TIDES OF
TRANSFORMATION

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The Power of Automating Processes

Enrollment Projection from Excel to SAS®

Kelly & Elizabeth

Kelly has been a "SASophile" since her first coding course in 2015. She primarily focuses on Base SAS and Enterprise Guide, platforms frequently used by smaller colleges and universities. Her passion is helping people and organizations develop and grow, particularly in the areas of data literacy, data culture, and equitable outcomes for students.

Elizabeth was first introduced to SAS in 2019 through the herculean efforts of the Community College Planning & Research Organization (CCPRO) of North Carolina. It has taken her a while to see the "SAS Light" but is thankful every day for the nudge to adopt SAS into her world. She is currently the Director of Academic Planning and Institutional Research at UNCSA, where Excel and Base SAS are the primary data cleaning and analysis tools for the institution.

The University of North Carolina School of the Arts (UNCSA)

- Located in Winston- Salem, NC

- Part of the UNC System

- Founded as America's first public arts conservatory with a mission to train talented young people for professional careers in the arts

- Comprised of 5 top-ranked schools offering a high school diploma, undergraduate, and master's degrees

- Total enrollment at Fall 2024 Census: 1367

Why Automate?

- Doing more with less.

- Standardizing processes.

- Improving efficiency.

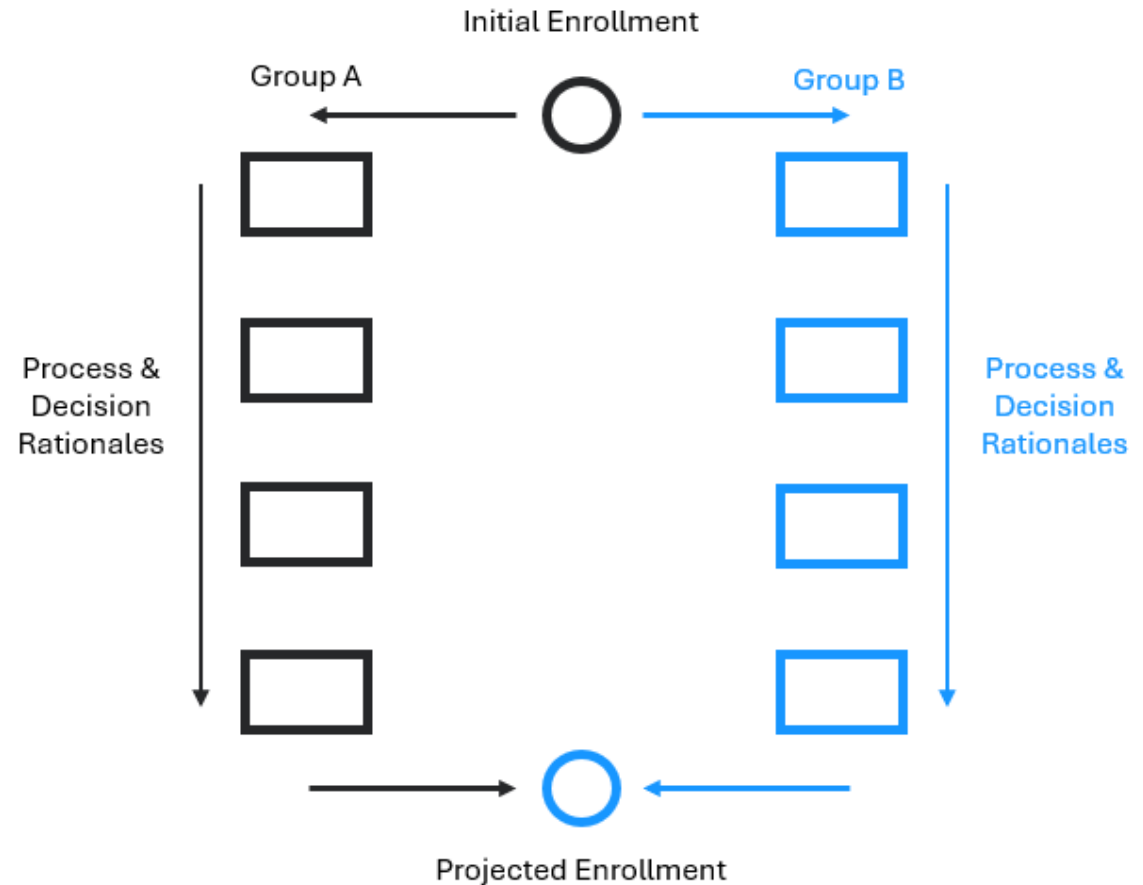- Staff can focus on time-sensitive requests.

Current Automation Project

Enrollment Projection (Fall 1 → Fall 2)

- Ongoing request
- Extensive manual process
- Multiple data sources

First Step – Compile Information

- Data Needs
  - Admissions / Enrollment
  - Attrition / Graduation
- Data Sources
  - Tables
  - Variables
- Current Process
  - Detailed process map
  - Annotated with rationales
- Previous Reports

Data Sources and Assumptions by Update

Data Used for Enrollment Projections

Timeframe / Update Version	Initial Projection (Proj 1)	Proj 2	Proj 3	Proj 4	Proj 5	Proj 6 (comparing projections to actual)
	after Fall Census	Fa1, November	after Spring Census	Sp, Mar/Apr (after grad app submission)	Su, July (after summer grades posted)	after Fall 2 Census
Fall 1 Enrollment	Fall Census	Fall Census	Fall EOT	Fall EOT	Fall EOT	Fall EOT
Fall 1 Completion	Assume *Zero* Fall 1 Completers	Fall 1 grad applications	Fall PG Actual Fall 1 Completions	Fall PG Actual Fall 1 Completions	Fall PG Actual Fall 1 Completions	Fall PG Actual Fall 1 Completions
Fall 1 to Spring Attrition	3yr Historic Fa1 to Sp Attrition Average	3yr Historic Fa1 to Sp Attrition Average	Actual Fall 1 Attrition (Spring Census - Fall EOT)	Actual Fall 1 Attrition (Spring Census - Fall EOT)	Actual Fall 1 Attrition (Spring EOT - Fall EOT)	Actual Fall 1 Attrition (Spring EOT - Fall EOT)
Spring Enrollment	Applying Historic Fa1 to Sp Attrition	Applying Historic Fa1 to Sp Attrition	Spring Census	Spring Census	Spring EOT	Spring EOT
Spring/Summer Completion	✕✕ HS: 12th Grade UG: BFA/BM- C4; DA ARCT- C4; MU ARCT- C2 GR: DP MFA- G3; FM MFA- G2; MU MM- G2; MU PB/PM- G1	✕✕ HS: 12th Grade UG: BFA/BM- C4; DA ARCT- C4; MU ARCT- C2 GR: DP MFA- G3; FM MFA- G2; MU MM- G2; MU PB/PM- G1	✕✕ HS: 12th Grade UG: BFA/BM- C4; DA ARCT- C4; MU ARCT- C2 GR: DP MFA- G3; FM MFA- G2; MU MM- G2; MU PB/PM- G1	Spring / Summer Graduate Application	Summer PG Actual Spring/ Summer Completions	Summer PG Actual Spring/ Summer Completions
Spring to Fall 2 Attrition	3yr Historic Sp to Fa2 Attrition Average	3yr Historic Sp to Fa2 Attrition Average	3yr Historic Sp to Fa2 Attrition Average	3yr Historic Sp to Fa2 Attrition Average	3yr Historic Sp to Fa2 Attrition Average	Actual Fall 2 Attrition (Fall 2 Census - Spring EOT)
Fall 2 Enrollment	Applying Historic Sp to Fa2 Attrition	Applying Historic Sp to Fa2 Attrition	Applying Historic Sp to Fa2 Attrition	Applying Historic Sp to Fa2 Attrition	Applying Historic Sp to Fa2 Attrition	Fall 2 Census
Application	Applying Historic Census Admissions Yield Average	Applying Historic Census Admissions Yield Average	Applying Historic Census Admissions Yield Average	Applying Historic Census Admissions Yield Average	Applying Historic Census Admissions Yield Average	Fall 2 Census Actual Admissions Yield

Project Framework

1. Enrollment calculations.
   a. Projected enrollment.
   b. Adjustments based on actual enrollment.
2. Attrition calculations.
   a. Projected attrition based on weighted, three-year average.
   b. Adjustments based on actual attrition.
3. Data from state database.
   a. Static datasets.
   b. Dynamic data extraction from Amazon Redshift using PROC SQL.
4. Export final data.
   a. Static reporting by PROC PRINT or PROC EXPORT to Excel.
   b. Dynamic export to Power BI.

Key Variable - Category

- Enrollment and recruitment is most like building a sports team.

- **Category** variable is used to identify students for tracking throughout the enrollment projection process, especially during attrition and completion calculations, and is used in the reporting structure.

SAS Approach

- Hard Coding
  - A first step to build process
  - Can be easier to debug

- Dynamic Coding
  - End goal
  - Minimize input variables
  - Easy for analyst to update

Using Macros

- Minimize code repetition
- Standardize processing / calculations across academic years
- Positional parameters

```
%MACRO Retention(Fall,Spring,Summer,Fall2);

%Retention(Fall2020,Spring2021,Summer2021,Fall2021);
```

Working with Variables

- %EVAL to build macrovariables.

```
%LET yr=2020;
%LET yr11=%EVAL(&yr + 1); /* yr11 = 2021 */
%LET yr01=%EVAL(&yr - 1); /* yr01 = 2019 */
```

- CATX to build new variables by concatenating current variables.

```
id_career = catx("-", student_cid,degree);
        /* Student_CID_Degree */
```

Working with Variables

- Avoiding a many-to-one MERGE by collapsing student records into an ARRAY

```
DATA Records_array;
RETAIN Student Tm01-Tm04;
   ARRAY Terms (4) $50. Tm01-Tm04; /* describes array */
      SET Records;
      BY Student;
```

- IF THEN to determine values of new variables

```
IF Fall_One = 1 AND F1_Compl = 0 THEN Poss_Spr_Stu = 1; /* Yes = 1 */
   ELSE Poss_Spr_Stu = 0; /* No = 0 */
```

Calculations

- Calculations designed to maximize projected student attrition and graduation, aka "worst case scenario"

- CEIL function to round calculations to nearest higher integer.

```
Returning=CEIL(Enrollment * RetentionRate);
/* Returning=CEIL(125*0.95) → Returning=CEIL(118.75) → Returning=119 */
```

5 Data Optimizations

- **Career**: **original** career level (HS, UG, GR ... from career_code_inst)

- **Degree**: **original** degree program (BFA, BM ... from major_1_degree_code_inst)
  - Group 1-year graduate certificates
  - Assign undergraduate certificates and non-degree-seeking students

- **Residency**: **most recent** residency (In-state, Out-of-state from residency_code)

- **Department**: **most recent** department / school (Dance, Drama ... from major_1_department_code)

- **Attrition Rate Weights**:
  - Weight factor, 1 year prior = 0.57
  - Weight factor, 2 years prior = 0.29
  - Weight factor, 3 years prior = 0.14

Optimizations – SAS Code

Degree

```
IF Major_1_degree_code_inst IN ("GAC","PAC","FPAC") THEN Degree = "GrdCrt";
   ELSE IF Major_1_degree_code_inst EQ "ARCT" AND Major_1_department_code EQ "DA" THEN Degree = "BFA";
   ELSE IF Major_1_degree_code_inst EQ "ARCT" AND Major_1_department_code EQ "MU" THEN Degree = "BM";
   ELSE IF Major_1_degree_code_inst EQ "000000" AND Major_1_department_code IN ("DA","DP","FM","DR","UAP") THEN Degree = "BFA";
   ELSE IF Major_1_degree_code_inst EQ "000000" AND Major_1_department_code EQ "MU" THEN Degree = "BM";
   ELSE degree=Major_1_degree_code_inst;
```

Category

```
/* Create sorting variable for calculation steps */
IF res02 NE " " THEN Cat_res=res02; ELSE IF res01 NE " " THEN Cat_res=res01;
IF dep02 NE " " THEN Cat_dep=dep02; ELSE IF dep01 NE " " THEN Cat_dep=dep01;

Category=CATX("_",Car01,Deg01,Cat_res,Cat_dep);
/* example: GR_MF_I_MU = Graduate_Degree Program_Residency_School */
```

Using PROCS

- PROC SUMMARY for calculations by student groups

```
PROC SUMMARY DATA=Students;
BY Group;
VAR Fall Spring Summer Fall2;
OUTPUT OUT=StudentCounts SUM= / AUTONAME;
RUN;
```

- PROC TRANSPOSE to rearrange data

```
PROC TRANSPOSE DATA=StudentCounts3yr OUT=ThreeYrCounts_flip;
BY Group;
ID StartTerm;
VAR Fall2Fall;
RUN;
```

Using PROCS

- PROC IMPORT to pull in data

```
PROC IMPORT datafile="C:\Users\&user\OneDrive - UNCSA\&path.Enrollment Projection\SAS\Data\&source\Fal_EOT_&yr10..csv"
        out=FallOne_EOT_&yr
        dbms=csv replace;
        delimiter=",";
        GETNAMES=YES;
        GUESSINGROWS=25000;
        DATAROW=2;
RUN;
```

- PROC TABULATE for internal reports

```
PROC TABULATE DATA=Final_2020;
CLASS Group Residency Major;
TABLE Major=" " ALL="Total", /* table row set-up */
    (Group=" " * (Residency=" " ALL="SubTotal")) ALL="Total" * (n)
    / BOX="Start Term = &StartFall" MISSTEXT="0"; /* table column set-up */
    KEYLABEL n=" ";
RUN;
```

Using PROCS

- PROC PRINT for external reporting

```
TITLE    "Enrollment Projection Update, Overall, &SYSDATE";

TITLE2   "Enrollment Projection Overall";
PROC PRINT DATA=ProjOverall NOOBS;
VAR Fal_Overall FalComp_Overall FaSp_ProjAttr_Overall FalSpAttr_Overall Diff_FalSp_ProjActAttr_Overall
        inSp_Overall ProjSpSuComp_Overall Fa2Elig_Overall SpFa2_ProjAttr_Overall Fa2Proj_Overall;
RUN;
title;
```

- Reporting Sequence
  - Overall
  - By Residency
  - By Career
  - By School

Report Structure

Enrollment Projection Update, Overall, 08MAR25

Enrollment Projection Overall

Fa1_Overall	Fa1Comp _Overall	FaSp_ProjAtt r_Overall	Fa1SpAttr_Overall	Diff_Fa1Sp_ProjActAt tr_Overall
1329	3	52	37	15

Enrollment Projection by Residency

Residency	Fa1_Resi	Fa1Comp_Re	FaSp_ProjAttr_Res	Fa1SpAttr_Residency
In-State	759	3	24	24
Out-of-State	570	0	28	13

Enrollment Projection by Level

Level	Fa1_Level	Fa1Comp_Lev	FaSp_ProjAttr_Lev	Fa1SpAttr_Level
1-HS	252	0	13	6
2-UG	905	3	29	27
3-GR	172	0	10	4

Enrollment Projection by School

School	Fa1_Scho	Fa1Comp_Sc	FaSp_ProjAttr_Sch	Fa1SpAttr_School
DA	227	0	9	5
DP	332	1	11	9
DR	143	0	3	2
FM	375	0	10	9
MU	251	2	19	11
UA	1	0	0	1

Key Takeaways so far

- Communication
  - Frequent check-ins
  - Data source documentation
  - Document data optimizations outside of and within SAS

- Working meetings
  - Watch out for mental fatigue

- Frequent cross-checking
  - Catch issues early
  - Understand PROC IMPORT versus INPUT
  - Understanding similar element structures from different data sources

- Doing math
  - Use functions that can handle missing data
  - Including projections beside actuals for comparison

Thank you! Please reach out with questions, thoughts, ideas …
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Download the article

"*Many Paths, One Field*"

based on the career survey at last year's conference. Available at aewasconsulting.com