

Scheduling for Trinity School at Meadow View

User's Manual

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Prepared By: Mary Barthelson Marissa Brienza Zachary Nuzzo

Sponsor: Tim Maloney Chair of Math and Science Trinity School at Meadow View

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1. General Information

This section will introduce the user to the Trinity School Scheduler (TSS) User Interface (UI), the Trinity Scheduling Integer Program (IP), and the Output Interface.

1.1 System Overview

Trinity School at Meadow View currently creates semester schedules by hand which is a time intensive process that can take them days or even weeks to complete The Trinity School Scheduling Tool was created to ease the scheduling process for Trinity. The tool finds feasible schedules for future school semesters given a variety of input parameters and creates a cohesive, clear master schedule. The tool is supported by Windows OS. The tool uses Microsoft Access, Microsoft Excel, and NEOS, a free internet-based service for solving numerical optimization problems.

1.2 Organization of Manual

The User's Manual consists of five sections: Getting Started, The TSS User Interface, The Trinity Integer Program, The Output Interface, and Trouble Shooting.

Getting Started explains how to set-up and open the Trinity School Scheduling Tool.

The TSS User Interface section gives directions on how to use the UI and describes all of its features.

The Trinity Scheduling Integer Program section gives a high level of the IP used to solve the scheduling problem and how to run the IP using the NEOS sever.

The Output Interface section provides instruction on how to import the solution file and how to get the master schedule output.

The Trouble Shooting section offers advice to avoid infeasibility.

2. Getting Started

The user has been provided a flash drive or CD/DVD with the Trinity School Scheduling Tool and all relevant documentation. The contents of the flash drive or CD/DVD are found in Table 1.

The TSS User Interface	TSS.accdc
The Output Interface	TSS_OutputUI.xlsm
LP Solve Software	Lpsolve.exe
User's Manual	UsersManual.pdf
Trinity Scheduling Final Report	TS_FinalReport.pdf
Trinity Scheduling Final Presentation	TS_FinalPres.pdf

Table 1: Flash Drive or CD/DVD Contents

Extract all contents of the flash drive or CD/DVD and save it all in a single folder. Read through the entirety of the User's Manual before attempting to use the Trinity Scheduling Tool. Read through the Final Report to understand the motivation behind the tool and the reasoning for the selected solution method.

3. The TSS User Interface

The TSS User Interface will be the first step in creating a master semester schedule. Begin by gathering all required data:

- Teacher names
- Teacher assignments for all sections
- Teacher availability for the 6 periods
- Teacher full/part-time status
- Section sizes for current student body
- Classroom names
- Classroom capacity
- Classroom content
- Classroom availability

Now, open the TSS User Interface in Microsoft Access (make sure to enable content). This is the homepage:

Trinity School Scheduler	-	×
<image/>		

Complete the following steps to ensure all data is entered:

- 1. Select the semester that needs to be scheduled by using the drop-down menu next to Semester.
- 2. Enter Section Information by clicking the respective button and entering data into the table. Click Save. Click Back to return to the Homepage.

	frm_Section	_Size	-	×
Grade	Boys	Girls		
7	11	11		
8	19	5		
9	15	9		
10	11	8		
11	16	12		
12	15	13		
	Back	Sal	10	
	Back	J		

- 3. Enter Teacher Information by clicking the respective button and entering data into tables.
 - a. Create a row for every teacher.

	frm_Tead	- 0 -		
Add a teacher for t	he semester/year			
Name				
Atkinson, Charles	Edit Schedule	Edit Sections		
Coady, Kathleen	Edit Schedule	Edit Sections		
Crimmins, Margaret	Edit Schedule	Edit Sections		
Dusenbury, Timothy	Edit Schedule	Edit Sections		
Fagerstrom, Fred	Edit Schedule	Edit Sections		
Flannery, Alice	Edit Schedule	Edit Sections		
Gianoli, Gina	Edit Schedule	Edit Sections		
Goodwin, Timothy	Edit Schedule	Edit Sections		
Jones, Kara	Edit Schedule	Edit Sections		
Krueger, James	Edit Schedule	Edit Sections		
Lin, Marion	Edit Schedule	Edit Sections		
Lombardo, Stephen	Edit Schedule	Edit Sections		
Lovdahl, Randy	Edit Schedule	Edit Sections		
Maloney, Timothy	Edit Schedule	Edit Sections		
Miller, Laura	Edit Schedule	Edit Sections		
Niklason, Scott	Edit Schedule	Edit Sections		
Quay, Grayson	Edit Schedule	Edit Sections		
Ridenour, Rick	Edit Schedule	Edit Sections		
Ryland, Rebecca	Edit Schedule	Edit Sections		
Sibben, Christopher	Edit Schedule	Edit Sections		
Sibben, Christopher Close	Edit Schedule New Teache	Edit Sect	tions	tions

b. For every teacher, enter his/her availability and choose his/her full/part-time status by clicking Edit Schedule. Click Done to save and return to the Teacher Information homepage.



c. For every teacher, choose his/her class assignments by clicking Edit Sections. Click Save. Click Done to return to the Teacher Information homepage.



- d. At a maximum four classes should be assigned to full-time teachers and a maximum of two classes should be assigned to part-time teachers. **Every class should only be assigned to one teacher.**
- e. Click Close to save and return to the Homepage.



4. To edit the room constraints, click on the Enter Room Constraints button and directly edit the capacity of each room.

-8	frm	n_Edit_Room_Content		-	×
Room:	West 1	Content Available:	10B Chemistry 10B Humane Letters 1 10B Humane Letters 2 10B Music III 1 10B Music III 2		
	Save	Close			

- a. Click on the Edit Content button for a room to edit the content available in the selected room. If a room can hold all types of classes, select all classes in the list.
- 5. All data has been entered. The data will be saved for later use. Remember, separate installations do not speak to each other.
- 6. Keep the TSS UI open and proceed to The Trinity Scheduling Integer Program section.

4. The Trinity Scheduling Integer Program

Once the user has entered all required data, the IP is ready to be created. On the TSS UI Homepage, in the schedule section, use the drop-down menu to select which IP you would like to run. There are two options:

- 1. Random: This will create a randomized objective function, and could result in different schedules being produced each time it is used.
- 2. Distance: This will set the objective function to maximize distance students travel between classes to encourage exercise and to stimulate the mind for the next class.

Please select one, and proceed:

- 1. On the TSS UI homepage, press Solve! to create a .LP file containing the IP formulation with the user-entered data.
- 2. This will create a file called "TSS.lp" in the same folder as the TSS UI. Open this file using LPSolve
- 3. Click the Save As button and save the file as a .MPS file. You can rename the file at this time, but we suggest keeping it named "TSS.mps" and overwriting any previous versions.
- 4. Save this file to the folder with the Trinity School Scheduling Tool.
- 5. Navigate to: <u>https://neos-server.org/neos/solvers/lp:Gurobi/MPS.html</u>
- 6. Upload the .MPS file you just saved:

NEOS 🗩 Contact 😡 Help	> Sign In 🖉 Sign Up
$\begin{array}{c} \textbf{Destrong}\\ \textbf{Destrong}$	NEOS Interfaces to Gurobi WWW Form & Sample Submissions Email XML-RPC - Disabled
Gurobi	
The NEOS Server offers the Gurobi Optimizer for the solution of linear programming (LP) problems that can be modeled in MPS format. The Guro solvers in the Gurobi Optimizer were designed from the ground up to exploit modern architectures and multi-core processors. For more information	bi Optimizer is a state-of-the-art solver for mathematical programming. The n on Gurobi products and services, see the Gurobi website.
Using the NEOS Server with MPS/Gurobi	
To solve an LP problem using MPS as input, you need only submit the MPS file. The MPS file may be submitted in gzipped or zipped format, and The LP problem must be specified by an MPS file with the option of a parameter file. The parameter file should consist of lines of the format Keyword Value where Keyword is one of the Gurobi parameter keywords and Value is the value of the parameter.	NEOS will automatically uncompress it.
Enter the path to the MPS file MPS file: Choose File No file chosen	

7. Now, check the "Return .sol file:" box to include the solution file as part of the results.

NEOS 🐠 Contact 🛛 Help	> Sign In	🖋 Sign Up
Control of the solution of linear programming (LP) problems that can be modeled in MPS format. The Gurob Optimizer is a state-of-the-art to be poly informat and multi-core processors. For more information on Gurob products and services, see the Gurob version.	solver for mathematical programming. Th	NEOS Interfaces to Gurobi WWW Form & Sample Submissions Email XML-RPC - Disabled we solvers in the Gurobi Optimizer were designed from the ground up
Using the NEOS Server with MPS/Gurobi		
To oble on LP problem using LHS as input, you need only adomt the LHSS IIE. The LHSS IIE may be submitted in garged or along domait, and NEOS will automatically uncompri- The LP problem must be specified by an NHSS IIE with the option of a parameter file. The parameter file should coreat of lines of the format keyword. Value where Keyword is one of the Carolob parameter keywords and Value is the value of the parameter.	ess it.	
Enter the path to the MPS file MPS file: Choose File TSS mps		
Enter the path to the parameter file Parameter file: Choose File No file chosen		
Check the box to include the solution file as part of the results. Return .sol file:		

8. Scroll down and enter a valid email address where the solution file and results can be sent.

Dry run: generate job XML instead of submitting it to NEOS	
Short Priority: submit to higher priority queue with maximum CPU time of 5 minutes	e-mail address
	name@domain.com
	By submitting a job, you have accepted the Terms of Use
	Submit to NEOS Clear this Form
	Please do not click the 'Submit to NEOS' button more than once.
c	ts and Questions · Terms of Use

- 9. Click "Submit to NEOS". After the IP is done running, the solution file will be sent to email address provided. This could take a few seconds to a couple hours depending on how constrained the problem is.
- - a. If the results say infeasible or show an error, please go to the Trouble Shooting section of this User's Manual.

neos@neos-server.org
a to me 🖃
/opt/aurobi/latest/linux64/lib:/opt/aurobi/latest/linux64/lib:/opt/rh/python27/root/usr/lib64
Load Avg. (3.8, 2.97, 2.46)
Changed value of parameter Threads to 1
Prev: 0 Min: 0 Max: 1024 Default: 0
Optimize a model with 438 rows, 6105 columns and 54030 nonzeros
Coefficient statistics:
Matrix range [1e+00, 1e+00]
Objective range [1e+00, 1e+00]
Bounds range [1e+00, 1e+00]
RHS range [1e+00, 7e+01]
Presolve removed 61 rows and 0 columns
Presolve time: 0.09s
Presolved: 377 rows, 6105 columns, 38805 nonzeros
Variable types: 0 continuous, 6105 integer (6105 binary)
Root relaxation: objective 0.000000e+00, 571 iterations, 0.07 seconds
Nodes Current Node Depetive Bounds Work
Explorexpl Obj Deput Intil I incumbent Bestad Gap I biologe Time
* 0 0 0 0.000000 0.0000 - 0s
Explored 0 nodes (1032 simplex iterations) in 0.29 seconds
Thread count was 1 (of 24 available processors)
Optimal colution found (tolorance 1,000,04)
Detained Solution found (Glerance 1.00e-04) Best objective 0.00000000000000000000000000000000000
Ontimal objective: 0.0

Solution for model LESolver
Objective value = 0
x1.1.1 0
x1.1.2 0
x1.1.3 0
x1.1.4 0
x1.1.5 0
x1.1.6 0
x1.2.1 0
x1.2.2 0
x1.2.3 0

11. Paste the results in to a .txt file using Notepad. Save this file as IP_Output.txt.

12. The IP has successfully solved, proceed to The Output Interface section.

5. The Output Interface

These are the final steps of the Trinity Scheduling Tool. Begin by opening the, TSS_OutputUI.xlsm and Enable Editing and Enable Content. This is the Homepage:

SCHOOL · MEADOW		Create New Schedule	
	STEP 1	Clear Schedule	Update All Tables
	STEP 2	Update File Path	Edit Teacher List
FRUM FULS CHURCH, VIEWING CHUN	STEP 3	Create Master Schedule	Edit Classroom List
	STEP 4	Go to Master Schedule	Edit Section List

5.1 Create a New Schedule

- 1. The Output Interface requires a few set-up steps upon first use, use on a new computer, or if the corresponding files have been moved to a new location on your computer. Set-up steps can be found in the "Output Interface Set-up" section below. Otherwise, proceed to step 2 to begin creating a schedule.
- 2. If changes have been made to inputs in the Access database update the section, teacher, and classroom lists in excel by clicking Update All Tables.
 - a. To review lists individually click the corresponding Edit button. Update the list automatically by clicking the update button. If no changes are needed, return to the homepage by clicking Go to User Overview.
 - b. If you get a path not found error, go to "Output Interface Set-up" below.
- 3. Next, click Clear Schedule to ensure there is a blank slate to work with.
- 4. Click Update File Path and upload the IP_Output.txt file created in the last section.
- 5. Click Create Master Schedule. It may take a few minutes to complete.
- 6. Once the Create Master Schedule macros finish executing, click Go To Master Schedule to view the semester schedule that was created. A few additional options will become available on the right of the Master Schedule (see below image for options).
 - a. The user has the option to export the schedule into another Excel workbook by clicking the Output to New Excel WB button.
 - i. This is where you can schedule alternating classes, Transfer Latin, and make any final changes to the master schedule.
 - b. The user has the option to create a teacher schedule with the Create Teacher Schedule button, which will appear on a new tab.
 - c. The basic master schedule can be output to a PDF using the Output PDF button.

	н	I	J	к	L	м	N	O P Q R S T U V W
Trin Sp	ty School at Meador ring 2017 Semester Sch	w View nedule						
			High	School				
9t	n Grade	10th Gra	de	11th Gra	de	12th	Grade	Go to User Overview
Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
								Output to PDF Output to New Excel WE
								Create Teacher Schedule Clear Schedule
								Delete Teacher Schedule
								-
								-
								-
								-
								-
								1

7. The Trinity Scheduling Tool has been used to completion. Proceed to the Section 6 for Trouble Shooting tips.

5.2 Output Interface Set Up

The Output Interface requires a few set-up steps upon first use, use on a new computer, if the corresponding files have been moved to a new location on your computer, or in the event you get an error when clicking any of the Update List buttons. These set up steps do not need to be completed upon every use. The tool needs to know the path to the database in order to pull data from it. The macro responsible for each list will need to be updated. The following steps will guide you:

- 1. To update macros, the developer tab must be available in the toolbar.
 - a. Click Options from the File menu on the toolbar.
 - b. The excel options window will appear. Select Customize Ribbons.
 - c. On the Main Tabs section, select Developer. Click ok.
 - d. Verify the Developer tab is available in toolbar. Refer to online resources for further help if troubleshooting is necessary.
- 2. Navigate to the Developer tab and click the Macros button . The Macro window should appear.
- 3. Next, select createConnectionClassroom and click Edit. The Microsoft Visual Basic Window will open.

Macro	?	×
<u>M</u> acro name:		
createConnectionClassroom	<u>R</u> un	
AddClass AddRoom AddSection	<u>S</u> tep	Into
AddTeacher	<u>E</u> d	lit
CopyToMaster CopyToTeacherSchedule	Crea	ate
createConnectionClassroom	Del	ata
createConnectionSection	Den	ete
CreateTeacherSchedule DeleteClass	<u>O</u> ptio	ons
Macros in: All Open Workbooks		
	Can	icel

4. The highlighted code below ("Data Source = Your Updated Path Here") needs to be updated with the path to the database file on your computer.

(General)	-	createConnectionClass
Sub createConnectionClassroom()		
Dim conn As Object		
Dim strConnection As String		
Dim rs As Recordset		
<pre>Set conn = CreateObject("ADODB.Connection")</pre>		
<pre>strConnection = "Provider=Microsoft.ACE.OLEDB.12.0;" & "Data Source=C:\Users\Mary\Documents\GMU\S</pre>	yst699 \T	SS v02.accdb"
conn.Open strConnection		
<pre>Set rs = conn.Execute("SELECT RoomID, RoomName FROM tbl_Room")</pre>		
Sheets("Classroom").Select		
Range(Range("A2"), Range("B2").End(xlDown)).Select		
ActiveCell.CurrentRegion.Clear		
ActiveSheet.Range("A2").CopyFromRecordset rs		
conn.Close		
Range ("A1").Select		
ActiveCell.FormulaR1C1 = "Room ID"		
Range("B1").Select		
ActiveCell.FormulaR1C1 = "Room Name"		
End Sub		

- a. Open windows explorer.
- b. Navigate to the path where the database file is saved.
- c. Select and copy the path from the address bar (pictured below).

∠ マ Syst699								
File Home Share View								
← → · · ↑ G:\Users\Mary\Documents\GMU\Syst699								
1 Ouish second		Name	Date modified	Туре	Size			
Google Drive	*	Potential Solutions	11/20/2016 4:00 PM	File folder				
Desktop	*	Barthelson Signed Midaco License	11/15/2016 2:24 PM	PDF File Microsoft Excel W	183 KB			
Documents	*	Data	10/23/2016 10:09	Microsoft Excel 97	46 KB			
🖊 Downloads	*	😰 IPRSlides_MaryEdits	10/11/2016 9:24 PM	Microsoft PowerP	307 KB			
Pictures	*	Ipsolve_output	11/13/2016 1:22 PM	Text Document	68 KB			

- d. Paste it into the highlighted section pictured. ("Data Source = Your Updated Path Here\TSS v02.accdb")
- e. This updates the macro to the path of the folder the database is located in. The file name after the highlighted selection should only be changed if the name of the database has been changed.
- f. The macro should be updated. Close the Visual Basic Window.
- g. Navigate to the Classroom tab and select Update List to test that Updates were made successfully.
- h. Repeat steps for createConnectionSection and createConnectionTeachers.
- i. Once lists have been updated you can proceed to create a new schedule.

6. Trouble Shooting

Here are some tips and tricks to avoid errors:

- 1. Make sure every class has only one teacher assignment.
- 2. Make sure sections sizes are correct, it is easy to hit extra numbers.
- 3. Make sure that at a maximum four classes are assigned to full-time teachers and a maximum of two classes are assigned to part-time teachers.
- 4. All teachers should be assigned at least one class.
- 5. If the Master Schedule has unexpected assignments (Mismatching class/teacher), check Access to ensure corresponding input data is correct.
- 6. If the Update Lists button creates an error, the path to the database needs to updated so it knows where to pull from. Review "Output Interface Set Up".

Infeasibility issues will typically be caused by incorrect data or a lack of classroom or teacher availability. Use the tips and tricks above to make sure there are no data issues. If there are none, go back to the TSS UI and edit the data by increasing the availability of teachers and relaxing classroom content restrictions until a feasible solution is produced.