

Submitting Code in the Background Using SAS® Studio

Jennifer Jeffreys-Chen, SAS Institute Inc., Cary, NC

ABSTRACT

As a SAS® programmer, how often does it happen that you would like to submit some code but not wait around for it to finish? SAS® Studio has a way to achieve this and much more! This paper covers how to submit and execute SAS code in the background using SAS Studio. The Background Submit feature in the SAS Studio interface enables you to submit code and continue with your work. You receive a notification when the job is finished, or you can disconnect from your browser session and check the status of the submitted code later. These techniques make it much easier to start long-running jobs and still get your other work done in the meantime.

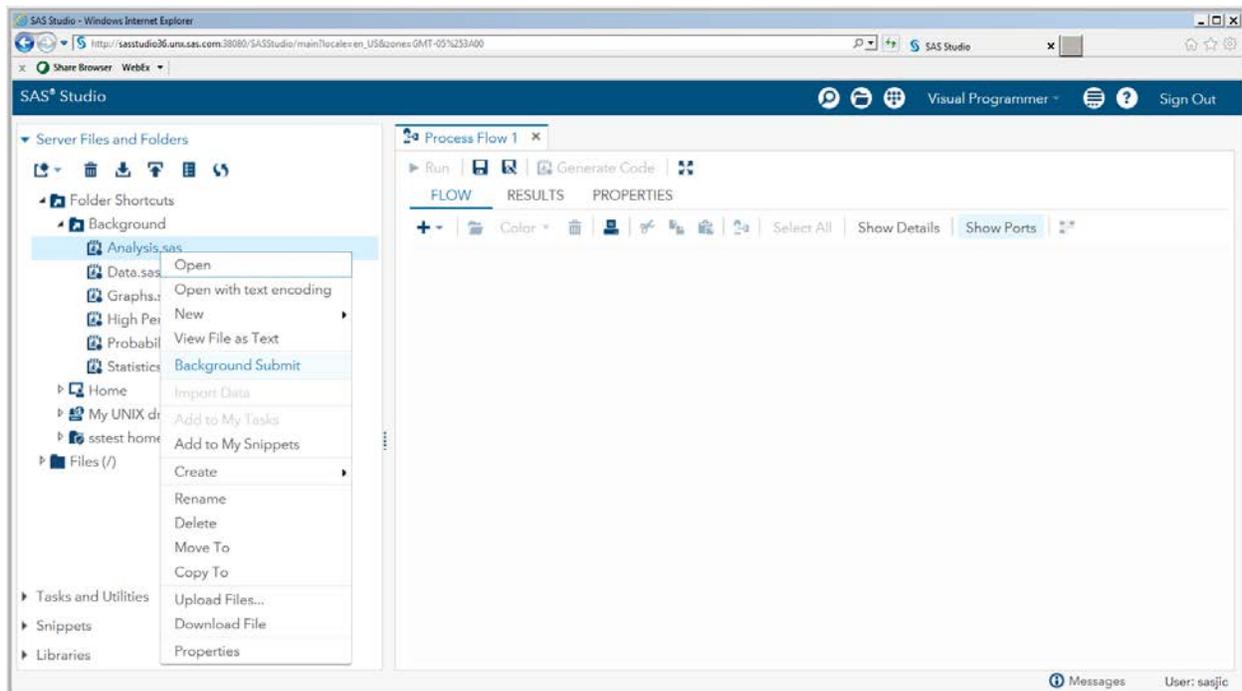
INTRODUCTION

In this paper, you will learn how to submit a background SAS job, check the job status, and easily find the resulting log and output. Administrators will learn about SAS Studio settings for optimum background submission load control. Support for background submission became available in SAS Studio 3.5 and was called Batch Submit. In SAS Studio 3.6, this functionality was renamed to Background Submit and further enhanced. This paper covers the functionality in SAS Studio 3.6.

SAS STUDIO BACKGROUND PROGRAM EXECUTION

SUBMITTING A BACKGROUND SAS JOB

You can run one or more saved SAS programs in the background and continue to use SAS Studio while the background jobs execute. To run a program as a background job, right-click the program in the **Server Files and Folders** section of the navigation pane, and then select **Background Submit** from the pop-up menu.

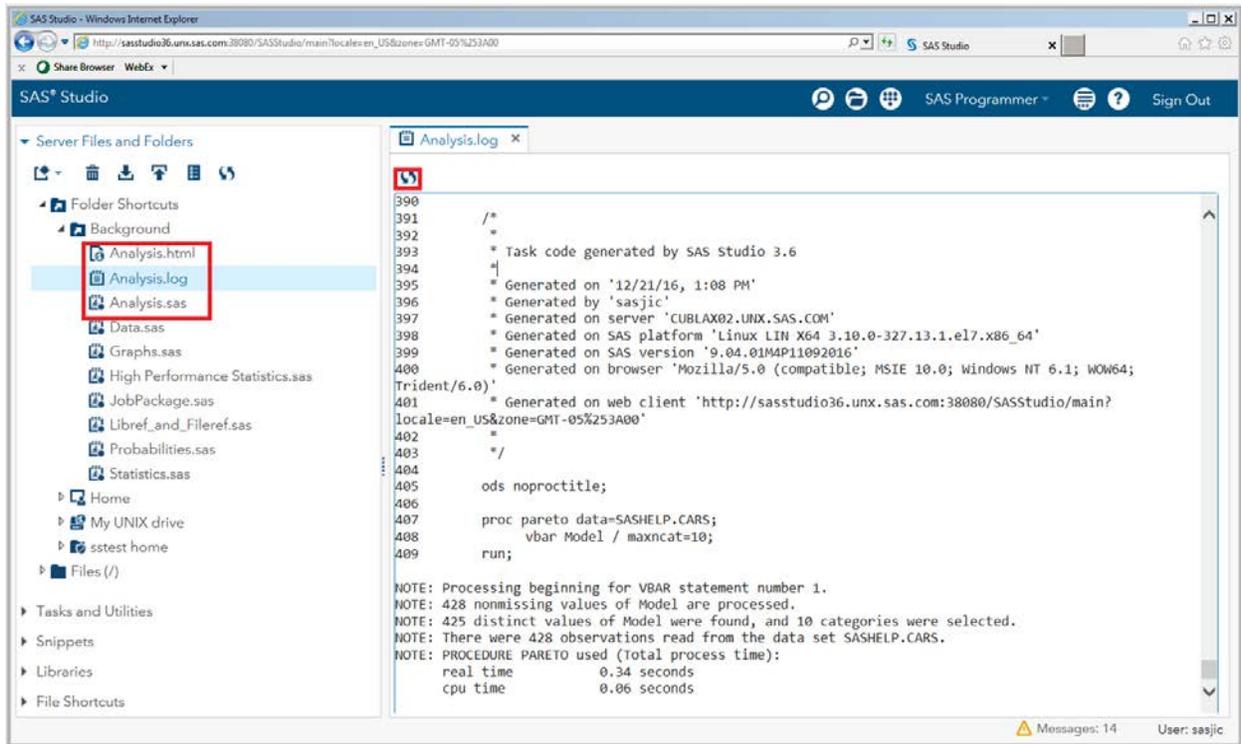


Display 1. Run Background Job from SAS Studio

Currently, you cannot submit unsaved content from a program tab as a background job. Also, a job that is running interactively in your SAS Studio user interface cannot be dynamically transferred to the background. To free up your user interface, you must cancel the job and use the Background Submit option to restart the job in the background.

CHECKING YOUR JOB STATUS

While a background job is running, you can watch its progress by opening its log file. You can access the job's log from the Background Job Status window or through the file tree in the **Server Files and Folders** section in the navigation pane. After the job begins executing, you must click  on the **Server Files and Folders** toolbar to see your new log file. After you open the log file, you can use the Refresh button () in the tab to refresh the log as you wait. The view of the log does not update automatically as the job progresses.



Display 2. Refresh to See Background Log and Output Files in the File Tree

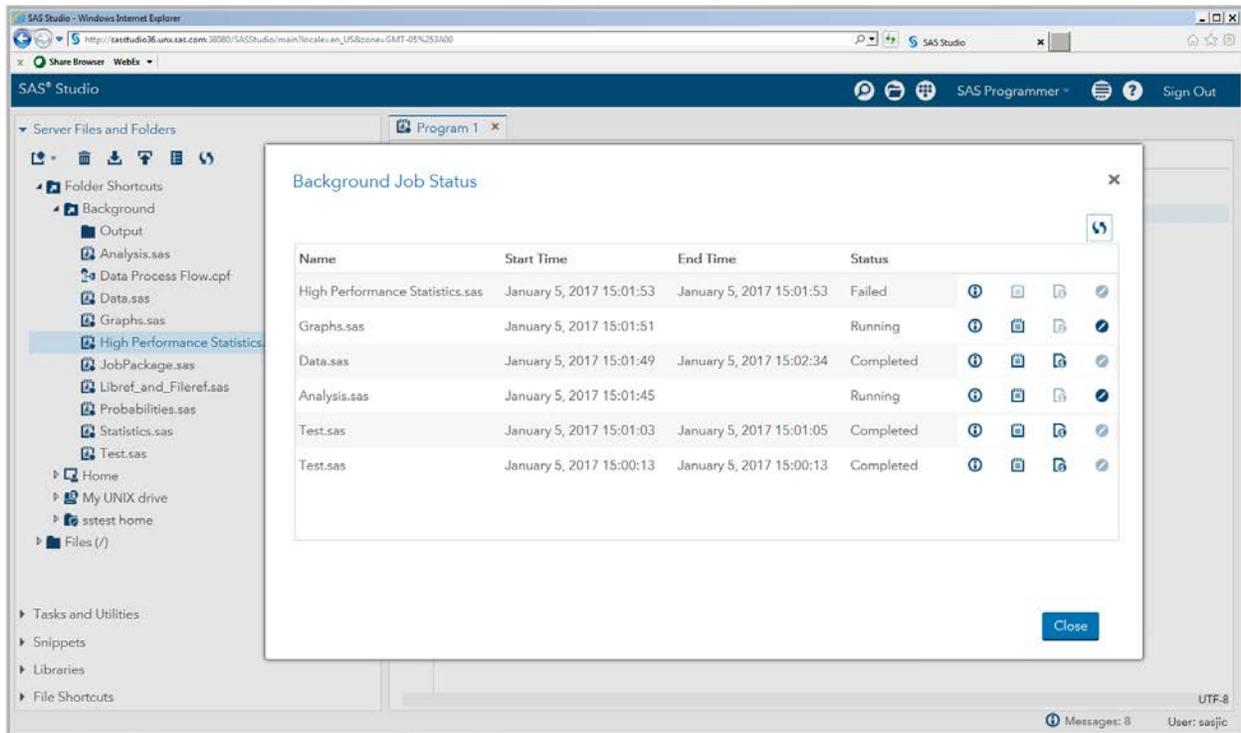
BACKGROUND JOB STATUS

To view the status of your background jobs, click  and select **Background Job Status**.

If the job status is **Completed**, the job executed successfully. This status does not indicate whether the programming statements themselves were successful. As usual, you must view the log to check for warnings and errors in the program itself.

Here are reasons that you might see a **Failed** status:

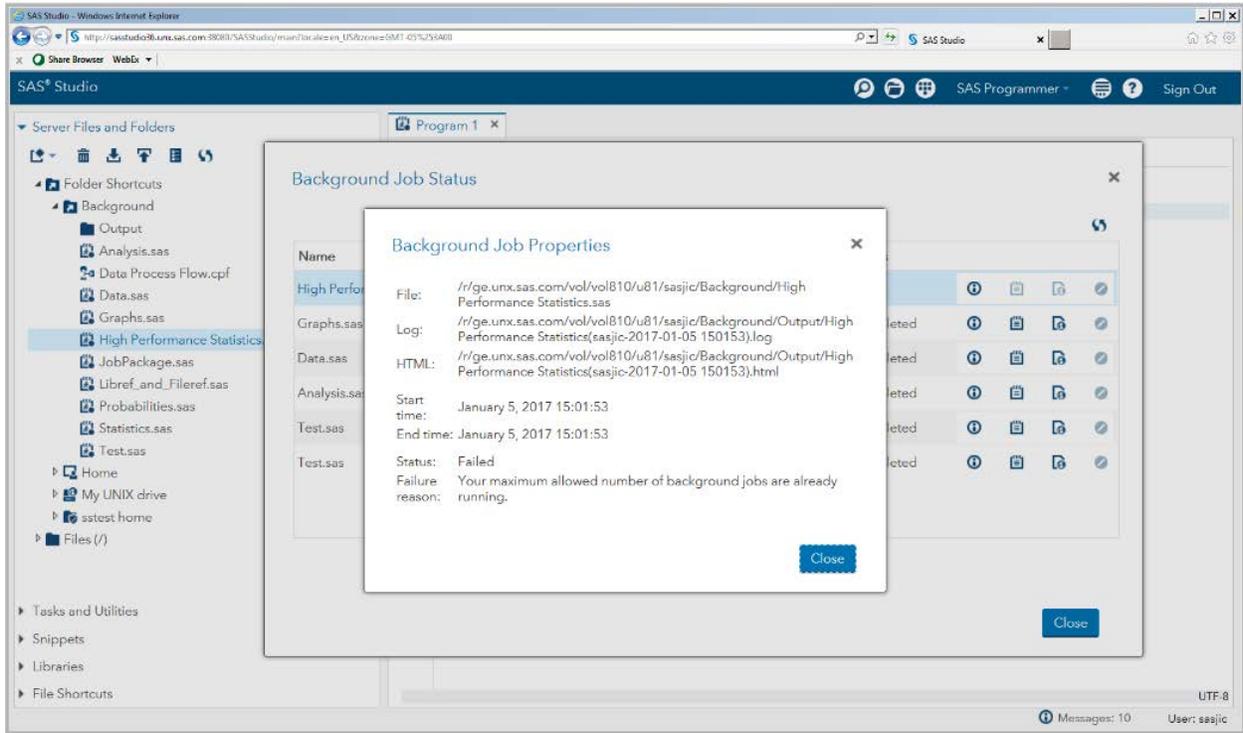
- The **If the background job log or output file already exists** preference is set to **Fail background job submission** and your job would have overwritten an existing log or output file.
- SAS Studio is already running the maximum number of jobs that it is configured to run.
- You are already running the maximum number of background jobs allowed for each user.



Display 3. Background Job Status Window

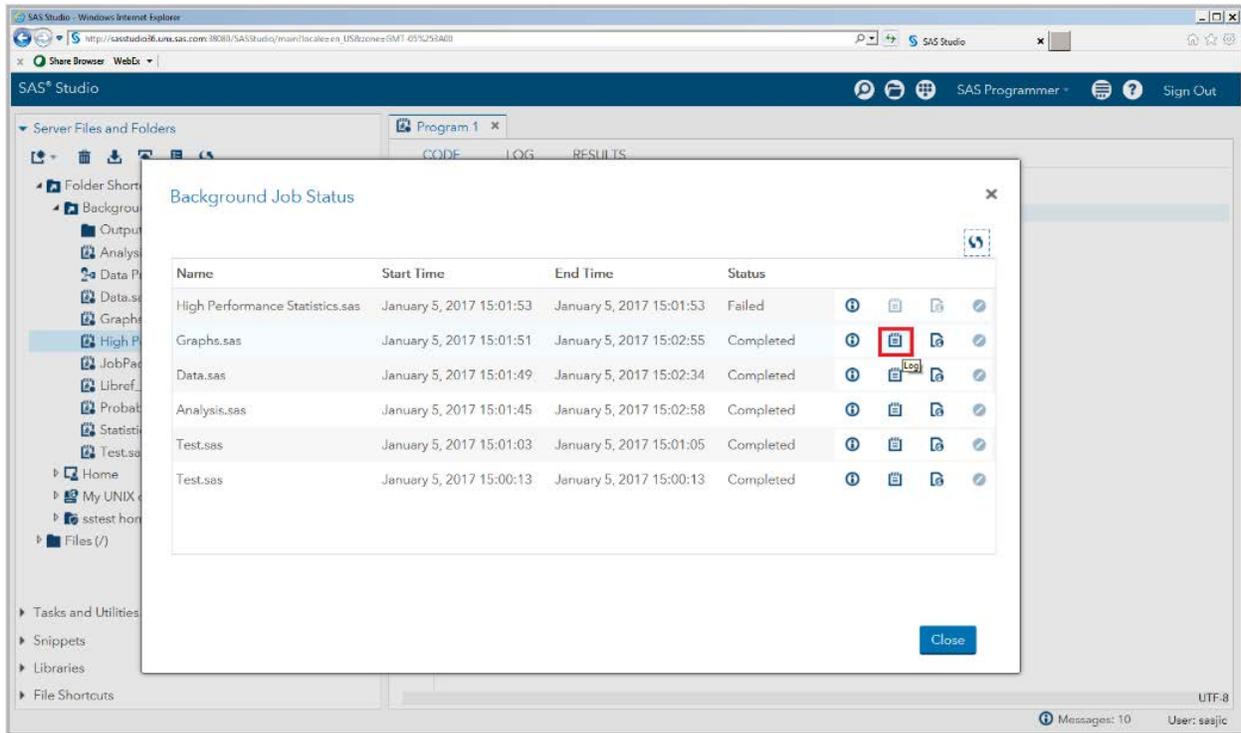
You can use the Background Job Status window to cancel the job, check the job results, and check the job properties. By default, items in the Background Job Status window are removed after 24 hours. Your administrator can customize the retention period for these items.

Click the  icon to see the location of the SAS job, the location of the output and the log files, the start and end times for the job, and the job status. If your job has a status of **Failed**, there are no log or output files, so the  and  icons are not enabled. If your job is running, those icons are enabled. Click these icons to check the job progress.

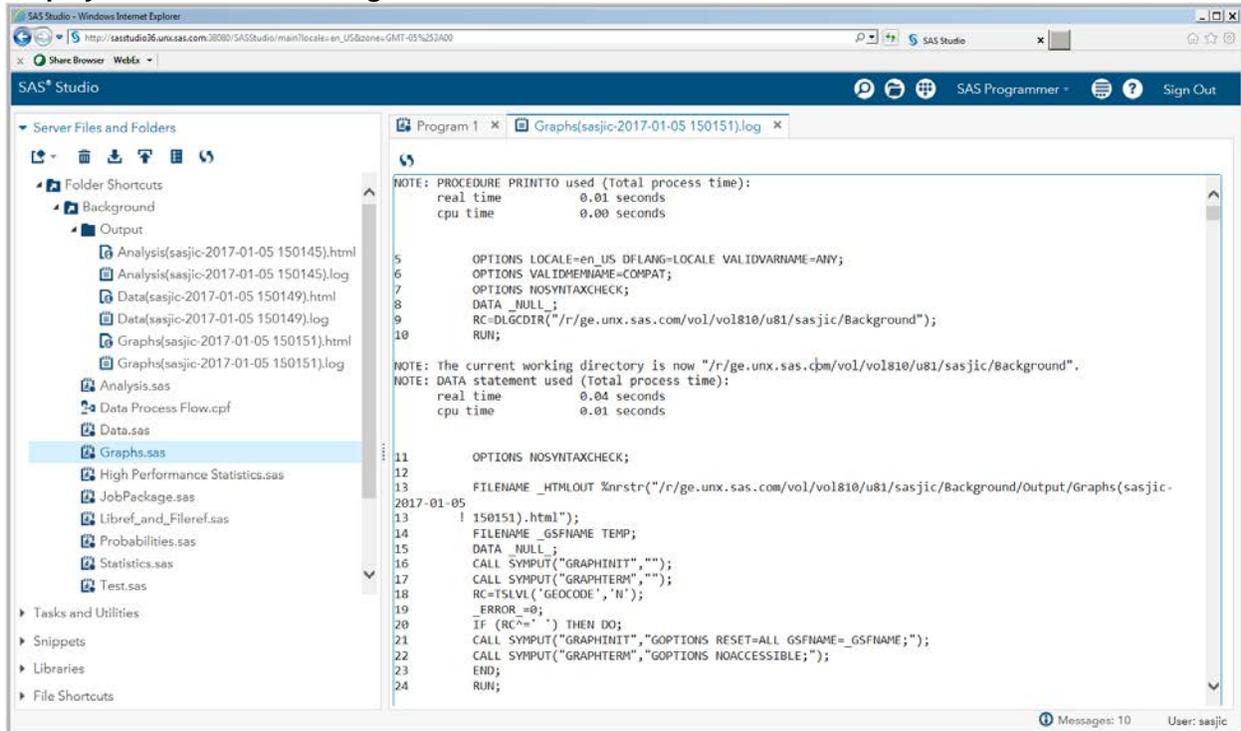


Display 4. Background Job Properties

Click  to open the job's log in a read-only tab.

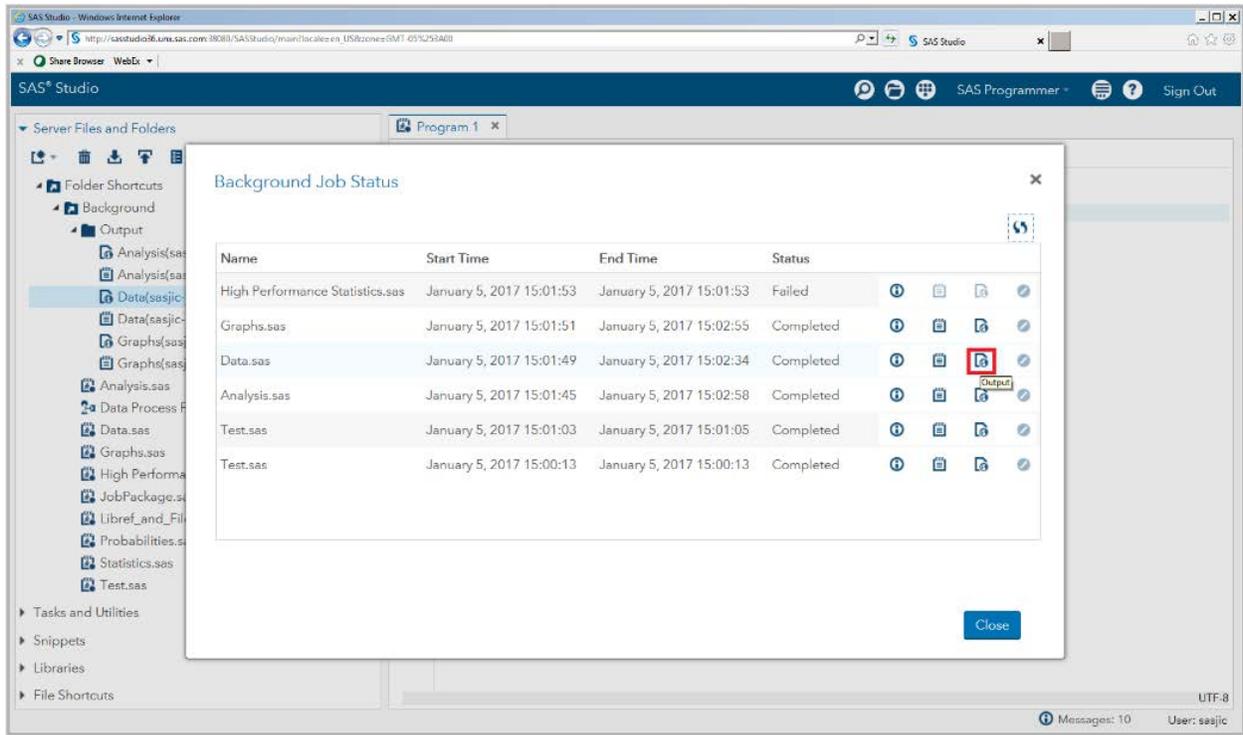


Display 5. Location of the Log Icon for a Job



Display 6. Viewing the Log for a Background Job

Click  to view the job output.



Display 7. Location of the View Output Icon

Depending on your browser, you might be prompted to save your HTML file and then given the choice to **Open**, **Open folder**, or **View downloads**. If you click **Open**, you should see the output from your job in a browser tab.

The screenshot shows a web browser window with a single tab titled 'Results: Data.sas'. The address bar shows the file path 'C:\Users\sajic\Downloads\Data(sajic-2017-01-05 150149) (1).html'. The main content area displays a table with the following data:

<i>Frequencies for Categorical Variables</i>				
Make	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Acura	7	1.64	7	1.64
Audi	19	4.44	26	6.07
BMW	20	4.67	46	10.75
Buick	9	2.10	55	12.85
Cadillac	8	1.87	63	14.72
Chevrolet	27	6.31	90	21.03
Chrysler	15	3.50	105	24.53
Dodge	13	3.04	118	27.57
Ford	23	5.37	141	32.94
GMC	8	1.87	149	34.81
Honda	17	3.97	166	38.79
Hummer	1	0.23	167	39.02
Hyundai	12	2.80	179	41.82
Infiniti	8	1.87	187	43.69
Isuzu	2	0.47	189	44.16
Jaguar	12	2.80	201	46.96
Jeep	3	0.70	204	47.66
Kia	11	2.57	215	50.23
Land Rover	3	0.70	218	50.93
Lexus	11	2.57	229	53.50
Lincoln	9	2.10	238	55.61
MINI	2	0.47	240	56.07
Mazda	11	2.57	251	58.64
Mercedes-Benz	26	6.07	277	64.72
Mercury	9	2.10	286	66.82

Display 8. Viewing the Output

	Display the background job properties, including file pathnames, start time, end time, and status.
	Open the program log in the SAS Studio work area.
	Open the program results in a separate window or download the results file.
	Cancel a running background job. Any output that has been created by the job is not deleted.

Table 1. Summary of Actions in Background Job Status Window

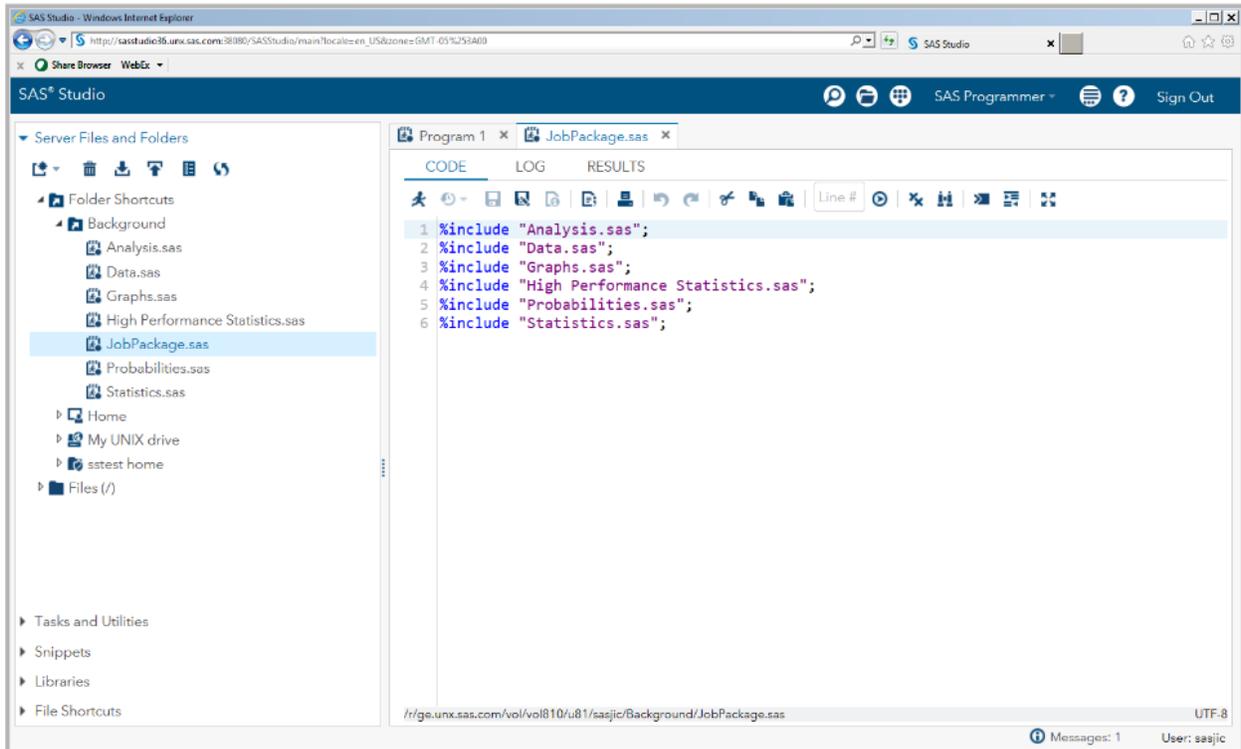
When log and output files are overwritten by a subsequent job, the log and output icons for that job are disabled in the Background Job Status window.

After the background job completes, you must refresh the **Server Files and Folders** section in the navigation pane to view any files that your job created, including the log and output files.

BACKGROUND JOB CONTEXT

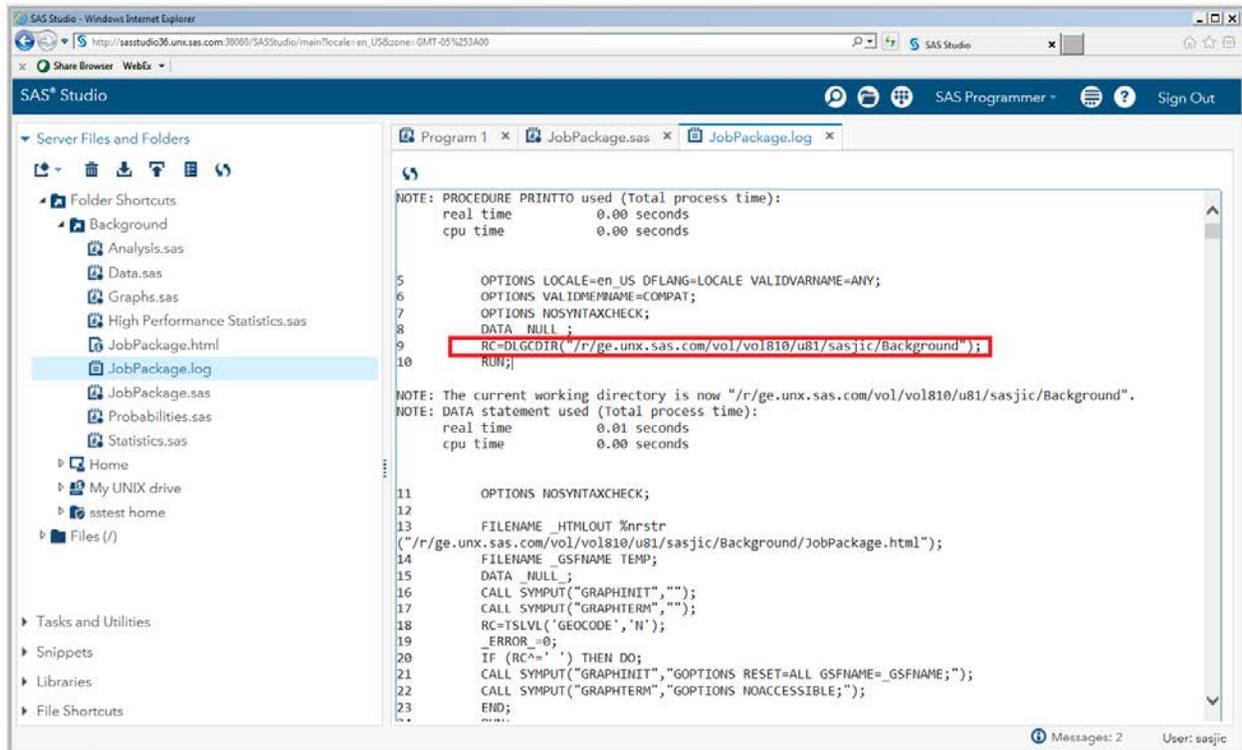
Current Directory

Before the program is run, the background process changes the current working directory to the directory where the program is located. This change enables your background job to access other assets in the same directory without specifying a complete path. In this example, the %INCLUDE statements execute correctly when running the JobPackage.sas file in the background because the all files reside in the same folder.



Display 11. Program Using %INCLUDE Statements without Full Path

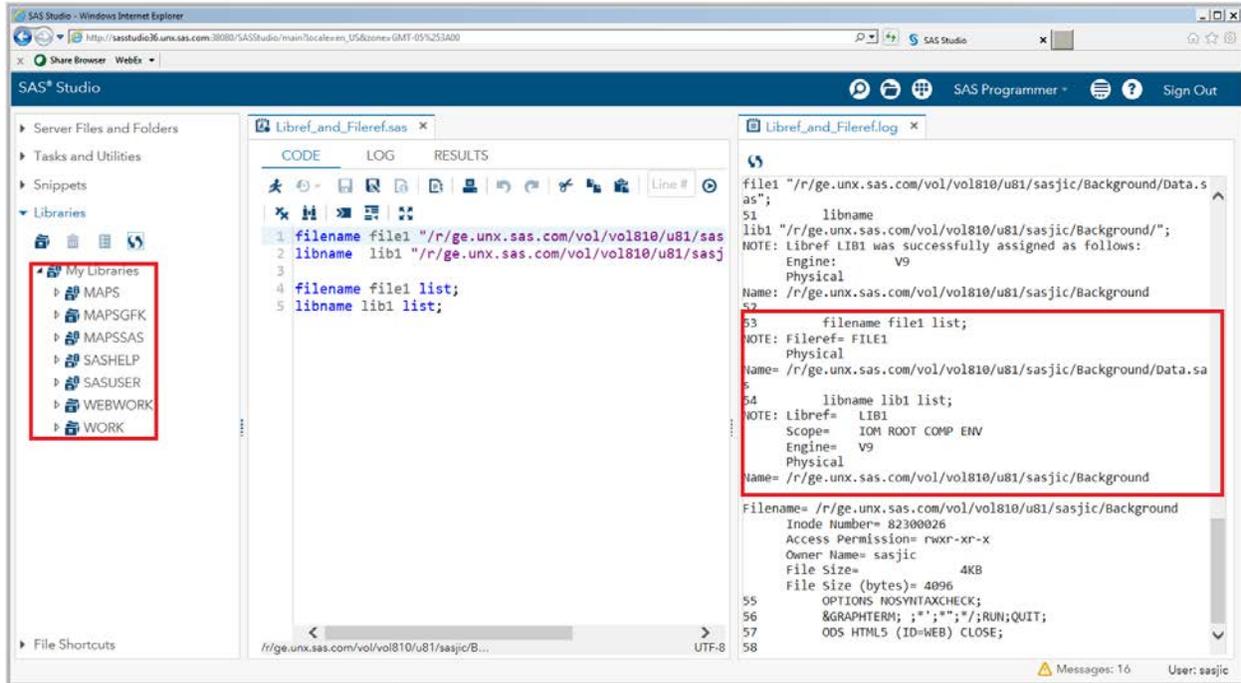
To see the code that SAS Studio adds to your program to set the working directory, select the **Show generated code in SAS log** option on the **General** tab of the Preferences window.



Display 12. Background Jobs Run from Current Directory

Separate Workspace Server

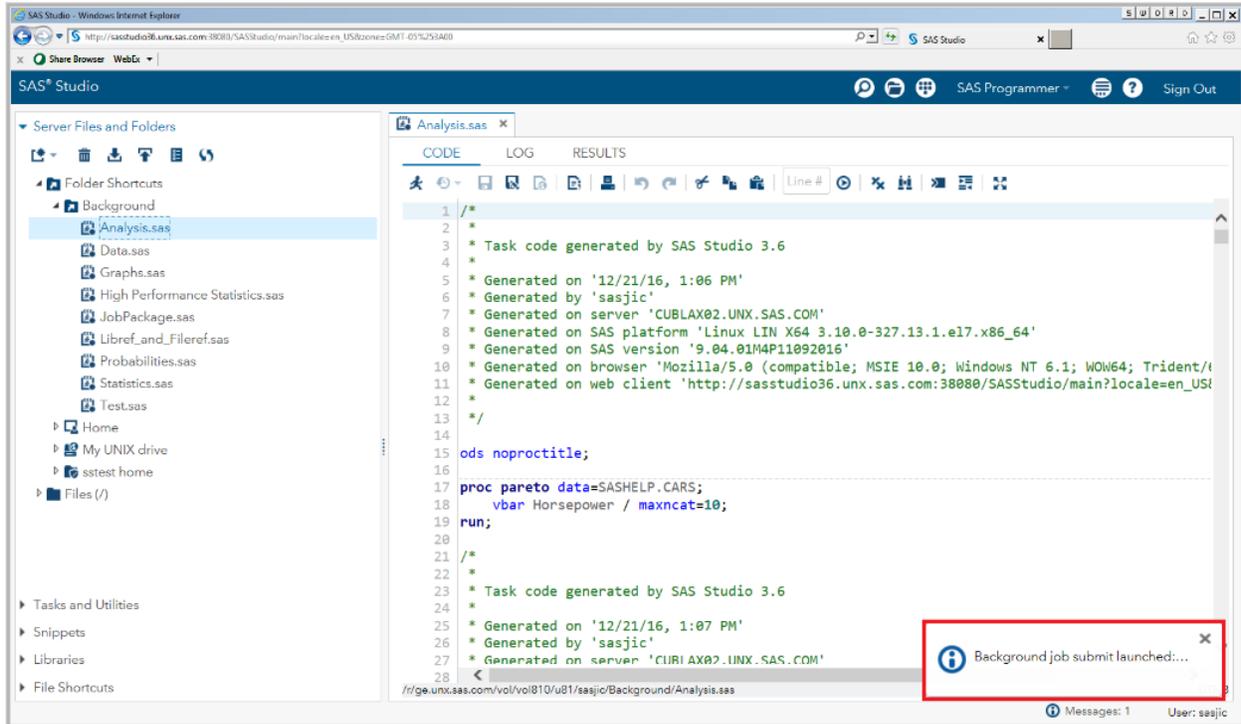
Because a background job uses a separate workspace server, it is unaware of the context that exists in the SAS Studio user interface including librefs, filerefs, macro variables, and so on. Similarly, any libraries created by your background program are not reflected in the **Libraries** section and any file references are not reflected in the **File Shortcuts** section in the navigation pane. Other session state information created by your background job is also unavailable in your SAS Studio user interface.



Display 13. User Interface Does Not Reflect Background Job Resources

BACKGROUND JOB NOTIFICATIONS

By default, a notification message is displayed when the program is submitted and again when the program has finished running. If you log off of SAS Studio while the program is running, the program continues to run, but the notification message that indicates when the program is finished will not be displayed. However, you will see the job results in the Background Job Status window if the retention period has not been exceeded for that job record.

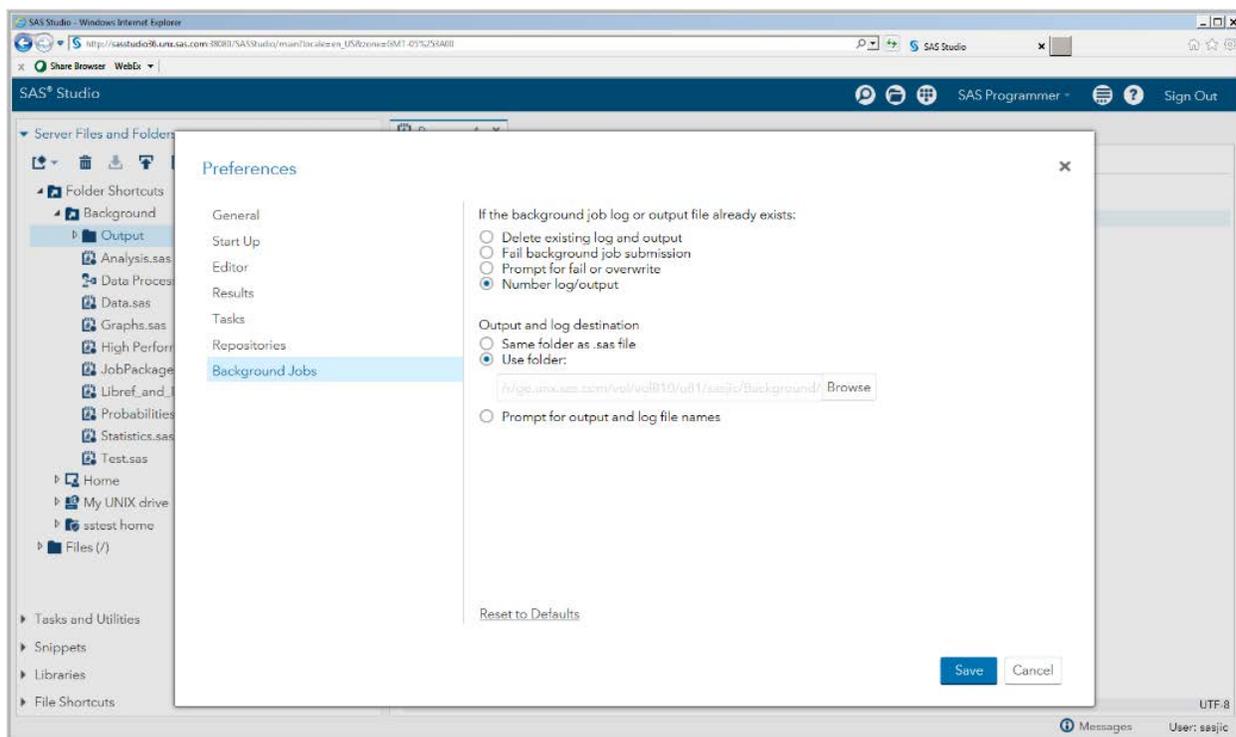


Display 14. Background Job Notification Message

CUSTOMIZING YOUR BACKGROUND JOB SUBMISSIONS

You can customize whether existing log and output files are deleted or overwritten when you rerun a background job. You can also specify the location for these files. The Preferences window enables you to customize how to handle background job submissions.

To set preferences for background job submissions, click , select **Preferences**, and then click **Background Jobs**.



Display 15. Background Jobs Preferences

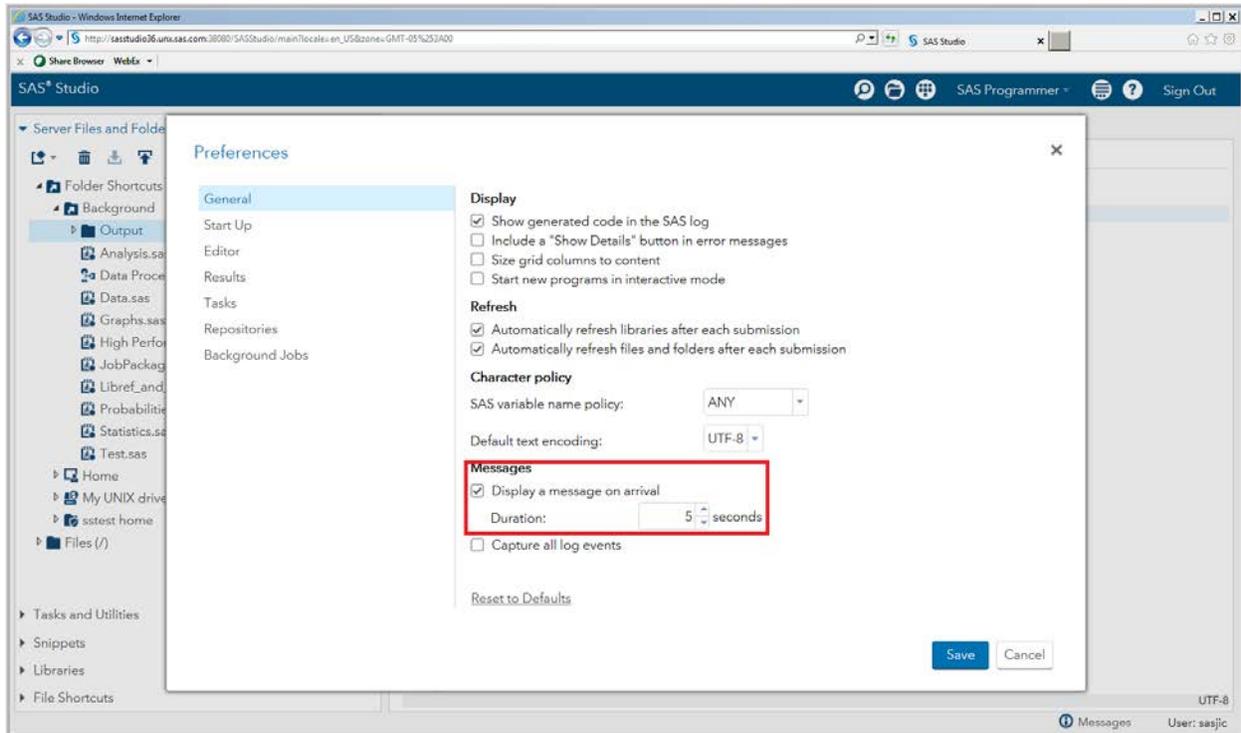
<p>If the background job log or output file already exists</p>	<p>specifies how to handle the background job submission if a log and output file already exist. You can choose from these options:</p> <p>Delete existing log and output deletes the existing log and output files and replaces them with new files when you resubmit the program as a background job.</p> <p>Fail background job submission cancels the background job submission. You must delete the existing log and output files and resubmit the program.</p> <p>Prompt for fail or overwrite displays a message window to confirm that you want to delete or rename the existing log and output files before submitting the background job. If you select No, the background job submission is canceled. This is the default value.</p> <p>Number log/output saves all log and output files by creating a unique filename for each file. The log and output files are saved as <i>program-name (userid-YYYY-MM-DD HHMMSS)</i>.</p>
<p>Output and log destination</p>	<p>specifies where to save the output and log files. You can choose from these options:</p> <p>Same folder as .sas file saves the log and output files to the same folder as the .sas code file.</p> <p>Use folder enables you to specify a location in which to save the log and output files. Click Browse to search for a folder.</p> <p>Prompt for output and log file names prompts you to specify a location in which to save the log and output files. By default, the log and output are saved in the same location as the .sas code file. Click Browse to search for a folder and specify a filename.</p>

Table 2. Preferences for Background Job Submission

If you select both **Prompt for output and log file names** and **Number log/output**, you are prompted for the file names, and the **Number log/output** option is ignored. Be sure to set the **Same folder as .sas file** or **Use folder** option if you would like to have uniquely numbered output. Also, if you specify a **Use folder** location, subsequently delete the folder that you set for this location, and then submit background jobs, the jobs will fail because your output and log files cannot be written.

You can change the length of time that the background job notification messages are displayed by using the **Display a message on arrival** option on the **General** page of the Preferences window. You can adjust the number of seconds that the message is displayed. The range of time that a message can be displayed is between 3 seconds and 30 seconds. The default value is 5 seconds.

Note that other SAS Studio messages besides background messages are written to the notification log.



Display 16. Notification Message Preference

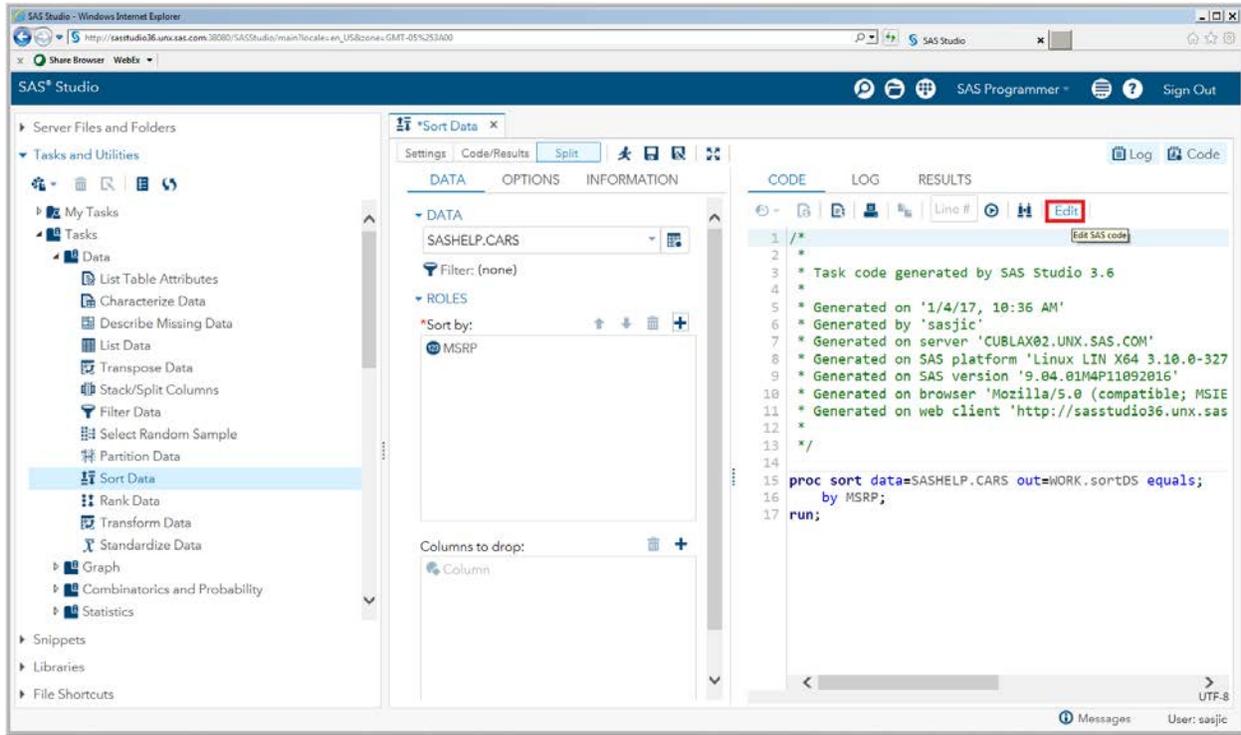
SUPPORTED FILE TYPES

You cannot run a program as a background job if the program is saved on an FTP server or on a SAS server running on the native z/OS file system. However, programs that are saved on a z/OS SAS server running the HFS file system can be run as background jobs. Of course, the simple workaround in both of these cases is to copy the file that you would like to submit to a supported file system using SAS Studio.

You cannot directly submit SAS Studio tasks (.ctk files) or SAS Studio process flows (.cpf files) as background jobs in SAS Studio. However, you can easily extract the SAS code from SAS Studio tasks and process flows and run the code as a background job.

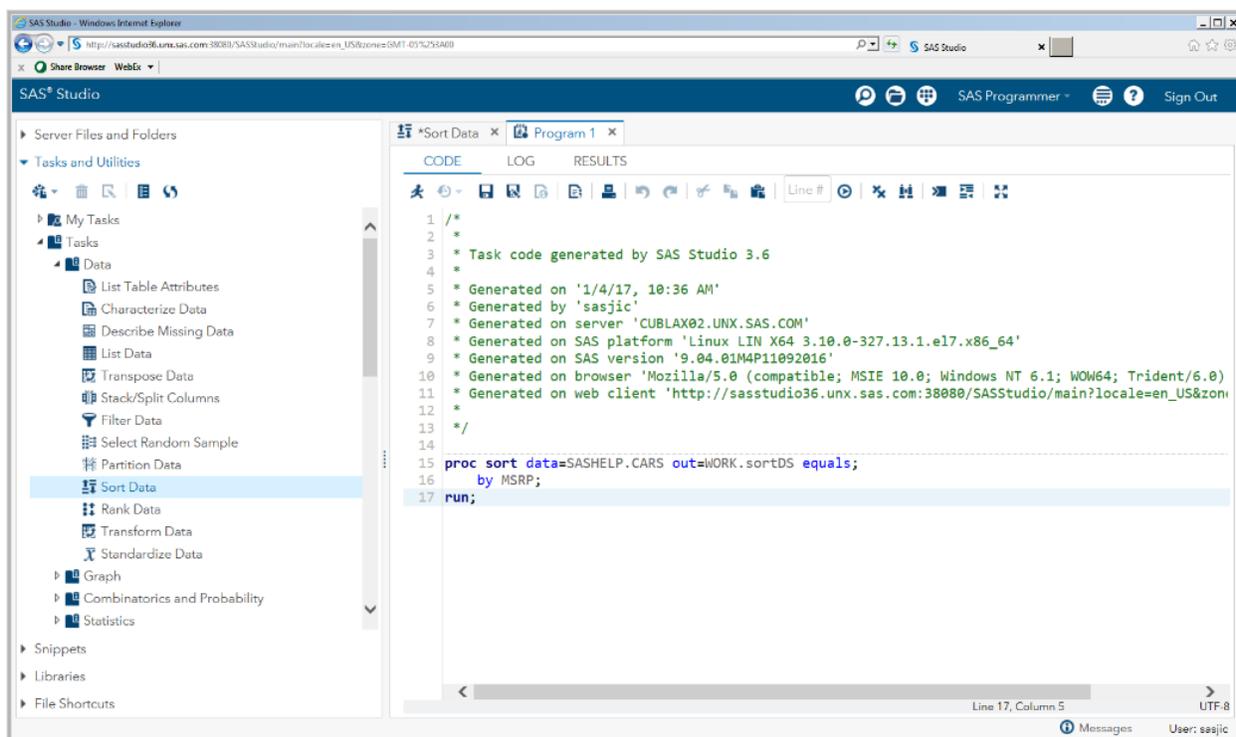
Extracting Task Code

If you would like to run code generated by a SAS Studio task in the background, open your task .ctk file and click **Edit** in the **Code** tab.



Display 17. Edit Button to Extract Task Code

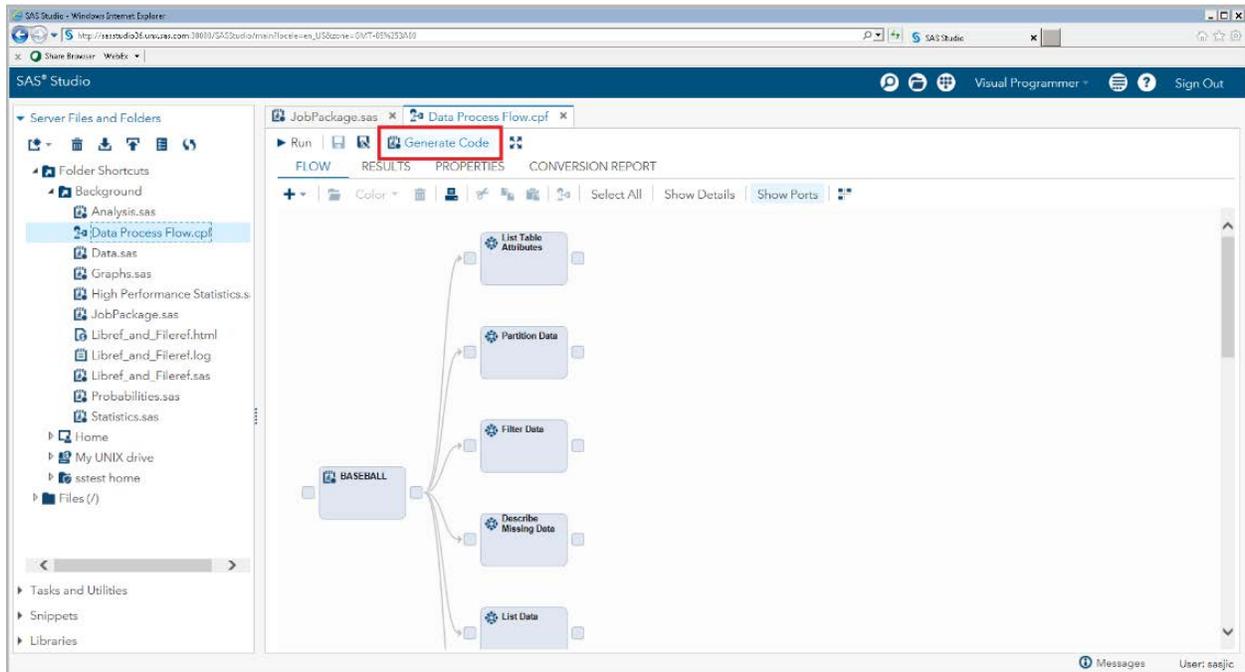
A new Code window opens and displays the code that the task generated. Save the contents to a .sas file and run the file as a background job.



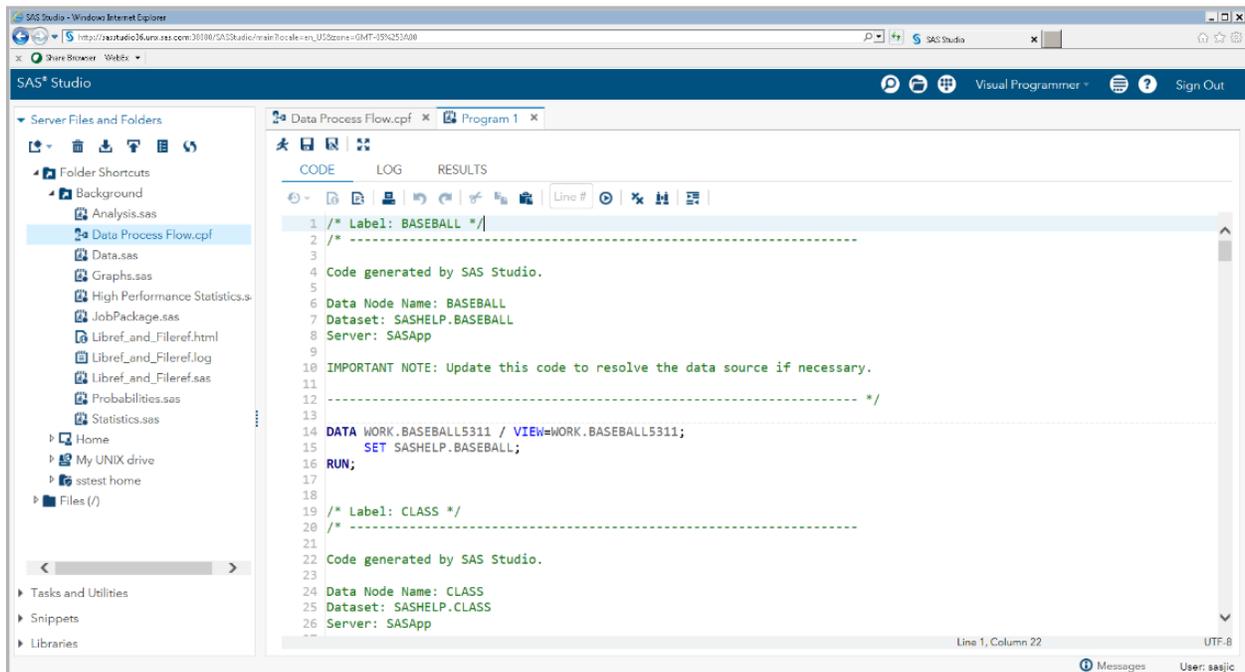
Display 18. Extracted Code from Task

Extracting Process Flow Code

If you would like to run your SAS Studio process flow (.cpf file) code in the background, you can extract the code from the process flow by clicking **Generate Code**. A **Code** tab opens and displays the extracted code that you can save to a .sas file and then submit as a background job.



Display 19. Generate Code Button to Extract Process Flow Code



Display 20. Extracted Code from Process Flow

ARCHITECTURE AND PERFORMANCE

CONFIGURING JOB MAXIMUMS

Regardless of your SAS Studio configuration, when you submit a SAS program in the background, a SAS workspace server is spawned to execute the program. After the program runs, the server is closed. Your SAS Studio configuration determines where that SAS workspace server runs. The `webdms.maxNumActiveBatchSubmissions` and `webdms.maxNumActiveBatchSubmissionsSystem` configuration properties can be used to limit the maximum number of simultaneous background submissions for an individual user and for your entire site, respectively. The values you should specify for these properties are highly dependent on the configuration and hardware capacity of your SAS environment.

If a user submits a background job that will cause the number of jobs he is allowed to run to exceed the value of `webdms.maxNumActiveBatchSubmissions`, the user sees this message: “Your maximum allowed number of background jobs are already running,” and the job is canceled. If the job will cause the total number of background jobs running in SAS Studio to exceed the value of `webdms.maxNumActiveBatchSubmissionsSystem`, the user sees this message: “Maximum allowed number of background jobs for all users are already running,” and the job is canceled. The user will have to try again later because jobs are not queued. While this mechanism is very simple, it prevents a user from stacking a bunch of jobs ahead of other users when there are limited resources.

As a general rule, do not increase the maximum concurrent batch jobs for all users above the total number of processors on your SAS workspace servers. A SAS program in a spawned workspace server is capable of dominating a single processor.

Single-User Edition

For a SAS Studio Single-User configuration, you can submit a SAS job in the background using SAS Studio or traditional batch mode which is described in “Running SAS in Batch Mode” in *SAS® 9.4 Companion for Windows*. With the Single-User edition, you have the option of using traditional SAS batch mode because SAS is installed on your machine. For both background and batch submit, the SAS workspace server that is spawned for your job runs on your machine. The single-user default value of 5 for `webdms.maxNumActiveBatchSubmissions` and `webdms.maxNumActiveBatchSubmissionsSystem` is appropriate for a Microsoft Windows machine configuration with 4 cores and 8 logical processors. To prevent overloading, it is best to keep the maximum allowed submission properties to at least two fewer than the number of logical processors on your machine. Note that this number has no effect in limiting your number of traditional batch submissions. If you have traditional batch submissions already running and you launch multiple SAS Studio background submissions at the same time, you risk maxing out your processors and hanging up your machine.

Basic Edition

The configuration properties for the maximum number of active background jobs are arguably most important to users of the Basic Edition, because in Basic Edition all SAS Studio users are serviced by a SAS environment on just one machine. The number of users and processes this configuration supports depend on the hardware that runs the SAS Web Application Server, the SAS Object Spawner, and the SAS Workspace Servers. Certainly a 32-processor, 65 Gig Pentium Linux machine will support far more users and processes than a standard 8-processor Windows machine. By default, the Basic edition of SAS Studio is configured so that each user is limited to 3 background submissions, and the total number of submissions is limited to 24. The SAS Studio administrator should tailor the `webdms.maxNumActiveBatchSubmissionsSystem` configuration property to a number smaller than the number of processors on the machine running the SAS environment.

Enterprise (Mid-Tier) Edition

If you have a very large SAS Studio user community, you will probably be using the Enterprise edition of SAS Studio, possibly with grid-launched workspace servers to support a heavy user load. By default, the Enterprise edition of SAS Studio is configured so that each user is limited to 3 background submissions,

and the total number of submissions is limited to 24. The administrator should configure the `webdms.maxNumActiveBatchSubmissionsSystem` property based on the hardware of the workspace servers that SAS Studio is configured to use. If the workspace servers are on a grid, your maximum can be increased based on the total number of processors that are on the grid.

If your Enterprise SAS Studio configuration has multiple workspace servers defined, a user's background jobs will run on the workspace server that he is connected to interactively. The user can determine this server by clicking  and then selecting **Change SAS Workspace Server**.

GENERAL CONFIGURATION

By default, SAS Studio enables users to submit SAS code in the background. An administrator can turn off this feature for all users by setting the `webdms.allowBatchSubmit` configuration property to `false`. To control how long background job status information is displayed in the Background Job Status window, use the `webdms.batchSubmissionResultsRetentionPeriod` property. By default, this information is kept for 24 hours and is deleted if you restart the SAS Web Application Server hosting SAS Studio.

CONFIGURATION PROPERTIES

Property Name	Description
<code>webdms.allowBatchSubmit</code>	specifies whether the Background Submit option is available when you right-click a <code>.sas</code> file in the navigation tree in the SAS Studio workspace. The default value is <code>true</code> .
<code>webdms.batchSubmissionResultsRetentionPeriod</code>	specifies the number of hours that a submitted job entry is listed in the Background Job Status window. The default value is 24. You cannot specify a decimal value for this property. No output files (<code>.html</code> or <code>.log</code>) are deleted when you use this configuration property. These files remain until they are deleted by the SAS Studio user.
<code>webdms.maxNumActiveBatchSubmissions</code>	specifies the maximum number of active background jobs for the current SAS Studio user. The default value depends on your edition of SAS Studio. For the SAS Studio Mid-Tier (Enterprise) Edition and SAS Basic Edition, the default value is 3. For the SAS Studio Single-User Edition, the default value is 5.
<code>webdms.maxNumActiveBatchSubmissionsSystem</code>	specifies the maximum number of background jobs that can be submitted for a given instance of SAS Studio across all users. The default value depends on your edition of SAS Studio. For the SAS Studio Mid-Tier (Enterprise) Edition and SAS Basic Edition, the default value is 24. For the SAS Studio Single-User Edition, the default value is 5.

Table 3. Configuration Properties for Background Submissions

GENERAL ADMINISTRATOR INFORMATION

On rare occasions, there have been situations where jobs appear to be running, but cannot be canceled. When job appears to be hung, sometimes the only way to clear it is to restart your web server. If you restart your SAS Web Application Server, all records in the Background Job Status window are cleared.

ADVANCED TUNING SETTINGS

Tuning your SAS workspace server machines might be necessary if your SAS Studio environment has lots of users, heavy workloads, or high rates of expensive transactions. For information about tuning your SAS environment, see [SAS 9.4 Web Applications: Tuning for Performance and Scalability](#).

CONCLUSION

Background submissions enable users to run SAS jobs and continue working in the SAS Studio user interface. This new feature is very helpful for running long jobs that would normally tie up the SAS Studio user interface.

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- SAS Institute Inc. 2016. *SAS 9.4 Web Applications: Tuning for Performance and Scalability*. 3rd ed. Cary, NC: SAS Institute Inc.

ACKNOWLEDGMENTS

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RECOMMENDED READING

- *SAS® Studio User's Guide – Using the Background Submit Feature*

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Jennifer Jeffreys-Chen
SAS Institute Inc.
SAS Campus Dr
Cary, NC 27513
919-677-4000
J.Jeffreys-Chen@sas.com

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