DOT/FAA/AM-98/7

Office of Aviation Medicine
Washington, D.C. 20591

Evaluating the Decision-Making Skills of General Aviation Pilots

Walter E. Driskill
Johnny J. Weissmuller
John C. Quebe
Darryl K. Hand
Metrica, Inc.
San Antonio, TX

David R. Hunter
Office of Aviation Medicine
Federal Aviation Administration
Washington, DC 20591

February 1998

Final Report

U.S. Department of Transportation
Federal Aviation Administration

NOTICE

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/AM-98/7		

4. Title and Subtitle	5. Report Date
Evaluating the Decision-Making Skills of General Aviation Pilots	February 1998
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Driskill, W.E., Weissmuller, J.J., Quebe, J., Hand, D.K.;[1] and Hunter, D.R.[2]	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
[1]Metrica, Inc. San Antonio, TX 78216 — [2]FAA Office of Aviation Medicine 800 Independence Ave., S.W. Washington, DC 20591	11. Contract or Grant No.
12. Sponsoring Agency name and Address	13. Type of Report and Period Covered
Office of Aviation Medicine Federal Aviation Administration 800 Independence Ave., S.W. Washington, DC 20591	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

An instrument consisting of 51 items was developed to assess pilot decision-making skill. Each item consisted of a stem, a short description of an aviation scenario requiring a decision on the part of the pilot. Four alternatives were provided, and subjects were instructed to rank order the alternatives from best to worst solution to the scenario presented. Rank-ordered judgments of a sample of 246 general aviation (GA) pilots (with an average of about 500 hours of total flying experience) were compared with the recommended solutions provided by an expert panel. Results indicated that, overall, GA pilots and an expert panel of pilots agreed in their judgments of the appropriate course of action in situations critical to flight safety. However, the degree of agreement of individual general aviation pilots with the recommended solutions varied widely. An index of agreement (Safety Deviation Index) was calculated that expressed the degree of agreement of individual GA pilots with the recommended solutions. Initial evaluation of this index indicates that it demonstrates adequate psychometric properties and that, as other research would suggest, it has little relationship with common demographic or flight experience measures.

17. Key Words	18. Distribution Statement
Pilots, Aircraft Pilots, Decision-Making, Aviation Safety, Linear Modeling, Policy Capturing	Document is available to the public through the National Technical Information Service Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	43	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

ACKNOWLEDGMENTS

An expression of appreciation is extended to Tom Hennessee and Owen Russel, present and former Federal Aviation Administration Flight Safety Program Manager for the San Antonio Flight Safety District Office; to Cynthia Gass of Airways Aviation; and to Stanley Finch of Berry Aviation. They gave freely of their time to provide intensive review of the scenarios used in this research. Their advice materially improved the quality of this study and is deeply appreciated.

TABLE OF CONTENTS

EVALUATING THE DECISION-MAKING SKILLS OF GENERAL AVIATION PILOTS

This report describes research comparing judgments of a sample of general aviation pilots (predominately Private Pilot certificate holders) and an expert panel of pilots with respect to decisions critical to flight safety. The objective was to develop a methodology to assess the decision-making skills of general aviation pilots by using a written format. Current techniques for assessing decision-making in pilots typically rely upon the observation of behavior in either a flight simulator or an actual aircraft — both of which are both time consuming and expensive. Hence, a methodology that could be used outside those settings would have significant advantages both for research and for training.

I. BACKGROUND

Based on a review of 361 general aviation accidents, a National Transportation Safety Board report (NTSB, 1989) concluded that 97% of the probable causes were attributable to flight crew. An earlier review by Jensen (1982) attributed as many as 85% to pilot error, and in 51.6% of the fatal accidents, *faulty decision-making* was cited as a probable cause.

Studies at the University of Illinois (cf., Barnett, 1989; Stokes, Kemper, & Marsh, 1992; Wickens et al., 1987) have evaluated pilot decision making in a simulated environment using MIDIS (Microcomputer based Decision Simulator). These studies have generally demonstrated that there is little relationship between pilot demographic characteristics (such as experience levels) and performance on decision-making tasks.

Two earlier studies (Driskill, Weissmuller, Quebe, Hand, Dittmar, & Hunter, 1997; Driskill, Weissmuller, Quebe, Hand, & Hunter, 1997) examined pilot decision-making through linear modeling of pilot worth functions. Pilots were presented with scenarios in which weather conditions (ceiling, visibility, and amount and type of precipitation) varied. Pilots were required to assign "comfort levels" to each scenario that indicated their relative risk assessments of the scenarios. These studies indicated that, while pilots tended to order scenarios involving flight under varying favorable and unfavorable weather conditions (e. g., unlimited ceiling and visibility and no precipitation to very low ceiling and visibility and freezing rain) in the same way, there were wide differences in the comfort levels they assigned to flight under the varying conditions. These results imply that some pilots either do not know the safety risk implications of flight, or some are more willing to incur safety risks when they fly.

The studies also showed that expert pilots (seasoned instructors, for example) had consistent ratings of weather conditions. This indicated that they shared a common concept of what constituted "good" and "bad" weather conditions. In the weather modeling studies, this common concept was used to establish baseline indices for the generation and selection of scenarios. This suggests that these experienced pilots may also share common concepts of "good" and "bad" decisions in other aviation settings, and that those common models could form a baseline against which the decision-making of other pilots might be compared.

The present study, therefore, sought to examine the degree to which the decisions of less experienced pilots agreed with the decisions recommended by expert pilots for a set of potentially hazardous in-fight events presented in a written format. Two questions were posed: (1) Do the judgments of less experienced pilots (about 500 hours total flying hours) differ from those of an expert panel in making decisions critical to flight safety? (2) To what extent are demographic factors associated with the decisions made? Although previous studies (for example, Stokes, Kemper, & Marsh, 1992) have addressed these issues to some extent, the present study is unique in the use of a written format for the assessment of decision-making.

In the research described below, three assumptions were made: (1) The affective or motivational component of aeronautical decision-making (a "Why Fly" factor) affects pilots' willingness to accept higher safety risk. (2) This willingness is reflected in how they judge alternative courses of actions in flights requiring decisions critical to flight safety. (3) When compared with expert pilot safety risk judgments, some pilots select courses of action having greater safety risk than other actions that could be taken.

A flight mission or "Why Fly" statement was used to establish the motivational dimension in each scenario. These statements were based on the following situational factors that could affect the way pilots judged the courses of action available to them:

1. weather phenomena
2. mechanical malfunctions
3. biological crises (e. g., sick pilot or passenger)
4. social influences (e. g., passenger requests impacting flight safety)
5. organizational (e. g., employer or Air Traffic Control requests for pilots to perform some action)

The remainder of this report presents the guidelines and methods for developing realistic flight descriptions and details about capturing expert pilot policy, collecting data from the sample of general aviation pilots, computing and comparing pilot safety risk indices, and analyzing how pilot demographic data and motivating conditions relate to pilot safety indices.

II. SCENARIO DEVELOPMENT

Because of the efficacy of scenarios for describing flights simulating situations requiring pilot judgments (Driskill et al., 1997), this study employed a scenario-based approach. Each scenario would consist of a succinct description of the situation at hand and four plausible alternatives. Although some studies (Wickens, et al, 1987; Stokes, Kemper, & Marsh, 1992) have suggested that the use of a multiple-choice format attenuates the differences between novices and experts, the overall design of the present study which relied upon self-administration of the data collection instrument dictated its use. How scenarios were developed is described below.

Guidelines

Eight principal guidelines directed scenario development:

1. Content of each scenario should be based on situations that have actually occurred in preparing for or making a flight.
2. Descriptions should clearly require a decision critical to flight safety.
3. Each scenario should contain four plausible and realistic alternative decision choices that pilots could reasonably be expected to make. No choice should be totally unsafe; nor should any be obvious or a "book solution."
4. Circumstances or events representing the motivational conditions (i. e., weather, mechanical, biological, sociological, and organizational) should be either explicit or stated in such a way that they are self-evident from the situation presented.
5. Plausibility and realism of situational descriptions and associated decision choices should be verified by expert pilots.
6. The four alternatives should contain flight safety risk elements differing with respect to amount or degree of risk.
7. Scenario content should eliminate effects of local knowledge on the part of respondents.
8. Because the data collection instrument was to be administered by mail, the amount of time required for completion should not exceed one hour.

Sources of Scenario Development

The task scientist, who has more than 30 years experience as a pilot, based development of the scenarios on four sources.

Previous FAA Research. Specification of initial scenario topics was based on the results of a large survey of American pilots (Hunter, 1995). A nationwide sample of pilots provided their own "hangar flying stories" about dangerous situations, courses of action, judgments made, and actions taken. Each anecdote was accompanied by lessons learned. The survey produced 135 anecdotal descriptions of lessons learned, e. g., "Don't let others do your preflight for you;" and "Do not ever let your passenger talk you into doing something your better judgment says don't do." Frequently, there was more than one lesson learned. In these cases, the primary and secondary factors were identified as potential targets for scenario development.

National Transportation Safety Board Records. A review of NTSB summaries of accident and incident reports was used to narrow the list of lessons learned. The review identified accidents or incidents in which the details matched items on the lessons learned list as well as being representative of the five motivational conditions. Later, details in the summaries were used to develop scenario content.

"Why Fly" Survey. Scenarios, except those involving weather phenomena and mechanical malfunctions, required a clear statement of flight mission or motivation. To determine the relative value of motivational statements for biological, organizational, and sociological scenarios, 30 pilots provided ratings of 25 of the most common reasons for flying. In the group of pilots, 10 were flight instructors and 16 were airline transport pilots. Seventeen of them were employed as pilots. They rated each reason for flying based on their willingness to accept risks in order to complete a flight, using a scale of 0 (only willing to accept the least risk) to 100 (willingness to accept greatest risk). They also provided the number of times they had flown for each of the reasons rated.

Measures (intraclass correlations) of interrater agreement and stability of responses about reasons for accepting greater risk and for number of times flown for each reason were computed using GRPREL from the Comprehensive Occupational Data Analysis Programs (CODAP). This analysis package is briefly described in Appendix E. Interrater agreement (r_{11}) was .65 and .49, respectively. Stability (r_{kk}) of responses was .98 and .96. Stability measures above .90 indicate that a survey of another comparable sample of subjects would yield highly similar results.

Means for each reason, also computed by GRPREL, are shown in Table 1. Review of the means indicates that the reasons pilots might be willing to accept greater risk

Table 1. Mean Ratings of Reasons for Taking Greater Flight Risks

Reason		Mean Rating
	High Rated	
Home-Holidays		87.73*
Search-Rescue		79.70
Angel Flight		74.97
	Midrange Rated	
Deliver Spare Parts		45.57
Hunting Trip		41.37
Instruct Students		38.63
Sightseeing		36.87
Proficiency Flight		36.45
Fly Boss to Meeting		35.43
Resort-Vacation		33.77
Photograph-Show Clients Property		31.55
Fly Co-Workers to Meeting		26.17
Fly Home (After 3 Days)		12.10
	Low Rated	
Fly Home (After 7 Days)		2.31
Visit Friends		1.77
Receive Instruction-Flight Check		1.72
Fly Home (After 1 Day)		1.47
Friends to Ball Game		1.41
Make Airline Connection		1.40
Home-Funeral		1.10
Fly Self to Meeting		1.07
Administer Flight Checks		0.87
Deliver Serum		0.60
Ferry-Deliver Airplane		0.40
Ferry VIPs		0.30

*Maximum Rating is 100.00; minimum rating is 0.00.

are easily categorized as high, midrange, and low. Three reasons are in the high rating category, with ratings ranging from 74.97 to 87.73; 10 have midrange ratings from 12.10 to 47.10; and 12 have low ratings of 0.30 to 2.31.

Subject Matter Expert Interviews. When draft scenarios and alternatives based on the preceding sources were developed, senior pilots completed a field review of candidate scenarios. These senior pilots provided an intensive, critical review of the scenarios and alternatives. Participating in the field review were present and former FAA Flight Safety Program Managers and senior flight instructors in local aviation schools. On the basis of their critical reviews, 51 scenarios were selected for use in the study.

Scenario Content

Aircraft. Since the baseline for expert pilot risk assessments was a pilot with approximately 500 flying hours, the most commonly flown aircraft used by these pilots appeared to be the Cessna 172. Flight in a rented aircraft of this type was the basis of each scenario. The choice, however, restricted the mechanical and performance scenarios to fairly basic malfunctions, when compared with some of the aircraft incidents reviewed. To make clear to all respondents (experts and national sample), a flier from an airplane rental agency was included in the survey. The flier described the airplane and onboard equipment.

Virtual Airspace. During the development stage, a decision was made to recast scenarios from the FAA survey and NTSB summary records into a virtual airspace designed around six fictitious airports containing the characteristics necessary to support scenario alternatives. Several factors influenced this decision. First, since the sources of the scenarios involved incidents or accidents occurring across the United States and several foreign nations, maintenance of each scenario in its original setting would have required extensive descriptions and possible supporting charts and airfield diagrams. Second, the effects of "local knowledge" should be eliminated. If actual airfields were used, it is possible that some respondents might be familiar with them and would bring some level of terrain or airspace "local knowledge" into the decision-making process.

Airport diagrams, patterned upon actual airport directories, were constructed to support the scenarios. The latitudes and longitudes were fictionalized and set in the middle of the United States to minimize references to similar airports. Included along with the airfield diagrams was information about runway length and lighting, indicating whether the tower operated on a 24-hour schedule, availability of airport surveillance radar, and listing telephone and maintenance availability. Because such information is not normally available to private pilots, a diagram of the fictitious Air Force base was not included. To discourage respondents from forming alternatives not in the four provided for each scenario, a comprehensive map showing all of the airfields was not included.

Scenario Format. Each scenario contained a stem describing the circumstances of the flight and clearly showing the need for a decision critical to flight safety. The stem for biological, sociological, and organizational scenarios contained an ***explicit*** statement of the mission of the flight. Results of the "Why Fly" survey were used to balance motivating conditions used in the stem. Motivation levels ranged from high (>75) to very low (<12) risk acceptance.

The need for a critical decision was self-evident in mechanical and weather scenarios, since these kinds of scenarios do not require a direct statement. Pilots at cruising altitude when their engine quits, for example, do not have to consider the purpose of their flight in order to initiate their decision-making processes to resolve their problem.

Each scenario stem was followed by four alternative decision choices. Intensive review by expert pilots assured that each alternative was plausible — that is, each offered a decision a 500-hour pilot might reasonably be expected to make — and differed with respect to the degree of safety involved.

Scenario Structure

The final set of scenarios used for data collection consisted of 51 scenarios with all supporting information (e.g., airport diagrams). By situational category, the distribution was as follows: mechanical 8, weather 14, biological 8, sociological 10, and organizational 11. Motivational levels, based on the "Why Fly" study, were distributed as follows: high or strong, 2; middle range, 14; and low range or weak, 35.

III. CAPTURING EXPERT PILOT POLICY

Formatting of the data collection instrument, instructions for performing the three judgment tasks, and criteria for selecting members of the expert panel are described below.

Formatting and Instructions for Expert Pilot Judgment Tasks

During the development of the scenarios, the field review by subject matter experts made it apparent that capturing the judgments of three factors for each of four alternatives would be very time consuming — possibly requiring two or more hours. Judgments of 30-35 scenarios were the most that could be captured in one hour. As a result, the 51 scenarios were divided into two subsets that were reproduced as General Aviation Pilot Study Form A and Form B. Each form contained 33 scenarios. Fifteen scenarios were common to both Form A and B; the remaining 18 scenarios were unique for each form.

Instructions were provided for the three kinds of rating tasks the experts were asked to perform. For the *first* task, pilots were asked to ***rank*** each scenario alternative with respect to "...the best course of action ***for a pilot with a Private Pilot Certificate (PPL) who has not taken the Instrument written or Flight Check, and has approximately 500 total hours of flying time.***" Alternatives were rated a *1* for the best course of action to *4* for the worst.

In the *second* rating task the experts were asked to rate the ***plausibility*** of each alternative in terms of the percentage of 500-hour pilots who might choose the courses of action described in each scenario. The experts used a scale ranging from 0 to 100 percent.

The *third* rating task asked the experts to estimate the risk associated with each alternative. Specifically, instructions stated *"...enter a number ranging from 0 to 100 which would best represent your estimate of how risky this course of action would be for a PPL with 500 flying hours to successfully complete."*

A page illustrating the layout of the scenarios and alternatives for rating by the safety experts is provided in Appendix A.

Safety Expert Criteria

Several criteria were established for selecting pilots to form the expert safety panel for assessing their safety risk judgments.

1. Since the objective of this research required expert panel members be pilots whose focus was overtly on flight safety, the first criterion for identifying experts was their employment in positions in which flight safety is a foremost job objective. A second criterion required *prima facie* evidence of the pilot's interest in safety above and beyond that exhibited by the previous national samples of pilots. Pilots meeting these criteria included FAA staff members, senior instructional staff in university aviation programs, and pilots who frequently attended safety seminars.
2. As a group, the level of experience should provide them with knowledge of the situations described in the 51 scenarios. In addition to age, 21 other experience items were developed, ranging from total hours logged, certification and ratings, to total and recent night and weather flying experience.
3. The expert responses were carefully examined for interrater agreement (r_{11}) and stability (r_{kk}) and assessed for the presence of multiple policies with regard to the rank ordering of the scenarios and ratings of percentage of safety risk. The minimum r_{11} was .20 which represents the average correlation of each rater with each other rater. The minimum for r_{kk} was .90; values at this level or higher indicate high probability that another set of raters would provide comparable ratings. In addition, GRPREL assesses each rater in terms of agreement with other raters and identifies "deviant" raters. Deviant raters are those whose rating policy does not significantly correlate ($p < 0.05$) with other raters. This process evaluates the existence of multiple policies. Usually, only one to three raters are identified as deviant because they did not follow instructions or reversed the scale used. When there is a larger number of deviant raters, GRPREL assesses them in the same way to determine if there is a significant secondary policy. A description of the GRPREL analysis system and representative references are available in Appendix E.
4. The experience level should exceed that of the national population in terms of total hours and levels of certification.

Collection of Expert Data

Forms A and B of the General Aviation Pilot booklet were personally delivered to pilots. They returned their responses by mail. Judgments were obtained from 31 pilots. This group was comprised of FAA staff personnel, including the present and former managers of the Flight Standards District Office (FSDO) in San Antonio; flight instructor personnel at Embry-Riddle Aeronautical University, University of North Dakota, Daniel Webster College, and Ohio State University; and pilots attending a one-day FAA sponsored safety seminar in San Antonio, Texas.

Demographics and experience of the pilots comprising the safety expert panel compare favorably with the criteria set for panel membership and are reported in Table 6 and compared with the sample of general aviation pilots.

Expert Interrater Agreement and Policy Stability

The rank order, percentage of safety risk, and alternative plausibility judgments of 31 experts were entered for GRPREL analysis.

Rank Order. Interrater agreement (R_{11}) and stability (R_{kk}) of the expert rankings of alternative courses of action are .44 and .93, respectively. Both values exceed the criteria set for agreement and stability. There was no evidence of a secondary policy.

Safety Risk. Interrater agreement (R_{11}) and stability (R_{kk}) of the expert rankings of alternative courses of action are .45 and .94, respectively. These values are almost identical to those for rank order.

The distribution of mean ratings is shown in Table 2. Percentage of safety risk means for the alternatives are distributed from 2.08 (lowest risk) to 86.95 (highest risk). The grand mean of the rankings is 36.52, with a standard deviation of 19.19.

Alternative Plausibility. In making their plausibility ratings, the experts were asked to estimate the percentage of 500-hour pilots who might choose the course of action represented in each alternative. The R_{11} and R_{kk} for these ratings were .22 and .84, respectively, based on 30 raters. The grand mean of the plausibility ratings for the 204 alternatives was 37.87 with a range from 9.09 (lowest plausibility) to 76.11. The distribution of ratings is shown in Table 3. Overall, the ratings appeared to be reasonable and plausible.

Effect of "Why Fly" on Expert Ranking and Rating

The "Why Fly" statement in each scenario was intended to represent the motivational component of aeronautical decision-making. If the statement had its intended effect, first-choice alternatives for scenarios should be expected to have higher risk ratings than alternative courses of action — that is, the first-ranked alternative would not be the alternative with the lowest-rated safety risk. A Pearson product moment correlation of alternatives rankings and ratings, however, was .808, indicating that the "Why Fly" statements had little overall effect on the rankings and ratings. Given this high correlation, any "Why Fly" effect is most likely to be specific to a given flight scenario.

The relationship between rankings and ratings is depicted in Table 4. This table shows the number of times the first-ranked alternative for a scenario corresponded with the alternative with the lowest safety risk rating. Note that the risk ratings for each alternative were converted to rank order to make the relationships more easily perceived. Several factors should be noted in the Table 4 data. First, for 42 of the scenarios, the first-ranked choice also had the lowest risk. Only nine scenarios had a higher risk alternative than the first-ranked alternative. Of these nine, the first-ranked choice had the second lowest risk percentage for four scenarios. The

Table 2. Distribution of Safety Risk Ratings Across the 204 Alternatives

Frequency	N	Frequency	N
91-100	0	41-50	34
81-90	2	31-40	34
71-80	6	21-300	31
61-70	18	11-20	39
51-60	26	01-10	14

Grand Mean = 36.52; Standard Deviation = 19.19

Table 3. Distribution of Plausibility Ratings Across the 204 Alternatives

Frequency	N	Frequency	N
91-100	0	41-50	56
81-90	0	31-40	48
71-80	2	21-30	42
61-70	8	11-20	24
51-60	23	01-10	1

Grand Mean = 37.87; Standard Deviation = 21.85

Table 4. Comparison of Expert First Choices with Risk Ratings for 51 Scenarios

Rank Order	Risk Order[1]	N Experts
1	**1**	**42**
1	2	4
1	3	5
2	1	6
2	**2**	**35**
2	3	8
2	4	2
3	1	3
3	2	9
3	**3**	**29**
3	4	10
4	2	3
4	3	9
4	**4**	**39**

[1]Percentage of risk converted to rank order; 1 = lowest risk, 4 = highest risk

remaining five had the next to highest risk alternative as the first ranked choice. No first-ranked choice, however, had the highest risk percentage.

Second, the highest coincidence of rank and risk rating was for the first- and fourth-ranked choices. As indicated, for 42 scenarios the first-ranked alternative also had the lowest percentage of risk. For 39 scenarios, the fourth-ranked choice also had the highest risk percentage.

Third, agreement between rank order and associated risk percentage was less for the second and third ranked alternatives. Rank ordering and percentage of risk coincided for 35 and 29 scenarios, respectively.

Scenario-specific information for the nine scenarios where the first-ranked alternative was not the alternative with the lowest safety risk rating is in Table 5. For six of the scenarios, the differences of percent safety risk were small, ranging from .70 to 8.42.

Risk percentages were higher for three other scenarios for which the "Why Fly" statements *may* have influenced the rankings. Scenario 36 describes flight to deliver medical serum to an American Red Cross team, and a potential mechanical problem is reported to the pilot. Scenario 46 involves flight to a football game where a weather problem intervenes in the flight. Scenario 51 describes a sight seeing trip with friends when a potential weather problem develops.

IV. COLLECTING GENERAL AVIATION PILOT JUDGMENTS

Data Collection Instrument

The 51 scenarios were reproduced in random order in a booklet entitled "General Aviation Pilot Study" (see Appendix B). To reduce the amount of time required to complete the research task, the pilots were asked only to rank order the alternative courses of action for each scenario. The study booklet consisted of a background information section, instructions for ranking scenario alternatives, a pamphlet describing the aircraft, airport diagrams and associated information, and the scenarios.

Table 5. Summary of Expert Rankings and Safety Risk Ratings

Scenario Number	Situational-Motivational Category	Lowest Alternative	% Risk Rating Lowest Alternative	Delta
51	Weather - Medium	b 39.54	d 13.18	26.36
46	Weather - Low	b 33.75	d 17.50	16.25
36	Mechanical - Low	c 30.00	d 16.42	13.58
34	Biological - Low	b 16.25	d 7.83	8.42
10	Biological - Medium	c 23.89	d 16.22	7.67
19	Biological - Low	b 20.00	a 13.68	5.28
05	Organizational - Low	a 15.07	d 10.55	4.52
24	Sociological - Medium	a 13.69	b 11.95	1.74
06	Organizational - Low	a 17.83	b 17.13	0.70

The background information section, titled Pilot Information, elicited the same demographic and experience information from the national sample as was obtained from the expert panel of pilots. In addition, the sample pilots were asked to provide information about the aircraft they flew most frequently.

The instructions, after explanation of the information supporting the scenarios, carefully described how alternatives should be ranked, the substance of which is quoted below:

> First, carefully read the scenario and the four listed alternative responses. Assume you have leased the Cessna 172 shown on the flyer from Aircraft Rental and Leasing. Feel free to use the airfield diagrams for assistance in understanding the problem.
>
> Second, based on your experience, decide which of the alternatives you would most likely select as your first course of action, what would be your second choice, then your third and fourth if you were the pilot in the scenario. To the left of each choice are the numbers (1 2 3 4), circle the 1 next to the choice you selected as your first. Next select the choice you consider second and circle the 2 to the left of the choice, then circle your third and fourth choices.

An example showing how rankings were to be marked was included.

The instructions explicitly stated that "This is not a test." Further, they stated "There are no right or wrong answers, and you are not asked to do anything illegal."[1]

Data Collection and General Aviation Sample Demographics and Experience

Data Collection. The data collection instrument was mailed to approximately 1,000 private pilots in the Eastern, Southwest, and Northwest Mountain Regions of the FAA. Pilots were randomly selected from current FAA records. The package contained a postage-paid envelope addressed to the Office of Aviation Medicine in Washington, D. C., for pilots to use in returning their responses. Responses from 246 pilots were returned to the Office of Aviation Medicine and key entered for data analysis.

Sample Demographics and Experience. Sample demographics and flying experience are compared with similar information for the 31 pilots in the expert safety panel in Table 6. A complete summary of the demographic and flying experience of the general aviation sample is provided in Appendix C.

The sample statistics support two conclusions. First, the sample satisfied the objective of the study to obtain the judgments of pilots with about 500 total flying hours. In addition, most of them (70%) were not instrument-rated. Second, the criterion related to the experience requirements of the expert panel of pilots was achieved, as the pilots in the GA sample had considerably less experience that the experts, nor did any of the general aviation pilots hold CFI or CFII certificates.

The GA pilot sample is comprised mostly of pilots from Texas (129), New York (63), and Washington (34), although pilots from 12 states are represented. The most distinguishing features of the national sample are the ownership of their own aircraft (by 50% of the pilots) and the less than 750 hours of total flying hours (by 76% of them). Other flying experience, as would be expected, is similarly limited: 78% have fewer than 50 hours night flying and over one-half have fewer than 24 hours of night flying. The aircraft they most frequently fly is equipped with a transponder (96%), 75% are IFR-capable, 37% are autopilot equipped, but only nine percent are equipped with weather radar. Most of the pilots (93%) report flying single-engine aircraft. While all are single-engine rated, only 11% are multi-engine rated; none are certified as CFI.

V. ANALYSIS OF SCENARIO ITEM RESPONSES

The mean vectors of rankings for the general aviation sample and the expert panel of pilots were correlated, and a Pearson r of 0.914 was obtained. The general aviation sample and experts rank-ordered the alternatives differently for only seven scenarios. Table 7 lists the seven scenarios where the differences occurred, along with the first choice alternative of the

[1] After virtually all the data collection had been completed it was discovered that some of the scenarios depicted VFR flights at altitudes normally used for IFR flight. According to the Airman's Information Manual, VFR flights in an easterly direction should be conducted at an odd thousand feet plus 500 feet (for example, 7,500 feet); while westerly VFR flights should be conducted at an even thousand feet plus 500 feet (for example, 6,500 feet). However, some of the scenarios used in the data collection indicated that the pilot was flying VFR at a whole number of thousands of feet. For example, the second scenario reads, "You are solo on a late night cross country cruising VFR at 9000 feet..." While this is not illegal, it is contrary to recommended operating procedures. Neither the experts nor the general aviation pilots commented upon this error, so it is believed not to have significantly influenced the results.

Table 6. General Aviation Sample and Expert Panel Demographics and Flying Experience Comparison

Demographic	**Sample**	**Expert**
Mean age in years	46.9	45.9
Male	96%	90%
Female	4%	10%
Military flying experience	3%	23%
Mean CFI/CFII years	0.0	12.0
<u>Percent Certificates Held</u>		
Private pilot	98%	6%
Commercial	2%	35%
ATP	0%	48%
CFI	0%	67%
CFII	0%	65%
Instrument	30%	97%
Single engine	100%	93%
Multi engine	11%	90%
<u>Mean flying hour logged</u>		
Total	589	4995
Weather (IMC) flying hours	41	581
Instructor flying hours	0	1683
Night flying hours	43	528
<u>Mean flying hours last 60 days</u>		
Total	10	55
Day	10	50
Weather	1	7
Instructor	0	33
Night	2	12

experts and the general aviation sample, the safety ratings associated with each alternative, and the difference between the experts and sample.

Item Analysis and Score Generation

A scoring key was developed by taking the alternative ranked #1 by the expert panel as the keyed alternative. This answer key is given in Table 8. Using this key, the responses of the general aviation sample were analyzed using the ITEMAN Item and Test Analysis Program (Version 3.50, Assessment Systems Corp.). This program generated item statistics (given in Table 9) for each of the 51 scenario-items.

ITEMAN also generated number-right scores (Safety Deviation Index, SDI) for all subjects and produced overall scale statistics for the SDI. These statistics are given in Table 10. The SDI scores were merged with demographic information and were subsequently analyzed using SPSS for Windows (Ver 6.0). Figure 1 shows the distribution of SDI for the 246 subjects. As may be seen from that figure, the distribution of scores is approximately normal, with a mean (and median) of 27.

Analysis of sample demographic variables

Correlations were computed between the SDI and the sample demographic variables, as shown in Table 11. Although the correlations are uniformly small and generally not statistically significant, they form an interesting pattern. Of particular note, the correlations for all the flying experience variables have a negative sign, while the single correlation with a positive sign is between the SDI and age.

Table 7. Mean Rank and Percentage of Safety Risk Differences Between Experts and Sample Pilots

Scenario	**1st-ranked Expert**	**Sample**	**Expert Rating**	**Sample Rating**	**Difference**
35	b	c	2.25	45.83	43.58
04	c	b	30.71	45.00	14.29
48	b	c	16.45	30.45	14.00
15	c	b	8.33	15.20	6.87
39	b	a	25.45	26.36	0.91
49	c	b	32.73	33.64	0.91
51	d	c	39.54	40.00	0.46

Note: Difference = Sample Rating - Expert Rating

Table 8. Scenario Keyed Responses

Scenario No.	Keyed Response	Scenario No.	Keyed Response	Scenario No.	Keyed Response
1	b	18	a	35	b
2	b	19	d	36	d
3	d	20	d	37	b
4	c	21	b	38	b
5	d	22	d	39	b
6	b	23	b	40	d
7	c	24	b	41	b
8	a	25	b	42	b
9	d	26	d	43	c
10	d	27	c	44	c
11	c	28	b	45	b
12	c	29	c	46	b
13	d	30	a	47	d
14	b	31	d	48	b
15	c	32	b	49	c
16	a	33	a	50	d
17	b	34	d	51	d

Note: The keyed response is that which was rank-ordered #1 by the expert panel.

Table 9. Item Statistics

Item No.	P	D	r_{pb}	Item No.	P	D	r_{pb}	Item No.	P	D	r_{pb}
1	.83	.28	.33	18	.89	.24	.35	35	.39	.58	.50
2	.70	.47	.40	19	.16	.11	.17	36	.08	.04	.05
3	.54	.53	.37	20	.88	-.08	-.07	37	.37	.60	.52
4	.44	.08	.07	21	.78	.40	.40	38	.44	.37	.32
5	.13	.18	.22	22	.94	.08	.20	39	.26	.18	.14
6	.24	.23	.22	23	.83	.32	.37	40	.51	.20	.21
7	.69	.13	.10	24	.22	.27	.33	41	.34	.49	.42
8	.57	.48	.43	25	.52	.41	.37	42	.53	.17	.13
9	.56	.40	.38	26	.51	.29	.24	43	.90	.19	.33
10	.16	.20	.27	27	.57	.57	.48	44	.97	.06	.19
11	.67	.44	.45	28	.61	.22	.18	45	.43	.42	.36
12	.71	.46	.44	29	.54	.19	.15	46	.28	.45	.44
13	.58	.60	.50	30	.57	.09	.07	47	.02	.00	-.01
14	.87	.18	.21	31	.46	.40	.35	48	.28	-.12	-.03
15	.44	.28	.30	32	.84	.10	.13	49	.27	.06	.07
16	.80	-.02	.00	33	.55	.32	.27	50	.85	.28	.37
17	.93	.09	.19	34	.17	.35	.42	51	.39	.47	.42

P= Proportion Correct
D= Discrimination Index
r_{pb} = point-biserial correlation for keyed response

Table 10. Safety Deviation Index statistics

N of Items	51
N of Examinees	246
Mean	27.2
Variance	36.0
S.D.	6.0
Median	27
Alpha	0.753
Mean P	0.534
Mean Biserial	0.371
Minimum Score	6
Maximum Score	44

Table 11. Correlations of the SDI and demographic variables

Variable	r	p
Age	.1044	.105
Total flying hours	-.0796	.218
Total weather flying hours	-.0991	.151
Total instrument flying hours	-.1198	.071
Total night flying hours	-.0306	.642
Flying hours - last 60 days	-.1121	.086
Weather flying hours - last 60 days	.-1417	.033
Instrument flying hours - last 60 days	-.0628	.345
Night flying hours - last 60 days	-.1509	.022

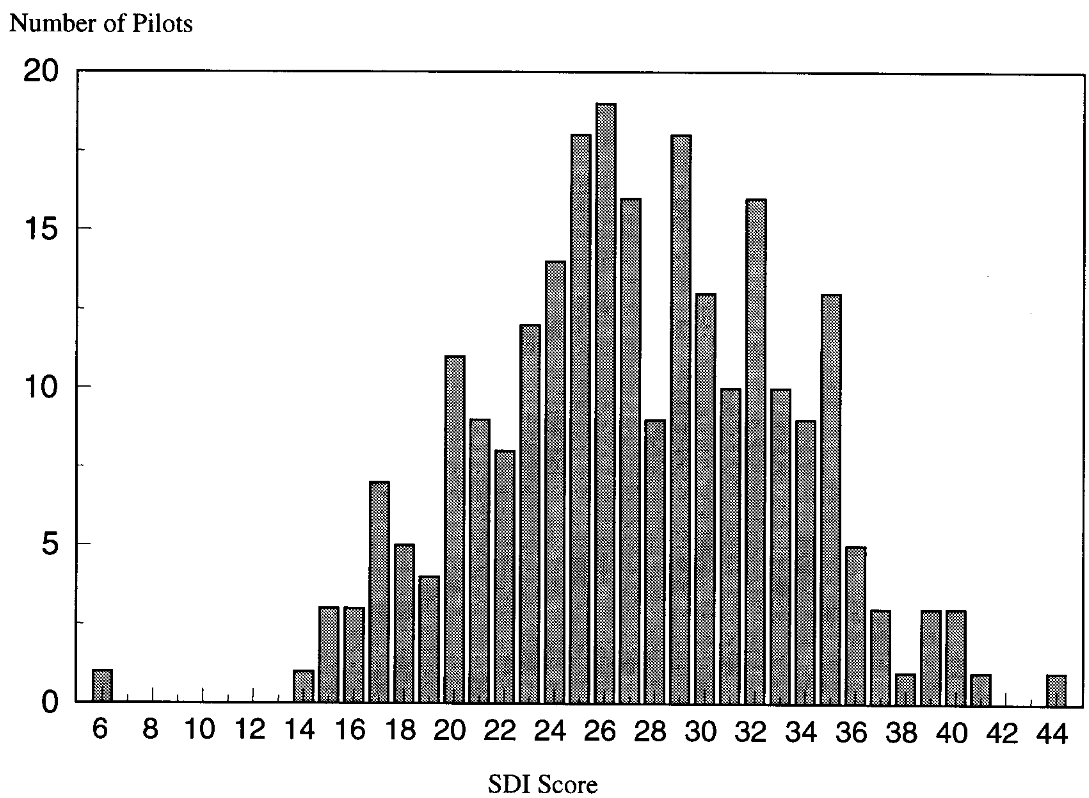

Figure 1. Distribution of Safety Deviation Index scores.

VII. CONCLUSIONS AND DISCUSSION

This study sought to examine the decision-making skills of typical general aviation pilots by comparing their preferred solutions to a number of scenarios with the solutions recommended by a panel of experts. It was found that, overall, general aviation and expert pilots agreed in their judgments of the appropriate course of action in situations critical to flight safety. That is, there was a high correlation between the vector of mean recommended solutions provided by the expert and the vector of mean solutions chosen by the general aviation pilots.

Notwithstanding the high overall agreement between general aviation and expert pilots, the degree of agreement by individual general aviation pilots with the recommended solutions varied widely. This was evidenced by the range of scores (6 to 44) obtained when the scenario items were analyzed using a simple right-wrong scoring system. That analysis showed that, on average, the general aviation pilots selected the recommended alternative for only about half of the scenarios.

Two demographic factors seem to influence the general aviation pilots' judgments: age and quantity of flying experience. Younger pilots tend to make judgments involving higher risk than older pilots. The same is true for more experienced pilots in terms of total and recent flying experience. Because the correlations are small and not all statistically significant, we must be cautious in interpreting these results, as the trend we see may prove, on further investigation, to simply be a spurious statistical result. However, because the implications are intriguing, and with the preceeding caveat in mind, we will explore them briefly. Recall that the data presented earlier (Table 4) suggest that the expert panel, in their rank ordering of the alternatives, generally assigned the #1 rank to the safest (that is, least risky) of the four alternatives given. Higher SDI scores are therefore indicative of subjects who endorse the least-risky (most conservative) solution for each scenario.

The data suggest, however tentatively, that while age is positively associated with increased conservatism (less risky), flying experience is negatively associated with conservatism. That is, older pilots are more conservative than younger pilots, but pilots with more experience are less conservative than pilots with little experience. Therefore, the pilots who are the least risk-averse would be those who are both young and who have higher levels of total and recent experience. This interpretation is consistent with the findings of two studies of weather information utilization (Driskill, Weissmuller, Quebe, Hand, Dittmar, et al., 1997; Driskill, Weissmuller, Quebe, Hand, et al., 1997) in which pilots rated a number of combinations of weather conditions in terms of their comfort level in flying under such conditions. Hierarchical cluster analyses indicated that the groups with the highest comfort level (that is, least risk-averse) were the youngest.

Similar results were also obtained from a study of risk factors for aircraft accidents in New Zealand (O'Hare, Chalmers, & Bagnall, 1996), in which a group of "high flyer" young, active pilots was overrepresented in accidents. However, Stokes, Kemper, & Marsh (1992, pg 34) investigated decision-making in simulated flights in the MIDIS and found "...no evidence that better decision making automatically comes with advancing years or the accumulation of flight hours." Since the methods and criteria used among these studies and the many others (cf., Barnett, 1989; Jensen, 1995; Wickens et al., 1987) that have evaluated the impact of age and experience on pilot performance differ considerably from those used in the present study, it is difficult to assess the comparability of their results. Further, we must again note that the correlations obtained here were quite small indeed and, for the most part, represent only trends that may not prove to be statistically reliable. Thus, this tentative finding must be treated with considerable caution but may be worth exploring in future studies.

The main purpose of the study seems to have been accomplished. That is, a written instrument was developed that may be used to evaluate the decision-making skills of general aviation pilots. The SDI derived from the instrument has adequate reliability as measured by coefficient alpha, and an approximately normal distribution, centered around a mean performance level of approximately 50% correct. These are necessary (though certainly not sufficient) conditions for an instrument that might be used to assess general aviation pilot decision-making. Additional studies will be required to evaluate the relationship of the SDI to external criteria such as accident involvement or involvement in potentially hazardous events (for example, running low on fuel), along with additional psychometric properties of the SDI and other potential indices derived from the instrument.

Finally, we must note that although general aviation pilots may demonstrate on paper that they have the knowledge and perspective for deciding upon and taking the safest course of action, there is no assurance that in real-time situations, under the pressures and motivations of the moment, that they will in fact apply this knowledge appropriately. Indeed, accident statistics (e.g., NTSB, 1989) suggest that they often do not make the correct choice in these critical situations. An instrument capable of reliably detecting individual differences in decision-making skills could therefore have a substantial impact on aviation safety by, for example, identifying those individuals most at risk for a decision-related accident or incident and therefore most in need of remedial decision-making training. Whether the current instrument has that capability remains unknown, but this will be addressed in future research.

VII. REFERENCES

Albert, W.G., Phalen, W.J., Selander, D.M., Dittmar, M.J., Tucker, D.L., Hand, D.K., Weissmuller, J.J., & Rouse, I.F. (1994). Large-scale laboratory test of occupational survey software and scaling procedures. *Proceedings of the 36th Annual Conference of the International Military Testing Association* (pp 241). Rotterdam, The Netherlands.

Barnett, B. J. (1989). Modeling information processing components and structural knowledge representations in pilot judgment. Unpublished doctoral dissertation, University of Illinois, Urbana-Champaign.

Christal, R. E & Weissmuller, J. J. (1988) The job-task inventory. In S. Gael (Ed.), *The job analysis handbook for business, industry, and government (Vol 2).* New York: John Wiley.

Christal, R. E. & Weissmuller, J. J. (1976). *New CODAP programs for analyzing task factor information.* (AFHRL-TR-76-3, AD-A025 121). Lackland AFB, TX: Occupational and Manpower Research Division, Air Force Human Resources Laboratory.

Driskill, W. E., Weissmuller, J. J., Quebe, J., Hand, D, Dittmar, M., & Hunter, D. R. (1997*). The use of weather information in aeronautical decision-making.* DOT/FAA/AM-97/3. Washington, DC: Federal Aviation Administration, Office of Aviation Medicine. Available from the National Technical Information Center, Springfield, VA 22161. Order #ADA323543.

Driskill, W. E., Weissmuller, J. J., Quebe, J., Hand, D, & Hunter, D. R. (1997*). The use of weather information in aeronautical decision-making*: II DOT/FAA/AM-97/23. Washington, DC: Federal Aviation Administration, Office of Aviation Medicine.

Goody, K. (1976). *Comprehensive occupational data analysis programs (CODAP): Use of REXALL to identify divergent raters.* (AFHRL-TR-76-82, AD-A025 847). Lackland AFB, TX: Occupation and Manpower Research Division, Air Force Human Resources Laboratory

Hunter, D. R. (1995). *Airman research questionnaire: Methodology and overall results.* DOT/FAA/AM-95/27. Washington, D.C: Federal Aviation Administration, Office of Aviation Medicine. Available from the National Technical Information Center, Springfield, VA 22161. Order #ADA300583.

Jensen, R. S. (1982). Pilot judgment: Training and evaluation. *Human factors, 24*, 61-73.

Jensen, R. S. (1995). *Pilot judgment and crew resource management.* Aldershot, England: Ashgate Press.

National Transportation Safety Board Safety Report (1989). *General aviation accidents involving visual flight rules flight into instrument meteorological conditions.* NTSB/SR-89/01. Washington, DC: National Transportation Safety Board, Bureau of Safety Programs.

O'Hare, D., Chalmers, D., & Bagnall, P. (1996). A preliminary study of risk factors for fatal and non-fatal injuries in New Zealand aircraft accidents: Final report to the Civil Aviation Authority of New Zealand. Dunedin, New Zealand: Department of Psychology and Injury Prevention Research Unit, University of Otago.

Phalen, W.J., & Mitchell, J.L. (1993). Innovations in occupational measurement technology for the U.S. military. *Proceedings of the Eighth International Occupational Analysts Workshop* (pp 12-16). San Antonio, TX: USAF Occupational Measurement Squadron.

Staley, M. R. & Weissmuller, J. J. (1981). *Interrater Reliability: The development of an automated analysis tool.* (AFHRL-TP-81-42, AD-A108 400). Brooks AFB, TX: Technical Services Division, Air Force Human Resources Laboratory.

Stokes, A.F., Kemper, K.L., & Marsh, R. (1992). *Time-stressed flight decision making: A study of expert and novice aviators.* (Technical Report ARL-93-1). Savoy, IL: University of Illinois, Aviation Research Laboratory.

U. S. Civil airmen statistics (1993). Washington, DC: Federal Aviation Administration.

Weissmuller, J. J., Phalen, W. J., & Tartell J. (June 1997) Defining and characterizing subgroups using interrater reliability and cluster analysis techniques. *Proceedings of the Tenth International Occupational Analysts' Workshop.* San Antonio, TX: USAF Occupational Measurement Squadron.

Wickens, C.D., Stokes, A., Barnett, B., & Davis. T. (1987). *Componential analysis of pilot decision making.* (Technical Report ARL-87/4). Savoy, IL: University of Illinois, Aviation Research Laboratory.

APPENDIX A

EXPERT PILOT PANEL DATA FORM

3. In the evening after an exhausting three day business meeting at a downtown hotel, you have loaded your rental airplane at the Downtown Airport and prepare to file your VFR flight plan for the two hour flight home when you discover you left your only pair of reading glasses in the meeting room back at the hotel. You have no problem seeing the panel gages, or distance vision, but can't read a map or chart. Weather is solid VFR and if you depart within the next 20 minutes you will arrive at your home airport before dark. You decide to:

Rank Order	Alternative	%Plausible	%Risk
1 2 3 4	a. Depart and fly home.		
1 2 3 4	b. Call the hotel, if they have your glasses go get them and fly home late this evening.		
1 2 3 4	c. Call the hotel, if they do not have your glasses, buy a cheap pair from an all night drug store and fly home tonight.		
1 2 3 4	d.. Call the hotel, if they have your glasses, go get them, spend the night and fly home in the morning.		

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

4. You are cruising at 4500 feet on top of a thin haze layer with the outside air temperature at 65 degrees. It has been twenty-five hours since the engine was overhauled and the run-up check was well within limits. The engine slowly loses RPM with no indications of oil or fuel problems. You suspect carburetor icing and pull on the carb heat. The engine backfires, vibrates and loses RPM fast. You decide to:

Rank Order	Alternative	%Plausible	%Risk
1 2 3 4	a. Pull out the mixture, stop the engine and check the fuel selector valve, mag switch settings and declare an emergency.		
1 2 3 4	b. Push in the carb heat, keep the engine running and divert to the closest airfield.		
1 2 3 4	c. Keep the carb heat on and see what happens.		
1 2 3 4	d. Push in the carb heat, keep the engine at idle, declare an emergency and ask for advice.		

APPENDIX B

GENERAL AVIATION PILOT STUDY MATERIALS

FEDERAL AVIATION ADMINISTRATION

GENERAL AVIATION PILOT STUDY

FEDERAL AVIATION ADMINISTRATION PILOT SURVEY

You have been selected to participate in a Federal Aviation Administration (FAA) study designed to identify areas of judgement where training would reduce the risk of incidents or accidents. You are especially valuable in this research as your expressed willingness to participate will allow us to examine pilot judgement across regions of the country, different age and levels of experience. We greatly appreciate your time and effort in completing this survey. We think you will find it interesting.

This survey consists of two parts. The first part is an experience questionnaire to enable us to quantify the experience factors of the pilots participating in this study. Notice that your name or other personal identifying information is not asked for nor recorded. There will be no way to match your survey response with you.

Please, complete the **Pilot Information Form** below. Enter or circle the response accurate for your aviation experience. **Be sure and circle all ratings you have had, not just the highest.**

PILOT INFORMATION *Circle or enter the correct response*				
Pilot Certificates Held: PP COM ATP CFI CFII		Instrument Rating? YES NO	Engine Rating SINGLE MULTI	Age:
State of Residence:	Sex: M F	Ever a Military Pilot? YES NO	Medical: Class I Class II Class III	
FLYING HISTORY *Enter the appropriate numbers to the best of your ability*				
Years as a Pilot:	Total Hours:	Weather Hours:	Hours of Instruction:	Night Hours:
FLYING HOURS IN THE LAST 60 DAYS *Enter the numbers to the best of your ability*				
Total Hours:	Day Hours:	Weather Hours:	Hours of Instruction:	Night Hours:
AIRCRAFT INFORMATION *Enter the data for the aircraft you most frequently fly*				
Number of Engines:	IFR Capable? YES NO	Auto-Pilot? YES NO	Weather Radar? YES NO	Transponder? YES NO
Do You Own this Aircraft? YES NO			Hours of Cruise Capable:	

The second part is a set of scenarios developed from real experiences reported to the FAA through previous studies. These scenarios contain a stem which sets the scene, and four courses of action which can be taken in response to the problem posed in the stem. Additional information including a diagram of each airfield (except for military installations) is provided. Airfield data relevant to each specific scenario is provided in a table immediately following the possible actions. For each of the 51 scenarios shown in Part 2 of the survey on pages 1 to 14, do the following steps:

First, carefully read the scenario and the four listed **Alternative** responses. Assume you have leased the Cessna 172 shown on the flyer from Aircraft Rental and Leasing. Feel free to use the airfield diagrams for assistance in understanding the problem.

Second, based on your experience, decide which of the alternatives you would most likely select as your first course of action, what would be your second choice, then your third and fourth if you were the pilot in the scenario. To the left of each choice are the numbers (1 2 3 4), circle the 1 next to the choice you selected as your first. Next select the choice you consider second and circle the 2 to the left of the choice, then circle your third and fourth choices.

Third, check that you have circled only one 1, 2, 3, or 4 for each alternative.

Last, put the completed survey in the pre-addressed envelope and drop it in the mail. NO POSTAGE NECESSARY!

This is not a test. There are no right or wrong answers, and you are not asked to do anything illegal. This is not a test of rules but a survey of pilots who have "been there, done that" and have survived to pass lessons learned from that experience to others just starting their flying careers. These scenarios were developed from *real* incidents reported in previous surveys where the pilot learned a valuable lesson and was willing to share with the aviation community.

Here is an example of what a properly completed question in the survey should look like.

15. Your airplane battery is dead and you are alone at the airfield. To start your airplane you decide to:

Rank Order	**Alternative**
1 2 (3) 4	a. Get your jumper cables and move the plane close enough to the 172 parked next to you and jump start the engine.
1 2 3 (4)	b. Prime the engine, turn on the master, set the mag switch to both, slightly crack open the throttle and swing the prop.
1 (2) 3 4	c. Connect the jumper cables from the airplane to your car and see if it will start.
(1) 2 3 4	d. Take the battery out and take it to be charged by an A&P mechanic.

Review the reference material on the next six (6) pages. Following your review, turn the last reference page and begin Part 2 by rating Items 1-51 on pages 1-14.

1. You are flying an "Angel Flight" with a nurse and non-critical child patient to meet an ambulance at a downtown regional airport. You filed VFR, it is 11:00 P.M. on a clear night when at 60 NM out you notice the ammeter reading zero and correctly deduce the alternator has failed. Your best guess is that you have from 15 to 30 minutes of battery power remaining. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Declare an emergency, turn off all electrical systems except for 1 NAVCOM and transponder and continue to the Regional Airport as planned.
1 2 3 4 b. Declare an emergency and divert to the Planter's County Airport which is clearly visible at 2 o'clock, 7 NM.
1 2 3 4 c. Declare an emergency, turn off all electrical systems except for 1 NAVCOM, instrument panel lights, intercom and transponder and divert to the Southside Business Airport which is 40 NM straight ahead.
1 2 3 4 d. Declare an emergency, turn off all electrical systems except for 1 NAVCOM, instrument panel lights, intercom and transponder and divert to Draper Air Force Base which is 10 o'clock at 32 NM.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Planters County	3200x75	No	No	Yes	Yes	0700-1800
Southside Business	4835x100 4129x100	Yes	Yes	Yes	Yes	0700-1800
Draper AFB	11500x300	Yes	No	Yes	Yes	None

2. You are solo on a late night cross country cruising VFR at 9000 feet with two hours left to your destination when you become very drowsy. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Direct the cold air vent onto your face, sing, keep moving about, anything you can to keep awake.
1 2 3 4 b. Land at an airfield 8 miles ahead, get a motel room and call it a night.
1 2 3 4 c. Descend and continue flying at a lower altitude.
1 2 3 4 d. Land at the airstrip ahead, walk around, then takeoff and continue.

3. In the evening after an exhausting three day business meeting at a downtown hotel, you have loaded your rental airplane at the Downtown Airport and prepare to file your VFR flight plan for the two hour flight home when you discover you left your only pair of reading glasses in the meeting room back at the hotel. You have no problem seeing the panel gages, or distance vision, but can't read a map or chart. Weather is solid VFR and if you depart within the next 20 minutes you will arrive at the Regional Airport before dark. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Depart and fly home.
1 2 3 4 b. Call the hotel, if they have your glasses go get them and fly home late this evening.
1 2 3 4 c. Call the hotel, if they do not have your glasses, spend the night, have a pair expressed to you and fly home tomorrow.
1 2 3 4 d. Call the hotel, if they have your glasses, go get them, spend the night and fly home in the morning.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

4. You are cruising at 4500 feet on top of a thin haze layer with the outside air temperature at 65 degrees. It has been twenty-five hours since the engine was overhauled and the run-up check was well within limits. The engine slowly loses RPM with no indications of oil or fuel problems. You suspect carburetor icing and pull on the carb heat. The engine backfires, vibrates and loses RPM fast. You decide to:

Rank Order	Alternative
1 2 3 4	a. Pull out the mixture, stop the engine and check the fuel selector valve, mag switch settings and declare an emergency.
1 2 3 4	b. Push in the carb heat, keep the engine running and divert to the closest airfield.
1 2 3 4	c. Keep the carb heat on and see what happens.
1 2 3 4	d. Push in the carb heat, keep the engine at idle, declare an emergency and ask for advice.

5. You are preparing to enter the VFR traffic pattern at the Regional Airport and hear the tower report winds from 280 at 15 knots, and they are vectoring traffic to the primary 8800 ft runways 35. A Piper Cherokee asks to use the 7753 x 150 runway 27. The Cherokee is told the runway is not active, but to you it looks OK. You decide to:

Rank Order	Alternative
1 2 3 4	a. Accept clearance to runway 35 and follow the traffic.
1 2 3 4	b. Ask to use runway 27.
1 2 3 4	c. Insist on using runway 27 stating that the crosswinds are unsafe for you to use runway 35.
1 2 3 4	d. Divert to the Southside Business Airport where the runway is almost directly aligned with the wind.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Southside Business	4835x100 4129x100	Yes	Yes	Yes	Yes	0700-1800

6. It is a cool clear summer afternoon with no wind when you arrive in ARSA going to the Regional Airport. You realize you are going to be spaced 4 miles behind a commercial 727 on final to runway 17. You decide to:

Rank Order	Alternative
1 2 3 4	a. Stay high on the glide slope and land past where you saw the 727 touchdown.
1 2 3 4	b. Ask for a 360 turn to increase the spacing.
1 2 3 4	c. Ask to land on runway 09.
1 2 3 4	d. Ask for a low approach and a visual pattern to runway 17.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

7. To prepare for when marginal VFR weather makes it difficult to return to your home airfield (uncontrolled), you practice in VFR conditions:

Rank Order	Alternative
1 2 3 4	a. An unofficial locally devised arrival to the pattern.
1 2 3 4	b. Have devised your own arrival route to the pattern or runway.
1 2 3 4	c. Practice a published IFR approach.
1 2 3 4	d. Don't do anything.

8. You as the pilot-in-command (PIC) are going to fly your old instructor pilot to the Planters County Airport so he can pick-up an airplane coming out of maintenance and give it a functional check flight. Both of you arrive at the airport later than you planned and he offers to do part of the preflight. You decide to:

Rank Order	Alternative
1 2 3 4	a. Do the planning, filing and preflight together.
1 2 3 4	b. Have him get the weather NOTAMS and file the flight plan while you preflight the airplane.
1 2 3 4	c. Have him preflight the airplane while you get the weather, NOTAMS, and file.
1 2 3 4	d. Ask him who should do what.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

9. You are at a small airport with minimal facilities and at the end of your walk around preflight the flaps refuse to retract from 30 degrees. It was a planned three hour flight back home to the Regional Airport. The attendant says he has seen this problem before and it is the limit switch sticking. There is no A&P here but there is an A&P at an airport 35 miles up the road. The attendant says he knows where a switch for this exact model 172 can be quickly picked-up and he could install it. He says he also could reach up through the inspection port and free the switch enough to raise the flaps, but cannot guarantee they will work when airborne. You call the rental agency and get their answering machine - you are on your own. You decide to:

Rank Order	Alternative
1 2 3 4	a. Leave the flaps down and fly to the nearby (35 miles) airport and have an A&P fix the problem.
1 2 3 4	b. Have the attendant reset the switch, get the flaps up and fly back to Regional.
1 2 3 4	c. Have the attendant change the switch, check it out then fly home and have the rental agency inspect the work.
1 2 3 4	d. Wait until the rental agency can fly an A&P in and change the switch.

10. You are planning a night cross country down to Florida and winds and weather favor cruising around 8000 feet MSL. The forecast winds and visibility will enable you to make your destination (solid VFR weather) with a 60 minute fuel reserve in one hop. You decide to:

Rank Order	Alternative
1 2 3 4	a. Let down early and cruise in at a much lower altitude if fuel permits.
1 2 3 4	b. Stay at altitude as long as possible before performing an en route descent.
1 2 3 4	c. Make sure there is a working oxygen system on board in case you need it.
1 2 3 4	d. Plan to use oxygen for this flight.

The next four scenarios (11 - 14) are related and occur on the same flight:

11. You are at the College Airport to pick-up three passengers and their baggage and return them to the Regional Airport. Before refueling you add up the weights and find with full fuel (40 Gallons) your load will be 40 pounds over the book's max gross weight. Weather for the 3:00 PM return trip is forecast at 6000' scattered, visibility 10+ and the winds at 5000 feet cruising altitude will net a 10 knot tailwind. Using the Operator's Manual fuel consumption rate and the tailwind you correctly calculate it will take 34 gallons of 100LL to land at Regional with exactly 30 minutes reserve. You will overfly the Justin County Airport and could land for fuel as a backup. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Load 34 gallons and file a flight plan direct to the Regional Airport.
1 2 3 4 b. Load 40 gallons and file direct to the Regional Airport.
1 2 3 4 c. Load only 34 gallons and file to the Regional Airport with a stopover at Justin County Airport.
1 2 3 4 d. Load 34 gallons, do not file and see if the fuel consumption and tailwind hold and decide later what to do.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Justin County Airport	3200x50	No	No	Yes	Yes	0700-1800
College Airport	5000x100 4099x100	Yes	No	Yes	Yes	24 hrs

12. You have taken-off from the College Airport and an en route weather check has a late afternoon thunderstorm approaching the Regional Airport from the opposite side of town. It is slow moving and is expected to cross the Regional Airport shortly after your ETA. You check and the fuel consumption and tailwind are holding. You have arrival fuel with a 30 minute reserve. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Continue to the Regional Airport and speed up a bit.
1 2 3 4 b. Land at the Justin County Airport, add fuel and continue to the Regional Airport circling northeast around the thunderstorm.
1 2 3 4 c. Land at the Justin County Airport and wait until the weather passes.
1 2 3 4 d. Land at the Justin County Airport, add fuel and continue to the Regional Airport circling southwest around the thunderstorm.

13. Your friends persuaded you to land at the Justin County Airport. You plan to fill each tank half full to keep the weight in the utility category. The thunderstorm remains slow moving, is over the Regional Airport on a path to the Justin County Airport and is growing in size and intensity. It is 6:00 PM, getting dark, the storm can be seen approaching and the attendant is leaving but will give everyone a lift into Driskill City. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Takeoff for the Regional Airport circling around the thunderstorm and coming in behind it.
1 2 3 4 b. Wait with the airplane until the weather passes, then fly into the Regional Airport.
1 2 3 4 c. Leave the passengers and baggage and fly the airplane anywhere away from the path of the storm.
1 2 3 4 d. Leave the airplane and either get a room in Driskill City or call and have someone drive out from the Big City and pick-up all of you.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Justin County Airport	3200x50	No	No	Yes	Yes	0700-1800

14. Your passengers decided to go into Driskill City and have someone drive out and pick them up.

The approaching thunderstorm continues to grow with reports of 80 MPH wind gusts and large hail. To save the airplane you take off and circle northeast around the storm to avoid any possible wall cloud. You plan to stay at least 20 NM away from the storm. You level at 3000 feet with the storm on the left wingtip and the Regional Airport VOR DME reading 27 NM. An undercast begins to develop and the lights of the city fade. You decide to:

Rank Order	Alternative
1 2 3 4	a. Hold altitude, start flying counterclockwise around the 27 NM arc to clear air behind the storm.
1 2 3 4	b. Contact Big City Approach control and tell them your problem and ask for vectors avoiding the storm to any clear airport.
1 2 3 4	c. Descend slowly to MEA (1000 feet) and establish VFR conditions before entering ARSA and contacting Big City Approach.
1 2 3 4	d. Make a right turn, put the storm on the tail as best you can, find clear air, and orbit until the Regional Airport reports VFR conditions.

15. Bad weather forced you to cancel flying your boss into another city where he is to address a convention. There are openings on a flight going to the same city departing from the airline terminal on the other side of the airport in 15 minutes. It will take too long to call a taxi so he asks you to run him over to the terminal in the 172. You decide to:

Rank Order	Alternative
1 2 3 4	a. Start the engine and ask ground control for permission to taxi to the back of the terminal, drop off a passenger and taxi back to the FBO ramp.
1 2 3 4	b. Start and ask ground control for permission to taxi around the airport for a maintenance check and conveniently drop the boss off near the terminal.
1 2 3 4	c. Say you're sorry but it is illegal for you to deliver passengers to the back side of the terminal and help find a ride through the FBO.
1 2 3 4	d. Ask ground control if there is any way a representative from the airline could meet you at a door to the ramp and escort the boss into the terminal.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

16. You have entered the left turn VFR traffic pattern for runway 27 at the Regional Airport and hear muffled bangs and feel serious vibrations. New dents in the top of the engine cowling confirm a cylinder has failed. The winds are 070/5 and you are just approaching extended centerline of runway 35. You decide to:

Rank Order	Alternative
1 2 3 4	a. Declare an emergency, shutdown the engine and turn left to land in the crosswind on runway 35.
1 2 3 4	b. Declare an emergency, shutdown the engine and turn left 180 degrees to land on the grass on the left side of runway 27.
1 2 3 4	c. Declare an emergency, shutdown the engine and turn left and stretch the turn to land on runway 27.
1 2 3 4	d. Declare an emergency, shutdown the engine and land straight ahead on the taxiway on the south side of runway 09.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

17. While en route you want to find out what is going on along the weather pattern you observe ahead. You decide to:

Rank Order	Alternative
1 2 3 4	a. Call an airport tower below and ask.
1 2 3 4	b. Call FSS and ask.
1 2 3 4	c. Find the ATC frequency, call and ask them.
1 2 3 4	d. Identify an airplane ahead and ask for a PIREP.

18. You have been away for five days and are returning to the Justin County Airport to return the 172 to the friend who loaned it to you and pick up your car. The weather is clear and cold as forecast and a white blanket covers the ground. When you near the Justin County Airport, you notice the runway has not been cleared. You cannot tell how deep the snow is, but the county road is fairly clear except for a small strip of snow down the middle. You decide to:

Rank Order	Alternative
1 2 3 4	a. Divert to the Regional Airport and return the plane another day.
1 2 3 4	b. Land, but hold the airplane off the runway until is in a full stall, and keep the nose wheel off the ground as long as possible.
1 2 3 4	c. Make a normal landing, but don't touch the brakes unless absolutely necessary.
1 2 3 4	d. First, do a touch and go to see how deep the snow is keeping your airspeed up and the nose wheel off the ground. If control is no problem, land.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Justin County Airport	3200x50	No	No	Yes	Yes	0700-1800

19. You just checked in with approach on 124.9 after a long solo cross country before entering ARSA. Listening to traffic being vectored, it becomes apparent the FedEx flights are all returning just ahead of you, and it could be 20 minutes before you land at the Regional Airport where you rented this airplane. The problem is you have to urinate and can't wait the 20 minutes plus taxi time. Your trusty relief bottle is in the pouch behind the front passenger seat. You decide to:

Rank Order	Alternative
1 2 3 4	a. Continue to follow vectors, get out the bottle and use it.
1 2 3 4	b. Tell approach of your problem and request landing priority.
1 2 3 4	c. Get clearance outside ARSA, find a safe area to loiter and use the bottle.
1 2 3 4	d. Divert to the Justin County Airport which you overflew 16 NM back and land.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Justin County Airport	3200x50	No	No	Yes	Yes	0700-1800

20. You have announced on CTAF and upon starting your turn to base you see another aircraft on a straight-in which will conflict. You decide to:

Rank Order	Alternative
1 2 3 4	a. Continue on, flash your landing lights.
1 2 3 4	b. Do a level left 360 degree turn for spacing.
1 2 3 4	c. Turn right, exit the pattern and re-enter.
1 2 3 4	d. Extend your downwind to take spacing behind the straight-in.

21. You are on short final at an uncontrolled airfield with one other airplane in the pattern and have not completed your checklist. You decide to:

Rank Order	Alternative
1 2 3 4	a. Check the flap setting and land.
1 2 3 4	b. Go around.
1 2 3 4	c. Check the mixture and land.
1 2 3 4	d. Keep your head out of the cockpit and land.

22. The early afternoon ramp temperature at the Regional Airport is already 94 degrees and the inside of the airplane is like an oven. You are flying your mother up to your sister's to be with her during surgery this evening. Your mother is afraid the hot airplane will make her airsick, so would you please spend as little time on the ground in the heat as possible. You are parked on the Aircraft Rental and Leasing ramp and see 10 aircraft lining up on the south taxiway for a runway 09 takeoff. Winds are 060/12. You decide to:

Rank Order	Alternative
1 2 3 4	a. Start and follow the traffic to runway 09.
1 2 3 4	b. Start and ask for a runway 35 takeoff.
1 2 3 4	c. Start and request an intersection takeoff on runway 09.
1 2 3 4	d. Delay going to the airplane until traffic has cleared.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

23. You are at a rancher friend's private airstrip and he asks you to fly him in his 172 to check on his cattle (his foot is in a cast). Weather appears to be around 3000 feet overcast with widely scattered showers within eyesight. You decide to:

Rank Order	Alternative
1 2 3 4	a. Go with what you see.
1 2 3 4	b. Telephone the FSS for a briefing.
1 2 3 4	c. Call to the local radio station for the forecast.
1 2 3 4	d. Ask the rancher what you should do.

24. Your BFR is coming due and you feel a little rusty. You decide to:

Rank Order	Alternative
1 2 3 4	a. Look for an instructor who can both get you current and administer the BFR.
1 2 3 4	b. Hire an instructor to get ready but have a different instructor give the BFR.
1 2 3 4	c. Practice solo and then take the BFR
1 2 3 4	d. Have a pilot friend work with you to get ready for the BFR.

25. You have stopped for gas at a small airstrip and are loaded with cargo. You can only fuel to 30 gallons in the tanks and keep under the airplane's max gross weight. A 30 gallon load will just enable you to make it home with the required reserve without another fuel stop. You have no calibrated dip stick and have a new attendant to pump the gas for you. You decide to:

Rank Order	Alternative
1 2 3 4	a. Fill it using the gages to read 3/4 full.
1 2 3 4	b. Fill it full then have the attendant drain off the difference between the tanks capacity and 30 gallons.
1 2 3 4	c. Leave the problem entirely to the attendant.
1 2 3 4	d. Use a calibrated stick the attendant has in the office that is from an earlier model 172

26. The weather is stuck in the summertime high mode with clear mornings, hazy afternoons, puffy clouds scattered at 5500 feet AGL with visibility at 7 miles or more. When you go cross country in these weather conditions you usually decide to:

Rank Order	Alternative
1 2 3 4	a. Don't file but fly airways.
1 2 3 4	b. File VFR and stay off airways.
1 2 3 4	c. Don't file and don't use airways.
1 2 3 4	d. File VFR on airways as much as possible.

27. Take-off and en route weather are VFR with a dry line scheduled through your destination about your ETA. It may push some thunderstorms ahead of it so your weather briefing ends with "VFR flight is not recommended." There are several good alternate airfields along the route of flight and beyond your destination. You decide to:

Rank Order	Alternative
1 2 3 4	a. Go without filing a flight plan.
1 2 3 4	b. File VFR to an airport short of your destination, land and let any weather pass over.
1 2 3 4	c. Delay your departure until the "VFR flight is not recommended" statement is removed from the forecast.
1 2 3 4	d. File VFR to your destination.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

28. You have been cruising at 8500 feet for four hours and are preparing to do a fairly steep en route descent directly onto short final at the Regional Airport. Weather en route was a -30 degrees but the warm sun made the flight most comfortable. Regional weather is 54 degrees, dew point of 52 degrees and calm winds. You decide to:

Rank Order	Alternative
1 2 3 4	a. Expedite the descent to give as much time on final approach as possible.
1 2 3 4	b. Make sure the carb heat and window defrosters are on and set at high.
1 2 3 4	c. Slow the descent rate to allow the airframe to warm before landing.
1 2 3 4	d. Find a rag and keep it handy in case you have to clean windows.

29. The weather for departure and the first half of your four hour cross country was slightly better than marginal VFR. You made it off and have leveled at cruise altitude in VFR conditions and are preparing to check in with Flight Watch. You suspect they will ask you for a PIREP to check their forecast. You decide to:

Rank Order	Alternative
1 2 3 4	a. Calculate your drift, determine the winds, make note of the cloud cover and types, and note the OAT to be ready when they ask.
1 2 3 4	b. Beg off - telling them you have your hands full and can't take the time.
1 2 3 4	c. Expect to give at least your position, cloud bases and tops, visibility and relate any deviations between what you saw and what was forecast.
1 2 3 4	d. Prepare to either confirm the accuracy of their forecast, or tell of the observable differences.

30. You have taken off from a resort headed back home when after 30 minutes you notice you cannot identify any landmarks or checkpoints on your route of flight. You check the instruments and find the cage knob on the RMI not fully in and turned. When you uncage it, it swings wildly and points back in the opposite direction you were supposed to track. You decide to:

Rank Order	Alternative
1 2 3 4	a. Plot out a reciprocal heading on your sectional, turn around, call Flight Following and tell them what you did, then determine your hours of fuel remaining and modify your flight plan.
1 2 3 4	b. Call Flight Watch, tell what you did and ask for a vector back on course.
1 2 3 4	c. Turn around, cancel your flight plan, don't say why, return to the airport where you took-off, land, fuel and start over.
1 2 3 4	d. Call Flight Watch, cancel your flight plan, then plot a new route home and go without a flight plan.

31. You have planned a four plus hour cross country and the weather could easily force you into rather undesirable routes which would take you over rough and desolate country. To match the best weather and route combination, you decide to:

Rank Order	Alternative
1 2 3 4	a. Select the route with which you feel the most comfortable and have the weather forecaster give you the forecast and if VFR is not recommended, repeat this process until you have a VFR route.
1 2 3 4	b. Tell the forecaster your departure point, destination and have him select the best route.
1 2 3 4	c. Give the forecaster three routes and have him give you the weather for each then you decide.
1 2 3 4	d. Delay the flight until you get VFR weather over the primary route.

32. You have called an aircraft mechanic you usually use whose hangar is on the Justin County Airport, and arrange to have your inoperative landing light rewired. Since you will arrive after dark, he advises you that the runway lights are out and the black asphalt runway may cause you a problem. You decide to:

Rank Order	Alternative
1 2 3 4	a. Ask him if he will park his pickup near the threshold and shine his lights down the runway.
1 2 3 4	b. Postpone the repair until you can land in daylight.
1 2 3 4	c. Go ahead and make a black-out landing.
1 2 3 4	d. Postpone the flight at least until the runway lights are working.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs
Justin County Airport	3200x50	No	No	Yes	Yes	0700-1800

33. You are one hour into a three hour cross country returning to the Regional in the mid afternoon and have been flying at 5000 feet MSL over a scattered deck of clouds and find yourself lost. The cloud deck thins out to where you can see the ground in all directions. You decide to:

Rank Order	Alternative
1 2 3 4	a. Call FSS on the radio, report yourself lost, and have them give you a position fix and vector back to course.
1 2 3 4	b. Find a prominent landmark, circle it until you can find it on your sectional, fix your position and lay out a heading to get back on course.
1 2 3 4	c. Go to the nearest town, descend and read the name of the town on a water tower or other prominent structure, fix your position and plot a heading to get back on course.
1 2 3 4	d. Find an airfield, land and ask where you are, refile, then continue.

34. You are flying your boss from the Regional Airport to Planter's County to appear as a witness before the Grand Jury. As you stop into the wind for your engine run up, your boss opens his door, leans out and vomits. When finished, he closes the door and says "Let's go." You have no airsick bags on board. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Takeoff and fly as planed to Planter's County and find some suitable airsick bags for the return trip.
1 2 3 4 b. Taxi back to the FBO, pick up some airsick bags and go.
1 2 3 4 c. Tell the boss you will not fly until he assures you he is well enough to make the flight.
1 2 3 4 d. Cancel the flight and taxi back.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

35. You have paid for and been planning this flight to the Lodge Resort at the Lake for six months. The weather is forecast good VFR with a summer haze under 3000 feet and broken scattered clouds along the route of flight. The only problem is you know you have a minor summer cold. You can clear your ears and only feel a little achy with no headache. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Take the minimal dosage of cold tablets and go.
1 2 3 4 b. Cancel the flight.
1 2 3 4 c. Call your doctor and ask for a prescription for medication.
1 2 3 4 d. Stick a menthol inhaler in your pocket, take no other medication and go.

36. You are 20 NM outbound from Regional Airport flying solo to deliver two coolers of medical serum to an American Red Cross field team when departure control calls advising that someone reported a right wheel pant was found off the departure end of the runway and it looks like it may have separated from a 172 and is painted a white similar to the color of your airplane. You neither heard nor felt anything unusual on takeoff and both brake pedals feel normal when you apply them. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Thank them for the call and ask it be delivered to Aircraft Rental and Leasing and continue your departure.
1 2 3 4 b. Unfasten your seatbelt, slide over to the right seat and confirm if it is yours.
1 2 3 4 c. Request clearance to return and request a fly-by the tower and have them determine if it is yours.
1 2 3 4 d. Request clearance to return and land to inspect the airplane.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

37. You need to depart the Planter's County Airport at 6:00 AM for a one hour flight to return the rented aircraft to the Regional Airport before 7:00 AM. You slide the left seat back to climb in and start the preflight when the seat comes off of the slide tracks. You get the seat back on the track and it seems to hold. You notice that two screws that hold a keeper on the back of the track are missing and find one under the back seat. The local mechanic will not arrive for two or three hours. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Borrow a screwdriver, put in the screw and fly as is having the rental firm checked or fix the seat back at the Regional Airport.
1 2 3 4 b. Wait until the mechanic arrives and have him fix the seat, then fly home.
1 2 3 4 c. Skip the repairs and fly the trip home from the right seat.
1 2 3 4 d. Go find a phone, call Aircraft Rental and Leasing and request guidance on what to do.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Regional Airport	8800x150 7753x150	Yes	Yes	Yes	Yes	24 hrs

38. You have taken off solo from the Regional Airport for a 45 minute flight to the Planters County Airport and have leveled at 3500 feet when you hear a banging start on the right side of the airplane. Everything checks OK so you call the FBO and ask for advice. After a short period they ask you to find both ends of the right seat belt. You can only find one. You decide to:

Rank Order **Alternative**

1 2 3 4 a. Reach over, open the right door, pull in the seatbelt and close the door.
1 2 3 4 b. Return to the Regional Airport, land and pull in the seat belt.
1 2 3 4 c. Continue and find an airspeed where the banging stops and continue to destination.
1 2 3 4 d. Find the closest airport out of ARSA, land and pull in the seatbelt.

39. You are looking for 172s to rent. You have decided the most important thing to look for in a rental plane is:

Rank Order **Alternative**

1 2 3 4 a. The overall appearance, is it neat and does it look cared for.
1 2 3 4 b. A clean engine with clean oil.
1 2 3 4 c. New COM/NAV radios.
1 2 3 4 d. Smooth skin, no dents or dings.

40. You have drawn the cross country route on your map and are going to pick your cruising altitude. You will be at altitude for approximately 3 hours. You decide to pick your cruising altitude primarily based on:

Rank Order **Alternative**

1 2 3 4 a. MEA
1 2 3 4 b. Aircraft cruise performance (true/fuel burn)
1 2 3 4 c. Winds aloft
1 2 3 4 d. Weather/visibility.

41. You are going to ferry an airplane to the factory and return another which has had new radios installed. You have completed all the flight planning and decide to:

Rank Order **Alternative**

1 2 3 4 a. Have another pilot (not an instructor) you trust check your planning.
1 2 3 4 b. Find an instructor to review your planning.
1 2 3 4 c. Feel confident enough not to need a review.
1 2 3 4 d. Ask the owner of the airplane to review your planning.

42. You are going to spend two hours in the traffic pattern. You plan to:

Rank Order	Alternative
1 2 3 4	a. Stay in the pattern at your home airport.
1 2 3 4	b. Go work where the traffic is least.
1 2 3 4	c. Go to a strange field.
1 2 3 4	d. Go to a challenging field (short, grass, etc.).

43. You arrive at the rental airplane where the attendant (whom you know is a commercial pilot) says it is gassed to the top, preflighted and ready to start. He will stay and help until you leave the parking ramp. You decide to:

Rank Order	Alternative
1 2 3 4	a. Thank him, check the fuel tanks, oil , then climb in and start.
1 2 3 4	b. Scan the airplane for any obvious errors, climb in the plane, and check the fuel gages. If they show full, begin your preflight at engine start.
1 2 3 4	c. Take out your checklist and do a complete preflight.
1 2 3 4	d. Do a fast walk around especially checking the fuel tanks and caps, oil stick and all doors closed.

44. You are cruising at 2500 feet on a beautiful clear day 10 miles out enroute to the Planters County Airport with your best friend then he/she asks "What do you do if the engine quits?" You decide to:

Rank Order	Alternative
1 2 3 4	a. Pull the mixture and show how the engine can be restarted.
1 2 3 4	b. Pull on the carb heat, bring the throttle to idle and demonstrate a forced landing to a low approach.
1 2 3 4	c. Tell your friend about what you would do.
1 2 3 4	d. Wait until you are over the uncontrolled airfield and demo a forced landing to a full stop.

Airport	Runway	24hr Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
Planters County	3200x75	No	No	Yes	Yes	0700-1800

45. You are planning a cross country which will require a fuel stop. In what order would you consider the following factors in selecting the airport at which to stop?

Rank Order	Alternative
1 2 3 4	a. The amenities (restrooms, food service, loaner car, etc.)
1 2 3 4	b. The pilot support facilities (FSS access, weather station, etc.)
1 2 3 4	c. The size of the airport and its congestion (those factors that make for slow fuel stops).
1 2 3 4	d. The cost of the fuel or the method for payment.

46. Three of your closest friends have bought you a choice ticket and are paying for you to rent this airplane and fly the four of you the 180 miles up to the university in the morning for the "BIG" early afternoon football game, then back in the early evening. Another friend will meet you at the college airport and drive all of you to the game and back. Departure weather was overcast 3000 ft ceiling with 5 miles and light haze with temperatures in the 60s. Pilots flying the same route reported enroute weather as occasional 1500 ft ceilings with 3 miles visibility and scattered showers. The College Airport is clear with bright sunshine. Forty-five miles from the College Airport you have descended to 1000 feet staying just below the ceilings and encounter rain dropping visibility to under 3 miles. The terrain is flat farmland with no published obstacles above 250 ft tall. You decide to:

Rank Order	Alternative
1 2 3 4	a. Remain under the clouds, keep visual contact with the ground and scoot through.
1 2 3 4	b. Do a 180 and return home.
1 2 3 4	c. Divert to the Madison County Airport located at 7 o'clock 50 NM and wait for the worst weather to pass.
1 2 3 4	d. Put it to a vote.

Airport	Runway	Tower	ARSA	Lighted Runway	Telephone Available	Maintenance
College Airport	5000x100	24 Hrs	No	Yes	Yes	24 hrs
	4099x100					
Madison County Airport	3800x75	None	No	Yes	Yes	None

47. You are halfway in a two hour late evening flight from the Regional Airport cruising at 4500 feet over a route with an MEA of 1500 feet. The weather has been clear as forecast when without any warning you find yourself in a cloud. You decide to:

Rank Order	Alternative
1 2 3 4	a. Continue straight ahead for a while and see what happens.
1 2 3 4	b. Make a 180 degree level turn and get out.
1 2 3 4	c. Start a wings level shallow descent to get under it.
1 2 3 4	d. Start a wings level climb to get on top.

48. You are packing your flight kit to go on a VFR cross country trip home for the Christmas Holidays. In addition to the sectional and flight plan, you usually include current editions of:

Rank Order	Alternative
1 2 3 4	a. Take a full set of IFR charts and terminal plates for the section of the country in which you fly.
1 2 3 4	b. Take only the VFR sectional and flight plan.
1 2 3 4	c. Plot what IFR information you think will be helpful on the sectional.
1 2 3 4	d. Always carry a full set of IFR charts and plates on a cross country.

49. When you get your weather briefing for a cross country flight requiring at least one fuel stop, which part of the forecast do you consider the most critical:

Rank Order	Alternative
1 2 3 4	a. The weather at the departure point.
1 2 3 4	b. En route weather to the fuel stop.
1 2 3 4	c. The weather at the fuel stop.
1 2 3 4	d. Weather at the final destination.

50. The enroute weather briefing for the three hour cross country was for scattered thunderstorms along the route of flight, and sure enough there is a cluster of cells developing dead ahead on your route of flight. Other clusters have sprung up on each side of you, and behind all close to 20 miles away. You decide to:

Rank Order	Alternative
1 2 3 4	a. Proceed looking for a route around or through the rain shafts which will allow you to remain VFR.
1 2 3 4	b. Fly upwind of any cloud build ups and stay VFR.
1 2 3 4	c. If the downwind route around dark cells is the only clear way, keep at least 20 miles from the closest cell.
1 2 3 4	d. Find an airport below in VMC, land, and wait until the thunderstorms pass and the route is clear.

51. It had rained all day, but the front pushed south of you and cleared the skies. You are out with two friends on a sight seeing trip to the hills 40 miles away and plan to be back before dark. With sunset still an hour away you notice ground fog beginning to form. You decide to:

Rank Order	Alternative
1 2 3 4	a. Apply full power and race back to the home airport.
1 2 3 4	b. Call Flight Watch and cruise back home.
1 2 3 4	c. Call on your home airfield's CATF to see if anyone is there and can tell you what the weather is doing.
1 2 3 4	d. Go directly to an airport you know is closer than your home airport, land and find out what the weather is doing.

THANK YOU!

PLEASE CHECK THAT YOU HAVE RESPONDED TO ALL THE SCENARIOS, WE FIND THAT SOMETIMES THE PAGES STICK TOGETHER.

MAKE SURE YOU FILL OUT THE PILOT INFORMATION FORM.

If you want information on the results of this study, please enclose a note with your name and address (don't put them on your answer sheets), and we will send you a copy of the report.

APPENDIX C

GENERAL AVIATION PILOT INFORMATION

Demographic Information

CERTIFICATES HELD	N	PERCENTAGE (%)
Private Pilot	242	98
Commercial Pilot	0	0
Airline Pilot Transport	4	2
Certified Flight Instructor	0	0
Certified Flight Instructor Instrument	0	0
RATING		
Instrument	73	30
Single-Engine	243	99
Multi-Engine	26	11
STATE OF RESIDENCE		
Arkansas	4	2
Arizona	2	1
California	1	<1
Florida	1	<1
Montana	1	<1
North Carolina	1	<1
New York	63	26
Ohio	7	3
Oregon	1	<1
Tennessee	1	<1
Texas	129	53
Washington	34	14
AGE		
10-19	3	1
20-29	21	9
30-39	42	17
40-49	79	32
50-59	54	22
60-69	36	15
70-79	8	3
80-89	1	<1
SEX		
Male	235	96
Female	9	4
MILITARY/PILOT CLASSIFICATION		
Yes	7	3
Class I	13	15
Class II	40	17
Class III	192	78

Flying Hours

TOTAL HOURS	PERCENTAGE (%)
1-250	36
251-500	30
501-750	10
751-1000	7
1001-1250	5
1251-1500	2
1501-1750	2
1751-2000	4
2001-2250	1
2251-2500	1
2501-2700	1
2701-3000	0
3001-3250	0
3251-3500	1

TOTAL WEATHER HOURS

0-49	78
50-99	9
100-149	4
150-199	3
200-249	1
250-299	1
300-349	2
Over 350	0

HOURS OF INSTRUCTION

0-9	2
10-19	0
20-29	1
30-39	8
40-49	14
50-59	10
60-69	13
70-79	12
80-89	6
90-99	4
100-109	7
110-119	6
120-129	4
130-139	2
140-149	2
150-159	5
160-169	0
170-179	1
180-189	2

TOTAL NIGHT FLYING HOURS

0-24	56
25-49	15
50-74	13
75-99	3
100-124	4
125-149	1
150-174	2
175-199	2
200-224	2
Over 225	1

FLYING HOURS LAST 60 DAYS

0-4	40
4-9	14
10-14	15
15-19	10
20-24	8
25-29	6
30-34	3
35-39	1
40-44	3

DAY HOURS LAST 60 DAYS

0-4	39
5-9	18
10-14	14
15-19	10
20-24	6
25-29	6
30-34	3
35-39	2
40-44	1

WEATHER LAST 60 DAYS

0	78
1	6
2	2
3	4
4	3
5	1
6	2
Over 6	2
180-189	2

NIGHT LAST 60 DAYS

0-4	91
5-9	6
10-14	1
15-19	0
20-24	1

INSTRUCTION LAST 60 DAYS

0-4	92
5-9	3
10-14	3
15-19	0
20-24	1

A/C Most Frequently Flown

NUMBER OF ENGINES	PERCENTAGE (%)
1	93
2	6

IFR CAPABLE?

Yes	75
No	25

AUTO PILOT?

Yes	37
No	63

WEATHER RADAR?

Yes	9
No	91

TRANSPONDER

Yes	96
No	4

OWN AIRCRAFT?

Yes	50
No	50

HOURS CRUISE CAPABILITY

2	1
3	11
4	36
5	35
6	12
7	3

Years as a Pilot

NUMBER OF YEARS	PERCENTAGE (%)
0-4	24
5-9	26
10-14	16
15-19	8
20-24	7
25-29	7
30-34	3
35-39	3
Over 40	5

APPENDIX D

SUMMARY STATISTICS BY SCENARIO

Scenario #	Expert Rank	Risk - 1	Risk - 2	Risk - 3	Risk - 4
1	b d c a	12.61	38.77	40.97	54.64
2	b d c a	9.90	40.61	54.19	60.97
3	d b c a	5.68	39.19	44.84	60.48
4	c b d a	30.71	45.00	61.93	84.33
5	d b c a	10.55	15.06	17.73	51.68
6	b c a d	17.13	17.83	20.70	52.83
7	c a b d	40.33	50.83	53.67	56.67
8	a d c b	16.28	23.59	24.90	27.14
9	d b c a	4.97	36.21	59.48	64.48
10	d c b a	16.22	23.89	36.96	47.50
11	c a d b	12.00	41.67	43.90	61.83
12	c b d a	9.45	44.68	47.74	63.87
13	d b c a	7.26	23.39	39.52	63.23
14	b d a c	29.84	45.97	59.03	70.32
15	c d a b	8.33	15.20	34.87	56.33
16	a d b c	22.63	50.26	54.74	59.74
17	b c d a	12.06	18.23	39.12	40.88
18	a b c d	6.05	48.58	54.47	67.89
19	d b c a	14.72	20.00	25.83	47.22
20	d c b a	11.05	25.79	48.42	76.32
21	b a c d	13.06	36.94	40.83	41.84
22	d a b c	8.06	24.72	41.67	54.72
23	b a c d	17.78	46.94	52.17	62.35
24	b a d c	11.95	13.68	38.95	47.37
25	b d a c	15.53	50.83	61.05	74.05
26	d b a c	20.00	26.39	55.28	61.11
27	c b d a	14.72	33.06	46.94	66.67
28	b c d a	27.63	32.37	42.89	56.58
29	c d a b	13.44	14.22	24.78	28.23
30	a b c d	21.67	25.00	49.17	61.39
31	d c a b	13.64	33.06	38.06	53.06
32	b d a c	5.79	26.58	67.10	86.95
33	a d b c	15.28	30.00	37.50	57.50
34	d c b a	7.83	16.25	21.42	43.50
35	b c d a	2.25	21.67	45.83	64.17
36	d c b a	16.42	30.00	34.58	39.83
37	b d c a	4.58	17.08	47.67	52.50
38	b d c a	17.92	18.33	42.08	58.33
39	b a c d	25.45	26.36	30.00	38.64
40	d a c b	22.92	30.75	36.25	40.50
41	b a d c	9.83	23.33	31.25	36.67
42	b a c d	17.50	18.33	48.75	63.33
43	c d a b	10.83	38.33	65.00	75.83
44	c d b a	2.08	38.33	51.25	79.17
45	b a d c	13.27	23.64	23.64	23.73
46	b c a d	17.50	33.75	76.67	79.54
47	d b c a	32.92	50.17	50.42	58.33
48	b c a d	16.45	28.18	30.45	33.18
49	c b a d	32.73	33.64	35.00	42.54
50	d b c a	18.64	44.54	51.82	64.09
51	d b c a	13.18	39.54	40.00	42.73

Alternatives are listed in the order given by the expert panel — the first alternative listed was ranked #1 by the expert panel, and so on.

Risk values are those assigned by the expert panel to the four alternatives. The Risk-1 value is that assigned to the alternative ranked #1 by the expert panel, and so on.

APPENDIX E

SOFTWARE AND ANALYSIS

Data analysis for this project was accomplished on a Unisys 1100 series mainframe computer at the Human Resources Directorate of the USAF Armstrong Laboratory (AL/HR) and on the IBM RS-6000 RISC model 530 machine at the Metrica facility. All software used was developed by and is the property of the USAF Armstrong Laboratory, Brooks AFB, San Antonio, Texas. More specifically, in addition to utility and custom software required to reformat input files, data analysis was carried out using software packages described in the Mathematical and Statistical Library of the Armstrong Laboratory. This library is reviewed in Albert, W. G. & Whitehead, L. K., MATHEMATICAL AND STATISTICAL SOFTWARE INDEX: SECOND EDITION (AFHRL-TP-85-47, August 1986). This index provides a brief description of each package and external references when available. Detailed program documentation is only available on the Unisys under their "@DA*DA.ADOC" retrieval system.

The Unisys 1100 is scheduled for shut-down and replacement in October 1997 by an IBM RISC machine at AL/HR which is already in operation, but not yet accessible to outside users. It is unknown to this contractor as to which Unisys-resident programs are being converted for operation on the RISC platform and which will be "lost". Metrica has already produced the RISC-based version of ASCII CODAP.

This project used the GRPREL (Group Reliability, Staley & Weissmuller, 1981) analysis procedure. A brief description of this package is provided below. Additional information of the use of this analytic tool is available in: Albert, et al., 1994; Christal & Weissmuller, 1976, 1988; Goody, 1976; Phalen & Mitchell, 1993; Staley & Weissmuller, 1981; and, Weissmuller, Phalen, & Tartell (1997).

GRPREL

GRPREL is the standard interrater reliability in the CODAP system. For a given list of items rated by a set of Subject Matter Experts (SMEs), this program reports two measures of interrater agreement (R_{11} and R_{kk}). The R_{11} value indicates the reliability of the observed set of ratings—while 0.10 is considered a minimum for usable rater agreement, a value of 0.20 or greater is desired. The R_{kk} value is driven by the number of raters actually used. Although an R_{kk} of 0.90 is usually desired, it may not be practical in a particular study because of a small number of raters (SMEs) that may be subdivided even further into smaller groups based on policy differences. The GRPREL program also computes means and standard deviations for each item in the list. Item-level reports are printed in three orders: original sequence, ordered descending y-mean value, and ordered descending on standard deviation. GRPREL computes each rater's correlation with the full-group mean vector and uses a probability evaluation to recommend the removal of deviant (non-cooperative or reversed scale) raters. The program can automatically iterate and remove flagged raters until either a sufficienct level of agreement (R_{kk} = 0.90) is reached or no raters can be found with a probability (of deviant rating) above 0.95.

☆U.S. GOVERNMENT PRINTING OFFICE: 1998 -660-088/60060