Doing Monte Carlo Research Using SPSS

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Reason for this Presentation

- Teach a new, versatile SPSS based approach to Monte Carlo (MC) research
- Many social scientists know only SPSS
  - Other languages do MC automatically
- Provide a brief overview of MC research

Overview of Presentation

- Overview of Monte Carlo Research (MCR)
- Examples of questions/topics for MCR
- Quick review of SPSS syntax
- Sources of random numbers
- Implementing steps of MCR using SPSS
  - Details of each step
- Practice doing MCR with SPSS

Overview of Monte Carlo Research (MCR)

- Address complex situations
- Four straightforward steps:
- Create data set reflective of the real world
- Analyze the data set
- Repeat the process many times
- Summarize the MC results

Address Complex Situations

- MC is a powerful tool for tough questions
- Situations too complex for analytic solution
  - No known method of analyzing the situation
- For example, What changes in rank standing might be expected on re-grading given test reliability of .9?

Four Straightforward Steps

- No step in MC research is hard to understand
- Performing MC research can be done with SPSS commands

Create Data Set Reflective of the Real World

- Assume you gave a Assessment Center type promotional exam to 100 candidates
- Assume 50 candidates appeal and are re-graded
- What might the data set be created to look like?
  - Same number of candidates?
  - Same range of scores?

Analyze The Data Set

- Analysis is often relatively easy
- Use our usual statistical tools
  - Correlations
  - Frequency distributions
  - Means
  - Etc.

Analyze The Data Set (continued)

- Need goals or focus of analysis
- Re-grading example, possible interest in:
  - Maximum change in rank
  - Mean change in rank
  - Number of changes in promotions

Repeat the Process Many Times

- SPSS can do this
- How do to it is the focus of this presentation

Summarize the MC Results

- For our re-grading example:
- Frequency distributions and means for:
  - Maximum change in rank
  - Mean change in rank
  - Number of changes in promotions

Summarize the MC Results
(continued)

- Average number of ranks changed
- Distribution of number of ranks changed
- Impact of change in ranks on who will be promoted (e.g., assuming appointment in order of rank)

Examples of Questions/Topics for MCR

- What changes in rank standing may be expected on re-grading given a specified test reliability?
- What validity and adverse impact is expected for pass-fail combinations of employee selection procedures with given validities and intercorrelations.

Examples of Questions/Topics for MCR (continued)

- In a multiple choice test for FF-EMT, will mean job performance be higher with multiple hurdle or compensatory approach for the test areas? Adverse impact?
- What difference in job performance is expected with random selection within bands as compared with top down selection?

Examples of Questions/Topics for MCR (continued)

- What would be the effect on overall passing rates, job performance, and adverse impact of including passing points on each area of a MC test that measures several KSAPs?
- How much lower is the validity calculated based on a 7 point criterion scale as compared with calculating validity using the underlying, continuous criterion values?

Examples of Questions/Topics for MCR (continued)

- To what extent does the validity of a test depend on the number of items in the test?
  - May be able to address this mathematically
  - Confirm your answer using MCR

Examples of Questions/Topics for MCR (continued)

- Evaluate tricky probability problems
  - May be able to address this mathematically
  - Confirm your answer using MCR

Research Decisions

- Refine the problem: know what you want.
- How to simulate the problem?
  - Use data from a real life situation or random
- How many cases, how many replications?
- What means, SDs, intercorrelations, etc?
- What distribution (normal, uniform, etc?)
- What effect size?

Quick Review of SPSS Syntax

- Some useful SPSS commands
- Useful conventions in writing SPS files
- Documenting your files
- Naming your files

Some Useful SPSS Commands

- READ (ascii flat file, fixed or free format)
- GET FILE (e.g., SPSS or Excel file)
- SAVE (spss data file, with all formatting)
- SORT CASES BY variable_name (A).
- MERGE (2 or more files by an identifier)
- OMS (outputs descriptive statistics to a file)
- WRITE OUTFILE (to fixed format ascii)

Create Ranks

- RANK VARIABLES = written oral (A).
- Default is to create new variables
  - rwritten
  - roral
- Can override this default and specify names for the new, rank variables
- (A) means ascending

Save SPSS Data File

- SAVE OUTFILE = 'c:\path\filename.sav'.
- SAVE OUTFILE = 'c:\path\filename.sav' / DROP ssn.
- SAVE OUTFILE = 'c:\path\filename.sav' / KEEP id lastname grade.
  - Clean up your SAV files with DROP and KEEP

SORT

- SORT CASES BY grade.
- LIST id lastname firstname grade.

- SORT CASES BY grade (D).
  - D for descending
  - A for ascending

Save Non-SPSS Data File

- SAVE TRANSLATE OUTFILE = 'c:\path\filename.xls' /TYPE=XLS / KEEP id gender eeo_gp age grade /FIELDNAMES.

- This creates an Excel file with variable names for column heads.

OMS

- OMS outputs descriptive statistics to a file
- Syntax is a bit complex
  - Read SPSS user manual for details
- This command (and all commands) are in sample SPS files I will provide

WRITE OUTFILE

- Sometimes may want to write to fixed format ascii
- Some calculations with data are easier done if you read data in a second time
- For example: combining several cases into one case
  - Print out
  - Read in several lines at a time

Add a Case Number

- COMPUTE id = $CASENUM
  - Gives a sequential id number for each case

Conventions for SPSS Files

- Conventions aid in understanding and use
- Syntax files (.SPS)
- File documentation
- Format/layout for syntax file
- File naming

Conventions for Syntax Files

- SPSS commands in upper case
- Variable names in lower case
- Use formatting to separate sections of code

File Documentation

- File name
- Date created
- Author
- Goal or purpose
- Log of changes over time
- Outline of command file
- Visual divisions of file into sections

Format/Layout for Syntax File

```
* file: c:\ipac\monte_carlo_create_data.sps

* Written 7/18/12, jpw.
* Updated 7/19/12, jpw.

* Goal: Create data file from random number file.

**********************************.
* Step 1. Get data file with random numbers named: monte_carlo_random.sav
* Step 2. Merge with test score data file names: exam_scores.sav.
* Step 3. Create replication number.
* Step 4. Create variable: re-grade.
* Step 5. Save data file named: monte_carlo_data.sav.
**********************************.
```


File Naming Conventions

- Makes it easy to find all files for a project
  - project_name.xls
  - project_name_random.sav
  - project_name.txt
  - project_name_file_information.xls

File Naming Conventions

- You many need several SPS files
- Make it easy to find all files for a project
  - project_name_1_create_data.sps
  - project_name_2_save_random.sps
  - project_name_3_merge.sps
  - project_name_4_analyze.sps
  - project_name_5_summarize.sps

File Documentation for MCR

- Excel file with summary of SPSS syntax files
  - File name with full path
  - Name of input file used
  - Name of output file produced
  - Names of variables in output file
  - Summary of what each syntax file does

Sources of Random Numbers

- Random number generators (RNG)
  - SPSS: pseudo random numbers
  - “True” random numbers
  - Multivar

Random Number Generator in SPSS

- Creates pseudo random numbers
- Can specify a SEED (starting number)
  - Lets you replicate your study
  - Not random insofar as same numbers are generated each time program is run
- Can choose from several distributions
  - Normal
  - Uniform

"True" Random Numbers

- Sources
  - Radioactive decay
  - Atmospheric noise

Random.org

- **http://random.org**
- Random digits based on atmospheric noise
- Can specify mean and s.d. and choose from:
  - Uniform
  - Normal

Random.org (continued)

- Integers
  http://www.random.org/integers/?mode=advanced
- Normal
  http://www.random.org/gaussian-distributions/?mode=advanced
- Has a quota of 10,000 20 digit numbers per day
  - After that, there is a small charge

Multivar (Freeware)

- Multivar (Aguinis, 1994)
  mypage.iu.edu/~haguinis/mmr/download/multivar.zip
- Generates normally distributed random variables (i.e., numbers) with specified intercorrelations
- A pseudo random number generator

Multivar (continued)

- Just click on name of file: multivar.exe
  - Visual basic program
- Has prompts for:
  - Number of samples
  - Number of variables
  - Number of cases per sample
  - Intercorrelations of all variables

Which RNG to Use

- univariate MCR
  - random.org
  - SPSS RNG
- multivariate MCR
  - multivar program by Aguinis

Implementing Steps of MCR Using SPSS

- Approach for today's program:
- Choose one research question for this didactic presentation
- Go through the SPSS programs to answer this research question.

Research Question for this Didactic Presentation

What changes in rank standing might be expected on re-grading an assessment center exercise in an actual public safety promotional examination assuming a test-retest reliability of .9?

Implementing Steps of MCR Using SPSS (continued)

- General, straightforward steps
- 1st: Create data set reflective of the real world (i.e., the test in question)
- 2nd: Analyze the data set
- 3rd: Repeat the process many times
- 4th: Summarize the MC results

Implementing MCR: 1st Step

- Create data set reflective of the real world
- We need
  - Original grades
  - Random numbers

Implementing MCR: 1st Step

- Develop data set
- Start with actual grades
- Create re-grades using
  - random number
  - reliability of .9
    - Is this internal consistency, test-retest, other?
    - We rosily assume it is test-retest reliability

Implementing MCR: 1st Step
(continued)

- Overview of Step 1 information
- 81 candidates, so 81 original grades
- Formula to create re-grade with r = .9

  re-grade = .674*grade + . 326*random number
- Random number has the same distribution as original grades, at least the same mean and SD

Implementing MCR: 1st Step
(continued)

- Four basic tasks in Step 1
- Save 81 original grades in SAV file w id's
  - Arbitrary id numbers
- Get normal random numbers from web
- Save normal random numbers with id's
  - Arbitrary id numbers
- Merge the two SAV files into final data set

1st Step. Review and Run Files

- monte_carlo_1_save_original_grades_reps.sps
  - Saves original grades with arbitrary id numbers
- monte_carlo_2_save_random.sps
  - Saves random numbers w arbitrary id numbers
- monte_carlo_3_merge_reps.sps
  - Merges original grades and random numbers
  - Calculates revised grades

monte_carlo_1_save_original_grades_reps.sps

- * Goal: Read original grades and save in SPSS file.
- **********.
- * Step 1. Get data file with original grades named: C:\ipac\grades_original_100_replications.txt
- * Step 2. Find mean, SD, and shape of distribution of original grades.
- * Step 3. Add id to each original grade.
- * Step 4. Save data file named: monte_carlo_original_grades.sav.
- **********.

monte_carlo_1_save_original_grades_reps.sps (continued)

- **********.
- * Step 1. Get data file with original grades named: C:\ipac\grades_original_100_replications.txt
- DATA LIST FIXED FILE = 'C:\ipac\grades_original_100_replications.txt' /grade_original 1-5 .
- FORMAT grade_original (F5.2).
- LIST /CASES = 10 .
- **********.

monte_carlo_1_save_original_grades_reps.sps (continued)

- * Step 2. Find mean, SD, and shape of distribution of original grades.
- FREQ grade_original /FORMAT=NOTABLE /STATISTICS MEAN STDDEV SKEW KURTOSIS /HISTOGRAM.
- * This plot shows distribution is roughly normal.
- * Mean = 25.1854, Std Dev = 10.29274
- * Kurtosis = -.686, Skew = .050
- * Neg kurtosis means curve is flatter than normal (with too many cases in the tails).

monte_carlo_1_save_original_grades_reps.sps (continued)

- **********.
- * Step 3. Add id to each original grade.
- COMPUTE id = $CASENUM.
- FORMAT id (F8.0).
- LIST id grade_original /CASES = 10.
- **********.

monte_carlo_1_save_original_grades_reps.sps (continued)

* Step 4. Save data file named:
monte_carlo_grades_original.sav.

- SAVE OUTFILE = 'C:\ipac\monte_carlo_grades_original_replications.sav'.
- GET FILE = 'C:\ipac\monte_carlo_grades_original_replications.sav'.
- List / CASES = 5.

monte_carlo_1_save_original_grades_reps.sps (continued)

- grade_original id
- 3.93 1
- 6.07 2
- 7.50 3
- 8.57 4
- 9.29 5
- Number of cases read: 5 Number of cases listed: 5

C:\ipac\monte_carlo_2_save_random_normal.sps

- * Goal: Read random numbers and save in SPSS file.
- **********.
- Step 1. Get data file with random numbers named: C:\ipac\2012_07_18_random_dot_org_10000_gaussian.txt.
- * Step 2. Add id to each random number.
- * Step 3. Save data file named:
monte_carlo_data_random_normal.sav.
- **********.

2012_07_18_random_dot_org_10000_gaussian.txt

- 0.1455635827
- -2.2802726912
- -0.9751831393
- 1.7179198403
- -0.2083552828
- 2.0962531838
- 0.2657040418

C:\ipac\monte_carlo_2_save_random_normal.sps (continued)

- * Step 1. Get data file with random numbers named: C:\ipac\2012_07_18_random_dot_org_10000_gaussian.txt.
- DATA LIST FIXED FILE = 'C:\ipac\2012_07_18_random_dot_org_10000_gaussian.txt' /rand 1-13 .
- FORMAT rand (F13.10).
- LIST /CASES = 5.
- FREQ rand /FORMAT=NOTABLE /STATISTICS MEAN STDDEV SKEW KURTOSIS /HISTOGRAM.
- * This confirms that the distribution is normal with mean = 0 and SD = 1.

C:\ipac\monte_carlo_2_save_random_normal.sps (continued)

- **********.
- * Step 2. Add id to each random number.
- COMPUTE id = $CASENUM.
- FORMAT id (F8.0).
- LIST id /CASES = 10.
- **********.

C:\ipac\monte_carlo_2_save_random_normal.sps (continued)

- **********.
- * Step 3. Save data file named: monte_carlo_data_random_normal.sav.
- SAVE OUTFILE = 'C:\ipac\monte_2_carlo_data_random_normal.sav' .
- GET FILE = 'C:\ipac\monte_carlo_2_data_random_normal.sav'.
- LIST /CASES = 20.

monte_carlo_3_merge_reps.sps

- * Goal: Merge original grade file with random number file, create new grades, and save in SPSS file.
- **********.
- * Step 1. Merge two data files.
- * Step 2. Transform random to have mean and SD of original grades.
- * Step 3. Create new grades (re-grading).
- * Step 4. Create replication indicator: sample_id
- * Step 5. Change id to 1 to 81 for all cases.
- * Step 6. Save data file named: monte_carlo_data.sav.
- **********.

monte_carlo_3_merge_reps.sps (continued)

- MATCH FILES / FILE= 'C:\ipac\monte_2_carlo_data_random_normal.sav'
  /FILE= 'C:\ipac\monte_carlo_1_grades_original_100_replications.sav'
  /BY id.
- LIST /CASES = 85.

monte_carlo_3_merge_reps.sps (continued)

- * Step 2. Transform random to have mean and SD of original grades.
- COMPUTE stddev_original_grades = 10.29274.
- COMPUTE rand_standardized = rand * stddev_original_grades.
- COMPUTE mean_original_grades = 25.1854 .
- COMPUTE rand_standardized = rand_standardized + mean_original_grades.
- FREQ rand_standardized /FORMAT=NOTABLE /STATISTICS MEAN STDDEV SKEW KURTOSIS /HISTOGRAM.
- * confirms that mean is 25.33 and sd is 10.24 (close enough).

monte_carlo_3_merge_reps.sps (continued)

- * Step 3. Create new grades (re-grading).
- * This creates two variables correlated .90.
- COMPUTE weight = .326.
- COMPUTE grade_regraded = weight*rand_standardized + (1-weight)*grade_original.
- CORRELATE grade_regraded WITH grade_original.
- * Correlation of grade with re-grade is close to .90.
- * Actually .87 for first 81 cases.

monte_carlo_3_merge_reps.sps (continued)

sample_id	id	grade_original	grade_regraded
1	1	3.93	11.35
1	2	6.07	4.65
1	3	7.50	9.99
1	4	8.57	19.75
1	5	9.29	13.77

monte_carlo_3_merge_reps.sps
(continued)

- * Step 4. Create replication indicator: sample_id.
- COMPUTE sample_size=81.
- COMPUTE sample_id =
  TRUNC ((sample_size - 1 + id) / sample_size).
- FORMAT sample_id (F10.0).
- LIST id sample_id /CASES = 810.
- * We have more random numbers than original grades. This omits surplus random numbers.
- SELECT IF (sample_id LE 100).

monte_carlo_3_merge_reps.sps
(continued)

- **********.
- * Step 5. Change id to 1 to 81 for all cases.
- COMPUTE sample_size = 81.
- IF (id > sample_size)
  id = 1 + mod ((id-1),sample_size).
- FREQ id.

monte_carlo_3_merge_reps.sps
(continued)

- **********.
- * Step 6. Save data file named: monte_carlo_data.sav.
- SAVE OUTFILE =
  'C:\ipac\monte_carlo_3_data_100_reps.sav'
  /KEEP sample_id id grade_original grade_regraded .

Implementing MCR: 2nd Step

- Create ranks for original and new grades
- Find difference in rank (absolute difference)
- Summarize differences in rank

2nd Step. Review and Run Files

- monte_carlo_4_analyze.sps
  - Gets ranks for original and new grades
  - Gets difference between ranks
  - Summarizes differences between ranks

monte_carlo_4_analyze.sps

- * Goal: Analyze data file.
- **********.
- * Step 1. Get merged data file.
- * Step 2. Get ranks for original and new grades within replications.
- * Step 3. Calculate the min, max and average difference in rank, and overview of MC results overall.
- * Step 4. Output statistics for each replication to SAV file: mean, min, max, etc.
- * Step 5. Look at txt file with rep summary statistics

monte_carlo_4_analyze.sps (continued)

```
**********************************.
* Step 1. Get merged data file.

GET FILE =
'C:\ipac\monte_carlo_3_data_100_reps.sav'.
LIST /CASES = 5.

**********************************.
```


monte_carlo_4_analyze.sps (continued)

```
* Step 2. Get ranks for original and new grades within replications.

SORT CASES BY sample_id     id .

SPLIT FILE BY sample_id.
* Create new rank variables starting w/ letter R.
RANK VARIABLES = grade_original grade_regraded (D) .
*LIST sample_id   id   grade_original   rgrade_o
     grade_regraded rgrade_r    /CASES = 82 .
SPLIT FILE OFF.

FORMAT  rgrade_o   rgrade_r  (F4.0).
```


monte_carlo_4_analyze.sps (continued)

```
**********************************.
* Step 3. Calculate the min, max and average difference in
rank, and overview of MC results overall.

COMPUTE rank_diff_abs = abs( rgrade_o - rgrade_r ).
VARIABLE LABEL rank_diff_abs
     "Orig rank - New rank".
FREQ  rank_diff_abs  /STATISTICS MEAN STDEV
MIN MAX  /FORMAT=NOTABLE  /HISTOGRAM.

FREQ  rank_diff_abs .
```


monte_carlo_4_analyze.sps (continued)

```
* Step 4. Output statistics for each rep to SAV file: mean, min, max, etc.

OMS  /SELECT ALL
       / IF COMMANDS = ["means"]  SUBTYPES = ["Report"]
   /DESTINATION FORMAT = SAV
       OUTFILE = 'C:\ipac\monte_carlo_4_analyze_100_reps.sav'
   /COLUMNS DIMNAMES=['Variables'] .

SORT CASES BY sample_id (A).
SPLIT FILE BY sample_id .
MEANS rank_diff_abs  /CELLS MEAN STDDEV MIN MAX
RANGE.
SPLIT FILE OFF.
OMSEND.
```


monte_carlo_4_analyze.sps (continued)

```
**********************************.

* Step 5. Look at txt file with rep summary
          statistics

GET FILE =
'C:\ipac\monte_carlo_4_analyze_100_reps.sav'.
LIST /CASES = 15.

**********************************.
```


monte_carlo_4_analyze.sps (continued)

Command_	Subtype_	Label_	Var1	Var2	Origrank	Newrank
Means	Report	Report	1	Mean	8.5926	
Means	Report	Report	1	Std. Deviation	6.92239	
Means	Report	Report	1	Minimum	.00	
Means	Report	Report	1	Maximum	26.00	
Means	Report	Report	1	Range	26.00	
Means	Report	Report	2	Mean	9.3827	
Means	Report	Report	2	Std. Deviation	7.37321	
Means	Report	Report	2	Minimum	.00	
Means	Report	Report	2	Maximum	33.00	
Means	Report	Report	2	Range	33.00	

Implementing MCR: 3rd Step

- Repeat the process many times
- This was done with the previous programs

Implementing MCR: 4th Step

- Overview
- Read summary statistics
- Summarize output of MC replications

monte_carlo_5_summarize_reps.sps

- * Goal: Summarize file that contains summary statistics for each replication.
- **********.
- * Step 1. Get descriptive statistics output file.
- * Step 2. Groom file, and save it as Text.
- * Step 3. Get newly written file.
- * Step 4. Summarize the data.
- **********.

monte_carlo_5_summarize_reps.sps
(continued)

- **********.
- * Step 1. Get descriptive statistics output file.
- GET FILE = 'C:\ipac\monte_carlo_4_analyze_100_reps.sav' / DROP command_ subtype_ label_.
- LIST /CASES = 15.

monte_carlo_5_summarize_reps.sps
(continued)

- Var1 Var2 OrigrankNewrank
- 1 Mean 8.5926
- 1 Std. Deviation 6.92239
- 1 Minimum .00
- 1 Maximum 26.00
- 1 Range 26.00
- 2 Mean 9.3827
- 2 Std. Deviation 7.37321
- 2 Minimum .00

monte_carlo_5_summarize_reps.sps
(continued)

- * Step 2. Groom file, and save it as Text.
- RECODE var1 (CONVERT) INTO replication.
- STRING output_statistic_name (A14).
- COMPUTE output_statistic_name = var2.
- RECODE OrigrankNewrank (CONVERT) INTO output_statistic.
- FORMAT output_statistic (F8.4).
- WRITE OUTFILE= 'C:\ipac\monte_carlo_4_summarize_100_reps.txt' /replication (F8.0) output_statistic_name (A14) output_statistic (F16.10).

monte_carlo_5_summarize_reps.sps
(continued)

```
* Step 3. Get newly written file.
DATA LIST FILE =
     'C:\ipac\monte_carlo_4_summarize_100_reps.txt'
  RECORDS=5
   /1 replication 1-8 mean  25-38
   /2                stddev  25-38
   /3                  min  25-38
   /4                  max  25-38
   /5                range  25-38.
FORMAT mean stddev  (F16.10).
LIST /CASES =10.
```


monte_carlo_5_summarize_reps.sps
(continued)

replication	mean	stddev	min	max	range
1	8.5926000000	6.9223900000	0	26	26
2	9.3827000000	7.3732100000	0	33	33
3	7.1111000000	6.0124900000	0	23	23
4	7.2593000000	7.1689900000	0	35	35
5	7.5309000000	6.1483500000	0	26	26
6	8.5185000000	6.9554100000	0	26	26
7	9.1111000000	7.5332600000	0	34	34
8	7.0123000000	5.9234600000	0	35	35
9	8.1728000000	6.8898300000	0	31	31
10	7.0864000000	5.985810000	0	32	32

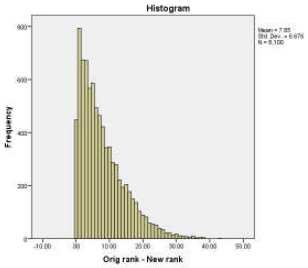
monte_carlo_5_summarize_reps.sps
(continued)

```
* Step 4. Summarize the data.

FREQUENCIES  mean stddev min max
range /FORMAT=NOTABLE
/HISTOGRAM /STATISTICS MEAN
STDDEV MIN MAX .

FREQUENCIES min max range
/STATISTICS.
```


Output/Findings

- Output from monte_carlo_4_analyze_reps.sps
- Histogram of difference between ranks for all replications

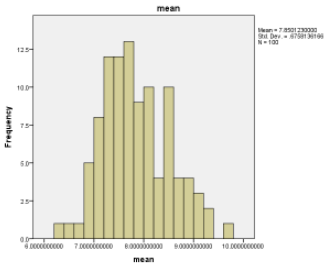
Changes in Rank Over All Replications



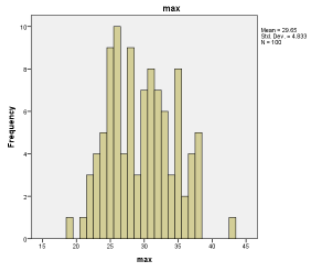
Output/Findings

- Output from monte_carlo_4_summarize_reps.sps
- Histogram of statistics from within replications

Average Change in Rank Within Replication



Maximum Change in Rank Within Replication



Conclusion

- If these results are valid:
- Even with .9 reliability, test will look shabby if the exercise is re-graded.
- Candidates may be outraged.

Caveats and Checks

- Are the results consistent when we:
  - Use a different set of random numbers
  - Conduct more replications
- Can we verify the formula for producing 2 variables with a correlation of .9
- Are the results sensible when use a reliability of .8 and .95?

Practice Doing MCR With SPSS

- If you have your own idea for MCR, try it now.
- Alternatively, you might address this question:
  If 20 appointments are made from among the 81 candidates, in rank order of score, how many changes in appointments will result from re-grading?

Approach to MCR Practice

- What approach can we use to address this question?
- What SPSS commands might we use?
- What logic might we implement with SPSS syntax?

Approach to MCR Practice (continued)

- Approach: Identify the top 20 candidates in the original data and in each replication.
- SPSS commands: RANK
- Logic:
  - If rank less than or equal to 20, set appointed indicator equal to 1, else wise 0
  - Subtract appointed indicators for original & each replication data set by candidate.

Practice Doing MCR with SPSS (continued)

- If you have questions, raise your hand or your voice.

Summary of MCR Using SPSS

- Create data set with multiple replications
  - Include a replication indicator
- Analyze the data by replication
  - Use SPLIT FILE
- Write the replication statistics to a file
  - Use OMS
- Read and summarize the replication statistics

Other Suggestions

- Learn/use other languages
  - R
  - SAS

Q&A's

- The floor is open
  - Questions
  - Comments

Call me any time to talk about this subject:

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Copies of this presentation are (or will be) available at any of these URLs: http://aprpsych/mc
http://appliedpersonnelresearch.com/mc
http://ipac.org

References

- Aguinis, H., *Multivar*. Downloaded 7/18/12 from mypage.iu.edu/~haguinis/mmr/download/multivar.zip