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PARAMETERIZATION OF INJURY VICTIM CONDITION AS A FUNCTION OF TIME

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PARAMETERIZATION OF INJURY VICTIM CONDITION

AS A FUNCTION OF TIME

A Report

by

JOE C. JONES

Submitted to the Industrial Engineering Department
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in partial fulfillment of the requirement for the degree of

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This report examines the relationship between response time and fatalities in evaluating an Emergency Medical Service System (EMSS). A search of the literature revealed that adequate data does not exist to presently develop fatality-response time relationships for evaluating EMS Systems. The paper proposes a data gathering procedure so that statistics can be derived to use in an EMSS simulation. A GASP simulation program is presented which shows how fatality-response time or injury-response time relationships can be used in evaluating an EMSS.

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FOREWORD

The research discussed in this report was accomplished as part of the Maintenance Effectiveness Engineering Graduate Program conducted jointly by the DARCOM Intern Training Center and Texas A&M University. As such, the ideas, concepts and results herein presented are those of the author and do not necessarily reflect approval or acceptance by the Department of Army.

This report has been reviewed and is approved for release. For further information on this project contact Dr. Ronald C. Higgins, Intern Training Center, Red River Army Depot, Texarkana, Texas, 75501.

APPROVED:

Ronald C. Higgins

DR. RONALD C. HIGGINS, Chief
Department of Maintenance Effectiveness Engineering

FOR THE COMMANDER:

James L. Arnett

JAMES L. ARNETT, Director,
Intern Training Center

ABSTRACT

Research Performed by Joe C. Jones

Under the Supervision of Dr. R. S. Morris

This report examines the relationship between response time and fatalities in evaluating an Emergency Medical Service System (EMSS). A search of the literature revealed that adequate data does not exist to presently develop fatality - response time relationships for evaluating EMS Systems. The paper proposes a data gathering procedure so that statistics can be derived to use in an EMSS simulation. A GASP simulation program is presented which shows how fatality - response time or injury - response time relationships can be used in evaluating an EMSS.

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During the course of this work, the author was employed by the US Army as a career intern in the DARCOM Maintenance Engineering Graduate Program. He is grateful to the US Army for the opportunity to participate in this Program.

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CHAPTER I

INTRODUCTION

Each year approximately 48,000 Americans die as a result of motor vehicle collisions. Of these 48,000 people, over half die before they reach a hospital. This figure emphasizes the importance of proper extraction, rapid transportation, and resuscitative measures applied at the scene of the accident and in transit to a hospital. (7)* There is a need for an effective Emergency Medical Service System (EMSS) to provide emergency medical service to not only automobile accidents, but to all other types of medical emergencies that occur within a community. The proper emphasis in the previous statement should be on the word effective. There is a need to be able to evaluate an existing system and recognize weaknesses. There is also the requirement to evaluate recommended changes by showing the effect of these changes on the system.

This paper examines one of several parameters that can be used separately, or in conjunction with other parameters, in evaluating the effectiveness of a present or proposed system. The parameter is that of medical emergency victim condition as a function of response time. The use of this parameter to evaluate system effectiveness can be seen in Table 1 (p. 2), "Percentage of U.S. Wounded Dying of Wounds". The table shows how the percentage of wounded dying from their wounds decreased from 8.1% of the wounded during World War I to 1.0% during the Vietnam conflict. During this

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* Numbers in parenthesis refer to numbered references in the List of References.

same period the average time to definitive surgery was decreased from an average of 12 to 18 hours during World War I to an average of 1.5 to 2 hours for the Vietnam conflict. (5) This improvement is not only the result of better medical care but also of the faster response time.

Table 1

PERCENTAGE OF U.S. WOUNDED*DYING OF WOUNDS

War	Years	Wounded	Case Fatality Rate (percent)	Average Time to Definitive Surgery (hours)
World War I	1917-18	153,000	8.1	12-18
World War II	1941-45	598,500	4.5	6-12
Korea	1950-52	--	2.5	2-4
Vietnam	1965	--	1.0	1.5-2

* Killed In Action categories excluded.

There is a reduction of fatalities due to better response time. In most accident situations, the greatest danger to the injured is from shock or loss of blood, or both. The delay between the time of injury and the time when an individual receives first aid often determines whether or not the individual will survive. (5) This paper will show how this fact can be used to evaluate an EMSS.

To examine the use of response time to evaluate an EMSS the paper will first examine statistics on the probability of survival for specific type injuries that were obtained during the Vietnam conflict. These statistics have been used to evaluate the improvement possible in using military helicopter ambulances for civilian medical emergencies. The second chapter, "Response Time and Victim Survival", will also point out weaknesses in the use of these statistics and why they are not appropriate for evaluating a civilian EMSS. (5)

The military survival statistics were the only statistical data found. It is possible to obtain large quantities of information about automobile accidents . m individual states but little useful information can be obtained about the number and types of medical emergencies steming from non-automobile accidents and disease. Accident and injury statistics are not reported in a uniform manner by the states, nor are the methods used by states necessarily consistent with those used by federal agencies. There is also a significant difference between rural and urban injury rates within a state. Seventy percent of motor vehicle deaths occur in rural areas and in communities with populations of less than 2500. (5) Unfortunately, urban and rural data are not always separately available. Because of this problem it was not possible to determine a set of probability survival curves for a civilian community or rural region. The third chapter, "Injury Classification Systems", is therefore devoted to an examination of data collection methods. The chapter examines several collection methods and proposes a method that would result in sufficient data to obtain survival curves for a given EMSS. Appendix A provides a copy of the Abbreviated Injury Scale (AIS) that is incorporated into the proposed data collection procedure.

The fourth chapter, "CASP Simulation Using Response Time", details how probability of survival curves can be used to evaluate the effectiveness of an

EMSS, or proposed changes to an EMSS. To facilitate this a GASP simulation program (Appendix B) is examined to show how the effectiveness of a system can be examined and improvements to the system evaluated. The program uses the survival curves discussed in Chapter Two and actual data from the Texarkana area to evaluate the Texarkana EMSS. The chapter also examines what changes are required of the program to adapt it to a larger simulation or to a statistical determination of event times and types. Appendix B includes a copy of the program and documentation on its use.

CHAPTER II
RESPONSE TIME AND VICTIM SURVIVAL

The only actual probability of survival curves found were in a military study for the feasibility of using military helicopters for civilian emergencies. The study, "Evaluation of Operations and Marginal Costs of MAST Alternatives" (5) included statistical tables derived from data collected during the Vietnam conflict. The only other information was from a study of fatalities from abdominal injuries, "Evaluation of the Management of Vehicular Fatalities Secondary to Abdominal Injury" (7). This chapter will discuss these two articles, examine what they contribute and why they are either inappropriate or inadequate for use in an EMSS simulation.

The article by Gertner, et. al., "Evaluation of the Management of Vehicular Fatalities Secondary to Abdominal Injury", developed a graph of time versus percent still alive. Figure 1 (p. 6) is from this study. As can be seen from the graph it covers a period from one hour after the crash to 6 weeks after the crash. The problem is that the article was a discussion of fatalities, not survivors, and the time period is in terms of hours and weeks not minutes. The time period of interest must be in terms of minutes since in most cases the response time of an EMSS should be under one hour. What is required is a graph, not of the percent still alive after a given time period, but of the probability of survival at that time period given no medical attention.

The Army study was to make qualitative estimates of the life-saving characteristics of an airborne emergency medical system. The study examined the effects, in terms of survival, of time delays that occur between the occurence of the emergency and the delivery of various levels of treatment. The Army has estimated survival in terms of such factors for 20 categories of battle casualties.

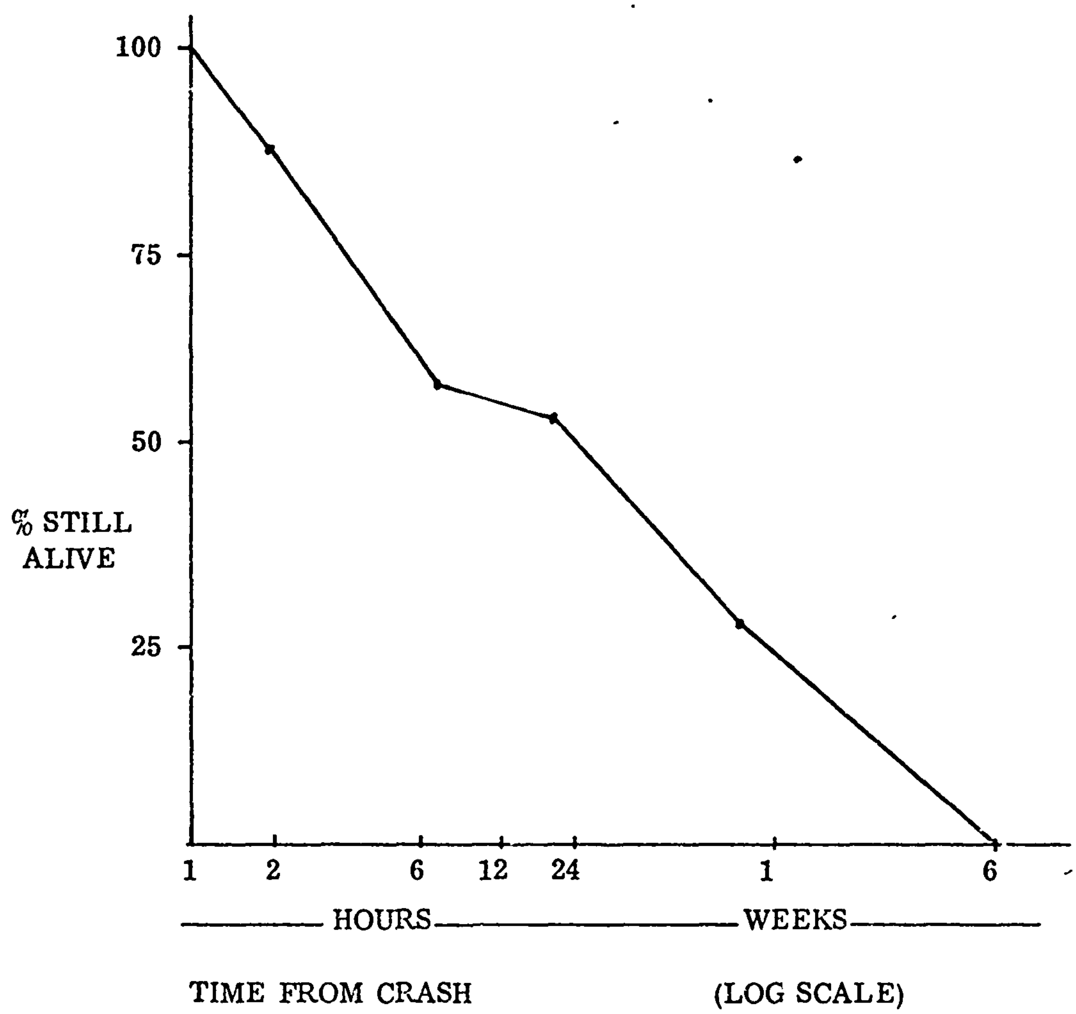

Figure 1. Percent of patients still alive by length of time after crash. Thirty-three deaths due to abdominal injuries.

The Army defined these levels of treatment that are related to the capabilities of the individual delivering treatment. These levels of treatment are:

(1) Initial Treatment: Treatment provided by medically trained attendants or technicians who are not physicians. The treatment normally consists of those actions that are designed to arrest

the progress of physiological instability in the traumatized individual.

(2) <u>Interim Treatment</u>: Treatment normally provided by physicians or physician assistants. It consists of those external actions required to sustain the individual with impaired physiological stability until the cause of the instability can be effectively corrected. It is primarily supportive in nature.

(3) <u>Specific Treatment</u>: Treatment devoted to a combination of the supportive aspects of care begun at the interim level and institution of resuscitative and restoration measures and procedures.

Table 2 (p. 8), "Characteristics of Casualties", is taken from this study. The table lists 10 of 20 categories of wounds covered in the report. The 10 categories listed are utilized in the GASP Simulation of Appendix B to show how response time can be used in evaluating an EMSS. The table lists a Survival Curve number for both before and after initial treatment, any travel restrictions caused by the wound and the average initial treatment time for the wound. Table 3 (p. 9), "Survival Potential Curves," gives the fraction surviving after indicated time periods for both before and after initial treatment. The study also included types of medical specialties required for each type wound, fraction dying during or after treatment, priorities for evaluation and treatment, whether the victim is ambulatory, and survival curves for before and after interim treatment.

Table 4 (p. 11), "Probability of Survival Tables", was derived for three injury categories: Compound and Comminuted Fractures of the Head,

Table 2

CHARACTERISTICS OF CASUALTIES

No.	Location	Wound	Survival Curve Initial Treatment		Travel* Restriction	Initial Treatment Time (Minutes)
			Before	After		
1	Head	Fractures--Compound and Comminuted	0	1	G, LLA, S	5
2	Head	Wounds--Perforated and Penetrating	8	9	G. LLA, S	5
3	Face	Fractures--Compound and Comminuted	18	19	N, S	5
4	Face	Wounds--Perforated and Penetrating	23	24	N, S	5
5	Thorax	Wounds--Perforated, and Penetrating (Lung, Pleura, Bronchi, Ribs)	32	33	G, LLA, S	15
6	Thorax	Wounds--Perforated and Penetrating, Heart, Trachea	36	37	G, LLA, S	10
7	Abdomen	Wounds--Perforated and Penetrating	39	40	N, S	5
8	Upper Ex-trem.	Fractures--Compound and Comminuted	22	22	N, S	20
9	Lower Ex-trem.	Fractures--Compound and Comminuted	43	44	N, S	20
10	Lower Ex-trem.	Wounds-Perforated, Penetrating and Lacerating	23	24	N, S	15

* S = Attendant supervision required during transport, N = No transport restrictions, G = Ground transport, LLA = Low level air transport.

Table 3

SURVIVAL POTENTIAL CURVES

Curve Number	Fraction Surviving After					
	0	30 min.	1 hr.	2 hrs.	5 hrs.	10 hrs.
0	.75	.72	.71	.69	.66	.63
1	.75	.72	.71	.70	.67	.64
8	.50	.48	.46	.42	.30	.20
9	.50	.50	.47	.44	.34	.24
18	.99	.95	.90	.87	.84	.81
19	.99	.96	.92	.88	.85	.82
22	.99	.99	.99	.99	.99	.99
23	.95	.93	.90	.89	.89	.88
24	.95	.94	.91	.90	.89	.88
32	.90	.85	.83	.80	.78	.75
33	.90	.90	.84	.81	.78	.76
36	.20	.19	.19	.18	.17	.16
37	.20	.20	.19	.18	.17	.16
39	.90	.85	.80	.75	.71	.65
40	.90	.86	.82	.77	.72	.67
43	.99	.95	.94	.94	.94	.93
44	.99	.97	.94	.94	.94	.93

Compound and Comminuted Fractures of the Face, and Compound and Comminuted Fractures of the Lower Extremities, are shown. The curves were obtained by plotting the fraction of casualties surviving in each time increment and fitting a smooth curve to the data to obtain the survival table shown.

To illustrate the use of this data, the following examples are taken from Evaluation of Operations and Marginal Costs of MAST Alternatives. (5)

Case 1: Victim is transported by ground ambulance directly to the hospital without any intervening treatment, and arrives five hours after the injury occurred. (Corresponds to a community having no local facilities and limited ambulance service.)

Case 2: Victim is transported by helicopter ambulance and arrives at hospital two hours after injury. (Corresponds to the same community as Case 1, but shows the impact of the helicopter.)

Case 3: Medically trained attendant (paramedic) provides initial treatment at end of first hour after injury, victim is transported by ground ambulance, and arrives at the hospital five hours after the injury occurred. (Corresponds to a community having well-trained ambulance attendants, but no local facilities.)

Case 4: Medically-trained attendant (paramedic) provides initial treatment at end of first hour after injury, victim is transported by helicopter ambulance and arrives at hospital two hours after injury. (Corresponds to a community having

Table 4

PROBABILITY - OF - SURVIVAL TABLES

Survival Curve No.	Time, hours 0	1/2	1	2	5	10	20	48
	A. Probabilities of surviving at the end of the time indicated, given that the casualty was alive at the end of the prior period.							
0	.75	.96	.96	.96	.96	.95	.88	.82
1	.75	.96	.96	.96	.96	.96	.94	.83
3	.75	.97	.97	.97	.96	.96	.95	.84
18	.99	.96	.95	.95	.95	.95	.95	.90
19	.99	.97	.96	.96	.96	.96	.96	.94
21	.99	.99	.97	.97	.96	.96	.96	.96
43	.99	.96	.96	.96	.96	.96	.96	.96
44	.99	.98	.97	.97	.97	.97	.97	.97
46	.99	.99	.97	.97	.97	.97	.97	.97
	B. Probability of surviving to time indicated.							
0	.75	.72	.69	.66	.64	.61	.53	.44
1	.75	.72	.69	.66	.64	.61	.58	.45
3	.75	.73	.71	.68	.66	.63	.60	.52
18	.99	.95	.91	.87	.84	.80	.77	.74
19	.99	.97	.94	.91	.89	.86	.83	.81
21	.99	.98	.95	.92	.89	.87	.84	.82
43	.99	.93	.90	.86	.81	.77	.74	.66
44	.99	.96	.92	.89	.85	.82	.78	.74
46	.99	.98	.95	.92	.89	.85	.82	.78

well-trained ambulance attendants but no local facilities, and shows the impact of the helicopter on such a community.)

Case 5: Local physician provides interim treatment at end of first hour after injury; victim is transported by ground ambulance and arrives at hospital five hours after the injury occurred. (Corresponds to a community that has local medical facilities, but not comprehensive capabilities to treat the types of injuries involved, and only ground ambulances.)

Case 6: Local physician provides interim treatment at end of first hour after injury; victim is transported by helicopter and arrives at hospital two hours after the injury occurred. (Corresponds to a community that has local medical facilities, but no comprehensive capabilities to treat the types of injuries involved, and shows the impact of the helicopter on such a community.)

Table 5 (p. 13), "Effect of Helicopter Ambulance", shows the results obtained using the above examples. The table uses the assumption that the ground ambulance time to the hospital was 5 hours, that helicopter ambulance time was 2 hours and initial treatment occurred after 1 hour. These examples show how response time versus probability of survival can be used to evaluate an EMSS system. Chapter Four will explore this aspect in detail. There are, though, a number of problems with using the injury categories and survival tables supplied by this study.

For example, the list of 20 categories does not cover all possible type injuries and emergencies that could occur in a civilian community. Also, especially true for motor vehicle accidents, it does not include the possibility of multiple injuries. In the case of multiple injuries the correlation between injury categories is unknown. Finally, the survival curve tables are discrete with the first time point after zero at 30 minutes. In most cases the response time to an emergency will be less than 30 minutes and so the tables are useless for

Table 5

EFFECT OF HELICOPTER AMBULANCE

Community	Injury Category	Fraction Dying: Ground Ambulance	Fraction Dying: Helicopter
No Facilities (no treatment)	Head Injuries	.36	.34
	Face Injuries	.19	.15
	Extremity Injuries	.16	.13
No Facilities Medically Trained Attendants (initial treatment only)	Head Injuries	.36	.34
	Face Injuries	.17	.13
	Extremity Injuries	.14	.11
Local Hospital Only (interim treatment only)	Head Injuries	.36	.33
	Face Injuries	.16	.12
	Extremity Injuries	.16	.16

Assumptions

Ground Ambulance Time to Hospital:	5 hours
Helicopter Time to Hospital:	2 hours
Initial or Interim Treatment Occurs at	1 hour.

purposes of evaluating response time impact or survival probability in the normal situation.

Because of these problems, and the lack of any other tables that do not exhibit the problems mentioned above, it is not presently possible to evaluate an EMSS accurately using response time impact on survival.

Chapter Three, therefore, will survey the present methods utilized to collect data on medical emergencies and proposes a data collection procedure so suitable statistical tables can be derived.

CHAPTER III
INJURY CLASSIFICATION SYSTEMS

The utilization of response time as a parameter is very dependent upon the victims condition. Emergencies are first classified by type, then it is necessary to classify victim condition.

Emergency type can be classified in a number of ways. Determination of emergency types for an area is dependent upon the area. The evaluation of a system can use past event data or events can be statistically determined. For either case it is suggested that an ambulance code be used for classification types. Table 6 (p. 16), "Ambulance Code", is the code used by the Texarkana EMSS. The use of these codes will be explained further in Chapter Four which show how they are utilized in a GASP simulation.

Once the type of emergency has been determined it is necessary to determine victim condition. This chapter discusses several methods of classification and then recommends a data collection form to collect statistics to determine survival curves for specified victim condition.

The National Safety Council has conventionally (1971) classified motor vehicle accidents into three categories:

(1) Severe: bleeding wound, distorted member, or any condition that requires a victim to be carried from the scene;

(2) Moderate: other visible injuries such as bruises, abrasions, swelling, limping, or other painful movement; and

Table 6

AMBULANCE CODE

Signal	Classification	Signal	Classification
0	Caution	43	
1	Receiving Poorly	44	Permission to leave for..
2	Receiving Well	45	Notify...of situation
3	Stop Sending	46	Request...at this location (50 #51 etc.)
10-4	Acknowledge		
5	Relay Message	47	
6	Busy Unless Urgent	48	
7	Out of Service	49	Traffic light out at...
8	In Service	50	Car Wreck
10-9	Repeat	51	
10	Subject to call at...	52	Ambulance Needed
11		53	Road Blocked at...
12	Stand by	54	
13	Weather Bulletin, Road Cond.	55	
14		56	
15	Civil Disturbance	57	
16		58	
17		59	Convoy or Escort
18		60	Squad in Vicinity
19	Return to Station	61	Personnel in Area
20	Location	62	
21	Call by Phone	63	
22	Disregard	64	
23	Arrived at Scene	65	
24	Assignment Completed	66	
25		67	
26		68	
27	Bring...to...	69	
28		70	Fire Alarm
29		71	Advise Nature of Fire
30	Unnecessary Use of Radio	72	Report Progress of Fire
31	Crime in Progress	73	
32	Man With Gun	74	
33	Emergency	75	Possible Stroke
34	Riot	76	Enroute...
35		77	Possibly under influence of alcohol
36	Correct Time		
37	Operator on Duty	78	Need Police Assistance
40	Silent; Run No Lights, Siren	79	Notify Coroner
39		80	Possible Insulin Shock
41	Call Off Duty Crew	81	Possible Epileptic(seizure)
42	Request Mutual Aid From...	82	Possible Overdose

Table 6 (Continued)

Signal	Classification	Signal	Classification
83	Traumatic Shock	93	C. B. Case
84	To Be Admitted	94	Gunshot Wound
85	Electric Shock	95	Stabbing
86	Has Lost a Lot of Blood	96	Mental Patient
87	Patient Burned	97	Possible Broken Bones
88	Possible Poison	98	Possible Internal Injuries
89	Attempted Suicide	99	Possible D.O.A.
90	Possible Heart Attack	100	Bomb Report
91	Possible Head Injuries	100	Confirmed Bomb Found
92	Doesn't Seem to be Serious		

(3) Slight: complaint of pain without visible signs of injury, or momentary unconsciousness.

The Committee on Medical Aspects of Automotive Safety has developed two scales; the Abbreviated Injury Scale (AIS) and the Comprehensive Research Injury Scale (CRIS) to provide a more definitive classification system for traumatic injuries, particularly those caused by automobile collisions.

AIS ratings are based on multiple criteria. The most commonly used criteria are energy dissipation (ED) necessary to produce the injury and the threat to life (TL) of the resulting injury. Other criteria used are permanent impairment (PI), treatment period (TP), and incidence (IN). The AIS, as it was introduced in 1968, lists example type injuries under five headings: (1) General; (2) Head and neck; (3) Chest; (4) Abdominal and Pelvic contents; and (5) Extremities. These categories are the same as is normally used by physicians in examinations. The severity of an injury is then rated on a scale of 0-10. Ratings of 6-10 are used to rate fatalities and a rating of 98 or 99 when either the presence of an injury or severity of an injury was not known. Appendix .. contains a copy of the Abbreviated Injury Scale. To utilize the AIS the followin. ·idelines and parameters should be used: (2,15)

(1) A ' 4 h time period following the injury producing accident should be used. Death occurring after 24 hours should not be considered a fatality.

(2) Diagnosis not listed in the AIS must be scaled by using the severity value of a similar injury.

(3) Only the most severe consequence of an injury in any given anatomical area should be scaled.

(4) Multiple injuries to several areas of the human body are scaled separately. Their total effect on the patient is recorded through the overall rating. The overall rating may be greater than any single rating but should not be less.

(5) Burns are scaled on a percentage area of the body.

(6) Pre-existing medical problems should be noted on the injury report form but no attempt should be made to rate such problems.

The CRIS separates the criteria used in scaling into five categories. The five criteria used are: energy dissipation (ED), threat to life (TL), permanent impairment (PI), treatment period (TP), and incidence (IN). The CRIS scale provides a greater number of injury types for each area of the anatomy. The scale also is more objective and requires the investigator to be more precise because of the separation of criteria used to scale an injury into the five classes mentioned previously. Table 7 (p. 20), "Quantitation Terminology", lists the quantitative terminology used to determine ratings for both the AIS and CRIS scales. The CRIS scales are broken up by major medical specialities. These specialities are: chest, abdominal, facial, genitourinary, gynecological, neurological, ophthalmological (eye), orthopedic, and otolaryngological (ear, nose, and throat).

Table 8 (p. 21), "Comprehensive Research Injury Scale - Orthopedic Injuries", shows the scale for orthopedic injuries for threat to life and incidence criteria. A complete listing of the scales by speciality for all criteria can be found in the article by States, Fenner, Flamboe, Nelson and Hames, "Field Application and Research Development of the Abbreviated Injury Scale". (15) One final criteria used in the CRIS scale is the effect of age. There is a consistent and significant difference in the ranking of some criteria because of the injured patient's age. The use of this criteria is seen in the example of the orthopedic scale where a fractured femoral shaft in an elderly patient (over age 65) is a serious threat to life and requires a higher coding. Treatment period of a child for this fracture is much less; six weeks compared to six months for an adult and requires a reduced coding. (3,15)

One area not covered by either the AIS or CRIS is consideration of the effects of multiple injuries in an accident. This problem was considered by Baker, et. al., in "The Injury Severity Score: A Method for Describing Patients With Multiple Injuries and Evaluating Emergency Care".

It was shown that it is possible to utilize an "Injury Severity Score" which is defined as the sum of the squares of the highest AIS grade in each of

Table 7

QUANTITATION TERMINOLOGY

Energy Dissipation	1-Little 2-Minor 3-Moderate 4-Major 5-Maximum	Treatment Period	1-2 weeks or less 2-2-8 weeks 3-8-26 weeks 4-26-52 weeks 5-52 weeks or more
Threat to Life	1-None 2-Minor 3-Moderate 4-Severe 5-Maximum	Incidence	1-Unusual 2-Occasional 3-Common 4-Very common 5-Most frequent
Permanent Impairment	1-20% or less 2-21%-40% 3-41%-60% 4-61%-90% 5-91%-100%		

the three most severly injured areas. The uses of the "Injury Severity Score" was shown to increase the correlation between severity of injury and mortality as compared to the AIS grade for the most severe injury. It was also shown that death rates were higher for persons in the 50-69 year age group than for younger persons, and increased markedly for those age 70 and over. Figure 2 (p. 23) "Mortality Versus Injury Severity Score", shows the relationship between mortality, age, and the injury severity score and Figure 3 (p. 24), "Injury Severity Score Vs Time", shows the relationship between time of death after the accident, injury severity score and percent of deaths.

To derive probability tables in terms of survival for a given response time it is necessary to classify victim condition in terms of either specific types of wounds, as was accomplished by the military or by severity

Table 8

COMPREHENSIVE RESEARCH INJURY SCALE-ORTHOPEDIC INJURIES

Extremities		Threat-to-Life Upper	Threat-to-Life Lower	Incidence Upper	Incidence Lower
Abrasion or Contusion		1	1	5	5
Laceration	Simple	1	1	5	5
	Extensive	1	3	5	1
	Severe-Major Nerves	2	2	1	1
	Severe-Major Vessels	4	4	1	1
Sprain	Major Joint	1	1	4	3
	Minor Joint	1	1	3	2
Crush	Limb	3	4	1	1
	Digit	2	3	2	2
Fracture	Scapula or Clavicle or Both	1		4	
	Humerus	2		3	
	Elbow	2		3	
	Radius and/or Ulna	2		2	
	Carpal, Metacarpal	1		2	
	Femoral Neck		3(+1E)		1
	Patella		1		4
	Femoral Shaft		3(-1C)		3
	Tibia With or Without Fibula		2(-1C)		4
	Fibula		1		2
	Malleolus		1		3
	Foot-Single		1		2
	Multiple		2		2
	Talus Displaced		2		1
	Segmental or Long Bone, Multiple	3	4	1	2
	Digit	1	1	3	3
	(All Open Fractures, +1 TL, -1 IN)				
Dislocation	Shoulder	1		2	
	Elbow	1		2	
	Wrist	1		2	
	Carpal, Metacarpal	1		2	
	Hip		2		2
	Knee		3(-1C)		1
	Ligament Tears		3(-1C)		1
	Ankle		1		3
	Tarsus		2		1
	Digit	1	1	3	3

Table 8 (Continued)

COMPREHENSIVE RESEARCH INJURY SCALE-ORTHOPEDIC INJURIES

Extremities	Threat-to-Life		Incidence	
	Upper	Lower	Upper	Lower
Above Elbow	4		1	
Below Elbow	3		2	
Above Knee		5		1
Below Knee		4		1
Digit	2	2	2	2
Pelvis				
Pelvic Fracture, Including Sacrum				
Simple	2		3	
Severe	3		2	
Sacro-iliac Fracture/Dislocation	3		1	
Symphysis Pubis Separation	3		1	
Spine	Cervical	Thoraco Lumbar	Cervical	Thoraco Lumbar
Acute strain, No Neuro Damage	1	1	4	4
Nerve-Root Damage	1	1	2	2
Cord Transection	5	2	1	1
Fracture, Transverse or Spinous Process	2	2	1	2
Fracture/Dislocation, No Neuro Damage	2	1	2	2
Nerve-Root Damage	3	2	2	2
Cord Transection	5	4	1	1

C-children; E-elderly; IN-incidence; TL-threat to life.

classifications as done in the AIS or CRIS scale. In either case the correlation between multiple injuries must be accomplished to adequately derive probability tables.

Because of the variety of different types of wounds that could be considered, the complexity of the determination of a multiple injury would result in a more complex probability table. The use of the AIS and the Injury Severity Score can accomplish the required data collection and correlation without excessive complexity.

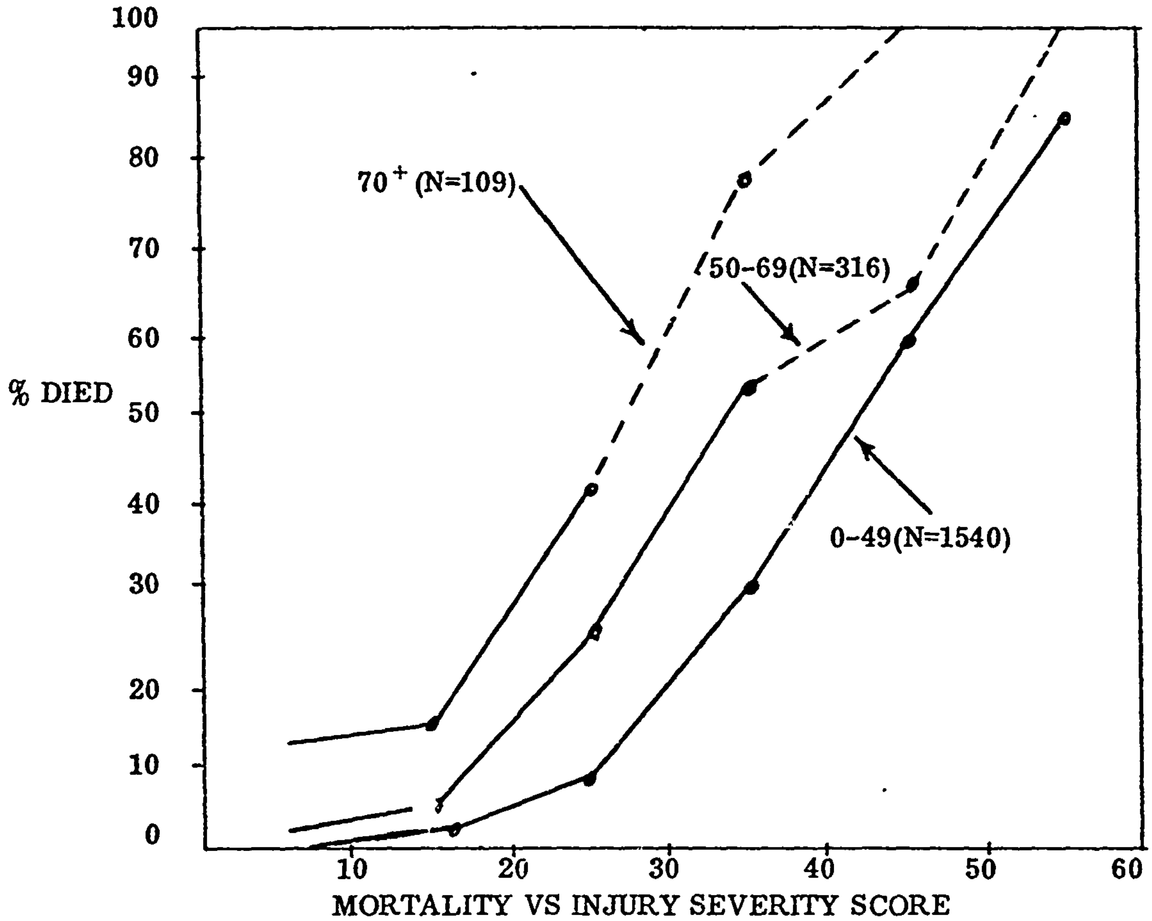

FIGURE 2. Mortality by Injury Severity Score for three age groups. DOA's excluded from calculations. Dotted lines connect points based upon less than 10 persons.

To determine the probability tables to be used in a GASP simulation such as in Appendix B, the use of the following procedure is suggested. Table 9 (p. 25), "Ambulance Patient Record", should be completed for all ambulance runs. Data can then used to derive probability tables to be used in simulations of the EMSS as discussed in Chapter Four.

The development of a procedure to derive the probability tables is a subject area for further research. Suggested procedures would include the use of regression to derive functions that would predict the probability of

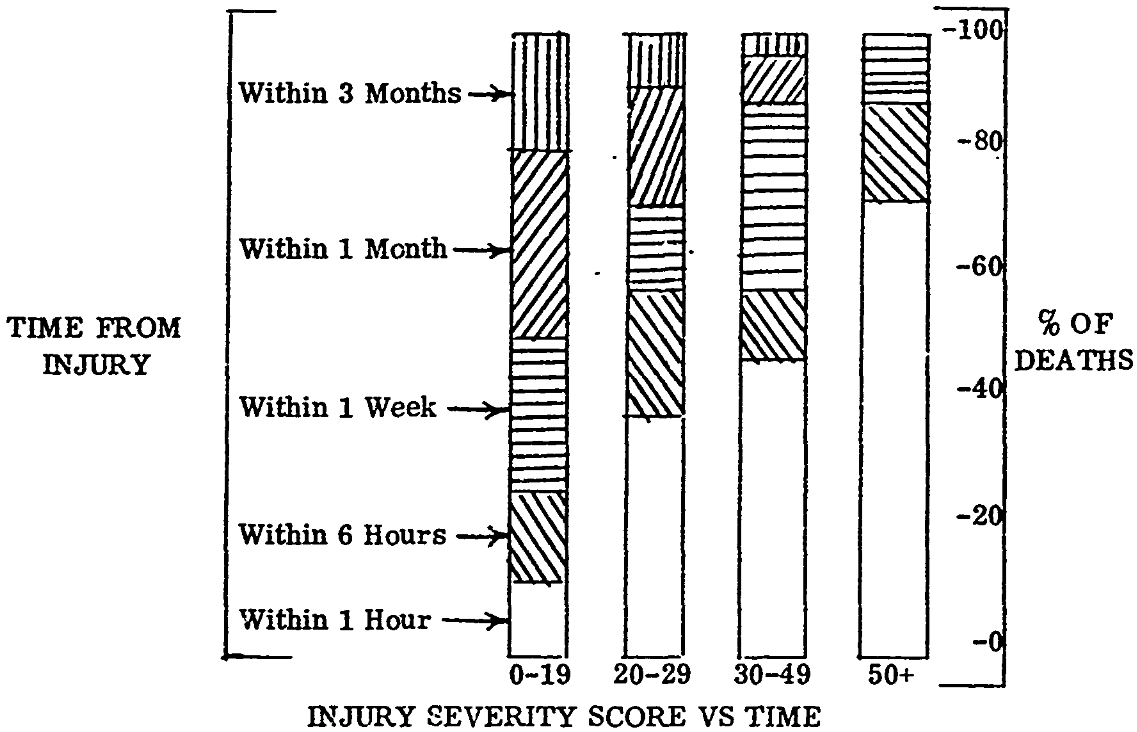

FIGURE 3. Length of time from injury until death by Injury Severity Score. Includes all deaths.

survival for specified injury severity scores.

Table 9

AMBULANCE PATIENT RECORD

PATIENT INFORMATION

Age__________

Sex__________

Any prior medical problem /_/ Yes /_/ No

(If yes explain in comment section)

AMBULANCE STATUS

Run Number__________

Ambulance Number_____

PATIENT CONDITION

_____General

_____Head and Neck

_____Chest

_____Abdominal and Pelvic Contents

_____Extremities

(Use AIS Code For Rating)

DATES AND TIMES

Date of Run__________

Time call Received__________

Time Ambulance Dispatched__________

Time Arrived at Scene__________

Time Arrived at Destination__________

Time Returned to Service__________

INCIDENT INFORMATION

Type of call__________(Use Ambulance Code)

Location of incident__________

Patient delivered to__________

FOLLOW-UP INFORMATION - FATALITIES

At Scene	/_/ Yes	/_/ No
On Arrival	/_/ Yes	/_/ No
Within 24 Hours	/_/ Yes	/_/ No
Unknown	__________	
Time of Death (If Known)	__________	

COMMENTS:__________

CHAPTER IV
GASP SIMULATION USING RESPONSE TIME

This chapter explains the use of response time in evaluating the effectiveness of a proposed EMSS as compared to an existing system. The effectiveness of a system is evaluated using the criteria at the reduction in mortality as a function of response time. The response time is defined as the time interval from receipt of an emergency call to the time the emergency victim first receives medical first aid from trained personnel. A reduction in response time can be affected by an increase in the number of emergency vehicles, the use of medically trained attendants on emergency vehicles, or from the location of dispatching being located so as to minimize response time.

An increase in the number of emergency vehicles will decrease the occurrance and size of queues of waiting emergency calls when all vehicles have been dispatched. However, the increase in the number of emergency vehicles results in a large increase in the cost of the system. The addition of one emergency vehicle to an EMSS adds not only the cost of the vehicle but increased personnel and maintenance costs. The article by Messer and Morris, "Emergency Medical Service Systems (EMSS) Requirement Analysis for Rural Regions", (10) examines the effects of five parameters, including number of vehicles, on EMSS costs and performance.

The use of medically trained ambulance attendents has a large effect on the response time of an EMSS. Without medically trained attendents the response time of the system would be the time from when a call is received until the ambulance arrives at the hospital. With medically trained attendents the time would be measured from the time the call is received until the ambulance arrives at the scene of the emergency. There is a large reduction in response time because of the use of medically trained emergency personnel.

The location the vehicles are dispatched from will also affect response time. Through the use of Operations Research techniques and the analysis of past data it is possible to "optimize" the dispatch locations and routes so as to decrease the response time of the system.

To fully evaluate the performance of an EMSS would include evaluation of the system in terms of number of vehicles, number and location of dispatching centers, medical training and equipment available to ambulance attendents, maintenance requirements for equipment, and system availability. The system should be evaluated in terms of overall cost and response time.

It is recognized that the response time of an EMSS is important in evaluating the effectiveness of the system. This paper gives more meaningful cost to evaluate a system. It can be shown that a proposed change to an EMSS would decrease the average response by 5 minutes at a cost of X dollars. (11) If it could be shown that this proposed change would also reduce mortality effectively saving Y lives per year the argument for the proposed change is much stronger.

To show the effect decreasing average response time would have on lives saved requires reliable data in terms of function or probability tables to describe the affect of response time on the mortality. As discussed in the preceeding chapter this data does not exist. To show how it can be used once it has been determined, a GASP simulation program was developed for demonstration purposes. The program uses the 10 wound types shown in Table 2 (p. 8) for the classification of injury. It uses the ambulance code of Table 6 (p. 16) for event types. Since the program is for demonstration purposes only, the probabilities for the wound types of Table 2 (p. 8) were taken from Table 3 (p. 9) at time zero and at 30 minutes for both before and after initial treatment, then the slope between the two points is used to describe a linear function of the probability of a fatality versus response time. Actual data from the Texarkana area was used for the simulation. The data consisted of the time a call was received, time the ambulance arrived at the scene, time the ambulance arrived at the hospital, time the ambulance was back in service and the event code for the incident. The code used was that of Table 6 (p. 16) with a 10 prefix, except code 1100 was used to designate a non-emergency transfer. The data was further grouped by day and month with calls sequenced from 001 for each month. The copy of the program can be found in Appendix B. Appendix C is the results for a one month simulation of the system. Appendix D is the input data used for the program.

The ambulance number was also included, along with the location of the emergency call and the hospital that the victim was taken to. The ambulance number was kept in the program file but not used. The emergency call location and hospital were not kept.

Since the data did not list the actual dispatch time it was not possible to simulate the occurrance of a waiting queue when all ambulances were on call, and a call received. The demonstration program, therefore, utilized the affect of having paramedic ambulance personnel.

The program uses 7 of the ambulance event codes of Table 6 (p. 16). The codes used, with a 10 prefix, are as follows: 1033, 1050, 1091, 1094, 1095, 1097, and 1098. These codes were used since they would tend to correspond to the 10 injury types of Table 2 (p. 8). In an actual simulation all ambulance codes for which there existed corresponding response-fatality tables, or functions, could be used. The program uses actual past data for all event times and event codes. All event times and codes can be simulated if necessary. (10) To simulate event types, and times, the corresponding distributions or probabilities of occurrance must be known or estimated.

The program uses GASP, a FORTRAN based, event type simulation package. The program is based on examples in Pritsker and Kiviat's, Simulation With GASP II (13); and Messer and Morris' article. (10) The program consists of a main program and 7 subroutines written by the author, and the GASP supplied subroutines. The main program reads in the event types to be checked for in the simulation, and the magnitude of the slopes between 0 and 30 minutes of Table 3 (p. 9), and calls SUBROUTINE GASP. SUBROUTINE EVNTS is written as given by Pritsker and Kiviats. SUBROUTINE ARIVD is used in conjunction with COLCT to determine statistics on response time and percent of lives lost due to the response time. SUBROUTINE HOSPT is used in conjunction with COLCT to determine statistics on, total time from the call until the ambulance arrives at the hospital, on time from the scene to the hospital, on time from when the call is received until the ambulance reaches the hospital, on percentage of lives lost with or without medically trained attendents, and on the difference between having or not having medically trained ambulance attendents. SUBROUTINE BACKS is used in conjunction with COLCT to gather statistics on the total time a trip takes. SUBROUTINE STRT reads in all events to be used in the simulation and places them into files. SUBROUTINE STRT ignores any data cards that are not completely filled out. For the program to work correctly, all data cards must be in ascending order, in terms of days and hours, with all times based on a 2400 hour clock. The last data card must have a 99 in the first two columns of the card. This causes SUBROUTINE ENDSM to be called which signals the end of the simulation and the output of all statistics gathered during the simulation. SUBROUTINE OTPUT is used to output any additional output not supplied by GASP.

Appendix D is the input, excluding cards with missing data fields, used in the simulation run for which Appendix C is the output. The output supplied by the program includes the means, standard deviations, miminums, maximums, and number of observations for the data gathered during the simulation. Page 60, in Appendix C gives this information, along with a brief explanation of the code used. Page 61 through page 70 of Appendix C gives an event by event output for all input events with one of the seven ambulance codes the program used.

From the output on Page 60 it is shown that there is about 0.7% difference between having or not having trained ambulance attendents. This would mean about a .7% decrease in the number of fatalities for the seven event types used in the simulation if the probabilities of injury types and fatalities statistics were correct. This information is strictly for demonstration, of how an event type simulation can be used to evaluate an EMSS.

The probabilities of fatalities, the probability of the occurrance of a specific type injury, and the corresponding use of the injury types and event codes have no factual basis and are only used to demonstrate how this information can be used.

This chapter has shown how it is possible to use response time versus mortality to evaluate an EMSS. The determination of factual data to be used in a simulation of this type can result in a much stronger argument for changes in an EMSS. The argument based on the number of lives saved as a consequence of injury response time is stronger than one based solely on response time.

CHAPTER V
RECOMMENDATIONS AND CONCLUSIONS

It is possible to evaluate an EMSS in terms of lives saved due to a reduction in response time. It is felt that an evaluation of an EMSS in terms of a reduction in the number of expected fatalities is a much stronger way to evaluate a system than is an evaluation in terms of response time alone.

The problem with this method is that tables or probability distributions describing mortality as a function response time do not exist in terms that would correspond to a civilian EMSS. What is required is the probabilities of occurrence of the different classifications of injury types a civilian EMSS could expect. Then a corresponding response time versus mortality table, or probability functions, are required to completely evaluate the system. It is felt that the use of the AIS code (2, 3), Appendix A, in conjunction with the Injury Severity Score (1), and the Ambulance Patient Record, Table 9 (p. 25) can be used to develop the required probabilities and tables or functions. This work would be in terms of accident victims, not medical emergencies caused by illness.

The suggested form of research to determine the required information would be through the use of the Ambulance Patient Record, Table 9 (p. 25). The use of the form by ambulance attendents, with a follow-up on fatalities by the researcher would result in sufficient information to derive categories or ranges of the Injury Severity Score, response time, and fatalities.

APPENDIX A

This appendix provides a copy of the Abbreviated Injury Scale. It is recommended that this code be used in filling out the "Ambulance Patient Record", Table 9 (p. 25).

ABBREVIATED INJURY SCALE

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
0	NO INJURY	O or D
1	MINOR	C

GENERAL

---Aches all over.

---Minor lacerations, contusion, and abrasions (first aid--simple closure).

---All 1st degree or small 2nd degree or 3rd degree burns.

HEAD AND NECK

---Cerebral injury with headache; dizziness; no loss of consciousness.

---"Whiplash" complaint with no anatomical or radiological evidence.

---Abrasions and contusions of ocular apparatus (lids, conjunctive, cornea, uveal injuries); vitreous or retinal hemorrhage.

---Fracture and/or dislocations of teeth.

CHEST

---Muscle ache or chest wall stiffness.

ABDOMINAL AND PELVIC CONTENTS

---Muscle ache; seat belt abrasion; etc.

EXTREMITIES

---Minor sprains and fractures and/or dislocation of digits.

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
2	MODERATE	B
	GENERAL ---Extensive contusions; abrasions; large lacerations; evulsions (less than 3" wide). ---10-20% body surface 2nd degree or 3rd degree burns. HEAD AND NECK ---Cerebral injury with or without skull fracture, less than 15 minutes unconsciousness; no post-traumatic amnesia. ---Undisplaced skull or facial bone fractures or compound fracture of nose. ---Lacerations of the eye and appendages; retinal detachment. ---Disfiguring lacerations. ---"Whiplash" - severe complaints with anatomical or radiological evidence. CHEST ---Simple rib or sternal fractures. ---Major contusions of chest wall without hemothorax or pneumothorax or respiratory embarrassment. ABDOMINAL AND PELVIC CONTENTS ---Major contusion of abdominal wall. EXTREMITIES AND/OR PELVIC GIRDLE ---Compound fractures of digits. ---Undisplaced long bone or pelvic fractures. ---Major sprains of major joints.	

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
3	SEVERE (Not Life-Threatening)	B

GENERAL

---Extensive contusions; abrasions; large lacerations involving more than two extremities, or large ovulsions (greater than 3" wide).

---20-30% body surface 2nd degree or 3rd burns.

HEAD AND NECK

---Cerebral injury with or without skull fracture, with unconsciousness more than 15 minutes; without severe neurological signs; brief post-traumatic amnesia (less than 3 hours).

---Displaced closed skull fractures without unconsciousness or other signs of intracranial injury.

---Loss of eye, or ovulsion of optic nerve.

---Displaced facial bone fractures or those with ontral or orbital involvement.

---Cervical spine fractures without cord damage.

CHEST

---Multiple rib fractures without respiratory embarrassment.

---Hemothorax or pneumothorax.

---Rupture of diaphragm.

---Lung contusion.

ABDOMINAL AND PELVIC CONTENTS

---Contusion of abdominal organs.

---Extroperitoneal bladder rupture.

---Retroperitoneal hemorrhage.

---Avulsion of ureter.

---Laceration of urethra.

---Thoracic or lumbar spine fractures without neurological involvement.

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
3	SEVERE (Not Life-Threatening)(Continued)	B
	EXTREMITIES AND/OR PELVIC GIRDLE ---Displaced simple long-bone fractures, and/or multiple hand and foot fractures. ---Single open long-bone fractures. ---Pelvic fracture with displacement. ---Dislocation of major joints. ---Multiple amputations of digits. ---Lacerations of the major nerves or vessels of extremities.	
4	SEVERE (Life-Threatening, Survival Probable)	B
	GENERAL ---Severe lacerations and/or ovulsions with dangerous hemorrhage. ---30-50% surface 2nd degree or 3rd degree burns. HEAD AND NECK ---Cerebral injury with or without skull fracture, with unconsciousness of more than 15 minutes, with definite abnormal neurological signs; post-traumatic amnesia 3-12 hours. ---Compound skull fracture. CHEST ---Open chest wounds; flail chest; pneunomediastinum; myocardial contusion without circulatory embarrassment; pericardial injuries.	

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
4	SEVERE(Life-Threatening, Survival Probable)(Continued)	B
	ABDOMINAL AND PELVIC CONTENTS ---Minor laceration of intra-abdominal contents(to include ruptured spleen, kidney, and injuries to tail of pancreas). ---Introperitoneal bladder rupture. ---Avulsion of the genitals. ---Thoracic and/or lumbar spine fractures with paraplegic. EXTREMITIES ---Multiple closed long-bone fractures. ---Amputation of limbs.	
5	CRITICAL (Survival Uncertain)	A
	GENERAL ---Over 50% body surface 2nd degree or 3rd degree burns. HEAD AND NECK ---Cerebral injury with or without skull fracture with unconsciousness of more than 24 hours; post-traumatic amnesia more than 12 hours; intracranial hemorrhage; ---Cervical spine injury with quadriplegia. ---Major airway obstruction. CHEST ---Chest injuries with major respiratory embarrassment (laceration of trachea, hemomediastinum, etc.) ---Aortic laceration. ---Myocardial rupture or contusion with circulatory embarrassment. ABDOMINAL AND PELVIC CONTENTS ---Rupture, ovulsion or severe laceration of intra-abdominal vessels or organs, except kidney, spleen or ureter.	

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
5	CRITICAL (Survival Uncertain) (Continued)	A
	EXTREMITIES ---Multiple open limb fractures.	
4	FATAL (Within 24 Hours)	K
	---Fatal lesions of single region of body, plus injuries of other body regions of Severity Code 3 or less. ---Fatal from burns regardless of degree.	
7	FATAL (Within 24 Hours)	K
	---Fatal lesions of single region of body, plus injuries of other body regions of Severity Code 4 or 5.	
8	FATAL	K
	---2 fatal lesions in 2 regions of body.	
9	FATAL	K
	---3 or more fatal injuries. ---Incineration by fire.	
10	FATAL	K
	---Fatal details unknown.	

Severity Code	SEVERITY CATEGORY/INJURY DESCRIPTION	Police Code
99	SEVERITY UNKNOWN	X
	---Injured, but severity not known.	
98	PRESENCE UNKNOWN	Z
	---Presence of injury not known.	

APPENDIX B

This appendix contains a copy of the GASP simulation program explained in Chapter IV. This first page of Appendix B is the required format for the Job Control Records, program, and data required to run the program. The simulation was run on a AMDAHL 470 using HASP.

REQUIRED FORM FOR RUNNING THE PROGRAM ON THE AMDAHL 470 SYSTEM

```
//JOB CARD
/*PASSWORD
/*JOBPARM  REGION=320K
//STEP1 EXEC FORTGCLG, REGION.GO=320K
//FORT.SYSIN DD *
....MAINPROGRAM.....
         .
         .
         .
....SUBROUTINES.....
         .
         .
         .
         .
//LKED.MYLIB DD DSN=USER.KRA.MORRIS.JOBLIB, DISP=SHR
//LKED.SYSIN DD *
INCLUDE MYLIB(GASP3601, GASP3602, GASP3603)
//GO.SYSIN DD Y
....DATA...

1st data card-EVENT CODE - 14 FORMAT
2nd - through 4th data card - Probability slopes, SF10.0
GASP DATA CARDS (See Reference #13, page 41) FORMAT
INPUT DATA CARDS
/*
```

The GASP Data Cards must include in the Type 8 data cards an event at time 0.0 in file one with ATRIB(2)=6.0. The last INPUT data card must have a 99 in the first two columns.

```
      DIMENSION NSET(10,1000)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BALTIM(400)
      NCRDR=5
      NPRNT=6
      READ(NCRDR,44)(ITEM(I),I=1,7)
   44 FORMAT(7I4)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                      C
C                                                                      C
C     ITEM(I)'S ARE THE AMBULANCE CODES MOST LIKELY TO RESULT IN ONE OF C
C       THE INJURY TYPES LISTED.                                       C
C         ITEM(1)=1033 IS FOR AN EMERGENCY OF UNKNOWN TYPE             C
C         ITEM(2)=1050 IS FOR A CAR WRECK                              C
C         ITEM(3)=1091 IS FOR HEAD INJURIES                            C
C         ITEM(4)=1094 IS FOR GUNSHOT WOUNDS                           C
C         ITEM(5)=1095 IS FOR A STABBING                               C
C         ITEM(6)=1097 IS FOR BROKEN BONES                             C
C         ITEM(7)=1098 IS FOR INTERNAL INJURIES                        C
C                                                                      C
C                                                                      C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      DO 50 I=1,2
      READ(NCRDR,45)(Y(I,J),J=1,10)
   45 FORMAT(5F10.0)
   50 CONTINUE
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C     Y(IJ)'S ARE THE SLOPES OF THE SURVIVAL POTENTIAL CURVES BETWEEN 0     C
C        AND 30 MINUTES.  THE Y(1,J)'S ARE BEFORE INITIAL TREATMENT AND     C
C        THE Y(2,J)'S ARE AFTER INITIAL TREATMENT.                          C
C     Y(I,1)  IS FOR COMPOUND AND COMMINUTED FRACTURES OF THE HEAD.         C
C     Y(I,2)  IS FOR PERFORATED AND PENETRATING WOUNDS TO THE HEAD.         C
C     Y(I,3)  IS FOR COMPOUND AND COMMINUTED FRACTURES TO THE FACE.         C
C     Y(I,4)  IS FOR PERFORATED AND PENETRATING WOUNDS TO THE FACE.         C
C     Y(I,5)  IS FOR PERFORATED AND PENETRATING WOUNDS TO THE THORAX        C
C        (LUNG,PIEURA,BRONCHI,RIBS)                                         C
C     Y(I,6)  IS FOR PERFORATED AND PENETRATING WOUNDS TO THE THORAX        C
C        (HEART AND TRACHEA)                                                C
C     Y(I,7) IS FOR CPERFORATED AND PENETRATING WOUNDS TO THE ABDOMEN.      C
C     Y(I,8) IS FOR CCOMPOUND AND COMMINUTED FRACTURES TO THE UPPER EXTREM  C
C     Y(I,9) IS FOR CCOMPOUND AND COMMINUTED FRACTURES TO THE LOWER EXTREM  C
C     Y(I,10)IS FOR CPERFORATED,PENETRATING, AND LACERATING WOUNDS TO THE   C
C        LOWER EXTREM.                                                      C
C                                                                           C
C                                                                           C
C     THIS PROGRAM UTILIZES SURVIVAL DATA FROM REFERENCE NUMBER 5 TO SHOW   C
C        HOW RESPONSE TIME CAN BE USED AS A MEASURE OF PERFORMANCE FOR      C
C        AN EMSS WHERE THE MEASURE OF PERFORMANCE IS IN POTENTIAL LIVES LOST C
C        BECAUSE OF RESPONSE TIME.                                          C
C                                                                           C
C                                                                           C
      DO 60 I=1,7
      WRITE(NPRNT,100)I,ITEM(I)
100   FORMAT( 6H CODE ,I1,3H = ,I4/)
60    CONTINUE
      DO 90 I=1,2
      DO 90 J=1,10
      WRITE(NPRNT,101)I,J,Y(I,J)
101   FORMAT( 3H Y(,I1,2H ,,I2,5H ) = ,F10.6)
90    CONTINUE
      CALL GASP(NSET)
      STOP
      END
```

```
      SUBROUTINE EVNTS(IX,NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1JOG,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCFLS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLL(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMRFC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
      GO TO (1,2,3,4,5,6),IX
    1 CALL RECED(NSET)
      RETURN
    2 CALL ARIVD(NSET)
      RETURN
    3 CALL HOSPT(NSET)
      RETURN
    4 CALL BACKS(NSET)
      RETURN
    5 CALL ENDSM(NSET)
      RETURN
    6 CALL STRT(NSET)
      RETURN
      END
```

```
      SUBROUTINE RECED(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1PIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                     C
C                                                                     C
C     THIS SUBROUTINE DETERMINES AVERAGE, VARIANCE, MINIMUM, AND MAXIMUM C
C        TIMES FOR THE TIME BETWEEN EMERGENCY CALLS.                  C
C     TIMREC IS THE TIME USED TO DESIGNATE THAT PERIOD.               C
C                                                                     C
C                                                                     C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      TIMREC=ATRIB(1)-ATRIB(7)
      CALL COLCT(TIMREC,1,NSET)
      RETURN
      END
```

```
      SUBROUTINE ARIVD(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN.MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                      C
C                                                                      C
C     THIS SUBROUTINE DETERMINES THE RESPONSE TIME OF THE AMBULANCE.  THE  C
C        TIME FROM WHEN THE CALL IS RECIEVED UNTIL THE AMBULANCE ARRIVES  C
C        AT THE SCENE.  IT DETERMINES THE AVERAGE RESPONSE, VARIANCE, MINIMUM  C
C        AND MAXIMUM RESPONSE TIME.  IT ALSO GATHERS DATA ON THE POTENTIAL  C
C        OF LOST LIVES BECAUSE OF RESPONSE TIME..                     C
C      REPTIM IS THE RESPONSE TIME.                                    C
C                                                                      C
C                                                                      C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      REPTIM=ATRIB(1)-ATRIB(4)
      CALL COLCT(REPTIM,2,NSET)
      CALL DRAND(ISEED,RNUM)
      IX=IFIX(RNUM*10.+1.)
C     THIS DO LOOP DETERMINES IF THE CALL IS ONE OF THE INCIDENT TYPES
C        FOR WHICH RESPONSE VS LIVES LOST STATISTICS ARE BEING GATHERED.
      DO 10 I=1,7
      X(I)=ITEM(I)
      IF(ATRIB(5).EQ.X(I))GO TO 30
   10 CONTINUE
      RETURN
   30 GO TO(40,40,50,40,40,40,60),I
C     AIVSAV IS THE PERCENTAGE OF LIVES LOST BECAUSE OF RESPONSE TIME
C        USING THE SLOPE OF THE PROBABILITY SURVIVAL CURVES.
```

```
40     AIVSAV=Y(1,IX)*REPTIM*100.
       GO TO 99
50     IF(RNUM.LT.2.5)IY=1
       IF(2.5.LE.RNUM.AND.RNUM.LT.5.0)IY=2
       IF(5.0.LE.RNUM.AND.RNUM.LT.7.5)IY=3
       IF(7.5.LE.RNUM.AND.RNUM.LE.10.0)IY=4
       AIVSAV=Y(1,IY)*REPTIM*100.
       GO TO 99
60     IF(RNUM.LT.3.3)IZ=8
       IF(3.3.LE.RNUM.AND.RNUM.LT.6.7)IZ=9
       IF(6.7.LE.RNUM.AND.RNUM.LE.10.0)IZ=10
       AIVSAV=Y(1,IZ)*REPTIM*100.
99     WRITE(NPRNT,100)ATRIB(8),ATRIB(5),REPTIM,AIVSAV
100    FORMAT( 8H SEQ NO ,F4.0,15H INCIDENT CODE ,F5.0,/,15H RESPONSE TIM
      1E ,F8.4,/,20H PERCENT LIVES LOST ,F8.6/)
       CALL COLCT(AIVSAV,6,NSET)
       RETURN
       END
```

```
      SUBROUTINE HOSPT(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),EJQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                      C
C                                                                      C
C     THIS SUBROUTINE DETERMINES AVERAGE TOTAL TRAVEL TIME, AVERAGE TIME C
C        TO THE HOSPITAL, MINIMUMS AND MAXIMUMS AND VARIANCES FOR THEM,  C
C        AND THE EFFECT ON LIVES WHEN AMBULANCE ATTENDENTS ARE NOT CAPABLE C
C        OF ADMINISTERING INITIAL TREATMENT..                          C
C      TRPTIM IS THE TIME REQUIRED FROM THE TIME THE CALL IS RECEIVED  C
C        UNTIL THE AMBULANCE ARRIVES AT THE HOSPITAL.                  C
C     HOSTIM IS THE TIME IT TAKES FOR THE AMBULANCE, MEASURED FROM THE C
C        TIME IT ARRIVES AT THE SCENE UNTIL IT REACHES THE HOSPITAL.   C
C                                                                      C
C                                                                      C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      TRPTIM=ATRIB(1)-ATRIB(4)
      CALL COLCT(TRPTIM,3,NSET)
      HOSTIM=ATRIB(1)-ATRIB(6)
      CALL COLCT(HOSTIM,4,NSET)
      REPTIM=ATRIB(6)-ATRIB(4)
      CALL DRAND(ISEED,RNUM)
      IX=IFIX(RNUM*10.+1.)
C     THIS DO LOOP DETERMINES IF THE CALL IS ONE OF THE INCIDENT TYPES
C        FOR WHICH RESPONSE VS LIVES LOST STATISTICS ARE BEING GATHERED.
```

```
      DO 10 I=1,7
      X(I)=ITEM(I)
      IF(ATRIB(5).EQ.X(I))GO TO 30
10    CONTINUE
      RETURN
30    GO TO(40,40,50,40,40,40,60),I
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                          C
C                                                                          C
C     BIVSAV IS THE PERCENTAGE OF LIVES LOST BECAUSE OF RESPONSE TIME      C
C        WHEN AMBULANCE PERSONNEL DO NOT HAVE MEDICAL TRAINING.            C
C     ATNSAV IS THE PERCENTAGE OF LIVES LOST BECAUSE OF RESPONSE TIME      C
C        WHEN AMBULANCE PERSONNEL HAVE MEDICAL TRAINING                    C
C     DIFF IS AN INDICATOR OF POTENTIAL LIVES SAVED                        C
C                                                                          C
C                                                                          C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
40    BIVSAV=Y(1,IX)*TRPTIM*100.
      ATNSAV=Y(1,IX)*REPTIM*100.+Y(2,IX)*HOSTIM*100.
      DIFF=BIVSAV-ATNSAV
      GO TO 99
50    IF(RNUM.LT.2.5)IY=1
      IF(2.5.LE.RNUM.AND.RNUM.LT.5.0)IY=2
      IF(5.0.LE.RNUM.AND.RNUM.LT.7.5)IY=3
      IF(7.5.LE.RNUM.AND.RNUM.LE.10.0)IY=4
      BIVSAV=Y(1,IY)*TRPTIM*100.
      ATNSAV=Y(1,IY)*REPTIM*100.+Y(2,IY)*HOSTIM*100.
      DIFF=BIVSAV-ATNSAV
      GO TO 99
60    IF(RNUM.LT.3.3)IZ=8
      IF(3.3.LE.RNUM.AND.RNUM.LT.6.7)IZ=9
      IF(6.7.LE.RNUM.AND.RNUM.LE.10.0)IZ=10
      BIVSAV=Y(1,IZ)*TRPTIM*100.
      ATNSAV=Y(1,IZ)*REPTIM*100.+Y(2,IZ)*HOSTIM*100.
      DIFF=BIVSAV-ATNSAV
```

```
 99    WRITE(NPRNT,101)ATRIB(8),ATRIB(5)
 101   FORMAT( 8H SEQ NO ,F4.0,15H INCIDENT CODE ,F5.0)
       WRITE(NPRNT,100)TRPTIM,HOSTIM,BIVSAV,ATNSAV,DIFF
 100   FORMAT( 17H TOTAL TRIP TIME ,F8.4,/,20H HOSPITAL TRIP TIME ,F8.4,/,
      1,41H PERCENT LIVES LOST WITH NO MEDICAL HELP ,F8.4,/,37H PERCENT L
      2IVES LOST WITH MEDICAL HELP ,F8.4,/,28H DIFFERENCE BETWEEN THE TWO
      3 ,F8.4/)
       CALL COLCT(BIVSAV,7,NSET)
       CALL COLCT(ATNSAV,8,NSET)
       CALL COLCT(DIFF,9,NSET)
       RETURN
       END
```

```
      SUBROUTINE STRT(NSET)
      DIMENSION NSET(10,1)
      DIMENSION KSEQ(400),KUNIT(400),KMNTH(400),KDAY(400),IREC(400),
     1IAR(400),IBAC(400),IEN(400),KINCNT(400)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,AINSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIMF(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
      IT=0
      JSEQ=1
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                        C
C                                                                        C
C     THIS SUBROUTINE SETS UP INPUT DATA INTO GASP FOR ALL EVENTS.  THE  C
C        LAST CARD IN THE DATA DECK MUST HAVE MONTH LISTED AS 99.  THE   C
C        SUBROUTINE READS UP TO 999 CARDS GIVING MONTH, DAY, SEQUENCE    C
C        NUMBER, AMBULANCE NUMBER, TIME THE CALL ARRIVED, TIME AMBULANCE C
C        ARRIVED AT  THE SCENE, AT THE HOSPITAL, AND WAS BACK IN SERVICE C
C        AND THE EVENT CODE FOR THE INCIDENT FOR A ONE MONTH COLLECTION  C
C        OF DATA.                                                        C
C                                                                        .
C                                                                        .
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      DO 12 IJ=1,999
      I=JSEQ
      READ(NCRDR,100)MNTH,IDAY,ISEQ,IUNIT,IRECHR,IREMIN,IARVHR,IARMIN,
     1IENDHR,IENMIN,IBACHR,IBAMIN,INCNT
  100 FORMAT(2I2,3I3,I2,I3,I2,I3,I2,I3,I2,I5)
      IF(MNTH-99)11,92,999
   11 CONTINUE
```

```
10    IF(IRECHR+IREMIN.LE.0)GO TO 12
      IF(IARVHR+IARMIN.LE.0)GO TO 12
      IF(IBACHR+IBAMIN.LE.0)GO TO 12
      IF(IENDHR+IENMIN.LE.0)GO TO 12
      IF(IRECHR-24)21,20,20
20    IRECHR=IRECHR-24
      IARVHR=IARVHR-24
      IBACHR=IBACHR-24
      IENDHR=IENDHR-24
21    CONTINUE
      KSEQ(I)=ISEQ
      KUNIT(I)=IUNIT
      KMNTH(I)=MNTH
      KDAY(I)=IDAY
      IREC(I)=IRECHR*100+IREMIN
      IAR(I)=IARVHR*100+IARMIN
      IEN(I)=IENDHR*100+IENMIN
      IBAC(I)=IBACHR*100+IBAMIN
      KINCNT(I)=INCNT
      AINCNT(I)=FLOAT(INCNT)
      ASEQ(I)=FLOAT(ISEQ)
      AUNIT(I)=FLOAT(IUNIT)
      AMNTH(I)=FLOAT(MNTH)
      ADAY(I)=FLOAT(IDAY)
      TIME(1,I)=FLOAT(IRECHR)
      TIME(2,I)=FLOAT(IREMIN)
      TIME(3,I)=FLOAT(IARVHR)
      TIME(4,I)=FLOAT(IARMIN)
      TIME(5,I)=FLOAT(IENDHR)
      TIME(6,I)=FLOAT(IENMIN)
      TIME(7,I)=FLOAT(IBACHR)
      TIME(8,I)=FLOAT(IBAMIN)
      JSEQ=JSEQ+1
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                              C
C                                                                              C
C     THE PROGRAM TAKES ALL TIMES LISTED BY DAY, MONTH, AND MINUTE AND         C
C        PUTS THEM INTO [redacted] MINUTES FOR THE MONTH.  ALL CARD DATA MUST BE FOR     C
C        THE SAME MONTH.                                                       C
C     RECTIM IS THE TIME THE CALL WAS RECIEVED                                 C
C     ARVTIM IS THE TIME THE AMBULANCE ARRIVED AT THE ACCIDENT SCENE           C
C     BACTIM IS  THE TIME THE AMBULANCE WAS BACK IN SERVICE                    C
C                                                                              C
C                                                                              C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      RECTIM(I)=(ADAY(I)-1)*1440.0+TIME(1,I)*60.0+TIME(2,I)
      ARVTIM(I)=(ADAY(I)-1)*1440.0+TIME(3,I)*60.0+TIME(4,I)
      ENDTIM(I)=(ADAY(I)-1)*1440.0+TIME(5,I)*60.0+TIME(6,I)
      BACTIM(I)=(ADAY(I)-1)*1440.0+TIME(7,I)*60.0+TIME(8,I)
12    CONTINUE
92    CONTINUE
      JSEQ=JSEQ-1
C     JSEQ IS EQUAL TO THE NUMBER OF INCIDENTS FOR THE MONTH
      WRITE(NPRNT,50)
50    FORMAT(     '1      CALL      MONTH      DAY      UNIT      CALL REC
     1 AT SCENE      AT HOSP      BACK SER      INCNT CODE'/)
      DO 77 I=1,JSEQ
      WRITE(NPRNT,88)KSEQ(I),KMNTH(I),KDAY(I),KUNIT(I),IREC(I),
     1IAR(I),IEN(I),IBAC(I),KINCNT(I)
88    FORMAT(5X,I3,9X,I2,7X,I2,6X,I3,7X,I5,8X,I5,8X,I5,8X,I5,
     17X,I5,7X,I5,/)
77    CONTINUE
      DO 22 I=1,JSEQ
C     THIS LOOP PUTS ALL ATRIBUTES INTO FILLM
      ATRIB(1)=RECTIM(I)
      ATRIB(2)=1.
      ATRIB(5)=AINCNT(I)
      ATRIB(8)=ASEC(I)
```

```
      IF(AINCNT(I)-1100.0)31,32,999
   31 ATRIB(3)=1.0
      GO TO 33
   32 ATRIB(3)=2.0
   33 IF(I-1)18,18,19
   18 ATRIB(7)=0.0
      GO TO 34
   19 ATRIB(7)=RECTIM(I-1)
   34  CALL FILEM(1,NSET)
      ATRIB(1)=ARVTIM(I)
      ATRIB(2)=2.0
      ATRIB(4)=RECTIM(I)
      ATRIB(5)=AINCNT(I)
      ATRIB(8)=ASEQ(I)
      IF(AINCNT(I)-1100.0)41,42,999
   41 ATRIB(3)=1.0
      GO TO 43
   42 ATRIB(3)=2.0
   43 CALL FILEM(1,NSET)
      ATRIB(1)=ENDTIM(I)
      ATRIB(2)=3.
      ATRIB(4)=RECTIM(I)
      ATRIB(5)=AINCNT(I)
      ATRIB(6)=ARVTIM(I)
      ATRIB(8)=ASEQ(I)
      IF(AINCNT(I)-1100.0)51,52,999
   51 ATRIB(3)=1.
      GO TO 53
   52 ATRIB(3)=2.
   53 CALL FILEM(1,NSET)
      ATRIB(1)=BACTIM(I)
      ATRIB(2)=4.
      ATRIB(4)=RECTIM(I)
      ATRIB(5)=AINCNT(I)
      ATRIB(6)=ARVTIM(I)
      ATRIB(7)=ENDTIM(I)
      ATRIB(8)=ASEQ(I)
```

```
      IF(AINCNT(I)-1100.0)61,62,999
   61 ATRIB(3)=1.
      GO TO 63
   62 ATRIB(3)=2.
   63 CALL FILEM(1,NSET)
   22 CONTINUE
      ATRIB(1)=ENDTIM(JSEQ)+1.
      ATRIB(2)=5.
      CALL FILEM(1,NSET)
      GO TO 70
  999 CONTINUE
   70 RETURN
      END


      SUBROUTINE ENDSM(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NCQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
      MSTOP=-1
      NORPT=0
      RETURN
      END
```

```
      SUBROUTINE OTPUT(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNO(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
      WRITE(NPRNT,71)
      WRITE(NPRNT,72)
      WRITE(NPRNT,73)
      WRITE(NPRNT,74)
      WRITE(NPRNT,75)
      WRITE(NPRNT,76)
      WRITE(NPRNT,77)
      WRITE(NPRNT,78)
      WRITE(NPRNT,79)
   71 FORMAT(1H1,' CODE 1 OF THE GENERATED DATA IS THE STATISTICAL DATA
     1',/,'      ON TIME BETWEEN CALLS '/)
   72 FORMAT( ' CODE 2 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
     1'      ON RESPONSE TIME TO THE CALL '/)
   73 FORMAT( ' CODE 3 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
     1'      ON TIME FOR THE TOTAL TRIP '/)
   74 FORMAT( ' CODE 4 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
     1'      ON TIME FROM THE ACCIDENT SCENE TO THE HOSPITAL '/)
   75 FORMAT( ' CODE 5 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
     1'      ON TIME TAKEN FOR THE ENTIRE CALL '/)
   76 FORMAT( ' CODE 6 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
     1'      ON PERCENT LIVES LOST DUE TO RESPONSE TIME '/)
   77 FORMAT( ' CODE 7 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
```

```
      1'      ON PERCENT LIVES LOST WITH NO MEDICAL TRAINING '/)
   78 FORMAT( ' CODE 8 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
      1'      ON PERCENT LIVES LOST WITH MEDICAL TRAINING '/)
   79 FORMAT( ' CODE 9 OF THE GENERATED DATA IS THE STATISTICAL DATA',/,
      1'      ON DIFFERENCE BETWEEN 7 AND 8 '/)
      RETURN
      END


      SUBROUTINE BACKS(NSET)
      DIMENSION NSET(10,1)
      COMMON ID,IM,INIT,JEVNT,JMNIT,MFA,MSTOP,MX,MXC,NCLCT,NHIST,
     1NOQ,NORPT,NOT,NPRMS,NRUN,NRUNS,NSTAT,OUT,SCALE,ISEED,TNOW,
     2TBEG,TFIN,MXX,NPRNT,NCRDR,NEP,VNQ(20)
      COMMON ATRIB(10),ENQ(20),INN(20),JCELS(5,22),KRANK(20),MAXNQ(20),
     1MFE(20),MLC(20),MLE(20),NCELS(5),NQ(20),PARAM(50,4),QTIME(20),
     2SSUMA(10,5),SUMA(10,5),NAME(6),NPROJ,MON,NDAY,NYR,JCLR
      COMMON ITEM(7),X(7),Y(2,10),TOTTIM,TRPTIM,HOSTIM,
     1BIVSAV,ATNSAV,DIFF,REPTIM,AIVSAV,TIMREC,JSEQ,AMNTH(400),ADAY(400),
     2ASEQ(400),AUNIT(400),AINCNT(400),TIME(8,400)
      COMMON RECTIM(400),ARVTIM(400),ENDTIM(400),BACTIM(400)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                        C
C                                                                        C
C     THIS SUBROUTINE DETERMINES AVERAGE, VARIANCE, MINIMUM, AND MAXIMUM C
C        TIMES FOR TOTAL OUT TIME, THAT IS THE TIME FROM WHEN A CALL IS  C
C        RECIEVED UNTIL THE DISPATCHED VEHICLE IS BACK IN SERVICE.       C
C     TOTTIM IS THIS PERIOD.                                             C
C                                                                        C
C                                                                        C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      TOTTIM=ATRIB(1)-ATRIB(4)
      CALL COLCT(TOTTIM,5,NSET)
      RETURN
      END
```

APPENDIX C

Output from the program of Appendix B, using the data of Appendix D for input.

GASP SUMMARY REPORT

SIMULATION PROJECT NO. 685 BY JOE C JONES

DATE 3/ 5/ 1976 RUN NUMBER 1

GENERATED DATA

CODE	MEAN	STD.DEV.	MIN.	MAX.	OBS.
1	332.7065	371.9666	0.0	1727.0000	133
2	6.2481	8.9022	1.0000	58.0000	133
3	21.3985	13.5903	5.0000	87.0000	133
4	13.1504	7.6063	2.0000	40.0000	133
5	37.5303	58.8427	10.0000	685.0000	132
6	0.7482	0.5114	0.0666	2.4000	47
7	2.0226	1.4227	0.3330	7.6000	47
8	1.3332	1.0877	0.0999	5.5996	47
9	0.6894	0.7028	-0.0000	4.1675	47

CODE 1 OF THE GENERATED DATA IS THE STATISTICAL DATA ON TIME BETWEEN CALLS

CODE 2 OF THE GENERATED DATA IS THE STATISTICAL DATA ON RESPONSE TIME TO THE CALL

CODE 3 OF THE GENERATED DATA IS THE STATISTICAL DATA ON TIME FOR THE TOTAL TRIP

CODE 4 OF THE GENERATED DATA IS THE STATISTICAL DATA ON TIME FROM THE ACCIDENT SCENE TO THE HOSPITAL

CODE 5 OF THE GENERATED DATA IS THE STATISTICAL DATA ON TIME TAKEN FOR THE ENTIRE CALL

CODE 6 OF THE GENERATED DATA IS THE STATISTICAL DATA ON PERCENT LIVES LOST DUE TO RESPONSE TIME

CODE 7 OF THE GENERATED DATA IS THE STATISTICAL DATA ON PERCENT LIVES LOST WITH NO MEDICAL TRAINING

CODE 8 OF THE GENERATED DATA IS THE STATISTICAL DATA ON PERCENT LIVES LOST WITH MEDICAL TRAINING

CODE 9 OF THE GENERATED DATA IS THE STATISTICAL DATA ON DIFFERENCE BETWEEN 7 AND 8

```
SEQ NO    1. INCIDENT CODE 1033.
RESPONSE TIME    8.0000
PERCENT LIVES LOST 0.800000

SEQ NO    1. INCIDENT CODE 1033.
TOTAL TRIP TIME  16.0000
HOSPITAL TRIP TIME    8.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP    1.6000
PERCENT LIVES LOST WITH MEDICAL HELP  1.6000
DIFFERENCE BETWEEN THE TWO    0.0

SEQ NO    2. INCIDENT CODE 1033.
RESPONSE TIME    4.0000
PERCENT LIVES LOST 0.266800

SEQ NO    2. INCIDENT CODE 1033.
TOTAL TRIP TIME  10.0000
HOSPITAL TRIP TIME    6.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP    1.6670
PERCENT LIVES LOST WITH MEDICAL HELP  1.4666
DIFFERENCE BETWEEN THE TWO    0.2004

SEQ NO    3. INCIDENT CODE 1033.
RESPONSE TIME    7.0000
PERCENT LIVES LOST 1.166900

SEQ NO    3. INCIDENT CODE 1033.
TOTAL TRIP TIME  19.0000
HOSPITAL TRIP TIME  12.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP    2.5327
PERCENT LIVES LOST WITH MEDICAL HELP  1.3327
DIFFERENCE BETWEEN THE TWO    1.2000

SEQ NO    5. INCIDENT CODE 1033.
RESPONSE TIME    5.0000
PERCENT LIVES LOST 1.000000

SEQ NO    5. INCIDENT CODE 1033.
TOTAL TRIP TIME    9.0000
HOSPITAL TRIP TIME    4.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP    0.9000
PERCENT LIVES LOST WITH MEDICAL HELP  0.9000
DIFFERENCE BETWEEN THE TWO    0.0

SEQ NO    6. INCIDENT CODE 1033.
RESPONSE TIME    4.0000
PERCENT LIVES LOST 0.800000

SEQ NO    6. INCIDENT CODE 1033.
TOTAL TRIP TIME  14.0000
HOSPITAL TRIP TIME  10.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP    2.8000
PERCENT LIVES LOST WITH MEDICAL HELP  1.1330
DIFFERENCE BETWEEN THE TWO    1.6670
```

SEQ NO 9. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.099900

SEQ NO 9. INCIDENT CODE 1033.
TOTAL TRIP TIME 8.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.3336
PERCENT LIVES LOST WITH MEDICAL HELP 1.1666
DIFFERENCE BETWEEN THE TWO 0.1671

SEQ NO 12. INCIDENT CODE 1050.
RESPONSE TIME 13.0000
PERCENT LIVES LOST 1.299999

SEQ NO 12. INCIDENT CODE 1050.
TOTAL TRIP TIME 38.0000
HOSPITAL TRIP TIME 25.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 7.6000
PERCENT LIVES LOST WITH MEDICAL HELP 3.4325
DIFFERENCE BETWEEN THE TWO 4.1675

SEQ NO 14. INCIDENT CODE 1033.
RESPONSE TIME 1.0000
PERCENT LIVES LOST 0.166700

SEQ NO 14. INCIDENT CODE 1033.
TOTAL TRIP TIME 6.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 0.6000
PERCENT LIVES LOST WITH MEDICAL HELP 0.6000
DIFFERENCE BETWEEN THE TWO -0.0000

SEQ NO 24. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.666500

SEQ NO 24. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 0.3330
PERCENT LIVES LOST WITH MEDICAL HELP 0.1665
DIFFERENCE BETWEEN THE TWO 0.1665

SEQ NO 31. INCIDENT C[illegible] 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 1.000000

SEQ NO 31. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.6670
PERCENT LIVES LOST WITH MEDICAL HELP 0.8335
DIFFERENCE BETWEEN THE TWO 0.8335

SEQ NO 35. INCIDENT CODE 1033.
RESPONSE TIME 4.0000
PERCENT LIVES LOST 0.533200

SEQ NO 35. INCIDENT CODE 1033.
TOTAL TRIP TIME 6.0000
HOSPITAL TRIP TIME 2.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 0.7998
PERCENT LIVES LOST WITH MEDICAL HELP 0.7332
DIFFERENCE BETWEEN THE TWO 0.0666

SEQ NO 36. INCIDENT CODE 1033.
RESPONSE TIME 2.0000
PERCENT LIVES LOST 0.266600

SEQ NO 36. INCIDENT CODE 1033.
TOTAL TRIP TIME 8.0000
HOSPITAL TRIP TIME 6.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.0664
PERCENT LIVES LOST WITH MEDICAL HELP 0.8666
DIFFERENCE BETWEEN THE TWO 0.1998

SEQ NO 38. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.833500

SEQ NO 38. INCIDENT CODE 1033.
TOTAL TRIP TIME 17.0000
HOSPITAL TRIP TIME 12.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.1339
PERCENT LIVES LOST WITH MEDICAL HELP 0.3335
DIFFERENCE BETWEEN THE TWO 0.8004

SEQ NO 43. INCIDENT CODE 1050.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.666500

SEQ NO 43. INCIDENT CODE 1050.
TOTAL TRIP TIME 15.0000
HOSPITAL TRIP TIME 10.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.9995
PERCENT LIVES LOST WITH MEDICAL HELP 1.6665
DIFFERENCE BETWEEN THE TWO 0.3330

SEQ NO 44. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.666500

SEQ NO 44. INCIDENT CODE 1033.
TOTAL TRIP TIME 15.0000
HOSPITAL TRIP TIME 10.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.9995
PERCENT LIVES LOST WITH MEDICAL HELP 0.9995
DIFFERENCE BETWEEN THE TWO 1.0000

SEQ NO 55. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.600000

SEQ NO 55. INCIDENT CODE 1033.
TOTAL TRIP TIME 9.0000
HOSPITAL TRIP TIME 6.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.5003
PERCENT LIVES LOST WITH MEDICAL HELP 1.2999
DIFFERENCE BETWEEN THE TWO 0.2004

SEQ NO 61. INCIDENT CODE 1033.
RESPONSE TIME 4.0000
PERCENT LIVES LOST 0.400000

SEQ NO 61. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 9.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.7329
PERCENT LIVES LOST WITH MEDICAL HELP 0.8329
DIFFERENCE BETWEEN THE TWO 0.9000

SEQ NO 63. INCIDENT CODE 1094.
RESPONSE TIME 4.0000
PERCENT LIVES LOST 0.800000

SEQ NO 63. INCIDENT CODE 1094.
TOTAL TRIP TIME 12.0000
HOSPITAL TRIP TIME 8.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.4000
PERCENT LIVES LOST WITH MEDICAL HELP 1.0664
DIFFERENCE BETWEEN THE TWO 1.3336

SEQ NO 67. INCIDENT CODE 1050.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.399900

SEQ NO 67. INCIDENT CODE 1050.
TOTAL TRIP TIME 8.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.0664
PERCENT LIVES LOST WITH MEDICAL HELP 0.8999
DIFFERENCE BETWEEN THE TWO 0.1665

SEQ NO 70. INCIDENT CODE 1097.
RESPONSE TIME 9.0000
PERCENT LIVES LOST 1.500299

SEQ NO 70. INCIDENT CODE 1097.
TOTAL TRIP TIME 29.0000
HOSPITAL TRIP TIME 20.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 4.8343
PERCENT LIVES LOST WITH MEDICAL HELP 4.1663
DIFFERENCE BETWEEN THE TWO 0.6680

SEQ NO 72. INCIDENT CODE 1033.
RESPONSE TIME 6.0000
PERCENT LIVES LOST 0.799800

SEQ NO 72. INCIDENT CODE 1033.
TOTAL TRIP TIME 36.0000
HOSPITAL TRIP TIME 30.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.1988
PERCENT LIVES LOST WITH MEDICAL HELP 0.1998
DIFFERENCE BETWEEN THE TWO 0.9990

SEQ NO 77. INCIDENT CODE 1050.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.500100

SEQ NO 77. INCIDENT CODE 1050.
TOTAL TRIP TIME 12.0000
HOSPITAL TRIP TIME 9.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.0004
PERCENT LIVES LOST WITH MEDICAL HELP 0.5001
DIFFERENCE BETWEEN THE TWO 1.5003

SEQ NO 78. INCIDENT CODE 1033.
RESPONSE TIME 7.0000
PERCENT LIVES LOST 1.166900

SEQ NO 78. INCIDENT CODE 1033.
TOTAL TRIP TIME 28.0000
HOSPITAL TRIP TIME 21.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 3.7324
PERCENT LIVES LOST WITH MEDICAL HELP 3.0331
DIFFERENCE BETWEEN THE TWO 0.6993

SEQ NO 82. INCIDENT CODE 1097.
RESPONSE TIME 7.0000
PERCENT LIVES LOST 0.700000

SEQ NO 82. INCIDENT CODE 1097.
TOTAL TRIP TIME 25.0000
HOSPITAL TRIP TIME 18.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.5000
PERCENT LIVES LOST WITH MEDICAL HELP 2.5000
DIFFERENCE BETWEEN THE TWO 0.0

SEQ NO 90. INCIDENT CODE 1033.
RESPONSE TIME 2.0000
PERCENT LIVES LOST 0.066600

SEQ NO 90. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 8.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.3330
PERCENT LIVES LOST WITH MEDICAL HELP 1.0666
DIFFERENCE BETWEEN THE TWO 0.2664

SEQ NO 94. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.166500

SEQ NO 94. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 8.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.6000
PERCENT LIVES LOST WITH MEDICAL HELP 1.2664
DIFFERENCE BETWEEN THE TWO 1.3336

SEQ NO 99. INCIDENT CODE 1033.
RESPONSE TIME 8.0000
PERCENT LIVES LOST 1.599999

SEQ NO 99. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.1671
PERCENT LIVES LOST WITH MEDICAL HELP 1.3336
DIFFERENCE BETWEEN THE TWO 0.8335

SEQ NO 103. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.099900

SEQ NO 103. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 7.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 0.3330
PERCENT LIVES LOST WITH MEDICAL HELP 0.0999
DIFFERENCE BETWEEN THE TWO 0.2331

SEQ NO 112. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.600000

SEQ NO 112. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 7.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.0000
PERCENT LIVES LOST WITH MEDICAL HELP 0.8331
DIFFERENCE BETWEEN THE TWO 1.1669

SEQ NO 113. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.833500

SEQ NO 113. INCIDENT CODE 1033.
TOTAL TRIP TIME 21.0000
HOSPITAL TRIP TIME 16.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 3.5007
PERCENT LIVES LOST WITH MEDICAL HELP 2.9663
DIFFERENCE BETWEEN THE TWO 0.5344

```
SEQ NO 119. INCIDENT CODE 1097.
RESPONSE TIME   5.0000
PERCENT LIVES LOST 0.333500

SEQ NO 119. INCIDENT CODE 1097.
TOTAL TRIP TIME  20.0000
HOSPITAL TRIP TIME  15.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP   2.6660
PERCENT LIVES LOST WITH MEDICAL HELP  2.1665
DIFFERENCE BETWEEN THE TWO   0.4995

SEQ NO 125. INCIDENT CODE 1033.
RESPONSE TIME   9.0000
PERCENT LIVES LOST 1.199699

SEQ NO 125. INCIDENT CODE 1033.
TOTAL TRIP TIME  14.0000
HOSPITAL TRIP TIME   5.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP   1.8662
PERCENT LIVES LOST WITH MEDICAL HELP  1.6997
DIFFERENCE BETWEEN THE TWO   0.1665

SEQ NO 130. INCIDENT CODE 1033.
RESPONSE TIME   5.0000
PERCENT LIVES LOST 0.833500

SEQ NO 131. INCIDENT CODE 1033.
RESPONSE TIME   2.0000
PERCENT LIVES LOST 0.266600

SEQ NO 131. INCIDENT CODE 1033.
TOTAL TRIP TIME  13.0000
HOSPITAL TRIP TIME  11.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP   0.8671
PERCENT LIVES LOST WITH MEDICAL HELP  0.1334
DIFFERENCE BETWEEN THE TWO   0.7337

SEQ NO 130. INCIDENT CODE 1033.
TOTAL TRIP TIME  19.0000
HOSPITAL TRIP TIME  14.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP   1.2673
PERCENT LIVES LOST WITH MEDICAL HELP  0.3335
DIFFERENCE BETWEEN THE TWO   0.9338

SEQ NO 134. INCIDENT CODE 1033.
RESPONSE TIME   3.0000
PERCENT LIVES LOST 0.500100

SEQ NO 134. INCIDENT CODE 1033.
TOTAL TRIP TIME  12.0000
HOSPITAL TRIP TIME   9.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP   1.2000
PERCENT LIVES LOST WITH MEDICAL HELP  1.2000
DIFFERENCE BETWEEN THE TWO   0.0000
```

SEQ NO 135. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.666500

SEQ NO 135. INCIDENT CODE 1033.
TOTAL TRIP TIME 17.0000
HOSPITAL TRIP TIME 12.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.2661
PERCENT LIVES LOST WITH MEDICAL HELP 1.8665
DIFFERENCE BETWEEN THE TWO 0.3996

SEQ NO 146. INCIDENT CODE 1033.
RESPONSE TIME 9.0000
PERCENT LIVES LOST 1.799999

SEQ NO 146. INCIDENT CODE 1033.
TOTAL TRIP TIME 20.0000
HOSPITAL TRIP TIME 11.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.6660
PERCENT LIVES LOST WITH MEDICAL HELP 2.2997
DIFFERENCE BETWEEN THE TWO 0.3663

SEQ NO 148. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.399900

SEQ NO 148. INCIDENT CODE 1033.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 7.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.3330
PERCENT LIVES LOST WITH MEDICAL HELP 1.0999
DIFFERENCE BETWEEN THE TWO 0.2331

SEQ NO 160. INCIDENT CODE 1033.
RESPONSE TIME 2.0000
PERCENT LIVES LOST 0.066600

SEQ NO 160. INCIDENT CODE 1033.
TOTAL TRIP TIME 8.0000
HOSPITAL TRIP TIME 6.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 0.5336
PERCENT LIVES LOST WITH MEDICAL HELP 0.1334
DIFFERENCE BETWEEN THE TWO 0.4002

SEQ NO 163. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.600000

SEQ NO 163. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 10.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.7329
PERCENT LIVES LOST WITH MEDICAL HELP 1.3999
DIFFERENCE BETWEEN THE TWO 0.3330

SEQ NO 165. INCIDENT CODE 1094.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.600000

SEQ NO 165. INCIDENT CODE 1094.
TOTAL TRIP TIME 10.0000
HOSPITAL TRIP TIME 7.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.0000
PERCENT LIVES LOST WITH MEDICAL HELP 0.8331
DIFFERENCE BETWEEN THE TWO 1.1669

SEQ NO 169. INCIDENT CODE 1033.
RESPONSE TIME 3.0000
PERCENT LIVES LOST 0.399900

SEQ NO 169. INCIDENT CODE 1033.
TOTAL TRIP TIME 9.0000
HOSPITAL TRIP TIME 6.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.8000
PERCENT LIVES LOST WITH MEDICAL HELP 0.7998
DIFFERENCE BETWEEN THE TWO 1.0002

SEQ NO 170. INCIDENT CODE 1097.
RESPONSE TIME 12.0000
PERCENT LIVES LOST 2.400000

SEQ NO 170. INCIDENT CODE 1097.
TOTAL TRIP TIME 52.0000
HOSPITAL TRIP TIME 40.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 6.9316
PERCENT LIVES LOST WITH MEDICAL HELP 5.5996
DIFFERENCE BETWEEN THE TWO 1.3320

SEQ NO 187. INCIDENT CODE 1033.
RESPONSE TIME 9.0000
PERCENT LIVES LOST 0.600300

SEQ NO 187. INCIDENT CODE 1033.
TOTAL TRIP TIME 23.0000
HOSPITAL TRIP TIME 14.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.5341
PERCENT LIVES LOST WITH MEDICAL HELP 0.6003
DIFFERENCE BETWEEN THE TWO 0.9338

SEQ NO 188. INCIDENT CODE 1033.
RESPONSE TIME 9.0000
PERCENT LIVES LOST 1.199699

SEQ NO 189. INCIDENT CODE 1033.
RESPONSE TIME 10.0000
PERCENT LIVES LOST 1.999999

SEQ NO 189. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 3.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.7329
PERCENT LIVES LOST WITH MEDICAL HELP 1.6330
DIFFERENCE BETWEEN THE TWO 0.0999

SEQ NO 188. INCIDENT CODE 1033.
TOTAL TRIP TIME 34.0000
HOSPITAL TRIP TIME 25.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 1.1322
PERCENT LIVES LOST WITH MEDICAL HELP 0.2997
DIFFERENCE BETWEEN THE TWO 0.8325

SEQ NO 186. INCIDENT CODE 1033.
RESPONSE TIME 5.0000
PERCENT LIVES LOST 0.833500

SEQ NO 185. INCIDENT CODE 1033.
TOTAL TRIP TIME 13.0000
HOSPITAL TRIP TIME 8.0000
PERCENT LIVES LOST WITH NO MEDICAL HELP 2.6000
PERCENT LIVES LOST WITH MEDICAL HELP 1.2664
DIFFERENCE BETWEEN THE TWO 1.3336

APPENDIX D

Input data for GASP simulation Program of Appendix A.

```
CODE 1 = 1033
CODE 2 = 1050
CODE 3 = 1091
CODE 4 = 1094
CODE 5 = 1095
CODE 6 = 1097
CODE 7 = 1098
Y(1 , 1 ) =   0.001000
Y(1 , 2 ) =   0.000667
Y(1 , 3 ) =   0.001333
Y(1 , 4 ) =   0.002000
Y(1 , 5 ) =   0.001667
Y(1 , 6 ) =   0.000333
Y(1 , 7 ) =   0.001667
Y(1 , 8 ) =   0.001333
Y(1 , 9 ) =   0.001333
Y(1 ,10 ) =   0.002000
Y(2 , 1 ) =   0.001000
Y(2 , 2 ) =   0.0
Y(2 , 3 ) =   0.001000
Y(2 , 4 ) =   0.000333
Y(2 , 5 ) =   0.0
Y(2 , 6 ) =   0.0
Y(2 , 7 ) =   0.001333
Y(2 , 8 ) =   0.000333
Y(2 , 9 ) =   0.001000
Y(2 ,10 ) =   0.000333
```

CALL	MONTH	DAY	UNIT	CALL REC	AT SCENE	AT HOSP	BACK SER	INCNT CODE
1	1	1	1	707	715	723	730	1033
2	1	1	1	1425	1429	1435	1452	1033
3	1	1	2	1441	1448	1500	1505	1033
4	1	1	2	1450	1510	1530	1544	1100
5	1	1	1	1805	1810	1814	1825	1033
6	1	1	1	1928	1932	1942	1950	1033
9	1	2	1	946	949	954	1000	1033
12	1	2	1	1205	1218	1243	1253	1050
13	1	2	1	1458	1500	1503	1510	1100
14	1	2	1	1557	1558	1603	1610	1033
17	1	3	2	902	914	926	936	1100
18	1	3	2	935	1009	1024	2100	1100
19	1	3	1	1325	1330	1350	1400	1100
20	1	3	1	1615	1617	1623	1640	1090
21	1	4	1	2	8	16	43	1070
22	1	4	2	950	1001	1015	1022	1100
23	1	4	1	1207	1211	1219	1224	1075
24	1	4	1	2105	2110	2115	2120	1033
26	1	5	1	419	423	431	436	1100
27	1	5	2	1016	1021	1050	1111	1100
28	1	5	2	1102	1106	1129	1137	1100
29	1	5	1	1600	1603	1607	1610	1078
31	1	5	1	2140	2145	2150	2210	1033
32	1	5	2	2140	2144	2148	2155	1019
35	1	6	1	426	430	432	440	1033
36	1	6	1	1122	1124	1130	1139	1033
37	1	6	2	1500	1510	1520	1535	1100
38	1	6	1	2257	2302	2314	2325	1033
39	1	7	2	822	831	842	850	1100
40	1	7	2	1013	1014	1020	1034	1100
41	1	7	2	1156	1200	1216	1224	1100
43	1	7	1	1610	1615	1625	1635	1050
44	1	7	1	1855	1900	1910	1915	1033
47	1	8	3	1430	1500	1525	1540	1100

50	1	9	2	949	957	1011	1017	1100
51	1	9	2	1028	1031	1054	1100	1100
52	1	9	1	1029	1031	1053	1102	1100
50	1	9	2	1106	1113	1124	1133	1100
53	1	9	1	1106	1125	1150	1211	1100
54	1	9	2	1208	1215	1235	1241	1100
55	1	9	1	1352	1355	1401	1416	1033
56	1	9	2	1405	1413	1438	1448	1100
57	1	9	2	1609	1623	1641	1702	1100
61	1	10	1	1315	1319	1328	1335	1033
63	1	10	1	1542	1546	1554	1602	1094
65	1	10	2	1751	1805	1827	1841	1100
66	1	11	2	1036	1047	1109	1123	1100
67	1	11	1	1254	1257	1302	1311	1050
68	1	11	2	2300	2305	2310	2320	1092
70	1	12	2	1134	1143	1203	1210	1097
71	1	12	2	1910	1916	1923	1929	1100
72	1	12	1	1923	1929	1959	2001	1033
73	1	12	2	1957	1959	2008	2014	1081
74	1	12	1	2008	2013	2023	2037	1090
76	1	13	2	325	335	350	400	1100
77	1	13	1	437	440	449	510	1050
76	1	13	2	445	450	500	510	1100
78	1	14	1	932	939	1000	1015	1033
81	1	14	2	1414	1419	1434	1441	1100
82	1	14	1	1554	1601	1619	1629	1097
83	1	14	2	1619	1626	1637	1648	1100
84	1	14	1	2310	2325	2340	2400	1090
85	1	15	2	1005	1009	1029	1045	1100
86	1	15	2	1113	1128	1138	1158	1100
89	1	15	1	1403	1411	1425	1433	1100
90	1	15	1	1455	1457	1505	1511	1033
91	1	15	1	1617	1627	1642	1648	1100
92	1	15	1	1638	1659	1726	1734	1100
91	1	15	1	2020	2024	2037	2044	1100
94	1	16	1	100	105	113	120	1033
96	1	16	2	1450	1507	1512	1530	1100

99	1	17	1	630	638	643	700	1033	
101	1	17	3	1051	1118	1146	1203	1100	
102	1	17	3	1116	1211	1225	1254	1100	
104	1	17	3	1248	1346	1415	1423	1100	
103	1	17	2	1330	1333	1340	1349	1033	
106	1	17	3	1423	1429	1434	1532	0	
111	1	17	1	2322	2327	2348	2409	1100	
112	1	18	1	127	130	137	143	1033	
113	1	18	1	857	902	918	930	1033	
114	1	18	2	1000	1014	1032	1040	1100	
116	1	18	2	1544	1608	1614	1637	1100	
118	1	18	1	2138	2143	2151	2159	1081	
119	1	19	1	1055	1100	1115	1125	1097	
120	1	19	2	1130	1135	1200	1210	1100	
123	1	20	2	615	625	635	640	1100	
124	1	20	1	1115	1120	1140	1150	1082	
125	1	20	1	1901	1910	1915	1925	1033	
126	1	20	1	2251	2257	2309	2320	1088	
127	1	20	1	2333	2338	2346	2354	1090	
128	1	21	2	1205	1215	1225	1235	1100	
129	1	21	1	1215	1217	1225	1250	1090	
130	1	21	1	1422	1427	1441	1457	1033	
131	1	21	2	1427	1429	1440	1445	1033	
133	1	21	1	2140	2146	2201	2212	1090	
134	1	22	1	901	904	913	925	1033	
135	1	22	1	1015	1020	1032	1056	1033	
136	1	22	2	1051	1054	1111	1119	1100	
137	1	22	2	1120	1127	1147	1155	1100	
138	1	22	2	1234	1235	1242	1248	1100	
140	1	23	2	1150	1200	1210	1220	1100	
141	1	23	2	1240	1250	1255	1305	1100	
142	1	23	1	1255	1345	1412	1415	1100	
145	1	23	1	1723	1726	1729	1735	1082	
146	1	24	1	212	221	232	244	1033	
147	1	24	1	725	730	740	750	1090	
148	1	24	1	810	813	820	825	1033	
149	1	24	2	1030	1035	1100	1110	1100	
153	1	24	1	1638	1647	1700	1712	1100	

156	1	25	1	132	141	152	159	1100
157	1	25	1	210	216	222	245	1100
160	1	25	1	2120	2122	2128	2140	1033
161	1	26	2	857	903	917	926	1100
162	1	26	2	928	934	950	957	1100
163	1	26	1	1018	1021	1031	1050	1033
165	1	26	1	2025	2028	2035	2057	1094
167	1	26	2	2310	2322	2327	2340	1100
169	1	27	1	1115	1118	1124	1133	1033
170	1	27	1	1317	1329	1409	1426	1097
171	1	27	2	1842	1849	1857	1916	1084
173	1	28	1	1040	1046	1056	1102	1100
176	1	29	2	1014	1019	1050	1059	1100
177	1	29	1	1021	1026	1055	1110	1100
178	1	29	2	1115	1121	1140	1150	1100
182	1	30	2	930	940	952	959	1100
183	1	30	1	1251	1256	1311	1325	1090
184	1	30	2	1301	1305	1331	1340	1100
185	1	30	2	1420	1430	1445	1500	1100
187	1	31	1	738	747	801	809	1033
188	1	31	1	1143	1152	1217	1222	1033
189	1	31	2	1155	1205	1208	1218	1033
186	1	31	1	1238	1243	1251	1300	1033
190	1	31	1	1730	1737	1745	1755	1083

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