DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

APRAS: Analytic Petroleum Resource Appraisal System - Microcomputer Programs for Play Analysis Using a Field-Size Model

By

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A -- Documentation (paper copy)
B -- Executable program (5.25" diskette)

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INTRODUCTION

The U.S. Geological Survey has made major progress in the design and development of petroleum resource appraisal studies involving play analysis and analytic probabilistic methodology using a variety of geologic models (Crovelli, 1987, 1988a, 1988b; Crovelli and Balay, 1986, 1988, 1990a). This Open-File Report describes a package of two programs, named APRAS and APRASAG, for IBM PC (and compatible) microcomputers for assessing and aggregating undiscovered oil and gas resources using a play analysis approach with a field size model. APRAS (pronounced "appraise") means Analytic Petroleum Resource Appraisal System. APRAS assesses resources in one play, and APRASAG aggregates plays and other aggregations.

Play Analysis

Play analysis is a general term for various geologic models and probabilistic methods of analyzing a geologic play for petroleum potential. APRAS is based on an analytic method using probability theory, rather than Monte Carlo simulation. Conditional probability theory is applied, along with many laws of expectation and variance. The risk structure considers both the uncertainty of the presence of the assessed petroleum resource and its amount if present. The geostochastic system can be applied in explored as well as frontier areas. In play analysis, geologic plays are defined within a petroleum assessment area, and the individual plays are analyzed. The individual play estimates of oil and gas are aggregated, respectively, to estimate the petroleum potential of the entire assessment area. A geologic model for the quantity of undiscovered petroleum resources in a play involves uncertainty because of the incomplete or fragmentary geologic information generally available.

GEOLOGIC PROBABILITY MODEL

A play in the context of undiscovered resources consists of a collection of potential hydrocarbon accumulations having a relatively homogeneous geologic setting, such as structural or stratigraphic commonalities. A hydrocarbon accumulation is a discrete oil or gas deposit that may consist of one or more pools depending on the specific play concept. An accumulation is modeled by separately considering the uncertainty of the occurrence of the assessed hydrocarbon exceeding a specific amount, and the quantity of the hydrocarbon if present. An accumulation of hydrocarbon is modeled as either crude oil and its associated dissolved gas, or solely as nonassociated gas. The amount of associated-dissolved gas in an accumulation of oil is calculated using a gas-oil ratio. Because gas refers to either nonassociated gas or associated-dissolved gas, the amount of gas in a play is the sum of the two types of gas from the accumulations. Three sets of geologic attributes or random variables are involved in this play analysis approach; those for the play, for the accumulation occurrence, and for the accumulation sizes. The play and accumulation occurrence attributes are concerned with the presence or absence of certain geologic characteristics at the play and accumulation levels, respectively. The hydrocarbon accumulation distributions are concerned with the size of the hydrocarbon accumulations.

The play attributes are: (1) existence of a hydrocarbon source, (2) favorable timing for migration of hydrocarbons from source to trap, (3) potential migration paths, and (4) existence of potential reservoir facies. The presence of all four play attributes (in which case the play is said to be favorable) is a necessary, but not sufficient, condition for the existence of oil or gas deposits in the play. Thus, if one or more of these attributes is not present, all the accumulations within the play are dry. Subjective judgments are made by experts for estimating the probability of the presence of each play attribute. The product of these four probabilities is the probability that the play is favorable for the existence of hydrocarbon accumulations and is called the *marginal play probability*.

A conditional probability of at least one undiscovered accumulation in the play exceeding specified minimum amounts for oil and gas is assigned; the condition being that the play is favorable. The hydrocarbon-type probabilities, that is, the respective probabilities of a given accumulation being either oil or nonassociated gas, are also estimated.

The hydrocarbon accumulation parameters include the oil and nonassociated gas accumulation sizes, both of which are treated as continuous independent random variables. The probability distribution for an accumulation size is determined from subjective judgments made by experts, usually geologists, based on actual geologic and geophysical data, when available, and the experience and knowledge of the experts using analog data and geologic extrapolations. A computer package named PROBDIST (Crovelli and Balay, 1990b) can be used to aid the user in selecting and refining an appropriate probability distribution model. The probability distribution for each accumulation size is described by a complementary cumulative distribution function determined from seven estimated fractiles (100th, 95th, 75th, 50th, 25th, 5th, 0th). (The 5th fractile, for example, is an accumulation-size value such that there is a 5 percent chance of at least that value.) In each play analyzed, the seven fractiles are estimated for the oil and nonassociated gas accumulation sizes.

The conditional number of accumulations in the play is treated as a discrete random variable, and seven fractiles are estimated. The condition is that there is at least one undiscovered accumulation in the play.

The average ratio of natural gas liquids (NGL) to nonassociated gas and the average ratio of NGL to associated-dissolved gas are estimated. A subplay model was developed to estimate resources in a fraction of the play from estimates of the entire play. An economic model truncates distributions of the field sizes using a minimum economic cut-off value. An aggregation model was needed to aggregate individual play and subplay estimates of oil and gas, respectively, to estimate the petroleum potential of assessment areas and sets of subplays.

Probability judgments concerning the play and accumulation attributes are developed by experts familiar with the geology of the area of interest. The experts review all available data relevant to the appraisal, identify the major plays within the assessment area (e.g., basin or province), and then assess each identified play. All of the geologic data required by this model for a play are entered on an oil and gas appraisal data form (Figure 1). Information from the data form is entered into computer data files as the input for a computer program based upon an analytic method.

OIL AND GAS APPRAISAL DATA FORM
(APRAS)

Evaluator__________________________ Play Name:__________________________________
Date______________________________ Province ______________________________ No.________
Code:______________________________

ATTRIBUTE			PROBABILITY FAVORABLE OR PRESENT	COMMENTS
PLAY ATTRIBUTES	Hydrocarbon Source (S)			
	Timing (T)			
	Migration (M)			
	Potential Reservoir Facies (R)			
	Marginal Play Probability S x T x M x R = MP			
ACCUMULATION ATTRIBUTE	Conditional Probability of at least one undisc. accumulation in play Minimum accumulation size assessed ______ x 10^6 BBL or ton or Sm^3 ______ x 10^9 CF or Sm^3			
HYDROCARBON ACCUMULATION PARAMETERS (undisc. accum's)	Reservoir Lithology ☐ Sandstone ☐ Carbonate ☐ Other			
	Hydrocarbon type	Gas		
		Oil		

	Attribute \ Fractiles		100	95	75	50	25	5	0
HYDROCARBON ACCUMULATION PARAMETERS (undisc. accum's)	Accumulation Size	Oil (10^6 BBL or ton or Sm^3)							
		Gas (10^9 CF or Sm^3)							
	Reservoir Depth (x 10^3 Ft. or m)	Oil							
		NA Gas							
Conditional No. of accumulations									

Average ratio of associated-dissolved gas to oil:______CF/BBL or Sm^3/ton or Sm^3/Sm^3
Average ratio of NGL to gas: NA Gas______BBL/10^6 CF or ton/10^6 Sm^3 or $Sm^3/10^6$ Sm^3
Assoc-Dis Gas______BBL/10^6 CF or ton/10^6 Sm^3 or $Sm^3/10^6$ Sm^3

Estimated percent of resource in subplay:______%

Cutoffs for accumulation size: Oil ______10^6 BBL or ton or Sm^3; NA Gas ______10^9 CF or Sm^3

Figure 1. Oil and gas appraisal data form for APRAS.

Units of Measure

APRAS works either with English units (barrels of oil, BBL, and cubic feet of gas, CF), with metric weight units (tons), or with metric volume units (standard cubic meters, Sm^3).

Input and Output

APRAS takes as input the values of various play attribute probabilities, resource-to-resource ratios, subplay percents, accumulation size cutoffs, and fractiles for distribution of accumulation sizes, reservoir depths, and conditional number of accumulations. It produces output in the form of fractiles for estimates of crude oil, nonassociated gas, dissolved gas, total gas, NGL for nonassociated gas, NGL for associated-dissolved gas, and total NGL. APRAS computes estimates for a geologic play, and APRASAG computes aggregate estimates for a number of plays or other aggregates. All of the geologic play data required by the model are entered on an oil and gas appraisal data form, and later transcribed to computer data files for processing by the APRAS software. The primary data form is reproduced in Figure 1.

METHODOLOGY

Subplay and Richness Factor

A supplementary data form is included in Appendix A as a guide for calculating the percentage of the resources in a play contained within a *subplay*, or *cluster*, which is a part of a play defined for example by political boundaries. This calculation involves the *rating* (or *richness factor*), R, which is the relative potential of the cluster compared to the average (mean) quantity of resource per unit area in the play. The headings on the supplementary data form are:

1. Cluster number
2. Play number
3. Play name
4. (A) Play area
5. (B) Cluster area
6. (C) Cluster percent of play area
7. (D) Cluster rating or richness factor
8. (E) Cluster percent of play resources

Column (C) is equal to the fraction of cluster area to total play area, converted to percent:

$$(C) = \frac{(B)}{(A)} \times 100$$

Column (E) is equal to the cluster area percent times the cluster rating (richness factor):

$$(E) = (C) \times (D)$$

The ratings approach allows geologists to account for the facts that (a) petroleum resources are not evenly distributed throughout a play; (b) there may have been no production of oil and gas in the cluster; (c) some plays containing clusters may have been explored heavily while others have not; and (d) past exploration and production results in the plays would provide valuable information to an assessment of the cluster. See the following table for a general ratings scale.

Example 1.

Rating of resource potential is high, $R = 2$. The resource potential of the cluster is estimated to be 2 times the average resource potential of the play (per unit area).

Example 2.

Rating of resource potential is low, $R = 0.3$. The resource potential of the cluster is estimated to be 0.3 times the average resource potential of the play (per unit area).

Table. General ratings.

Qualitative assessment	Quantitative assessment
High (above average)	$R > 1.5$
Medium (average)	$0.5 < R \leq 1.5$
Low (below average)	$0 < R \leq 0.5$
Zero	$R = 0$

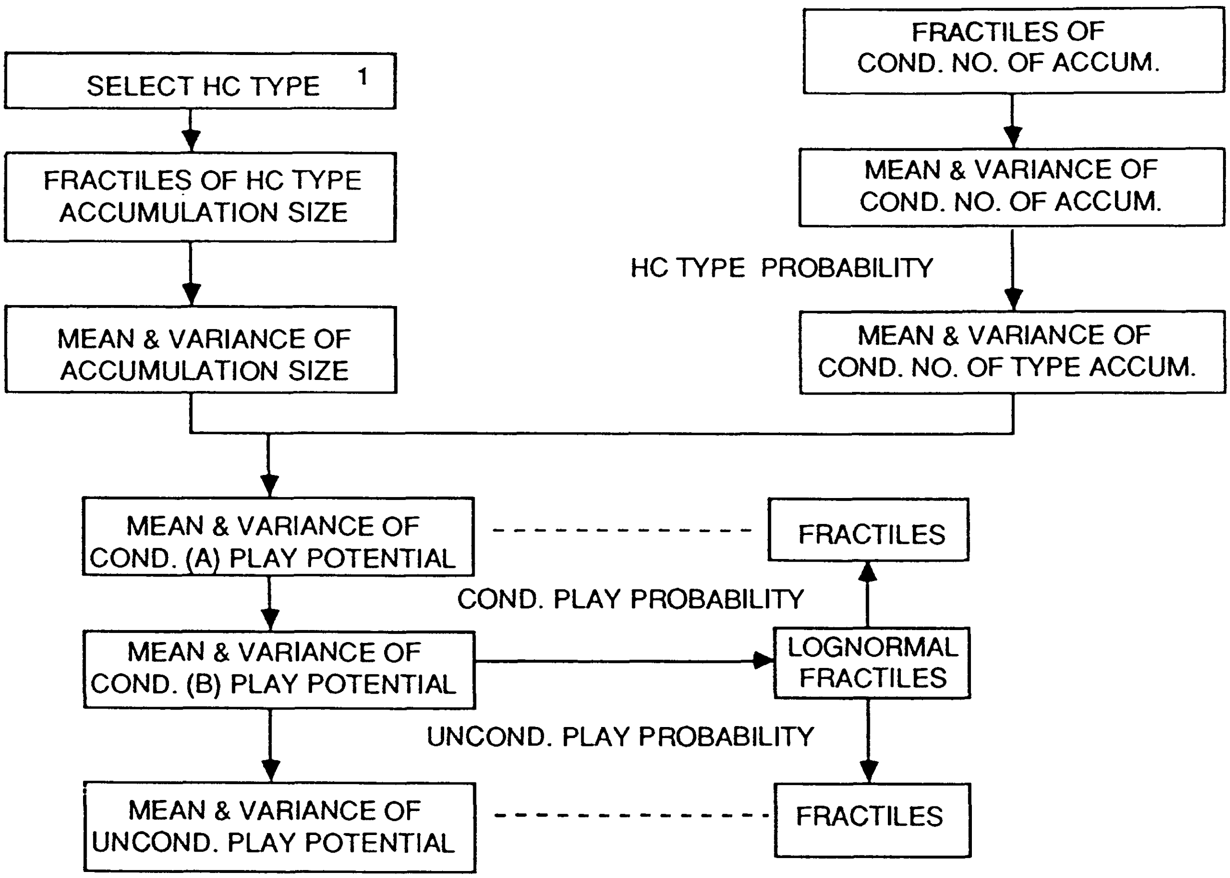
Note: $R = 1$ assessment implies that the cluster has average potential compared to the play as a whole.

APRAS

The analytic method was developed by the application of many laws of expectation and variance in probability theory. It systematically tracks through the geologic probability model, computes all of the means and variances of the appropriate random variables, and calculates all of the probabilities of occurrence. In arriving at probability fractiles, the lognormal distribution is used as a model for the play resource distribution (Crovelli, 1984). Oil, nonassociated gas, associated-dissolved gas, gas, natural gas liquids (NGL) in nonassociated gas, NGL in associated-dissolved gas, and NGL in gas resources are each assessed in turn. A simplified flow chart of the method is presented in Figure 2.

The basic steps of the analytic method of play analysis (field-size model) are:

1. Select the play.
2. Select oil as the first resource to be assessed.
3. Compute the mean and variance of the accumulation size of oil using the estimated seven fractiles and assuming a uniform distribution between fractiles, that is, a piecewise uniform probability density function (as is done in the case of a simulation method).
4. Compute the mean and variance of the conditional number of accumulations from the estimated seven fractiles, assuming a uniform distribution between fractiles (as is also the case in a simulation method).
5. Compute the mean and variance of the conditional number of oil accumulations by applying the hydrocarbon-type probability of oil to the mean and variance of the conditional number of accumulations.



[1] OIL, NONASSOCIATED GAS, ASSOCIATED-DISSOLVED GAS, GAS, NGL IN NONASSOCIATED GAS,NGL IN ASSOCIATED-DISSOLVED GAS, AND NGL IN GAS RESOURCES ARE EACH ASSESSED IN TURN.

Figure 2. Flowchart of analytic method of play analysis (field-size model).

6. Compute the mean and variance of the conditional (A) play potential for oil--the quantity of oil in the play--given the play is favorable and there is at least one undiscovered accumulation within the play. These values are determined from the probability theory of the expectation and variance of a random number (conditional number of oil accumulations) of random variables (oil accumulation size).
7. Compute the conditional play probability of oil--that is, the probability that a favorable play with at least one undiscovered accumulation in the play has at least one oil accumulation. This probability is a function of the hydrocarbon-type probability of oil and the conditional number-of-accumulations distribution.
8. Compute the mean and variance of the conditional (B) play potential for oil--the quantity of oil in the play--given the play is favorable and there is at least one oil accumulation within the play. These values are determined by applying the conditional play probability of oil to the mean and variance of the conditional (A) play potential for oil.
9. Compute the unconditional play probability of oil--the probability that the play has at least one oil accumulation. This probability is the product of the conditional play probability of oil, the conditional probability of at least one undiscovered accumulation in the play, and the marginal play probability.
10. Compute the mean and variance of the unconditional play potential for oil--the quantity of oil in the play. These values are determined by applying the unconditional play probability of oil to the mean and variance of the conditional (B) play potential for oil.
11. Model the probability distribution of the conditional (B) play potential for oil by using the lognormal distribution with mean and variance from step 8. Calculate various lognormal fractiles.
12. Compute various fractiles of the conditional (A) play potential for oil by a transformation to appropriate lognormal fractiles of the conditional (B) play potential for oil using the conditional play probability of oil.
13. Compute various fractiles of the unconditional play potential for oil by a transformation to appropriate lognormal fractiles of the conditional (B) play potential for oil using the unconditional play probability of oil.
14. Select nonassociated gas as the second resource to be assessed. Repeat steps 3 through 13, substituting nonassociated gas for oil and using the accumulation size of nonassociated gas and the hydrocarbon-type probability of nonassociated gas.
15. Select associated-dissolved gas as the third resource to be assessed. Repeat steps 3 through 13, substituting associated-dissolved gas for oil, with two basic modifications as follows. The accumulation size of oil is multiplied by a gas-oil ratio. The hydrocarbon-type probability of associated-dissolved gas is the same as the hydrocarbon-type probability of oil.
16. Select gas as the fourth resource to be assessed. Repeat steps 3 through 13, substituting gas for oil, with two basic modifications as follows. Replace step 3 to compute the mean and variance of the accumulation size of gas by using conditional probability theory and conditioning on the two types of gas. The hydrocarbon-type probability of gas is 1.0.
17. Select NGL in nonassociated gas as the fifth resource to be assessed. Repeat steps 3 through 13, substituting NGL in nonassociated gas for oil, with two basic modifications as follows. The accumulation size of nonassociated gas is multiplied by

the average ratio of NGL to nonassociated gas. The hydrocarbon-type probability of NGL in nonassociated gas is the same as the hydrocarbon-type probability of nonassociated gas or zero if the NGL ratio is zero.

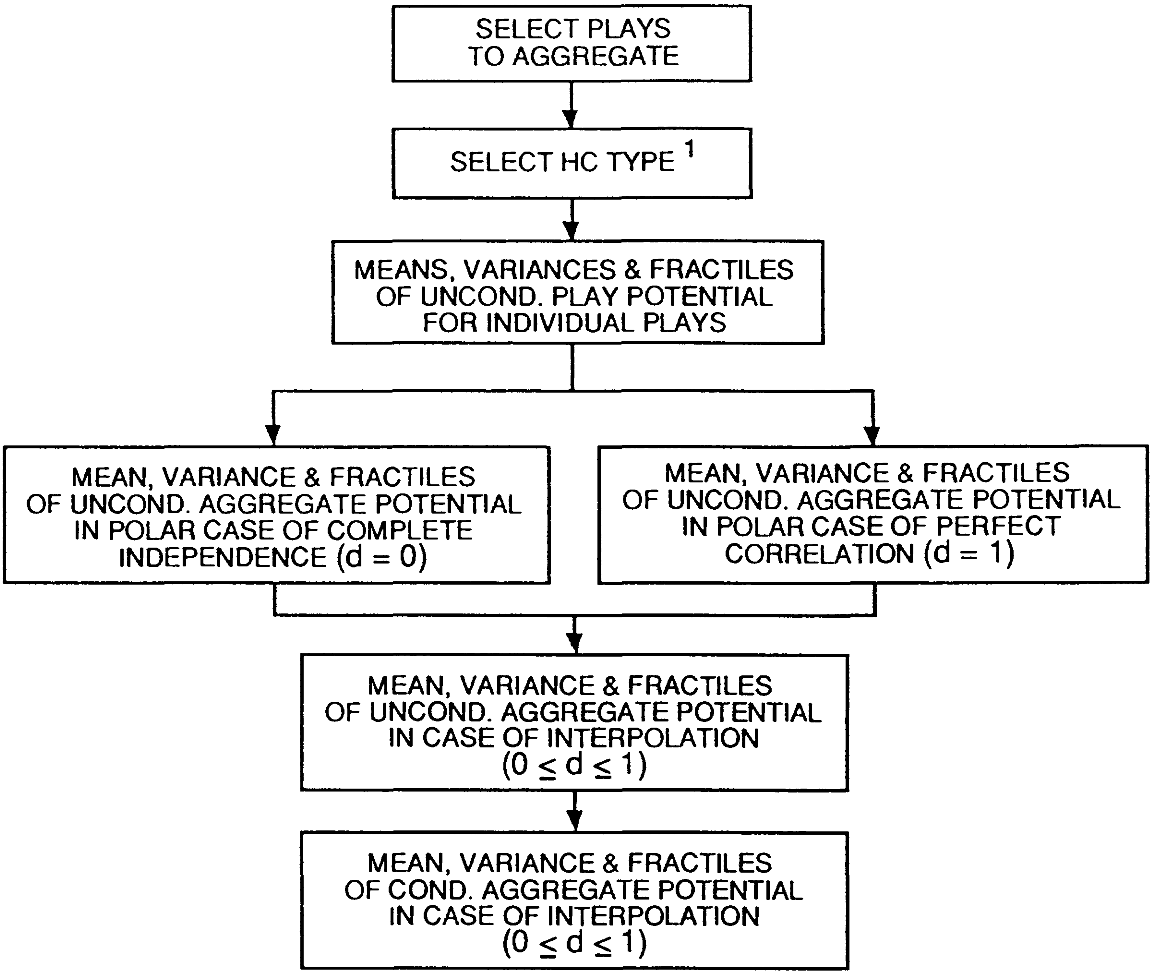
18. Select NGL in associated-dissolved gas as the sixth resource to be assessed. Repeat steps 3 through 13, substituting NGL in associated-dissolved gas for oil, with two basic modifications as follows. The accumulation size of associated-dissolved gas is multiplied by the average ratio of NGL to associated-dissolved gas. The hydrocarbon-type probability of NGL in associated-dissolved gas is the same as the hydrocarbon-type probability of associated-dissolved gas or zero if the NGL ratio is zero.
19. Select NGL in gas as the seventh resource to be assessed. Repeat steps 3 through 13, substituting NGL in gas for oil, with two basic modifications as follows. Replace step 3 to compute the mean and variance of the accumulation size of NGL in gas by using conditional probability theory and conditioning on the two types of NGL. The hydrocarbon-type probability of NGL in gas depends on whether or not the two NGL ratios are equal to zero.

APRASAG

A separate methodology was developed to estimate the aggregation of a set of plays. The resource estimates of the individual plays from play analysis using the APRAS program are aggregated using an analytic probability method. Oil, nonassociated gas, associated-dissolved gas, gas, NGL in nonassociated gas, NGL in associated-dissolved gas, and NGL in gas resources are each aggregated in turn. APRASAG is also able to aggregate a set of plays under a dependency assumption. A simplified flow chart of play aggregation is presented in Figure 3.

The basic steps of the analytic method of play aggregation are:

1. Select plays to aggregate.
2. Select oil as the first resource to be aggregated.
3. Compute the mean, variance and fractiles of the unconditional aggregate potential for oil in the polar case of complete independence--the quantity of oil in the assessment area of the aggregated plays under independence. (a) Determine the mean and variance by adding all the individual play means and variances of the unconditional play potential for oil, respectively. (b) Calculate the unconditional aggregate probability of oil--the probability that the assessment area has at least one play with oil--from the individual unconditional play probabilities of oil under the assumption of independence. (c) Compute the mean and variance of the conditional aggregate potential for oil--the quantity of oil in the assessment area, given the assessment area has at least one play with oil. These are determined by applying the unconditional aggregate probability of oil to the mean and variance of the unconditional aggregate potential for oil. (d) Model the probability distribution of the conditional aggregate potential for oil by using the lognormal distribution with mean and variance from (c). (e) Compute various fractiles of the unconditional aggregate potential for oil by a transformation to appropriate lognormal fractiles of the conditional aggregate potential for oil using the unconditional aggregate probability for oil.
4. Compute the mean, variance and fractiles of the unconditional aggregate potential for oil in the polar case of perfect positive correlation--the quantity of oil in the



[1] OIL, NONASSOCIATED GAS, ASSOCIATED-DISSOLVED GAS, GAS, NGL IN NONASSOCIATED GAS, NGL IN ASSOCIATED-DISSOLVED GAS, AND NGL IN GAS RESOURCES ARE EACH AGGREGATED IN TURN.

Figure 3. Flowchart of analytic method of play aggregation.

assessment area of the aggregated plays under perfect correlation. (a) Determine the mean and standard deviation by adding all the individual play means and standard deviations of the unconditional play potential for oil, respectively. (b) Calculate the unconditional aggregate probability of oil--the probability that the assessment area has at least one play with oil--from the individual unconditional play probabilities of oil under the assumption of perfect positive correlation. (c) Compute various fractiles of the unconditional aggregate potential for oil by adding all the individual play fractiles of the unconditional play potential for oil, respectively.

5. Compute the mean, variance and fractiles of the unconditional aggregate potential for oil in the case of interpolation between the polar case of complete independence (d = 0) and the polar case of perfect positive correlation (d = 1)--the quantity of oil in the assessment area of the aggregated plays under a degree of dependency, d ($0 \leq d \leq 1$). Interpolate the mean, standard deviation, fractiles, and unconditional aggregate probability of oil between the two polar cases of steps 3 and 4.
6. Compute the mean, variance and fractiles of the conditional aggregate potential for oil in the case of interpolation--the quantity of oil in the assessment area, given the assessment area has at least one play with oil. (a) Determine the mean and variance of the conditional aggregate potential for oil by applying the interpolated unconditional aggregate probability of oil to the interpolated mean and variance of the unconditional aggregate potential for oil. (b) Model the probability distribution of the conditional aggregate potential for oil by using the lognormal distribution with mean and variance from (a). Calculate various lognormal fractiles.
7. Select nonassociated gas as the second resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of nonassociated gas--namely, the individual play means, variances and fractiles of the unconditional play potential for nonassociated gas, as well as the individual unconditional play probabilities of nonassociated gas.
8. Select associated-dissolved gas as the third resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of associated-dissolved gas--namely, the individual play means, variances and fractiles of the unconditional play potential for associated-dissolved gas, as well as the individual unconditional play probabilities of associated-dissolved gas.
9. Select gas as the fourth resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of gas--namely, the individual play means, variances and fractiles of the unconditional play potential for gas, as well as the individual unconditional play probabilities of gas.
10. Select NGL in nonassociated gas as the fifth resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of NGL in nonassociated gas--namely, the individual play means, variances and fractiles of the unconditional play potential for NGL in nonassociated gas, as well as the individual unconditional play probabilities of NGL in nonassociated gas.
11. Select NGL in associated-dissolved gas as the sixth resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of NGL in associated-dissolved gas--namely, the individual play means, variances and fractiles of the unconditional play potential for NGL in associated-dissolved gas, as well as the individual unconditional play probabilities of NGL in associated-dissolved gas.

12. Select NGL in gas as the seventh resource to be aggregated. Repeat steps 3 through 6 using play-analysis estimates of NGL in gas--namely, the individual play means, variances and fractiles of the unconditional play potential for NGL in gas, as well as the individual unconditional play probabilities of NGL in gas.

Relationship Between APRAS and APRASAG

APRASAG relates to APRAS as follows. APRAS not only generates a file of resource estimates for an individual play but also outputs a second file of results that consists of the unconditional play probability, cutoff, mean, standard deviation and fractiles of the unconditional play potential for each of the seven resources. The second file is needed for an aggregation of plays and forms an input file for APRASAG. Therefore, after APRAS is run on each play in a set of plays, any subset of plays can be aggregated by running APRASAG on the corresponding subset of aggregation input files. APRASAG not only generates a file of resource estimates for an aggregation of plays but also outputs a second file of results needed for an aggregation of aggregations,which forms yet another input file for APRASAG. Hence, after APRASAG is run on each aggregation in a set of aggregations, any subset of aggregations can be aggregated at once. Compared to the simulation method, the application of APRASAG can result in tremendous savings of time and cost, especially when analyzing many aggregations involving hundreds of plays.

EXAMPLES

Figure 4a shows the summary of the input for a hypothetical play printed by APRAS, and Figure 4b shows the output of resource estimates. Figure 5a shows the summary for input of a set of hypothetical plays printed by APRASAG, and Figure 5b shows the output of aggregate estimates.

COMPUTER REQUIREMENTS

The computer system used to run APRAS should include:

IBM PC compatible computer
MS-DOS 3.1 operating system or later, or equivalent PC-DOS
monochrome or color monitor
two diskette drives (one of which must be 5.25"), or one diskette and a hard disk
512 Kbyte memory
printer able to print 132 characters on a line

APRAS does not require a math coprocessor; but it uses the coprocessor if one is installed in the computer, with a noticeable improvement in speed. The program does not require a graphics adapter.

APRAS 91.09 Assessment C:\ELK\CENTRAL.LIS 21-Jan-1992 13:08:17 Run No. 1

I N P U T   S U M M A R Y

Play Name	Province Name	Province #	Evaluator	Assessment Date
Central Miocene	Elk Basin	099	R. A. Crovelli	5 Aug 1991

Play Attribute Probabilities

Hydrocarbon Source	Timing	Migration	Reservoir Facies	Marginal Play Probability
0.900	1.000	0.850	1.000	0.765

Conditional Prob. of at Least One Accumulation	Gas-Oil Ratio CF/BBL	Hydrocarbon Prob. Gas	Hydrocarbon Prob. Oil
1.000	1475.000	0.300	0.700

Geologic Variables	F100	F95	F75	F50	F25	F05	F0	Cutoff
Oil Accum. Size (10^6 BBL)	1.00000	1.60000	5.50000	13.0000	28.4000	98.0000	288.000	1.40000
NA Gas Accum. Size (10^9 CF)	6.00000	7.50000	10.8000	22.4000	38.0000	94.0000	195.000	14.6000
Oil Reservoir Depth (10^3 Ft)	1.00000	(3.16666)	(5.33333)	7.50000	(10.2500)	(14.8333)	18.5000	
Gas Reservoir Depth (10^3 Ft)	4.00000	(5.33333)	(6.66666)	8.00000	(11.3750)	(17.0000)	21.5000	
Cond. Number of Accumulations	4	6	9	12	14	19	26	

Average Ratio of NGL to NA Gas	Average Ratio of NGL to AD Gas	Estimated % of resource in subplay
25.500	29.000	55.00000

(BBL/10^6 CF)

G E O L O G I C   V A R I A B L E S and P R O B A B I L I T I E S   O F   O C C U R R E N C E

	Mean	Std. Dev.
Cond. # Accum.	11.5500	4.22463
# Accum.	11.5500	4.22463
Oil Res. Depth	8.11875	3.74260
Gas Res. Depth	9.48854	3.85630

	Resource				NGL		
	Oil	NA Gas	AD Gas	Gas/HC	NA Gas	AD Gas	Total
Prob. Accumulation has	0.6767	0.2004	0.6767	0.8771	0.2004	0.6767	0.8771
Cond. Play Prob.	0.9995	0.8904	0.9995	1.0000	0.8904	0.9995	1.0000
Uncond. Play Prob.	0.7646	0.6811	0.7646	0.7650	0.6811	0.7646	0.7650
Prob. Exceed Cutoff	0.9667	0.6681					
Play Potential Cutoffs	0.7700	8.0300	1.1357	4.5430	0.2047	0.0329	0.1317

Figure 4a. Input summary for APRAS.

ESTIMATED RESOURCES for Central Miocene

	Mean	Std. Dev.	F95	F75	F50	F25	F05
OIL (10^6 BBL)							
Cond. No. of Accumulations	7.81550	3.27093	3	5	8	10	14
Accumulation size	17.3606	25.4314	.....	.....	.....	.....	.....
Cond. (B) Play Potential	135.746	90.9641	41.6759	74.8495	112.700	169.891	307.043
Uncond Play Potential	103.796	98.1999	0.00000	32.2300	88.6192	148.151	283.116
NONASSOCIATED GAS (10^9 CF)							
Cond. No. of Accumulations	2.31498	1.60249	0	1	2	3	5
Accumulation size	25.5899	19.6772	.....	.....	.....	.....	.....
Cond. (B) Play Potential	66.5353	49.0921	21.5152	35.4193	52.8475	81.3657	156.979
Uncond Play Potential	45.3187	51.0200	0.00000	0.00000	36.4218	65.5187	137.564
ASSOCIATED-DISSOLVED GAS (10^9 CF)							
Cond. No. of Accumulations	7.81550	3.27093	3	5	8	10	14
Accumulation size	25.6068	37.5113	.....	.....	.....	.....	.....
Cond. (B) Play Potential	200.225	134.172	61.4719	110.403	166.233	250.589	452.889
Uncond Play Potential	153.100	144.845	0.00000	47.5392	130.713	218.523	417.597
TOTAL GAS (10^9 CF)							
Cond. No. of Accumulations	10.1305	3.86977	4	7	10	12	17
Accumulation size	25.6030	34.2642	.....	.....	.....	.....	.....
Cond. (B) Play Potential	259.372	147.342	95.7330	158.112	225.150	321.454	538.237
Uncond Play Potential	198.418	169.417	0.00000	77.3320	182.976	285.456	501.523
NGL for NONASSOCIATED GAS (10^6 BBL)							
Cond. No. of Accumulations	2.31498	1.60249	0	1	2	3	5
Accumulation size	0.65254	0.50177	.....	.....	.....	.....	.....
Cond. (B) Play Potential	1.69665	1.25185	0.54864	0.90319	1.34761	2.07482	4.00296
Uncond Play Potential	1.15563	1.30101	0.00000	0.00000	0.92876	1.67073	3.50787
NGL for ASSOC-DISS GAS (10^6 BBL)							
Cond. No. of Accumulations	7.81550	3.27093	3	5	8	10	14
Accumulation size	0.74260	1.08783	.....	.....	.....	.....	.....
Cond. (B) Play Potential	5.80653	3.89099	1.78269	3.20169	4.82075	7.26708	13.1338
Uncond Play Potential	4.43989	4.20050	0.00000	1.37864	3.79068	6.33717	12.1103
TOTAL NGL (10^6 BBL)							
Cond. No. of Accumulations	10.1305	3.86977	4	7	10	12	17
Accumulation size	0.72202	0.98586	.....	.....	.....	.....	.....
Cond. (B) Play Potential	7.31445	4.20148	2.67174	4.43183	6.33166	9.07085	15.2652
Uncond Play Potential	5.59551	4.80857	0.00000	2.15459	5.13565	8.04582	14.2140

Figure 4b. Output summary for APRAS. The dots under the fractiles for accumulation size mean that these estimates are not computable.

APRASAG 91.09 Aggregation C:\ELK\ELKAGG.AGL 21-Jan-1992 13:17:04 Run No. 1

I N P U T S U M M A R Y Project : Elk Basin Dependency = 0.0000

Component	Resource	U.P.P.	Cutoff	Mean	S.D.	F95	F75	F50	F25	F05	Units
Central Miocene	Oil	0.76463	0.77000	103.796	98.1998	0.00000	32.2299	88.6191	148.151	283.116	10^6 BBL
	NA-Gas	0.68112	8.03000	45.3186	51.0199	0.00000	0.00000	36.4218	65.5186	137.563	10^9 CF
	AD-Gas	0.76463	1.13575	153.099	144.844	0.00000	47.5392	130.713	218.523	417.596	10^9 CF
(c:\elk\central.agg)	Gas	0.76499	4.54300	198.418	169.416	0.00000	77.3319	182.975	285.455	501.523	10^9 CF
	NA-Gas-NGL	0.68112	0.20476	1.15562	1.30100	0.00000	0.00000	0.92875	1.67072	3.50787	10^6 BBL
	AD-Gas-NGL	0.76463	0.03293	4.43988	4.20049	0.00000	1.37863	3.79068	6.33717	12.1103	10^6 BBL
	NGL	0.76499	0.13174	5.59551	4.80856	0.00000	2.15459	5.13564	8.04581	14.2140	10^6 BBL
Eastern Carbonates	Oil	0.60347	0.48000	0.82404	0.89368	0.00000	0.00000	0.81025	1.26828	2.36769	10^6 BBL
	NA-Gas	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10^9 CF
	AD-Gas	0.60347	0.44400	0.76224	0.82665	0.00000	0.00000	0.74949	1.17316	2.19011	10^9 CF
(c:\elk\eastern.agg)	Gas	0.60347	0.44400	0.76224	0.82665	0.00000	0.00000	0.74949	1.17316	2.19011	10^9 CF
	NA-Gas-NGL	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10^6 BBL
	AD-Gas-NGL	0.60347	0.03929	0.06745	0.07315	0.00000	0.00000	0.06632	0.10382	0.19382	10^6 BBL
	NGL	0.60347	0.03929	0.06745	0.07315	0.00000	0.00000	0.06632	0.10382	0.19382	10^6 BBL
Southern Shore	Oil	0.99999	0.51240	43.3621	17.2443	21.5162	31.1178	40.2638	52.1574	75.7733	10^6 BBL
	NA-Gas	1.00000	1.76778	2248.28	803.020	1197.59	1676.02	2117.19	2674.62	3743.99	10^9 CF
	AD-Gas	0.99999	3.30498	279.685	111.226	138.779	200.710	259.701	336.415	488.737	10^9 CF
(c:\elk\southern.agg-)	Gas	1.00000	176.778	2527.96	884.292	1386.54	1898.68	2377.46	2989.37	4180.05	10^9 CF
	NA-Gas-NGL	1.00000	0.03977	50.5863	18.0679	26.9458	37.7104	47.6369	60.1791	84.2399	10^6 BBL
	AD-Gas-NGL	0.99999	0.09452	7.99901	3.18107	3.96910	5.74031	7.42747	9.62148	13.9779	10^6 BBL
	NGL	1.00000	3.97750	58.5853	20.4169	32.1888	44.0533	55.1272	69.2609	96.7165	10^6 BBL
Central, Eastern & Southern	Oil	0.99999	0.48000	147.982	99.7064	44.9914	81.2663	122.682	185.461	336.291	10^6 BBL
	NA-Gas	1.00000	1.76778	2293.60	804.639	1235.92	1719.95	2164.19	2723.30	3790.66	10^9 CF
	AD-Gas	0.99999	0.44400	433.547	182.625	205.453	304.176	399.519	524.951	777.608	10^9 CF
	Gas	1.00000	176.778	2727.14	900.375	1545.30	2085.32	2581.68	3207.12	4402.91	10^9 CF
	NA-Gas-NGL	1.00000	0.03977	51.7420	18.1147	27.9182	38.8270	48.8337	61.4221	85.4409	10^6 BBL
	AD-Gas-NGL	0.99999	0.03293	12.5063	5.26960	5.92867	8.77378	11.5230	15.1417	22.4350	10^6 BBL
	NGL	1.00000	3.97750	64.2483	20.9757	36.6151	49.2916	60.8996	75.4812	103.253	10^6 BBL

Figure 5a. Input summary for APRASAG. U.P.P. means unconditional play probability.

E S T I M A T E D   R E S O U R C E S   for   Central, Eastern & Southern

	Mean	Std Dev	F95	F75	F50	F25	F05
Oil (10^9 BBL)							
Cond Aggregate Potential	0.147982	0.099706	0.045027	0.081274	0.122683	0.185461	0.336292
Uncond Aggregate Potential	0.147982	0.099706	0.044991	0.081266	0.122683	0.185461	0.336292
Non-Associated Gas (10^12 CF)							
Cond Aggregate Potential	2.293602	0.804640	1.235927	1.719956	2.164199	2.723302	3.790670
Uncond Aggregate Potential	2.293602	0.804640	1.235927	1.719956	2.164199	2.723302	3.790670
Associated-Dissolved Gas (10^12 CF)							
Cond Aggregate Potential	0.433548	0.182625	0.205583	0.304220	0.399520	0.524952	0.777609
Uncond Aggregate Potential	0.433548	0.182625	0.205454	0.304177	0.399520	0.524952	0.777609
Total Gas (10^12 CF)							
Cond Aggregate Potential	2.727150	0.900375	1.545300	2.085328	2.581681	3.207122	4.402914
Uncond Aggregate Potential	2.727150	0.900375	1.545300	2.085328	2.581681	3.207122	4.402914
Non-Associated Gas NGL (10^9 BBL)							
Cond Aggregate Potential	0.051742	0.018115	0.027918	0.038827	0.048834	0.061422	0.085441
Uncond Aggregate Potential	0.051742	0.018115	0.027918	0.038827	0.048834	0.061422	0.085441
Assoc-Dissolved Gas NGL (10^9 BBL)							
Cond Aggregate Potential	0.012506	0.005270	0.005932	0.008775	0.011523	0.015142	0.022435
Uncond Aggregate Potential	0.012506	0.005270	0.005929	0.008774	0.011523	0.015142	0.022435
Total NGL (10^9 BBL)							
Cond Aggregate Potential	0.064248	0.020976	0.036615	0.049292	0.060900	0.075481	0.103253
Uncond Aggregate Potential	0.064248	0.020976	0.036615	0.049292	0.060900	0.075481	0.103253

Figure 5b. Output summary for APRASAG.

Although APRAS/APRASAG are not designed specifically for the Microsoft Windows™ environment, they do run under Windows version 3.0 either full screen or in a window. Full screen operation is recommended. The only visual enhancement in the program that is not honored under Windows is blinking text. The mouse cannot be used with APRAS or APRASAG.

APRAS INSTALLATION GUIDE

An IBM-PC compatible 5.25" diskette containing the executable programs and documentation files for APRAS is distributed in association with this Open-File Report. The diskette is a separate Open-File Report, number 92-21B. The files on the diskette are:

APRAS.EXE	The main system program;
APRASAG.EXE	The aggregation program;
APRAS.DOC	The documentation file;
INSTAL2D.BAT	The installation script for a 2-diskette computer;
INSTALHD.BAT	The installation script for a hard disk computer;
TEST.PLA	A file of sample data for testing the APRAS system using English units;
AGGTEST.AGC	A file of parameters for testing APRASAG;
TEST1.AGG TEST2.AGG TEST3.AGG	Three files of sample aggregation data needed for running APRASAG with AGGTEST.AGC.

The APRAS.DOC file contains most of the present Open-File Report. It can be copied onto a printer using the DOS command

PRINT *disk*:APRAS.DOC

where `disk` should be replaced by the drive letter of the disk drive containing the APRAS issue disk. For example, if the issue disk is in drive B, the command would be
`PRINT B:APRAS.DOC.`

Below are instructions for installation of the necessary executable files to generate an APRAS working system on either a dual diskette computer or a computer with a diskette and a hard disk. Information on running the APRAS system after it is installed appears on page 19.

In all the instructions that follow, italics are used to show a part of a command which you must replace with a phrase that fits your application.

Installation for a Two-diskette System

APRAS can be installed on either a 5.25" or 3.5" double-density or high-density diskette. The software is distributed on a 5.25" diskette, so you must have at least one 5.25" drive available. To install APRAS on a PC with two diskette drives:

- With a working copy of DOS in drive A, format a new DOS system disk in drive B, using the following command:

```
FORMAT  B:/S
```

  Label this disk "APRAS SYSTEM DISK."

- Copy the PRINT program (which is a part of DOS) onto the new APRAS system disk:

```
COPY  PRINT.COM  B:
```

  Any other programs or files which you may need can also be copied onto the system disk.

- Format a second disk in drive B to use as a data disk:

```
FORMAT  B:
```

  Label this disk "APRAS DATA DISK."

- Insert the APRAS system disk in drive A, and the APRAS issue disk (the one on which APRAS was delivered) into drive B. Log onto this disk by typing the DOS command

```
B:
```

- Run the APRAS installation program for two diskettes by typing

```
INSTAL2D  A:
```

  This command takes care of creating a directory named \APRAS on the new system disk and copying the necessary files into it. Remove the issue disk from drive B.

- Make a backup copy of the new system disk which is now in drive A, and keep it in a secure place for recovery of the system in case the working system disk is damaged. Refer to the DOS manual for your machine for help in copying a diskette.

When running APRAS, you should put the APRAS system disk in drive A and the data disk in drive B, and log onto drive A as the default drive.

Installation for a Hard Disk System

To install APRAS on a PC with a hard disk and a 5.25" diskette drive, use the following procedures. NOTE: the APRAS installation creates a new directory named \APRAS on the hard disk. If there already exists a directory with that name on the hard disk, the installation may fail. You should eliminate or rename the existing \APRAS directory (refer to your DOS manual) before running the installation procedure.

- Insert the APRAS issue diskette (the one on which APRAS was delivered) into a diskette drive, and log onto this disk by typing the DOS command

  `disk:`

  In place of *disk* substitute the letter of the diskette drive containing the issue disk.

- Run the APRAS installation program for hard disk systems by typing

  `INSTALHD    disk:`

  This time in place of *disk* substitute the drive letter of the hard disk where you want to install APRAS, and include the colon after the drive letter. An example of the install command is `INSTALHD  C:`

- Use an ASCII text editor to modify the PATH command in the AUTOEXEC.BAT file in the root directory of the hard disk. At the end of the PATH command, add the text

  `;disk:\APRAS`

  where *disk* is the same as in the preceding paragraph. For example, if you have installed APRAS on disk C, append to the PATH command the phrase

  `;C:\APRAS`

  If the AUTOEXEC.BAT file doesn't have a PATH command in it, add a line at the end of the file which says

  `PATH disk:\APRAS`

  An example of this is `PATH C:\APRAS`.

  If the hard disk doesn't have an AUTOEXEC.BAT file, use an ASCII text editor to create one, and put the above PATH command in it.

- To make the changes in AUTOEXEC.BAT take effect before running APRAS for the first time, reboot the system by keying CTRL-ALT-DEL. This makes it possible to use APRAS immediately. From this point on, the modifications in AUTOEXEC.BAT will take effect automatically every time the computer is turned on.

It is possible to put the data files in the same directory with the system, but you may prefer to package the data files in a separate directory. You can also keep the data on a diskette instead of on the hard disk, but this is less convenient.

When running APRAS, you can change to any desired directory on the hard disk for the data files, and run APRAS from there. APRAS generates a number of new files while processing the data, and puts them in the same directory and on the same disk as the data file.

APRAS OPERATION GUIDE

Before running APRAS, it must be correctly installed on your PC. If this has not been done, you must run through the installation procedure described on page 16. After installation is complete, proceed with the operation of the system, described in this section.

In most respects, operation of APRAS is the same whether you are using a dual diskette system or a hard disk system. These two installations have slightly different methods of starting out; both cases are covered separately below.

A summary of these operating procedures appears in Appendix B.

Starting APRAS - Diskette Computers (two diskette drives)

- Insert the APRAS system disk into drive A and log onto this drive.

- Unless the PRINT program has already been loaded into memory, type the DOS command

  ```
  PRINT  /D:PRN
  ```

  This loads the program needed by APRAS to print the output of assessments. PRN is the name of the standard parallel printer attached to port LPT1. If your printer is different, replace PRN by the name of another printer port; see the DOS manual.

- Scroll the paper in the printer so the print head is about 1.5 cm (0.5") below the tearoff perforations. Turn on the printer and set it to print 132 columns across the width of the paper. This may be done manually with some printers, or using a mode-setting program with others.

- Insert a formatted data disk into drive B.

- Run APRAS by typing the command

  ```
  APRAS
  ```

- When APRAS asks for a file name, type a name of the form

  `drive:datafile.PLA`

  In place of `drive` substitute the drive letter of the disk where you plan to store data files, and in place of `datafile` substitute your chosen data file name. For example, you might give the file name `B:FILE5.PLA`. The suffix .PLA suggests "play data," but another suffix (such as .DAT) is possible. You can omit the drive prefix if it agrees with the default drive. The data file name must be 8 or fewer letters or digits, not counting the .PLA suffix. The suffix is not required as part of the name, but it is recommended. You must avoid the suffixes .LIS, .AGG, and .AGL as APRAS uses these for its own output files.

Starting APRAS - Hard Disk Computers

- Log onto the hard disk in your computer which contains APRAS. Change to the directory where you plan to store data files.

- Unless the PRINT program has already been loaded into memory, type the DOS command

  ```
  PRINT  /D:PRN
  ```

  This loads the program needed by APRAS to print the output of assessments. PRN is the name of the standard parallel printer attached to port LPT1. If your printer is different, replace PRN by the name of another printer port; see the DOS manual.

- Scroll the paper in the printer so the print head is about 1.5 cm (0.5") below the tearoff perforations. Turn on the printer and set it to print 132 columns across the width of the paper. This may be done manually with some printers, or using a mode-setting program with others.

- Run APRAS by typing the command

  ```
  APRAS
  ```

- When APRAS asks for a file name, type a name of the form

  `datafile``.PLA`

  In place of *`datafile`* substitute the name you have chosen for your data. For example, you might give the file name `SOUTH.PLA`. The .PLA suffix suggests "play data," but another suffix (such as .DAT) is possible. The data file name must be 8 or fewer letters or digits. The suffix is not required, but it is recommended. You must avoid the suffixes .LIS, .AGG, and .AGL as APRAS uses these for its own output files.

  The file name may include a directory path prefix if needed, for example `\MYDATA\TESTRUN.PLA`.

Operation of APRAS - Both Diskette and Hard Disk Computers

After loading APRAS and specifying a data file name, both diskette and hard disk systems work the same way. A diskette system works a bit slower.

If the named data file is an old one, then APRAS gives the options of editing the file or sending the file directly to the APRAS assessment program. The details of this are given later.

If the named data file does not already exist, APRAS asks if you want to create a new file with that name. Answer Y (for Yes) or N (for No). The N response is provided as an escape in case you really wanted an existing file but typed its name incorrectly.

APRAS now asks you to specify which system of units you want for your data. Use the up/down cursor keys to move the screen pointer to the desired units, then press RETURN.

The first data entry screen appears. It includes a bar at the top of the screen with the name of the file being edited, and a bar at the bottom showing a menu of the control keys: the arrow keys, the RETURN and TAB keys, PgUp and PgDn. The details of working with the data input editor are described next.

Operation of the Data Entry Editor - New Files

The program accepts keyboard input of parameters through a series of three display screens. Each screen contains cells for entry of a group of parameters.

Screen #1
Play name
Province name
Province number
Evaluator's name
Assessment date
Play attribute probabilities for: (a) hydrocarbon source
(b) appropriate timing
(c) migration paths
(d) reservoir facies

Screen #2
Conditional probability of at least one accumulation
Gas/oil ratio
Hydrocarbon type probability for gas
Average ratio of NGL to: (a) nonassociated gas
(b) associated-dissolved gas
Estimated percent of resource in subplay
Cutoffs for accumulation size for: (a) oil
(b) nonassociated gas

Screen #3
Fractiles for oil accumulation size (F100, F95, F75, F50, F25, F5, F0)
Fractiles for gas accumulation size (F100, F95, F75, F50, F25, F5, F0)
Fractiles for oil depth (F100, F50, F0) (see Note below)
Fractiles for gas depth (F100, F50, F0)
Fractiles for conditional number of accumulations (F100, F95, F75, F50, F25, F5, F0)

Note: The sets of fractiles for depth are provided as a record, for documentation purposes. Depth data are not used in computing the assessment. But APRAS expands the sets of three depth fractiles into full sets of seven fractiles by computing the missing ones, and the depth fractiles are included on the summary output file.

Editing controls
For a new file, APRAS has already entered dummy data into some of the cells. You can move through the cells and substitute actual values for your application.

You can step sequentially through the cells on a screen by striking the RETURN key after entering each value. The right arrow key and the TAB key have the same function as RETURN. By using the cursor keypad and other control keys you can browse randomly through the cells on the visible screen, and through the adjacent screens, until you come to the cell where you want to enter or edit data. These are the screen controls:

Up arrow key (↑)	Jumps the cursor to the next line above the current line. If the cursor is already on the first line of the screen, there is no effect.
Down arrow key (↓)	Jumps the cursor to the next line below the current line. If the cursor is already on the last line of the screen, there is no effect.
Right arrow key (→)	Jumps the cursor to the next cell to the right of the current cell. If the cursor is already on the last cell on the current line, the cursor jumps to the first cell on the next line below. If the cursor is already on the last line of the screen, there is no effect.
Left arrow key (←)	Jumps the cursor to the next cell to the left of the current cell. If the cursor is already on the leftmost cell of the current line, there is no effect.
RETURN key TAB key	These have the same effect as the right arrow key.
PgUp key	Jumps to the previous screen. If the cursor is already on screen #1, APRAS displays `No previous screen.`
PgDn key	Jumps to the next screen. If the cursor is already on the last data screen (screen #3), APRAS displays `No following screen.`

ESC key — Can be pressed from any cell on any screen to escape from the data entry function. APRAS then gives the option to send the data to the resource assessment module, to return for more editing on the data, or to quit.

The size of each cell limits the amount of space for that entry. If a cell is completely filled with characters, the editor jumps to the next cell.

As you enter values, APRAS monitors the entries for correctness. If an entry contains an error, APRAS sounds a buzzer, displays an error message on the screen and waits for you to retype correctly. If you realize there is a typing error in the current cell while you are typing data into it, you can backspace over the bad characters and then retype.

Numeric entries
If the parameter is a number, it can be entered in any reasonable form: real numbers can be in fixed point notation (like 3.1416) or in floating point scientific notation (like 2.386E+3, which means 2.386×10^3). Wherever APRAS requests real numbers, integers are also acceptable. When APRAS requests integers (as in the number of geologic prospects), these must be typed without a decimal point (like 34, never as 34.0).

Probability entries
If the entry being requested is a probability, it must be entered as a real number in the range 0.0 to 1.0. A probability which is out of range causes an error message.

Percent entries
If the entry being requested is a percent, it must be entered as a real number in the range 0 to 100. If it is out of range, an error message is given.

Fractile entries
The entries in each row of fractiles on screen #3 must be in nondecreasing order. If they are not, an error message is given. The fractiles for oil and gas accumulation size must not be all the same, unless they are all zeros.

Exiting the editor
When you have entered all the data on the three screens, press the ESC key. APRAS displays the "do-what" menu:

```
Do what with this file?

E = Return to editing
A = Assess the play (and save the file)
X = Exit and save file; no assessment
Q = Quit without saving.
```

Press the letter key corresponding to the action wanted. Either upper or lower case letters are accepted. If you type X, APRAS saves the data in the file directory and returns to DOS; only the new version of the file is kept, and it replaces the old version, if any. If you type Q, the system terminates without saving the newly created (or edited) file; this option is used if you realize the current edits are useless and you don't want to save this version of the data. If you type A, APRAS saves the file in the directory, then sends the data directly to the APRAS assessment module (see below). If you type E, then APRAS re-enters the data entry module for further review and editing. This is the same as editing an old file, and this process is described next.

Operation of the Data Entry Editor - Old Files

If you specify the name of an already existing data file when first entering APRAS, the system shows a do-what menu similar to the one in the paragraph above.

Editing
If the file needs to be edited before sending it on to the APRAS assessment program, press the E key. Then APRAS runs through the data entry screens as before, but now it shows the cells already filled with the parameters in the existing file. If the existing values on a screen are correct, press PgUp or PgDn to review the other screens. If the content of a cell needs to be changed, move the cursor to that cell and type the new entry to replace the old. There is no way to edit the content of a cell; you must retype it completely. When the edited file is correct, press ESC while any data input screen is visible to return to the do-what menu.

Assessing the play
Whenever the do-what menu appears on the screen, you have the option of sending the current data file to the APRAS assessment module. To do this, press the A key. The APRAS assessor reads the input data file, performs the assessment of resources, and produces two output files: a listing which summarizes the input data and displays an estimate of resources in the play; and a file of parameters which can be fed into the aggregator program (see page 25) to combine estimates of several plays after they are processed by APRAS.

The summary listing file is named by APRAS to agree with the data file name, but has the file name suffix .LIS. The aggregation data file is named by APRAS to agree with the data file name, but has the suffix .AGG. For example, if the original data file name is TEST.PLA, then APRAS generates new files with names TEST.LIS and TEST.AGG.

Number of accumulations
When the assessment program starts, it asks if you want to include computations of fractiles for the number of resource type accumulations in the play. This computation is potentially the most time consuming part of the APRAS method. Including it is optional because its effect on running time depends on a complex interaction between the number of prospects fractiles and several other parameters. Probably it should be included for a first run (type y or Y in response to the query) because for most data sets the computing time is acceptably low. APRAS displays an iteration counter on the screen to show progress through the computation of number of accumulations. If the program is running too long, you may abort APRAS by entering CTRL-Break, then restart it on the same data file. This time, enter n or N when asked if you want to include the number-of-accumulations computation, and the program should finish in at most a few seconds. In this case, APRAS prints a row of dots on the summary output file for number of accumulations to show that this computation was bypassed.

The run number
Next APRAS asks for a run number; any identifier up to 10 characters is accepted. This is intended to help keep track of the results after several different runs of the same play with variations in the data input on each run. The run number is printed at the top of the .LIS output listing.

During the assessment
Now APRAS runs its assessment. It may take from 5 seconds to several minutes to complete, depending on the content of the data file and whether you have elected the option to compute number of accumulations. Certain numeric errors may occur during the assessment, such as overflow or division by zero. APRAS attempts to trap such errors, but their occurrence is due to a complex interaction between the many input parameters. If a numeric error occurs, restart the program and use it to examine the input data file for data entries which are missing, inconsistent with the other values, or out of reasonable range.

Printing the output
When APRAS is finished, it asks how many copies of the .LIS summary file to print; press one of the number keys 0...9. Then APRAS returns to DOS, leaving the .LIS and .AGG output files, as well as the source data file, in the file directory. The computer can be used for other work while the printer is running. But remember not to modify a file after it has been added to the print queue, until it has finished printing. In particular, you should not run a new assessment of a play while a previous output file for the same play is still in the print queue; otherwise, the printing may be disrupted.

If you choose not to print at this time, you can use the DOS PRINT command later to print the .LIS files.

APRASAG OPERATION GUIDE

APRASAG is a program which combines the resource assessments of two or more plays from previous runs of APRAS. APRASAG aggregates the plays and produces two new output files: (1) a summary listing file showing input values and output estimates; and (2) another .AGG file which can later participate in a higher level aggregation. Figure 4 shows a flow chart describing the function of APRASAG.

Starting APRASAG
For either diskette or hard disk computers, starting APRASAG is similar to starting APRAS, as described in APRAS OPERATION GUIDE.

Control file
The program requests a name for the aggregation control file for this aggregation. A control file directs APRASAG in gathering and processing the data associated with the aggregation of a number of plays. It contains a set of common parameters and a list of the names of aggregation files generated by previous runs of APRAS (or of APRASAG) which will participate in the aggregation. APRASAG can connect to an existing control file, or it can be used to enter data into a new control file. Type the desired file name and press RETURN. An

example of a control file name is `ALLPLAYS.AGC`, where the file name suffix .AGC suggests "aggregation control." Any other suffix could be used instead, but you must avoid using the suffixes .LIS, .AGG, and .AGL as the system uses these for its own purposes. Further, be sure to avoid giving an aggregation control file the same first name as any other existing file.

If the named file does not already exist, APRAS asks if you want to create a new file with that name. Answer Y (for Yes) or N (for No). The N response is provided as an escape in case you really wanted an existing file but typed its name incorrectly. If the named file is an old one, then APRASAG gives the options of editing the file or sending the file directly to the aggregation program.

Editing controls
APRASAG uses the same editing controls as APRAS.

Screen #1
On the first data entry screen, you are asked to enter names for the project and for the current aggregation. These entries are for identification, and they are reproduced on the output page. The other cell on screen #1 is for entry of the inter-component dependency, and it must be given as a real number anywhere in the range 0 to 1 (0 means completely independent; 1 means perfectly positively correlated).

Other screens
The following screens allow you to specify the component files which will participate in the aggregation, by entering the names of existing aggregation files (files with .AGG file types) generated through previous runs of APRAS for individual plays or of APRASAG for earlier aggregations. Enter as many as 992 .AGG file names on these screens, including directory prefixes if necessary. APRASAG monitors the files entered on these screens, and advises if there are errors. Errors occur if a file does not exist, if it is not a legitimate aggregation file, if its units of measure are inconsistent with other files in the list, or if the data in the file are somehow corrupted.

To erase an existing aggregation component file name, move to the screen displaying the component, move the cursor to the component file name to be deleted, and press the space bar.

Exiting the editor
When you have entered all the information on the various screens, press the ESC key. APRASAG displays the do-what menu:

```
Do what with this file?

E = Return to editing
A = Aggregate plays (and save file)
X = Exit and save file; no aggregation
Q = Quit without saving.
```

Press the letter key corresponding to the action wanted. Either upper or lower case letters are accepted. If you type X, APRASAG saves the control data in the file directory and returns to DOS; only the new version of the file is kept, and it replaces the old version, if any. If you type Q, the system terminates without saving the newly created (or edited) control file; this option is used if you realize the current edits are useless and you don't want to save this version of the control data. If you type A, APRASAG saves the control file in the directory, then sends the file directly to the aggregation module. If you type E, then APRASAG re-enters the data entry module for further review and editing.

During aggregation
There is a possibility that APRASAG will encounter computational problems with certain aggregation data files having unusually small unconditional play probabilities. This problem is unpredictable, as the computation is a complex interaction between these probabilities and several other parameters of the aggregation. If this happens, APRASAG outputs a message, for example `arithmetic fault in nonassociated gas`, and it enters rows of dots on the output summary file to indicate the bypassed fractile computations. But a valid aggregation output file is still produced, and this .AGG file can participate in further aggregations.

Printing the output
When APRASAG finishes its computations, it displays the names of the output files it has generated. One of these is a summary output file, whose name agrees with the first name of the aggregation control file, but has the suffix .AGL ("aggregation listing"). The other output file is another .AGG file, which also has the same first name as the control file, and which can be used to join in further aggregations.

Finally, you are asked how many copies of the summary output file (the .AGL file) to print. Press one of the number keys 0..9. Then APRASAG returns to DOS, leaving the .AGL and .AGG output files, as well as the control data file, in the file directory. The computer can be used for other work while the printer is running. But remember not to modify a file after it has been added to the print queue, until it has finished printing. In particular, you should not run a new aggregation while a previous output file for the same aggregation is still in the print queue; otherwise the printing may be disrupted.

APPENDIX A
SUPPLEMENTAL DATA FORM FOR PERCENTAGES

Petroleum Resource Assessment: ______________________________

Cluster Number	Play Number	Play Name	(A) Play Area	(B) Cluster Area	(C) Cluster Percent of Play Area (B)/(A) x 100	(D) Cluster Rating or Richness Factor	(E) Cluster Percent of Play Resources (C) x (D)

APPENDIX B
SUMMARY OF USER INSTRUCTIONS

Assess Play

- Type APRAS
- Enter data file name; type, e.g., TOPSET.PLA
  (If using separate data diskette, type, e.g., B:TOPSET.PLA)
- Enter and edit data
  - Advance through cells; press any of RETURN (or ENTER), TAB, or →
  - Move up/down through lines; press ↑ or ↓
  - Move to left; press ←
  - Move up/down through screens; press PgUp or PgDn
  - Correct errors in cell; press BackSpace to erase previous characters
- Exit from data edit mode; press ESC
- Do what choices; press
  - E to return to editing
  - A to assess the play
  - X to exit and save file
  - Q to quit without saving
- S command:
  - press Y or N for number of accumulations switch
  - enter run number
  - see iteration counter for number of accumulations
  - generates 2 files (summary and aggregation), e.g., TOPSET.LIS and TOPSET.AGG
- Print assessment summary output; type, 0, 1, ..., 9 for number of copies
- See operating system prompt

Aggregate Plays

- Type APRASAG
- Enter control file name; type, e.g., ALASKA.AGC
  (If using separate data diskette, type, e.g., B:ALASKA.AGC)
- Enter and edit control data; same controls as for APRAS
- Exit from data edit mode; press ESC
- Do what choices; same as for APRAS
- A command:
  - enter run number
  - generates 2 files (summary and aggregation), e.g., ALASKA.AGL and ALASKA.AGG
- Print aggregation summary output: type 0, 1, ..., 9 for number of copies
- See operating system prompt

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