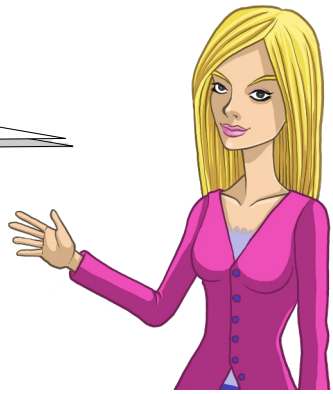
IBM Student Mainframe Challenge
Part One
Time to complete – about an hour

Welcome to the Mainframe Challenge! You'll be joining our team of mainframe programmers to learn some skills then prove yourself above the other contestants! Good luck!

Hi, my name's Gemma. Welcome to the team! I've been here for a few months already, so I'll be able to offer some help and advice about using the mainframe, and about what the contest requires.



The goal of Part One is to learn how to use an IBM System z mainframe without having used one before.

I'll set some tasks and questions throughout the contest to see how you're getting on. There will also be prizes for the fastest contestants in each part (if you answer correctly, of course!)

Psst! The boss told me earlier what the prizes for each part will be...but you will need to check with your contest organiser to find out more!

So, you want to learn the mainframe? Become a whiz with z/OS? Make millions touting your desperately sought-after skills all over the world?

First things first, let's teach you how to log on to the mainframe. (Everyone has to start somewhere.)

Part One of the Mainframe Challenge covers the following tasks:

1. Logging on to the mainframe
2. Using TSO to:

a) view details of, and allocate a new dataset,
b) copy, read and modify a dataset member (equivalent to Windows folder file),
c) invoke a program from the TSO command entry panel,
d) transmit files to another user on another system.

The software

In order to access the mainframe you'll need some software that will allow you to connect to it, and will be able to display the z/OS interface. We call it a *3270 terminal emulator* (snappy, huh?) - they are available for multiple platforms.

If you're using Windows...

Go to http://www.tombrennansoftware.com/download.html and download the Vista V1.27.exe file. Install it by running the .exe file and following the installation instructions.

If you're using a Mac...

Go to http://brown.edu/cis/tn3270/ and install the latest available version.

If you're using Linux...

You'll need to install the following package: `x3270 -port1023` (available from http://x3270.bgp.nu/)

After installation

Everyone got their emulator installed? Then let's begin...

The next step is to start it running. (Predictable, I know.) The default location after a Windows installation is Start → Programs → Vista tn3270 → Vista Standard session.

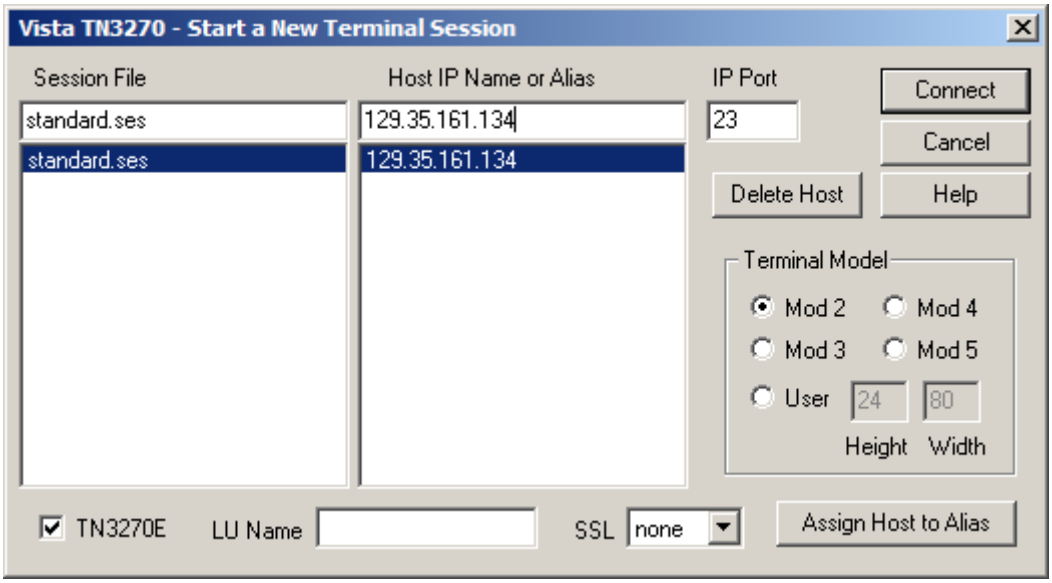
You might see this error:

Don't worry about it, just continue. Now we can set up your emulator and connect to the mainframe.

Configuration

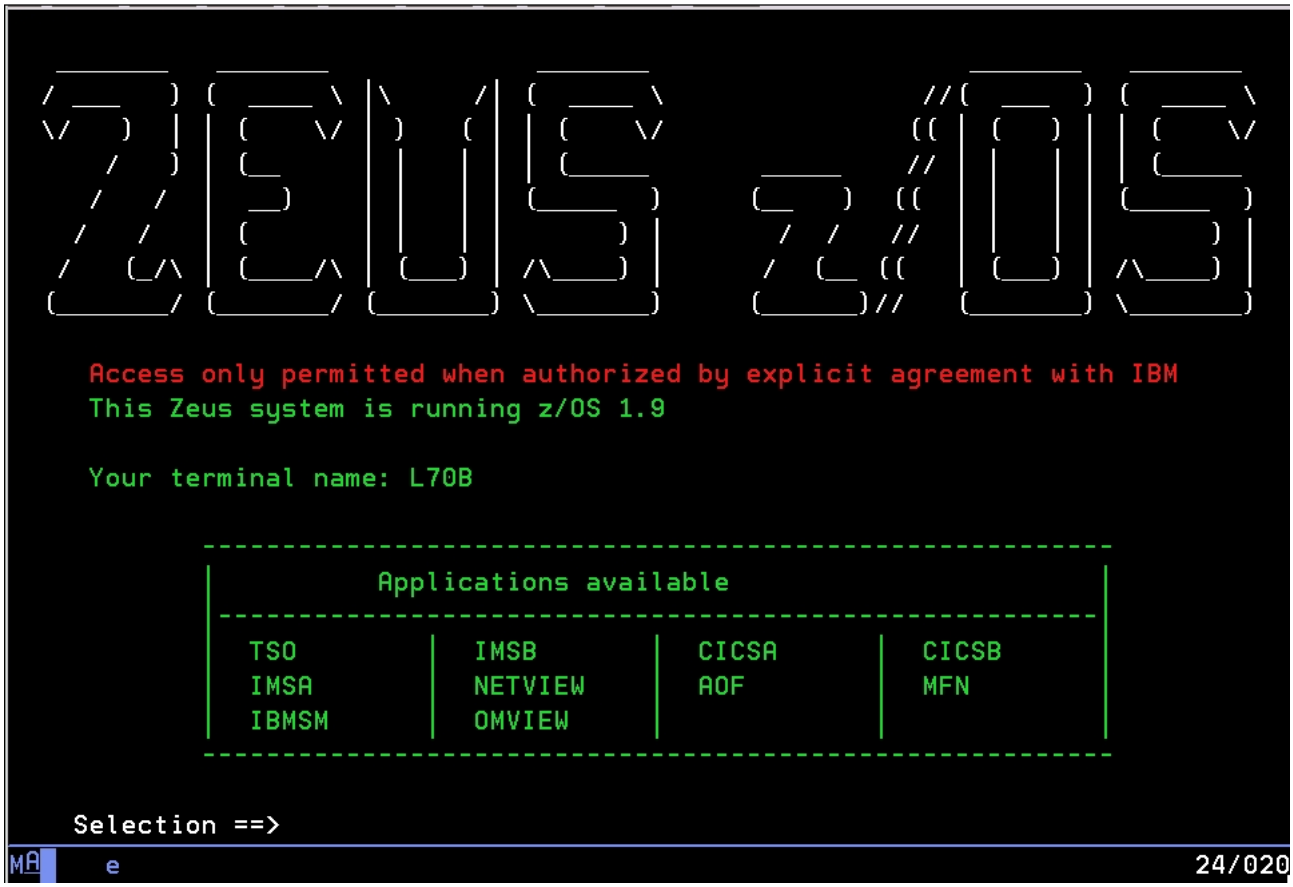
➔ **Configure your emulator as shown below.**

(Windows users: from the menu bar in Vista Session A, select File → Reconnect Ask.)



The Host IP Name is **129.35.161.134** and the IP Port is **23**. These values point towards the z/OS system you'll be accessing.

➔ **Fill in these two values, and click Connect**. If all is well, you should see this:



Congratulations, you have connected to the mainframe! Don't rest on your laurels yet, there's more to come.

A z/OS primer

Now's a good time to give you some background information about z/OS, before you dive into it.

z/OS is an upgrade of what used to be called OS/390. Both of these operating systems are an evolution of MVS (which stands for Multiple Virtual Storage). General mainframe literature still contains many references to these terms. When you're connected to the mainframe, you will find that things are a bit different to what you are used to...

A world where `Ctrl` == `Enter`

A number of keys on your keyboard don't have the same function as they would in your usual operating system. For example, the biggest one to remember is that to enter a command, you need to press `Ctrl`, not Enter! (That's the *right* `Ctrl` only, not the left one.)

In the z/OS world, the `Enter` key is a navigation control, and will move the cursor down to the next form field on the screen.

Many z/OS emulators allow you to use the `Enter` key to enter a command, so it won't matter if you forget - but the warning's there if you need it.

I've summarised the common differences below:

Action	Key on mainframe	Key on other O/Ss	Notes
Enter a command	`Ctrl`	`Enter`	
Scroll up one page	`F7`	`Page Up`	
Scroll down one page	`F8`	`Page Down`	
Exit current screen	`F3`	`Esc`	`Esc` is the closest equivalent, and not always used
Scroll left one screen	`F10`	(none)	Isn't that great? This is extra functionality only available on z/OS!
Scroll right one screen	`F11`		
Change to Insert mode	`Insert`	`Insert`	You get this one for free
Move cursor to next field	`Tab`	`Tab`	This one too
Move cursor to first field on next line	`Enter`	(none)	This is what will happen when you forget about `Ctrl`!

However, ultimately it depends on the emulator you're using. These are the common settings, you should be able to find out the mapping that your emulator uses if it's different.

Now that you know all that, let's put it into action by logging on...

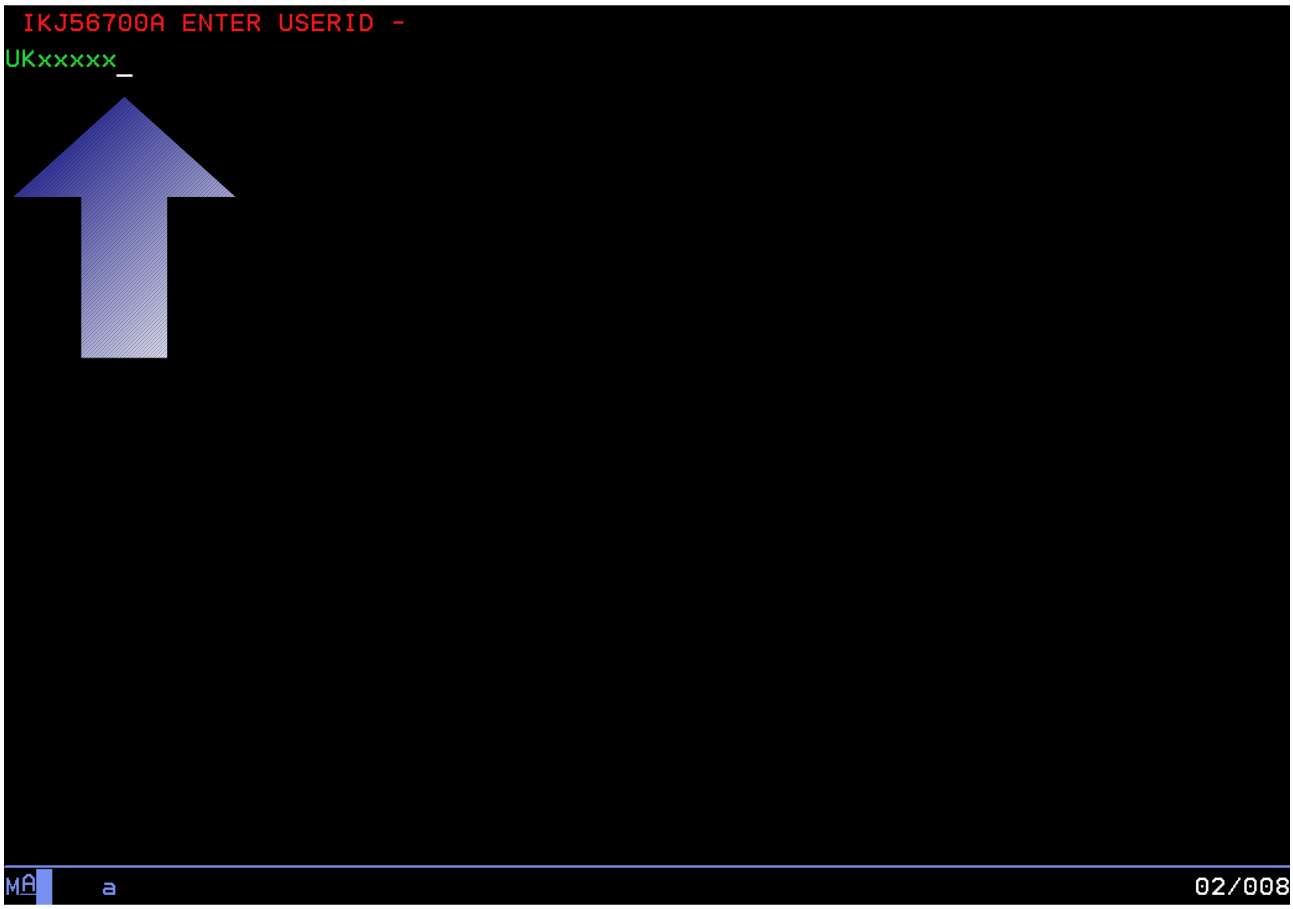
Logging on

Remember where you were? The mainframe welcome screen?

You should have a cursor (looking like this: `_`) after a prompt (looking like this: `==>`) saying SELECT APPLICATION (looking like this: `SELECTION`).

➔ **Type TSO at the prompt and enter.**

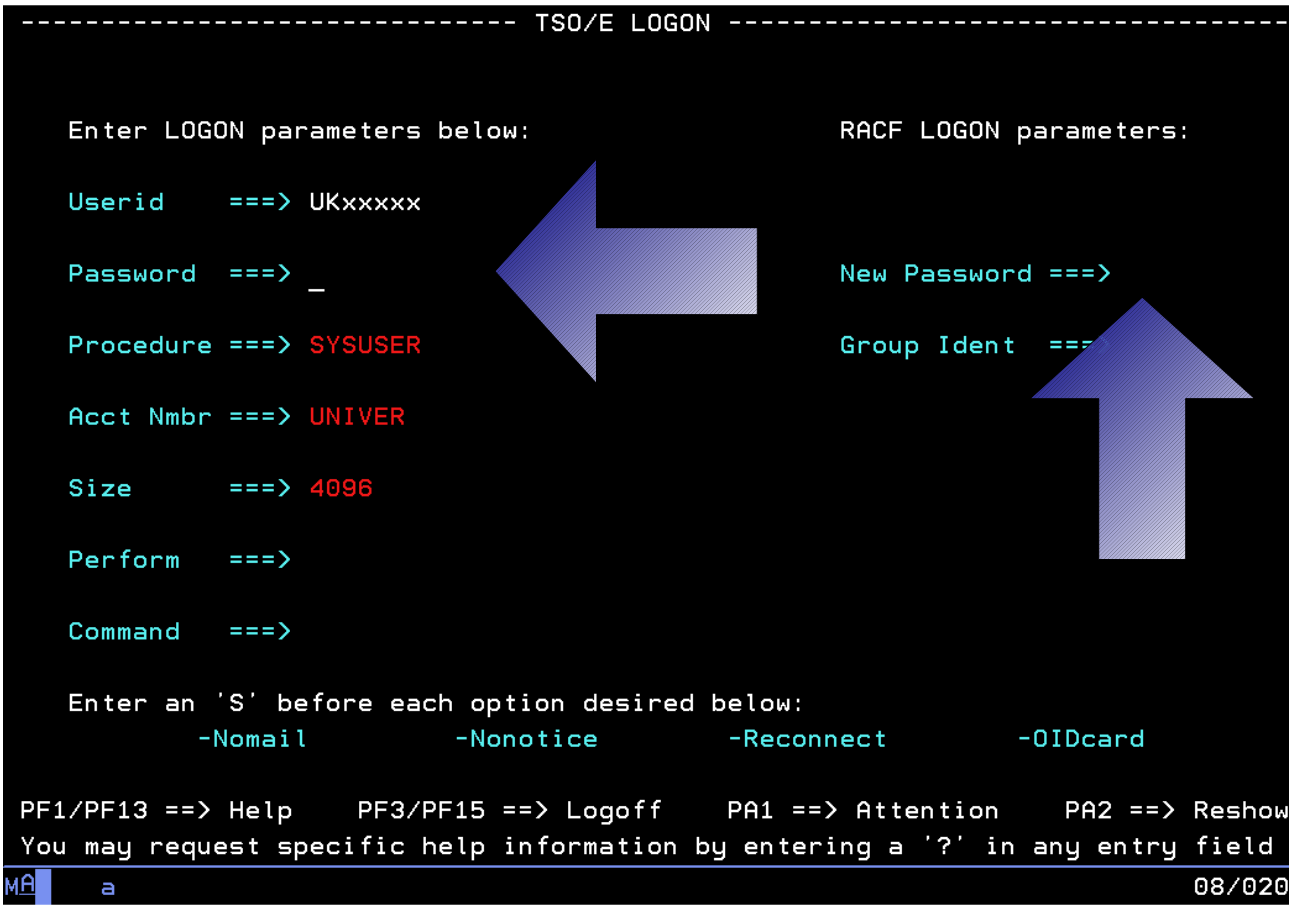
You will see a big black screen with a red message saying: `IKJ56700A ENTER USERID`. Much like this, in fact:



➔ **Enter the user id that you have been allocated.**

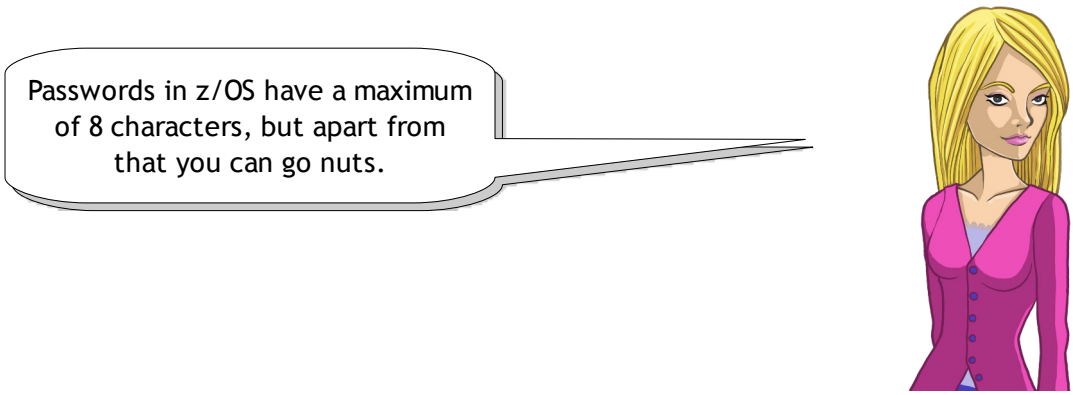
For the UK contest it will be 7 characters long, and start with UK. From now on whenever I say UKxxxxx, substitute your own user id. Now press `Enter`. (You know I mean `Ctrl`, right?)
You will be taken to this screen so that you can enter your password (which is the same as your user id the first time you log on):

➔ **At the password prompt (`==>`) type in your user id and hit `Ctrl`.** You will be prompted to choose a new password.

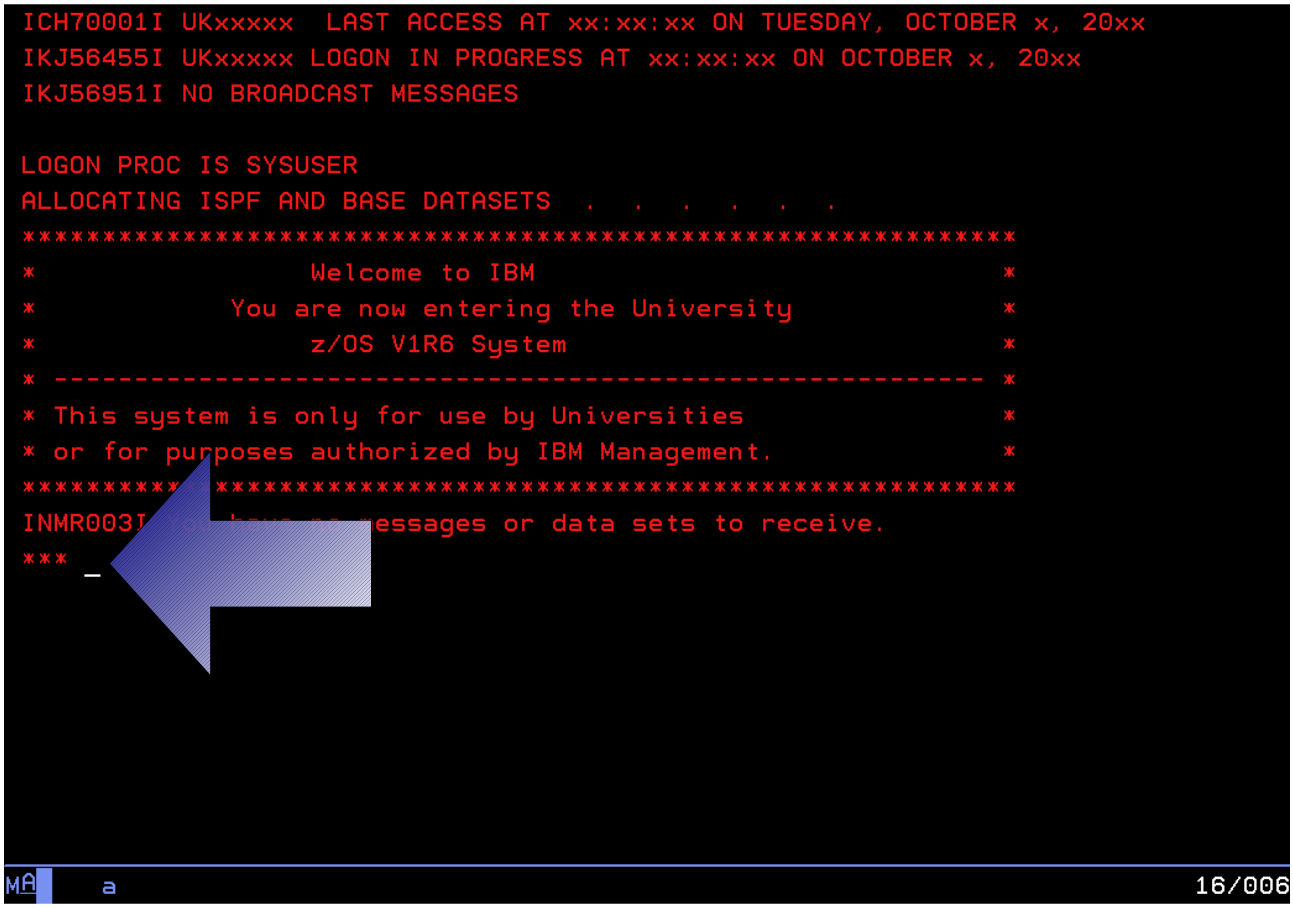


➔ **Enter your new password twice** (followed by `Ctrl` each time).

At the bottom of the logon screen, there is a note to say you can press `PF1` or `PF13` for help. `PF` or "program function" is the old name for `F` or "function" keys. So, when there is an instruction to press (for example) `PF3`, the key you want is `F3` on your keyboard.



You will be taken to the ZEUS welcome screen:



(I know what you're thinking. Could be more welcoming, right?)

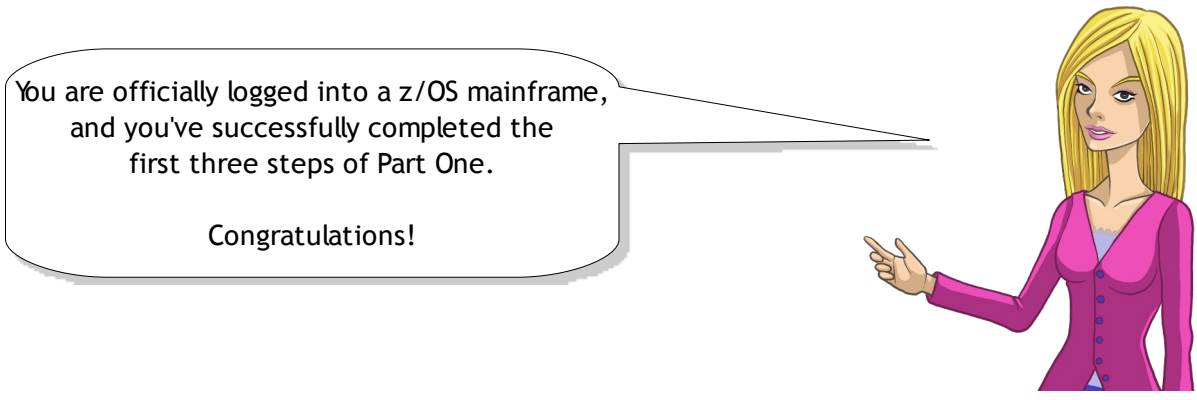
Notice at the bottom of the text you see this: `***` The three asterisks mean that the system is waiting for your input to continue on its way, so press `Ctrl` to continue.

```
 Menu  Utilities  Compilers  Options  Status  Help
------------------------------------------------------------------------------
                          z/OS Primary Option Menu

0  Settings      Terminal and user parameters          User ID . : UKxxxxx
1  View          Display source data or listings       Time. . . : xx:xx
2  Edit          Create or change source data          Terminal. : 3278
3  Utilities     Perform utility functions             Screen. . : 1
4  Foreground    Interactive language processing       Language. : ENGLISH
5  Batch         Submit job for language processing    Appl ID . : ISR
6  Command       Enter TSO or Workstation commands     TSO logon : SYSUSER
7  Dialog Test   Perform dialog testing                TSO prefix: UKxxxxx
P  IBM Products  IBM program products                  System ID : TESTMVS
                                                  r    MVS acct. : UNIVER
 Licensed Materials - Property of IBM                  Release . : ISPF 5.6
 5694-A01 (C) Copyright IBM Corp. 1980, 2004.     ions
 All rights reserved.
 US Government Users Restricted Rights -
 Use, duplication or disclosure restricted
 by GSA ADP Schedule Contract with IBM Corp.      s

Option ===>
 F1=Help      F2=Split     F3=Exit      F7=Backward  F8=Forward   F9=Swap
F10=Actions  F12=Cancel
MA    a                                                          22/014
```

Ahh! This is what we've been waiting for!

This is ISPF. This is where the magic happens. This is your point of control.

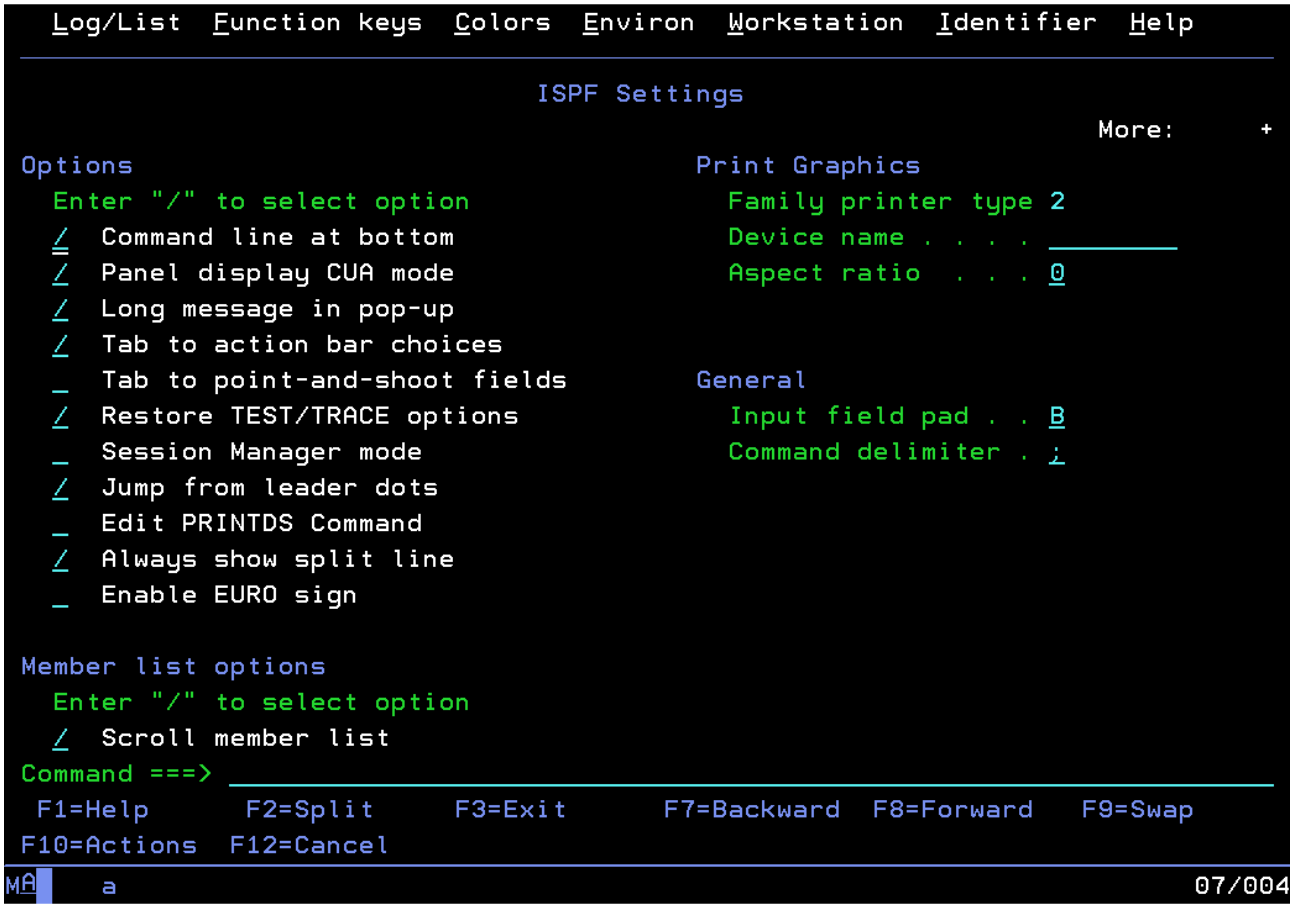
(While we're on the subject of control, hit `Ctrl` to clear the copyright message out of the way.)



Customise your environment

In ISPF you can edit settings to make the environment your own. Let's try it out by moving the command line from the bottom of the screen to the top of the screen (this is what all the pro's do).

So, you've got your cursor on the command line. Enter `0` – this will take you through to the ISPF settings menu:



On this screen, practise navigating through the menu by pressing the `Tab` key repeatedly. You'll see the cursor moving through every field on the screen.

`Tab` `Tab`
`Tab` `Tab`
`Tab` `Tab`
`Tab`
`Tab`
`Tab` `Tab`

Now try pressing the `Enter` key repeatedly. (Yes, I actually mean `Enter` this time!) You can see the cursor going to a new line each time, seeking out the first field on each line. (Don't worry if your emulator is set up differently.)

`Enter`
`Enter`
`Enter`

Navigate to the field (that looks like this: **/**) beside '`Command line at bottom`'. Delete the '**/**' using the delete key and press enter (yeah, yeah, I mean `Ctrl`).
See the command line jump to the top of the screen!

Oh F3, we sing of thee

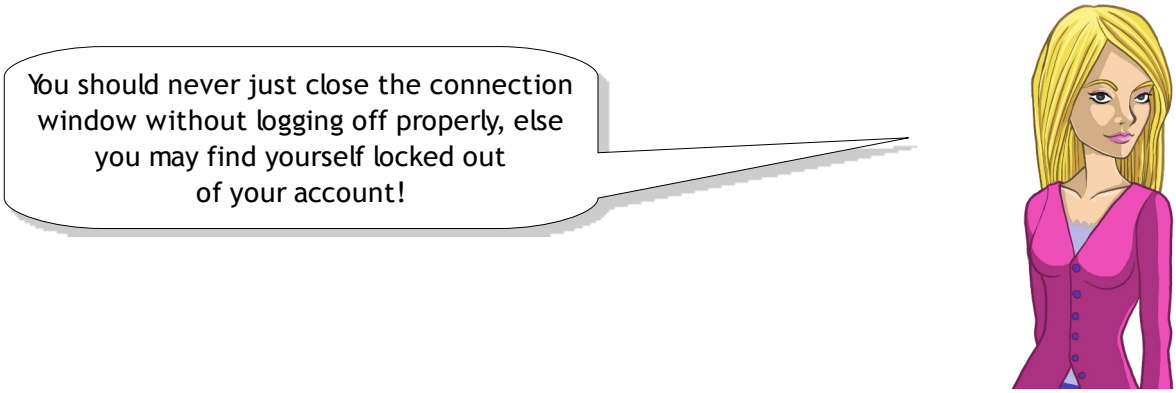
The F3 key is another useful navigation command because it exits the screen you're in and goes to the previous screen, sort of like the Back button in an Internet browser. If you hit it twice from here...

...WAIT! Don't do that!

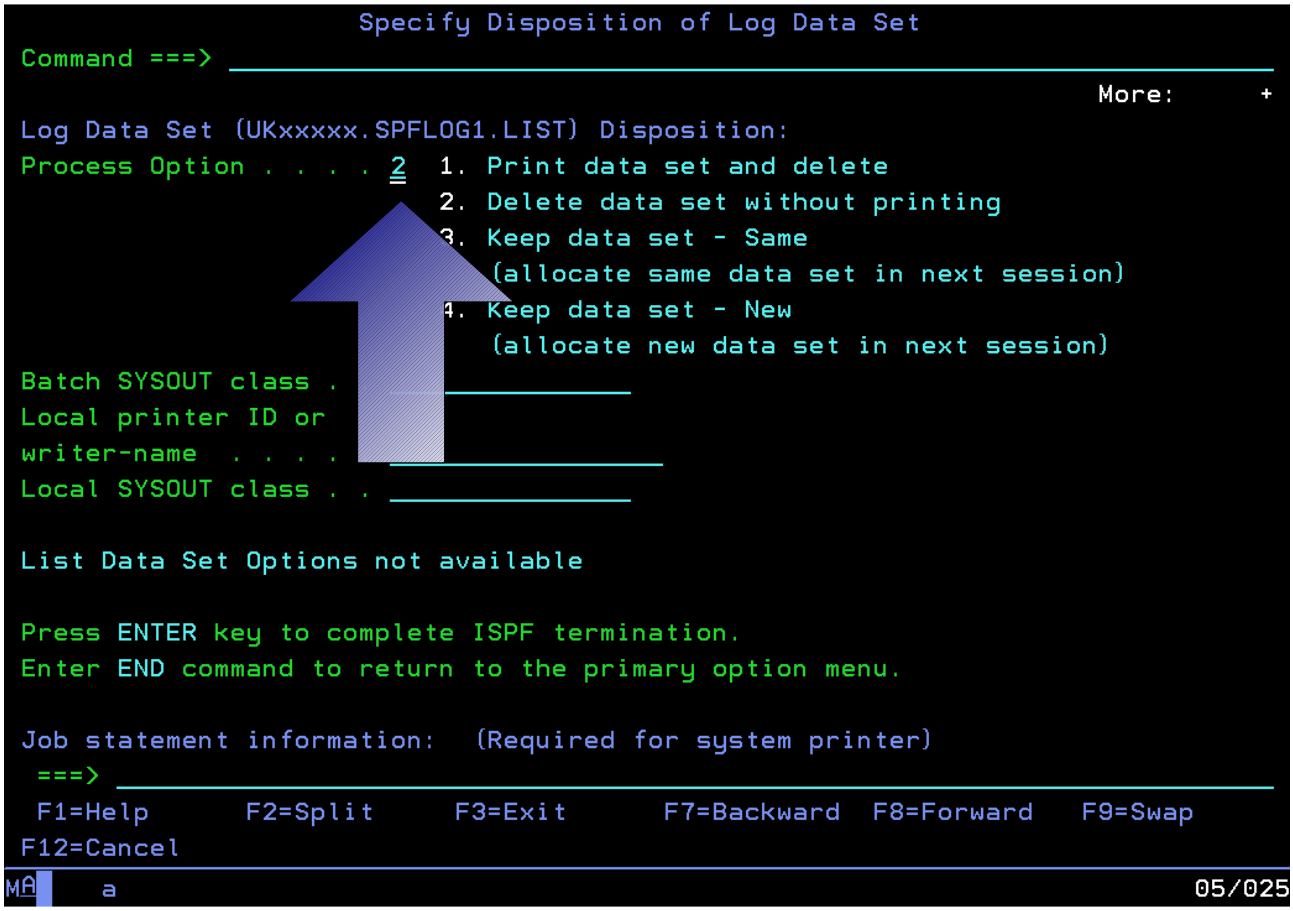
...you'll find yourself at the TSO READY prompt. (If this happens, just enter ISPF again.)

Logging off

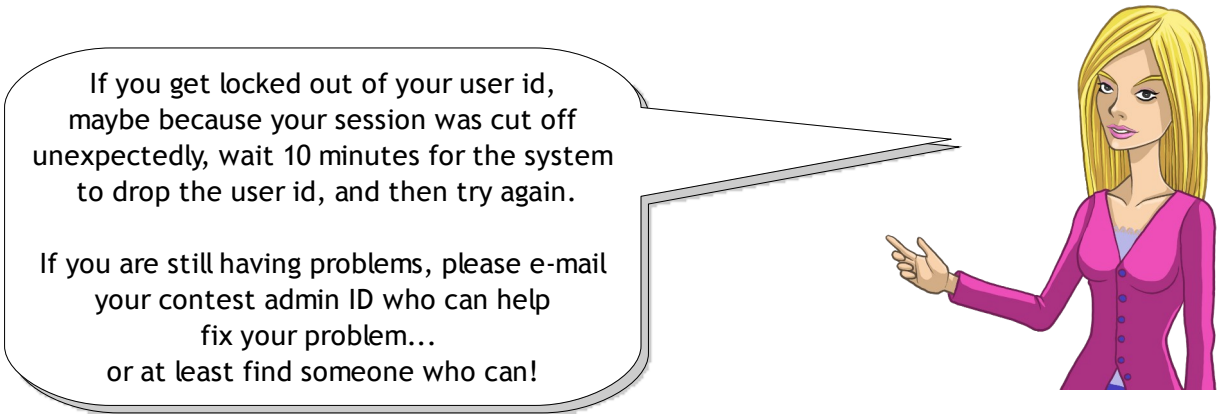
In fact, this is what you want to do when you want to log off; F3 back to the TSO READY prompt and then type logoff.



When you want to log off, if you have done any extensive work during your session, you may be presented with a further screen (much like the one below):



If you come across this screen, select Option 2 ("`Delete data set without printing`") and press enter. *Then* you can log off as described above.



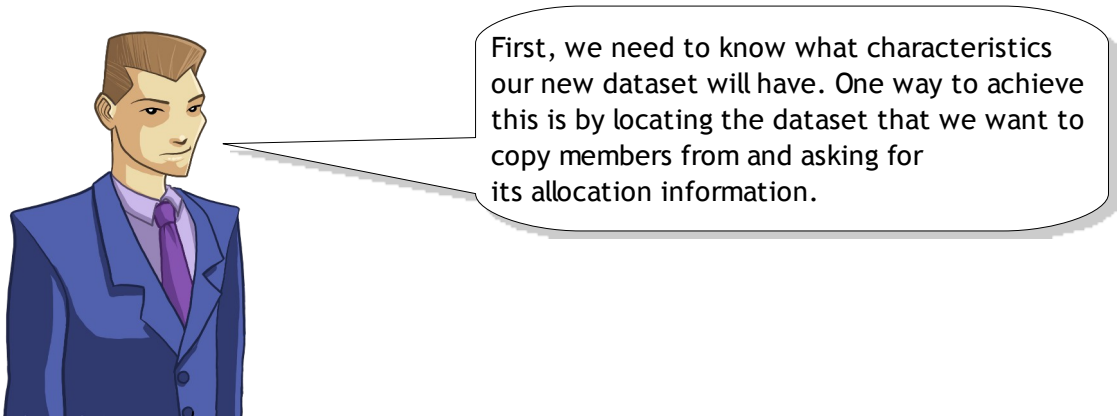
Creating a new dataset

As a logged-on user on the mainframe you have allocated storage, equivalent to Unix quotas, where you can create *datasets* (equivalent to Windows folders) to store *dataset members* (equivalent to Windows files).

In this part of the Mainframe Challenge you will specify for each electrical appliance within your student house how many of each there are, and on average how long they are on for. The target of this part of the challenge is to set up your appliance data dataset member so that the daily consumption falls within a target range.

2.1 Allocate a new dataset

You will create a new dataset based upon the characteristics of an existing dataset. You can then copy in the template appliance data dataset member to your new dataset.



- ➔ **Go to the main menu within ISPF (use `F3` to return there)**
- ➔ **Select option 3 (by typing `3` and pressing `Enter`) to enter the Utility Selection Panel.**

Have a look through the options available. You should see that option 4 allows you to list datasets.

- ➔ **Select this option by typing `4` and pressing `Enter`.**

You are now in ISPF utility 3.4.

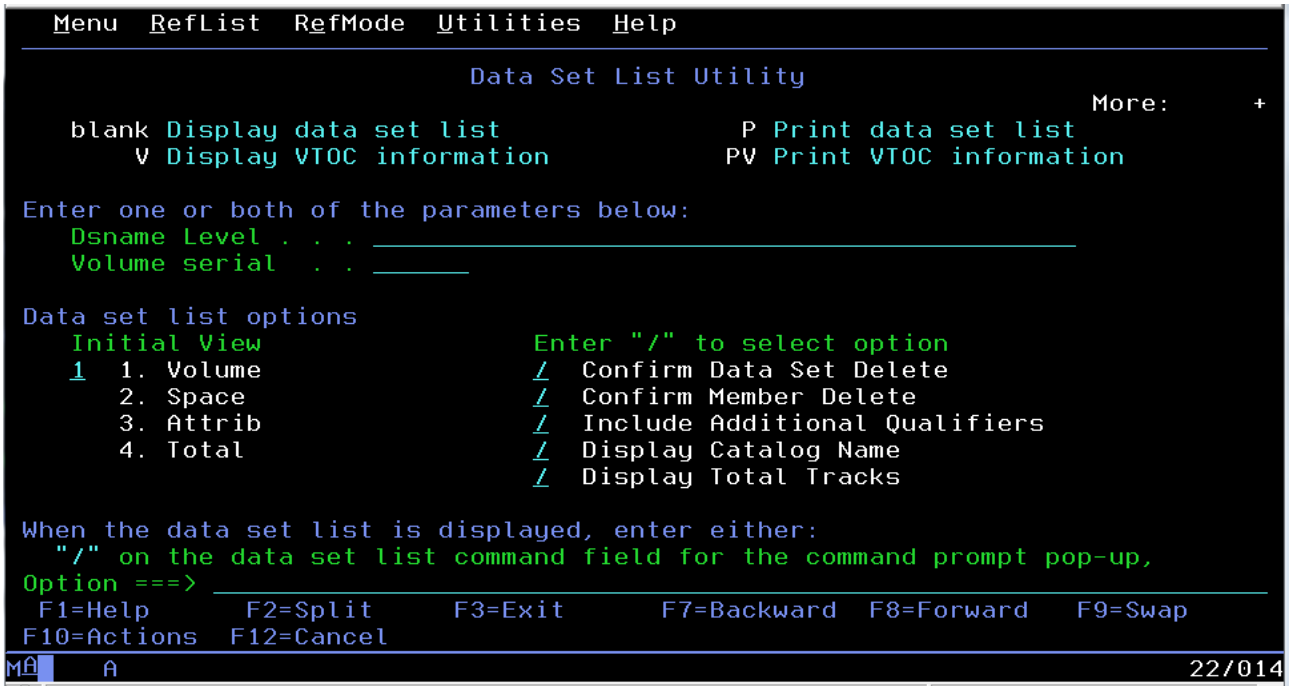


Illustration 1: ISPF utility 3.4 - Data Set List Utility

➔ **In the Dsname Level field type `ZOS.CONTEST2.PART1.DATA` and then press `Enter`**

A list of one dataset will appear, matching the name specified. In the `Command` column, ask for the dataset's allocation information by specifying `i` in that column, as shown in Illustration 2 and then press **`Enter.`**

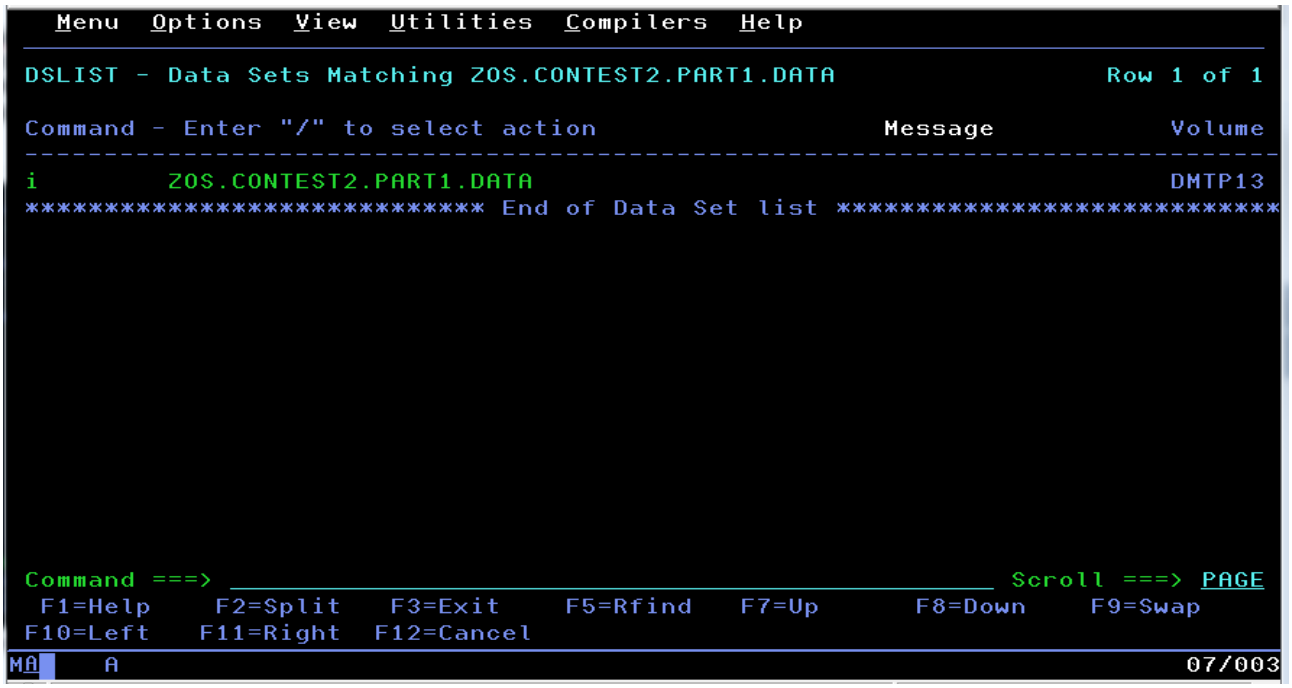


Illustration 2: Data Set List - Obtaining allocation information

What follows is shown in Illustration 3; there are many pieces of information that can be used to recreate a similar dataset. By viewing these details, z/OS will remember them so that they can be used as default values during the allocation of a new dataset. Have a look at the details and you can see its type: `PDS`; its record format: `VB`=Variable Block; volume serial: `DMTP13`; and lots of other useful information.

```
                          Data Set Information

Data Set Name . . . . : ZOS.CONTEST2.PART1.DATA

General Data                            Current Allocation
 Management class . . : STANDARD         Allocated bytes . . : 131,040
 Storage class  . . . : BASE             Allocated extents . : 1
  Volume serial . . . : DMTP13           Maximum dir. blocks : 10
  Device type . . . . : 3390
 Data class . . . . . : **None**
  Organization  . . . : PO               Current Utilization
  Record format . . . : VB                Used bytes  . . . . : 32,760
  Record length . . . : 32756             Used extents  . . . : 1
  Block size  . . . . : 32760             Used dir. blocks  . : 1
  1st extent bytes  . : 131040            Number of members . : 1
  Secondary bytes . . : 65520
  Data set name type  : PDS

  Creation date . . . : 2011/09/30      Referenced date . . : 2011/09/30
  Expiration date . . : ***None***

Command ===>
 F1=Help       F2=Split      F3=Exit       F7=Backward  F8=Forward   F9=Swap
F12=Cancel
MA    A                                                          22/015
```

Illustration 3: Data Set Information

➔ **From the main menu within ISPF (use `F3` to return there), select option `3` and press `Enter` to enter the Utility Selection Panel.**

Looking through the options available to you, you will see that option 2 allows you to allocate a new dataset.

➔ **Type in `2` and press `Enter`.**

You are now in ISPF utility 3.2, as shown in Illustration 4.

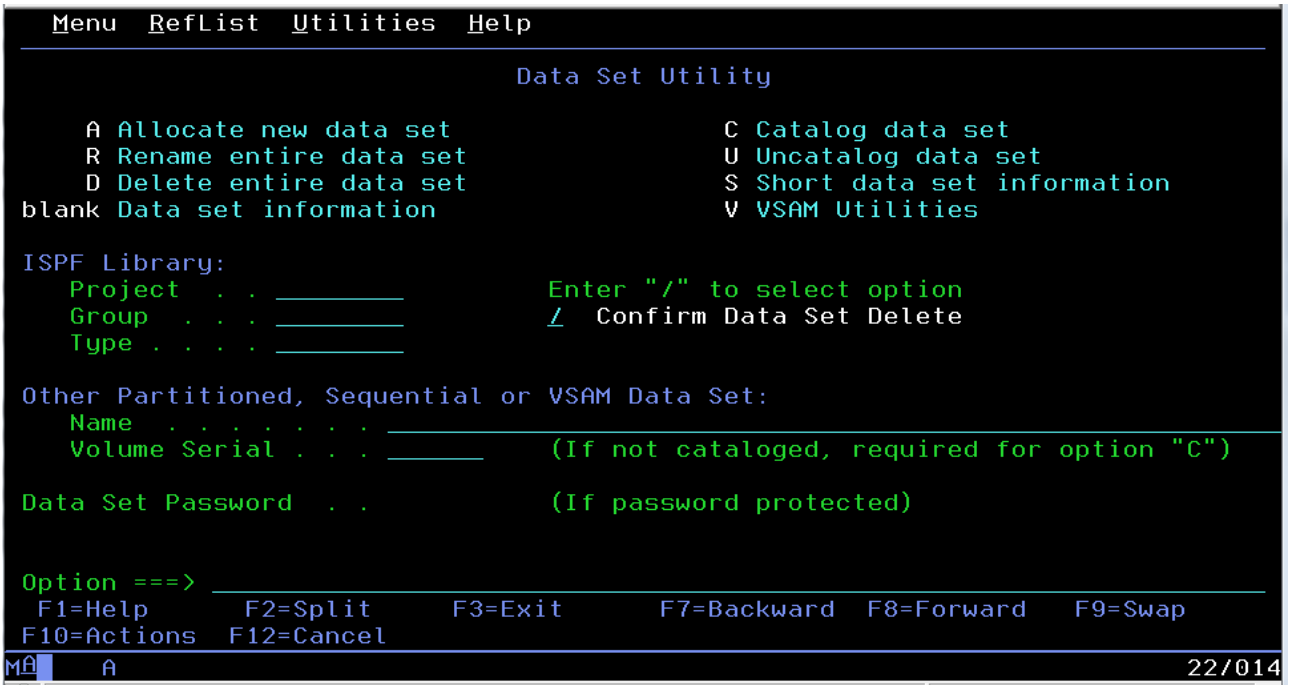


Illustration 4: ISPF utility 3.2 - Data Set Utility

In the ISPF Library section the `Project`, `Group` and `Type` fields will specify the new dataset name, where:

- `Project` will be the same as your User ID (referred to as `<user>` later in this section) that you used to log on to ZEUS,
- `Group` is a name that you will recognise to aid grouping of files, e.g. `CHALLNGE`,
- `Type` is a name that you will recognise to classify the type of files within a dataset, e.g. `DATA`.

Each field can be up to 8 characters in length.

➔ **Specify the name of your dataset using the fields above.**

➔ **On the Option line type `A` and press `Enter`.**

You are now presented, as shown in Illustration 5, with a panel that has allocation information filled in, based upon the previous dataset that you viewed.

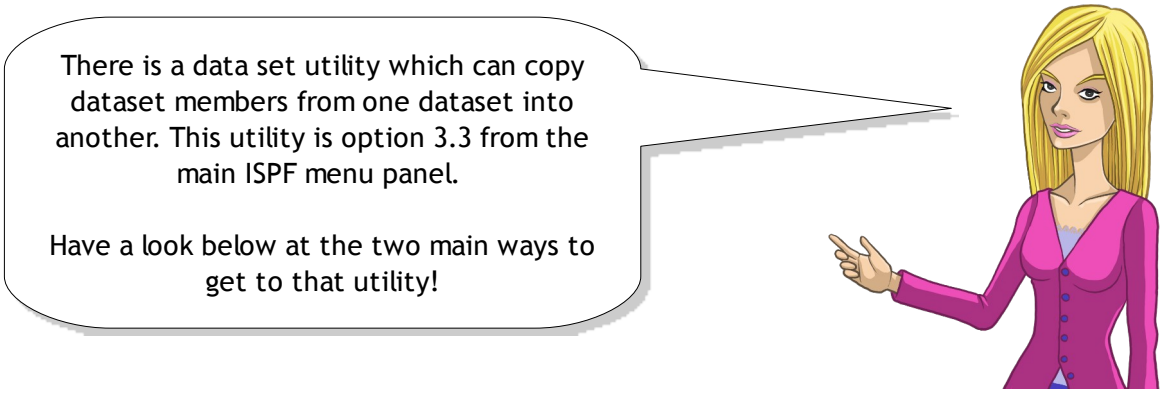
```
 Menu  RefList  Utilities  Help
 ------------------------------------------------------------------------
                          Allocate New Data Set
                                                                More:     +
Data Set Name  . . . : UKxxxxx.CHALLNGE.DATA

Management class . . . STANDARD       (Blank for default management class)
Storage class  . . . . BASE           (Blank for default storage class)
 Volume serial . . . . DMTP13         (Blank for system default volume) **
 Device type . . . . . ________       (Generic unit or device address) **
Data class . . . . . . ________       (Blank for default data class)
 Space units . . . . . BYTE           (BLKS, TRKS, CYLS, KB, MB, BYTES
                                       or RECORDS)
 Average record unit   _              (M, K, or U)
 Primary quantity  . . 131040         (In above units)
 Secondary quantity    65520          (In above units)
 Directory blocks  . . 10             (Zero for sequential data set) *
 Record format . . . . VB
 Record length . . . . 32756
 Block size  . . . . . 32760
 Data set name type    PDS            (LIBRARY, HFS, PDS, LARGE, BASIC, *
Command ===> ___________________________________________________________
 F1=Help      F2=Split     F3=Exit      F7=Backward  F8=Forward   F9=Swap
F10=Actions  F12=Cancel
MA    A                                                        22/015
```

Illustration 5: Allocate New Data Set - with prefilled details

Press **Enter** again and your dataset will be allocated. The message '`Data set allocated`' will be presented on the page shown in Illustration 4.

2.2 Copying house appliance data into your new dataset

We will be using an energy consumption calculation program to analyse raw data that show the energy usage of the house appliances. To get to the point where we can invoke the energy consumption calculation program, we need some input data which we can modify between each invocation of the program.



1. Press **F3** until you get back to the main ISPF menu panel, then type in **3** and press **Enter** followed by typing **3** and pressing **Enter** again,
2. Type **=3.3** into the Command field and press **Enter**

When you are in utility 3.3 you will be presented with the page as shown in Illustration 6.

```
 Menu  RefList  Utilities  Help
                          Move/Copy Utility

 C  Copy data set or member(s)          CP Copy and print
 M  Move data set or member(s)          MP Move and print

Specify "From" Data Set below, then press Enter key

From ISPF Library:
   Project . . . ________       (--- Options C and CP only         ---)
   Group . . . . ________ . . . ________ . . . ________ . . . ________
   Type  . . . . ________
   Member  . . . ________          (Blank or pattern for member list,
                                    "*" for all members)

From Other Partitioned or Sequential Data Set:
   Name  . . . . . . . . ____________________________________________
   Volume Serial . . . ______     (If not cataloged)

Data Set Password  . .            (If password protected)
Option ===> ____________________________________________________________
 F1=Help      F2=Split     F3=Exit      F7=Backward  F8=Forward   F9=Swap
F10=Actions  F12=Cancel
MA    A                                                        22/014
```

Illustration 6: ISPF utility 3.3 - Move/Copy Utility

From this panel you can copy the house appliance data which you will eventually edit when it is in your new dataset.

➔ **In the `Name` field of the `From Other Partitioned or Sequential Data Set` section of the page type: `'ZOS.CONTEST2.PART1.DATA(HOUSE)'`**

➔ **Then, in the Option field type `c` and press `Enter`.**

We have now selected what we are going to copy, now we need to specify where it is going to be placed.

➔ **Within the To ISPF Library section of the next page, specify your new dataset in the Project, Group and Type fields.**

Leave the `Member` field blank so that it will use the same name; as demonstrated in Illustration 7. Then press **`Enter`**.

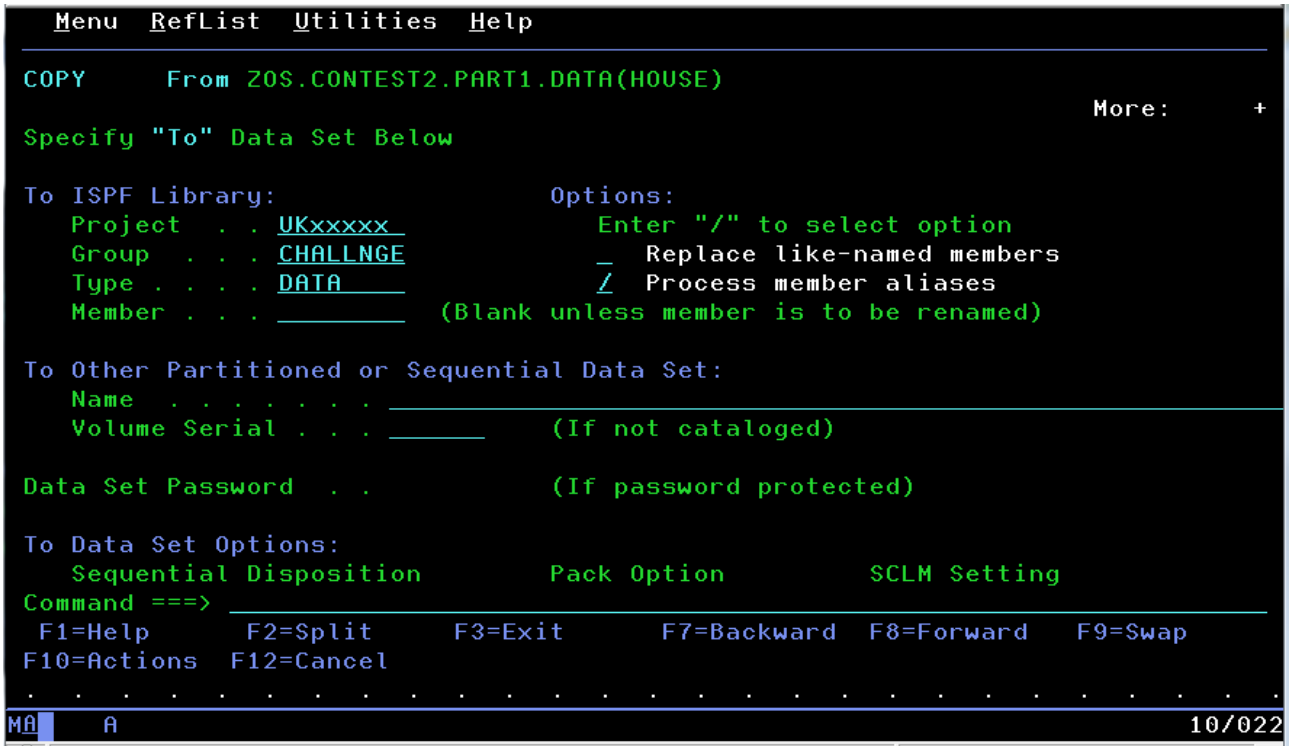


Illustration 7: Copying the HOUSE dataset member

The message `Member HOUSE copied` will be presented on the page shown in Illustration 6.

2.3 Invoking the house consumption calculation program

We now have an input file that we can use as input to our house consumption calculation program. There are various ways to invoke a program within TSO, one of which is to 'call' it from within ISPF option 6. Let us do just that.

In the Option or Command field on the page that you are on type **=6** and press **Enter**.
You will be presented with a command input panel which looks like that shown in Illustration 8.

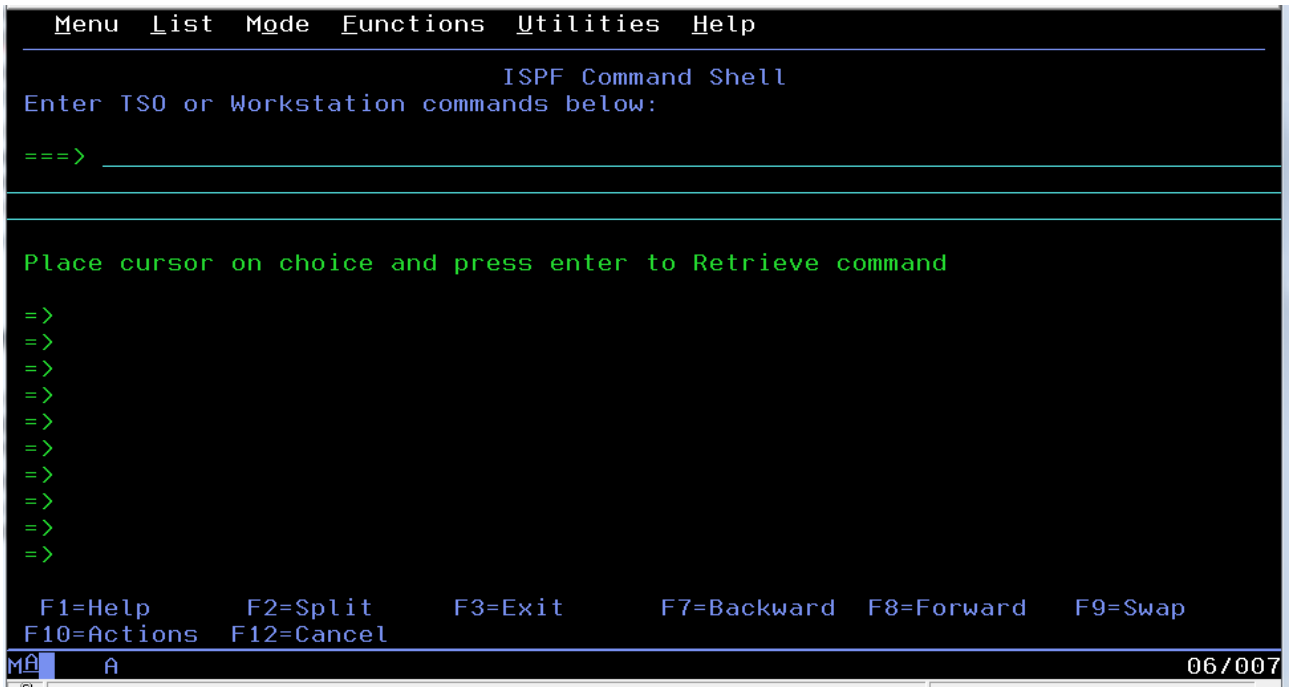


Illustration 8: ISPF option 6 - ISPF Command Shell

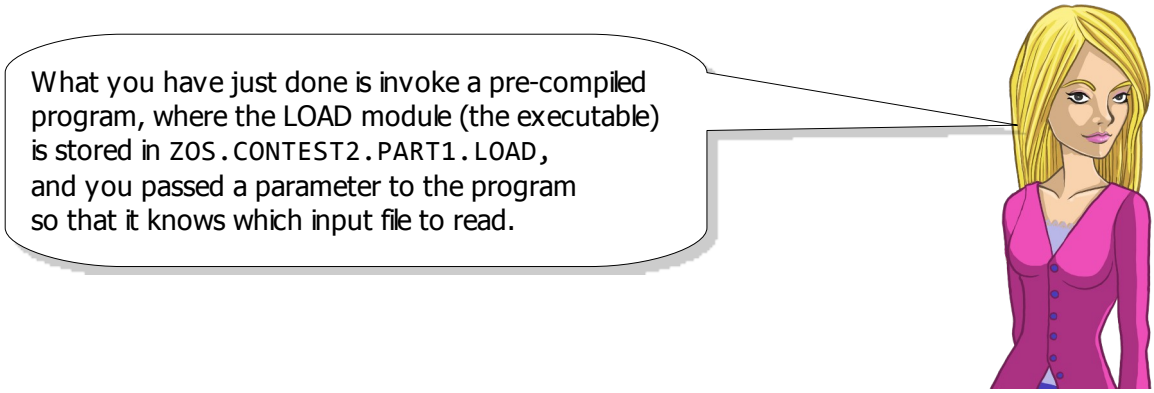
On the command line (after the `==>` text) type in the following command then press **Enter**:

call 'ZOS.CONTEST2.PART1.LOAD(ANALYSE)' 'HOUSE=<user>.CHALLNGE.DATA(HOUSE)'

where **<user>** is your ZEUS user ID.

The output from this program invocation will be presented directly on to the screen. If you are presented with '***' at the end of the screen then press **Enter** to move to the next screen.

> If you enter this command incorrectly you are likely to encounter the message 'IKJ56718A REENTER THIS OPERAND+'. If you do, ensure that zOS is waiting for your input and there is not any more output (indicated by the '***' at the end of the screen) and issue the attention command: either right-click and select '**PA1**' or press '**Esc**'.



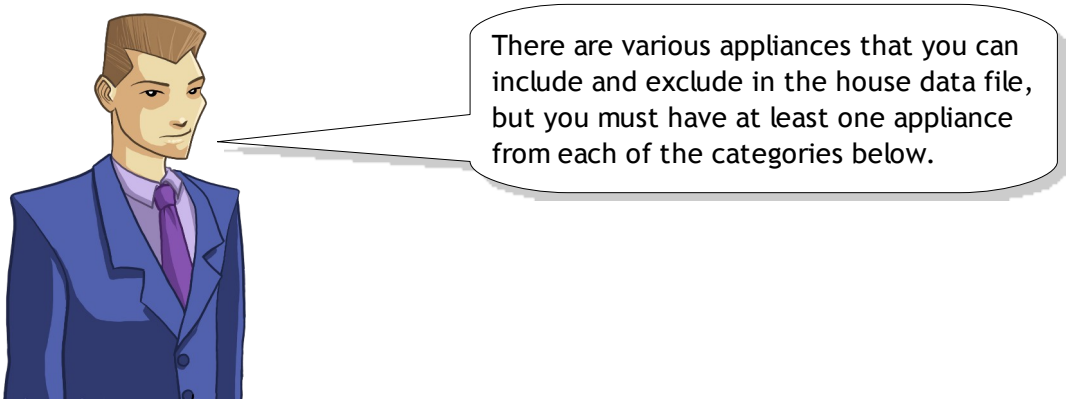
The output given will show you the data read from the file and will have calculated the consumption of your virtual house. It will indicate whether you are within the appropriate target range (as indicated in the output); the last line of the output will indicate whether or not you are within the target range.

Sample output:

```
Welcome to the IBM Mainframe Challenge
---
Obtaining consuming appliances in the HOUSE …
Base : 100 W
Target is 8000 Wh
Error +/-: 10 %

Television:1 90 mins
Computer:1 120 mins
Games console:2 75 mins
Economy light:3 60 mins
Economy light:1 240 mins
Washing machine:1 70 mins
Dishwasher:1 75 mins
Charger:1 60 mins
Power shower:1 10 mins

Result
---
Target = 8.000 kWh. Actual = 6.514 kWh.
Error target = 10%, actual = -18%
 *** TRY AGAIN ***
***
```

2.4 Editing a dataset member

In order to produce a successful outcome when invoking the program as described in Step 2.4, you must modify the input file.



Category	Appliance
1	Television
1	Computer
1	Games console
2	Economy light
2	Incandescent light
3	Tumble dryer
3	Washing machine
3	Dishwasher
4	Charger
4	Power shower

Table 1: Appliance data

To edit a dataset you must navigate to ISPF utility 3.4.

From the main menu within ISPF (use `F3` to return there), type in **`3`** and press **`Enter`** to enter the Utility Selection Panel.

Looking through the options available to you you will see that option 4 will give you the option to list datasets. Type **`4`** and press **`Enter`**. You are now in ISPF utility 3.4.

In the Dsname Level field type `<user>.CHALLNGE.DATA` and then press **`Enter`**. What will appear is a list of one dataset matching the name specified.

In the command column ask to edit members in the dataset by specifying `e` in the Command column, and then press **`Enter`**.

You will now be presented with the list of members available within that dataset. Tab down to the line which has the `HOUSE` member on it and edit that member by specifying `e` to the left of the member as

represented in Illustration 9. Edit the member by pressing **Enter**.

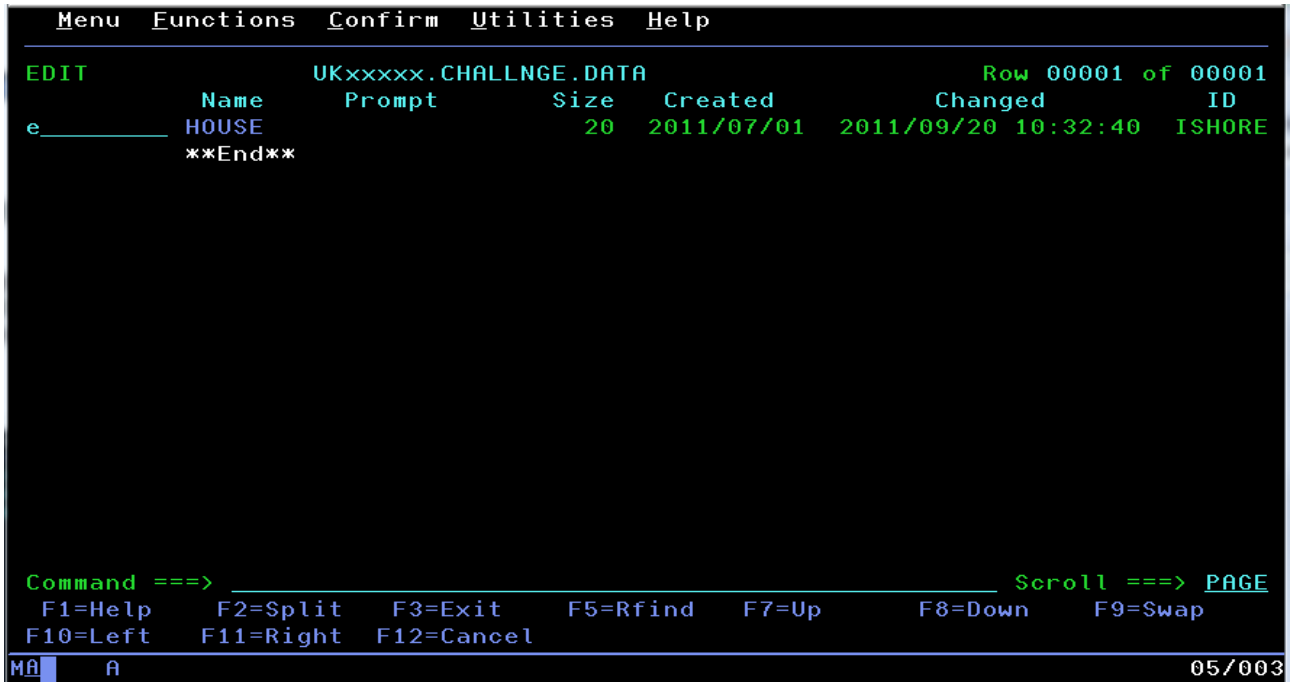


Illustration 9: ISPF utility 3.4 - editing a dataset member

You will now be within an editing session where you can update the dataset member. There are many commands and actions that you can now use to edit this member but the main ones that you will need are:

Use `F3` to save the file and exit.
Use `F12` to exit the file without saving.
Use `F7` and `F8` to page up and down respectively.
Use `F10` and `F11` to scroll left and right on the screen.
Over-type text on lines to change the text.
Commands can be typed (and **Enter** pressed) in the line number column on the left:

- `d` – will delete a line
- `i` – will insert a new line

Lines can be added but ignored by the program by starting them with a `#` character.

➔ **When you have modified the dataset member, repeat Step 2.3.**

If you are successful then you can continue to Step 2.5 to transmit the resulting dataset to the Mainframe Challenge administrator.

2.5 - Transmit the results dataset

Upon successful completion of Part 1 a new dataset will be created that must be transmitted to the Mainframe Challenge administrator. The created dataset will be named `<user>.<user>.RESULT`.

To transmit this dataset return to the ISPF Command Shell (ISPF utility 6), as described in Step 2.3, and type in the following command:

```
xmit ZOS19.MATTK dsn('<user>.<user>.RESULT')
```

where `<user>` is your ZEUS user ID.