

Universidad de Puerto Rico
Recinto Universitario de Mayagüez
JUNTA ADMINISTRATIVA

Aprobada
19/12/2017
(Fecha)
Judith Ramirez Valentin
(Firma)

**ACTA NÚMERO 16-17-011 E
DE LA REUNIÓN EXTRAORDINARIA CELEBRADA EL
LUNES, 12 DE DICIEMBRE DE 2016**

Presentes:

Dra. Betsy Morales Caro, Presidenta Designada
Decana de Asuntos Académicos

Prof. David Muñoz, Decano Interino
Colegio de Administración de Empresas

Dr. Fernando Gilbes Santaella, Decano Interino
Colegio de Artes y Ciencias

Dr. Víctor Siberio Torres
Representante del Senado Académico

Dr. Agustín Rullán, Decano
Colegio de Ingeniería

Prof. Lucas N. Avilés Rodríguez
Decano de Administración

Dr. Francisco Maldonado Fortunet
Decano de Estudiantes

Dr. Raúl Macchiavelli, Decano y Director
Colegio de Ciencias Agrícolas

Dr. Noel Artilés León
Representante del Senado Académico

Excusados:

Dra. Celeste E. Freytes González, Presidenta Int.
Universidad de Puerto Rico

Sr. Marcus Ramos Cintrón
Representante Estudiantil

Dr. John Fernández Van Cleve, Rector

Invitados:

Dr. Omell Pagán Parés
Decano Auxiliar de Asuntos Académicos

Dra. Mercedes Ferrer, Directora
Oficina de Investigación Institucional y Planificación

Dra. Wandaliz Torres García, Catedrática Auxiliar
Departamento de Ingeniería Industrial

Secretaria:

Prof. Judith Ramírez Valentín

Asistentes:

Sra. Nilda E. Pérez Collazo
Sra. Liz J. Rivera Valentín

Se reúne la Junta Administrativa del Recinto Universitario de Mayagüez en la fecha arriba indicada previa convocatoria del Rector, Dr. John Fernández Van Cleve. La reunión es presidida por la Dra. Betsy Morales Caro, Decana de Asuntos Académicos y Presidenta Designada. La reunión

comienza a la una y cuarenta y dos minutos de la tarde en la Sala de Conferencias del Edificio de MuSA. La Secretaria pasa lista y constata el quórum con la presencia de nueve miembros de la Junta.

IMIS Y CUPOS PRELIMINARES PARA EL AÑO ACADÉMICO 2017

La Dra. Betsy Morales Caro, Decana de Asuntos Académicos y Presidenta Designada, saluda a los miembros de la Junta y excusa al Dr. John Fernández Van Cleve de la reunión, ya que se encuentra en gestiones oficiales.

La doctora Morales Caro indica, que en la tarde de hoy nos acompañan el Dr. Omell Pagán Parés, Decano Auxiliar de Asuntos Académicos, la Dra. Mercedes Ferrer, Directora de la Oficina de Investigación Institucional y Planificación y la Dra. Wandaliz Torres García, Catedrática Auxiliar del Departamento de Ingeniería Industrial.

A continuación, el Dr. Agustín Rullán Toro, Decano del Colegio de Ingeniería, indica que en la Facultad de Ingeniería desarrollaron un proyecto modelo basado en la capacidad que tienen los distintos departamentos para así determinar el cupo y el IMI para los estudiantes de nuevo ingreso. Este proyecto ha sido apoyado, además, por la Oficina de Investigación Institucional y Planificación. El doctor Rullán Toro solicita a la Junta que le permitan a la doctora Torres García presentar el proyecto modelo. La Junta permite que la doctora Torres haga la presentación (la presentación forma parte del acta).

Luego de discutir ampliamente las recomendaciones de los IMIS y CUPOS de las distintas facultades, la Junta acuerda los siguientes IMIS y CUPOS Preliminares para el Año Académico 2017 que serán sometidos a la Oficina de Asuntos Académicos de Administración Central. La Junta acuerda que se espere hasta la próxima reunión de la Junta a celebrarse el jueves, 15 de diciembre, para que el Dr. John Fernández Van Cleve, Rector, esté presente y el Sr. Wilson Crespo Valentín, Director de la Oficina de Presupuesto, presente ante este organismo un análisis presupuestario sobre este particular.

A continuación los IMIS y CUPOS Preliminares para el Año Académico 2017:

Facultad	Programa	PRELIMINAR	
		Cupo	IMI 2017
Administración de Empresas	Administración de Oficinas – BAO	30	260
	Contabilidad – BCAE	60	280
	Finanzas – BCAE	25	280
	Gerencia de Operaciones - BCAE	30	280
	Gerencia de Recursos Humanos (ESOR) - BCAE	15	280
	Mercadeo - BCAE	30	280
	Sistemas Computadorizados de Información – BCAE	30	280
Artes y Ciencias – Artes	Artes Plásticas - BA	30	260
	Ciencias Políticas - BA	30	270
	Ciencias Sociales BA	30	280
	Economía –BA	25	260
	EDFI-Adiestramiento y Arbitraje - BA	30	260

	EDFI-Enseñanza - BA	25	260
	Estudios Hispánicos - BA	15	260
	Filosofía BA	10	280
	Historia – BA	25	270
	Inglés – BA	30	280
	Lengua y Literatura Francesa - BA	10	260
	Literatura Comparada - BA	10	260
	Psicología – BA	65	300
	Sociología – BA	30	270
	Teoría del Arte – BA	10	260
Artes y Ciencias – Ciencias	Biología – BC	185	325
	Biotecnología Industrial - BC	50	340
	Ciencias de Computación - BC	25	300
	Ciencias Físicas - BC	20	300
	Educación Matemática - BC	10	300
	Enfermería - BC	55	300
	Física Teórica - BC	30	315
	Geología - BC	35	300
	Matemáticas - BC	25	300
	Microbiología Industrial - BC	70	320
	Pre-Médica - BC	60	320
	Química – BC	70	320
Ciencias Agrícolas	Agricultura General - BC	50	290
	Agronegocios - BCA	15	275
	Agronomía - BCA	45	290
	Ciencias del Suelo - BCA	10	280
	Economía Agrícola - BCA	15	270
	Educación Agrícola - BCA	15	270
	Extensión Agrícolas - BCA	15	270
	Horticultura - BCA	15	280
	Ciencia Animal - BCA	55	315
	Pre-Veterinaria	25	335
	Protección de Cultivos - BCA	10	280
Sistemas Agrícolas y Ambientales	35	275	
Ingeniería	Agromensura y Topografía - BC	75	295
	Ciencias e Ingeniería de la Computación - BC *	50	320
	Ingeniería Civil - BC	115	310
	Ingeniería Computadoras - BC	105	330
	Ingeniería de Software - BC *	50	320

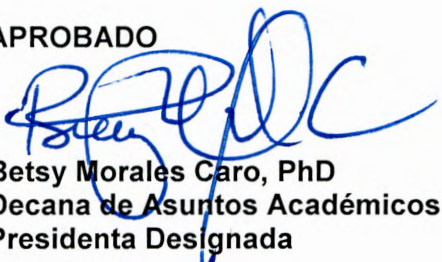
Ingeniería Eléctrica - BC	100	320
Ingeniería Industrial - BC	95	315
Ingeniería Mecánica - BC	125	340
Ingeniería Química - BC	100	325

Cubierta la agenda en su totalidad se clausura la reunión a las tres y cincuenta y tres minutos de la tarde.

POR TODO LO CUAL DOY FE Y CERTIFICO,


Judith Ramírez Valentín
Secretaria

APROBADO


Betsy Morales Caro, PhD
Decana de Asuntos Académicos y
Presidenta Designada

JRV/lrv

A Decision Support System for Measuring Freshmen Admissions Impact on Course Offerings: A 10-Yr Trend Model

Wandylistmary Colón-Vélez, Samuel A. Bonet-Olivencia, Anariely Rivera-Negrón,
Mercedes Ferrer, Agustín Rullán and Wandaliz Torres-García

University of Puerto Rico, Mayagüez

This project is supported by the Dean of Engineering and the Office for Institutional Research and Planning (OIIP) at the University of Puerto Rico, Mayaguez Campus (UPRM).

A. Objectives

The objective is to develop a methodology and tool to roughly calculate the institutional capacity over the years to determine how many spaces are available for freshmen at UPRM in general. Though this is the long term aim of this project, we started an initial model that learned the trends of students' enrollment and capacity levels (course offerings) over the last 10 years. The model estimates the number of sections required to fulfill demand based on the number of freshmen admitted and non-freshmen still in the system.

B. Historical Data Requests

During this phase, OIIP provided 10 years of data, from academic years 2005-2006 through 2015-2016, which allowed the evaluation of the behavior and flow of the UPRM students across their curriculum, with the objective of creating a model to predict future behavior. Data for the following variables, which were identified as relevant for the analysis, was requested for each semester (Semester 1-Fall and Semester 2-Spring) of each academic year:

- Freshmen Trends
 - Number of freshman students enrolled per faculty per admission program
 - Courses that each freshman student enrolled
 - Grades obtained by each freshman on each course enrolled (*not incorporated in model yet*)
- Other Students Trends (Non-Freshmen Students)
 - Number of current students ("Others") enrolled per course offered
- Institutional Capacity
 - Department of origin of each course
 - Total number of sections available for each course
 - Total number of spaces available for each course
 - Total number of spaces utilized for each course
 - Courses Waiting Lists
 - Teaching personnel appointment type (*in progress*)

It is important to highlight that the profile information of each student was maintained in complete confidentiality during the whole process

B.1 Exploratory Analysis of the Data

An exploratory analysis has been held with the purpose of studying the general behavior of the data through the academic years and also for identifying possible patterns. One aspect of interest is the total freshman enrollment through the years. As can be seen in Figure 1, a considerable reduction is observed starting in the academic year 2010-2011 and finishing in the academic year 2012-2013. A slow paced increment in the freshman enrollment is seen from the academic year 2013-2014 onwards.

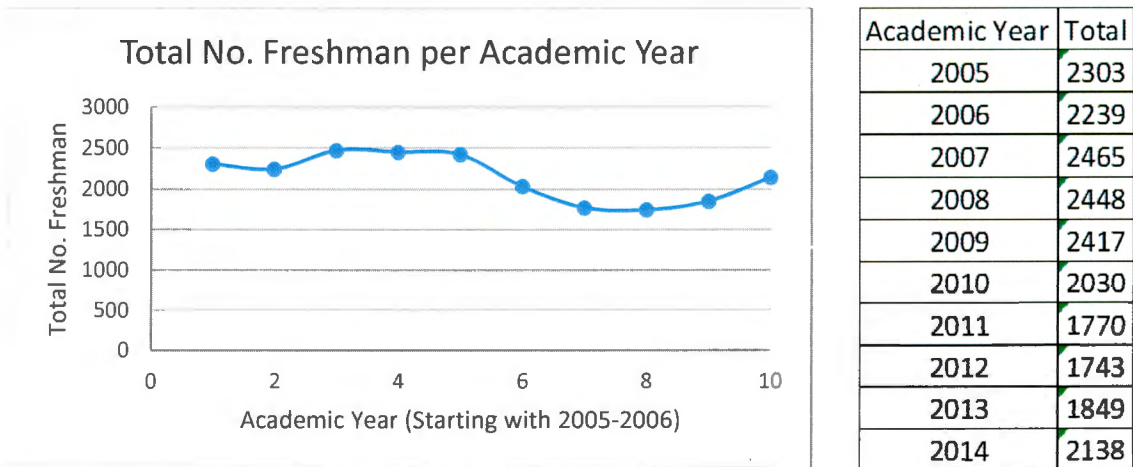


Figure 1. Total No. Freshman per Academic Year

By doing the same, but dividing the freshman enrollment by faculty, it was identified (Figure 2) that the behavior of the data through the academic years is similar for the Engineering, Science, and Arts faculties. In the case of Business and Agricultural Sciences, the pattern is similar but inverse. These similarities per faculty in the behavior of the data can represent a positive aspect from the modeling point of view.

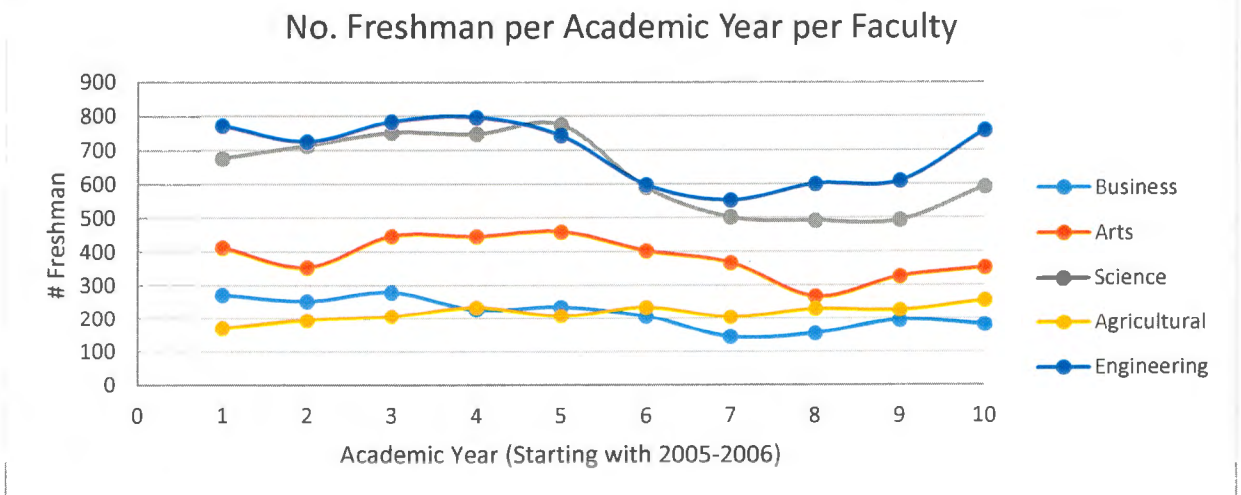


Figure 2. No. Freshman per Academic Year per Faculty

C. Methodology

Various models were attempted including discrete-event simulations but the resulting model presented here is based on a moving average approach. This model consist in the creation of a VBA macro within EXCEL that estimates the number of spaces required for freshmen in all courses. The admin-user can change the number of freshmen students (that might be admitted) to estimate the impact on the number of spaces per course for those freshmen. This model is based on the last 10 years of historical data by computing proportions of freshmen in each course per program where these proportions are estimated using a moving average approach.

Our methodology has four main steps as shown in Figure 3. First we generate proportions of freshmen per course conditional to the admission program using a moving average model of the last 10 years. An example of how the moving average is implemented for ESPA 3101 for students from academic program 1602 can be seen in Figure 4. The period or lag for the moving average can be specified by the user. The model also can estimate the number of freshmen per program based on trends in the data or the user can input the number of freshmen for each program directly in the tool. Then the proportions are used to estimate the number of spaces freshmen could need per course. We have added in the model an estimate of the non-freshmen students in each course as well to account for the total spaces needed in our system. Lastly using information on the average size of the classrooms and the spaces required we determine the number of sections needed.

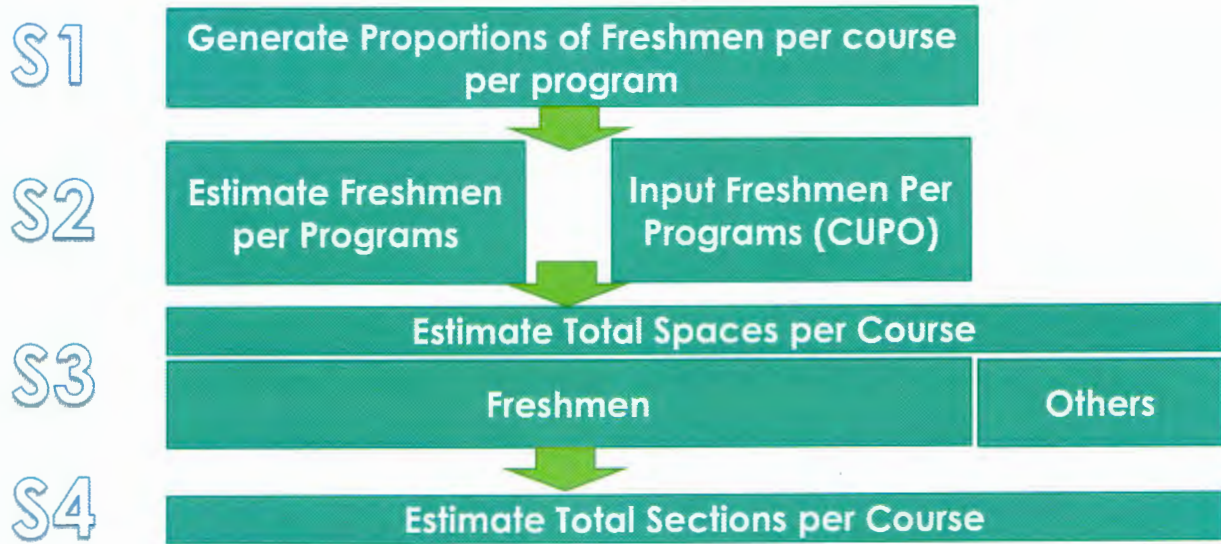


Figure 3. Model Methodology Steps

The methodology is completely programmed in Excel and Visual Basic Macros for easier management with the ultimate objective to estimate the number of sections required for all courses based on the number of freshmen admitted and other students still in the system. Among the inputs of the tool are the total number of freshmen to be admitted or the user can input the number of

freshmen for each program separately. In Figure 5, we show a draft of the tool user interface in Excel.

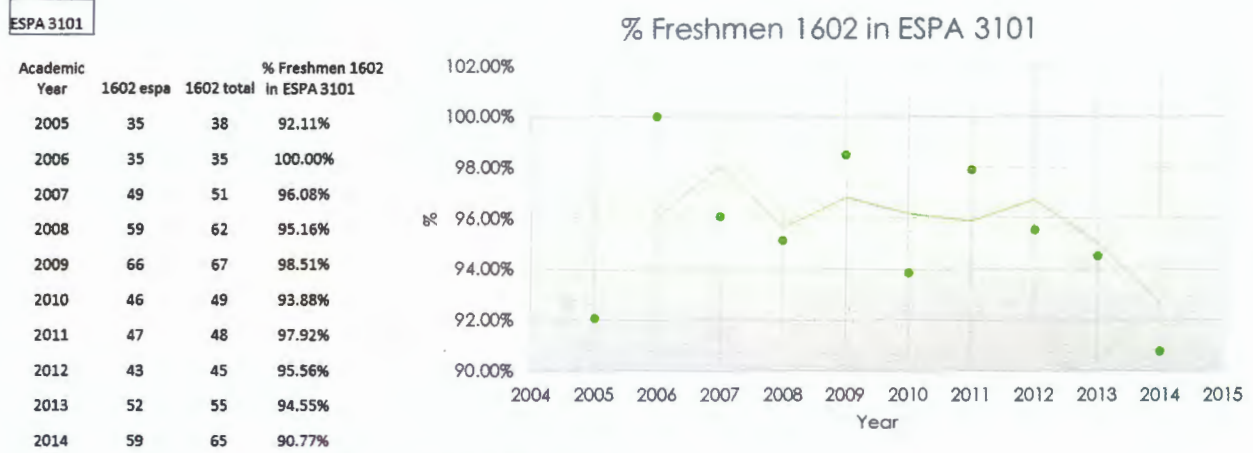


Figure 5. Moving Average for ESPA 3101 and Program 1602

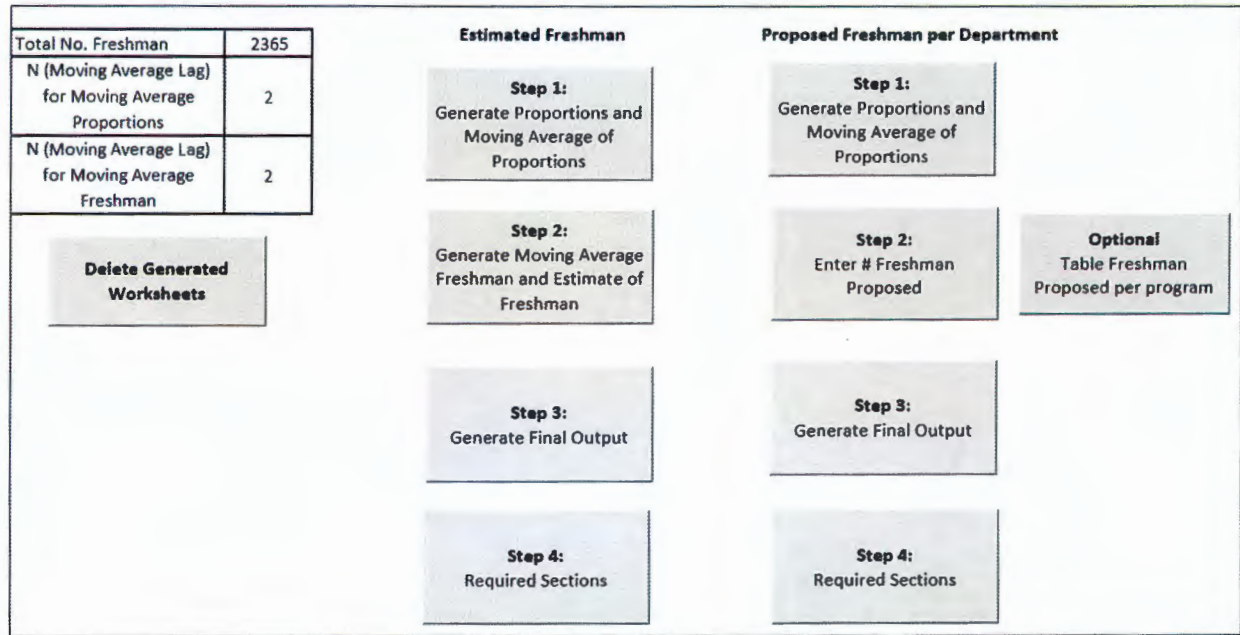


Figure 5. Model Implementation Tool

The output that the tool provides includes some descriptive information of the course, the estimates for freshmen and non-freshmen spaces required per courses as well as spaces not fulfilled using waiting lists to gather the total utilization estimated and convert this in number of sections using the average size of sections in the past. A partial view of the output results are shown in Figure 6.

Dept.	Courses	Lab	Freshmen Course	No. of Estimated Freshman per course	No. of Estimated Others Students per course	Avg. No. of Student in Wait List	Total Utilization Estimated	10Yr Average Students per Section (Expected Value)	Required Sections (Expected Value)
Departamento de Química	QUIM 1000	FALSE	1	74	1	0	75	37	2
Departamento de Química	QUIM 1000	FALSE	1	74	1	0	75	37	2
Departamento de Química	QUIM 1000	FALSE	1	74	1	0	75	37	2
Departamento de Química	QUIM 3001	FALSE	1	0	0	0	0	54	0
Departamento de Química	QUIM 3001	FALSE	1	0	0	0	0	54	0
Departamento de Química	QUIM 3001	FALSE	1	0	0	0	0	54	0
Departamento de Química	QUIM 3001L	TRUE	0	0	0	0	0	19	0
Departamento de Química	QUIM 3025	FALSE	0	0	72	0	72	30	2
Departamento de Química	QUIM 3025L	TRUE	0	0	72	0	72	14	5
Departamento de Química	QUIM 3041	FALSE	1	203	34	1	238	47	5
Departamento de Química	QUIM 3041	FALSE	1	203	34	1	238	47	5
Departamento de Química	QUIM 3041	FALSE	1	203	34	1	238	47	5
Departamento de Química	QUIM 3042	FALSE	0	0	64	0	64	37	2
Departamento de Química	QUIM 3042L	TRUE	0	0	64	0	64	16	4
Departamento de Química	QUIM 3055	FALSE	0	0	62	0	62	34	2
Departamento de Química	QUIM 3055L	TRUE	0	0	62	0	62	14	4
Departamento de Química	QUIM 3061	FALSE	0	0	81	0	81	38	2
Departamento de Química	QUIM 3061L	TRUE	0	0	81	0	81	17	5
Departamento de Química	QUIM 3062	FALSE	0	0	13	0	13	25	1
Departamento de Química	QUIM 3062L	TRUE	0	0	13	0	13	13	1
Departamento de Química	QUIM 3071	FALSE	1	0	60	0	60	29	2
Departamento de Química	QUIM 3071	FALSE	1	0	60	0	60	29	2
Departamento de Química	QUIM 3071	FALSE	1	0	60	0	60	29	2
Departamento de Química	QUIM 3071L	TRUE	0	0	61	0	61	15	4
Departamento de Química	QUIM 3085	FALSE	0	0	19	0	19	30	1
Departamento de Química	QUIM 3086	FALSE	0	0	1	0	1	5	0
Departamento de Química	QUIM 3131	FALSE	1	916	260	0	1176	54	22
Departamento de Química	QUIM 3131	FALSE	1	916	260	0	1176	54	22
Departamento de Química	QUIM 3131	FALSE	1	916	260	0	1176	54	22

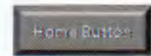
Figure 6. Model Output

D. Preliminary Results

D.1 Validation

To validate our model we used current number of sections offered in 2015 based on the 2,365 freshmen. We measure deviations by subtracting required sections estimated by the model minus the number of sections offered in 2015 per course. The model could predict 1778 out of 1913 courses within -1 to 1 deviations (~ 93%). Some of the larger deviations are due to research and graduate courses that because of the nature are very variable. Therefore, excluding those the model can predict with ± 1 deviations 91% (1051 out 1153 courses). From these the largest deviations were 10 and -10. Some of the largest deviations were justified as in the case of ADMI3007 and CONT3005 which are currently offered less because of curricular reform in the Business Administration programs (Cert. 15-94). As seen in Figure 7, most of the courses with large deviations are courses that freshmen enrolled in their first semester. The model is stating for the amount of students in 2015, more sections should have been opened in those courses shown in Figure 7. This lists still reflects many undergraduate research and special problems courses.

Courses	Total Utilization Estimated	Course Credit Hours	Sections per course 2015	10Yr Average Students per Section (Expected Value)	Required Sections (Expected Value)	Difference Required Sections (Exp. Value) Sections per Course 2015
ADMI 3007	268	1	2	23	12	10
HUMA 3111	1385	3	32	34	41	9
HIST 3241	491	6	5	38	13	8
CONT 3005	304	3	2	34	9	7
INEL 4998	55	1	12	3	18	6
ESOR 4006	182	3	0	29	6	6
TMAG 4015	91	3	4	9	10	6
CIBI 3031	676	1	10	42	16	6
EDFI 3665	291	3	4	31	9	5
CISO 3121	562	3	8	42	13	5
PSIC 3001	823	3	17	37	22	5
BOTA 4996	6	1	1	1	6	5
INCI 4998	22	1	6	2	11	5
EDFI 3076	633	3	17	29	22	5
EDFI 3295	206	3	5	22	9	4
ADMI 4016	169	3	2	27	6	4
ESPA 3315	121	3	0	30	4	4
FINA 4029	222	3	3	32	7	4
MATE 3086	288	3	6	29	10	4
ESOR 4008	93	3	0	24	4	4
MATE 3171	1410	1	31	41	34	3
INGL 3268	115	3	1	27	4	3
QUIM 4999	33	1	13	2	16	3
FINA 3006	148	3	1	35	4	3
INGL 3211	701	1	22	28	25	3
PROC 4995	5	1	2	1	5	3
INME 4001	219	3	4	32	7	3
QUIM 3133	1118	1	56	19	59	3
ADMI 4995	25	1	0	9	3	3
COMP 4998	30	1	1	8	4	3
MATE 3031	577	3	11	42	14	3
MATE 3063	453	3	11	33	14	3
QUIM 4998	124	2	22	5	25	3
GERE 4007	79	3	0	30	3	3
BIOL 4902	39	1	17	2	20	3



Courses Column Legend
 Courses with Freshman and

Figure 7. Model Validation: deviations larger than 2

D.2. Preliminary Evaluation: 2016 CUPO

In the meeting on Monday December 12, 2016, we preliminarily used the tool to see if we could use the information provided by the model to make an educated decision on the freshmen quota establishment for 2016. Using the direct input option of the tool as shown in Figure 8, we evaluated the impact of admitting 2350 students next year. Similar behavior as the one in the validation if we compared to the sections opened in 2015. Need to open more sections in courses mainly dedicated to freshmen (See Figure 9).

Program	Code Program	# Proposed Freshman
Agricultura General - BC	102	50
Agronomía - BCA	103	45
Economía Agrícola - BCA	104	15
Educación Agrícola - BCA	105	15
Extensión Agrícolas - BCA	106	15
Horticultura - BCA	107	15
Ciencia Animal - BCA	108	55
Tecnología Mecánico-Agrícola - BCA	109	35
Pre-Veterinaria	110	25
Protección de Cultivos - BCA	112	10
Agronegocios - BCA	113	15
Ciencias del Suelo - BCA	114	10
Contabilidad - BCAE	302	60
Finanzas - BCAE	304	25
Sistemas Computadorizados de Información - BCAE	308	30
Gerencia de Operaciones - BCAE	309	30
Mercadeo - BCAE	311	30
Gerencia de Recursos Humanos (ESOR) - BCAE	313	15
Administración de Oficinas - BAO	319	30
Ingeniería Civil - BC	501	115
Ingeniería Eléctrica - BC	502	100
Ingeniería Industrial - BC	503	95
Ingeniería Mecánica - BC	504	125
Ingeniería Química - BC	505	100
Agrimensura y Topografía - BC	506	75
Ingeniería Computadoras - BC	507	105
Enfermería - BC	703	55
Literatura Comparada - BA	901	10
Artes Plásticas - BA	904	30
Teoría del Arte - BA	905	10
Historia - BA	906	25
Inglés - BA	907	30
Filosofía BA	908	10
Estudios Hispánicos - BA	909	15
Lengua y Literatura Francesa - BA	912	10
Biología - BC	1202	185
Pre-Médica - BC	1203	60
Química - BC	1204	70
Matemáticas - BC	1205	25
Ciencias Físicas - BC	1207	20
Física Teórica - BC	1208	30
Geología - BC	1209	35
Microbiología Industrial - BC	1219	70
Ciencias de Computación - BC	1220	25
Educación Matemática - BC	1222	10
Bioteología Industrial - BC	1223	50
EDFI-Adiestramiento y Arbitraje - BA	1302	30
EDFI-Enseñanza - BA	1303	25
EDFI-Recreación - BA	1304	0
Ciencias Sociales BA	1602	30
Economía -BA	1603	25
Ciencias Políticas - BA	1604	30
Psicología - BA	1605	65
Sociología - BA	1606	30

Figure 8. Direct User Input: Freshmen Quota per Academic Program

Courses	Total Utilization Estimated	Course Credits Hours	Sections per course 2015	10Yr Average Students per Section (Expected Value)	Required Sections (Expected Value)	Difference Required Sections (Exp. Value) Sections per Course 2015
ADMI 3007	266	3	2	23	12	10
HUMA 3111	1377	3	32	34	40	8
HIST 3241	480	3	5	38	13	8
CONT 3005	300	4	2	34	9	7
INEL 4998	55	1	12	3	18	6
ESOR 4006	181	3	0	29	6	6
TMAG 4015	91	3	4	9	10	6
EDFI 3665	284	2	4	31	9	5
CIBI 3031	630	3	10	42	15	5
BOTA 4996	6	1	1	1	6	5
INCI 4998	22	1	6	2	11	5
PSIC 3001	798	3	17	37	22	5
ADMI 4016	167	3	2	27	6	4
CISO 3121	511	3	8	42	12	4
ESPA 3315	122	3	0	30	4	4
EDFI 3295	197	1	5	22	9	4
FINA 4029	222	3	3	32	7	4
ESOR 4008	93	3	0	24	4	4
EDFI 3076	604	1	17	29	21	4
MATE 3086	270	3	6	29	9	3
INGL 3268	115	3	1	27	4	3
QUIM 4999	33	1	13	2	16	3
FINA 3006	148	3	1	35	4	3
PROC 4995	5	1	2	1	5	3
INME 4001	219	3	4	32	7	3
ADMI 4995	25	1	0	9	3	3
COMP 4998	30	1	1	8	4	3
MATE 3063	453	3	11	33	14	3
QUIM 4998	124	1	22	5	25	3
GERE 4007	79	3	0	30	3	3
HIST 3242	93	3	0	37	3	3
BIOL 4902	39	1	17	2	20	3

Home Suite 1

Courses Column Legend

Courses with Freshman and

Figure 9. Deviations larger than 2 when compared to the number of sections offered in 2015

Freshmen Course		(All)	
Course Number		(Multiple Items)	
Departments	Sum of Required Sections (Expected Value)	Sum of Sections per course	Sum of Difference Required Sections (Exp. Value) - Sections per Course 2015
Departamento de Administración de Empresas	169.56	111	58.56
Departamento de Agronomía y Suelos	66.01	76	-9.99
Departamento de Biología	517.14	516	1.14
Departamento de Biotecnología Industrial	3.28	4	-0.72
Departamento de Ciencia y Tecnología de Alimentos	25.46	23	2.46
Departamento de Ciencias Marinas	32.17	36	-3.83
Departamento de Ciencias Sociales	181.26	147	34.26
Departamento de Economía	39.92	42	-2.08
Departamento de Economía Agrícola	24.38	30	-5.62
Departamento de Educación Agrícola	19.37	20	-0.63
Departamento de Educación Física	138.96	128	10.96
Departamento de Enfermería	40.85	54	-13.15
Departamento de Estudios Hispánicos	130.23	136	-5.77
Departamento de Física	145.04	147	-1.96
Departamento de Geología	72.98	65	7.98
Departamento de Horticultura	32.10	27	5.10
Departamento de Humanidades	163.01	159	4.01
Departamento de Industrias Pecuarias	110.50	116	-5.50
Departamento de Ingeniería Eléctrica y Computadoras	208.90	197	11.90
Departamento de Ingeniería Agrícola	24.85	27	-2.15
Departamento de Ingeniería Civil	162.75	149	13.75
Departamento de Ingeniería General	102.05	113	-10.95
Departamento de Ingeniería Industrial	71.97	69	2.97
Departamento de Ingeniería Mecánica	136.65	150	-13.35
Departamento de Ingeniería Química	90.79	95	-4.21
Departamento de Ingles	197.98	201	-3.02
Departamento de Matemáticas	241.26	219	22.26
Departamento de Programas Generales en Ciencias Agrícolas	9.00	14	-5.00
Departamento de Protección de Cultivos	47.07	50	-2.93
Departamento de Química	302.60	301	1.60
División de Educación Continua y Estudios Profesionales	50.58	54	-3.42
Ninguno	122.03	124	-1.97
(blank)			
Grand Total	3680.668429	3600	80.66842904

Figure 10. Results per department

Figure 10 shows an overview of the model estimates for the 2016 quota provided to the model by department. It also shows the greatest need to open more sections in red based on the model estimates of the trends in course enrollment and waiting list. A similar analysis was done but only for courses that freshmen take in their first semester where mathematics, social sciences, biology, mechanical engineering, physical education, business administration and humanities. The needs for business administration might not be as large since we know there are reducing the offer of some courses due to curricular reform (see Figure 11).

Departments	Sum of Required Sections (Expected Value)	Sum of Sections per course	Sum of Difference Required Sections (Exp. Value) - Sections per Course 2015
Departamento de Administración de Empresas	53.49	25	28.49
Departamento de Agronomía y Suelos	4.20	5	-0.80
Departamento de Biología	62.76	59	3.76
Departamento de Ciencia y Tecnología de Alimentos	0.17	0	0.17
Departamento de Ciencias Sociales	116.14	76	40.14
Departamento de Economía	31.55	31	0.55
Departamento de Economía Agrícola	2.01	6	-3.99
Departamento de Educación Agrícola	4.39	4	0.39
Departamento de Educación Física	106.77	95	11.77
Departamento de Estudios Hispánicos	113.96	114	-0.04
Departamento de Física	45.33	47	-1.67
Departamento de Geología	12.72	14	-1.28
Departamento de Humanidades	116.77	113	3.77
Departamento de Industrias Pecuarias	23.68	23	0.68
Departamento de Ingeniería Eléctrica y Computadoras	1.36	1	0.36
Departamento de Ingeniería Agrícola	0.00	0	0.00
Departamento de Ingeniería General	51.47	58	-6.53
Departamento de Ingeniería Industrial	0.00	0	0.00
Departamento de Ingeniería Mecánica	14.79	8	6.79
Departamento de Ingeniería Química	15.13	19	-3.88
Departamento de Ingles	103.82	115	-11.18
Departamento de Matemáticas	139.36	125	14.36
Departamento de Química	132.41	131	1.41
División de Educación Continua y Estudios Profesionales	16.09	19	-2.91
Ninguno	23.90	28	-4.10
Grand Total	1192.253644	1116	76.2536437

Figure 10. Results per department for courses freshmen take in their first semester

E. Accomplishments and Challenges

Achievement 1: Up to this point, we managed to study the 10-year behavior of freshmen admissions and their distributions across different courses.

Achievement 2: Currently we can calculate a rough estimate of the number of spaces required for any amount of freshmen though to be admitted in our institution using the overall trend-behavior over the last 10 years. As well to the non-freshmen students still in our academic institution.

Challenges: This rough calculation does not takes into account current resources available, it assumes that what has been offer in the past 10 years is the our best measure of capacity. This model assumes that the proportion trend over the last 10-years is the correct way to plan for course allocation. Meaning that if we as an institution have been planning this incorrectly hence the model will provide an estimate based on this incorrect planning strategy. Nonetheless it does offer important information on how students are distributed among those courses and how they select them. Also, we want to incorporate in the model, which courses are offered by temporary employees or by contract.

F. Future work

There are several students interested in continuing this work and improve the model by making a reverse analysis. Instead of placing as input the number of freshmen, place the number of spaces available per course and estimate the number of freshmen we can serve taking into account any other student requiring a space in those courses. Therefore, we plan to repeat a similar approach but backwards or reverse. To accomplish this we will need to model better the available number of spaces available per course hence a capacity analysis.

F.1 Capacity Analysis – Constrained model

To develop a methodology and tool to roughly calculate the institutional capacity in terms of student-hours, and based on the results obtained in phase I, determine how many spaces are available for freshmen at UPRM in general. During this phase, data on human resources, such as the amount of professors per department, typical teaching loads and FTE's, as well as information on physical facilities could be collected, evaluated and integrated to the previous model in order to determine the amount of resources available to serve new students. Basic assumptions such as total flexibility of professors among each department could be made.

Once we have a better understanding of our current resources, the model should be able to better model the maximum number of students that should be admitted at UPRM regardless of the program of admission.

G. Acknowledgement

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