



**Naval Postgraduate School
Operations Analysis Curriculum (360)**

2002

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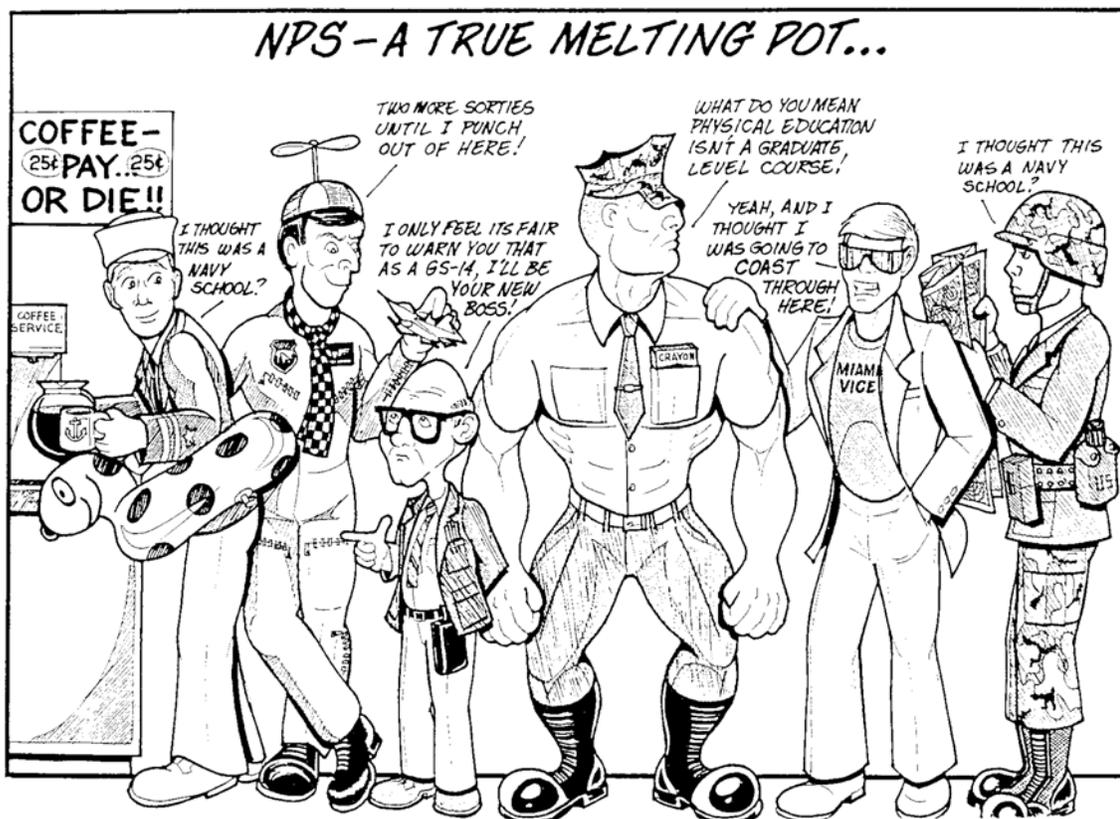
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Introduction

Welcome to the Naval Postgraduate School and the Operations Analysis (OA) Curriculum, a seven or eight quarter curriculum leading to the degree Master of Science in Operations Research (MS/OR). The Navy established the curriculum in 1951 when it recognized that the OR techniques pioneered in WWII were worth preserving, and has maintained it ever since. By now, as the cartoon¹ shows, all services and even an occasional DoD civilian can be found in attendance. Foreign officers are also admitted. NPS distinguishes between the OA curriculum, a course of study, and the OR department, a collection of faculty. The rest of the world may not distinguish between OA and OR, and may use terms such as Management Science or Systems Analysis to refer to essentially the same thing. Whatever the name, the subject is scientific decision making as applied to tactics, strategy, logistics, force planning, etc.

The Navy sponsor for the OA curriculum is the Director of the Assessment Division (N81). Navy graduates may spend a tour there, or in one of many other billets that require the xx42 P-code. Other services have similar coding systems. We think that the techniques and attitudes that you will learn here will prove to be of practical and intellectual value to you throughout your career and life, whether you are serving in a coded billet or not.



On account of the wide spectrum of interests found in the student body, the OA curriculum has developed several *options* that will be described later. All lead to the same degree and the same P-code.

¹ This cartoon, as well as the Ratman cartoons in the sequel, was drawn by Gus Stafford, an OA alumnus who graduated in 1990

You should select an option by the end of your third quarter. You will also need to select a few electives and possibly an experience tour site. These choices should be made under the guidance of the OA program officer, the option advisor, and the OA academic associate. The academic associate and the program officer function as a team that is responsible for the general welfare of the OA curriculum, taking into account guidance from the sponsor and feedback from you. Take advantage of the presence of these advisors, particularly (once you have selected an option) the option advisor.

Most of the classes that you attend will have identifying numbers that begin with the two letters OA, which means that the course is the responsibility of the OR department. Most of the students that you meet in these courses will be in the OA curriculum, the principal exception being students from the Operational Logistics (OL) curriculum and the MOVES curriculum. The OL and OA curricula both lead to the MS/OR degree, but the sponsor and P-code for OL are different. The MOVES curriculum leads to a different degree.

Graduation Requirements

NPS has the usual A, B, C, grading system, with an A being 4 points, an A-minus 3.7 points, a B-plus 3.3 points, a B 3 points, a B-minus 2.7 points and so forth. Throughout your tenure at NPS, the registrar will compute and report to your advisors various statistics concerning your performance to date. The most important of these is the Graduate Quality Point Rating (GQPR), the average grade obtained in all “graduate” courses (courses whose identifier numbers start with either 3 or 4 and which are not pass/fail). Your GQPR must exceed 3.0 (a B average) if you are to be awarded any MS degree at NPS. There are other grade point requirements, but it is hard to flunk them while passing the GQPR test. In general, OR students tend to earn higher grades in graduate level courses, so it is natural for GQPR to gradually increase as you proceed through the curriculum. A GQPR of 2.95 after three quarters is therefore cause for concern rather than despair. Even so, any GQPR less than 3.0 is worth some introspection and consultation. A small fraction of students who complete the OA curriculum are not awarded the MS/OR degree. Among those who are not, the most common reason is $GQPR < 3.0$. The next most common reason is failure to finish a thesis.

There are also some requirements concerning the courses taken. You are unlikely to get in trouble on this score, but still it is worth recording the two most important requirements: NPS requires at least 32-quarter hours of graduate (3000 or 4000 level) courses, plus a thesis, and the OR department requires at least 20-quarter hours of 4000 level courses, of which 16 quarter hours must be OA. The quarter hours for each course are stated in the catalog and in the option matrices at the end of this introduction. A 3-1 course counts for 3.5 quarter hours because the second “lab” component is given only half the weight of the first “lecture” component. A complete list of all graduation requirements, including those mentioned above, can be found in the Academic Council Policy Manual, available from the NPS home page at <http://www.nps.navy.mil/>. The OR department’s home page is also worth investigating, since it includes information about the research and teaching interests of the faculty, as well as this document.

OA Options

Each option is shown at the end of this introduction as a matrix with the cell entries being course identifiers. Each row shows the four courses or equivalent usually taken in that quarter. The fifth quarter is set off because it includes the experience tour, the first block of time that is set aside for working on your thesis. Many students leave NPS to work directly with a sponsor during this period. The two courses at the beginning of the fifth quarter are accelerated; that is, they meet twice as often for only six weeks.

Core Courses

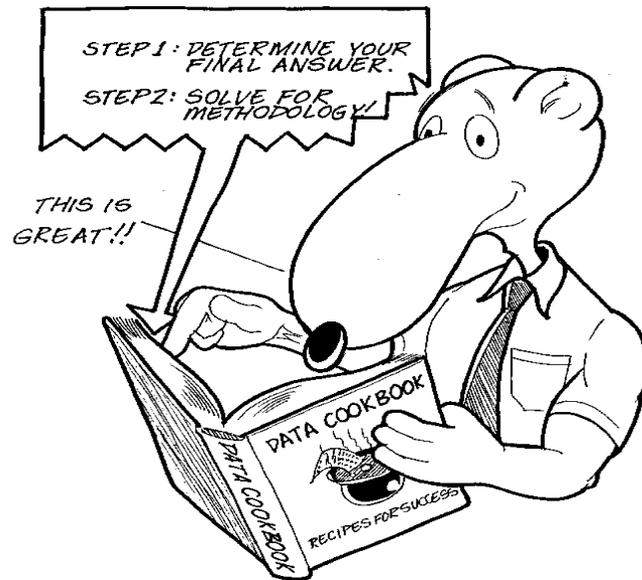
Options differ very little from each other before the experience tour, so it is reasonable to refer to those courses as a common “core”. OR is a quantitative discipline, and the core is designed to introduce the required ideas, tools, and software. The OA3101, 2, 3 sequence is devoted to probability and statistics. The OA3201, OA4201, OA4202 sequence introduces optimization, beginning with linear programming in OA3201 and progressing to various generalizations and special cases in the other two. Stochs I (OA3301) deals with random phenomena that fluctuate with time. The OA3302, OA4604, OA4655 sequence introduces a variety of techniques useful for modeling and simulating combat. By the time you begin work on your thesis, you should have a solid technical background that is tailored and rounded out in the last two or three quarters.

Electives

Electives are usually OA-xxxx courses, but you may also consider courses taught by other departments. The Stochs II elective (OA4301) has a project, as you can probably gather from Stafford’s cartoon on the next page. The objective should be to round out your education, to go more deeply into some subject that interests you, or to learn something that supports your thesis.

There are a few constraints on elective choices. They must be approved by your advisors, for one thing, and even with everyone’s approval, you can’t take a course if it isn’t offered. Course scheduling in the OR department is done by the Associate Chairman for Instruction (ACI), who has a budgetary limit that essentially determines the number of sections that can be offered in a given year. In early September the ACI receives a demand forecast for the next fiscal year and makes a tentative teaching plan. NPS collects this information and in November releases the “tentative course schedule” for the rest of the academic year. It usually doesn’t change much from year to year. This schedule is worth looking at if you are wondering what electives to take, but remember that it is only tentative. Courses are taught in accordance with what demand actually turns out to be. Actual demand can differ a lot from the forecast, particularly late in the fiscal year. What this means to you is that you can influence the electives that are actually taught by mentioning your desires to the ACI, signing up for electives as early as possible, and by convincing your classmates to do likewise. Roughly speaking, electives get taught in the same order as they get voted for, provided the votes come in early enough to permit faculty to plan their workload.

WHILE RESEARCHING FOR HIS GROUP'S STOCH'S PROJECT, RATMAN HAPPENS UPON A USEFUL REFERENCE



The OR Department

Most of the courses that you take are taught by one of the approximately 30 faculty in the OR department. These same faculty are also likely to be involved as either advisors or second readers when you write your thesis. Most faculty are civilians with PhD's in a variety of areas, but there are also several military instructors. The easiest way to find out about the faculty is by browsing the department's home page, where you will find information about background, interests, publications, and thesis advising. If you find someone whose interests appear to overlap with your own, stop by and introduce yourself.

In case you are curious, life for a civilian faculty member usually consists of alternating quarters of research and teaching, with thesis advising and other academic duties going on continuously. Research is funded by the conventional academic mechanism of writing research proposals. The NPS contract is for 10 months, but most faculty extend it to 12 months with funded research. Much of this research is funded by the armed services -- this is the so-called "reimbursable" research that in most years makes the NPS budget feasible. All of this requires a certain amount of planning ahead, which partly explains why we are not as flexible with regard to offering electives as we would like to be.

Professional Societies

The Institute of Management Science and the Operations Research Society of America were combined in 1995 to form INFORMS (neat, huh? they got OR and MS and everything right in there), the main US society for our profession. INFORMS (www.informs.org) publishes several journals, the most readable of which is *Interfaces*. You might wish to browse through a copy, and more specifically you might wish to browse through Vol. 26 number 5, which includes an article on the OA curriculum! INFORMS also publishes a magazine, *OR/MS Today*, that is available, along with several other benefits, by joining the society as a student for a nominal annual fee. Application forms are available from the academic associate. INFORMS has a Military Applications Society (MAS) that you can select upon joining. For more information about INFORMS, see the web site at <http://www.informs.org/>.

INFORMS and its captive society, MAS, are an entirely unclassified forum, which distinguishes them from the Military Operations Research Society (MORS). MORS (www.mors.org) meetings have classified sessions, and are usually held at military bases, occasionally NPS. MORS and MAS together publish the unclassified *PHALANX* newsletter, which comes free if you join INFORMS/MAS (it also comes free even if you don't, since the program office gets a supply to give away).

The original OR journal was *Operations Research*, which is still published by INFORMS. Other relevant journals are *Management Science*, *Naval Research Logistics* (Professor Rosenthal is the editor), *European Journal of Operations Research*, and the journals produced by the OR societies in several other countries. The NPS library subscribes to all of those named plus several others.

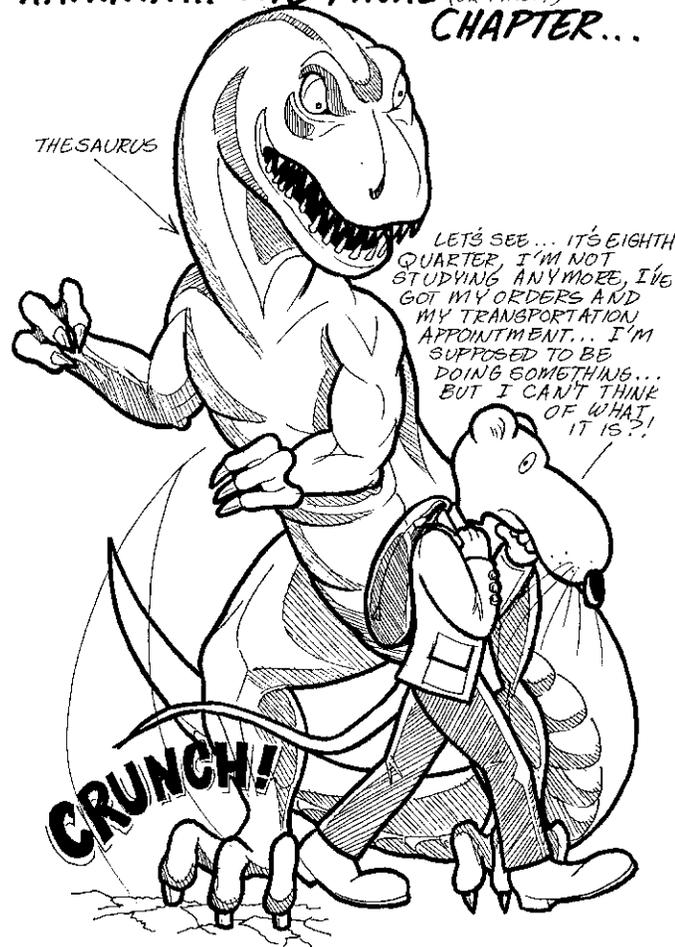
Thesis

All OA options include some thesis "slots" in quarters 5, 6, 7, and 8. Most students say that the completion of a thesis requires more time than those slots would seem to imply. In fact, many schools have stopped requiring a thesis for the MS/OR degree due to the large time commitment on the part of both students and faculty. However, a thesis is still very much a requirement at NPS. *After* your thesis is complete, you will probably join most other alumni and faculty in defending it as having been worth the time and effort.

Begin planning your thesis right after you finish reading this, and expect to have at least a rough idea of what your topic is going to be by the end of the fourth quarter. The OR department publishes a separate document *Guidelines for Students Writing Theses in Operations Research* that is available in the program office and worth consulting. A Preliminary Report of Thesis is due by the end of the fifth quarter. To avoid a visit by Ratman's "Thesaurus" monster, it is best to begin planning early.

The best source of thesis topics is your own experience. One of the beauties of OR is that our quantitative approach to decision making is applicable to such a wide variety of circumstances that there is likely to be something in your background that hasn't been analyzed quantitatively, but could be. Theses have been made out of the observations that a submarine has to decide what heading will minimize the chance of collision when coming to periscope depth, or that an LCAC must decide how much equipment to load from which mother ship in supporting an invasion, or that a particular change in personnel policy may or may not have resulted in jobs being performed better in a particular set of billets. All of these topics were chosen based on prior experience of the authors. In fact, one of the reasons why NPS can still afford to require a thesis is that NPS students are comparatively mature and experienced. Capitalize on your experience in selecting a topic.

RATMAN... THE FINAL (OR FIRST?) CHAPTER...



The topics named above may sound overly simple, but they are not. “Chance of collision” begs to have a model of how collisions involving submarines and surface ships might occur. The LCAC is trying to do things fast, so it will shortly realize that the relationship between time and quantity in loading needs to be clearly understood, and that it needs to know what other LCACs are doing. How does one quantify “better performance” in a billet, and can the relevant statistics be estimated from available data? Considerations such as these can make a deceptively simple sounding problem turn out to be surprisingly complex. *Any OR research topic has a tendency to grow*, so the risk of selecting a problem that is trivial is much smaller than the risk of selecting a problem that is too big for the time available. An OR thesis is intended to be a scientific undertaking, so the details will take time. The devil (or worse yet, Ratman’s Thesaurus) is often found in those details. Start small.

The program office keeps a compilation of thesis abstracts that will give you a good idea of the kind of OR theses that have been written in the past. A copy of each thesis can be found in the library, including theses that are classified. Faculty can also be a source of thesis topics. If a lecture topic intrigues you, or if you think an introduced technique might be applicable to a thesis you have in mind, discuss it with the faculty member. Sponsors sometimes call faculty about problems that need to be solved. Ideally these calls will result in an entry in the catalog of prospective thesis topics at <http://web.nps.navy.mil/~opnsrsch/oacurric/projects-table.htm>, but a direct approach to faculty can also be useful.

Your thesis advisor is the most important faculty thesis contact. The thesis work is yours to do and yours to communicate, but the advisor is your consultant throughout. Every thesis must also have a second reader. The usual role for a second reader is basically quality control and making sure that the thesis is comprehensible by someone not intimately connected with the work; however, the arrangement will depend on the faculty member that you select. As with your advisor, make sure that you understand what your second reader expects and when he expects it. At least one of these two advisors must be an OR faculty member, and at least one, not necessarily the same person, must have a PhD. If you have trouble finding appropriate faculty, talk to the academic associate. As soon as you have a topic and advisors lined up, but not later than the end of the fifth quarter, complete the required thesis proposal and have everyone sign it.

NPS has a Thesis Manual that specifies standards for how a thesis must be written and a thesis processor to make sure that the standards are followed. The program office will make sure that you are aware of all the latest details. However, the most important rule for good writing is to first make sure that you have something to say. Before beginning your write-up, consult with your advisor as to whether you have reached that desirable state.

After Graduation

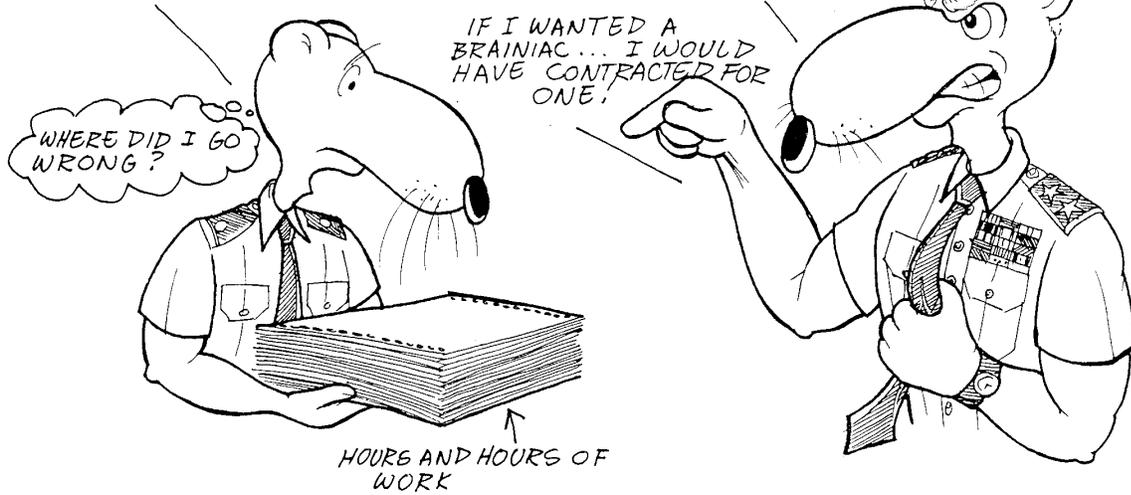
It sometimes happens that an experience tour is undertaken by a student who is wondering how anybody can even comprehend four and a half quarters of OR techniques, let alone apply them, only to be pleasantly surprised at being able to do something that others regard as actually useful! The useful technique may simply be the ability to write a computer program or correctly interpret a probability analysis, rather than one of the more esoteric parts of OR. The same thing often happens to recent graduates. It turns out that a byproduct of all the mathematics and abstraction that comes with studying OR is a certain confidence about making decisions using computers, models and numbers. This sophistication often leads to an effortless clarity of thinking that is valuable in itself and enviable to those without a similar education. The real goal of the NPS OA curriculum is to give you the opportunity to become sophisticated in that sense. If you can get there, you will be a more effective decision maker during your career in the military, and probably in whatever you do after you leave. Your effectiveness will only occasionally take the form of a sophisticated analysis, but your approach to problems will still be valued.

We like to get feedback from alumni. We occasionally even attempt a survey, although our surveys usually suffer from our inability to keep track of rapidly moving graduates. It is much easier for you to keep track of us, since the OA curriculum has been in Monterey since 1951. Please keep in touch, either through the mail (zip code is 93943) or the OR home page.

FOLLOWING GRADUATION, RATMAN IS GIVEN A REALITY CHECK...

BUT SIR... MY ALGORITHM IS ORDER $O(n^2)$, AND I SOLVED THE PROBLEM OPTIMALLY.....

THAT'S JUST GREAT MAJOR! I NEEDED THE ANSWER FOR LAST WEEK'S BUDGET MEETING, AND YOU DIDN'T DELIVER!



IF YOU CAN'T SEE THE FOREST FOR THE TREES... CUT THE TREES DOWN FOR COMPUTER PAPER AND WRITE AN ALGORITHM!

ACADEMIC CALENDAR AY 2002

Fall Quarter

Reporting Date(International).....	Sunday	16 Sep 2001
Reporting Date.....	Monday	24 Sept
Instruction Begins.....	Monday	1 Oct
Columbus Day (Holiday).....	Monday	8 Oct
Reporting Date for Refresher(International)..	Sunday	28 Oct
Reporting Date for Refresher.....	Monday	5 Nov
Veteran's Day (Holiday).....	Monday	12 Nov
Refresher Begins.....	Tuesday	13 Nov
Thanksgiving Day (Holiday).....	Thursday	22 Nov
Final Examinations Begin.....	Friday	14 Dec
Graduation.....	Wednesday	19 Dec
Christmas Break.....	21 Dec - 4 Jan 2002	

Winter Quarter

Reporting Date(International).....	Sunday	30 Dec 2001
Reporting Date.....	Monday	7 Jan 2002
Instruction Begins.....	Wednesday	9 Jan
Martin Luther King's Birthday (Holiday).....	Monday	21 Jan
Reporting Date for Refresher(International)..	Sunday	3 Feb
Reporting Date for Refresher.....	Monday	11 Feb
President's Day (Holiday).....	Monday	18 Feb
Refresher Begins.....	Tuesday	19 Feb
Final Examinations Begin.....	Monday	25 Mar
Graduation.....	Friday	29 Mar

Spring Quarter

Reporting Date(International).....	Sunday	17 Mar
Reporting Date.....	Monday	25 Mar
Instruction Begins.....	Monday	1 April
Reporting Date for Refresher(International)..	Sunday	28 April
Reporting Date for Refresher.....	Monday	6 May
Refresher Begins.....	Monday	13 May
Memorial Day (Holiday).....	Monday	27 May
Final Examinations Begin.....	Monday	17 Jun
Graduation.....	Friday	21 Jun
Summer Break.....	21 Jun - 5 Jul	

Summer Quarter

Reporting Date(International).....	Sunday	23 June
Reporting Date.....	Monday	1 Jul
Independence Day (Holiday).....	Thursday	4 Jul
Instruction Begins.....	Monday	8 Jul
Reporting Date for Refresher(International)..	Sunday	4 Aug
Reporting Date for Refresher.....	Monday	12 Aug
Refresher Begins.....	Monday	19 Aug
Labor Day (Holiday).....	Monday	2 Sep
Final Examinations Begin.....	Monday	23 Sep
Graduation.....	Friday	27 Sep

ACADEMIC CALENDAR AY 2003

Fall Quarter

Reporting Date(International).....	Sunday	15	Sept	2002
Reporting Date.....	Monday	23	Sept	
Instruction Begins.....	Monday	30	Sept	
Columbus Day (Holiday).....	Monday	14	Oct	
Reporting Date for Refresher(International)..	Sunday	27	Oct	
Reporting Date for Refresher.....	Monday	4	Nov	
Veteran's Day (Holiday).....	Monday	11	Nov	
Refresher Begins.....	Tuesday	12	Nov	
Thanksgiving Day (Holiday).....	Thursday	28	Nov	
Final Examinations Begin.....	Monday	16	Dec	
Graduation.....	Thursday	19	Dec	
Christmas Break.....		20 Dec -	3 Jan	2003

Winter Quarter

Reporting Date(International).....	Sunday	29	Dec	2002
Reporting Date.....	Monday	6	Jan	2003
Instruction Begins.....	Wednesday	8	Jan	
Martin Luther King's Birthday (Holiday).....	Monday	20	Jan	
Reporting Date for Refresher(International)..	Sunday	2	Feb	
Reporting Date for Refresher.....	Monday	10	Feb	
President's Day (Holiday).....	Monday	17	Feb	
Refresher Begins.....	Tuesday	18	Feb	
Final Examinations Begin.....	Monday	24	Mar	
Graduation.....	Friday	28	Mar	

Spring Quarter

Reporting Date(International).....	Sunday	16	Mar	
Reporting Date.....	Monday	24	Mar	
Instruction Begins.....	Monday	31	Mar	
Reporting Date for Refresher(International)..	Sunday	27	April	
Reporting Date for Refresher.....	Monday	5	May	
Refresher Begins.....	Monday	12	May	
Memorial Day (Holiday).....	Monday	26	May	
Final Examinations Begin.....	Monday	16	Jun	
Graduation.....	Friday	20	Jun	
Summer Break.....		20 Jun -	4 Jul	

Summer Quarter

Reporting Date(International).....	Sunday	22	Jun	
Reporting Date.....	Monday	30	Jun	
Independence Day (Holiday).....	Friday	4	Jul	
Instruction Begins.....	Monday	7	Jul	
Reporting Date for Refresher(International)..	Sunday	3	Aug	
Reporting Date for Refresher.....	Monday	11	Aug	
Refresher Begins.....	Monday	18	Aug	
Labor Day (Holiday).....	Monday	1	Sep	
Final Examinations Begin.....	Monday	22	Sep	
Graduation.....	Friday	26	Sep	

OA Options

ENGINEERING SCIENCE CURRICULA (460)

ACADEMIC ASSOCIATE: Rob Dell, x2853

SIX WEEK

R	OA-R160 (2-2) Introduction to Operations Analysis II ¹	MA-R117 (3-3) Refresher: Single Variable Calculus ¹	MA-R142 (2-0) Refresher: Matrix Algebra ¹	MA-R125 (3-0) Introduction to Finite Mathematics ¹
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ONE QUARTER

1	OA-1600 (2-2) Introduction to Operations Analysis	MA-1117 (5-2) Single Variable Calculus	MA-1025 (4-0) Finite Mathematics for Operations Research	MA-1042 (2-0) Matrix Algebra
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TWO QUARTERS

1	NW-3230 (4-0) Strategy and Policy	MA-1117 (5-2) Single Variable Calculus	CS-3010 (4-0) Computer Systems Principles	XX-XXXX Elective ²
2	OA-1600 (2-2) Introduction to Operations Analysis	MA-1118 (5-2) Multivariable Calculus	MA-1025 (4-0) Finite Mathematics for Operations Research	MA-1042 (2-0) Matrix Algebra

NOTES:

(1) Accelerated six week course.

(2) Elective selection must be approved by Academic Associate and Program officer.

OPERATIONS ANALYSIS CURRICULUM (360)

NAVY MODELING SIMULATION, AND ANALYSIS OPTION (With JPME)

OPTION ADVISOR: Matt Boensel, X3489

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I		OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis		OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	NW 3230 (4-2) Strategy and Policy	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I		OA 2900 (1-0) Workshop
4	OA 3602 (4-0) Search Theory and Detection	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation		OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		NW 3210 (3-0) National Security Decision Making	
5b	OA 3900 (5-0) Experience Tour					
6	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4602 (4-0) Joint Campaign Analysis		NW 3270 (3-0) Joint Maritime Operations	NW 3211 (3-0) National Security
7	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4801 (4-0) Spreadsheet Analysis		NW 3271 (3-0) Joint Maritime Operations	
8	OA 0810 (0-8) Thesis Research	XX 4XXX Elective	OA 4702 (4-0) Cost Estimation		NW 3272 (3-0) Joint Maritime Operations	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.
 Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
 OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
 OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
 OA4607 Tactical Decision Making.

OPERATIONS ANALYSIS CURRICULUM (360)

NAVY MODELING SIMULATION, AND ANALYSIS OPTION (Without JPME)

OPTION ADVISOR: Matt Boensel, X3489

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I	OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis	NW 3211 (3-0) National Security Decision Making	OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I	OA 2900 (1-0) Workshop
4	OA 3602 (4-0) Search Theory and Detection	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation	OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		
5b	OA 3900 (5-0) Experience Tour				
6	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4602 (4-0) Joint Campaign Analysis	OA 4702 (4-0) Cost Estimation	
7	OA 0810 (0-8) Thesis Research	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4801 (4-0) Spreadsheet Analysis	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.

Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
OA4607 Tactical Decision Making.

OPERATIONS ANALYSIS CURRICULUM (360)

LAND COMBAT OPTION

OPTION ADVISOR: Tom Lucas X3039

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I	OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis	OA 4601 (4-0) Models for Decision Making	OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I	OA 2900 (1-0) Workshop
4	OA 3602 (4-0) Search Theory and Detection	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation	OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		
5b	OA 3900 (5-0) Experience Tour				
6	OA 0810 (0-8) Thesis Research	OA 4603 (4-0) Test and Evaluation	OA 4602 (4-0) Joint Campaign Analysis	OA 4656 (4-0) Advanced Combat	
7	OA 0810 (0-8) Thesis Research	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4801 (4-0) Spreadsheet Analysis	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.
 Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
 OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
 OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
 OA4607 Tactical Decision Making.

OPERATIONS ANALYSIS CURRICULUM (360)

SUPPLY CORPS OPTION (with JPME)

OPTION ADVISOR: Kevin Maher, X2691

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I		OA 2900 (1-0) Workshop	
2	MA 3110 (3-0) Intermediate Analysis	OA 3501 (4-0) Inventory I	OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II		OA 2900 (1-0) Workshop	
3	OA 4501 (4-0) Supply Systems Seminar	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I		OA 2900 (1-0) Workshop	
4		OA 4201 (4-0) Nonlinear Programming	MN 3372 (4-0) or MN 3377 (4-0) Mat Log or Inv	OA 3302 (4-0) Simulation	NW 3230 (4-2) Strategy and Policy	OA 2900 (1-0) Workshop	
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		NW 3210 (3-0) National Security Decision Making		
5b	OA 3900 (5-0) Experience Tour						
6	OA 0810 (0-8) Thesis Research	OA 4302 (4-0) Reliability	OA 4XXX Course to Support Thesis ⁽¹⁾		NW 3270 (3-0) Joint Maritime Operations	NW 3211 (3-0) National Security	
7	OA 0810 (0-8) Thesis Research	MN 4310 (4-0) Logistics Engineering	OA 4801 (4-0) Spreadsheet Analysis			NW 3271 (3-0) Joint Maritime Operations	
8	OA 0810 (0-8) Thesis Research	MN 4676 (4-0) Defense Transportation	OA 4702 (4-0) Cost Estimation			NW 3272 (3-0) Joint Maritime Operations	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.
 Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
 OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
 OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
 OA4607 Tactical Decision Making.

OPERATIONS ANALYSIS CURRICULUM (360)

MARINE CORPS OPTION

OPTION ADVISOR: Greg Mislick X3113

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I		OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis		OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	NW 3230 (4-2) Strategy and Policy	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I		OA 2900 (1-0) Workshop
4	OA 3602 (4-0) Search Theory and Detection	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation		OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis			
5b	OA 3900 (5-0) Experience Tour					
6	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4656 (4-0) Advanced Combat	MN 3331 (4-0) Systems Acquisition		
7	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4801 (4-0) Spreadsheet Analysis		NS 3079 (4-0) PME	
8	OA 0810 (0-8) Thesis Research	OA 4602 (4-0) Joint Campaign Analysis	OA 4702 (4-0) Cost Estimation		NS 3079 (4-0) PME	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.
 Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
 OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
 OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
 OA4607 Tactical Decision Making.

OPERATIONS ANALYSIS CURRICULUM (360)

HUMAN FACTORS OPTION (with JPME)

OPTION ADVISOR: Nita Miller, X2281

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I		OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis		OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	NW 3230 (4-2) Strategy and Policy	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I		OA 2900 (1-0) Workshop
4	Human Factors Elective (I)	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation		OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		NW 3210 (3-0) National Security Decision Making	
5b	OA 3900 (5-0) Experience Tour					
6	OA 0810 (0-8) Thesis Research	Human Factors Elective (II)	Human Factors Elective (I)		NW 3270 (3-0) Joint Maritime Operations	NW 3211 (3-0) National Security
7	OA 0810 (0-8) Thesis Research	Human Factors Elective (II)	OA 4801 (4-0) Spreadsheet Analysis		NW 3271 (3-0) Joint Maritime Operations	
8	OA 0810 (0-8) Thesis Research	Human Factors Elective (II)	OA 4702 (4-0) Cost Estimation		NW 3272 (3-0) Joint Maritime Operations	

Thesis advisors and students pick courses to support thesis and option.

Elective (I) must pick two of the following: OA-3402 Human Factors in System Design

OA-4401 Human Performance Evaluation

MV-4001 Human Factors of Virtual Environments

Elective (II) must include at least two advanced statistics courses

OPERATIONS ANALYSIS CURRICULUM (360)

INTERNATIONAL OPTION

OPTION ADVISOR: Rob Dell, X2853

1	MA 3042 (4-0) Linear Algebra	MA 1118 (5-2) Calculus	OA 3101 (4-1) Probability	OA 2200 (3-1) Computation I	OA 2900 (1-0) Workshop
2	MA 3110 (3-0) Intermediate Analysis	IT 1500 (4-0) International Seminar	OA 3102 (4-2) Statistics	OA 3200 (4-1) Computation II	OA 2900 (1-0) Workshop
3	OA 3401 (4-0) Human Performance	OA 3201 (4-0) Linear Programming	OA 3103 (4-1) Data Analysis	OA 3301 (4-0) Stoch Models I	OA 2900 (1-0) Workshop
4	OA 3602 (4-0) Search Theory and Detection	OA 4201 (4-0) Nonlinear Programming	OA 4655 (4-0) Joint Combat Modeling	OA 3302 (4-0) Simulation	OA 2900 (1-0) Workshop
5a		OA 4202 (4-0) Networks	OA 4604 (4-0) Wargaming Analysis		
5b	OA 3900 (5-0) Experience Tour				
6	OA 0810 (0-8) Thesis Research	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4301 (3-2) Stoch Models II	
7	OA 0810 (0-8) Thesis Research	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4XXX Course to Support Thesis ⁽¹⁾	OA 4801 (4-0) Spreadsheet Analysis	

⁽¹⁾ Thesis advisors and students pick courses to support thesis research.
 Typical courses are: OA4106 Survey Methods; OA4108 Data Mining; OA4203 Math Programming;
 OA4301 Stochastic Models II; OA4302 Reliability; OA4304 Decision Theory;
 OA4333 Advanced Simulation; OA4603 Test and Evaluation; and
 OA4607 Tactical Decision Making.