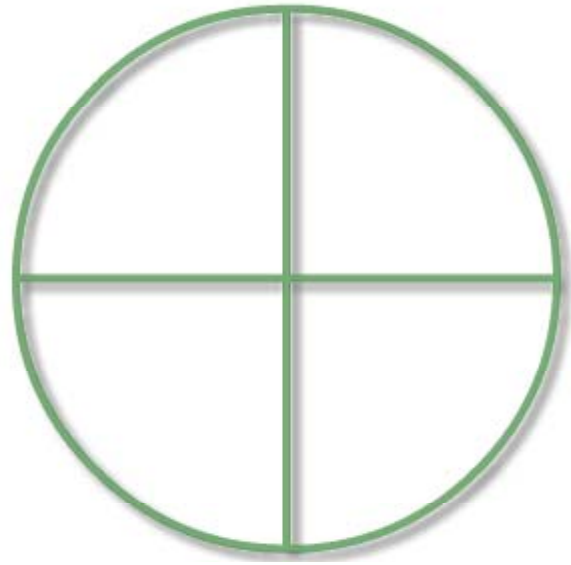# Function Points Analysis
Training Course
ANSWERS

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Chapter 1

Questions:

Problem 1
How would you estimate the number of hot chocolates being sold at the AFC Championship game in Kansas City (use your imagination, the Chiefs could be there)?

Look at other football teams in the same climate. It would not be useful to examine hot chocolates sold in Miami or San Diego. The key factors would be things like number of fans, the expected temperature.

What are the keys factors to consider?

Who would you benchmark against and why?

Problem 2
What is the average cost per mousepad if you produce 1,000 units at the following costs?

Artwork is a fixed cost at $500
Sets Up costs are $250
Shipping costs are $10
Papers for production will cost $2.50 per unit.
Pads are $ .25 per unit.
Application of paper to pad cost is $.35 per unit

Are the unit costs the same for all items?

Is it correct to assume that unit costs are fixed for software? (Intuitively, do you expect the per unit cost to create reports the same as the per unit cost to build a data base.)

(500+ 250+10)/1000 + 2.50 + .25 + .35 = 3.86

The same can be said for software applications, the unit cost is not fixed across the entire application. Online screens may have one cost and Interface may have a totally different cost.

Chapter 4

1. The following information is heard in the Rome Train Station. How many data elements are heard?   That is, what information varies from one train arrival to the next?

The train arriving from Florence will arrive on Track 46 at 8:30 a.m.
The train arriving from Naples will arrive on Track 43 at 11:00 a.m.

The variable information is city, tract and time (3 DET's).

2. The totals on a particular report change colors depending if the amount is above or below $ 500.

   For example if the amount is -$250 it appears as **$250,** but if the amount is over 0 then the value appears blue. For example if the amount is **$1,000.** How many data elements are represented by the number and by the color?

If there is a control file that is maintained with preferences the color would be considered a DET. For example, if the use could select to display a + or the color blue then the information is dynamic.

Chapter 5 (External Inputs)

All of these questions are just looking up the information on a reference card. Also, it is a good way to get people to participate early in the class.

1. If an EI has one file type referenced and 5 data elements is it rated, low average or high? What about 7 data elements?   Or 25 Data elements?

2. How many data elements are there on the control input in the body of the chapter?

9 data elements. The 6 check boxes, the 2 radio buttons groups and the action key. There can be some discussion on the the other buttons. The default key could be an inquiry if the information is read from a file, the cancel button is nothing (just clears the fields), the help could be treated as an EQ also.

3. Does every EI have to update an ILF?   Why?

No, there could be a control input that does not update an ILF.

4. What are the criteria for an EI to be rated high?

5. Fill in the "value" of a low _____ average _____ and high _____ EI?

The following screen is used to add a new customer to an application. The OK command button and the Next command button both add the new customer to the database.

6. How many data elements are there in this input screen?

10 DET's (including 1 DET for the OK or for the Next). Only one of the action keys are counted.

7. If this screen updates one internal logical file how many unadjusted function points does this screen represent?

The screen would be rated as a low EI (10 DET's, 1 FTR).

8. How many data elements does the phone number represent?

In this case the phone number is one data element.   Sprint or MCI sees a phone number as several data elements not just one. The real distinguishing factor is how the number will be use.

9. Is the Cancel command button counted as a data element? *No, it is only navigation*

Application A has a batch input file. The batch file is one physical file, but contains many different types of records. The first field is a record identifier number. The record identifier number can range from 1-75.   The second field describes if the record is new and adds to the file, changes a previous batch input or a deletes a previous batch input (add, change and delete). Depending on the record identifier number there are a unique set of data elements, a different set of files are updated and referenced, and different processing logic is followed. Every single record identifier number updates more than 3 files (has more than 3 FTR's) and contains more than 5 data elements. How many function points does this one batch input represent?

The batch file can add, update, or delete and there are 75 different record types and each one would be rated as a high.

3 x 75 x 6 = 1,350

Ice Cream Cone Sales by Month

Flavor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Vanilla	80	85	85	90	110	120	135	145	90	84	75	70	1169
Chocolate	75	80	70	83	100	105	109	120	80	70	69	65	1026
Strawberry	30	35	35	40	70	80	95	105	40	34	25	20	609
Pistachio	8	9	9	9	11	12	14	15	9	8	8	7	119
Other	12	13	13	13	15	17	19	20	14	13	13	12	174
Total	205	222	212	235	306	334	372	405	233	209	190	174	

1. How many data elements are there in the above chart?

Flavor, Month, Total by Flavor, Total by Month or 4 DET's

2. Is there recursive (repetitive) information?   What is it?

The recursive information is flavor, months and the totals. Think about if there was a report with just flavor and total..

3. How many data elements are there in the following line chart?   Can recursive information be seen easier in graphs?
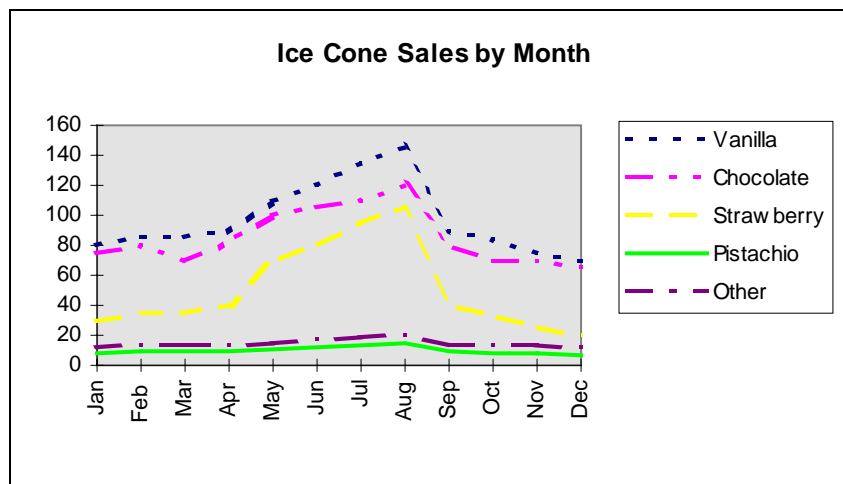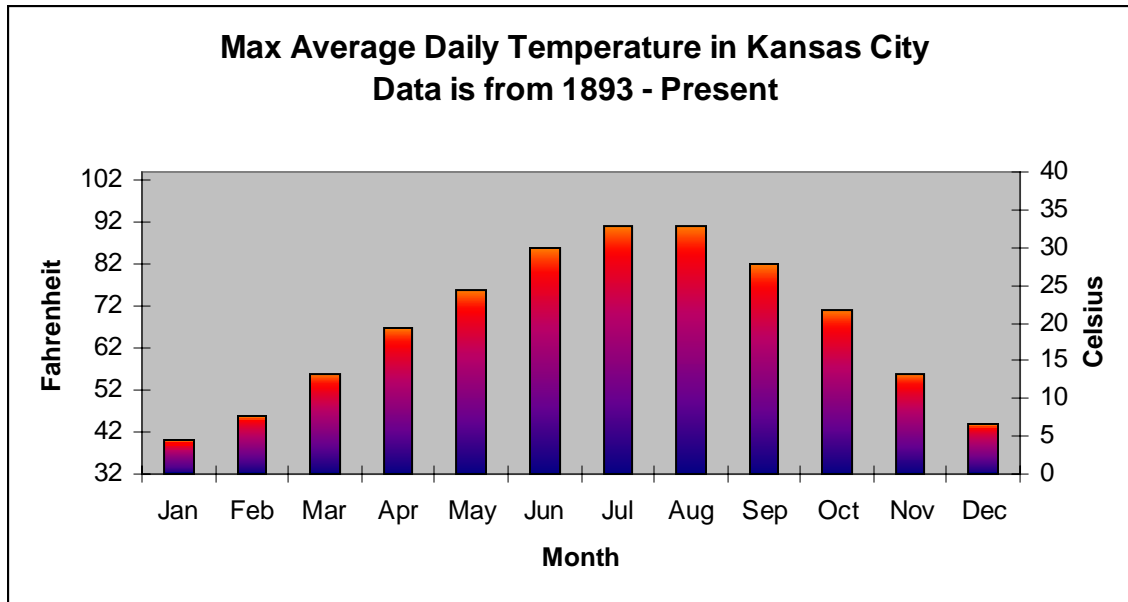
2 data elements. Flavor and Month.

Figure 1

4. How many data elements are in the following chart with 2 y - axis?

Max Average Daily Temperature in Kansas City
Data is from 1893 - Present

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Chart: Fahrenheit (left axis 32–102) and Celsius (right axis 0–40) bar chart of Max Average Daily Temperature by Month.

Fahrenheit Scale, Month and Celsius. Even though Celsius is derived from Fahrenheit it is still considered another data element. Also, we need to determine if "Kansas City" is a DET and "1893-Present"

5. How many data elements are there in the following pie chart?

Flavor and Percent or 2 DET's

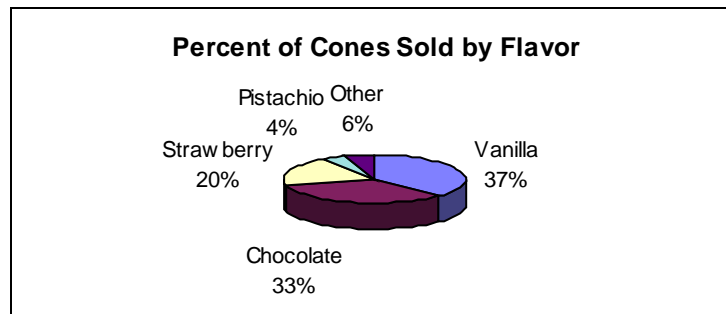**Percent of Cones Sold by Flavor**

Figure 2

6. If an EO has 4 file types referenced and 15 data elements is it rated, low average or high?

7. What about 5 data elements with 4 FTR's?   Or 45 Data elements with 4 FTR's?

8. Is it possible to have an EO that does not reference any ILF's?   Why?

If an EO must contain derived data, then the information has to come from somewhere. In this case it could come from an EIF, but an EO must reference at least one FTR.

9. What is the criterion for an EO to be rated low?

10. Fill in the "value" of a low _____ average _____ and high _____ EO? How does this compare to an EQ?   Why the difference?

11. You have a list of 25 reports and you can safely assume that each report is separate elementary processes, estimate the number of unadjusted function points.

One approach would be to rate them all as average.

12. You are given a list of the following 5 reports and the only information you have are the number of FTR's.
Report 1, 3 FTR's
Report 2, 5 FTR's
Report 3, 1 FTR

Report 4, 2 FTR's
Report 5, 1 FTR

Estimate the number of unadjusted function points. What method did you use?

One way to estimate would be to use only the rows from the EO table, the first column is low, second is average, third is high.

13. How would estimate the unadjusted number of function points if you were provided the following information.

Report 1, 4 DET's
Report 2, 25 DET's
Report 3, 10 DET's
Report 4, 15 DET's
Report 5, 2 DET's

One way to estimate would be to use only the rows from the EO table, the first column is low, second is average, third is high

14. What method did you use?

15. Previously, the line graph of ice cream cone sales was counted as one unique External Output. If a graph were exactly the same except in Italian, would this be considered another unique external output?

It would not be considered another unique EO, but the EO would have more DET's and more FTR's. There would be another FTR that would contain the languages and more DET's would be dynamic.

16. Two separate checks are created an expense check and a payroll check. Both checks look identical and have the following fields, employee name, employee address, amount of check, date of check is printed. The expenses check uses the expenses reimbursement file and the employee file and the payroll check uses the payroll file and the employee file. The calculations for each check are different.   How many external outputs are there? Explain your answer?

There would be two External Outputs. The key is different files are referenced also there are different calculations.

Chapter 7

The following customer list is displayed by clicking on the title bar "Customer." The following list is displayed (and is read from a file).

If a particular customer is double clicked additional information is displayed.


1. How many EQ's does the **Customer Button**, **Customer: Job List** and **Edit Customer** represent?

One for the summary and one for the detail. The customer button and Customer Job List Combine to make one, the Job List and Edit customer combine to make the second EQ.

If **Customer:Job** is clicked then the following menu is displayed. If new is selected a blank (empty screen appears – same fields as **Edit Customer**). If delete is selected on delete confirmation is displayed.
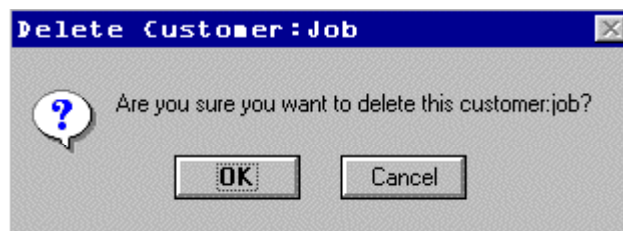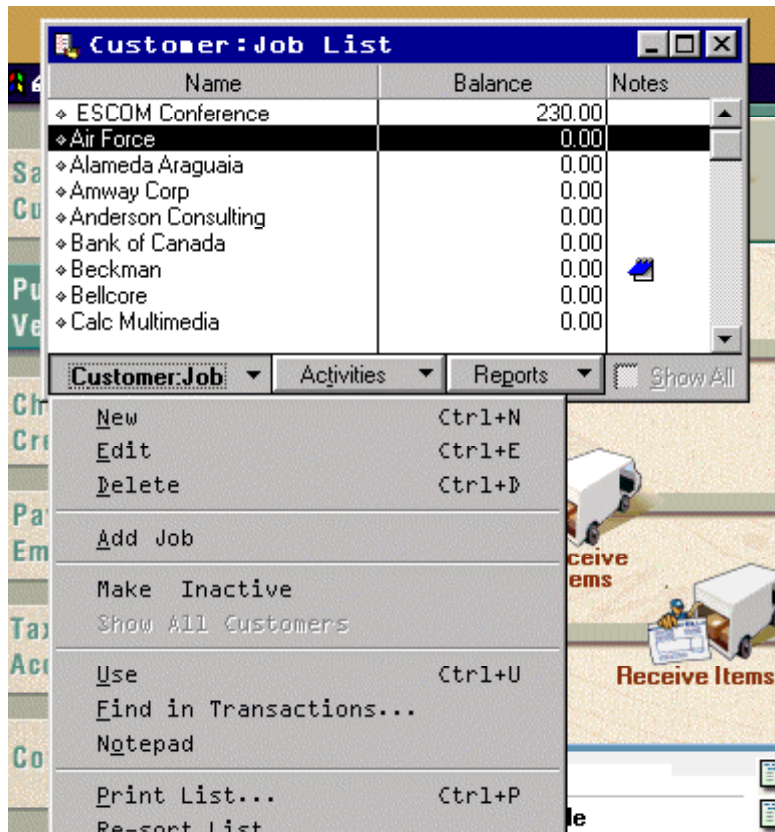
2. How many EI's does this series of screens (Edit, New and Delete) represent?

One for each type of transaction 3 EI's. The delete confirmation is considered another data element.

3. If an EQ references one file type and has 25 data elements is it rated, low average or high? What about 5 data elements?   Or 45 Data elements?

4. Does every EQ have to have at least one FTR?   Why?
   How does this differ from an EO?

Yes – otherwise where does the information come from. There has to be some FTR to get the information from.

5. What is the criterion for an EQ to be rated high?

Chapter 9

1. If a single internal logical file is separated into 3 physical files because of implementation concerns, then how many internal logical files are counted?

It is still considered 1 ILF.

2. A logical group of data is best described as?

Well, a logical group of data

3. If an ILF has one record type and 25 data elements is it rated, low average or high? What about 5 data elements?   Or 45 Data elements?

4. Does every ILF have to have at least one EI?   Why?
Yes, because an ILF must be maintained. Otherwise where does the information come from.

5. Should every ILF have at least one external output or external inquiry?   Why?
It should. Think about it, why is information being stored in an ILF?

6. What are the criteria for an ILF to be rated high?

7. Fill in the "value" of a low ____ average ____ and high ____ ILF? How does this compare to an EIF? Why the difference?

Examine the following tables. The user requires detail information about customers and sales representatives.

1. How many internal logical files?   *There are two ILFs*

2. How many data elements?   Is there more than one record type?
There are 9 DET's in the first table and 8 DET's in the second. The key information is counted in both tables.

3. Can the tables be formed to combine one internal logical file?
No, because there would be redundant data in the tables.

Customer Table

Customer Number	Name	Address	City	State	Zip Code	Balance	Credit Limit	Sales Rep Number
AN91	Atwater Nelson	215 Watkins	Oakdale	IN	48101	$347	$700	04
AW52	Alliance West	266 Ralston	Allanson	IN	48102	$49	$400	07
BD22	Betodial	542 Prairie	Oakdale	IN	48101	$57	$400	07
CE76	Carson Enterprise	96 Prospect	Bishop	IL	61354	$425	$900	11

Sales Representative Table

Sales Rep Number	Last Name	First Name	Address	City	State	Zip Code	Area Manager Number
04	Right	Mike	95 Stockton	Oakdale	IN	48101	14
05	Perry	Tom	198 Pearl	Oakdale	IN	48101	17
07	Sanchez	Rachel	867 Bedford	Benson	MI	49246	17
11	Morris	Katie	96 Prospect	Bishop	IL	61354	21

Imagine a database that stores information about albums.

The database is broken down as Artist, Album Name, Publication Date, and Songs. The key to the database is both Artist and Album Name. The field *songs* have three subset fields. Song contains tack number, song name and length of playing time.

For example,

> Bruce Springsteen, Born to Run, Songs. The first row of the song subset is #1, Born To Run, 4:30.

Figure 3 - Songs Field

    1. How many internal logical files are represented by this database?
One ILF
    2. How many total data elements?
Artist, Album Name, Publication Date, and Songs (number, title, duration)
    3. How many total record types are there on the database?
2
    4. What is the recursive information?
The song information

Chapter 11

1. What is the value adjustment factor if all of the general system characteristics scored a value of 5 (strong influence)?

1.35

2. What is the value adjustment factor if each of the general system characteristics has no influence (a score of 0)?

.

.65

3. What is the origin of the .65 in the value adjustment factor calculation?

If all the GSC's receive a median value of 2.5 then, the TDI would be 14 * 2.5 = 35. If we wanted to have the VAF to add up to 1.00 then a constant factor or .65 needs to be used.

4. What is the possible (theoretical) range of the value adjustment factor?
.65 to 1.35

Chapter 12

1. An application has a base unadjusted function point count of 500, a value adjustment factor of 1.10. What is the adjusted function point count?

500 x 1.10 or 550

2. An application has 100 unadjusted function points and a value adjustment factor of 1.02. An enhancement project adds 25 function points, deletes 20 function points, and changes 15 function points (in this case assume CHGB = CHGA).   The new value adjustment factor is 1.05.

3. What is the new (after the enhancement) adjusted function point count?
*AFP = [(UFPB + ADD + CHGA) - (CHGB + DEL)] * VAFA*
AFP = [(100+25+15)-(15+20)] 1.05*

4. What is the enhancement function point count?
*EFP = [(ADD + CHGA + CFP) * VAFA] + (DEL* VAFB)*
*EFP = [(25+15+0)*1.05+(20 * 1.02)*

An application has the following:
10 Low External Inputs, 12 High External Outputs, 20 Low Internal Logical Files, 15 High External Interface Files, 12 Average External Inquiries, and a value adjustment factor of 1.10.

5. What is the unadjusted function point count?

10 x 3 = 30
12 x 7 = 84
20 x 7 = 140
15 x 10 = 150
12 x 4 = 48

452

6. What is the adjusted function point count?

452 x 1.10

CASE STUDIES ANSWERS

Collection Letter

<today_date>

Dear <title> <last_name>,

Our records indicate that you are past due <num_of_days>. If you do not pay within <pay_day>, then we will kindly repo your <color><style_ automobile>.

<greeting>.

Warm Regards,
<repo_man>

Example letter

December 18, 1999

Dear Mr. Harmon,

Our records indicate that you are past due 255 days. If you do not pay within 5 days from the date of this letter, then we will kindly repo your red Ford 150 Truck.

Please have a Merry Christmas and prosperous New Year.

Warm Regards
Rocky Balboa

Questions and other information

❖ The number of past due days (num of days) is date of letter minus the due date. Due date derived from the *Payment File*
❖ *Pay day* is calculated.
❖ *Repo Man* is read from the *Employee File*
❖ Title and Last Name are read from the *Customer File*
❖ The *greeting* is based upon the date of the letter and an appropriate message from the *Greeting File*.

What are the data elements? **8, today's date is counted because it is meaningful information.**
Is this letter an EO or an EQ, why? EO since pay day is calculated.
How many FTR's? **4 FTR's**

Control Inputs

Accounting

1. How many data elements are on the "Checking Preferences" control Screen?

   5 DET's one for each check box and the OK button.

Checking

2. How many data elements are on the "General Preferences" control Screen?

   12 total DET's, 9 check boxes, 2 radio buttons, and the OK

Finance Charge

3. The how many control inputs are represented by the menu items to the right?

   Looks like it could be 4 control EI's, but need more information.

General

4. If the "default" reads values from a control file, then how is "default" treated? It would be treated as an EQ.

Iconbar

Menus

Checking Preferences

☐ Print account names on voucher

☐ Change check date when check is printed

☐ Start with payee field on check

☑ Warn about duplicate check numbers

✔ OK

✗ Cancel

? Help

Default

General Preferences

Desktop

◉ Save when closing company
○ Save current desktop
○ Don't save the desktop

Time Format

Show portions of an hour as

◉ Decimal (10.20)
○ Minutes (10:12)

☐ Pressing Enter moves between fields

☐ Automatically place decimal point

☑ Automatically recall last transaction for this name

☑ Warn when editing a transaction

☑ Warn when deleting a transaction or unused list item

☑ Beep when recording a transaction

☐ Never update name information when saving transactions

☐ Turn on all one time messages

☑ Hide Qcards for all windows

✔ OK

✗ Cancel

? Help

Default

Graphical Information

Income and Expense by Month
Oct 1 - Dec 15, '97

☐ Income
☐ Expense

$ in 1,000's

20		
10		
0		

Oct '97   Nov '97   Dec 1 - 15, '97

Income Summary
Oct 1 - Dec 15, '97

☐	Landscaping Services	%61.63
☐	Design Services	36.77
☐	Markup Income	1.21
☐	Other Income	0.39
	Total	$43,758.50

By Account

Expense Summary
Oct 1 - Dec 15, '97

☐	Payroll Expenses	%44.63
☐	Job expenses	25.71
☐	Rent	8.11
☐	Cost of Goods Sold	5.68
☐	Insurance	5.52
☐	Interest Expense	3.63
☐	Tools and Misc. Equipment	2.06
☐	Utilities	1.52
☐	Professional Fees	1.27
☐	Automobile	1.05
☐	Other	0.83
	Total	$29,610.57

By Account

1. What are the external outputs?

The three graphs (bar, and two pie)

2. What are the data elements for each EO?

Date range, item, percentage and total.

3. How are the legends treated? **In this case the legends are part of the graphs.**

Graphs Part II

There are two data ILF's that contain information needed to produce the graph. There is an additional control file, which alters the way the graph looks.

1. Is there a control EI and control ILF for "graphs"?

    Yes… this will increase the number of FTR's

2. How many total FTR's are referenced for the graphs?

    3 Total, the two data and control
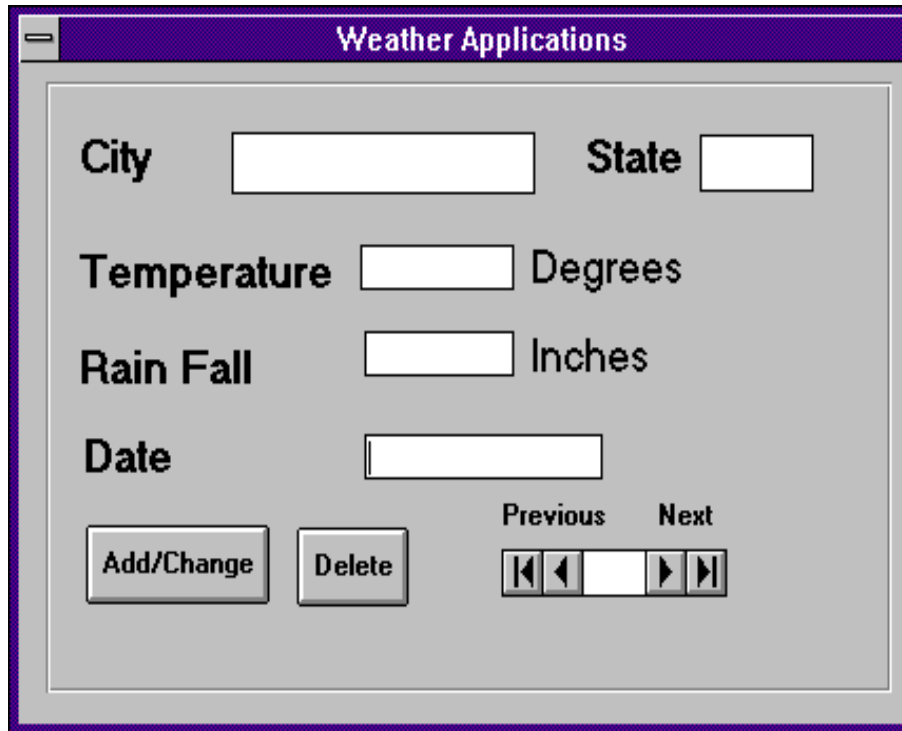
3. Does this graph represent another EO?

No, it is the same as before, but now there are more FTR's.
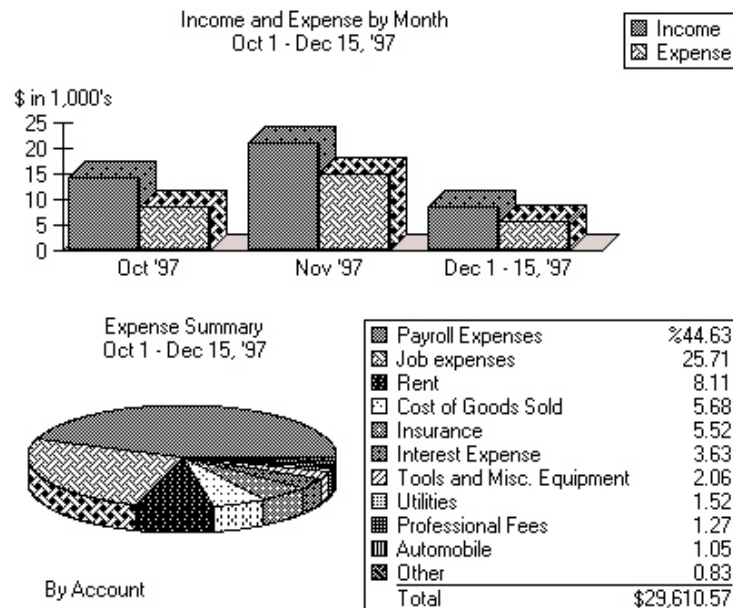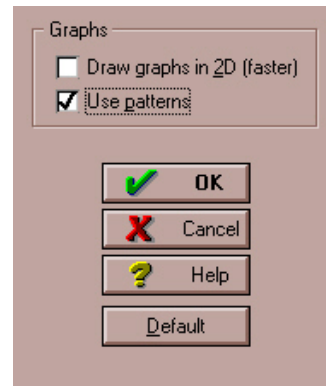
The Weather Application

Release 1.0

The following application was designed to capture temperature and rainfall by city and state. There is only one input screen, one file and one report. Each field on the following input screen can be modified (add, changed or deleted). The add and change functions are different. All previous entries viewed by using the scroll bar. Assume a VAF of 1.0.

Weather Storage File				
City	State	Temperature	Rain Fall	Date

Average Temperature and Rain Fall by City and State				
		Temperature	Rain Fall	Date
City 1	State 1			
	Detail Readings for City 1			
	Averages			
City 2	State 2			
	Detail Readings for City2			

	Averages			

Based on the weather application fill in the following table. The exercise is designed to identify the exact number of data elements.

Component (EI,EXTERNAL OUTPUT, EQ, ILF and EIF)	Number of Data Elements?	What are the data elements?

What is the total unadjusted number of function points?

Explanation of Problem

Each EI has 6 data elements (the input field) and the action key. The EQ has 6 data elements also (the fields and the action key). The scroll button represents only one DET.

The ILF has only 5 DET's

The report has 7 data elements – do not forget average temperature and average rain fall (by the way there is no average date).

All the components are low.

Adding A New Customer

The following two screens are used to add a new customer to an application. The customer is not considered added until both Address information and Additional Information is completed.

The OK and Next buttons both save information to the file.

Figure 4

There are four drop down list boxes on the Additional Info tab (Type, Terms, Rep and Tax Item). The first three (Type, Terms and Rep) are read from files that are maintained by the application. Tax item is hard coded. Please ignore the "Define Fields" button.

Figure 5

The drop down lists Type, Rep and Terms are displayed at the end of this case study.

For this part of the application please answer the following questions.

1. How many external inputs are there?

Only one
2. How many total data elements are there on the external input?
23 (if I counted right), do not forget the customer is taxable field! And the action key.

3. What are the data elements?
   The fields that data can be input and the action key.
4. In terms of function points what are Type, Terms and Rep?

The are external inquiries

5. In terms of function points how are Type and Terms treated the second time they appear?
   The Rep and Terms drop down box are used again when invoices are created.

They are not counted as EQ's, but they would be treated as DET's for the EI's.

Enhanced Weather Application

Release 2.0

Release 2.0 is an enhancement to "The Weather Application" Release 1.0. The user wants the ability to save temperature as either Celsius or Fahrenheit. To accomplish this a radio button is added to the input screen, which allows the user to select either Celsius or Fahrenheit. An additional field is added to the file, and an additional field is added to the reports.   Assume that the value adjustment factor increases to 1.14.

How many "enhancement" function points does this represent?

What is the baseline function point of release 2.0?

Every item in the application changed. There was a new field on all the EI's, a new field on the EQ, EO and ILF.   Hence, the enhancement is the same size as the original baseline.

In the first version there was 3 Low EI's, one Low EQ, one Low EO and one Low ILF (9 + 3 + 4 + 7) or 26 unadjusted function points.

Just multiply 26 x 1.14, which is 29.6 (or 30) adjusted function points.

BikeWare

Release 1.0

BikeWare is a software product designed for competitive bike riders.   BikeWare captures and stores a variety of information.   BikeWare is for a single rider only. The rider wants to be able to change, add or delete information about a ride or rider. The following information is either entered by the rider or calculated. All **bold** items are stored. The following information is grouped logically into two major groups (ride and rider):

Ride Information

> **Average Speed**
> **Bike Chill Factor**
>> T = Temperature during the Ride
>> W = Average Speed
>> X = .303439 * sqr (W) - .0202886 * W
>> Bikechill = Int (91.9 - (91.4 - T) * (X + .474266))
>
> **Cadence**
> **Calories Burned** = Exponential $^{((.092037 * Average Speed) - 4.26))}$ * (Duration of Ride) *Weight of Rider)
>
> **Date of the Ride**
> **Distance of the Ride**
> **Duration of Ride**
> **Temperature during the Ride**

Rider Information

> **Age** (age of rider in years)
> **Weight** (weight of rider)
> **Sex** (sex either male or female)

Graphs

Four separate graphs (see below) can be created by days, by weeks or by months for each item below. A different set of calculations will be used depending of the graph is days, weeks or a months graph.   Each graph is available on line or as a hard copy and processing logic is different.

> **Distance of Ride**
> **Average Speed**
> **Duration of Ride**
> **Calories Burned**

For BikeWare determine the following information:

Identify the external inputs, how many data elements and how many files will be referenced?

Item	DETs	FTR's	Rating	Value
EI Ride Add	**8**	**2**	**Ave**	**4**
EI Ride Change	**8**	**2**	**Ave**	**4**
EI Ride Add	**8**	**1**	**Low**	**3**

Item	DETs	FTR's	Rating	Value
EI Rider Add	**1**	**1**	**Low**	**3**
EI Rider Change	**1**	**1**	**Low**	**3**
EI Rider Add	**1**	**1**	**Low**	**3**

How many files type referenced are there for the add, the change and the delete? Is it always the same?

There are two FTR's because the EI needs the other FTR to make a calculation. The second FTR does not need to be referenced to make a deletion.

How many internal logical files are there and what are the data elements?

There are two ILF's. There are 8 in the ride ILF and 3 in the rider ILF. Only those values that are saved are counted as DET's.

How many external outputs? Describe the external outputs also?
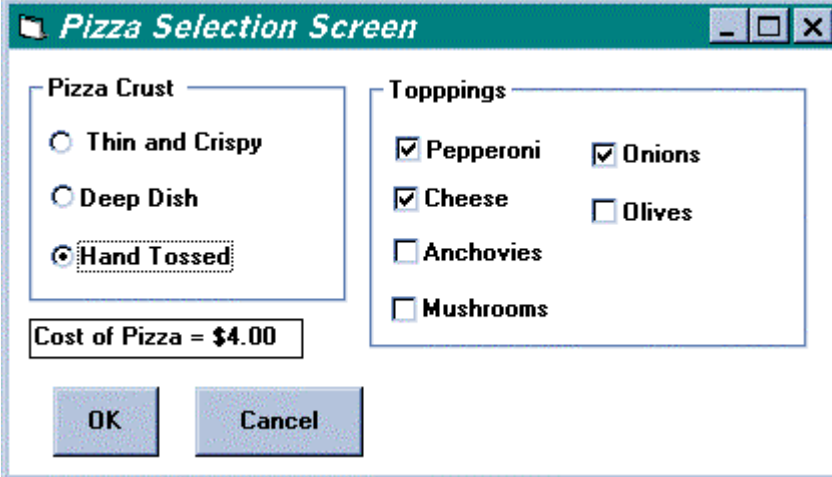
There are 24 EO's.

	Days	Weeks	Months	Totals
Distance of Ride	1	1	1	3
Average Speed	1	1	1	3
Duration of Ride	1	1	1	3
Calories Burned	1	1	1	3
Total	4	4	4	12

Since there is online and hardcopy and processing logic is different there are 12 x 2 or 24 total EO's

How many data elements for each external output? **Just two ….**

Pizza Screen Design

Option 1

Toppings are read from another application (kitchen application). If the topping is not available it is not displayed.

The cost of the Pizza is calculated automatically.

Figure 6

When the OK button is clicked the Toppings, Pizza Crust Type and Cost of Pizza are saved.

Option 2
The Items in the drop down box are hard code – not read from a file.
Available Toppings are read from another application (kitchen application).
When a Topping is selected from Available Toppings it is copied to Selected Toppings

Figure 7

The Cost of the Pizza is automatically calculated.
When the OK button is clicked the Selected Toppings, Pizza Crust Type and Cost of Pizza are the saved.

What are the differences if any between Option 1 and Option 2? Please fill in the table below.

Option 1		Option 2	
Component	**Data Elements**	**Component**	**Data Elements**
Toppings (EQ)	**1 and very recursive**	**Same**	
EIF (from kitchen app)	**1 perhaps more but it is still a low**	**Same**	
EI Add	**4 DET's**	**Same**	

Problem Explained.
The number of components and DETs are exactly the same in both options. An EI can have derived data.

www.PIZZACLUB.COM

Part 1

WWW.PizzaClub allows customers to order pizza via the Internet. The following is only one screen of many screens.

1. Once the customer has accessed www.PizzaClub.Com they fill out this screen.
2. When the customer clicks on the form the information is saved to a file.
3. If any of the fields are not filled out (populated) the customer receives and error message telling them "All fields must be populated".
4. What are the data elements? **The fields, the error message and action key (9)**
5. How many unadjusted function points does this screen and one file represent. **10 (low EI and assumed low ILF.**

Figure 8

Part 2

Www.PizzaClub.com is going to be enhanced.   Instead of allowing the customer to type city and state, they will input the zip code number. The application will search the zip code file and then automatically populate City and State. The customer can override the populated fields. The zip code file is maintained by another application.

How many unadjusted function points does this enhancement represent?

What are the new components?

What data elements are impacted?

In the example there are two new components an EQ and an EIF. There is no impact to the existing application. The process of saving information to a file which we counted before remains exactly the same. There is now an transaction that proceeds the EI that we count. And this new EQ transaction uses one EIF.

It is important to note that the user can intervene prior to the EI. That means the EQ transaction stopped. If there was no user intervention. The EI would have two FTR's and the query transaction would be part of the EI and not a separate transaction.

Control Information

What are the data elements in the following control screen (alignment)?

5 data elements
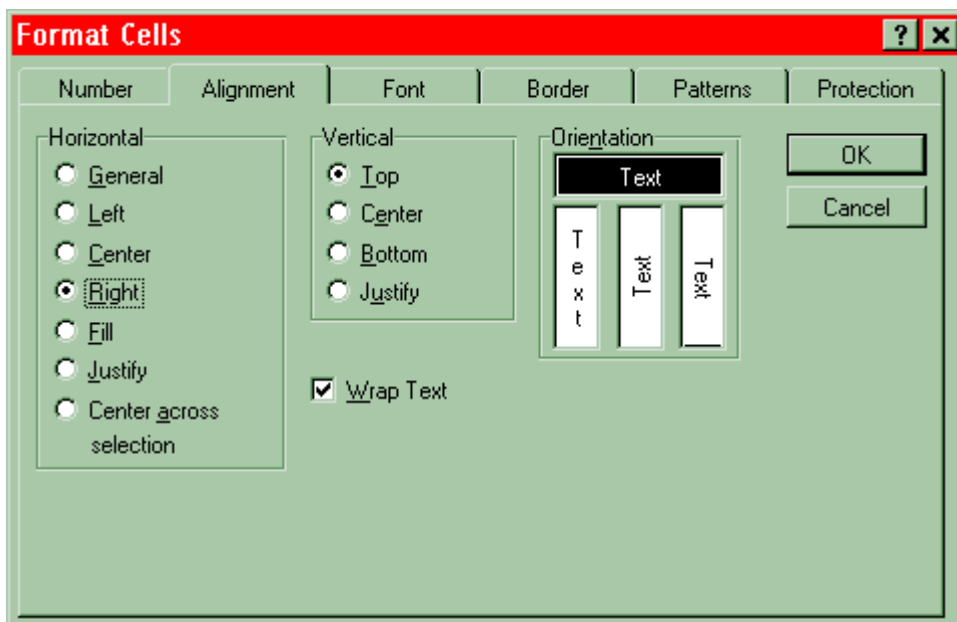
Figure 9 - Control Screen

How many data elements are there in the following "Data Entry Preferences" control screen? **9   6 DET's for the check boxes + 2 different radio buttons selections + 1 for the action key.**

If this control screen updates one internal logical file, then how many unadjusted function points does this represent? **10 (one low EI and one low ILF --- 3 plus 7)**
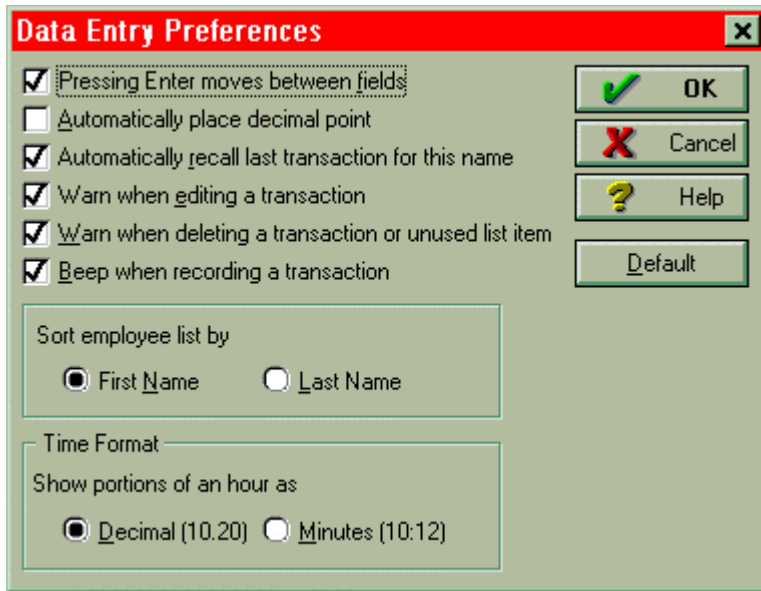

Figure 10