfactory placement test scores as defined by mathematics faculty, or successful completion (grade of C or better) of MATH131, or permission of the instructor.	**MATH171 Pre-Calculus** This course covers the following topics: functions, relations, graphs, domain and range, composition of functions, inverse functions; exponential and logarithmic functions and expressions; trigonometric functions; fractions, roots and radicals; complex numbers; and the conic sections. Other topics to be investigated include topics in algebra, geometry and trigonometry. Prerequisite: Satisfactory placement test scores as defined by the mathematics faculty or MATH141 with C or better or permission from the instructor.
Programs	• Biotechnology	• Computer Aid Drafting (CAD)

Courses That Do Not Count Toward Graduation Credit Listed by Campus

Berlin

PRE012 Introductory Mathematics (3 credits)
A basic skills course covering basic mathematical concepts including the use of a calculator. Designed to improve analytical thinking skills and problem solving strategies. Topics covered are whole numbers, fractions, decimals, percents, ratio and proportion, signed numbers, simple equations and basic geometry. Students who complete the required competencies pass this course. Students who do not receive a grade of B or better will be required to retake the course. (Does not satisfy graduation requirements.)

PRE013 Introduction to Algebra (3 credits)
An introduction to algebra intended for students who have had little or no algebra. Topics covered include operations with signed numbers, simplifying algebraic expressions, solving linear equations and formulas and variation. Basic geometry will also be covered. Students who complete the required competencies pass this course. Students who do not receive a grade of B or better will be required to retake the course. (Does not satisfy graduation requirements.)

Claremont

ISVC012   Developmental Math (3 credits)
This course is designed to be a preparatory course for those students with anxiety toward mathematics, gaps in their learning history, or for those students who heed a review of basic mathematical operation before taking Algebra I or Statistics. Math concepts to be reviewed will be: Whole Number Operation, Fractions, Decimals, Percents, Units of Measurement, Signed Numbers, and Introductory Algebra. (Prerequisites: Minimum Accuplacer Score in Arithmetic 34-63 or written permission of instructor.)

ISVC016   Algebra I (3 credits)
Students will begin the course with a review of exponents, order of operations, and evaluation of expressions. Next will be graphing, the Cartesian coordinate system and the distance formula. The straight line and various methods of solution of two simultaneous linear equations will be investigated. Linear inequalities will also be solved analytically and graphed. Students will investigate higher order polynomials by learning to factor trinomials, complete the square, and solve quadratic equations. Applications (word problems) will be integrated throughout the course and in particular, the process of solving problems will be stressed. The graphing calculator will be used frequently. (This course does not meet degree requirements.) (Prerequisite: Accuplacer Arithmetic score of 64, Algebra score of 36, Developmental Math or completed waiver form.)

Concord

MT 103 Algebra I - Part I
The first in a sequence of preparatory courses for students planning to major in health sciences, business, or computer information systems. Topics will include: fractions, decimals, percents, linear equations and inequalities, polynomials, exponents, graphing, applications of algebra. The four institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA. Prerequisite: NHTI's MT 111 with a grade of "C" or higher or recommendation by the Math Department based on NHTI assessment testing. Completion of this course with a grade of "C" or higher and MT 104 with a grade of "C" or higher will satisfy the math prerequisite for MT 123.

MT 104 Algebra I - Part II
The second in a sequence of preparatory courses for students planning to major in: health sciences, business, or computer information systems. Topics will include: rational expressions, systems of linear equations, radical expressions, quadratic equations, applications of algebra. *The four institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA.* (Prerequisite: NHTI's MT 103 with a grade of "C" or higher or recommendation by math department based on NHTI Assessment Testing)

MT 108 Introductory Technical Mathematics I
The first in a sequence of preparatory courses for students planning to major in the engineering technologies. Topics will include: fractions, decimals, percents, exponents, operations with signed numbers, introduction to algebra, linear equations, factoring, graphing, elementary geometric concepts and formulas. *The five institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA.* Completion of this course with a grade of "C" or higher and MT 109 with a grade of "C" or higher will satisfy the math prerequisite for MT 133.

MT 109 Introductory Technical Mathematics II
The second in a sequence of preparatory courses for students planning to major in the engineering technologies. Topics will include: quadratic equations, logarithms, graphing of functions, systems of linear equations, radicals, Pythagorean theorem, similar figures, elementary trigonometry. A graphing calculator* will be required. *The five institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA.* Completion of this course with a grade of "C" or higher and MT 108 with a grade of "C" or higher will satisfy the math prerequisite for MT 133.

MT 111 Pre-Algebra
This course will review the essential math skills required for success in an elementary algebra course. Topics will include: basic arithmetic operations with whole numbers, decimals, fractions, signed numbers, percent, ratio and proportion, systems of measurement and conversions, introduction to basic algebra and geometry. Completion of this course with a grade of "C" or higher will satisfy the prerequisite for MT 103. The five institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA.

MT 113 Accelerated Introductory Mathematics
This course is designed for those students who are starting engineering technology or information technology programs and need a review of high school algebra, algebra II, or geometry. Topics include: introduction to algebra, solutions of linear equations, factoring algebraic fractions, exponents, quadratic equations, properties of logarithms, basic concepts of geometry including the Pythagorean theorem, similar figures and solid geometry, trigonometry. A graphing calculator* will be required. *The six institutional credits awarded for this course do not count toward graduation requirements but are calculated into GPA.* Completion of this course with a grade "C" or higher will satisfy the math prerequisite for MT 133. (Prerequisite: high school Algebra I)

MT 115 Practical Mathematics in Electronic Technology
This course is designed to reinforce basic mathematical concepts and introduce terminology and problem solving with applications employed in Engineering Technology to students planning to enter the Electronic and Computer Engineering Technology and Broadband Networking and Communications Technology curriculums. Topics covered include: engineering notation; precision and accuracy of numbers; use of the TI-86 calculator and order of operations; solution of literal equations; units of measure; and conversion within and between systems of units. Also included are: an introduction to basic electric circuits; component identification; and measurement techniques. Exercises and laboratory experiments will concentrate on developing methods of analysis employed in problem solving. Emphasis is placed on terminology and development of methods and analytical skills applied in engineering technologies. Theory will be reinforced through laboratory experiments. *(The institutional credit awarded for this course does not count toward graduation requirements but is calculated into GPA; grading will be Pass/Fail.)*

Laconia

LMAT0850 Fundamentals of Mathematics (3 Credits)
This course deals with basic mathematical concepts and development of critical thinking through the solution of applied problems. Students do an extensive review of the arithmetic skills necessary for algebra or tech math classes and then begin an exploration of early algebra topics. Students who have advanced placement status should take either LMAT1230 Introductory Algebra or LMAT1320 Tech Math I.

Manchester/Stratham

MATH070 Developmental Mathematics
The content of the course is designed to either review or to enhance the mastery of basic mathematical concepts and skills that are needed to successfully complete future courses in math. The inclusion of numerous real-data and real world applications relating to everyday life or to other academic disciplines will enable the student to begin the development of a firm foundation of math facts and problem-solving skills. Calculators will not be used in this course until the very end of the term. Offered every semester. Credits do not count toward degree requirements.

MATH080   Developmental Algebra
This course is for the student who possesses an adequate background in basic math concepts and skills, but who has never taken an algebra course or who needs a refresher course Topics covered are operations with signed numbers; algebraic expressions; linear equations/inequalities; exponents; square roots; understanding and manipulating formulas; translating and solving word problems; interpreting/analyzing data, and basic graphing techniques, and applications of all skills. Offered every semester. Credits do not count toward degree requirements. Pre-requisite: MATH 070 or placement test.

Nashua

MTHN097 Mathematics I
This is a course for students who have difficulty with basic mathematics or who need a good review in basic arithmetic computation skills. The course begins with the arithmetic of whole numbers and them goes into fractions, decimals, percent, word problems, unit conversions, and finally introductory algebra. Credits do not count toward degree requirements.

MTHN099 Algebra I
A mathematics course which deals with the basic and inter- mediate algebra topics including solving equations, inequalities, systems of linear equations; factoring and simplifying algebraic expressions; basic graphing techniques and applications of all skills. Prerequisite: Placement Test or mastery of MTHN095/MTHN097. Credits do not count toward degree requirements.

Appendix B
Mathematics Requirements by Program

NHCTC - Berlin
Mathematics Requirements by Program

	MAT112 Algebra and Trigonometry I	MAT170 College Algebra	MAT211 Algebra and Trigonometry II	MAT 212 College Mathematics	MAT 214 Statistics	MAT215 Calculus I	MAT220 Math in Our World	MAT225 Finite Mathematics
Accounting				x				
Applied Engineering Technology	x		x					
Automotive Service Management	x							
Automotive Technology	x							
Business Administration				x	x			
Criminal Justice				x				
Culinary Arts				x				
Early Childhood Education				x				
Environmental Science	x				x			
Forest Information Technology	x		x		x			
General Studies*	x		x	x	x	x	x	x
Geographic Information Systems	x		x		x			
Human Services				x				
Information Technology	x		x					
Liberal Arts*	x		x	x	x	x	x	x
Mobile Equipment Technology	x							
Nursing				x	x			
Office Management				x				
Surveying Technology	x		x		x			
Teacher Preparation					x		x	

* Varies depending on students' needs

NHCTC-Claremont

Mathematics Requirements

by Program

	MTHC106 Statistics	MTHC110 Algebra and Trigonometry	MTHC115 Finite Mathematics	MTHC120 Pre-Calculus	MTHC210 Calculus I	MTHC211 Calculus II	MTHC212 Multivariate Calculus	MTHC215 Linear Algebra	MTHC116 Math Language, Logic and Proof	MTHC217 Probability and Statistics	MTHC220 Elementary Differential Equations
Accounting	x										
Adventure Recreation & Leisure Studies	x										
Business Computer Management	x										
Clinical Laborotory Technician	x										
Computer Science-Networking Option		x		x							
Computer Science-Internet/Website Design		x		x							
Criminal Justice	x										
Early Childhood Education	x										
Human Services	x										
Liberal Arts	x	x									
Nursing	x										
Occupational Therapy Assistant	x										
Physical Therapy Assistant	x										
Respiratory Therapy	x										
Restaurant Management		x									
Teacher Education	x	x									

NHTI - Concord
Mathematics Requirements by Program

	MT120 Contemp. College Math	MT123 Intermediate Algebra	MT125 Finite Mathematics	MT 129 Math for Allied Health	MT133 Elementary Functions	MT 134 Pre-Calculus	MT 205 Calculus I	MT 206 Calculus II	MT 251 Statistics
Accounting		x	x						
Addiction Counseling	x								
Animation and Graphic Game Programming*		x			x				
Architectural Engineering Technology					x	x	x		
Broadband Networking & Communications Technology					x	x	x		
Business Administration		x	x						
Computer Engineering Technology					x	x	x		
Criminal Justice	x								
Dental Hygiene				x					
Early Childhood Education	x								
Education-Associate of Arts		x	x						
Education-Associate of Science*	x	x							
Electronic Engineering Technology					x	x	x		
General Studies	x								
Health Science	x								
Hotel Administration	x								
Human Services	x								
Information Technology		x	x						
Liberal Arts**		x	x						x
Manufacturing Engineering Technology					x	x	x		
Marketing		x							
Mechanical Engineering Technology					x	x	x		
Nursing				x					
Paralegal Studies		x							
Paramedic Emergency Medicine				x					
Radiation Therapy					x				
Radiologic Technology	x								
Real Estate	x								
Sports Management		x							
Travel & Tourism	x								
Visual Arts		x	x						

NHCTC-Laconia

Mathematics Requirements

by Program

Program	LMAT1230 Introductory Algebra	LMAT131 Boolean Algebra	LMAT1320 Technical Math I	LMAT 1330 Technical Math II	LMAT 1410 Geometry	LMAT2050 Mathematical Concepts	LMAT2100 Intermediate Algebra	LMAT2104 Trigonometry	LMAT2150 Statistics	LMAT2250 Finite Math	LMAT2350 Pre-Calculus	LMAT2450 Advanced Topics	LMAT2700 Calculus I	LMAT2710 Calculus II
Accounting	x													
Automotive Service Education Program			x											
Business Management	x													
Computer Technologies	x								x					
Early Childhood Education	x													
Electrical Power and Control Technologies		x	x	x										
Electrical Systems Installation and Maint.			x	x										
Energy Services and Technology	x													
Fine Arts	x				x									
Fire Technology	x													
General Studies	x													
Graphic Design and Printing Technology	x													
Human Services	x													
Liberal Arts	x								x					
Lodging and Conference Management	x													
Marine Technology			x											
Nursing	x													
Office Technology Management	x													
Restaurant Management	x													
Teacher Preparation						x	x							

*Most programs require Mathematics electives; therefore, students take courses based on the placement exam.
The courses listed by major are the minimum requirements. Students are encouraged to enroll in the higher
level courses when possible.

NHCTC - Manchester

Mathematics Requirements by Program

Program	MATH111 Numerical Geometry	MATH131 College Algebra I	MATH132 Business Mathematics	MATH 135 Numerical Algebra and Trig.	MATH141 Technical Mathematics	MATH151 Intermediate Algebra	MATH170 Discrete Mathematics	MATH171 Pre-Calculus	MATH200 Finite Mathematics	MATH202 Probability and Statistics	MATH204 Calculus I	MATH214 Calculus II
Accounting		x							x			
Administrative Professional			x									
Automotive Technology	x			x								
Building Construction Technology	x			x								
Computer Technologies					x							
Early Childhood Education		x										
Exercise Science		x										
Graphic Design		x	x									
Heating Ventilation and Air Conditioning	x			x								
Human Services		x										
Interior Design		x	x									
Liberal Arts		x							x			
liberal Arts/Teacher Prep.								x	x			
Management		x							x			
Marketing		x							x			
Medical Assistant		x										
Nursing		x										
Welding	x			x								

Notes:

1. Math151 may be substituted for Math131 with satisfactory placement scores or instructor permission.

2. The courses listed by major are the minimum requirements. Students are encouraged to enroll in higher level math courses.

NHCTC - Nashua

Mathematics Requirements by Program

Program	MTHN104 Topics in Mathematics	MTHN106 Elementary Statistics	MTHN108 Contemporary Mathematics	MTHN110 Algebra and Trigonometry	MTHN115 Finite Mathematics	MTHN120 Pre-Calculus	MTHN210 Calculus I	MTHN211 Calculus II	MTHN212 Multivariate Calculus	MTHN215 Linear Algebra	MTHN216 Math Language Logic and Proof	MTHN217 Probability and Statistics	MTHN220 Elementary Differential Equations
Automotive Technology			x										
Aviation Technology			x										
Business Administration		x		x									
Collision Repair Technology			x										
Computer Aided Drafting & Design Technology			x										
Computer Engineering Technology			x		x								
Computer Science			x										
Early Childhood Education	x												
Electronic Engineering Technology			x		x								
General Studies			x	x									
Honda Automotive Technology			x										
Human Services	x												
Liberal Arts			x	x									
Machine Tool Technology			x										
Nursing		x											
Paralegal Studies		x		x									
Restaurant Management			x	x									
Speech Language Pathology Assistant				x									
Teacher Education			x	x									
Telecommunications Technology			x										

NHCTC - Stratham

Mathematics Requirements by Program

Program	MATH111 Numerical Geometry	MATH131 College Algebra I	MATH132 Business Mathematics	MATH135 Numerical Algebra and Trig.	MATH141 Technical Mathematics	MATH151 Intermediate Algebra	MATH170 Discrete Mathematics	MATH171 Pre-Calculus	MATH200 Finite Mathematics	MATH202 Probability and Statistics	MATH204 Calculus I	MATH214 Calculus II
Accounting	x											
Automotive	x			x								
Biotechnology					x				x			
Business Management	x								x			
Computer Aided Drafting							x					
Criminal Justice	x											
Computer Technologies				x								
Early Childhood Education	x											
General Studies*												
Hospitality Management	x											
Information Systems Technology				x								
Liberal Arts**												
Liberal Arts/Business	x							x				
Liberal Arts/Teacher Prep	x								x			
Marketing												
Nursing	x											
Surgical Technology	x											
Veterinary Technology					x							

*3 credit elective

**3 and 4 credit elective

Appendix C
Competencies for enrollment in typical first math courses for graduation credit

Competencies based on Manchester's MATH080	Competencies based on Nashua's MTHN099	Competencies based on Concord's MT103 and MT104
- Perform operations with signed numbers - Simplify algebraic expressions - Solve and graph linear equations and linear inequalities - Solve formulas for specific variables - Apply the rules of exponents (including rewriting expressions with negative exponents using positive exponents) - Evaluate square roots - Translate and solve word problems - Graph straight lines - Find the slope of a line given two points	- Perform operations with signed numbers - Simplify algebraic expressions - Solve and graph linear equations and linear inequalities - Solve formulas for specific variables - Apply the rules of exponents (including rewriting expressions with negative exponents using positive exponents) - Evaluate square roots - Translate and solve word problems - Graph straight lines - Find the slope of a line given two points - Simplify polynomials (adding, subtracting, multiplying and dividing) - Factor polynomials - Solve systems of linear equations in 2 variables	- Perform operations with signed numbers - Simplify algebraic expressions - Solve and graph linear equations and linear inequalities - Solve formulas for specific variables - Apply the rules of exponents (including rewriting expressions with negative exponents using positive exponents) - Evaluate square roots - Translate and solve word problems - Graph straight lines - Find the slope of a line given two points - Simplify polynomials (adding, subtracting, multiplying and dividing) - Factor polynomials - Solve systems of linear equations in 2 variables - Simplify rational expressions (including adding, subtracting, multiplying and dividing) - Solve quadratic equations

NHCTC-MaTHSC Grant – TASK III

Identifying and Sharing Best Practices in Math Remediation for Entering Students in the New Hampshire Community Technical College System

Prepared by: Sarah Bedingfield

<u>Overview of the Study</u>

The research from this grant study reveals that annual enrollments of students into developmental math courses are well over 30%. We also note from the research that this percentage reflects only those students who actually enrolled in a math course; the reality is that many more students tested at the developmental level but chose an alternative to route to remediate math deficiencies. For students, this means extra time and money dedicated to the pursuit of a two-year degree. For colleges, this means extra time and money dedicated to developmental coursework and support services. The overall goal, of course, is to help students to succeed and complete their educational goals. With this in mind, the NHCTC Steering Committee set as one of its tasks (with three parts) to:

1. Identify remediation strategies for students that test at the developmental level in math;
2. Identify essential non-math skills that contribute to success; and
3. To inform high schools what students need to know about college math.

Assisting in this task were Learning Center Staff and Math Faculty from each of the seven campuses: Stratham, Manchester, Berlin, Laconia, Nashua, Claremont and Concord. Gathering information involved two phases; in the first phase, Learning Center Staff (and a few math faculty) were surveyed (Appendix A) about support services provided for students who are underprepared for college level math. At the conclusion of this survey, a forum was held at the Concord campus in which Learning Center Staff were invited to attend. The goal of the forum was to provide clarity to survey answers as well as contribute additional information. The results of the forum prompted an additional survey (Appendix B), distributed to Math Faculty at each of the seven campuses with questions that targeted student characteristics and essential skills. In all thirty-eight NHCTC Staff and Faculty provided responses.

Findings

The results of the surveys are shown below.

Table 1: What issues or characteristics are students bringing to the classrooms that serve as barriers to their success?	
Weak Math Skills	71%
Fear or Anxiety	63%
Weak Analytical Skills	61%
Low Motivation	61%
Low or Erratic Attendance	61%
Weak Study Skills	61%
Table 2: What non-math skills are essential for success?	
Motivation to Learn	93%
Strong Study Skills	82%
Time Management	75%
Reading Comprehension	64%
Self-Direction	57%
Analytical Skills	57%

Table 3: What are the most effective supports for students in developmental classes? (Top 4 answers)	
Learning Center Staff	Math Faculty
1-on-1 Tutoring	1-on-1 Tutoring
Computer Based Tutorials	Supplemental Instruction
Study Skills Instruction	Study Skills Instruction
Math Center	Math Workshops

Secondary School Recommendations

The following section reflects a summary of the numerous comments and recommendations survey respondents offered over the course of the study. What is important about these comments is that they serve to inform high schools about steps or strategies they can take in preparing students for college level math in areas that are related to content knowledge:

- Develop a global understanding of the value of math. Basic math, logic, reasoning, and problem solving are skills used throughout school and life

- The calculator is a great tool, but should not be a "crutch". You need to "understand" math, not just "do" math.

- Attendance alone is insufficient to pass a college course in math. Success is based on active participation and assessment.

- Do not allow too much time to go by without taking a math course or using your math skills.

- Know your learning style and how that impacts your approach to learning math. Use appropriate strategies for taking notes and studying for tests.

- Take ownership of your learning. Ask for help when needed; moving onto the next lesson, unit, or course without an understanding leads to disaster

<u>Summary</u>

An important lesson that came out of this study is that math skills are universal and show up in various disciplines. When students are not prepared for college level math courses, they are also not prepared for disciplines that depend on solid math skills such as nursing, chemistry, and accounting. Not having the requisite math skills often results in students delaying entry into a program of their choice or in some cases, feeling persuaded to choose alternative career paths. It is time to accept math not as an isolated set of courses, but as a valued set of skills that are nurtured and exercised throughout one's lifetime.

Appendix A
Learning Center Staff Survey

Appendix B
Math Faculty Survey

NHCTC-MaTHSC Grant – TASK IV

Demystifying NHCTCS Math Requirements by Major

Prepared by: Bob Condon

<u>Overview of the Study</u>

In order to better assure that students matriculating at any one of the seven System Colleges, had mastered the fourteen math competencies described in TASK II, this project set out to determine:

- Were the colleges providing, in their promotional and academic literature, clear information to prospective students regarding the math course requirements for all academic majors;

- What assistance the NHCTC System could provide in helping secondary school personnel to make the case to their students of the importance remaining enrolled in math courses in the junior and senior years, even though they may have met the minimum mathematics requirements for graduation; and

- How best to make the case to prospective students that while admission would likely be granted to one of the System Colleges, to applicants who had not mastered the required math competencies, those students would then be required to register and pay for developmental math instruction that would not carry degree-credit.

<u>Findings</u>

The following conclusions have resulted from discussions with a sampling of NH secondary school math faculty, superintendents, principals, and guidance staff – As well as NHCTC System math faculty, learning center staff, academic vice presidents, and admissions staff:

- The good news is that all NHCTC catalog curriculum guides display <u>all</u> math course requirements by academic major. For prospective students who read the academic literature provided by the Colleges, particularly the catalogs, there should be very little confusion about the math courses required by each institution. In addition to becoming aware of math requirements by major, students reviewing the literature would also learn that every associate's degree program, includes a minimum of one college-level math course.

- As an additional aid to prospective students, their parents, and the guidance community, quick reference matrices have been prepared which detail math requirements, by major, by campus. These matrices were developed by Julie Morin, Math Faculty at NHCTC-Manchester, and appear in Appendix B of TASK II.

- The bad news encountered is that a lack of math preparedness is causing nearly one in three math enrollments in the NHCTC System, to be in a developmental, not for degree-credit, course.

  Additionally:
  - If a common cut-score of 62 (52% of a maximum score of 120) on the Accuplacer Elementary Algebra exam is applied to the five campuses utilizing the Accuplacer testing system in a similar way …
  - And, the results are compiled with NHTI's actual placement testing outcomes, employing four proprietary exams …
  - Only, approximately, 33% of the test-takers are performing at a level to suggest a likelihood of success in an algebra-based, threshold math course.

- All parties interviewed agreed that more math instruction, beyond the minimums required by the DOE and school districts, is desirable for both career and postsecondary education preparation. Furthermore, there was a universal belief that the timing of additional instruction was as important as the content – with senior year engagement being viewed as most valuable.

- Unfortunately, no consensus was reached as to what might be a successful strategy to better engage reluctant math students to enroll in elective math courses in the 11th and 12th grades. Several possibilities were discussed:

  - The new DOE requirement of three math units would not help in the districts interviewed because that requirement had already been adopted. In high schools utilizing block scheduling, it is possible to complete three math units by January of the sophomore year, raising concerns about the gap between the last math course taken and the beginning of a career or postsecondary education experience.

  - Admissions officers and guidance counselors agreed of the importance of continuing to emphasize the importance of more math, later in the secondary school experience. Several counselors felt that what admissions officers say about the academic preparation needed for acceptance and success, does make an impression on prospective students and encouraged admissions personnel to further emphasize the benefits of additional, elective, math course enrollment.

- The following statement, suggested for inclusion in the admissions section of NHCTC catalogs, received universally favorable comments:

    All Associate Degree programs require the completion of at least one college-level mathematics course. Admission may be granted to applicants lacking the required math competencies to enroll in a college-level math course, however, students in this circumstance will be required to enroll in, pay for, and pass, a developmental (credits do not count towards the degree) math course.

- The above has been referred to as the, *Pay me now, or Pay me later* statement. This association has merit as developmental math courses cost between $500 and $650, plus books. They are often a first-year student's most difficult course, and they do not carry degree-credit. A further unfortunate aspect of this paradigm is the unintentional impact of developmental courses, for the reasons described above, serving more as *filters* than *bridges* to college success.

- One possible, partial solution, for this dilemma might be the *Running Start, Threshold Math Course, Option*, to be discussed in TASK V.

Summary

As a summary activity for this Task, an *NHCTC Math Requirements – Advisors Handbook* will be developed for distribution to all NH high schools and to the academic advisors in the System Colleges. The primary purpose in producing this publication will be to provide secondary school math faculty, and guidance counselors, with easily accessible and detailed reference to the math requirements for all NHCTC academic majors, by campus. Of co-importance will be the hoped for use of this information as a tool to convince students of the importance of staying engaged in math instruction in the junior and senior year, as preparation for addressing the specific math challenges associated with their choice of NHCTC academic major. This Handbook will be printed on durable, colored paper, and spiral bound. The Handbook will include:

- A description of the fourteen math competencies, required of all students enrolling in one of the NHCTC System Colleges. These competencies are described in the *Findings* section of TASK II.

- The matrices of math requirements by major, and by campus. There are seven matrices, and they, also, can be found in TASK II, under Appendix B.

- The listings of:

  - Issues and characteristics students bring to the classroom that serve as barriers to success;
  - Non-math skills essential for success; and
  - The most effective supports for students in developmental classes.
    [The full listings may be found in the *Findings* section of Task III]

- Essential information regarding the application process for admissions, including the application timeline.

NHCTC-MaTHSC Grant – TASK V

Measuring the Impact of Math Courses in the Running Start Program

Prepared by: Shirley Wang and Bob Condon

Overview of the Study

Three NH high schools were recruited to participate in the study: Berlin HS-Tom Sweeny, Pelham HS-Wendy Dorval, and Salem HS-Debbie Payne. A total of six math courses, carrying Running Start credit, were being offered in the subject high schools, and all were included in the study:

High School	HS Course	NHCTC Equivalent
Berlin	Advanced Algebra/Trig Calculus AB College Prep Algebra II Pre-Calculus	Algebra & Trig II Calculus I Algebra & Trig I Algebra & Trig II
Pelham	Business Math	Business Math
Salem	AP Calculus	Calculus I

Running Start Program Defined:

- The NHCTC System Colleges, partner with NH High Schools to offer dual enrollment Math courses that give students the ability to earn college credit, while still in high school, with reduced tuition. Students participating in this offering are typically juniors and seniors.

- NHCTC courses taken in the *Running Start Program* are accepted at NH's Community Technical Colleges, and at many other colleges and universities.

The Accuplacer Elementary Algebra and College-Level Math Exams were utilized to pre-test students, at the beginning of their respective courses, in September of 2006. The same exams were utilized to post-test the students, at the conclusion of their courses, in January of 2007. A minimum score of 85 (71% of a maximum possible score of 120) on the Elementary Algebra exam was required for the test-takers to branch up to the College Level Exam.

The purpose of the pre and post-test examinations was to provide a basis for analysis to measure the impact of the completion of math courses, in the Running Start program, on math skill performance, utilizing a nationally accepted college placement instrument. In all six courses, a high percentage of the students enrolled completed both exams, yielding strong, representative, samples for assessment.

The Data and Findings

Table A, provides the pre and post-test results for the Elementary Algebra Exam:

Table-A ~ Elementary Algebra Exam

Course Name	# of Test-taker	Highest		Lowest		Average	
		Pre-	Post-	Pre-	Post-	Pre-	Post-
Business Math	17	114	119	37	29	67	72
College Prep Algebra II	21	87	113	60	56	71	82
Advanced Algebra/ Trig	11	97	115	64	79	81	97
Pre-Calculus	18	119	119	89	91	104	111
Calculus AB	25	119	119	89	86	111	111
AP Calculus (3 sections)	63	119	119	78	84	108	112

Table B, provides the pre and post-test results for the College-Level Exam:

Table-B ~ College-Level Math Exam

Course Name	# of Test-taker	# of Test-Takers Branching into CLM		Average Score	
		Pre-	Post-	Pre-	Post-
Business Math	17	5	7	37	35
College Prep Algebra II	21	1	8	7	41
Advanced Algebra/Trig	11	5	10	13	35
Pre-Calculus	18	17	18	59	74
Calculus AB	25	23	25	67	84
AP Calculus (3 sections)	63	60	63	61	75

NOTE: Appendices A-F, provide individual course analyses and summary comments for all six dual enrollment courses.

Two Additional TASK V Components

I.   The Running Start Threshold Math Course Option:

As suggested in Task IV, the Running Start program provides the basis for a strategy that has some promise to partially address the issue of a lack of math preparedness evident from the placement test scores of NHCTC prospective students. This strategy involves the certification, for Running Start credit, of existing high school math courses that are determined to be the equivalent of threshold math courses (requiring the lowest cut-score/carries degree-credit) offered within the NHCTC System. Current examples include: Business Math (Pelham HS) and College Preparatory Algebra II (Berlin HS).

This option would have the following benefits for students who may be math reluctant/phobic:

- Allows them to engage in a college equivalent math course, in familiar surroundings, and during the phase of their high school experience when they may have considerable flexibility in their course schedules;

- The credits they will earn are transferable to all the NHCTC System Colleges (and to many other colleges and universities), and will satisfy the full math requirement for many associate degree programs;

- Successful completion of the math course in the Running Start program, negates the need to take math placement exams when entering one of the System Colleges, and eliminates any prospect of being required to enroll in a developmental course;

- And, most importantly, success in this dual enrollment course has earned the student the opportunity to enter their postsecondary education experience with the confidence and momentum created by passing a college-level math course.

This curricula option is worthy of further consideration and discussion among representatives from the NHCTC System and interested individuals from high schools participating in the Running Start program.

II.   Running Start Videoconference Option:

The feasibility/desirability of offering math courses in the Running Start program by utilizing a videoconference delivery system was explored through discussions with a sampling of interested parties. These individuals were all NH based and included: administrators engaged in providing videoconferencing services; teachers and guidance personnel who have been involved in the offering of courses via videoconferencing; and NHCTC and secondary school personnel interested in the concept of the interactive classroom.

The essence of the findings from these discussions may be summarized accordingly:

- The technology exists that is reasonably reliable, moderately priced, and of only moderate complexity to operate;

- While there have been, recently, several successful attempts at offering advanced secondary school courses by videoconference, none were discovered that are currently underway;

- The reasons most often given for the paucity of offerings, using this delivery system, are the challenges of: general organization, added instructional complexity, and – most adamantly – class scheduling between schools;

- One use of videoconferencing technology that appears to be taking hold, are "one-off," interactive, enrichment events. An example would be a high school marine science class that would utilize the videoconferencing

programming offered by SeaWorld in Florida. This type of offering adds a unique dimension to a curricula offering, during a regularly scheduled class period, and requires coordination only once during the semester.

It is not clear from the discussions held when, if ever, this methodology might inspire a broader, more dedicated, following. Some suggest that the speed of the internet and the growing number of self-paced, on-line courses, might well undermine the larger commitment necessary for the success of, true, interactive classroom experiences. This is a circumstance, where only time will tell the outcome.

Business Math

Prepared by Shirley Wang

Business Math is a course offered by **Pelham High School with equivalent** to NHCTC-Manchester Business Math - A threshold college-level math course.

Business Math, due to the nature of the course, is designed to help students to perform personal and business operations effectively and efficiently. Topics cover:
- Interest, US Rule, and Maturity Value problems
- Checking/Savings Accounts Reconciliation problems
- Paycheck/Payroll Deduction/FWT/FICA/Medicare problems
- Loan/Installment Buying/Rule of 78/Rebates/Revolving Charge Card problems
- Retirement/Annuities/Future & Present Value/Sinking Fund problems
- Discount, Trade/Cash, Credit Term, and Partial Payment Problems
- Markup, Markdown, Cost, Selling Price, & Perishable Problems
- Compound Interest/Future & Present Value/Table & Formula problems
- Home Ownership, Mortgages, & Monthly Payment Problems
- Sales Tax, Excise Tax, and Property Tax Problems

Students are expected to understand the basic terminology and methodology of mathematics applied to the financial area. It helps students to understand the principles of finance and banking which influence their daily lives. Overall, it is a course focused more on arithmetic than on algebra.

Detailed Test Results have been analyzed based on Accuplacer-Elementary Algebra Scores, and may be found in Table A.1-2 and a similar analysis based on College-Level Math Scores, can be found in Table A. 3-4.

Table A.1   Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of test-takers
# of test-takers placed into (Pre-test)	1	4	7	5	17
# of test-takers placed into (Post-test)	2	5	7	3	17

*Range of Score was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table A.2 Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	114	37	67	17
Post-test	119	29	72	17

Table A.1 shows 2 more students were able to place above 81 on their Elementary Algebra scores, and Table A.2 even confirms a 6% of increase on their average Elementary Algebra scores.

Table A.3 Student Distribution by College-Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of test-takers placed into (Pre-test)	0	0	0	3	14	17
# of test-takers placed into (Post-test)	0	0	0	3	14	17

Range of Score was based on the ACCUPLACER system College Level Math Proficiency Statements

Table A.4 Statistical Analysis Based on College-Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into CLM	Total # of Test-takers
Pre-test	46	28	37	5	17
Post-test	44	18	35	7	17

Table A.4 indicates that two more students were able to branch into College- Level Math, though the average test score declined by 5%.

Points of interest:
- Generally speaking, this course covered the required information in decimals/fractions, banking, percents, discounts, interest, loans, taxes, depreciation, insurance and investments. By taking this course, students made improvement in their math competencies. The increase in average grades on Elementary Algebra, and the modest increase in students branching into College- Level Math, indicates that additional students were mastering basic algebra skills. Due to the nature of this course (focusing more on Arithmetic than Algebra), the Accuplacer Arithmetic might be a more appropriate beginning point for evaluative testing.

Appendix B

College Preparatory Algebra II

Prepared by Shirley Wang

College Preparatory Algebra II is a course offered at **Berlin High School** which is equivalent to **NHCTC-Berlin's Algebra & Trigonometry I** - A threshold, college level, degree-credit, math course.

College Preparatory Algebra II, by design, covers more Introductory college algebra material. In addition, as a threshold course, accepted by NHCTC -Berlin for degree-credit, this course is designed to help students to master elementary algebra skills. Topics cover:
- Simplify algebraic expressions
- Solve linear equations, formulas, and systems of linear equations with one or three unknowns
- Apply critical thinking to analyze and solve word problems
- Evaluate and graph functions
- Solve right triangle (trigonometry) problems
- Apply vectors

Students are expected to understand exponents, simplifying algebraic expressions, radicals, multiplication of polynomials, solving linear equations, functions and graphing, systems of linear equations, right triangle trigonometry, and vectors. By taking this course, students are able to acquire a solid foundation in algebra and trigonometry, prepare themselves for other advanced level math courses such as Pre-Calculus and finite mathematics. It will help students to develop problem-solving and critical thinking skills.

Detailed Test Results have been analyzed based on Accuplacer-Elementary Algebra Scores (see Table F.1-2), and a similar analysis based on Accuplacer College-Level Math Scores, can be found in Table F. 3-4.

Table F.1 Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of Test-takers
# of Test-takers placed into (Pre-test)	0	2	19	0	21
# of Test-takers placed into (Post-test)	1	10	10	0	21

*Range of Score was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table F.2 Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	87	60	71	21
Post-test	113	56	82	21

100% of the students tested above 56. Students scoring at this level have at least minimal elementary algebra skills as stated by Accuplacer. Table F.2 indicates a 16% increase in average Elementary Algebra post-test scores.

Table F.3   Student Distribution by College-Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of Test-takers placed into (Pre-test)	0	0	0	1	20	21
# of Test-takers placed into (Post-test)	0	0	0	4	17	21

Range of Scores was based on the ACCUPLACER System, College Level Math Proficiency Statements.

Table F.4 Statistical Analysis Based on College-Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into College Level Math	Total # of Test-takers
Pre-test	54	0	7	1	21
Post-test	62	17	41	8	21

After taking this course, 38% of the students were able to branch into College Level Math. Table F.4 indicates 485% increase in the post-test scores on the College-Level Math exam (the small size of the sample skews these results). These scores show a significant improvement in student math skills as a result of taking this course.

 Points of interest:
- Overall, this course covered the intended information for College Preparatory Algebra II. By taking this course, students made significant improvements in their math competencies. The increase in average scores on both the Elementary Algebra and College-Level Math exams, and the successful branching up to the College-Level Math Exam by 38% of the students, in the post-test, indicates that a majority of the test-takers had significantly strengthened their algebra skills as the result of taking this course.

Appendix C

Advanced Algebra & Trigonometry

Prepared by Shirley Wang

Advanced Algebra & Trigonometry is a course offered by **Berlin High School,** which is equivalent to **NHCTC- Berlin's Algebra & Trigonometry II** - An upper level college Math course.

Advanced Algebra & Trigonometry, is designed to help students to make the transition from intermediate algebra into calculus. Topics cover:
- Solve quadratic equations
- Solve exponential equations
- Solve logarithmic equations
- Graph trigonometric functions
- Solve triangles using the law of Sines and the law of Cosines.
- Apply trigonometric identities

Students are expected to understand quadratic equations, exponential and logarithmic functions, oblique triangles, trigonometric graphs, identities, and equations. This course helps students to acquire a solid foundation in algebra and trigonometry, and to prepare them for other advanced level math courses, such as calculus and finite mathematics. It will also help students to develop problem-solving and critical thinking skills. Overall, it is a course for students who already have solid algebraic skills and are eager to advance their skills to the next level of Mathematics.

Detailed Test Results have been analyzed based on Accuplacer-Elementary Algebra Scores (see Table D.1-2), and a similar analysis based on Accuplacer-College Level Math Scores, can be found at Table D. 3-4.

Table D.1 Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of Test-takers
# of Test-takers placed into - (Pre-test)	0	5	6	0	11
# of Test-takers placed into - (Post-test)	1	9	1	0	11

*Range of Scores was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table D.2 Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	97	64	81	11
Post-test	115	79	97	11

100% of the students Pre-tested above 64. Students scoring at this level have at least minimal elementary algebra skills as stated by Accuplacer.

Table D.2 indicates a 20% increase in average Elementary Algebra Post-test scores.

Table D.3 Student Distribution by College Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of Test-takers placed into (Pre-test)	0	0	0	1	10	11
# of Test-takers placed into (Post-test)	0	0	0	4	7	11

Range of Scores was based on the ACCUPLACER system College Level Math Proficiency Statements

Table D.4 Statistical Analysis Based on College Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into College Level Math	Total # of Test-takers
Pre-test	30	0	13	5	11
Post-test	53	0	35	10	11

After taking this course, 90% of students branched into College Level Math.

Table D.4 indicates a 170% average increase in the Post-test scores on the College Level Math exam.

 Points of interest:
- Overall, this course covered all the necessary material in Advanced Algebra & Trigonometry. By taking this course, students made significant improvements in their math competencies. The increase in average grades in Elementary Algebra and College Level Math, and the successful branching up to the College Level Math Exam of 90% of the students, validates the strong algebra skills of the test-takers.
- Enrollment in Advanced Algebra & Trigonometry, has prepared students to access higher-level mathematics courses beyond Intermediate Algebra.

Pre-Calculus

Prepared by Shirley Wang

Pre-Calculus is a course offered by **Berlin High School,** which is equivalent to **NHCTC- Berlin's Algebra & Trigonometry II** - An upper level college Math course.

Pre-Calculus, is designed to help students to make the transition from intermediate algebra into calculus. Topics cover:
* Solve quadratic equations
* Solve exponential equations
* Solve logarithmic equations
* Graph trigonometric functions
* Solve triangles using the law of Sines and the law of Cosines.
* Apply trigonometric identities

Students are expected to understand quadratic equations, exponential and logarithmic functions, oblique triangles, trigonometric graphs, identities, and equations. By taking this course, students will acquire a solid foundation in algebra and trigonometry, preparing themselves for other advanced level math courses such as calculus and finite mathematics. It will help student to develop problem-solving and critical thinking skills. Overall, it is a course for students who already have solid algebraic skills and are eager to advance their mathematics skills to the next level.

Detailed Test Results have been analyzed based on Accuplacer-Elementary Algebra Scores (see Table C.1-2), and a similar analysis based on Accuplacer-College Level Math Scores, can be found at Table C. 3-4.

Table C.1   Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of Test-takers
# of Test-takers placed into (Pre-test)	6	12	0	0	18
# of Test-takers placed into (Post-test)	14	4	0	0	18

*Range of Scores was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table C.2 Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	119	89	104	18
Post-test	119	91	111	18

On both the Pre and Post-Tests, 100% of the students tested above 81. Students at this level have sufficient elementary algebra skills as stated by Accuplacer.
Table C.2 indicates a 7% increase in average Elementary Algebra Post-test scores.

Table C.3   Student Distribution by College Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of Test-takers placed into (Pre-test)	1	1	5	10	1	18
# of Test-takers placed into (Post-test)	2	1	10	4	1	18

Range of Scores was based on the ACCUPLACER system College Level Math Proficiency Statements

Table C.4 Statistical Analysis Based on College Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into College Level Math	Total # of Test-takers
Pre-test	109	0	59	17	18
Post-test	110	18	74	18	18

100% of the students branched into the College-Level Math Exam after taking this course. Table C.4 indicates a 25% of increase in average College Level Math test scores. These exams show a significant improvement in student algebraic skills after finishing this course.

Points of interest:
- Generally speaking, this course covered the required information in Pre-Calculus. By taking this course, students made significant improvements in their math competencies. The increase in average grades on Elementary Algebra and College Level Math and the successful branching up to the College Level Math Exam of 100% the students, indicates that nearly all of the test-takers had substantial algebra skills and are ready for next level of study.
- Pre-Calculus has provided students a better opportunity to access higher- level mathematics courses beyond Intermediate algebra.

Appendix E

Calculus AB

Prepared by Shirley Wang

Calculus AB is a course offered by **Berlin High School** which is equivalent to **NHCTC-Berlin's Calculus I** - An advanced college level Math course.

Calculus AB, is designed to help students to advance their math competencies in calculus. Topics cover:
- Methods of problem solving
- Concept of limit
- Applying differentiation to problems involving velocity, acceleration and rates of change, science and economics
- Learn new and more effective methods of graphing functions
- Understanding the concepts of integral
- Applying exponential and logarithmic functions

Students are expected to understand and explore: functions, limits, differentiation and its applications, and integration. Application of the techniques discussed will be employed in curve sketching and problems in the physical sciences, as well as other areas. By taking this course, students will develop their problem-solving and critical thinking skills. Overall, it is a course for students who already have solid algebraic skills and are eager to advance their mathematics skills from intermediate algebra to calculus.

Detailed statistical analyses, based on Accuplacer-Elementary Algebra Scores, can be found at Table D.1-2, and a similar analysis based on Accuplacer-College Level Math Scores, can be found at Table D. 3-4.

Table D.1   Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of Test-takers
# of Test-takers placed into (Pre-test)	20	5	0	0	25
# of Test-takers placed into (Post-test)	17	8	0	0	25

*Range of Score was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table D.2 Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	119	89	111	25
Post-test	119	86	111	25

On Pre and Post-exams, 100% of the students scored above 85. Students at this level already had sufficient elementary algebra skills as stated by Accuplacer.

Table D.3 Student Distribution by College Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of Test-takers placed into (Pre-test)	3	1	13	5	3	25
# of Test-takers placed into (Post-test)	6	5	12	2	0	25

* Range of Score was based on the ACCUPLACER system College Level Math Proficiency Statements

Table D.4 Statistical Analysis Based on College Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into College Level Math	Total # of Test-takers
Pre-test	119	0	67	23	25
Post-test	119	46	84	25	25

After taking this course, 100% of the students branched into College Level Math. Table D.4 indicates a 25% increase in average test scores. By taking this course, students show a significant improvement in their algebra and calculus skills.

Points of interest:
- In General, this course covered sufficient information in calculus. By taking this course, students made significant improvement in their math competencies. The increase of average grades on College Level Math and having 100% of the students branching into College-Level Math, indicates a high percentage of test-takers learned substantial algebra skills by taking this course.

- The nature of this course demands that it focus on College-Level Math, and the students who take this course are defined as strongly college bound. This combination of factors helps to explain the significant improvement in their College-Level Math scores.
- Calculus AB has provided students with a good opportunity to access higher-level mathematics beyond Intermediate Algebra.

AP Calculus

Prepared by Shirley Wang

AP Calculus is a course offered by **Salem High School,** which is equivalent to **NHCTC-Manchester Calculus I** – An advanced college level Math course.

AP Calculus**, is designed to help students to advance their math competencies on calculus. Topics cover:**
- Graph functions
- Limits and continuity
- Derivatives and anti-derivatives, and their applications
- Define integrals and their applications
- Solve related rates problems
- Compute relative and absolute extreme and sketch curves
- Find areas and volumes using calculus
- Apply L'Hospital's rule properly

Students are expected to understand and explore: functions; limits; continuity; derivatives; rules for differentiating algebraic, trigonometric, exponential and logarithmic functions; chain rule; implicit differentiation; related rate problems; max-min problems; curve sketching; integrals, areas and volumes. By taking this course, students are able to develop problem-solving and critical thinking skills. Overall, it is a course for students who already have solid algebraic skills and are eager to advance their mathematics skills from intermediate algebra to the calculus I, as they prepare themselves as college-bound students.

Detailed statistical analyses, based on Accuplacer-Elementary Algebra Scores, can be found at Tables B.1-2, and a similar analysis based on Accuplacer-College Level Math Scores, can be found at Tables B. 3-4.

Table B.1   Student Distribution by Elementary Algebra Score Range

Score Range *	109 above	82 ~ 108	44 ~ 81	28~ 43	Total # of Test-takers
# of Test-takers placed into (Pre-test)	30	32	1	0	63
# of Test-takers placed into (Post-test)	48	15	0	0	63

*Range of Scores was based on the ACCUPLACER system Elementary Algebra Proficiency Statements

Table B.2   Statistical Analysis Based on Elementary Algebra Scores

	Highest Score	Lowest Score	Average Score	Total # of Test-takers
Pre-test	119	78	108	63
Post-test	119	84	112	63

On the Post-Exam, 100% of students scored above 81. Students at this level have sufficient elementary algebra skills, as stated by Accuplacer. Table B.2 also confirms a 6% increase in average Elementary Algebra scores.

Table B.3   Student Distribution by College Level Math Score Range

Score Range *	103 above	86 ~ 102	63 ~ 85	40~ 62	39 less	Total # of test-takers
# of Test-takers placed into (Pre-test)	1	2	28	25	7	63
# of Test-takers placed into (Post-test)	6	13	29	14	1	63

* Range of Scores was based on the ACCUPLACER system College Level Math Proficiency Statements

Table B.4 Statistical Analysis Based on College Level Math Scores

	Highest Score	Lowest Score	Average Score	# of Test-takers Branching into College Level Math	Total # of Test-takers
Pre-test	118	0	61	60	63
Post-test	114	40	75	63	63

After taking this course, 100% of the students branched into College Level Math. Table B.4 reflects a 23% increase in average test scores. The post-testing shows a significant improvement in acquired student college-level math skills.

 Points of interest:
- Overall, this course sufficiently covered the required topics in calculus. By taking this course, students made a significant improvement in their math competencies. The increase in the average final scores in Elementary Algebra and College-Level Math, along with the branching of a 100% of the students into College-Level Math, indicates that a significant majority of test-takers had substantial algebra skills.
- AP Calculus has provided these students with an excellent opportunity to access higher level mathematics course content beyond Intermediate algebra.

NHCTC-MaTHSC Grant – Task VI

Raising Math Aspirations at Career Technical Education Centers

Prepared by: Bob Condon

Overview of the Study

Three pilot NH Career Technical Education Centers were recruited to participate in a series of activities designed to measure math preparedness, provide enhanced senior year course selection advising, and determine the impact of enrollment in a math course, in the senior year, on performance using a standardized test.

The three pilot Centers were:
- Cheshire Career Center – Keene ~ Director, Jim Logan
- Region 9 Vocational Technical Center – Wolfeboro ~ Director, Steve Guyer
- Region 14 Applied Technology Center – Peterborough ~ Director, Chet Bowles

Key elements of the study were:
- A representative sample of juniors and seniors were tested using the Accuplacer math exams in the spring of 2006;
- Students began by taking the Accuplacer Arithmetic exam – Those students scoring $\geq$ 85 (71%), then branched to the Elementary Algebra exam;
- Senior scores were utilized as an overall, pre-test, baseline, and those students received a test report and an interpretation of the meaning of those scores, from Center personnel;
- Spring 2006, junior scores, became the basis for an advising effort to encourage test-takers, showing weakness in math skills, especially those scoring below 85 on the Arithmetic exam, to enroll in a math course in the senior year – Additionally, the junior year scores provided the basis for comparison with their post-test results in the spring of 2007; and
- The study was particularly interested in examining the difference in performance levels of juniors who enrolled in a math course in the senior year, versus those who did not.

Unanticipated Study Issues

Several circumstances have impacted on the study design, and outcomes, that were not anticipated at the time of its development:

- Center personnel suggested that, in some instances, those students with the greatest skill deficiencies were most resistant to the recommendation that they engage in additional math instruction;
- The spring 2006 testing provided only a limited amount of time for the advising process with juniors;

- Complicating the advising effort for students with skill deficiencies were, in some instances:
  - The lack of availability of "refresher" or "remedial" courses for upperclassmen
  - The lack of available seats in appropriate courses due to the lateness of the spring 2006 testing process, in relation to the registration cycle for course selections for the 2006-07 academic year
- The difficulty in generating spring 2007 test results early enough for analysis and inclusion with the printing of the NHCTC-MaTHSC Grant Report, also, in the spring of 2007.
- Should this study be repeated, consultation with the participating Center Directors would be necessary to develop a timeline that would better accommodate both the school schedules and the necessary testing and advising.

Findings to Date

The table below provides the summary data for the spring 2006 CTE Accuplacer testing of both juniors and seniors. The table reflects the results for both classes based on performance against the branching score of $\geq$ 85 on the Arithmetic exam, and an NHCTC system wide, hypothetical, math placement test, cut-score of $\geq$ 62 on the Elementary Algebra exam.

The 2004-06 NHCTC System performance on achieving the $\geq$ 62 Elementary Algebra cut-score is 26%. The CTE overall average for spring 2006 is 27%.

Spring 2006 CTE Accuplacer Testing Results

Total Juniors Tested:	**212**
Juniors Scoring $\geq$ 85 on Accupl. Arith.	81 = 38%
Juniors Scoring **$\geq$ 62** on Accupl. El. Alg.	52 = **25%**
Total Seniors Tested:	**187**
Seniors Scoring $\geq$ 85 on Accupl. Arith.	71 = 38%
Seniors Scoring **$\geq$ 62** on Accupl. El. Alg.	55 = **29%**

NOTE: A TASK VI set of appendices will be produced, once all spring 2007 post-test data have been received. For a copy of these appendices, please contact:
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